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Table of Contents

SIGNATURE PAGE 6
OVERVIEW 7
Phase 1 – A Technology Demonstration 7
Phase 2 – Initial System Research and Development and User Tests 8
Phase 3 – Further Research and Development Based on User Tests 9
Phase 4 – Development and Deployment of Full CTPS Test and Evaluation System 11
TECHNICAL TASKS 14
1. PROGRAM AND SUBCONTRACT MANAGEMENT 14
1.1 Program Management 14
1.2 Subcontract Management 14
1.3 Contract Administration 14
1.4 Administrative Support 15
2. SYSTEM INTEGRATION 15
2.1 System Engineering 15
2.2 Develop and Perform CTPS Testing 28
2.3 Develop User/Operator Documentation 28
2.4 Reserved 29
3. COMPONENT RESEARCH AND DEVELOPMENT 29
3.1 Clean-up of CTPS Phase 3 Software 29
3.2 Develop and Implement Casualty Handler 29
3.3 Enhance Triage Controller to Support Selected 91W/CLS Training 31
3.4 Enhance PATSIM to Support Selected 91W/CLS Training 35
3.5 Implement System-wide Pause/Save/Restart Capability 36
3.6 Develop and Implement Medical AAR Federate for Use with Selected 91W/CLS Training Tasks 36
3.7 Develop and Implement a Casualty Instantiator 40
3.8 Enhance FOM and Federate RTI Interfaces 40
3.9 Enhance CTPS Executive 42
3.10 Maintain Design to HLA Compliance 42
3.11 Extend CTPS System to Include Operational Data 43
3.12 Reserved 50
3.13 Reserved 50
3.14 Reserved 50
3.15 ECC Database Translator Enhancements 50
3.16 Wireless Ethernet Casualty Transfer 50
4. DEVELOP A CTPS-BASED TRAINING PROGRAM 51
4.1 Analysis of 91W/CLS Training Objectives 51
4.2 Development of 91W/CLS Task List Supported by Current HPS Technology 51
4.3 Implementation of Selected Patient Scenarios for 91W/CLS Training 51
5. RESERVED 54
6. DELIVERY OF CTPS SYSTEM HARDWARE 54
6.1 Deliver CTPS 4 HPS Hardware 55
6.2 PC Hardware 55
6.3 Networking Hardware 56
6.4 Demonstrate Integrated CTPS System 56
6.5 Field Operations/Support 57
6.6 Perform User Training 57
6.7 Upgrade CTPS Phase 3 Hardware 58
7. MAINTAIN CTPS LABORATORIES 59
7.1 CTPS Laboratory at IST 59
7.2 CTPS Laboratory at METI 60
7.3 CTPS Laboratory at Tekamah 62
8. BUILD, HOST, AND MAINTAIN A CTPS WEB SITE 63
9. MANNEQUIN DATA BUS ARCHITECTURE 63

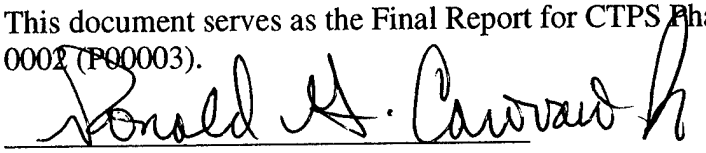
10. RESERVED 72
11. CTPS PROGRAM DEMONSTRATIONS 72
11.1 AMSUS Demonstration 72
11.2 I/ITSEC Demonstration 72
12. CTPS USER TESTS 73
Joint Trauma Training Center 74
NASA-Johnson Space Center 74
National Training Center 75
National Capital Area Medical Simulation Center 75
DREAMS Digital Ambulance 76
Portsmouth Naval Hospital 76
Appendix A: Financial Summary
Appendix B: Program Management Plan
Appendix C: Tekamah Final Report
Appendix D: Analysis of the Human Patient Simulator to Support 91W MOS and Combat Life Saver Training
Appendix E: IST Final Report
Appendix F: Feasibility Analysis for the Enhancements of the CTPS's Electronic Casualty Card Database Translator
Appendix G: HLA Federate Certification of a CTPS System vs. Proposed CTPS Gateway
Appendix H: User Test Report—Joint Trauma Training Center
Appendix I: User Test Report—NASA Johnson Space Center
Appendix J: User Test Report—National Training Center
Appendix K: User Test Report—National Capital Area Medical Simulation Center
Appendix L: IST CTPS Laboratory Demonstration Log
Appendix M: CTPS Test and Evaluation Functionality Checklist
Appendix N: Equipment Loan Agreement
Appendix O: Summary of Test Instrumentation Installed at the Center for Total Access, Fort Gordon, GA
Appendix P: CTPS User Documentation
Appendix Q: CTPS Scenario

Table of Exhibits

Exhibit 1 CTPS Phase 4 System Battlefield Medical Footprint 12
Exhibit 2 Military Medical Echelon of Care, and Patient Transfer Options within the Echelon 17
Exhibit 3 Description of Individual Node Architectures and Node Function Description 18
Exhibit 4 System Diagram Depicting Flow of Patient Objects (Data Flow) Through Nodes of CTPS 19
Exhibit 5 Hardware Component Diagram for CTPS System 20
Exhibit 6 Three Nodes in the CTPS System as Installed at Fort Gordon, Georgia 21
Exhibit 7 The Combat Support Hospital Node in the CTPS System as Installed at Fort Gordon, Georgia 22
Exhibit 8 Dr. Eric Allely of Tekamah Demonstrates the Interaction between the Casualty Handler User Interface and the Triage Controller at the Casualty Collection Point Node at Fort Gordon, Georgia 23
Exhibit 9 Casualty Handler User Interface 31
Exhibit 10 Patient View and Selection Panel 34
Exhibit 11 Examination and Treatment Panel 35
Exhibit 12 AAR Map Panel 37
Exhibit 13 Station View Panel 38
Exhibit 14 Patient View Panel 39
Exhibit 15 CTPS System HLA/RTI Architecture 41
Exhibit 16 Government Owned Equipment 55
Exhibit 17 New METI CTPS Laboratory 60
Exhibit 18 METI CTPS Laboratory Ribbon Cutting 62
Exhibit 19 PC/104 Cardstack as developed for the CTPS System 68
Exhibit 20 The (SBC) for the PC/104 Cardstack is shown in close-up view 69
Exhibit 21 METI Version D Mannequin that hosts the Mannequin Data Bus Architecture Components ... 70
Exhibit 22 METI Version D Mannequin Leg and Thigh that houses the PC/104 Cardstack 70
Exhibit 23 METI Version D Mannequin Leg and Thigh that houses the PC/104 Cardstack in close up 71
Exhibit 24 METI Version D Mannequin Leg and Thigh that houses the PC/104 Cardstack shown in close up with access panel closed 71
Exhibit 25 AMSUS 2001 Exhibit Layout 72
Exhibit 26 I/ITSEC 2001 Exhibit Layout 73
Exhibit 27 CTPS Phase 4 User Tests 74

SIGNATURE PAGE

This document serves as the Final Report for CTPS Phase 4, Agreement N61339-99-3-0002 (P00003).



Ronald G. Carovano, Jr.
Director of Government Systems
Medical Education Technologies, Inc.

OVERVIEW

The purpose of the CTPS Program is to more realistically assess the impact of battlefield casualties in order to increase medical readiness. The system primarily consists of commercial-off-the-shelf (COTS) and government-off-the-shelf (GOTS) live, virtual, and constructive simulation components. Its capabilities include simulating, replicating, and assessing battlefield injuries by type and category, monitoring the movement of casualties on the battlefield, capturing the time of patient diagnosis and treatment, and comparing interventions and outcomes at each military healthcare service delivery level. The CTPS System is Department of Defense (DOD) High Level Architecture (HLA) compliant. The CTPS Program goals are:

- To provide more realistic representations of casualty instances
- To provide enhanced initial, refresher, and sustainment training for medical personnel
- To provide an improved mechanism for analysis and test and evaluation of issues in casualty medical treatment
- To increase readiness by having better prepared military medical personnel, ultimately decreasing the fatalities due to combat conditions.

To date, the program has undergone four phases. These are summarized below.

Phase 1 – A Technology Demonstration

The first CTPS phase sought to identify the fundamental objectives of the proposed system and determine which hardware would be best suited to support them. MILES/ECC, a GOTS product, was of particular interest because it is a widely deployed technology in existing battlefield simulations, and it could be leveraged by the CTPS system to initiate the simulation of a wide range of casualty types in varying states of health. The METI Human Patient Simulator™ (HPS™), a COTS product, was targeted as the primary focus for care-providers, as it offers a full-scale patient mannequin that is controlled by mathematical models capable of providing dynamic feedback.

Objective. This phase's primary goal was to construct a technology demonstration that showed how the HLA could facilitate the integration of the GOTS MILES/ECC, the COTS HPS, and custom CTPS software. It was determined that the system would include three fundamental capabilities:

- Introduce new casualties via a link with the MILES/ECC
- Allow treatment to be administered via a link with a full-scale patient simulator
- Provide a casualty collection federate (PATSIM) that would serve as a simulation resource for casualties that are not being simulated on a full-scale patient simulator.

Accomplishments. The MILES/ECC system was integrated through the development of a special type of application called an RTI Gateway. This gateway software acts as a translator; it is programmed to understand two languages. In the case of the MILES/ECC product, the RTI Gateway understood the protocol of the MILES/ECC itself, and it also knew how to communicate with the Run-Time Infrastructure (RTI) layer

of the HLA network. In doing so, it effectively bridged these two disparate technologies so that data from the MILES/ECC was visible on the network at large. Once this was done, it was possible for the CTPS system to create casualty entities based on input from the MILES/ECC.

For the purposes of the technology demonstration, it was decided that casualty entities would accumulate in a queue within the PATSIM federate, and as the HPS became available, it would automatically receive the next casualty from the queue. This was accomplished using the same approach that successfully integrated the MILES/ECC. An RTI Gateway application was written, and it understood both the protocol of the HPS and that of the HLA's RTI. The result was that the HPS could simulate the appropriate type of casualty at the direction of the PATSIM federate.
As mentioned above, the role of the PATSIM federate was to maintain a queue of casualty entities and provide them to the HPS as it soon as it became available. As casualties waited for the simulator, PATSIM provided vital-sign data for each by playing back a prerecorded data file that corresponded to the casualty's injury type. Despite limited simulation capabilities, PATSIM served the purposes of the demonstration well. Because the prerecorded information was captured from a patient simulation package, it allowed observers to see how simulated data would be presented as the system evolved to support that capability.

Phase 2 – Initial System Research and Development and User Tests

The technology demonstration of the first phase succeeded in showing some of the potential of a full CTPS system. Phase 2 would serve to advance the system by adding new federates and enhancing existing ones. Additionally, it would address some of the omissions demanded by the limited scope of the first phase. Finally, it would solicit feedback from potential users by exposing them to components of the CTPS system.

Objectives. On a technical level, the Phase 1 system had many apparent limitations. First, the MILES/ECC system could provide only the most rudimentary patient data set. This meant that all scenarios of a given type would play out exactly the same. That is, they would not vary in severity. In order to better diversify, say one gunshot wound from another, the casualty data from the MILES/ECC would have to somehow be enhanced so that more data was available to the rest of the system. The second phase sought to incorporate ORCA to provide this capability.

The next capability to be addressed was PATSIM's limited ability to serve as a patient simulation resource. The Phase 1 PATSIM federate was simply a place-holder for a resource that could provide dynamically varying patient data for casualties that did not reside on a full-scale patient simulator (which would itself provide this functionality). Phase 2 addressed this limitation by introducing a new PATSIM based on state-engine technology.

The final consideration of the Phase 2 design was the limited way that casualties could be transferred between CTPS federates. In Phase 1, once a casualty was transferred to a simulation resource and the simulation began, it could not be transferred again without

removing the casualty from the system altogether. Phase 2 sought to correct this by allowing the CTPS system to track the casualty's state of deterioration along with its injury type. The casualty would begin its simulation on one resource, progress through worsening states, and complete its simulation on another. This was possible because the final simulation resource would be able to begin its simulation in the middle of the patient's overall decline using this newly available state information.

Accomplishments. Phase 2 accomplished all of its goals with varying degrees of success. The integration of the ORCA system was one effort that resulted in limited success. Engineers found that the ORCA product possessed no external data exchange capability. In short, there was no way to create an RTI Gateway that interfaced directly with this product, because there was no externally accessible protocol through which ORCA could communicate. To compensate, limited data sets were extracted from the ORCA database, and a makeshift ORCA RTI Gateway enhanced casualties based on only this very small subset of data. The result provided a glimpse of what ORCA could have brought to the system if it had been designed with a more accessible architecture.

The Jackson Medical Simulation Library (JMSL) is a state machine that served as the basis for the new PATSIM federate. At the end of Phase 2, PATSIM was able to serve as a simulation resource for casualties that were not being simulated on an HPS. This made it possible for the state of unattended patients to independently worsen. Then, as patients were selected to receive care on an HPS, their current state of deterioration was communicated to the HPS, and it began its simulation where PATSIM left off. The state-oriented implementation made transferring patients between federates a simple matter of communicating the casualty's injury type and state of deterioration. However, the primary disadvantage of the approach is that every possible patient state must be synchronized among the simulation resources. This has profound implications when one considers that the addition of a single scenario has the potential to add many patient states to the system, and that these would all have to be reflected on the various federates. For more than just a few scenarios, it was clear that this approach would quickly become unmanageable.

In addition to its technical accomplishments, Phase 2 was the first in which CTPS system components were made available to users for evaluation. This feedback would later be used in planning the evolution of the hardware and software of the CTPS system.

Phase 3 – Further Research and Development Based on User Tests

Following Phase 2, it was anticipated that CTPS Phase 3 would continue as a combination of Research and Development and User Tests. A careful examination of the CTPS Phase 2 system resulted in a prioritization of the proposed Phase 3 improvements, and it was clear that only the most important changes would be possible. Additionally, Phase 3 marked the end of support for the ORCA federate, which, as mentioned above, was only a very modest enhancement to the system.

Objectives. As discussed in the Phase 2 overview, the complexity of adding additional scenarios to the CTPS system was of great concern. In the context of the Phase 2 design,

adding a single scenario meant programming each simulation federate so that it was able to identify new set of patient states. While this was acceptable within the limited scope of the Phase 2 system, it was obvious that the final product would need an easier, more flexible approach. The crux of the problem was that Phase 2 introduced a new PATSIM federate that was based on a state-engine. The only way that the state engine could exchange data with the other simulation resources was by dividing injury scenarios into sub-scenarios and then associating these with states that PATSIM understood. To solve this problem, it was decided that Phase 3 would incorporate continuous, mathematical models of physiology into each simulation resource. These models would share a common data set (via the HLA's Federate Object Model, or FOM technology), and because of their continuous nature, would achieve patient transfer by simply passing control of the associated FOM objects between simulation resources. The key implication of the new approach was that the number of parameters represented in the FOM would grow from two in Phase 2 to more than 160 in Phase 3, and that would prove to have unanticipated implications for the HLA's Run Time Infrastructure.

During the Phase 2 User Tests, prospective users often commented that there needed to be a better way to determine which casualties would remain untreated (and employ PATSIM as their simulation resource) and which would receive immediate attention (via a full-scale patient simulator). To address this issue, it was decided that Phase 3 would incorporate a new federate through which triage could be performed. The new federate would allow CTPS users to request current vital-sign data for any casualty within the system. It would then be at the discretion of the user to determine which patients needed immediate care and which could wait.

Users were also concerned that the absence of an AAR capability within the CTPS system would hamper is usefulness as a training and certification tool. Therefore, Phase 3 initiated the effort to investigate the incorporation of TREDS, a GOTS product, into the system to serve as its AAR.

Accomplishments. Phase 3 proved to be very important to the CTPS program. From the addition of the new Triage Controller federate to the new model-based simulation resources, much was learned about how the system should evolve in future phases. Of course, the most profound architectural change was the incorporation of physiologic model-based simulation resources. As was planned, they shared data using an enhanced FOM object that incorporated over 160 parameters. With this technology in place, it was possible to demonstrate the bi-directional transfer of casualty entities between simulation resources. For example, a patient would begin its simulated life in the new, model-based PATSIM federate. There it would remain until the student indicated, through the Triage Controller, that the patient's condition was life threatening and treatment should begin immediately. The Phase 3 design dictated that PATSIM would then divest ownership of the casualty object to the HPS, which, in turn, would re-instantiate it locally based on its FOM attributes. This is the fundamental improvement of the CTPS Phase 3 system; because a patient's physiologic state can be completely represented through a FOM object on the HLA, it is possible to seamlessly redirect that patient between simulation assets.

In addition to the architectural enhancements, the Triage Controller federate proved to be a worthwhile addition. It employs a graphical user interface to represent all of the casualties that are present within the CTPS system. Students can then assess the condition of these various patients, and based on the severity of their injuries, decide the order in which they should receive treatment. During the program's design, it was decided that care must be taken to provide only information that is actively requested. This is important because it forces the student to actively monitor the condition of the casualties as would be required in a real-world situation.

As in past the first two phases, a great deal was learned in Phase 3. First, an investigation revealed that TREDS could not be integrated to serve as the CTPS System's AAR component. Second, in moving from the state-based PATSIM of Phase 2 to the new model-based federate, PATSIM lost the ability to control the destiny of the casualties it simulated. True to its design, the Phase 3 PATSIM included physiologic models but it lost the ability to independently make acute, pre-scripted changes to the patient's condition. Doing that would require an additional component that can modify the patient's parameters so that the physiologic model can simulate a deteriorating patient. It is just this combination of models and scriptability that allow the HPS to simulate a patient in an unstable physiological state. Phase 3 introduced only the former capability; the latter will be introduced in an upcoming phase.

Phase 3 was the first to encounter HLA-related performance issues. With the number of parameters represented in the CTPS FOM rising to over 160, the system increasingly relied on the HLA to share casualties' attributes among the distributed federates. While the number of parameters was much greater than it had been in previous CTPS phases, it is still relatively small within the context of simulation science. Therefore it was very surprising to find that the HLA had difficulty accommodating more than three casualty entities on a single system. Clearly, such a small number of casualties will not be acceptable for the final implementation of the CTPS system. DMSO is aware of HLA-related performance issues, and has released several revisions of the Run Time Infrastructure since the Phase 3 effort began. These HLA bottlenecks will be carefully considered as future CTPS system designs are crafted.

Phase 4 – Development and Deployment of Full CTPS Test and Evaluation System

Following the success of the preceding phases, the development team (consisting of STRICOM, METI, Tekamah, and IST) convened a face-to-face meeting to establish task priorities in anticipation of development funding for Phase 4. The results showed that a complete CTPS System could be developed and deployed at a military user location for test and evaluation. Simultaneous with this technical planning, sponsorship of the CTPS Program was transitioned from the Office of the Secretary of Defense Live-Fire Test and Evaluation to US Army Medical Research and Materiel Command (MRMC, Fort Detrick, MD), with the Telemedicine and Advanced Technology Research Center (TATRC, Fort Detrick, MD) serving as MRMC's project officer. Together, TATRC and STRICOM assembled the CTPS Integrated Product Team—a steering committee

consisting of representatives from military medical agencies throughout DoD. Guidance from the CTPS IPT further honed the contractual assignments undertaken in Phase 4.

Objectives. The ultimate objective of Phase 4 was to deploy a full CTPS System for test and evaluation. The CTPS IPT felt very strongly that an independent evaluator (outside of the core developers) should be employed to perform the assessment. Thus, the development team was challenged to create a system that was flexible enough to be configured to support an Independent Test and Evaluation (IT&E), yet simple enough that the end-user could be trained to operate the equipment on their own. Additionally, the developers were challenged to create an operational scenario that would be applicable for both Combat Lifesaver (CLS) training and the newly created 91Whiskey (91W) Army Combat Medic.

Accomplishments. Phase 4 resulted in the installation of the first medical, distributed interactive simulation system. Located at Fort Gordon, GA, the CTPS System is configured to mirror the battlefield medical footprint, with six distinct locations shown below.

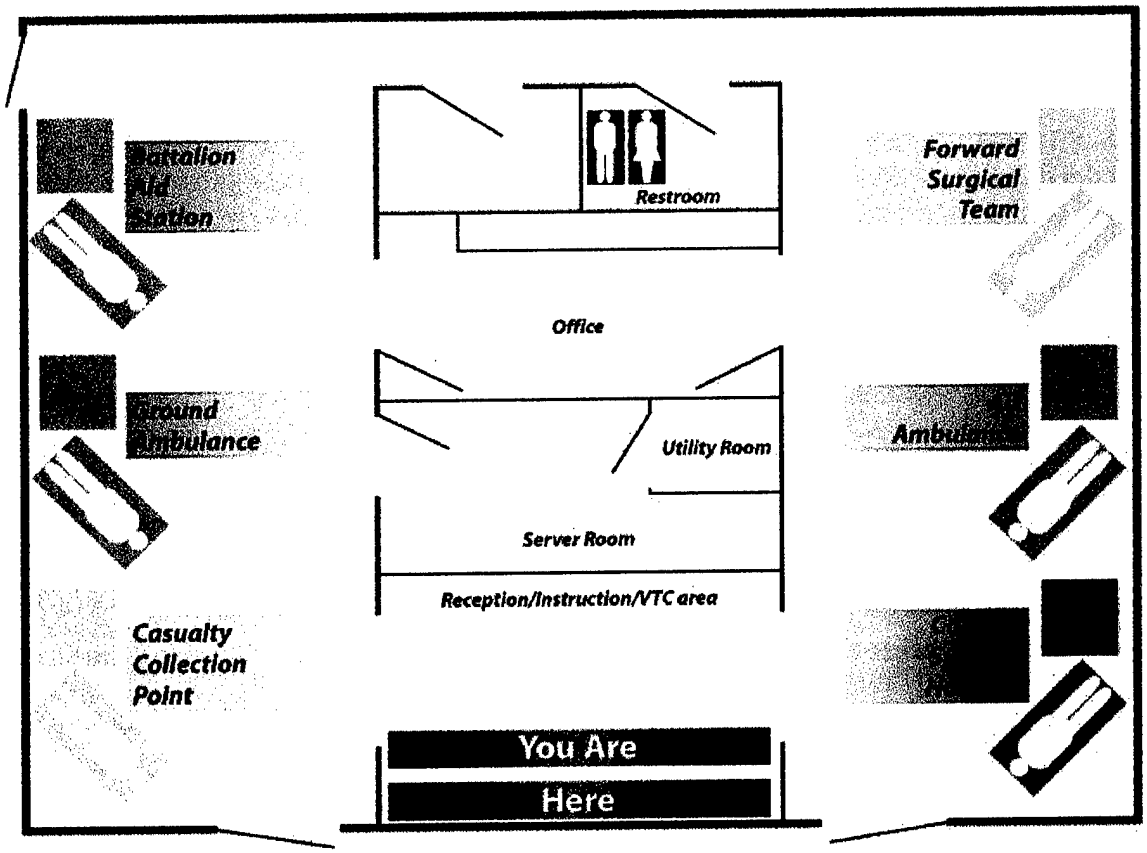


EXHIBIT 1: CTPS Phase 4 System Battlefield Medical Footprint

The Center for Total Access (CTA, Fort Gordon, GA) is the custodian of the CTPS System. During technical and clinical training, CTA staff and the CTPS development team conducted an extensive clinical and technical verification of the entire system. (See Appendix M: CTPS Test and Evaluation Functionality Checklist). Phase 4 concluded with CTA is embarking on the IT&E with the CTPS development team falling back into a supporting role.

Summaries of all technical tasks undertaken in Phase 4 are described in the next section. Overall, CTPS has fulfilled the promise of delivering a highly capable, yet user-friendly, military medical distributed interactive simulation system. With the Phase 4 System in-place, the CTPS Program is poised to accept feedback from the IT&E for additional development and testing in future phases.

TECHNICAL TASKS

The following summarizes all contract tasks undertaken and the technical accomplishments of CTPS Phase 4.

1. PROGRAM AND SUBCONTRACT MANAGEMENT

1.1 Program Management

METI sustained program management activities throughout Phase 4. Specifically, program cost, schedule, and quality were monitored and managed to ensure successful completion of this phase. Additionally, program communications, marketing, and interagency coordination were addressed by the METI Program Manager to further serve its role as the STRICOM Program Manager's Deputy in executing the intent of the Agreement.

1.2 Subcontract Management

Throughout Phase 4, the METI Management Team provided full subcontract management to both IST and Tekamah, including risk mitigation, progressive deliverable management, contract administration, supervision of deliverables, and invoicing and billing.

Subcontract to IST

As in Phase 3, IST posed a significant subcontract management challenge. However, because the subcontract deliverables were inherently low-risk items, IST was able to produce an overall, minimally acceptable result. IST did provide a location for STRICOM CTPS demonstrations and also did deliver a CTPS Web Page. However, IST did not execute its other tasks (such as HLA compliance) to the level-of-excellence METI would prefer. Fortunately, tasks where IST under-performed do not pose any risk to the ongoing success of the CTPS Program.

In all fairness to IST, most of the tasks assigned were oriented towards commercial-level production and thus do not play to the strengths of an academic research institute. IST's Final Report is attached as Appendix E.

Subcontract to Tekamah

Given its significant development responsibilities, subcontract management for Tekamah was more challenging than in previous phases. All deliverables were provided on budget, although all software was delivered at least two months late. However, the quality was good, and in some cases, exceptional (See Appendix D: Analysis of the Human Patient Simulator to Support 91W MOS and Combat Life Saver Training.) Tekamah's Final Report is attached as Appendix C.

1.3 Contract Administration

METI provided contract administration, invoicing and billing, and accounting to good commercial practices. Contract administration assisted in a DCAA financial review and

accounting system review, involving overhead rates, accounting system, and labor categories. Overhead rates and labor category rates were approved, thus the CTPS Phase 5 cost proposal was validated and approved. A final financial report is attached as Appendix A.

1.4 Administrative Support

METI provided complete administrative support to the program, including report preparation; in process review coordination; customer, user, and subcontractor interface; and demonstration and conference support.

2. SYSTEM INTEGRATION

2.1 System Engineering

The tasks relevant to the System Engineering portion of the CTPS Phase 4 contract are described below.

Develop System Engineering Plan

For the CTPS program, the System Engineering task was to develop and execute a plan that would result in the delivery of the CTPS system as a fully functioning system, which then would undergo analysis by an independent agency. The first subtask in this process was to develop a Systems Engineering Management Plan (SEMP). The SEMP is a document which defines the architecture of the CTPS Program. Incorporated into this task is the development of Systems Engineering diagrams and statements of work, which form the basis for engineering tasks and management oversight of the program. This plan outlines the CTPS Program vision, goals, and objectives; requirements traceability matrix; technical management plan; subcontract management plan; configuration management plan; system architecture; work plan; quality control plan; test plan; and configuration and data management plan.

Observation of Military Medical Echelon of Care

Development of the CTPS System at both the conceptual and at the physical level was enhanced by a trip by Bill Waggener, System Engineer, and Jim Azukas, Director of Engineering, to the National Training Center at Fort Irwin, CA, to observe the military echelon of care in a battlefield simulation. The report from this trip is included as Appendix J. This trip was very instructive in providing real-world input to the system design and to the design of system components. As only one example, the Triage Controller was enhanced by the addition of the assignment of casualty triage categories, which were observed at the NTC (and through independent research) to be Minimal, Delayed, Immediate, and Expectant. Another example of the benefit of this type of observation was the insight gained into the mobility aspects of the forward level medical elements. A Forward Aid Station, for example, can pack up and move in ten minutes or less, a significant mobility issue to keep in mind when designing simulation systems.

Develop System Engineering Diagrams

In support of this development, top-level system diagrams were generated including operational diagrams, functional diagrams, component diagrams, and various Data flow diagrams. System Diagrams were completed which depict Node Descriptions and Architecture, and also diagrams were completed depicting Node Interaction and Casualty Object Flow through the system.

System Engineering also provided detailed system node hardware descriptions, including networking considerations, Ethernet switching, and how nodes will connect to each other and to the system wide components such as the Casualty Handler Federate interface.

Photographs of the CTPS System that was installed at Fort Gordon are included to aid in conceptualizing the physical realization of the system.

These diagrams and photographs are included below, with a textual description of their contents presented afterwards.

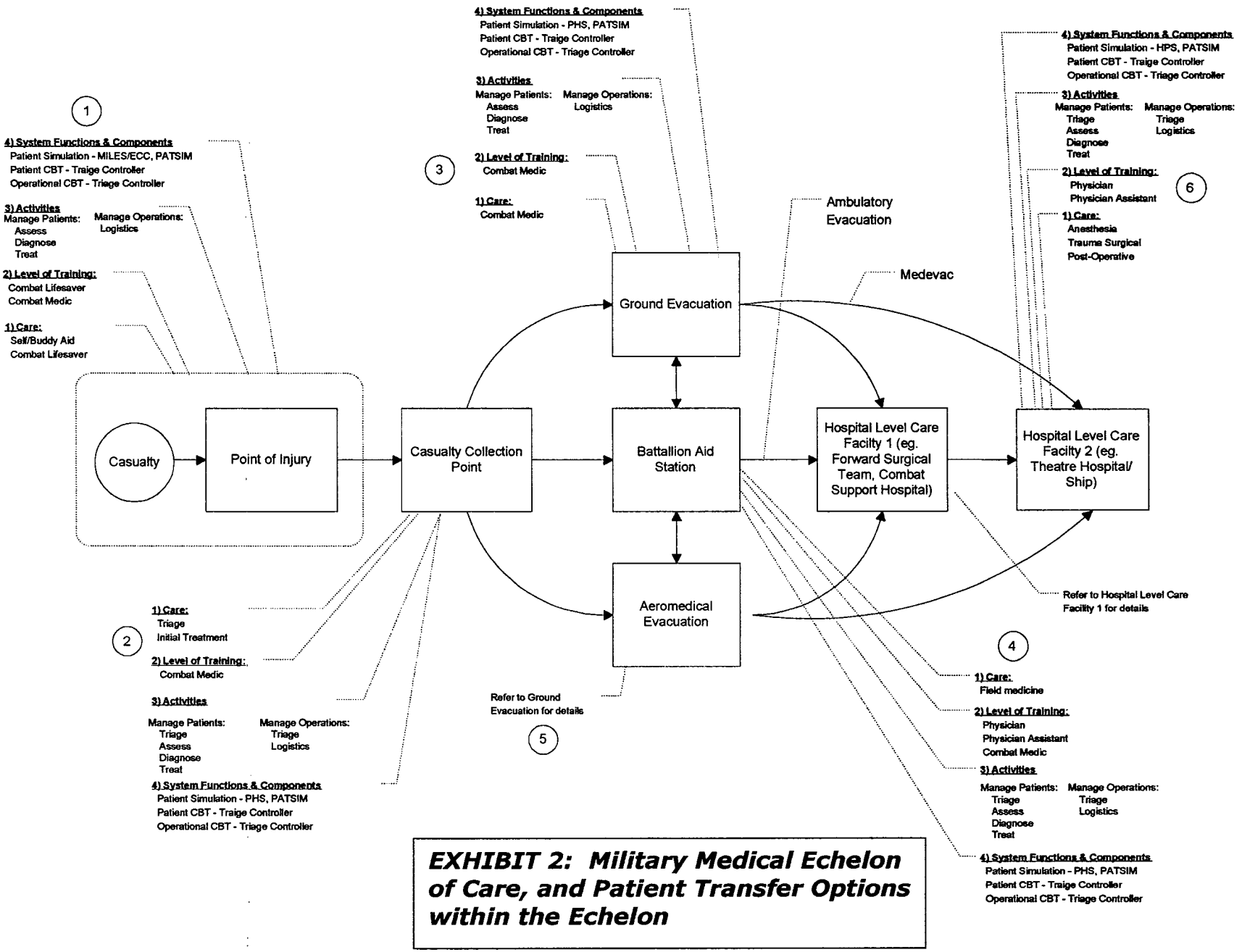
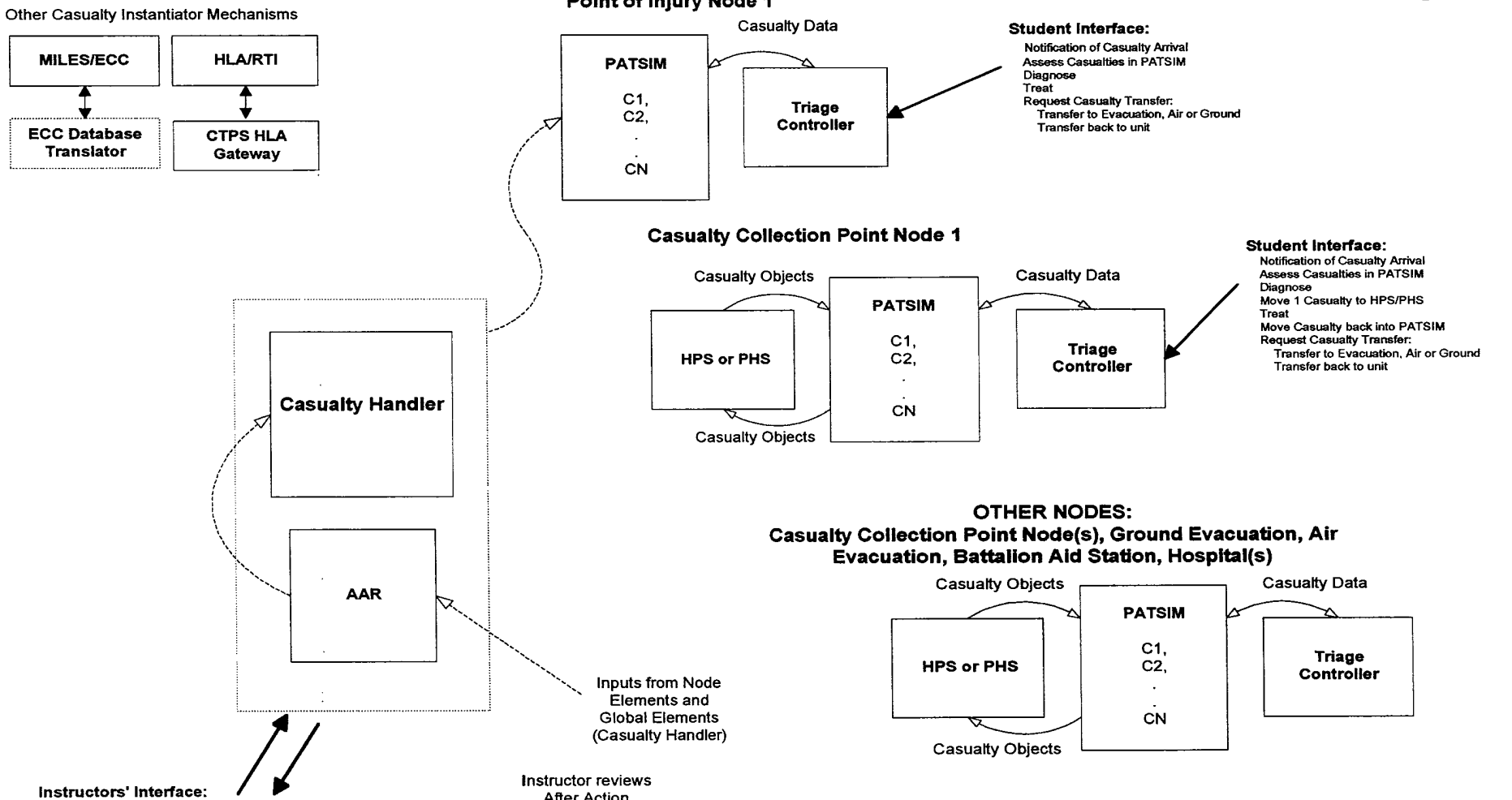


EXHIBIT 2: Military Medical Echelon of Care, and Patient Transfer Options within the Echelon



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	System Diagram Depicting Node Descriptions and Architecture				
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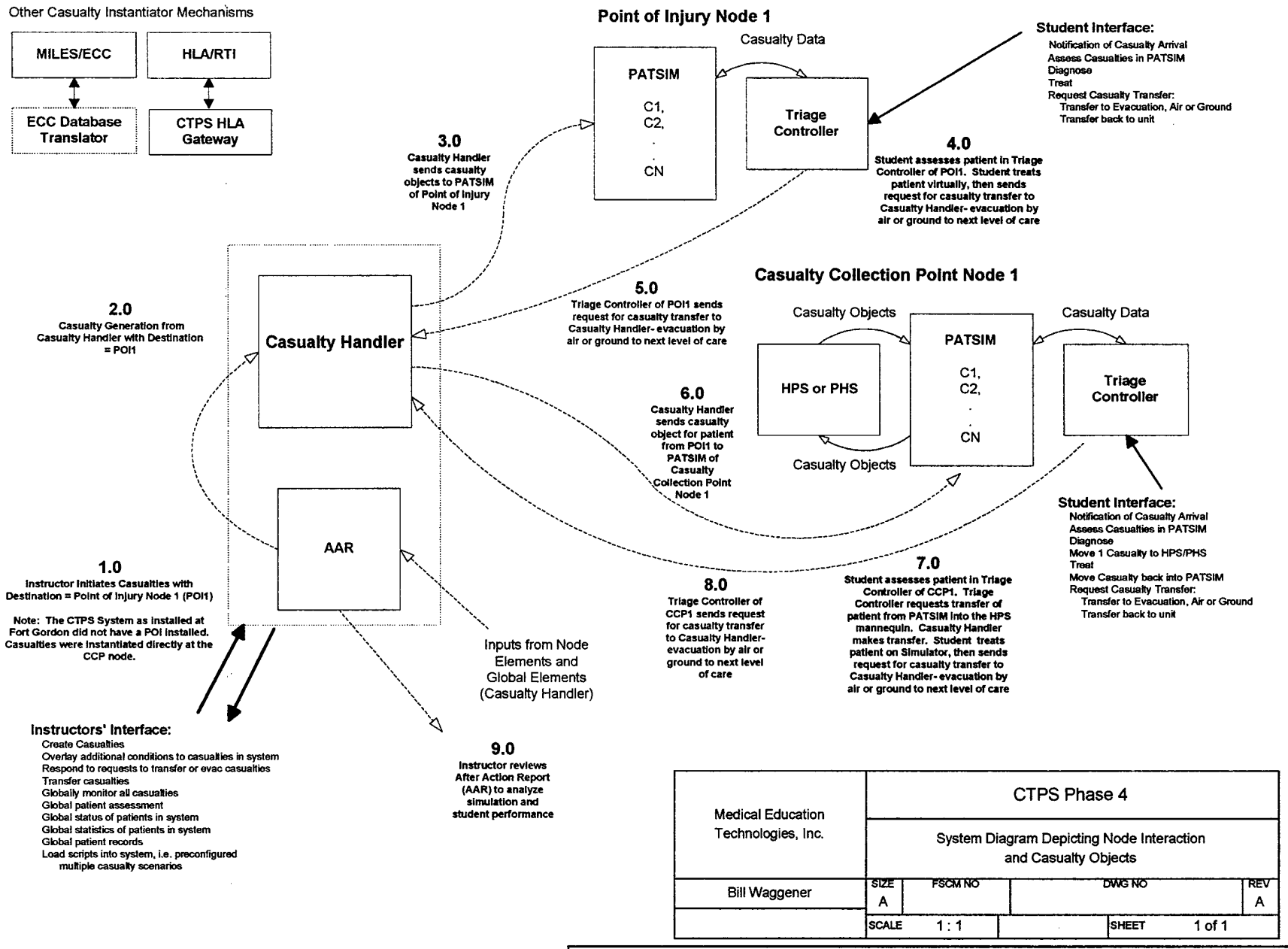
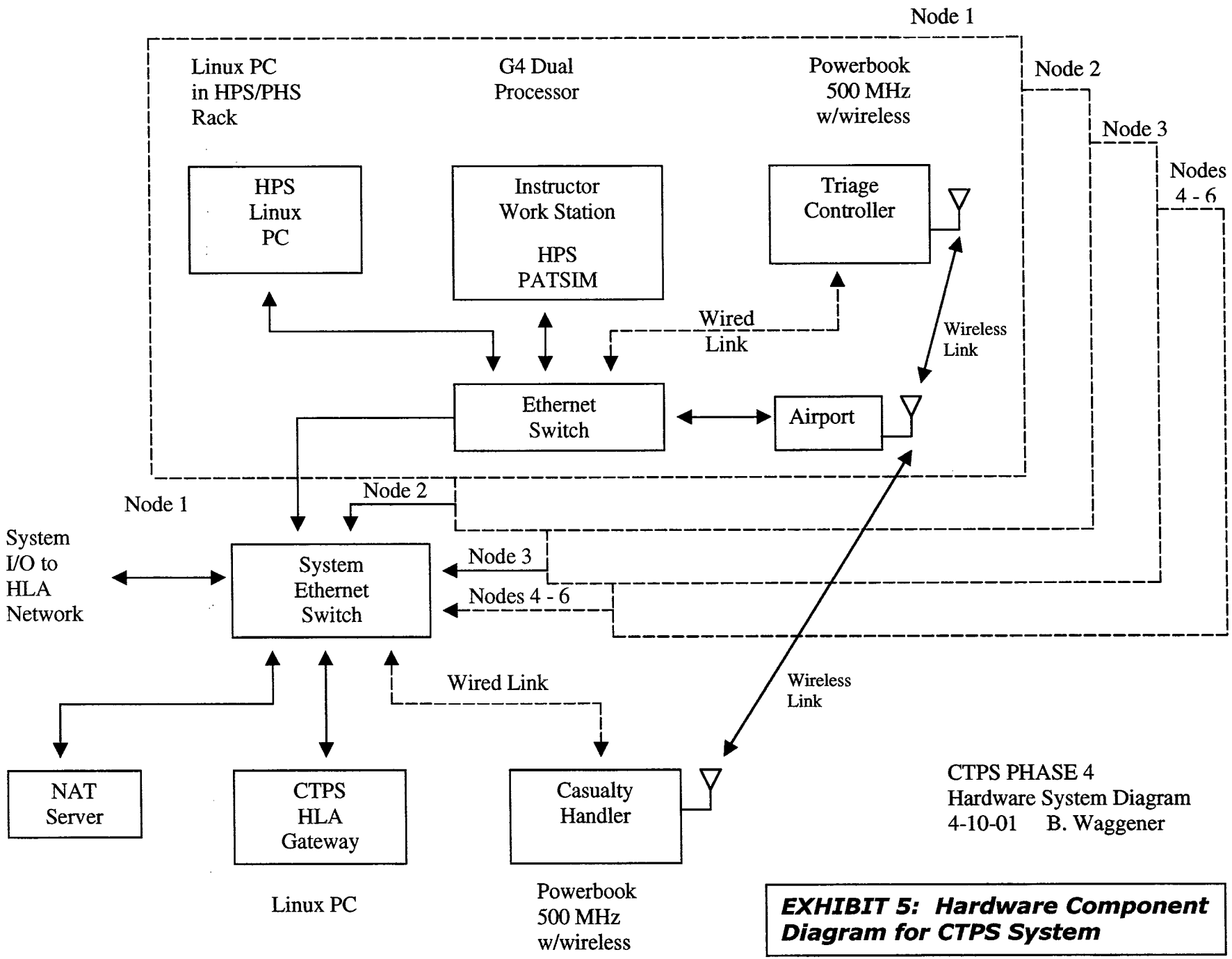
EXHIBIT 3: Description of Individual Node Architectures and Node Function Description



Medical Education Technologies, Inc.	CTPS Phase 4				
	System Diagram Depicting Node Interaction and Casualty Objects				
Bill Waggener	SIZE A	FSCM NO	DWG NO		REV A
	SCALE 1 : 1			SHEET 1 of 1	

EXHIBIT 4: System Diagram Depicting Flow of Patient Objects (Data Flow) Through Nodes of CTPS



CTPS PHASE 4
Hardware System Diagram
4-10-01 B. Waggener

EXHIBIT 5: Hardware Component Diagram for CTPS System

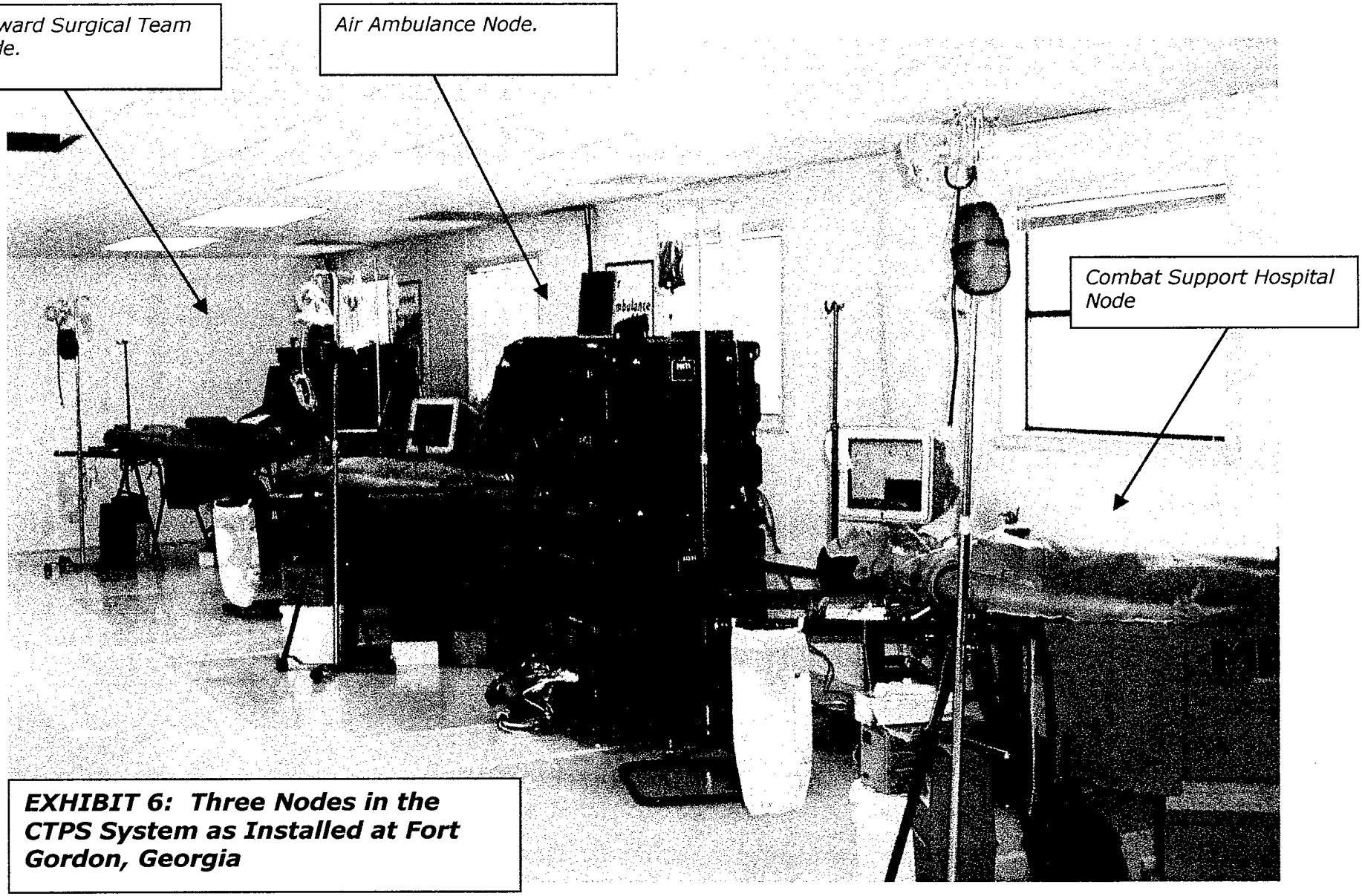
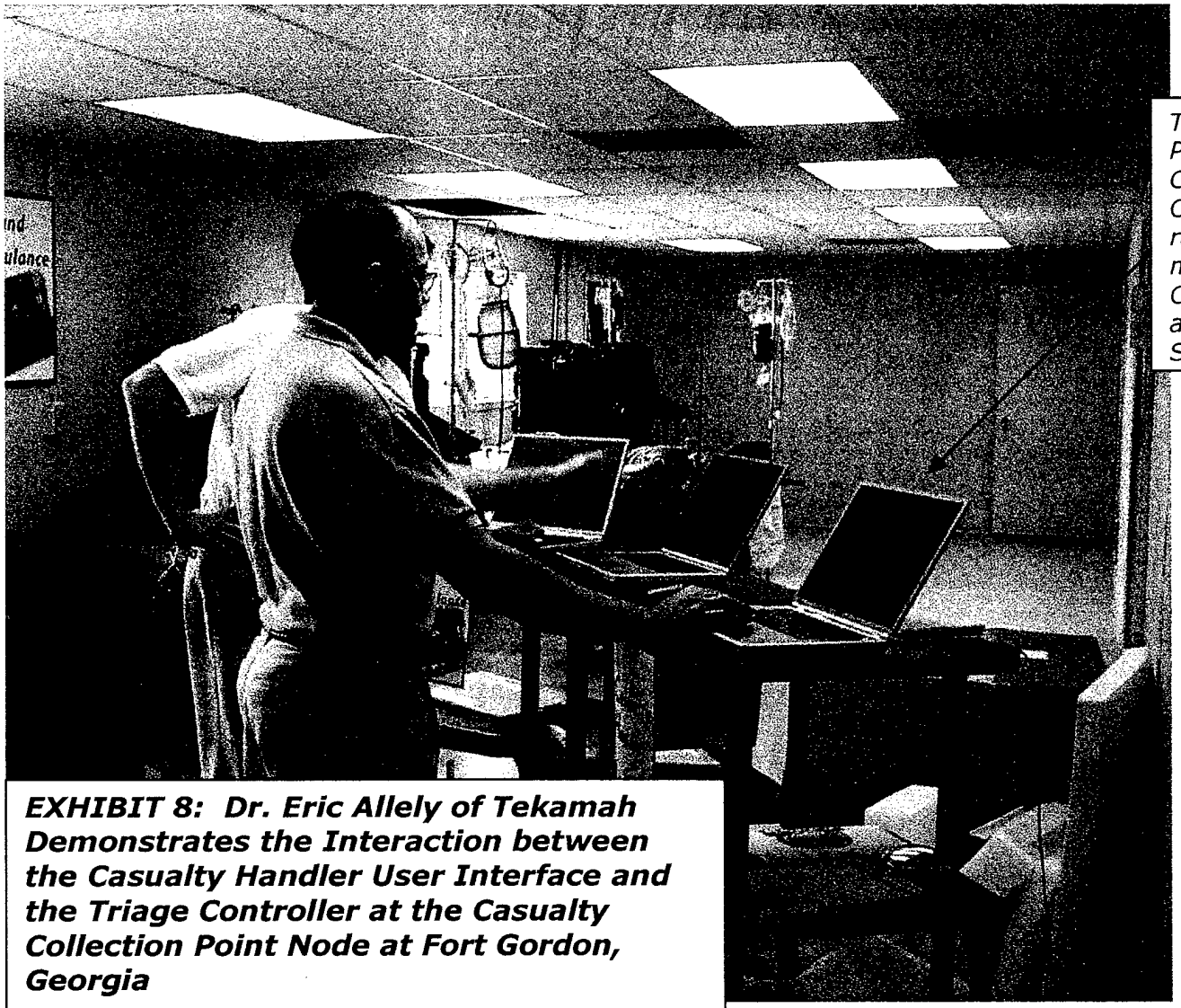


EXHIBIT 6: Three Nodes in the CTPS System as Installed at Fort Gordon, Georgia

EXHIBIT 7: The Combat Support Hospital Node in the CTPS System as Installed at Fort Gordon, Georgia



Titanium PowerBook (500 MHz G4 Processor) with Wireless Airport Connection to Desktop G4 Computer. The laptop computers run the Triage Controller at every node, and run the AAR and Casualty Handler User Interface on a separate laptop used by the Simulation Controller.

EXHIBIT 8: Dr. Eric Allely of Tekamah Demonstrates the Interaction between the Casualty Handler User Interface and the Triage Controller at the Casualty Collection Point Node at Fort Gordon, Georgia

Exhibit 2: Military Medical Echelon of Care, and Patient Transfer Options within the Echelon

In this exhibit, the Military Medical Echelon of Care is described within the context of casualty simulation and casualty transfer. The mapping of the Military Medical Echelon of Care and the CTPS System is accomplished by introduction of the node concept. In this sense, a node is regarded as a CTPS asset or assets which simulate some aspect of the Echelon of Care. In the CTPS System fielded at Fort Gordon, the nodes that are simulated are listed below.

Casualty Collection Point (CCP) - This level of care is simulated by a Triage Controller Laptop computer, and a Pre-Hospital Patient Simulator (PHS).

Ground Evacuation (GEVAC) – This level of care is simulated by a Triage Controller Laptop computer, and a Pre-Hospital Patient Simulator (PHS).

Battalion Aid Station (BAS) – This level of care is simulated by a Triage Controller Laptop computer, and a Pre-Hospital Patient Simulator (PHS).

Forward Surgical Team (FST) – This level of care is simulated by a Triage Controller Laptop computer, and an HPS. The HPS has more capability than a PHS unit (especially anesthesia delivery), which reflects the ability of personnel at an FST to perform surgical procedures.

Air Evacuation (AEVAC) – This level of care is simulated by a Triage Controller Laptop computer, and a Pre-Hospital Patient Simulator (PHS).

Combat Support Hospital (CSH) – This level of care is simulated by a Triage Controller Laptop computer, and an HPS. The HPS has more capability than a PHS unit (especially anesthesia delivery), which reflects the ability of personnel at a CSH to perform surgical procedures.

Just as the complexity and capability of each level of the Echelon increases as a casualty traverses the Echelon, the capabilities of the simulation assets at each node increases as the simulated casualty is transferred as a patient object from node to node. The nodes in the CTPS system are flexible such that the simulation assets can be configured to be representative of a different location in the Echelon of Military Care. For example, one could configure a system with multiple CCP's.

Exhibit 3: Description of Individual Node Architectures and Node Function Description

In this exhibit, the Architecture of each node is described, along with a listing of functions performed by each node.

Exhibit 4: System Diagram Depicting Flow of Patient Objects (Data Flow) Through Nodes of CTPS System

This exhibit has common elements with the previous Exhibit 3, but the flow of Casualties as Patient Objects (Data Flow) is diagrammed. If one follows the numbers, a casualty can be traced through two nodes of the system. Note: The Point of Injury node is not implemented physically in the delivered system at Fort Gordon, however, this node can be thought of as a CCP node without a physical mannequin simulator.

Exhibit 5: Hardware Component Diagram for CTPS System

This exhibit depicts the configuration of hardware elements in the CTPS System.

Exhibit 6: Three Nodes in the CTPS System as Installed at Fort Gordon, Georgia

This exhibit depicts one half of the CTPS System as installed at Fort Gordon, Georgia. The nodes shown in the photo are the (from back to front) FST, AEVAC, and CSH nodes. On the other side of the building reside the other three nodes - the CCP, GEVAC, and BAS nodes.

Exhibit 7: The Combat Support Hospital Node in the CTPS System as Installed at Fort Gordon, Georgia

This node is shown as a detailed depiction of the hardware installed at each node in the system. Each node consists of an HPS or PHS Patient Simulator, Equipment Rack, Desktop Dual Processor G4 Macintosh computer, monitor emulator laptop computer, and Powerbook Laptop computer. Each Macintosh computer is running the Mac OS X (pronounced "OS Ten") operating system, with the following application software loaded:

- Desktop Macintosh: PATSIM, METI Patient Simulation Software (Version 6). One node (presently AEVAC) has the Casualty Handler Engine software resident.
- Powerbook: Triage Controller (configured for that specific node)

Also installed in the system is a laptop, which is used by a simulation director – the Casualty Handler node. This laptop has the following software loaded:

- Casualty Handler User Interface
- AAR Logger and Display

Exhibit 8: Dr. Eric Allely of Tekamah Demonstrates the Interaction between the Casualty Handler User Interface and the Triage Controller at the Casualty Collection Point Node at Fort Gordon, Georgia

In this photo, the way in which the user interacts with the laptop based Triage Controller, AAR, and Casualty Handler elements are displayed. The laptops for each node contain a wireless element which allow them to connect to a desktop or system based network to pass patient assessment data back and forth to the patient modeling and simulation elements of the system, i.e. PATSIM. The Casualty Handler User Interface is also resident on a laptop, and from there, the simulation director can instantiate multiple patients, overlay scenarios onto those patients, monitor their status, and transfer patients to other nodes in the system. The roll around carts, which the laptops sit on, facilitate easy interaction with Observer/Controllers and personnel who are undergoing training.

Develop and Execute System Installation

METI System Engineering developed and executed plans for the CTPS system installation. These plans described the hardware and software components and how they will be integrated together in the CTPS system. Also included in this planning were the details of the necessary facility equipment and the setup of the system. Discussions with the independent evaluators (CTA) produced a document which shows the physical layout of the System as it would be installed at Fort Gordon. This layout is shown as Exhibit 5 under Appendix P of this document.

As a prerequisite to installation, the system components were upgraded to HPS Version 6. The upgrade task consisted of adding an Instructors' Workstation (Macintosh Dual Processor G4) to each PHS and HPS in the system, adding networking capability with Ethernet Interface cards and Ethernet Switches, making the existing processor in the HPS/PHS rack operate under Linux (with DOS loaded as well in a dual boot configuration), and adding Mannequin Identification systems to each of the mannequin umbilicals.

When this upgrade task was completed, an extensive system integration effort took place in the CTPS lab in Sarasota. The movement of simulated casualties in the CTPS system was tested to verify continuity of the simulation, even as these casualties were transferred from one node in the system to another. During this integration phase, the ability of the system to pass text events from one node to another was integrated. An example of this ability follows. If a casualty is being treated at the CCP, and an ET tube is inserted, an IV line is run, and a tourniquet applied, these events can be captured and passed on with a patient object as that object passes from node to node through the system. This record of physical interventions is important for textual description of activity in the CTPS After Action Review (AAR). As a node treats multiple casualties, the trainees or Observer/Controllers will need to moulage the mannequin, and install physical interventions that were applied during treatment at a prior node. This functionality

provides a record of physical interventions, so a particular casualty being simulated can be set up in the correct manner. It is also of the utmost importance to capture casualty interventions, so that the AAR can display what interventions were performed, when they occurred, and where they took place.

A site survey was performed by the CTPS Program Manager and System Engineer at the end of April. On this visit to Fort Gordon, the candidate site was inspected and discussions were held with representatives from the CTA, the Gas supplier, and the Ft. Gordon Safety Inspectors' Office. Subsequent to the final selection of an installation location, two other locations were investigated due to space allocation conflicts at Fort Gordon. Although the site investigation efforts for these two prior location candidates proved to be diversionary work, the final location for installation ended up being the best of the three candidates. Due to these changes in site, the installation was delayed until mid-July.

System Verification

On August 15, a system verification exercise was performed by the CTA. This exercise was performed using a checklist developed by the CTA, and uses a pass/fail type of evaluation. Due to time constraints, the entire checklist was not performed, but all of the tested items passed. The checklist is attached to this document as Appendix M.

Every function which is detailed in the checklist has been tested successfully by the CTPS team. The items shown in Appendix M in yellow are those which were witnessed by two CTA evaluators during the August 15 verification test. Items on the checklist pertaining to the HPS or PHS simulators were not demonstrated, as these are COTS items, and the checklist items for the HPS/PHS units are the same as a feature verification of a purchased item. The time involved to check all the features of the HPS/PHS units exceeded the time allocated for system testing, so the check-off on August 15 concentrated on CTPS System specific elements, such as the Casualty Handler, Triage Controller and AAR.

2.2 Develop and Perform CTPS Testing

For this task, IST was to deliver a CTPS System Test plan which describes the testing of the CTPS system at a component level and at a system level. IST has delivered the test report as part of their Final Report, which is included as Appendix E.

2.3 Develop User/Operator Documentation

Generation of system and component documents has been an ongoing operation during Phase 4 of the CTPS program. This documentation effort has been incorporated into the CTPS System User's Manual. The User's Manual for the CTPS System has been completed and is attached to this report as Appendix P.

The User's Manual for the Triage Controller and AAR has been completed and is attached to this report as part of Appendix P.

2.4 Reserved

The task proposed was not contracted in this phase.

3. COMPONENT RESEARCH AND DEVELOPMENT

3.1 Clean-up of CTPS Phase 3 Software

The Phase 3 Clean Up was undertaken to update the CTPS gateways and implement the gateway architecture developed during the Phase 3 Extension (refer to the CTPS Phase 3 Final Report for details).

CTPS Phase 3 Software programs enhanced in this task include:

- HPS RTI Gateway
- ECC RTI Gateway
- CTPS Executive.

Improved gateways developed as part of the Phase 3 Clean Up were successfully tested. The "Post Phase 3 Clean Up" CTPS System was evaluated and improved performance was confirmed. The "Post Phase 3 Clean Up" CTPS System was demonstrated at AMSUS and I/ITSEC.

Performance, reliability, capacity and efficiency have been improved. Tests to date indicate that the "Post Phase 3 Clean Up" system boots more quickly and can now run 15 patients simultaneously (increased from 2-3 pre-Phase 3 Clean Up) without failure. The CTPS System is now deployed using 2 PCs rather than the 4 required prior to the Phase 3 Clean Up task's completion.

This effort was undertaken to serve two purposes; to support CTPS System Demonstrations, such as AMSUS and I/ITSEC, and also to provide a working system at IST. This system was transferred to STRICOM, and has been an example of a working Phase 3 CTPS System during the development efforts of Phase 4. This gateway clean up effort has since been obviated by the development of Phase 4, as the system design has evolved from a one gateway per federate design to a one gateway per system design.

3.2 Develop and Implement Casualty Handler

CTPS Phase 4 brought about a change in the way patients are managed within the system. Previous phases have attempted to store all patient data in the FOM's Casualty entity. Although this has been implemented with limited success, the vast amount and varying nature of the data that is exchanged in the Phase 4 system made this approach impractical. Instead, Phase 4 introduced a new Casualty Handler. The Casualty Handler serves as a repository for patient data, drug response data, and scenarios. With this new software, the amount of information that must be stored in the FOM's Casualty entity decreases dramatically. Instead of storing the entire set of patient attributes, the new Casualty entity is required to store only the most important patient data such as vital signs, patient name, injury type, etc.

The Casualty Handler's responsibilities are greater than storing patient information. It instantiates casualties, and applies a selected scenario to be overlaid onto a casualty. After applying a scenario, the Casualty Handler will execute the scenario operation. It then tracks the scenario that is applied to a given casualty. This consolidated approach allows the Casualty Handler to specify the patient's destiny (which may vary based on user intervention) in addition to its physiologic parameters.

The Casualty Handler is composed of 2 sub-components:

- Script Engine – this component archives and executes scenarios for all patients.
- Graphical User Interface – this component provides an interface for the operator to create and transfer casualties, and monitor physiological parameters.

Script Engine – an overall specification and conceptual design for the script engine was completed, then a prototype was developed and tested. A detailed investigation of certain aspects of this design was conducted. Specifically, prototypes of Script Engine sub-processes were implemented according to the design, then evaluated in order to validate the design concept. This Casualty Handler Engine was then implemented at Fort Gordon as a separate module, running on a dual-processor desktop G4 so that additional CPU processing resources might be made available to this software module.

Graphical User Interface – The Casualty Handler User Interface gives the system controller the ability to instantiate casualties. The user can overlay scenarios onto casualties which have been instantiated, and then send the casualties to the CCP node (the default origination point, changeable through configuration files). Once in the system at the CCP, the casualties can be transferred to any node in the system, by use of the Casualty Handler User Interface. Each casualty in the system can be viewed in detail via the Casualty Handler User Interface. The user can view real time simulated physiology for the casualty, at any point in the system. The user can also view interventions in an event log (i.e. drugs administered with dosage and time, interventions such as defibrillation events and the time). Shown below is an example screenshot from the Casualty Handler User Interface.

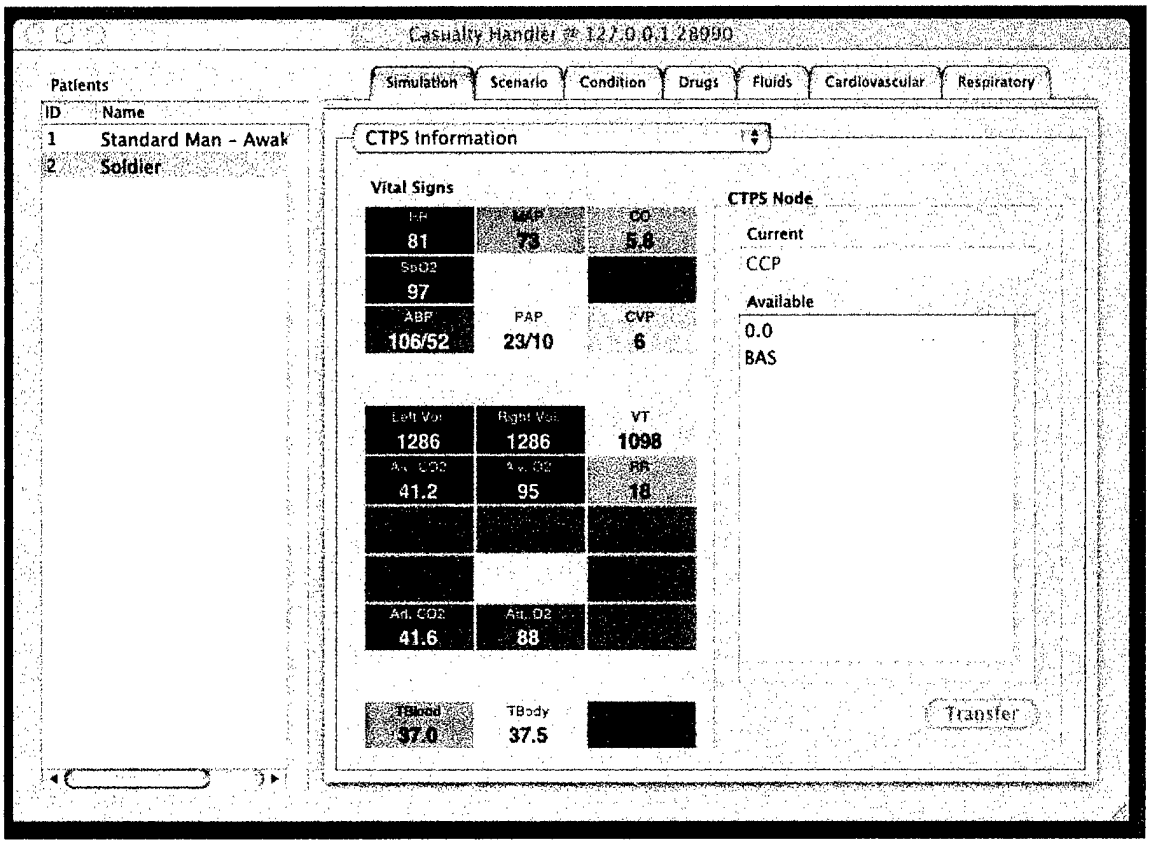


EXHIBIT 9: Casualty Handler User Interface

The above screenshot displays two casualties in the system, with two nodes available, the CCP and BAS. The casualty can be transferred from one node to another by selection of the casualty, and then selecting the node to transfer to, and then clicking on the "Transfer" button.

3.3 Enhance Triage Controller to Support Selected 91W/CLS Training

The Triage Controller in the CTPS System is software that simulates realistic triage and patient situations under combat conditions. This software was significantly enhanced in Phase 4 of the CTPS Program. In this phase, the Triage Controller supports the implementation of selected patient scenarios for 91W/CLS training, and provides interoperability training of HPS casualties.

The following excerpt from the Triage Controller User's Manual provided by Tekamah (and appended to this report as part of Appendix P) provides a description of the functionality of the enhanced Triage Controller.

> The Triage Controller provides an interface for selected operational attributes developed for inclusion in CTPS 91W/CLS scenarios and selected medical information not currently supported by HPS technologies (91W/CLS related).

These additional attributes focus on medical information critical during the 91W and CLS decision-making process.

Together with the HPS, the Triage Controller and AAR provide CTPS with the ability to simulate multiple casualties, train users in casualty and resource management as well as evacuation decision making, and provide instructors the ability to review student performance.

The Triage Controller simulates a casualty treatment station by providing a view of its patients and resources available for treatment. This station can be at the site of injury, the battalion aid station, the medevac helicopter, the ground ambulance, or any other military medical treatment facility.

The patients at the simulated location can be examined and treated from the Triage Controller. Alternatively, from the Triage Controller the user can select a patient to be simulated on an HPS. The full sized automated mannequin can be examined and treated much like a real patient using tools identical, or similar, to the tools and instruments that would be used on a real patient.

The Triage Controller provides additional support to simulations and training in the form of treatments to be applied to a simulated patient that cannot be performed at present on the HPS. As an example, consider the patient with a bilateral amputation below the knee where the student selects to control the bleeding with a tourniquet. When the action is selected in the Triage Controller, the Controller informs the Patient Simulation software so that the physiology of the patient changes and the bleeding stops. This cannot be accomplished on the HPS since it does not have the hardware to detect that a tourniquet has been applied to the injury. The instructor can define additional treatments by editing the configuration files of the Triage Controller and patient simulation models. See Appendix C of the User's Manual for the Triage Controller (contained in Appendix P of this final report).

A list of the enhancements to the Triage Controller follows.

- Text based casualty assessment was added. The trainee can communicate with a casualty by taking a patient history and asking text-based questions through the Triage Controller User Interface. The answers are scripted, and can be modified to suit a different scenario.

- Images were added that illustrate the casualty. The trainee can view the images to get an idea of the injury and casualty state for assessment and triage purposes.

- The Triage Controller can now display video imagery to aid the trainee in conceptualizing the operational scenario. This video depicts the events leading up to the start of the 91W/CLS scenario developed by Tekamah. It shows two

vehicles driving along a dirt road, a mine explosion, and depictions of the casualties that result as the scenario unfolds.

- Triage category can be set. This categorization corresponds to the DIME protocol (Delayed, Immediate, Minimal, Expectant).

- Enhancements were made to the surgical node Triage Controllers. The capability of the FST and CSH nodes to send a virtual patient to an Operating Room to resolve the scenarios which require surgical events (spleenectomy, vascular repair) was developed.

- The Triage Controller was enhanced by adding the capability to order X-Ray imaging. The Triage Controller will display two Chest X-Ray images (normal and tension pneumothorax).

- Enhancements were made to the Triage Controller to order and display the results of Blood Gas Analysis testing.

- Medical Supply storage was added to give the Triage Controller the ability to set a finite amount of medical supplies in a simulation. This will enhance the simulation by giving the medical personnel choices to make regarding which casualties receive items (IV bags, for example) from the limited set of supplies. The supplies can be restored if a resupply is scheduled.

- A Hold area was added to the Triage Controller in which casualties can wait and still have their condition monitored. This simulates a waiting area in which casualties can reside until evacuated.

- Communications - Text based messages have been added that enable Operational Orders to be scripted to control the action of node elements in the simulation.

- Transportation (evacuation) – Additions were made to the Triage Controller that simulate loading and unloading of casualties.

Two example screens from the Triage Controller User Interface are shown as Exhibits 10 and 11.

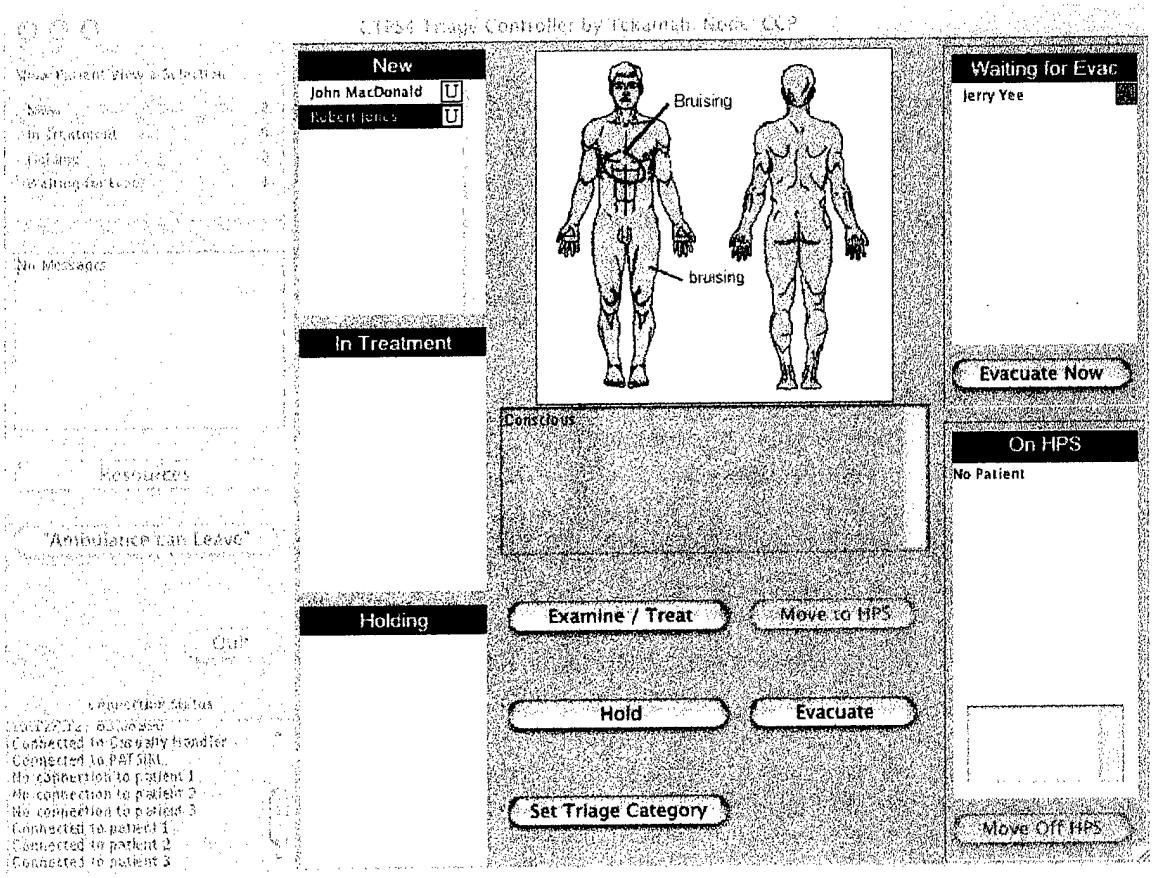


EXHIBIT 10: Patient View and Selection Panel

Exhibit 10 depicts the Patient View and Selection Panel, which allows the trainee to view all of the casualties at a node. Further detail on operation is provided by the Triage Controller User's Manual which is listed as part of Appendix P.

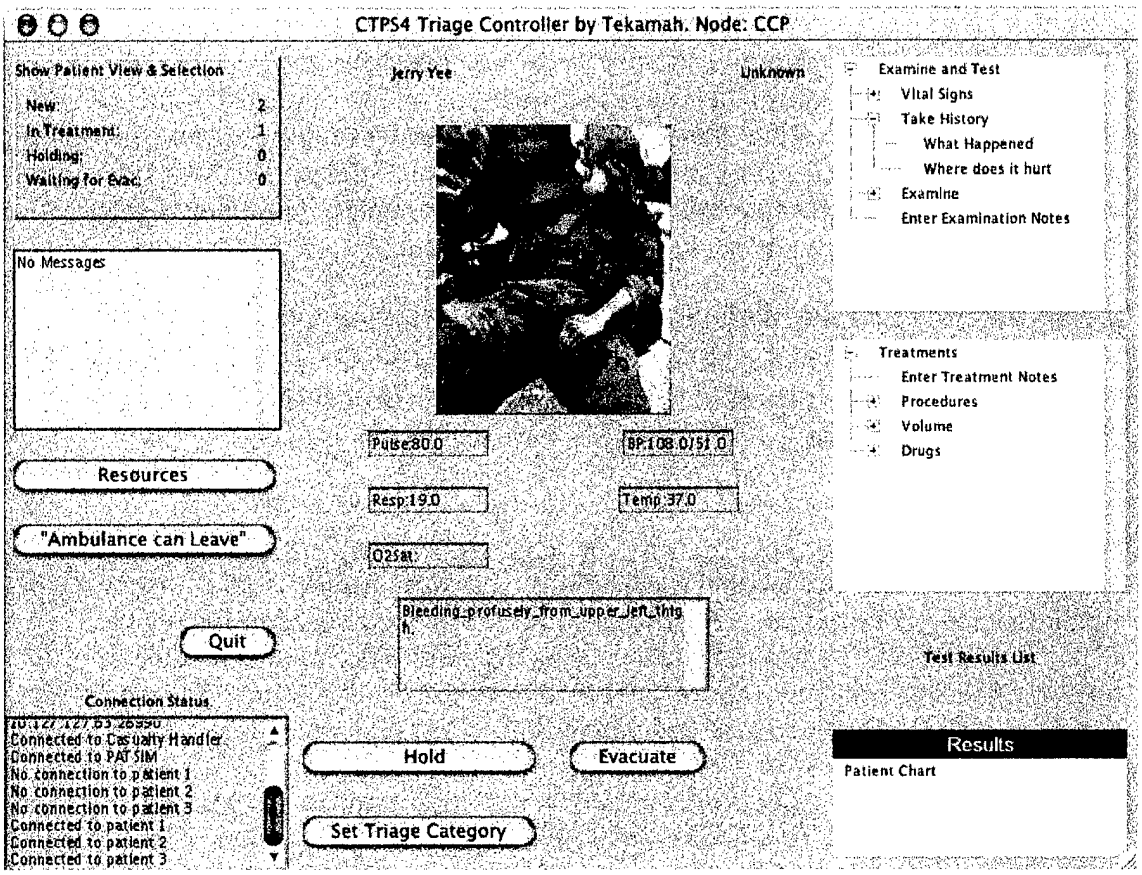


EXHIBIT 11: Examination and Treatment Panel

Exhibit 11 depicts the Examination and Treatment Panel. In this panel, the trainee can examine and apply treatments to a selected casualty. Further detail on operation is provided by the Triage Controller User's Manual which is listed as part of Appendix P.

3.4 Enhance PATSIM to Support Selected 91W/CLS Training

3.4.1 PATSIM Software

The PATSIM software was enhanced to support the selected set of 91W/CLS Training objects as specified by Tekamah. The ability to simulate multiple casualties is central to the concept of triage. PATSIM was enhanced in this phase to support the simulation of multiple casualties. In addition, this phase resulted in PATSIM software acquiring more of the capabilities of the HPS.

The main component of the PATSIM software is the Model Engine. This component simulates patients using the same physiologic models implemented in the HPS. The work performed on this sub-component is described below under section 3.4.2, PATSIM Physiologic Models.

3.4.2 PATSIM Physiologic Models

The physiologic models that give life to CTPS casualty entities are constantly evolving. In Phase 4, the physiologic models were modularized and reconstructed using object-oriented data structures. This change allowed discrete model enhancements to be added without the need to refine or comprise the overall design of the model. This leads to a physiologic model architecture based on plug-in code modules, thus removing legacy design considerations from the development of new models.

3.5 Implement System-wide Pause/Save/Restart Capability

To date, the CTPS System has lacked the ability to suspend or restart a simulation. In Phase 4, the system was enhanced so that the state of the overall simulation can be paused, restarted, or saved. Each feature is discussed below.

Pause

Pausing a simulation was accomplished by adding a pause feature to all components that are time-based. For example, PATSIM and the HPS are comprised of time-based, physiologic models. To accommodate pausing the entire system, each module was enhanced to include a pause feature that can be invoked by the Casualty Handler User Interface. The indication that the simulation is paused is presented via the scenario simulation clock, which stops when the system is paused and starts again when play is activated. The physiology of every casualty in the simulation freezes when the simulation is paused. A 10 second loop of physiological data continually runs during the pause state, so that the vital signs display will still update, and monitoring waveforms can still be viewed.

Play

The play (or restart) feature reverses the effect of the pause command. It is invoked by the Casualty Handler User Interface to play the simulation from the point at which it was paused.

Save

The ability to perform a system-wide save of a simulation was added in Phase 4. This capability maximizes the time invested in a simulation by allowing it to be saved to a mass storage device for later retrieval. The save function was implemented by saving the present physiological state of every casualty in the simulation. This implementation uses the Casualty Handler User Interface to actuate the save function.

3.6 Develop and Implement Medical AAR Federate for Use with Selected 91W/CLS Training Tasks

The AAR module was developed to provide feedback to the user and to also provide a means to compare the care of the casualty with a standard of expert care. This care can not only take the form of assessments and treatments, but other aspects of care such as the choice of evacuation asset by the Combat Medic. The following excerpt from the

AAR User's Manual provided by Tekamah (and appended to this report as part of Appendix P) provides a description of the functionality of the enhanced AAR.

> The AAR utility records patient physiological data and station event information during a simulation and brings it up for review after the training simulation is over. The AAR provides a display of the actions that occurred while treating patients during a simulation or training exercise.
>
> The AAR package comprises the AAR Logger (Logger) and the AAR Viewer (Viewer). The Logger records the changes in patient and station status in a specially formatted data file. After the simulation or training session is complete and the Logger closed, the Viewer may be used to read the data file and display the status of any patient or station at any given time.

The detailed description of the operation of the Phase 4 AAR is contained in the User's Manual for the Triage Controller and AAR document, as supplied by Tekamah. A sample screen from the AAR map view is shown in Exhibit 12.

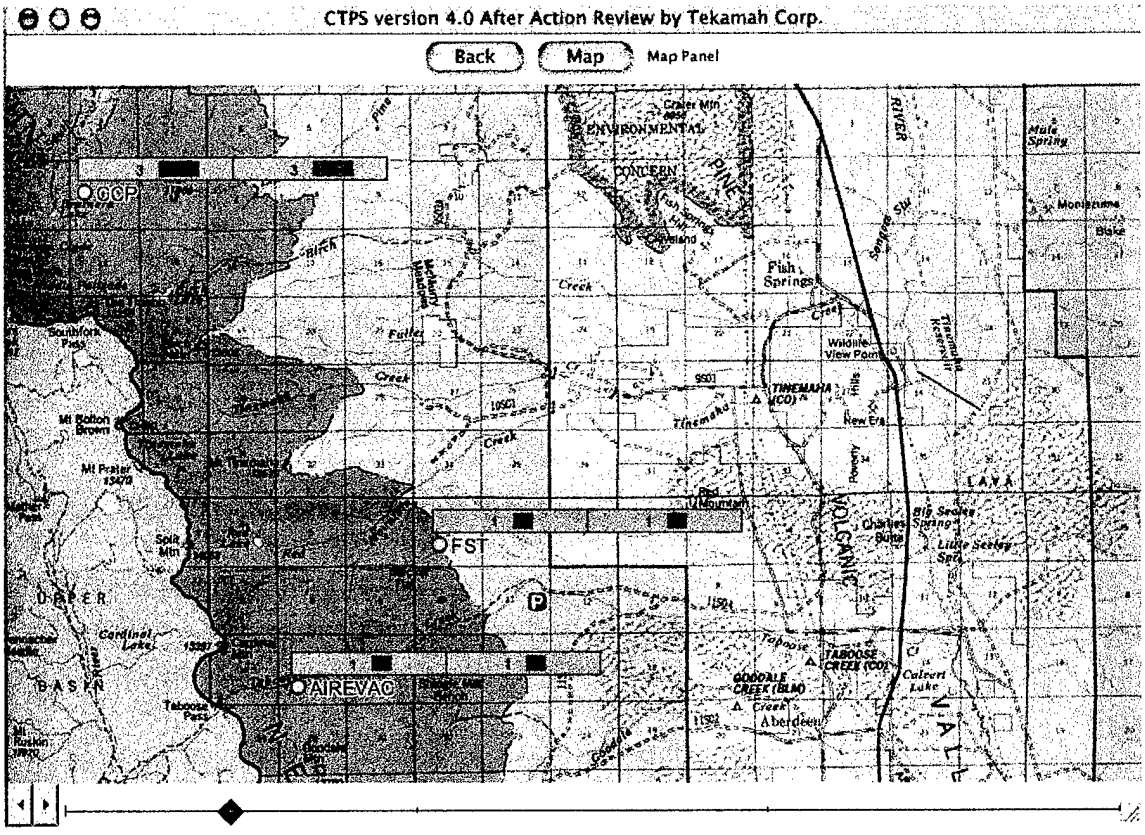


EXHIBIT 12: AAR Map Panel

An example screen from the Station View panel of the AAR is shown in Exhibit 13. This panel shows which casualties are at which node at a particular instant in time.

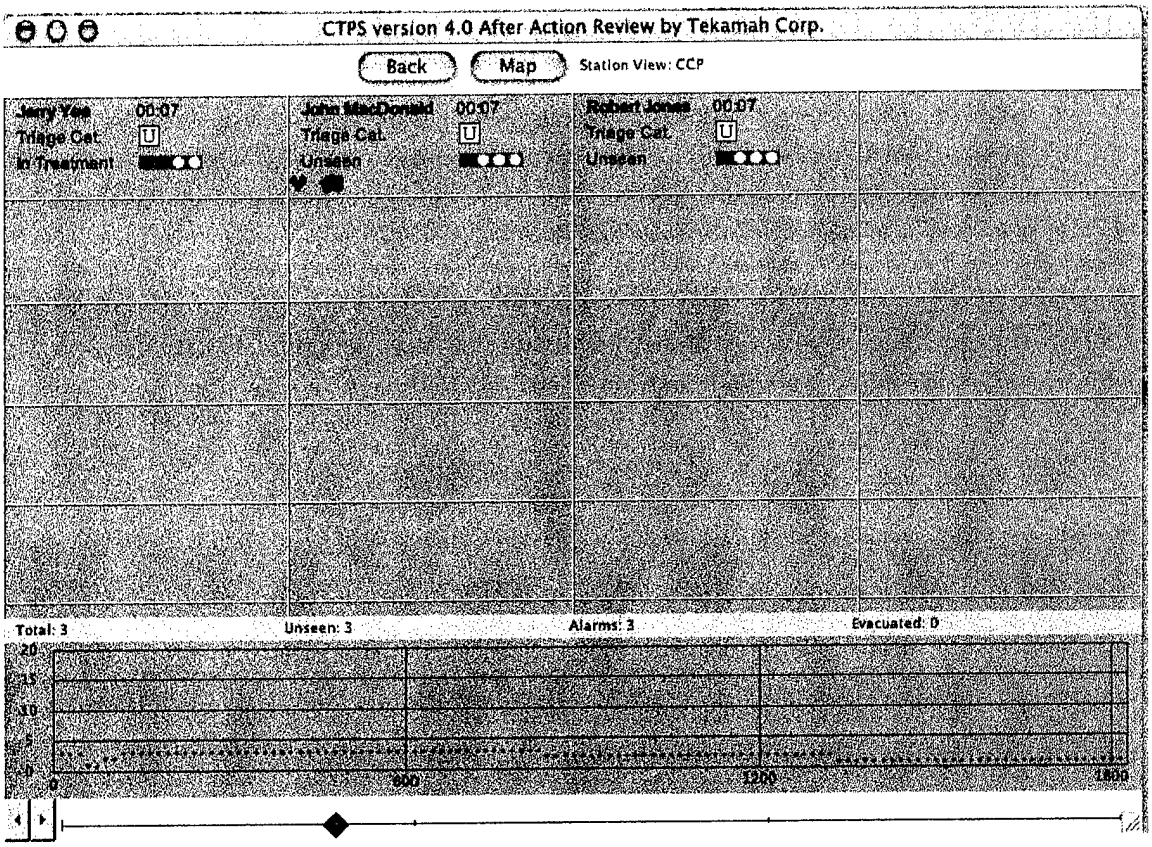


EXHIBIT 13: Station View Panel

An example screen from the Patient View panel of the AAR is shown in Exhibit 14. This panel shows information about one particular casualty at a particular instant in time. The way in which the AAR is constructed lends itself to use in several differing ways. The system can be reviewed at a node level, with the reviewer observing casualty flow in and out of a node, or it can be observed at a patient level, with the reviewer watching a patient flow through the nodes of a system.

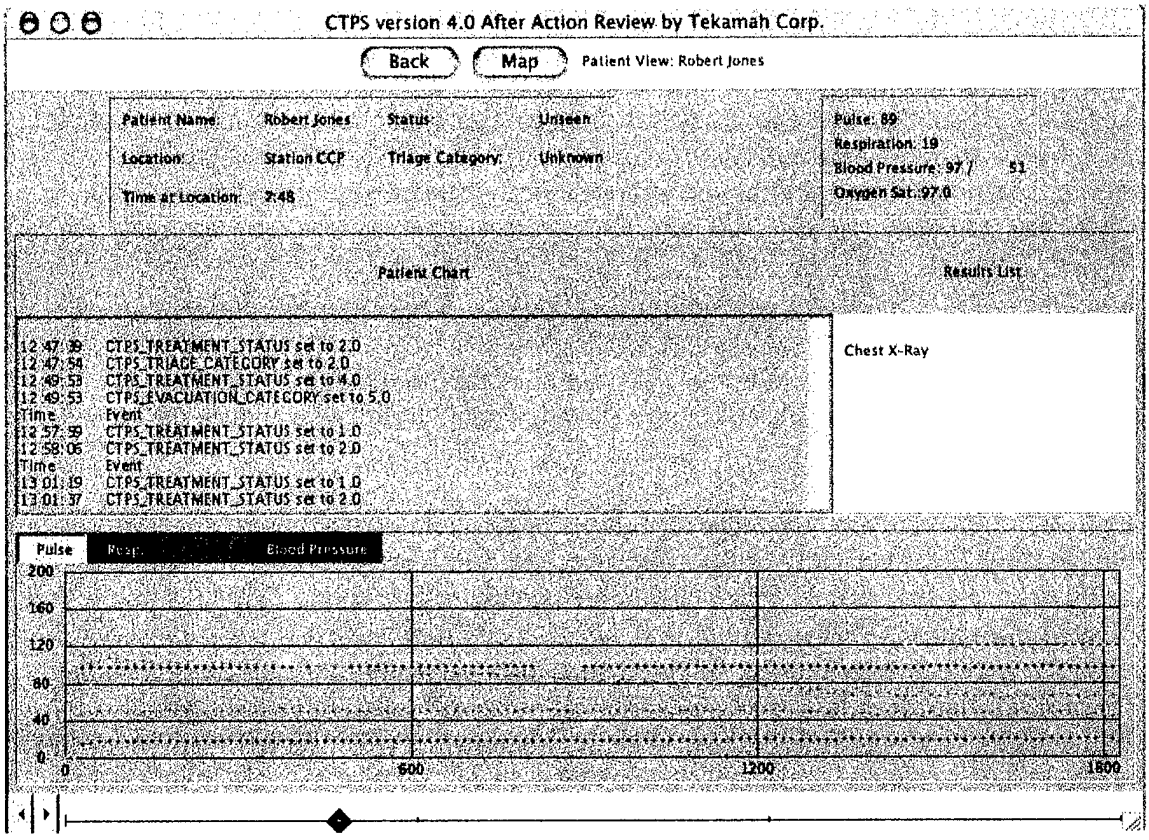


EXHIBIT 14: Patient View Panel

3.7 Develop and Implement a Casualty Instantiator

Initially, a Casualty Instantiator was envisioned to allow user selected casualties to be created. In the CTPS Phase 4 system, the functionality of the Casualty Instantiator is a component of the Casualty Handler. See Section 3.2, Develop and Implement Casualty Handler, for more details.

3.8 Enhance FOM and Federate RTI Interfaces

Federations are simulation networks of multiple federates. A federate is a program or gateway that communicates on the RTI. The CTPS System can, because of design to HLA specifications, participate in simulations that are networked together as a federation. The CTPS System has undergone several changes (described below) that have resulted in the complete system being considered as a federate. The CTPS System federate communicates with other simulation federates through a software program called the CTPS HLA Gateway.

In the Phase 4 CTPS System, physiologic parameters, drug responses, and scenario state information are all maintained by the Casualty Handler. This information is made available to any federates belonging to the same federation that the CTPS System federate resides in, if they subscribe to receive this data. In this way, non–CTPS federates can monitor the status of patients being simulated inside the CTPS System.

The FOM in Phase 3 contained a large number of physiologic parameters. In CTPS Phase 4, the FOM's Casualty Entity was revised to reflect patient status information. In this Phase, a smaller subset of the physiologic parameters are used. These parameters are reflected from the CTPS System out into the HLA environment. It is not necessary to reflect the previous large number of parameters because many of the parameters in the previous FOM are very low level physiological parameters, and by reducing the parameters that are output from the system, RTI bandwidth is conserved. Also, many of the parameters in phase 3 were input parameters. Phase 4 parameters are output only, and so the input parameters are not needed.

Originally, the CTPS System internal software components such as the Casualty Handler and PATSIM were intended to use a piece of software called the RTI Conduit to communicate amongst themselves, using the RTI. However, METI performed extensive HLA/RTI development, and determined that the system design would have to be changed to improve the system HLA/RTI interface. This development included tests that explored data transfer using interactions, maximum bit rates for data, optimum packet sizes, and whether or not a low and high traffic priority scheme needed to be implemented.

As a result of this testing, the system design has evolved from a one gateway per federate to a one gateway per system implementation. In other words, the entire CTPS System is considered a federate. What this means is that the CTPS system internal data traffic (i.e. data not destined for any federate outside the CTPS system) can operate as HIDEP data (METI's internal data communication protocol) over TCP/IP at a rate which is much greater than that allowed by the RTI, and with less latency. Essentially, internal system

traffic travels on an internal network, without traversing the RTI. This change results in a significant improvement in internal system throughput (the speed at which system software modules communicate data packets with each other). Communication with outside federates is accomplished through use of a piece of software which was developed called the CTPS HLA Gateway. This change is shown in Exhibit 15.

These architecture modifications were made and tested in the METI laboratory, with a HLA peer that tested the flow of data across the RTI to the CTPS HLA Gateway.

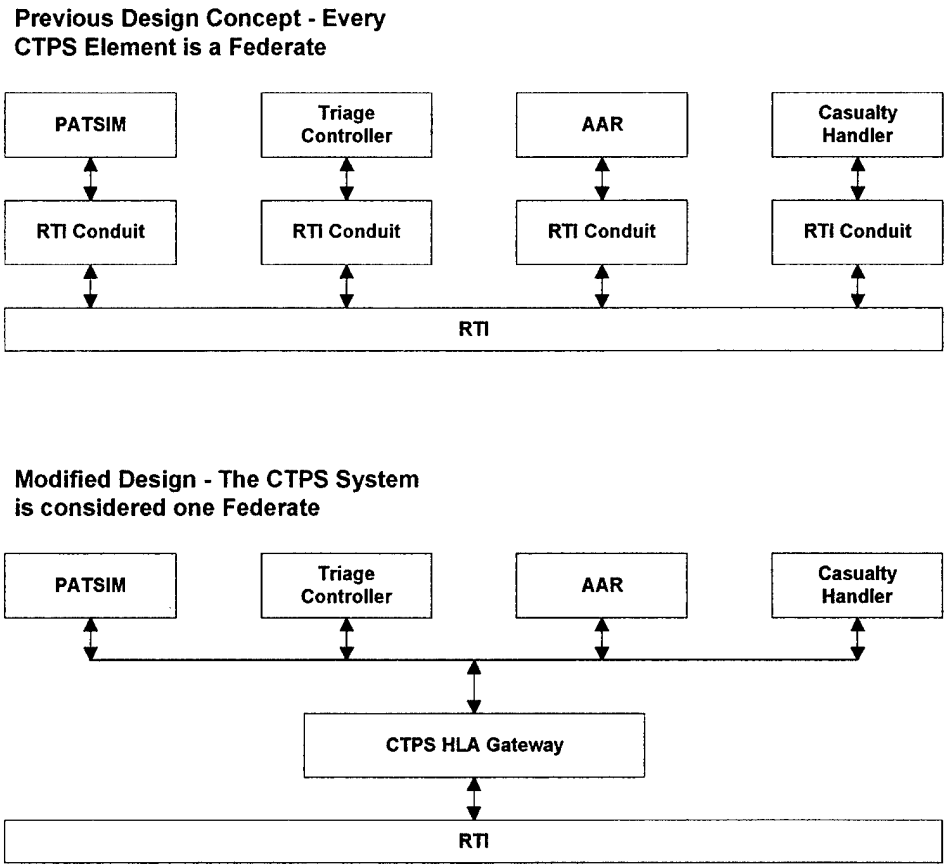


EXHIBIT 15: CTPS System HLA/RTI Architecture

3.9 Enhance CTPS Executive

CTPS Phase 4 has brought substantial changes to the design and architecture of the CTPS System. New components such as the Casualty Handler have been added. As a result, it was discovered that the Casualty Handler User Interface and Casualty Handler Engine components effectively replace the CTPS Executive federate from the previous phase of the program. See Section 3.2, Develop and Implement Casualty Handler for more details.

3.10 Maintain Design to HLA Compliance

3.10.1 Implementation

The Defense Modeling and Simulation Office (DMSO) publishes a set of guidelines to which system designs must adhere in order to maintain HLA compliance. From the program's inception, a requirement of CTPS has been to maintain HLA compliance, and this phase has seen that trend continue. The modules which have been designed both at METI and at Tekamah have maintained HLA compliance with RTI libraries according to RTI 1.3.

The original RTI Conduit design has developed, due to the testing described in section 3.8, into a design (the CTPS HLA Gateway), that can conceptually be thought of as a "Reflector". In this concept, casualties which are being simulated at one or more nodes in the CTPS System possess certain attributes that characterize the casualty state at any one instance in time. These attributes of the casualties are channeled to the CTPS HLA Gateway, which takes the attributes internal to the CTPS System and performs a mapping to casualty entity objects, which are defined by the CTPS FOM.

In this way, internal casualty simulation attributes are "reflected" out into the HLA/RTI domain. Any external simulation federates belonging to the same federation (such as those that would exist in a distributed HLA compliant simulation) wishing to observe casualty attributes can subscribe to receive this data.

Conversely, the external simulation federates which belong to the same federation as the CTPS System federate might like to start to introduce some simulation casualties into the CTPS System. This process is also accomplished through use of the CTPS HLA Gateway. The federate initiating the casualties can then monitor their status via attributes reflected out to the RTI.

3.10.2 Design Consulting

In Phase 4, IST was tasked with monitoring current activities in the HLA community to identify emerging trends, paradigms, and techniques. This was done through other programs at IST, through interactions with colleagues conducting HLA research, and through participation at SIW and DMSO meetings. The principle activities in this task were to determine if and how current or potential changes to the HLA would impact the CTPS RTI modules, the impact of those updates on the CTPS system, and recommendations on how such updates should be implemented.

This effort has concentrated on analysis of the effect of architecting the CTPS HLA Gateway aspects of the CTPS system as a "one federate" implementation as described in more detail above in section 3.10.1.

Allison Griffin, IST Research Associate, performed an analysis of the current state of CTPS with regards to HLA. This analysis is attached as Appendix G. A summary of the initial analysis follows:

- CTPS is an HLA federate. CTPS was certified as HLA compliant in December 1999 to HLA version 1.3
- According to Phil Zimmerman, DMSO HLA Staff, currently there is no DOD policy on the re-certification issue. The topic was to be brought up at the next Architecture Management Group (AMG) in August of 2001. No feedback has been provided regarding the output of this meeting. The following advice was provided by Ms. Zimmerman:
- Since the CTPS federate is already tested to 1.3, it's less of an issue unless:
  - something significant has changed in the CTPS SOM
  - something significant has changed in the CTPS federate
  - something significant has changed in the CTPS conformance statement
- Ms. Zimmerman reiterated at the end of her email, this is only advice not policy or guidelines.

3.10.3 Administration

Obtaining HLA certification is a process consisting of gathering and documenting data and software in a specific format to be provided to the compliance agent. The purpose of this task was for IST to organize and deliver HLA testing data in a format compatible with DMSO requirements.

As discussed above in section 3.10.2, IST performed research into certification of the CTPS System. IST received the initial Conformance Notebook (CTPS Phase 3) from DMSO and reviewed the documentation to determine if there has been a significant modification to the CTPS federate that might require a follow-up certification process.

An updated FED file (Federation Executive Process configuration file) and an updated OMD file (Object Model Development file) reflecting the CTPS Phase 4 architecture were created by METI and sent to IST. IST issued their final report without action to decide whether or not to re-certify the system with this data.

3.11 Extend CTPS System to Include Operational Data

3.11.1 Analysis, Development and Selection of Operation Attributes for Inclusion in CTPS 91W/CLS Scenarios

Based on the work done in section 4.3, Implementation of Selected Patient Scenarios for 91W/CLS Training, Tekamah was to develop additional operational training attributes for the CTPS System. These attributes were focused on non-medical information critical to

the 91W/CLS decision making process. Particular emphasis was given in areas where the direct care of the casualty changes with operational conditions.

The analysis, development and selection of operational attributes for inclusion in CTPS 91W/CLS scenarios was performed by Tekamah, and the report is included as Appendix D.

A subset of the operational attributes is provided below to indicate the nature of the resulting research.

Operational Attribute Subset:

- Medical re-supply
- Receiving different casualties than expected
- General wartime chaos
- Communications
- Transportation (evacuation)
- Wrong deployment package
- Extreme heat and cold
- NBC environments
- Various class 8 resources limitations
- Evacuation limitations
- Under-fire environments
- Changing prioritization's
- Lack of fluids

3.11.2 Analysis, Development and Selection of Additional Medical Information Not Currently Supported by HPS Technologies (91W/CLS related)

Based on the work done in section 4.3, Tekamah developed additional medical training attributes for the CTPS System. These additional attributes concentrated on medical information critical during the 91W/CLS decision making process, but not currently supported by the HPS technology.

The analysis, development and selection of additional medical information not currently supported by HPS technologies (91W/CLS related) was performed by Tekamah, and the extensive report is included as Appendix D.

A list of the additional medical information not currently supported by HPS technologies is listed below. Fifteen additional attributes for HPS were recommended:

- Anaphylaxis shock management
- OB emergencies
- Changing Skin color
- Diaphoresis
- Battle signs
- Pulse quality

- Distension (Jugular Venous)
- Trachea Deviation
- Pulsating mass
- Fluid for ABG, CBC tests
- Timing more realistic
- Twitching
- Secretions
- Visible inflammation
- Moveable HPS

3.11.3 Enhancement of Triage Controller to Provide Human-Computer Interface to Selected Operational Attributes

Based on the analysis done in 3.11.1 and 3.11.2, Tekamah enhanced the Triage Controller to provide the necessary human-computer interface with the additional operational and medical attributes listed below.

For the operational attributes, the Triage Controller enhancements to provide a human-computer interface are described in the table below.

Operational Attribute	Triage Controller Implementation	Example of Implementation
Medical re-supply	Configuration File	A Triage Controller at a node has a finite amount of medical supplies. This supply is depleted when the items (such as IV bags) are used. The amount of supply can be viewed by activation of the "Resources" button on the Triage Controller.
Receiving different casualties than expected	Different Casualty scenario overlay through Casualty Handler	The Triage Controller receives casualties from the Casualty Handler. If the Triage Controller is expecting the casualties that are part of the standard CTPS scenario, a change can be made to introduce a different scene by overlaying different scenarios onto the casualties, which are sent to the Triage Controller of a particular node. Also, the system can send a casualty from the Casualty Handler to any of the other nodes at any time. This could simulate casualties that either walk-in to the CSH, or are injured right outside of the CSH and do not take the normal evacuation route into the hospital.

General wartime chaos	Configuration File, use of holding area	The Triage Controller responds to general wartime chaos through several means. The expected evacuation asset (air ambulance or ground ambulance) might not arrive due to mechanical breakdown, weather, mission diversion, or enemy action. The Triage Controller has the ability to put casualties in a Hold area, where they can be monitored while waiting for evacuation. Other elements of wartime chaos can be simulated, as listed below. • The removal of the ability to take X-rays (FST and CSH Triage Controller elements) • The removal of the ability to order tests (FST and CSH Triage Controller elements) • The removal of supplies at a Triage Controller node • The arrival of incorrect supplies • The arrival of more casualties than expected • The arrival of casualties which simulate non-combatants (i.e. the overlay of a gunshot scenario onto an elderly male, or a female base patient type) • Many more scenario variations can be created to test the trainees, due to the flexibility of the system.
Communications	Configuration File, Text based user interface	The actions of a Medical Resource Officer (MRO) are simulated by configuration files that activate the air ambulance node and send a message to the Triage Controller of the air ambulance node, indicating that a convoy has been ambushed and ordering the air ambulance to fly to the CCP node. A similar message appears on the ground ambulance node Triage Controller. The Triage Controller can simulate communication with outside assets like air and ground ambulances at a particular node by use of the "Ambulance Can Leave" button. The combat medic can communicate with a casualty by taking a patient history and asking text-based questions through the Triage Controller User Interface.

Transportation (evacuation)	Evacuate and "Unload" buttons, Text pane indicates evacuation asset has arrived	Simulated through use of air ambulance and ground ambulance Triage Controllers, the Triage Controller at any particular node can simulate the loading and unloading of casualties by operation of the "Unload Now" button. The Evacuate button is used to transfer casualties, and a text panel indicates when an evacuation asset has arrived at that node of the system.
Wrong deployment package	Configuration File	Simulated by use of configuration files which indicate quantity and type of supplies at a Triage Controller. By configuring the wrong supplies, the wrong deployment package can be simulated.
Extreme heat and cold	Configuration file, pictures, text based assessment	This can be simulated by manipulation of the Triage Controller configuration files to present a different picture of the casualty – in cold weather, one that indicates heavy clothing that obscures exit wounds or hides swelling from broken limbs, etc. Extreme heat can be simulated through use of the text based assessment that the Triage Controller User can perform, which can indicate level, or absence of perspiration, consciousness level, etc. Text based assessment at the Triage Controller can also be restricted by design, to simulate reduced ability to access the casualty because of clothing restrictions, etc.
NBC environments	Configuration File, pictures, text based assessment	This environment can be simulated by manipulation of the Triage Controller configuration files to present a different picture of the casualty – one that illustrates the casualty in NBC gear – this can also hinder casualty assessment at the Triage Controller. Text based assessment can also be restricted because of the simulated NBC environment. Photographs can also illustrate this environment.
Evacuation limitations	Configuration File, Hold area	Simulated through use of configuration files. The expected evacuation asset (air ambulance or ground ambulance) might not arrive due to mechanical breakdown, weather, mission diversion, or enemy action. The Triage Controller has the ability to put casualties in a Hold area, where they can be monitored while waiting for evacuation.

Under-fire environments	Configuration File, Hold area	This can be simulated by limiting the amount of casualty assessment performed (through configuration file modification). Also, evacuation assets might be late, or not arrive at all due to enemy action. In addition, air evacuation might not be possible, due to the possibility of the air ambulance giving away the unit position, or the desire not to expose the air ambulance to enemy fire.
Changing prioritizations	Configuration File, Hold area	The Triage Controller can exhibit this situation by changes in configuration files. For example, if the air ambulance priority has changed, and is redirected from the CCP, then the combat medic at the CCP has to hold his casualties and treat them until an evacuation asset arrives.
Lack of fluids	Configuration File	The Triage Controller at a node has a finite amount of medical supplies. This supply is depleted when the items (such as IV bags) are used. The amount of supply is set through configuration file, and can be viewed by activation of the "Resources" button on the Triage Controller. When the fluids are exhausted, they are gone until resupplied.

For the medical attributes, the Triage Controller enhancements to provide a human-computer interface are described in the table below.

Medical Attribute	Triage Controller Implementation	Example of Implementation
Anaphylaxis shock management	Configuration File, Pictures, Text based assessment	Assessment available in the Triage Controller, configurable by alteration of text configuration file.
OB emergencies	Configuration File, Pictures, Text based assessment	OB emergencies - Visual effects and text descriptions simulating OB emergencies available in the Triage Controller by picture and text information.
Changing skin color	Configuration File, Pictures, Text based assessment	Text based assessment information in the Triage Controller, and photograph displayed at the Triage Controller.

Diaphoresis	Configuration File, Pictures, Text based assessment	Visual effects and text descriptions simulating perspiration available in the Triage Controller by picture and text information, configurable by alteration of configuration file.
Battle signs	Configuration File, Pictures, Text based assessment	Text based assessment information in the Triage Controller, and photograph displayed at the Triage Controller.
Pulse quality	Configuration File, Text based assessment	Text based assessment information in the Triage Controller.
Venous distension	Configuration File, Text based assessment	Visual effects and text descriptions simulating venous distention available in the Triage Controller by picture and text information, configurable by alteration of configuration file.
Tracheal deviation	Configuration File, Text based assessment	Visual effects and text descriptions simulating tracheal deviation available in the Triage Controller by picture and text information, configurable by alteration of configuration file.
Pulsating mass	Configuration File, Text based assessment	Text based assessment information in the Triage Controller.
Fluid for ABG, CBC tests	Configuration File	Tests can be ordered and results analyzed by alteration of configuration file.
Twitching	Configuration File	Text based assessment information in the Triage Controller.
Secretions	Configuration File, Pictures, Text based assessment	Visual effects for secretion of blood and fluids available in the Triage Controller by picture and text information.
Visible inflammation	Configuration File, Pictures, Text based assessment	Visual effects for inflammation available in the Triage Controller by picture and text information.

3.11.4 System Support for Operational Data

A portion of Tekamah's investigations have dealt with the addition of support for the operational aspects of military medical care. The information that has resulted from these investigations has been fed back to the software modules in the CTPS System which were not developed by Tekamah. These modules, which were developed by METI, are PATSIM, and the Casualty Handler.

PATSIM was enhanced to provide for the simulation of multiple casualties. This enhancement provides support for operational aspects by enabling the system to simulate a multiple casualty triage. The ability of PATSIM to simulate multiple casualties can

also be used to simulate the evacuation of multiple casualties from a node, hold-back of multiple patients at a node (to simulate under-fire environments), and so forth.

The Casualty Handler also supports operational simulation aspects. The Casualty Handler supports the work done in all parts of section 3.11. As an example, in the operational attribute "Receiving other casualties than expected", the Casualty Handler supports the generation of casualties which deviate from the expected types of CTPS scenario casualties.

3.12 Reserved

The task proposed was not contracted in this phase.

3.13 Reserved

The task proposed was not contracted in this phase.

3.14 Reserved

The task proposed was not contracted in this phase.

3.15 ECC Database Translator Enhancements

The ECC has a fixed list of casualty types that are linked to an ECC database translator. The translator converts the ECC casualty type into another format, which is then usable by the CTPS System. For this task, IST was to investigate and implement modifications to the ECC database translator to trigger additional casualty types consistent with the CTPS expanded casualty list.

A technical report was delivered by IST and is appended to this document as Appendix F.

METI understands the importance of incorporating an operational link to the CTPS system through use of the SAWE/MILES II gear. However, after evaluation of the feasibility study and technical report prepared by IST, and also through internal review, METI has concluded that the approach used in Phase 3 and evaluated in Phase 4 is one which does not merit further study.

3.16 Wireless Ethernet Casualty Transfer

The distributed nature of the military medical footprint requires that the CTPS System be deployed in a variety of environments. To accommodate situations where it is not practical to implement a terrestrial network, Phase 4 provided an effort to investigate the transfer of casualties wirelessly, over Ethernet.

Hardware elements were received, and testing was performed. In this testing, IEEE 802.11b compatible wireless cards were installed into Powerbook laptop computers, and wireless connectivity with the METI facility LAN was established using Apple's Airport Base Station. The transmit/receive limitations of the wireless connection were tested by traveling in and out of the engineering workspaces with the laptop receiving streaming video (internet connection) to determine when the signal strength was low enough for the connection to drop out. The connection was valid at distances of 200+ feet indoors. This

is more than adequate for a Triage Controller application to communicate with its associated node. The wireless connection was also tested by running HPS Version 6 software as a computer remote control. In this mode, the wireless connection was not directly controlling a mannequin's operations at a low level (data acquisition and control), but rather was sending and receiving high-level commands. The laptop operated well in the CTPS laboratory in this role.

Wireless Triage Controller laptops and a wireless Casualty Handler laptop were deployed in the CTPS System installation at Fort Gordon, Georgia. In deploying this equipment for each node, METI exceeded the deliverables originally proposed in this phase of the program.

4. DEVELOP A CTPS-BASED TRAINING PROGRAM

4.1 Analysis of 91W/CLS Training Objectives

Tekamah conducted a review and analysis of the Training Objectives for the 91W MOS and the CLS Course. The goal of this task was to develop a list of the Terminal Learning Objectives that address critical training for both the 91W and CLS. The analysis includes recommendations for training modalities of the selected training objectives. In particular, focus was placed on psychomotor skills. The complete report is included as Appendix D.

4.2 Development of 91W/CLS Task List Supported by Current HPS Technology

Based on the work done in task 4.1, Tekamah developed a detailed task list and a list of the related Enabling Learning Objectives for 91W and CLS Terminal Learning Objectives that are supported by the current HPS technology. This information is contained in the report included as Appendix D.

4.3 Implementation of Selected Patient Scenarios for 91W/CLS Training

Using the detailed task list developed in task 4.2, Tekamah developed and implemented HPS scenarios to address the selected training tasks for 91W and CLS training.

This scenario is described in detail in the Tekamah Users Manual for the Triage Controller and AAR, which is included in Appendix P. A portion is reproduced below to describe the scenario developed.

OVERVIEW OF THE SCENARIO

Twelve soldiers were en route to their garrison in two HUMMVs. They were driving on a dirt road when the lead vehicle ran over a mine. The explosion flipped the vehicle over killing two of the six occupants instantly. The other four survived the initial blast but were seriously injured. The trailing vehicle immediately pulled to the side of the road and its six occupants dismounted and rushed to render assistance. Immediately after dismounting, they began to take fire from a sniper concealed in the brush adjacent to the road.

One of the members from the trailing vehicle was hit by the snipers first shot. Two others began returning fire while a fourth radioed for assistance and the remaining two (one a medic) began attending to the injured soldiers. The exchange of gunfire lasted less than five minutes before the sniper was killed. In that short time he was able to inflict two gunshot wounds, raising the number of injured soldiers to six.

CASUALTY DESCRIPTIONS

Blunt Abdominal Injury (ruptured spleen)
The soldier riding in the front right seat was unbelted and was thrown out of the HUMMV, landing several yards from vehicle. Upon initial inspection he has a small laceration on his forehead and reports having a sharp pain in his left wrist. He is stoic when talking about his injuries and is very concerned about his fellow soldiers. Initial vitals reveal only a slightly elevated heart rate. With further examination he is tender on the left side of his torso where he apparently struck the ground. Breath sounds are normal. Abdomen is normal.

His underlying injury is a ruptured spleen. As he bleeds into his peritoneal space he becomes increasingly hypovolemic and has rebound tenderness upon examination. Volume replacement has little effect. His only hope for survival is prompt evacuation to a treatment facility with surgical capabilities. Without surgical intervention (spleenectomy) this casualty will die in approximately 60 minutes.

Blunt Chest Injury (pericardial tamponade)
The blast arrested the vehicle's forward motion and flipped it over on its top. The driver's chest struck the steering wheel. Upon inspection he has a bruise on his chest over the lower half of the sternum as well as a bruise on his left leg where it stuck the side of the vehicle during the rollover. He complains of soreness where he struck the steering wheel and a sharp localized pain with inspiration. As time progresses he reports the chest pain becoming "sharper" with the pain radiating to his neck. His respiratory rate increases and he has trouble breathing. He is anxious and lightheaded.

The force of the impact of his chest on the steering wheel fractured ribs immediately over his heart. The impact with the heart caused a small bleed into his pericardial sac. As the fluid accumulates his condition becomes more severe eventually leading to unconsciousness. The problem can be managed (temporarily) at any location with staff capable of a pericardiocentesis. (BAS, FST, of CSH). With the pressure in the pericardium relieved, the bleeding stops on its own and does not require surgical correction.

Closed Head Injury
One of the soldiers riding in the rear of the first HUMMV was thrown against the metal frame of the vehicle. His head struck a metal post creating a small laceration and significant bruising. He suffered a brief loss of consciousness and reports both neck and head pain. After 5 minutes he loses consciousness.

His underlying injury is a cerebral contusion. The intra-cranial pressure increases over the course of the scenario. His best chance of survival is evacuation to a treatment facility with an intensive care unit.

Compound Fracture of the Left Leg (tibia)
One of the four passengers riding in the rear of the HUMMV had his left foot and ankle wedged between two pieces of gear during the rollover while his torso twisted 180 degrees. The twisting of his left leg resulted in a compound, spiral fracture of his tibia. He did not sustain any other injuries. Upon examination he has significant external bleeding. His heart rate is elevated. His pedal pulse is absent on the left but he is neurologically intact.

The fractured tibia transected the popliteal artery. Without immediate application of a pressure dressing or tourniquet, he progresses through increasingly severe states of hypovolemic shock. Once the bleeding is properly managed, he responds well to volume replacement. Vascular repair is necessary to salvage the leg.

Gunshot Wound to the Left Chest
The sniper hit one of the soldiers in the left chest. The bullet entered in the left upper quadrant. The entrance wound is not grossly bleeding. No exit wound is found. Pulse is normal. Diminished breath sounds on the left. He remains conscious and over time begins taking more rapid, shallow breaths and complains of difficulty getting enough air. The rapid breathing is followed by tracheal deviation to the right and jugular venous distension.

The bullet missed his heart and large blood vessels but destroyed a portion of the upper lobe of the left lung leaving a significant opening between several larger bronchioles and the pleural space. Over time intra-thoracic pressure increases causing a tension pneumothorax. Treatment (needle decompression) can be done at any echelon. Once decompressed, the needle kinks or is clotted off with each transfer of the casualty until the needle decompression is replaced with a chest tube.

Gunshot wound to the Right Thigh (Femoral artery bleed)
The sniper's first bullet hit one of the soldiers in the left upper thigh. The entrance wound located in the high anterior-medial portion the midline is bleeding profusely. An exit wound is found on the mid-portion of the left gluteus. Popliteal and pedal pulses are absent in the injured leg. The solider is initially coherent but becomes confused then loses consciousness as he becomes increasing hypotensive.

The bullet clipped the femoral artery. Direct pressure, a pressure dressing or tourniquet are not effective. He continues to bleed internally regardless of attempts to stop the bleeding externally and does not respond to volume resuscitation. His only chance of survival is to be evacuated to a treatment facility capable of surgical intervention (vascular repair).

EVACUATION RESOURCES AND SUPPORTING MEDICAL TREATMENT FACILITIES

The scenario has six treatment nodes each with its own HPS, Triage Controller and supporting equipment. Four of the nodes represent treatment locations that are in fixed position and two nodes represent evacuation vehicles. The four "fixed" treatment nodes are: a CCP, a BAS, an FST, and a CSH. The two evacuation vehicles are a ground ambulance and an air ambulance.

The CCP is set up by the medic at the site of the explosion.

Ground ambulance evacuation times are as follows: The BAS is 10-15 minutes away from the CCP, the FST is 15-20 minutes away from the BAS, and the CSH is 20 minutes away from the FST. The ground ambulance is capable of transporting four casualties at a time.

Air evacuation times are: CCP to CSH is 10-12 minutes; the BAS is situated in a wooded area without easy access to a landing site – air evacuation is not supported; CCP to FST is 7-10 minutes; and FST to CSH is 5-7 minutes. The air ambulance is only capable of transporting two casualties at a time.

The first evacuation asset on the scene is a helicopter capable of transporting two litter casualties directly to a Combat Surgical Hospital (transport time: 10-12 minutes). Second on the scene is a ground ambulance capable of transporting four litter casualties directly to a BAS (transport time: 10-15 minutes).

THE UNFOLDING SCENARIO

In addition to managing the casualties, each of the locations will need to have a working understanding of the capabilities at each node and the transit time between nodes. This situational awareness will be most important at the CCP. In addition to the first look and triage of the casualties, the medic will need to re-triage each of the casualties prior to making an evacuation decision. Those most in need of definitive surgical care may not be obvious initially. If one or more of the more severe cases is not loaded onto the air ambulance, the best course of action would be to hold the severe casualty at the CCP rather than evacuating to the BAS. Waiting for the second trip via air ambulance will get the casualty to definitive surgical care faster than sending them by ground.

5. RESERVED

The task proposed was not contracted in this phase.

6. DELIVERY OF CTPS SYSTEM HARDWARE

The CTPS Phase 4 System installed at Fort Gordon, GA, consists of three elements: HPS's, Personal Computers, and Networking Components. All are COTS items.

6.1 Deliver CTPS 4 HPS Hardware

The HPS's and accessories were acquired under GSA Contract Number GS-02F-0014J. The METI serial numbers for all equipment delivered to the Government are shown in Exhibit 16.

Human Patient Simulators	Portable Gas Stations	Trauma/Disaster Casualty Kits
HPS 101	PGS 005	TDCK 001
HPS 107	PGS 006	TDCK 002
PHS 035	PGS 007	TDCK 003
PHS 036	PGS 012	TDCK 004
PHS 039	PGS 013	TDCK 005
PHS 040	PGS 014	TDCK 006

EXHIBIT 16: Government Owned Equipment

6.2 PC Hardware

A total of eight Apple Macintosh Personal Computers (7 laptop PC's and 1 desktop PC) were acquired for the Triage Controller, Casualty Handler, and CTPS System/Internet Gateway. The configurations are as follows:

Triage Controller (6) and Casualty Handler (1)
Apple PowerBook G4
500 MHz PowerPC G4 Processor
1 MB Backside Level 2 Cache
512 MB RAM
20 GB Hard Disk Drive
15.2-inch Active-Matrix TFT Color Display
8 MB Video Memory
Slot-loading DVD-ROM Drive
AirPort™ 802.11B Wireless Ethernet
Mac OS X Operating System

CTPS System/Internet Gateway
Apple PowerMac G4
Dual 533 MHz PowerPC G4 Processors
1 MB Backside Level 2 Cache
384 MB RAM
40 GB Hard Disk Drive
17-inch Color CRT
8 MB Video Memory
CD-RW
Gigabit Ethernet Adapter
10/100Base-T Ethernet Adapter
Mac OS X Operating System

6.3 Networking Hardware

Each Triage Controller PowerBook is networked to a specific HPS via Apple AirPort 802.11B wireless Ethernet. As described above, each PowerBook is equipped with an AirPort wireless Ethernet card. Likewise, each HPS has it's own AirPort Base Station to exchange data with the PowerBooks.
Each of the six HPS's is hardwired to an Asante 24-port 10/100Base-T Ethernet Switch, thus forming the CTPS System private, local area network. Finally, one Ethernet port of the CTPS System/Internet Gateway PC is connected to the Ethernet Switch and the other is connected to the internet, thus bridging the two networks.

6.4 Demonstrate Integrated CTPS System

System Installation and IPT Demonstration

As previously described, the CTPS System was installed with the CTA, at Fort Gordon, GA. As part of the CTPS IPT Meeting on July 18, the following capabilities were demonstrated.

- The Casualty Handler was used to instantiate casualties, overlay specific scenarios onto those casualties, and transfer them to the CCP.
- The Triage Controller at each node was used to assess the casualties, assign triage categories, apply treatments to casualties, detect evacuation assets, and evacuate casualties to other system nodes with continuity of simulation.
- Each node in the system had PATSIM running for the continuous simulation of casualty objects.
- The system AAR logged casualty activity and displayed casualty status and node status as each casualty moved from node to node in the system.
- The transfer of casualties through the use of Wireless Ethernet was demonstrated using the Triage Controller and Casualty Handler.

CTPS System Scenario Demonstration

During the July 18 demonstration, the CTPS System scenario was shown. This scenario (listed in Appendix Q) was developed by Tekamah and included six casualties: two gunshot wounds, and four motor vehicle accident injuries. The injuries represented are:

- Blunt abdominal injury
- Blunt chest injury
- Compound fracture of the left leg (tibia)
- Gunshot wound to the left chest
- Gunshot wound to the right thigh (femoral artery bleed)
- Closed head injury

The Casualty Handler User Interface instantiated the patients, scenarios were overlaid on the casualties, and the casualties were electronically transferred wirelessly to the Triage Controller User Interface on the CCP node on the system. The triage capability of the system was exhibited by moving casualties in and out of the examination/treatment windows, and their condition was assessed and classified according to the DIME protocol. A twist in the scenario demonstrated the system's ability to simulate situational awareness. In the scenario, three casualties require surgery, with one casualty only presenting this need after a time interval. A helicopter can evacuate two patients almost immediately, and so two casualties leave the CCP. After this, a ground ambulance arrives that can take the four remaining patients. The temptation for the medic on the ground is to load these remaining patients, and clear his patient load. However, if the patients are re-assessed as they should be, then the medic should find that one patient has seriously deteriorated, and he should send the ambulance with three patients, and keep back the serious patient to wait for the helicopter to return. This kind of scenario adds some measure of situational awareness training, as it forces the medic to think outside of his section of the medical echelon in his triage process.

After the simulation demonstration ended, a review took place using the AAR software. The movement of casualties through the system was shown, the interventions were displayed for each casualty at each node, and the evaluation of casualties at different times and in differing nodes in the CTPS system was demonstrated.

6.5 Field Operations/Support

The CTPS System Integrator supported operation and evaluation as part of the System Integration and Delivery of CTPS System Hardware tasks. For this support, the team inspected and reviewed the site selections, installed hardware and software, demonstrated the system as described in task 6.4 above, and supported the independent test and evaluation team. Further support has been provided via conference calls and e-mail.

6.6 Perform User Training

Users were trained in the installation, operation, maintenance and troubleshooting of the system. This training is described below.

- CTPS System Training was conducted for CTA Staff during the week of August 13-17, 2001.
- Primary and Secondary clinical trainers attended the weeklong training, with emphasis on system operation and clinical demonstration.
- Primary and Secondary technical personnel attended the weeklong training, with emphasis on system technical aspects.
- The clinical trainers and technical personnel were cross-trained on each other's areas of expertise. During this training, the following topics were covered in detail, with demonstrations, Instructor lecture, hands-on student training, and question/answer formats.

1.0 Overview of CTPS system. Demonstration of the capabilities of the CTPS system, highlighting patient triage, movement between individual nodes, and after action reporting.
2.0 HPS simulator. Demonstration and hands-on training for the individual HPS units. Instruction showed simulator power on, software launch, and activation of all clinical features the simulator.
3.0 Casualty Handler & AAR Logger. Demonstration and hands-on training for the Casualty Handler User Interface and AAR Logger. Instruction demonstrated software launch, GUI navigation, instantiation of patients, overlay of CTPS casualty scenarios, and movement of casualties to any node in the system, as well as monitoring capabilities for casualties in the system.
4.0 Triage Controller. Demonstration and hands-on training for the Triage Controller. Instruction demonstrated software launch, GUI navigation, triage, assessment, treatment, and evacuation of casualties in the CTPS system.
5.0 CTPS Clinical Scenario orientation. Demonstration and hands-on training in the use of the six clinical scenarios provided with the CTPS system: blunt abdominal injury; blunt chest injury; compound fracture of the left leg (tibia); gunshot wound to the left chest; gunshot wound to the right thigh (femoral artery bleed); and closed head injury.
6.0 AAR. Demonstration and hands-on training for the Triage Controller. Instruction demonstrated software launch, GUI navigation, casualty movement monitoring, casualty intervention monitoring, and evaluation of casualty status at different times and in differing nodes in the CTPS system.

- HPS Clinical Scenario training. Demonstration and hands-on training on aspects of scenarios – starting, editing, and creating scenarios, as well as monitoring a casualty's status in a particular scenario.

At the end of this training period, the users of the system had received training in the installation, operation, maintenance and troubleshooting of the system. The trainees were confident in their ability to run the CTPS simulation, and operate all of the individual components of the system.

6.7 Upgrade CTPS Phase 3 Hardware

Prior to the start of CTPS Phase 4, six HPS's had been delivered to the Government. The METI serial numbers of these systems are shown below.

- HPS 28
- HPS 54
- PHS 01
- PHS 02
- PHS 03
- PHS 04

Each of these simulators was upgraded during Phase 4 with the following capabilities:

- Enhanced chest excursion
- Improved chest tube
- Updated trauma features control board
- Hematology model
- Peritoneal lavage
- Improved drug recognition system
- HPS Version 6 system software and hardware

The following were also delivered:

- Enhanced warranties for one year (August 1, 2000 – July 31, 2001)
- One HPS was upgraded to the portable configuration (PHS 03)
- Two Trauma/Disaster Casualty Kits were delivered for the METI CTPS developmental environment

Finally, an unexpected cost was also absorbed in that, PHS 02 was totally re-furbished as part of this task. This was the system that was partially destroyed by rodents during the CTPS Phase 3 User Test with the Defense Medical Readiness Training Institute (DMRTI) at Camp Bullis in San Antonio, TX.

7. MAINTAIN CTPS LABORATORIES

Three distinct CTPS Laboratories were maintained to support development and demonstration of the CTPS System.

7.1 CTPS Laboratory at IST

IST was contracted to provide a laboratory to serve dual uses. First, the lab provided a location for IST's research and development activities. Second, the lab provided a location for program demonstrations by STRICOM and IST.

Research and Development

Early in Phase 4, IST elected to re-locate the CTPS lab to a smaller, less visible location, so that the original lab location could be used for another research program. The lab was equipped with two HPS's, four PC's, and the MILES/ECC. Gas supplies and system networking infrastructure were also provided. These elements formed a functional CTPS Phase 3 System. Following the I/ITSEC exhibition in November 2000, METI upgraded the CTPS System to include the results of Task 3.1 Clean-up of CTPS Phase 3 Software (see results described above). This upgrade provided an improved platform for both development and demonstration.

Program Demonstrations

As part of their subcontract, IST kept a log of all demonstrations. For each demonstration, the following information was recorded:

- Date of the demonstration

- Name, title, and organization of all individuals for whom the demonstration was given
- Purpose of demonstration
- Name of the individual(s) who hosted the demonstration

From September 2000 through April 2001, 27 demonstrations were recorded (see Appendix L: IST CTPS Demonstration Log). In mid-April 2001, the lab was relocated to new STRICOM facilities and the log was closed.

7.2 CTPS Laboratory at METI

In previous phases, METI maintained a modest, 500 square foot lab for research and development. Given that an entire CTPS System (which includes six HPS's and numerous PC's) was to be fielded, a much larger development environment was required. Thus, a 2000 square foot lab was established during the first ninety days of Phase 4. The layout of the lab is shown below.

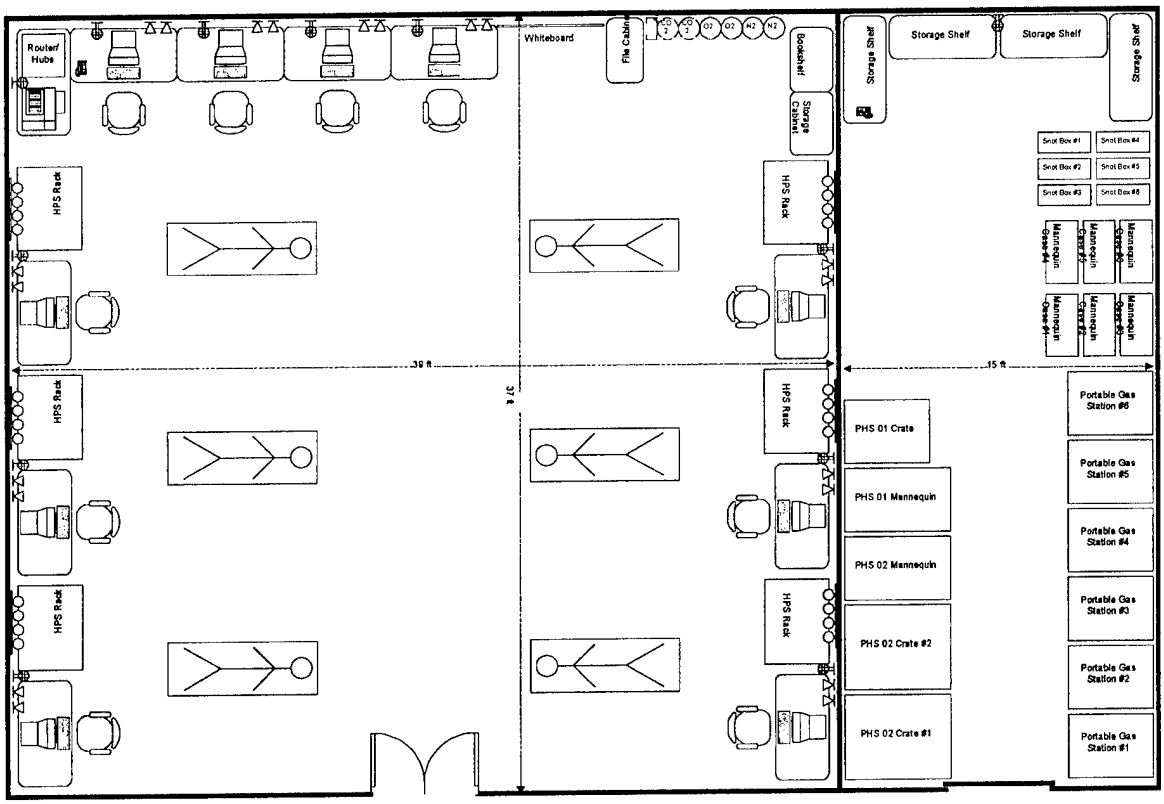


EXHIBIT 17: New METI CTPS Laboratory

The lab consists of two sections—a development environment and a secure storage space.

Development Environment

The CTPS Development Environment provides a spacious and secure location for the ongoing engineering of the CTPS System, featuring:

- Keyed facility for access limited to METI CTPS developers.
- Six bays for HPS's. Each bay includes AC power, gas supply connections, and local-area-network ports.
- Central station for compressed gas supplies
- 24-port Ethernet switch, providing CTPS System local-area-network and connectivity to METI servers and the Internet.
- Four PC-development workstations
- Other equipment, such as a printer, flipchart, bookshelf, storage cabinet, additional tables and chairs.

Secure Storage Space

Over $2 million in government-owned equipment has been purchased for the CTPS Program. Given the numerous users tests, exhibitions, and system deployment requirements, a secure location was established for storage and staging of shipping/receiving. This facility is keyed separately from the development environment to maintain tight control over items in storage.

Though occupied and operational since October 31, a brief ribbon cutting ceremony for the new CTPS lab was held in conjunction with the CTPS IPT Meeting held at METI on March 8, 2001.

EXHIBIT 18: METI CTPS Laboratory Ribbon Cutting

7.3 CTPS Laboratory at Tekamah

In November 2000, Tekamah moved into new offices, which included an area set-aside as a CTPS lab. The following equipment was provided to Tekamah for their development environment:

- HPS 54
- Air Compressor
- Compressed gas regulators and hoses
- Apple PowerBook G4
- Apple PowerMac G4
- Apple Airport Base Station

METI intends to leave the compressor, hoses, and regulators with Tekamah in anticipation of development undertaken in future phases. All other equipment been returned to the METI CTPS Laboratory.

8. BUILD, HOST, AND MAINTAIN A CTPS WEB SITE

In order to maintain direct communications between the development team and the user community, IST was contracted to develop and host a CTPS web site. The final web site was delivered by IST and approved by STRICOM in May 2001. Briefly, the web site includes:

- Program background information
- Overview of system components
- User test and evaluation sites
- Calendar of events
- Document repository
- Discussion forum
- Contact information with links to CTPS agencies

At the conclusion of IST's work in this phase, STRICOM contracted with IST to maintain the CTPS web site as part of STRICOM's "Cool Tech" web page project. Thus, the CTPS web site will be available even after the conclusion of Phase 4.

The CTPS web site is available at:

Address: http://ctps.itcenter.org
User Name: ctps
Password: go!ctps

9. MANNEQUIN DATA BUS ARCHITECTURE

The HPS currently transmits data to and receives data from the mannequin through a large cable with discrete wire pairs allocated to each signal. The signals transmitted to the mannequin are both analog and digital in nature, ranging from multiple analog audio frequency signals to digital valve control signals. While adequate for earlier versions of the HPS, this approach does not readily support application of patient simulation in new environments or the addition of new mannequin capabilities. In order to configure multiple HPS's (or variants thereof) with a variety of modular capabilities, and to configure each to be used in a harsh, remote environment, a flexible and scalable bus architecture for communication with the mannequin must be implemented. Such an architecture will provide the basis for mannequin control and communication in a new HPS variant for use in the most far forward areas of the military medical footprint. A high-speed serial bus architecture can meet these goals as well as provide additional benefits. Signals will be digitized, packetized, and transmitted serially at a high speed to the mannequin. Connectivity to the mannequin will be simplified substantially while ensuring the scalability of the design. For example, adding new mannequin features, such as control signals or audio sounds, would be a question of adding more packets to the

data stream. In addition, multiple mannequins can communicate with a single computer and data bus.

During Phase 4, the following sub-tasks were executed:

Preliminary Architecture Design: Various commercial off the shelf bus architectures were evaluated and a preliminary design was determined on the basis of this evaluation.

Specification Development: A detailed specification was authored to guide development on the basis of the initial investigation and design.

Preliminary Design and Investigation: Various significant technical challenges were investigated in detail in order to facilitate detailed design, including:

Defibrillation Tolerance: The design resistance to actual defibrillation was ensured.

Audio Signal Fidelity: The bus' ability to transmit high fidelity heart and breath sounds was ensured.

Real Time Software Requirements: The bus' ability to control hardware that is dependent upon near real time responsiveness was ensured.

Testability: Design for manufacture is an important principle in the design of any system. The testability of the design was ensured.

Detail Design: The development of the prototype design was executed.

Prototype Development: A prototype of the bus architecture was fabricated.

Design Finalization and Release and Manufacturing Engineering and Documentation: These tasks involve preparation of METI's manufacturing infrastructure for production.

Two designs were investigated and evaluated as part of the Preliminary Architectural Design and Specification Phases. The first design utilized a wired or wireless Ethernet connection to the mannequin, which would allow commands and data to be passed to and from the mannequin. In this approach, the real time audio frequency data (heart and breath sounds, ECG waveforms) would be output to the speakers and ECG points through the use of a dedicated signal processor residing in the mannequin. This allows for the sounds and other real time signals to be reproduced with high fidelity, without the possibility of jitter or dropout induced by processor interrupt servicing. The operating system for the host processor in the mannequin which works in conjunction with the signal processor can handle all of the non-real time tasks and can most likely run an operating system like Linux, and would probably not need a real-time operating system (RTOS).

The second approach provided for a high-speed serial bus (Firewire or IEEE 1398) which would be connected to the mannequin and through which the real-time audio data is sent from a general purpose processor. The data in this design would travel over a cable to the mannequin, and once there would be processed and each channel would be queued and processed such that there would be no signal dropouts or jitter induced by the communication link and by the processor feeding the signals to the mannequin.

Evaluation in this phase of the program has determined that the architecture will accommodate audio signals through the use of soundcard technology. These soundcards will reside on the CPU bus, and sounds will be sent out to a soundcard when it is necessary to change sounds. It was also determined that the architecture will provide a streaming mode for model driven outputs. As an example, low bandwidth signals (such as the ECG and EEG) which are highly integrated into the model will be output to the mannequin as a real-time signal over Ethernet.

The decision made was that the interface to the embedded CPU in the mannequin would be an Ethernet interface, running METI's HIDEP communication protocol over TCP/IP. This approach will maximize the use of COTS equipment in the design.

Several advantages to this architecture are apparent. First, the embedded computer can control several different types of subsystems inside the mannequin – data acquisition, command, and control. Secondly, signals that originate in the mannequin can interface with the embedded computer, which perform signal processing before sending data to the host computer. Thirdly, the use of computer components which are readily available off-the-shelf will minimize the amount of custom circuitry which would be necessary to build.

After the high level communication architecture was decided, the architecture for the embedded design was developed. The design uses a Single Board Computer (SBC) residing in the mannequin, which runs the Linux operating system and communicates with on-board data acquisition and control modules to perform system functions such as actuation of audio signals, output of control signals, and output of real time signals such as the ECG. The SBC communicates with the host computer over Ethernet. The host computer sends the SBC command and control signals, as well as low bandwidth real time signals, and receives conditioned output signals in packetized form from the mannequin embedded computer.

Detailed design produced hardware and software design actions for the system, as listed below.

Hardware Form Factor

The hardware form factor selected for the design is called PC/104. This is a standard that constrains the design of cards to 3.6 inches by 3.8 inches. The PC/104 standard uses stackthrough connectors to connect an ISA bus to each card in the stack of cards. In this manner, a very compact stack of circuit cards can perform exactly the same functions as a full size PC. The cardstack is very rugged and there are multiple manufacturers generating circuit cards built to the standard. The standard uses PC based technologies,

so many COTS PC circuit cards and PC motherboard elements (CPU's, memory, video cards, sound cards, etc) can be found in the PC/104 form factor. Since this design is intended to reside in the chest or leg of the mannequin, space is of the utmost concern.

Once the decision on the form factor was made, work was done to build up and integrate three PC/104 card stacks. Each of these card stacks consists of an SBC, an analog to digital (A/D) converter module, a digital to analog (D/A) module, a digital input/output module (DIO), and a power conversion module. The card stack is shown in Exhibit 19.

Power Subsystem

The power requirements for the embedded system were developed. A PC/104 module for power input was implemented, which enables the bus architecture design to run off of one common DC power supply (+12 Volts.) One significant advantage to this design approach is that there is no live 120 Volts AC inside the mannequin. Given the amount of human contact the mannequin receives, this choice is the safest implementation of system power input and distribution. The PC/104 card stack was run in an extensive test using a battery as its DC power source, and satisfactory performance resulted. Using a 44 Ampere – hour battery. The PC/104 Cardstack ran successfully for over six hours. This test included electrical loads from a monitor, a wireless hub, and a constant resistive load that simulates other current drains in a mannequin.

Mechanical Design

Work was performed on the mechanical design, such as developing the cabling needed to interface the PC/104 card stack with the actuating mechanisms inside the mannequin. Cable harnesses were designed for both signal and power cables. Environmental tests of the card stack were designed such that the effects of operation of the embedded computer in an enclosed environment (thigh of mannequin) can be quantified.

Network Communication

The SBC, running the Linux operating system was able to achieve network connectivity over Ethernet, which provides system communication with the Instructors Workstation computer.

Audio Subsystem

The SBC in the PC/104 CardStack sent audio samples from a file on the SBC over the ISA bus to a PC/104 sound card. The output of the sound card was sent to external speakers, which provides basis for the generation of heart and breath sounds. Work was done to configure the system to have multiple sound cards accept different sound files simultaneously, a prerequisite for the transmission of Heart, Breath, and other sounds to the mannequin.

Software Development

The software operating systems were installed. The SBC in the development environment is operating with a hard disk partition with both Red Hat Linux, and Windows operating systems installed. The bus architecture design uses Linux as the embedded operating system, but the use of a dual boot provides a windows development

environment in which work on the data acquisition modules can be done in parallel with Linux software driver development. Software was ported from the rack-mounted Linux PC (a 233 MHz Pentium II class machine) to the SBC (a 266 MHz Pentium III class machine).

Photographs of Mannequin Data Bus Architecture

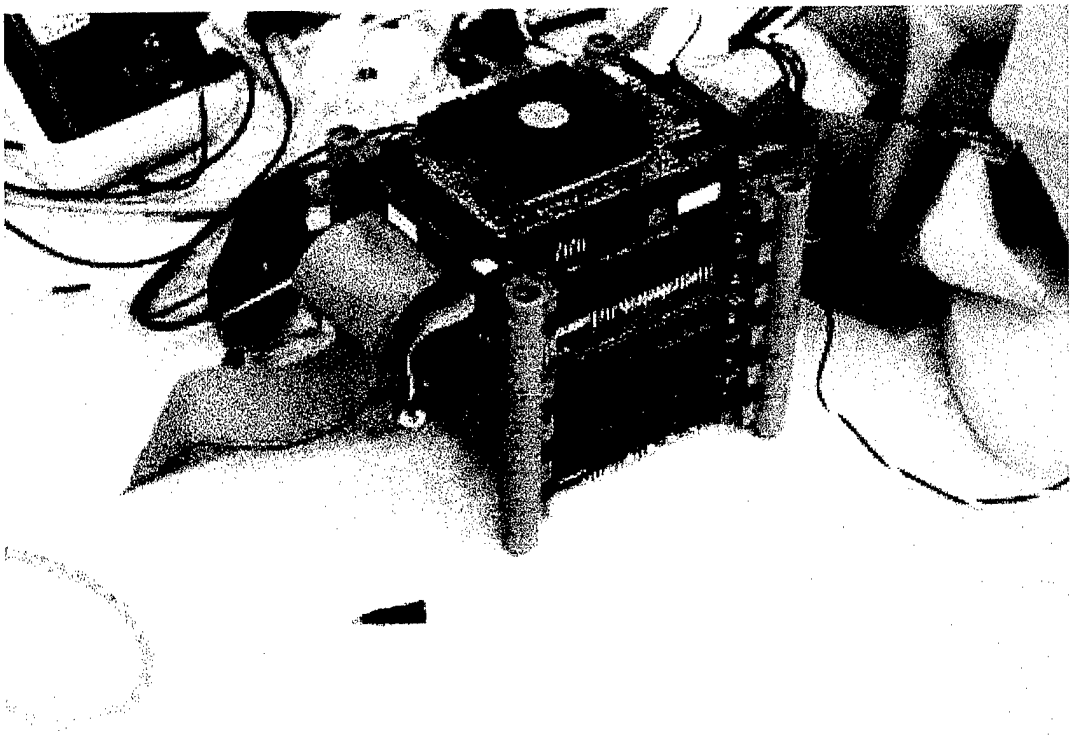


EXHIBIT 19: PC/104 Cardstack as developed for the CTPS System. The SBC is on the top of the stack (with CPU fan). A pen is displayed to demonstrate the relative size of this computing platform.

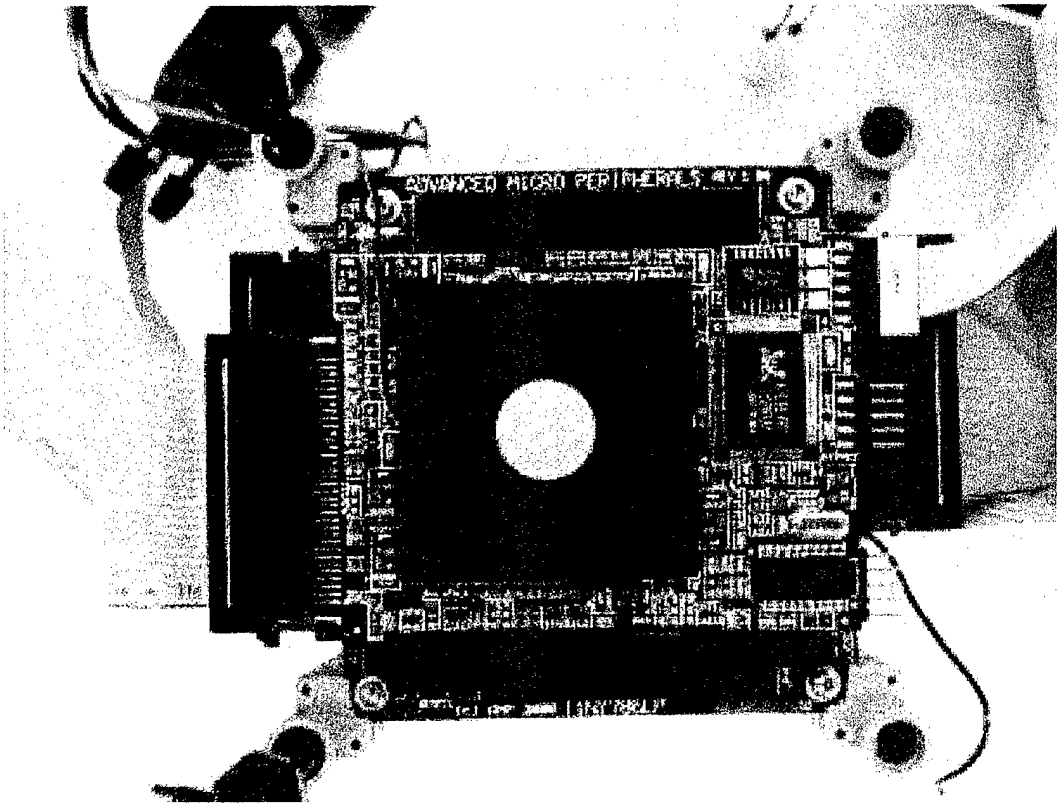


EXHIBIT 20: The SBC for the PC/104 Cardstack is shown in close-up view. The actual size is 3.6 inches by 3.8 inches.

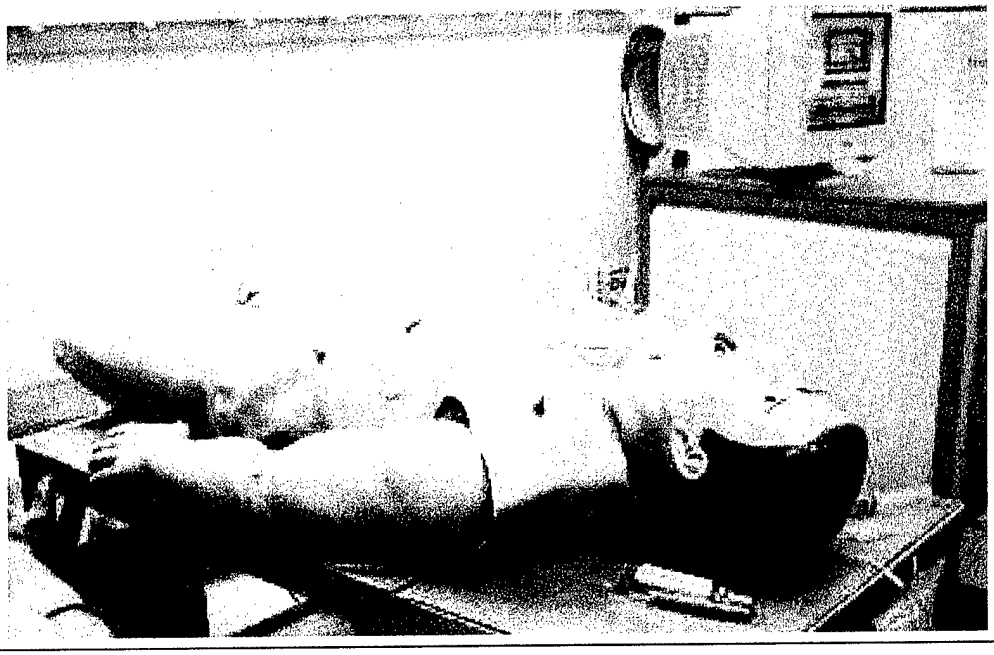


EXHIBIT 21: METI Version D Mannequin that hosts the Mannequin Data Bus Architecture Components.

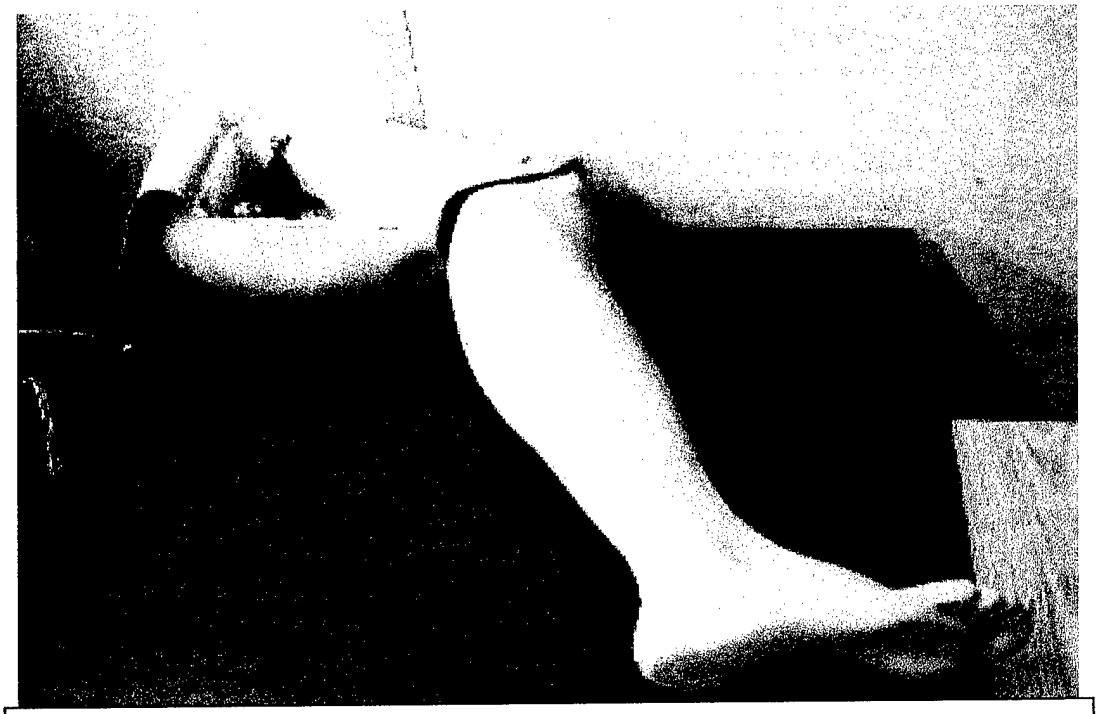


EXHIBIT 22: METI Version D Mannequin Leg and Thigh that houses the PC/104 Cardstack. Airflow will be provided by a manifold in the thigh and venting. A representative PC/104 card is shown in the thigh.

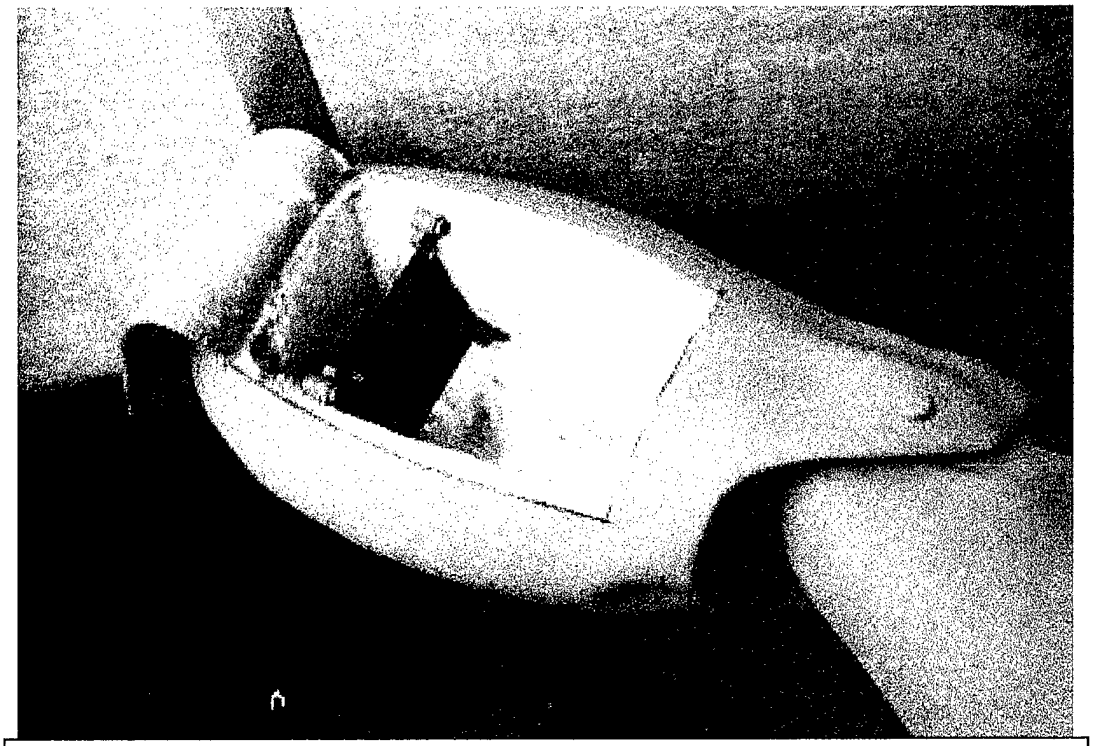


EXHIBIT 23: METI Version D Mannequin Leg and Thigh that houses the PC/104 Cardstack in close up.

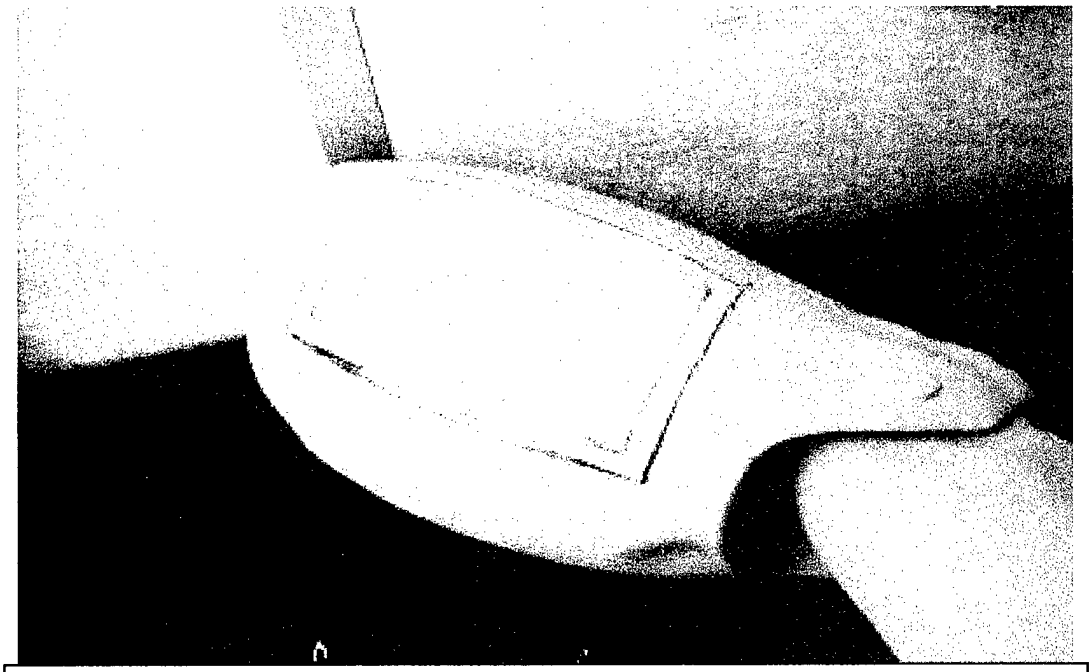


EXHIBIT 24: METI Version D Mannequin Leg and Thigh that houses the PC/104 Cardstack shown in close up with access panel closed.

10. RESERVED

The task proposed was not contracted in this phase.

11. CTPS PROGRAM DEMONSTRATIONS

As in previous phases, CTPS was exhibited at two major meetings—AMSUS and I/ITSEC.

11.1 AMSUS Demonstration

The CTPS System was exhibited at the 2000 Annual Meeting of the Association of Military Surgeons of the United States (AMSUS) in Las Vegas, NV. This demonstration served as the primary means to update the military medical community regarding the CTPS Program. A schematic overview of the exhibit booth is shown below.

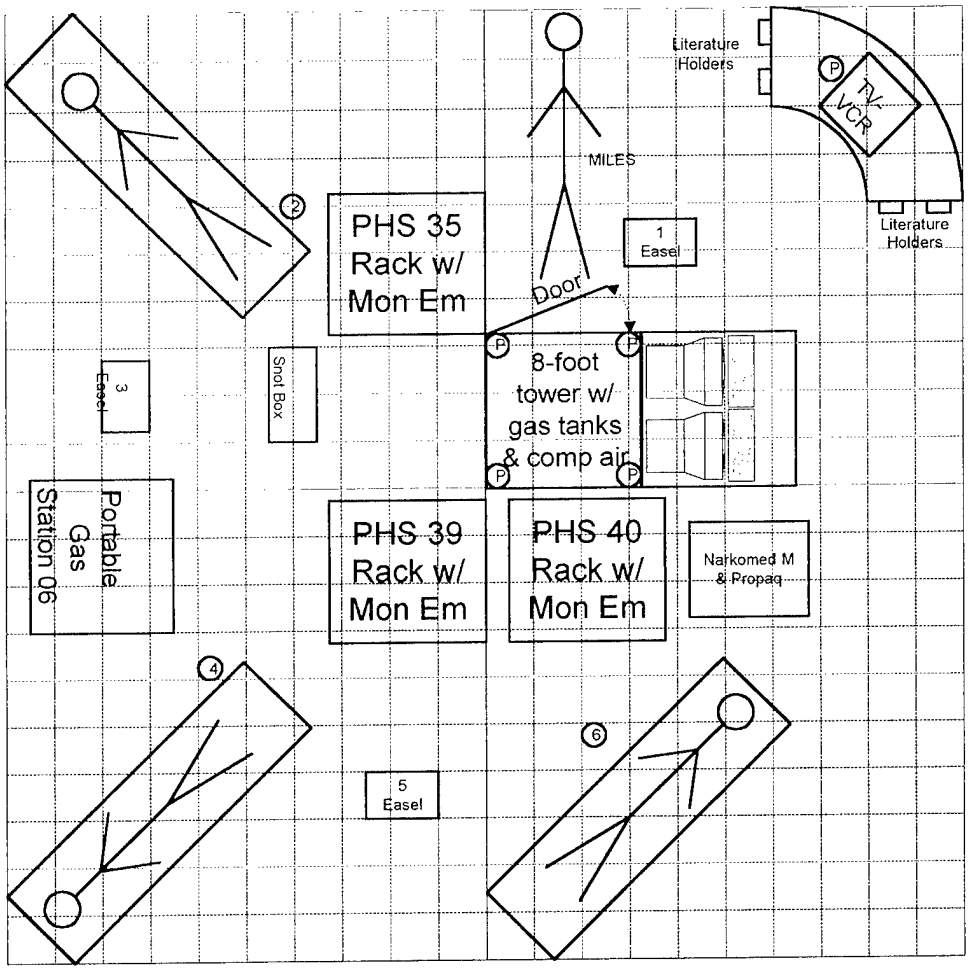


EXHIBIT 25: AMSUS 2001 Exhibit Layout

11.2 I/ITSEC Demonstration

The CTPS System was exhibited at the 2000 Annual Meeting of the Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC) in Orlando, FL. This

demonstration served as the primary means to update the simulation and training communities regarding the CTPS Program. A schematic overview of the exhibit booth is shown below.

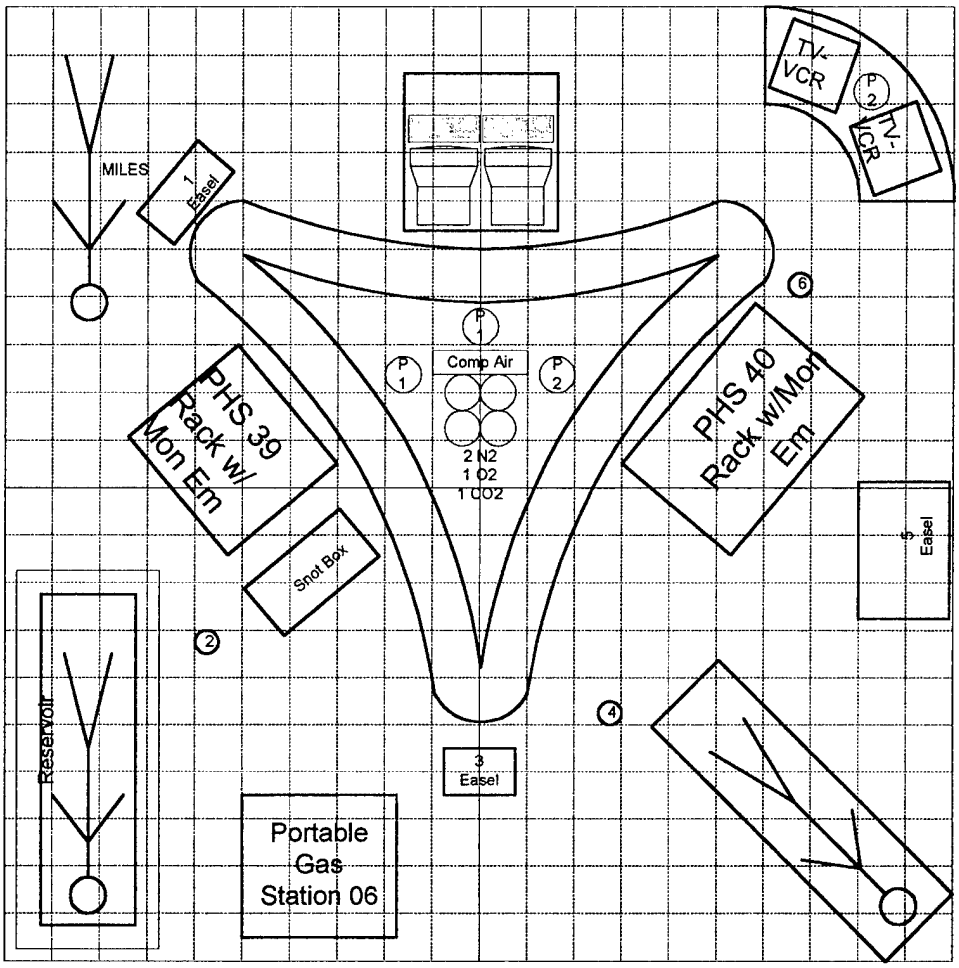


EXHIBIT 26: I/ITSEC 2001 Exhibit Layout

12. CTPS USER TESTS

As performed in all phases of the CTPS Program, the development team continued to involve the end-user throughout Phase 4. Six user tests were conducted to ensure that the technology serves and enhances the end-user mission for primary, refresher, and sustainment training.

User tests executed are shown below:

Location	Dates	Purpose
Joint Trauma Training Center Ben Taub Hospital Houston, TX	October 1999 – April 2001	Use of simulation for objective performance evaluation of military trauma teams
NASA Medical Sciences Division Johnson Space Center Houston, TX	December 2000 – March 2001	Space medicine applications for: • Operational testing • Equipment design • Crew medical officer training
National Training Center Fort Irwin, CA	February 2001	Site survey for future CTPS requirements
National Capital Area Medical Simulation Center Uniformed Services University of Health Sciences Silver Spring, MD	March 2001 – July 2002	• Evaluation of HPS • USUHS Medical Student Training and Evaluation
Disaster Relief and Emergency Medical Services (DREAMS™) Digital Ambulance Texas A&M University College Station, TX	July 2001 – October 2001	Integration of complimentary MRMC technology programs. CTPS used to generate realistic emergency medical simulations for test and evaluation of DREAMS Digital Ambulance.
Emergency Medicine Department Portsmouth Naval Hospital Portsmouth, VA	August 2001 – November 2001	Training and evaluation with Portsmouth Naval Hospital ER staff and trainees. Integration with MedTeams™ program

EXHIBIT 27: CTPS Phase 4 User Tests

Highlights from each user test are detailed below:

Joint Trauma Training Center

The Joint Trauma Training Center (JTTC) was, itself, a pilot project established by the Department of Defense for sustainment training of military medical trauma teams across all services. While JTTC did use the simulator for training purposes, the primary use was to objectively quantify the performance of the medical teams during simulated trauma cases. Following a simulator orientation session, each trauma team would run through a simulated case and be scored on their performance. At the end of the month-long rotation at JTTC, the same team would run through a second simulated case, which was also scored. The team's performance improvements were dramatic, thus indicating the value of the total JTTC training experience. A full report, including two abstracts submitted by JTTC for presentation at major medical conferences, are attached to Appendix H.

NASA-Johnson Space Center

NASA provided the first non-military user test. As with JTTC, NASA was interested in more than just training. Specifically, their investigation evaluated the use of the HPS for medical procedure development, clinical equipment evaluations, and as a training aid for crew, flight surgeons and biomedical engineers. Experiments were done to identify

limitations (if any) with the ISS Medical Checklist and the ISS Crew Health Care System.

The evaluation determined that the METI HPS would improve or enhance:

1. *Device Evaluation*
   Medical devices can be deployed and tested as they will be used under multiple clinical conditions.

2. *Procedure Development*
   Procedures specific to space medicine pathology can be developed and tested on the HPS using the CHeCS hardware.

3. *Training*
   The HPS ensures standardization of clinical skill sets for space medical care providers (crew, flight surgeons and biomedical flight controllers).

The full report is attached as Appendix I.

National Training Center

At the National Training Center (NTC), located at Fort Irwin, CA, METI CTPS engineers had the opportunity to observe a full-scale battlefield simulation, including actual forces such as infantry, armored vehicles, and aircraft. During the simulation, METI engineers saw the multiple echelons-of-care as they would be found in an actual battlefield, including company casualty collection point, forward aid station, main aid station, CMEDD station, and combat support hospital. Seeing an actual instantiation of the military medical footprint has provided the vision for the engineering challenges to fielding the CTPS System at the NTC or any of the Combat Training Centers. The full report is attached as Appendix J.

National Capital Area Medical Simulation Center

The National Capital Area Medical Simulation Center (colloquially known as the NCA Sim Center) has, perhaps, the most extensive collection of advanced medical simulators and training devices assembled under one roof. Among others, these devices include:

- Medsim Patient Simulator
- Medsim UltraSim™ Abdominal Ultrasound Simulator
- Immersion Medical (formerly HT Medical) Bronchoscopy Simulator
- Immersion Medical CathSim™ Venous Catheterization Simulator

With their extensive expertise in applying these COTS technologies, the NCA Sim Center undertook a "head-to-toe" evaluation of the HPS. Using a traditional grading scale, the HPS scored just over a "B" average on seven evaluation criteria. The full report is attached as Appendix K.

DREAMS Digital Ambulance

The DREAMS Digital Ambulance user test was initiated at the direction of MG Parker, Commander of US Army Medical Research and Materiel Command, who sponsors both the CTPS and DREAMS Programs. With the overall goal of DREAMS being to bring cutting edge technology for disaster medical relief, the Digital Ambulance utilizes the ultimate in telemedicine technology. Because of its standard patient interfaces, the HPS was literally dropped into the back of the ambulance and attached to the monitoring equipment. This also marked the first user test initiated using the HPS Version 6 software.

This user test is currently in progress and the final report will be delivered to STRICOM under CTPS Phase 5, Agreement N61339-01-C-0080.

Portsmouth Naval Hospital

Portsmouth Naval Hospital offered the second opportunity for a user test with the US Navy. As with the DREAMS Digital Ambulance, HPS Version 6 was delivered for this user test. The system is being applied and evaluated with ER staff in conjunction with MedTeams™—an emergency healthcare delivery process which uses teamwork as a fundamental tool for promoting patient safety. Coordinated through Dynamics Research Corporation, MedTeams was created to bring about system change by applying teamwork behaviors to the high-performance, high-stress emergency care environment.

This user test is currently in progress and the final report will be delivered to STRICOM under CTPS Phase 5, Agreement N61339-01-C-0080.

Appendix A: Financial Summary

Combat Trauma Patient Simulation System
N61339-99-3-0002
Jul-01

		Labor Dir Cost Cont to Date Actual	23.20% W/Fringe Proposal Negotiated	20.87% W/Fringe CY 2000 Actual	Production Costs	Sub-Cont & Material Actual	15.80% Matl/SubCt Ovhd Negotiated	11.10% Subct/Matl CY 2000 Act Ovhd	10% Eng Ovhd Negotiated	16.80% Eng Ovhd CY 2000 Actual	25% G&A Neg Budget	69.80% G&A CY2000 Actual	Total CTPS @ Negotiated Rates	Total CTPS Actual Rates	METI Contribution Difference	OTA Amount
1.0 Program Management																
1.1 Program Manager		79,924	98,466	96,604							24,617	67,430	121,221	164,034	42,813	
1.3 Contract Admin		46,623	57,440	56,353							14,360	39,335	70,713	95,688	24,975	
1.4 Contract Admin Support		29,066	35,809	35,132							8,952	24,522	44,084	59,654	15,570	246,646
Software/Pub/Travel						11,420	1,804	1,268			3,306	8,856	16,530	21,544	5,013	20,367
Sub-total		155,613	191,715	188,089		11,420	1,804	1,268			51,235	140,142	252,549	340,919	88,371	
2.0 System Integration																
2.1 System Engineering		84,868	104,557	102,580		1,032	163	115	10,456	17,233	29,052	84,430	144,065	204,243	60,178	
System Engineering (Prod/Tech)		45,948	56,608	55,537					5,661	9,330	15,567	45,278	77,836	110,145	32,309	
Sub-total		130,816	161,165	158,117		1,032	163	115	16,117	26,564	44,619	129,708	221,901	314,389	92,488	205,943
2.2 CTPS System Testing						16,500	2,607	1,832			4,777	12,795	23,884	31,127	7,243	20,434
2.3 Develop User Documentation		1,964	2,420	2,374		2,000	316	222	242	399	665	1,935	3,327	4,708	1,381	30,362
W/ Tekamah						20,000	3,160	2,220			5,790	15,510	28,950	37,730	8,780	28,940
Sub-total		1,964	2,420	2,374		38,500	6,083	4,274	242	399	6,455	17,445	32,277	42,438	10,161	
3.0 Component R&D																
3.1 Clean-up CTPS Phase 3 SW		10,897	13,425	13,171					1,343	2,213	3,692	10,738	18,460	26,122	7,662	15,176
3.2 Dev. Casualty Handler Federate		33,765	41,598	40,812					4,160	6,856	11,440	33,272	57,198	80,940	23,743	22,764
3.3 Triage Controller Federate	TEK					48,000	7,584	5,328			13,896	37,223	69,480	90,551	21,071	69,480
3.4 PATSIM Federate/Physiologics		6,042	7,444	7,303					744	1,227	2,047	5,954	10,235	14,484	4,249	45,924
3.5 System-wide Pause/Save/Restart	[1]	0				53,900	8,516	5,983			15,604	41,798	78,020	101,681	23,661	59,302
3.6 Implement AAR Federate 91W/CLS	TEK					80,000	12,640	8,880			23,160	62,038	115,800	150,918	35,118	115,800
3.7 Dev. & Impl. Casualty Instantiator		3,146	3,876	3,803					388	639	1,066	3,100	5,329	7,542	2,212	7,588
3.8 Enhance FOM & Fed RTI Interfaces	[1]	362	446	438		61,500	9,717	6,827	45	74	17,804	47,692	89,021	116,018	26,997	15,176
3.9 Enhance CTPS Executive		2,664	3,282	3,220		8,500	1,343	944	328	541	2,461	6,592	12,304	16,035	3,731	22,764
3.10 HLA Compliance	IST	402	495	486		3,300	521	366	50	82	955	2,559	4,777	6,225	1,449	21,738
3.11 Extend CTPS System W OP Data	METI&TEK	80	99	97		152,000	24,016	16,872	10	16	44,004	117,873	220,020	286,745	66,725	251,343
3.15 ECC Database Translator	IST					18,875	2,982	2,095			5,464	14,637	27,322	35,607	8,286	24,558
3.16 Wireless Ethernet Casualty Trans		1,980	2,439	2,393		20,952	3,310	2,326	442	402	6,786	18,199	33,930	44,272	10,342	62,044
Sub-total		59,338	73,104	71,722		447,027	70,630	49,620	7,508	12,049	148,379	401,675	741,895	977,141	235,246	
4.0 Develop CTPS-based Training Program	TEK					120,000	18,960	13,320			34,740	93,057	173,700	226,377	52,677	173,700
6.0 CTPS 4 Hardware Upgrade						20,454	3,232	2,270			5,921	15,862	29,607	38,586	8,979	26,200
(HPS/PHS & Accessories Separate)																
HPS Upgrades					137,021						34,255	95,641	171,276	232,662	29,469	138,926
Warranties/Version 6 (ODC)						100,000	15,800	0			28,950	0	144,750	100,000	(44,750)	139,500
7.0 CTPS Labs (METI & IST)						57,148	9,029	6,343			16,544	44,317	82,722	107,808	25,087	82,827
8.0 Build Website						12,065	1,906	1,339			3,493	9,356	17,464	22,760	5,296	7,480
9.0 Mannequin Bus Architecture		27,770	6,443	5,796		50,314	7,950	5,585			23,119	62,446	115,595	151,911	36,315	102,933
11.0 Program Demonstrations																
11.1 AMSUS						44,250	6,992	0			11,063	30,887	62,304	75,137	12,833	62,500
11.2 I/ITSEC						21,861	3,454	0			5,465	15,259	30,780	37,120	6,340	31,250
12.0 User Tests		17,722	4,112	3,699		64,513	10,193	7,161			24,135	64,980	120,674	136,654	15,979	78,062
Total Program Management & R&D Costs													2,197,495	2,803,901	574,489	2,129,727
6.1 CTPS Hardware (HPS/PHS & Acc) [GSA Price]		1,021,688											1,021,688	1,021,688		1,021,688
													3,219,183	3,825,589		3,151,415

Notes:
Version 6.0 Software Development Contribution. $60,000 of Independent R&D for Version 6.0 contributed. Version 6.0 Allows for multiple user and patient physiologic modeling simulation. Version 6.0 Software is directly associated with the implementation and scope of the work on Task 3.4.

Various R&D tasks are principally software related and due to changes in design to enhance performance, the actual charges to tasks varied. The software in total meets or exceeds all R&D design criteria and performance specifications. Some work was contracted out to Independent Software Contractors that charged some tasks and increased the cost of those tasks.

Appendix B: Program Management Plan

Combat Trauma Patient Simulation (CTPS)

Phase 4

Program Management Plan

Medical Education Technologies, Inc.
6000 Fruitville Road
Sarasota, FL 34232

July 2001

Table of Contents

Revision History 3

1 General 5

2 Background 5

2.1 Requirements Traceability Matrix 5

2.2 Guidelines for Program Execution 6

2.3 Phases 6

2.3.1 Phase 1 (April 1997 – December 1997) 6

2.3.2 Phase 2 (April 1998 – April 1999) 6

2.3.3 Phase 3 (January 1999 – July 2000) 6

2.3.4 Phase 4 (August 2000 – July 2001) 6

2.3.5 Phase 5 (August 2001 – December 2001) 6

2.3.6 Phase 6 (2002) 7

3 Program Management 7

3.1 Vision, Goals, and Objectives 7

3.1.1 Vision 7

3.1.2 Goals 7

3.1.3 Objectives 7

3.2 Organization, Roles, and Responsibilities 8

3.2.1 CTPS Organization Chart 8

3.2.2 Roles and Responsibilities 8

3.2.3 Key Personnel 10

3.2.4 Team Members 10

3.3 Areas and Locations 12

3.4 Schedule and Milestones 13

4 Coordination Instructions 13

4.1 Timecards 13

4.2 Meetings 13

4.2.1 Weekly CTPS Planning Meetings 13

4.2.2 Monthly CTPS In-Process Reviews 14

4.2.3 Quarterly Integrated Product Team Reviews 14

4.3 Travel 14

4.4 Reports 14

4.4.1 Monthly Reports 14

4.4.2 Final Reports 14

4.4.3 Technical Reports 14

Appendix 1: User Test Locations 15

Appendix 2: CTPS Human Patient Simulator Asset Allocation Schedule 17

Revision History

Version 1.0 ..... September 30, 2000

Version 1.1 ..... October 31, 2000

Prime Contractor change in POC for the CTPS Systems Engineer

TATRC added as a User Test location

Simulator allocation schedule updated (PHS 41 replaced with PHS 40)

Version 1.2 .....November 30, 2000

City of Orlando Fire Department added as a User Test location and added to the simulator allocation schedule

HPS Version 6.0 software upgrade schedule changed to four system upgrades for each of the months of March, April, and May 2001

Version 1.3 .....January 3, 2001

User Tests with National Capital Area Medical Simulation Center and Orlando Fire Department re-scheduled to start March and January, respectively.

Upgrades re-scheduled: PHS 01—December, PHS 02—February, PHS 03—March, PHS 04—February.

PHS 39 will be used for a CTPS Exhibition in January at the USAF Vendor Fair

Prime Contractor change in POC for the CTPS Systems Engineer

Version 1.4 .....January 27, 2001

City of Orlando Fire Department removed as a User Test location, due to cancellation by user

Version 1.5 .....February 11, 2001

Upgrade of PHS 04 moved to April to facilitate swap-out with PHS 01 and dovetail with installation at new STRICOM CTPS lab.

Version 6 Upgrade schedule amended as follows:

April: HPS 101P, HPS 107P, PHS 35P, PHS 36P, PHS 39P, PHS 40P

May: PHS 02P, PHS 03P, PHS 04

June: HPS 28, HPS 54, PHS 01

Version 1.6 .....May 27, 2001

User Test scheduled with Texas A&M University for July

Version 6 Upgrade schedule amended as follows:

May: HPS 101P, HPS 107P, PHS 35P, PHS 36P, PHS 39P, PHS 40P

June: PHS 02P, PHS 03P, PHS 04

July: HPS 28, HPS 54, PHS 01

Subcontractor change in POC for Principal Investigtor at IST

Version 1.7 ..... June 22, 2001

User Test scheduled with Portsmouth Naval Hospital for August

Version 1.8 ..... July 30, 2001

The Requirements Traceability Matrix is included in Section 2.1

Section 2.3 Phases was updated to reflect the new focus of Phases 5 and 6

CTPS Program Management Organization Chart Updated to Reflect New Reporting Structure within METI

1 General

Combat Trauma Patient Simulation (CTPS) is a multi-year, research and development program to investigate the use of simulation for military and civilian medical training and test and evaluation. It originally was congressionally directed and DoD sponsored with US Army Simulation, Training, and Instrumentation Command (STRICOM) as the military program manager. Currently, CTPS is in the transition phase from incubation, to proof-of-concept, to formal acquisition, with primary sponsorship by the US Army's Medical Research and Materiel Command (MRMC).

The purpose of this document is to answer the what, who, where, when, and how of CTPS.

2 Background

2.1 Requirements Traceability Matrix

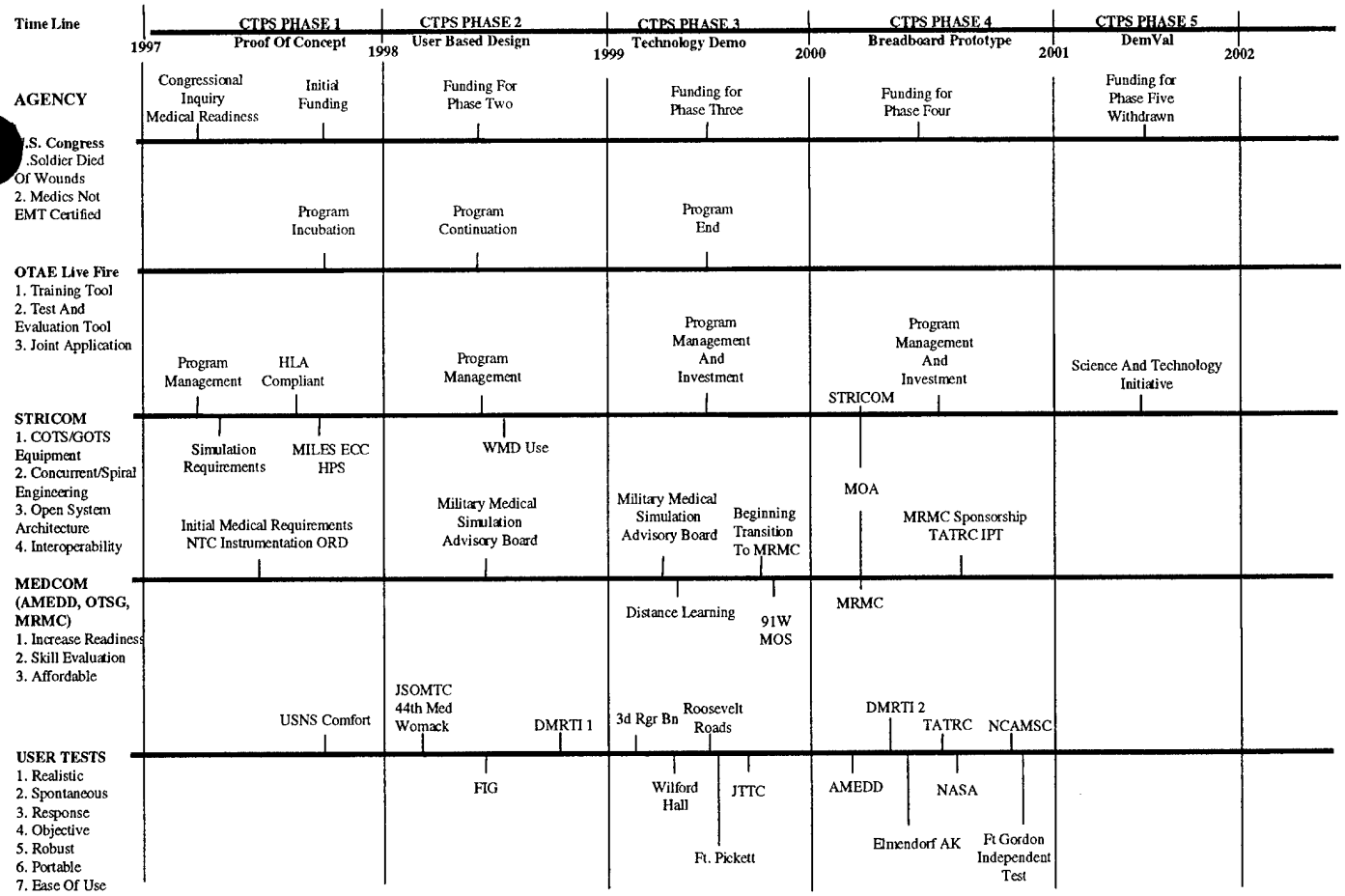


Figure - Requirements Traceability Matrix
Combat Trauma Patient Simulation Program

2.2 Guidelines for Program Execution

The two guiding principles of program execution are:

- Dual-use of commercial-off-the-shelf (COTS) and government-off-the-shelf (GOTS) products to minimize funding, risk, and schedule impact
- Use of spiral engineering and user-based design to ensure effective product delivery in a reasonable time frame

2.3 Phases

The CTPS Program was envisioned to be executed in five phases. Phases 1 through 4 are funded:

2.3.1 Phase 1 (April 1997 – December 1997)

Simulation technology demonstration to integrate three medical simulation components in an HLA configuration to establish connectivity and limited interoperability.

2.3.2 Phase 2 (April 1998 – April 1999)

- Establish a joint service military medical simulation advisory board to assess the CTPS program.
- Produce and evaluate a limited CTPS "breadboard" prototype, with bilateral patient transfer and high emphasis on potential user participation.
- Conduct a series of user tests with the Human Patient Simulators to evaluate training ability and realism of patient and treatment replication to obtain military service buy-in.

2.3.3 Phase 3 (January 1999 – July 2000)

- Develop a pre-production CTPS system with enhanced patient transfer and casualty instantiation capabilities in the CTPS Laboratory in Sarasota, FL.
- Develop enhancements to the Human Patient Simulators as recommended by the user test sites.

2.3.4 Phase 4 (August 2000 – July 2001)

Field a pre-production CTPS system at a selected location for full evaluation of training and test & evaluation efficacy.

2.3.5 Phase 5 (August 2001 – December 2001)

This is the Demonstration and Evaluation (DEMVAL) Phase. Under the guidance of MRMC, the Independent Test and Evaluation (IT&E) will be performed.

2.3.6 Phase 6 (2002)

Produce and field CTPS systems to the services. Continue the research and development effort.

3 Program Management

3.1 Vision, Goals, and Objectives

3.1.1 Vision

The Vision of the CTPS Program is to enhance warfighter survivability, particularly with regard to the category of "soldier died of wounds."

3.1.2 Goals

The Goals of the CTPS Program are:

- To provide more realistic representations of casualty occurrences.
- To provide enhanced initial, refresher, and sustainment training for medical personnel
- To provide an improved mechanism for analysis and test & evaluation of issues in casualty medical treatment.
- To increase readiness by having better prepared military medical personnel, ultimately decreasing fatalities due to combat conditions.

3.1.3 Objectives

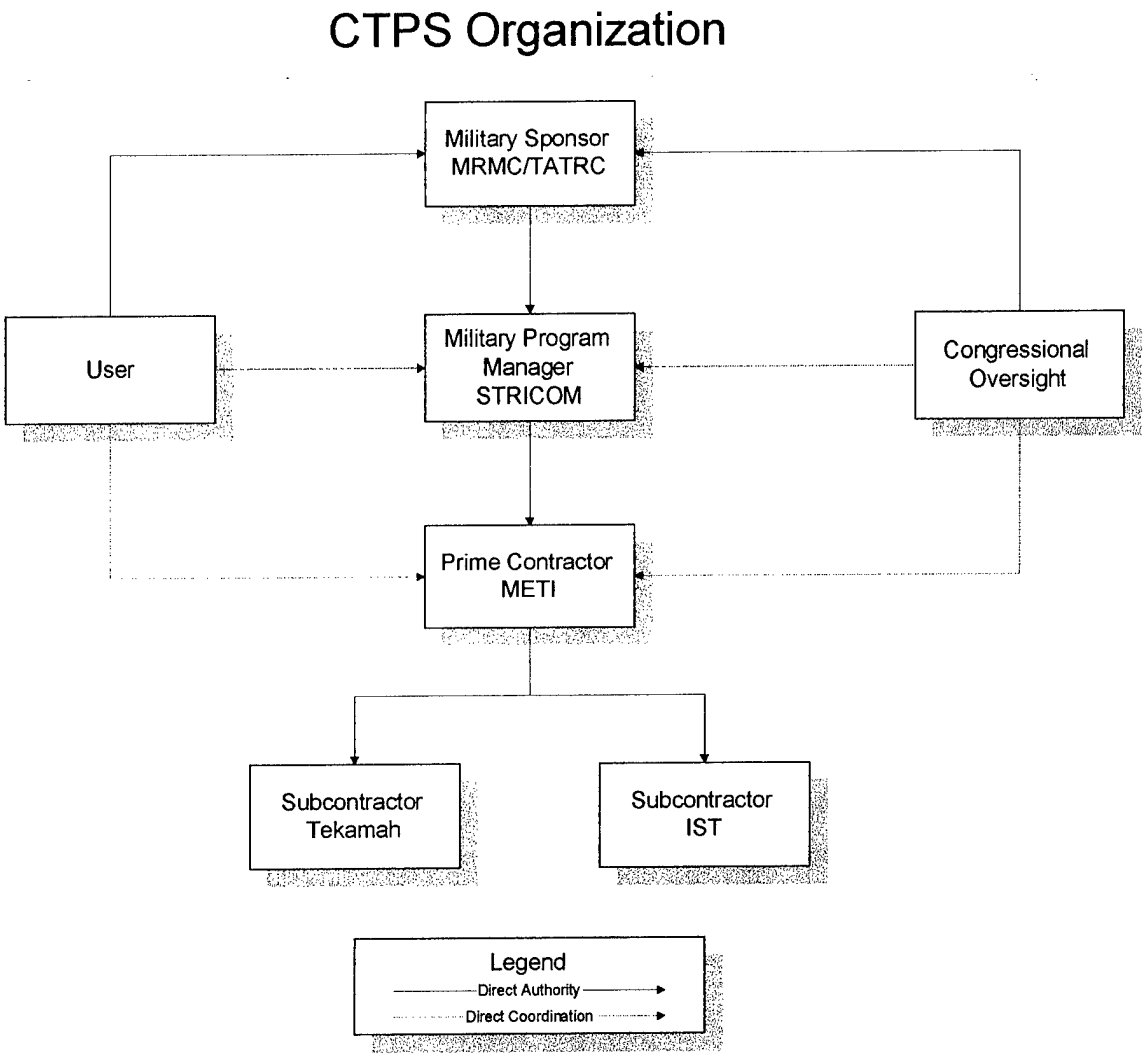
The Objectives of the CTPS Program are defineable, observable, and measurable; and include, but are not limited to:

- Use COTS and GOTS products
- Develop a military medical after-action review system
- Implement a user-based design
- Create an affordable system that is:
  - Interoperable
  - Expandable
  - Modular
  - Flexible
  - Standards-based Implementation
- Produce an operational scenario/training application suitable for mission rehearsal and test & evaluation.
- Measure and quantify system training effectiveness
- Win service advocacy

- Move the program acquisition

3.2 Organization, Roles, and Responsibilities

3.2.1 CTPS Organization Chart



The CTPS Organization is diagrammed above. Arrows indicate the direction of responsibility, with solid lines showing direct authority and dashed lines indicating direct coordination among organizations.

3.2.2 Roles and Responsibilities

Military Sponsor

TATRC is the Military Sponsor for CTPS and is responsible for

- Acting as the Congressional Liaison
- Acting as the User Liaison
- Funding the Program
- Moving the Program to Acquisition

Military Program Manager

STRICOM is the Military Program Manager for CTPS and is responsible for

- Managing the Schedule
- Managing the Budget
- Assuring Quality

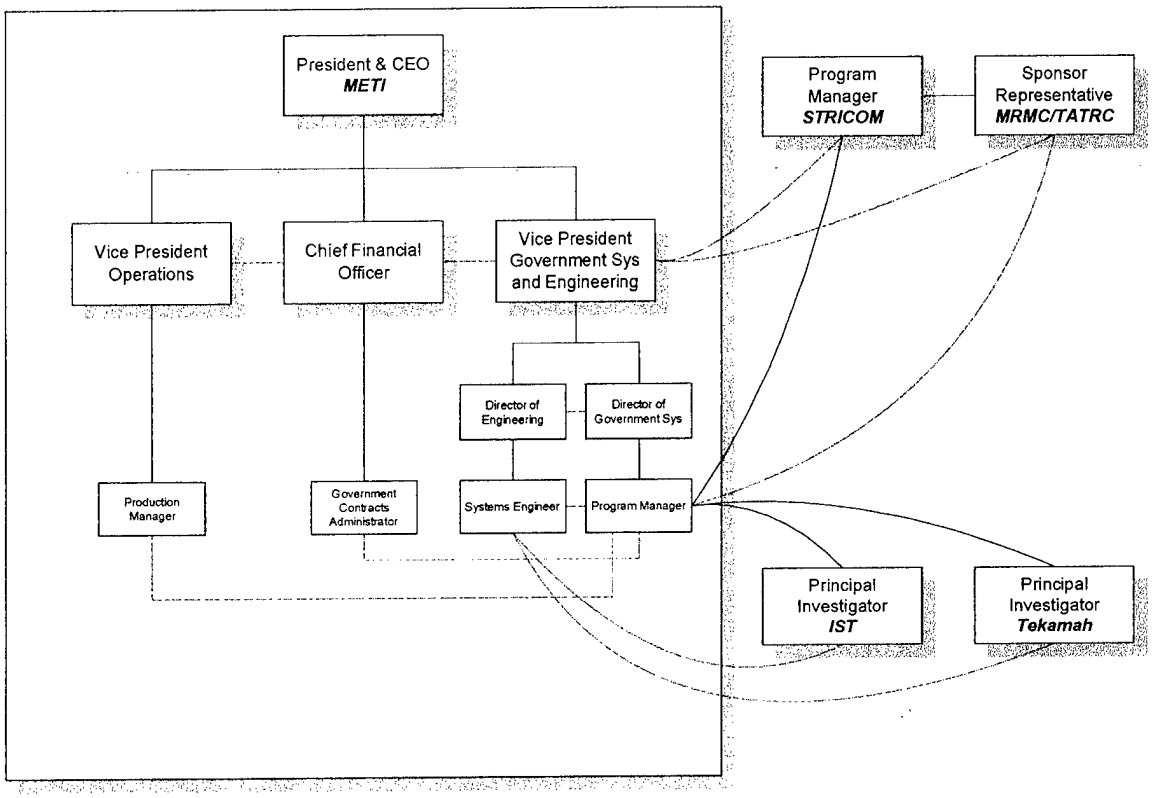
Prime Contractor

METI is the Prime Contractor for CTPS and is responsible for

- Program Management
- Subcontract Management
- Program Administration
- System Engineering
- Hardware Delivery
- User Tests
- Program Demonstrations
- System Installation and User Training

3.2.3 Key Personnel

CTPS Program Management Organization



The CTPS Program Management Organization, as diagrammed above, shows the relationships between respective organizations and key personnel. Lines of direct responsibility (solid) and coordination (dashed) show interactions among organizations and team members.

3.2.4 Team Members

Sponsor Representative

Harvey Magee
Project Officer
TATRC
504 Scott Street
ATTN: MCMR-AT
Ft. Detrick, MD 21702
Phone: (301) 619-4002
Fax: (301) 619-7911
E-mail: magee@tatrc.org

Military Program Manager

Beth Pettitt
Principal Investigator

AMSTI-ES
STRICOM
12350 Research Parkway
Orlando, FL 32826-3276
Phone: (407) 384-3934
Fax: (407) 381-7662
E-mail: Beth_H._Pettitt@stricom.army.mil

Prime Contractor Program Manager

Ron Carovano
Deputy Director of Government Systems
METI
6000 Fruitville Road
Sarasota, FL 34232
Phone: (941) 377-5562
Fax: (941) 377-5590
E-mail: rcarovano@meti.com

Systems Engineer

Note: In December, Bill Waggener was assigned as the Systems Engineer to replace Jim Azukas, METI's Director of Engineering, who was previously serving in this role in an interim capacity.

Bill Waggener
CTPS Systems Engineer
METI
6000 Fruitville Road
Sarasota, FL 34232
Phone: (941) 377-5562
Fax: (941) 377-5590
E-mail: bwaggener@meti.com

Government Contracts Administrator

Mark Klingel
METI
6000 Fruitville Road
Sarasota, FL 34232
Phone: (941) 377-5562
Fax: (941) 377-5590
E-mail: rcarovano@meti.com

Subcontract Principal Investigator—IST

Note: In May 2001, Ed Degnan, PhD, was assigned as the Principal Investigator to replace Peter Kincaid, PhD.

Ed Degnan, PhD
Research Associate
IST
3280 Progress Drive
Orlando, FL 32826
Phone: (407) 882-1339
Fax: (407) 658-5059
E-mail: edegnan@ist.ucf.edu

Subcontractor Principal Investigator—Tekamah

Eric Allely
President
Tekamah Corporation
243 Church Street NW, Suite 100
Vienna, VA 22180-4434
Phone: (301) 816-4900
Fax: (301) 816-4901

3.3 Areas and Locations

Elements of Phase 4 of the CTPS Program will be performed at the following locations

Program Management, Coordination, and Administration

- TATRC, Fort Detrick, MD
- STRICOM, Orlando, FL
- METI, Sarasota, FL

System Engineering

- METI
- IST
- Tekamah

Hardware Delivery

CTPS Government Laboratory, Sarasota, FL

User Tests

See Appendix 1 for locations and Appendix 2 for fielding plan.

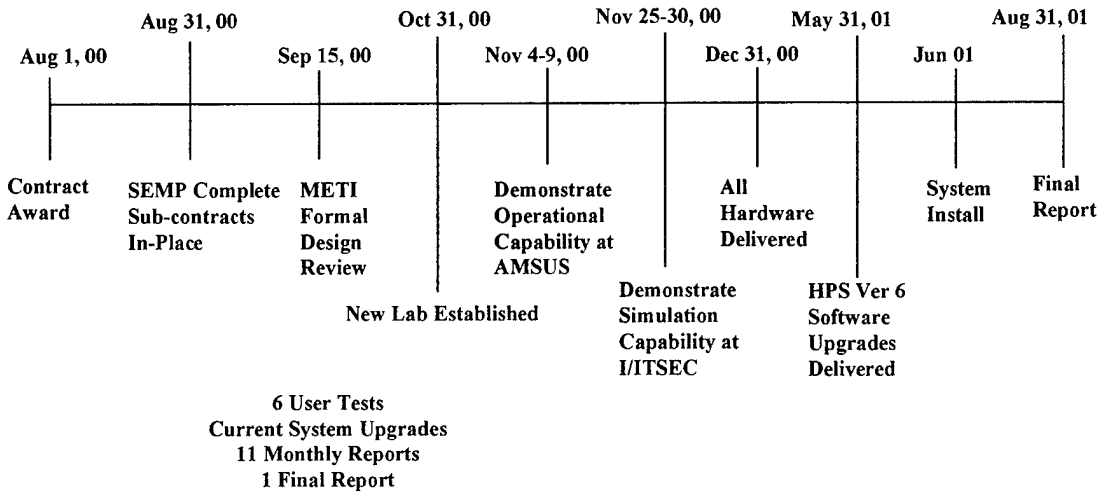
Program Demonstrations

- AMSUS Conference, Las Vegas, NV
- I/ITSEC, Orlando, FL

System Installation and User Training

Regional Medical Training Site—Medical, Fort Gordon, GA

3.4 Schedule and Milestones



The diagram above shows the program management schedule and milestones for CTPS Phase 4.

4 Coordination Instructions

4.1 Timecards

The Prime Contractor will maintain a timecard system for monthly tracking of CTPS Program effort.

4.2 Meetings

A Program Management meeting schedule was established to enable communication among all program team members. These meetings include:

4.2.1 Weekly CTPS Planning Meetings

These meetings provide the opportunity to convene the Prime Contractor team leaders in the areas of Program Management, Engineering, and Contracts Administration.

4.2.2 Monthly CTPS In-Process Reviews

These meetings are convened specifically to brief the METI Executives on the program status. Specific portions of this briefing are dedicated to Program Management, Engineering, Contracts, and Finance. For each portion, the following items are reviewed: Milestones, Deliverables, Subcontract Management, Cost, Schedule, Significant Events, and Issues. Additionally, a portion of the meeting is dedicated to respond to Executive questions raised at the previous IPR.

4.2.3 Quarterly Integrated Product Team Reviews

These meetings are convened by the Program Sponsor between Government and Contractor organizations.

4.3 Travel

The Prime Contractor Program Manager and Systems Engineer will be required to travel to both subcontractor and Government facilities for CTPS program review and coordination meetings.

4.4 Reports

4.4.1 Monthly Reports

Monthly reports are provided by subcontractors to the Prime Contractor. These reports review project status; project activities; travel, meetings, presentations, and publications; administrative issues; and a financial statement.

Monthly reports are provided by the Prime Contractor to STRICOM. These reports review Program and Subcontract Management; and Engineering and Technical Work. The reports also include an Executive Summary and Financial Appendix.

4.4.2 Final Reports

Subcontractors will provide a final report to the Prime Contractor. These reports will be included as appendices to the final report provided by the Prime Contractor to STRICOM.

4.4.3 Technical Reports

Additional technical reports will be provided as specified per the contract agreements for both the Prime Contractor and subcontractors.

Appendix 1: User Test Locations

CTPS Phase 4 User Tests are planned for the following locations:

- Joint Trauma Training Center, Houston, TX
- NASA Johnson Space Center, Houston, TX
- National Capital Area Medical Simulation Center, Silver Spring, MD
- National Training Center, Fort Irwin, CA
- Texas A&M University, College Station, TX
- Portsmouth Naval Hospital, VA

Appendix 2: CTPS Human Patient Simulator Asset Allocation Schedule

	August	September	October	November	December	January	February	March	April	May	June	July
Original Simulator Set												
HPS 28	METI	METI	Upgrade 10/13 Tekamah 10/23	Tekamah	Tekamah	Tekamah	Tekamah	Tekamah	Tekamah	Tekamah	Tekamah	
HPS 54	JTTC	METI	METI	Upgrade	Upgrade	METI	METI	NCA Sim Ctr	NCA Sim Ctr	NCA Sim Ctr	NCA Sim Ctr	
PHS 01	METI	METI	METI	METI	Upgrade	METI	METI	METI	STRICOM	STRICOM	STRICOM	
PHS 02P	METI	Repair/Upgr	Repair/Upgr	Repair/Upgr	Repair/Upgr	Repair/Upgr	Repair/Upgr	METI	METI	METI		TAMU
PHS 03(P)	AMEDD	METI	METI	METI	METI	METI	Upgrade + Portable	Upgrade + Portable	METI	METI		METI
PHS 04	IST	IST	IST	IST	IST	IST	IST	IST	Upgrade	METI		METI
New Simulator Set												
HPS 101P	METI	Ft McCoy VA WMD	METI	METI	NASA	NASA	NASA	NASA	METI		CTPS Site	CTPS Site
HPS 107P	METI	JTTC	JTTC	JTTC	JTTC	METI	METI	METI	METI		CTPS Site	CTPS Site
PHS 35P	METI	ATACCS	METI	AMSUS I/ITSEC	METI	METI	METI	METI	METI		CTPS Site	CTPS Site
PHS 36P	METI	METI	TATRC	TATRC	TATRC	TATRC	TATRC	METI	METI		CTPS Site	CTPS Site
PHS 39P	N/A	N/A	METI	AMSUS I/ITSEC	METI	USAF Vendor Fair	METI	METI	METI		CTPS Site	CTPS Site
PHS 40P	N/A	N/A	METI	AMSUS I/ITSEC	SOMA	METI	METI	METI	METI		CTPS Site	CTPS Site

METI	Upgrades
Shows & Demos	CTPS System Installation
User Tests	
Program Partners	

Not scheduled, 2 user tests in the spring

Appendix C: Tekamah Final Report

Note: The June Monthly Report serves as Tekamah's Final Report

Tekamah Corporation
Monthly Report to Medical Education Technologies, Incorporated
Subcontract Number METI00-CTPS-TEK01
June 2001

Project Overview

CTPS is a DoD sponsored program initiated to provide an integrated military medical simulation system for training, test and evaluation, and realistic assessment of the impact of battlefield casualties. CTPS capabilities include: simulating, replicating, and assessing injuries by type and category; monitoring the movement of casualties on the battlefield; capturing the time of patient diagnosis and treatment; and comparing intervention and outcome results at various levels. The CTPS system uses Human Patient Simulators (HPS), which are full scale, fully interactive mannequins to train and evaluate healthcare practitioners.

Tekamah was actively involved in the CTPS program during Phase III and is continuing its work during Phase IV by developing new training content, enhancing and improving software federates, and by connecting other simulation assets to the CTPS program.

Table 1 shows the Project Deliverables by month through August. For revised dates for July and August, please see the Project Timeline in Table 2 and following written descriptions. The project tasks and deliverables are organized to reflect project activity by job function (analysis / engineering / documentation).

Project Activities

The project activities are organized by job function (analysis / engineering / documentation). The task headings are modified slightly from the original contract headings. For reference purposes, we have noted the subcontract task numbers in parentheses following each activity heading.

1. Analysis/Development-CTPS Support of 91W/CLS Training

a. Review of Training Objectives for 91/CLS (Task 2.1.1)
Status: **Completed**. The results of this research are contained in the report "Use of the Human Patient Simulator to Train 91W MOS and Combat Life Saver Related Skills."

b. Identification and Selection of HPS Supported Tasks for Inclusion in CTPS4 (Task 2.1.2)
Status: **Completed**. The results of this research are contained in the report "Use of the Human Patient Simulator to Train 91W MOS and Combat Life Saver Related Skills."

c. Selection of Additional Medical Tasks* (Task 2.5.2)
Status: **Completed**. The results of the research that identified additional medical tasks are contained in the report "Use of the Human Patient Simulator to Train 91W MOS and Combat Life Saver Related Skills."

d. Selection of Operational Tasks* (Task 2.5.1)
Status: **Completed.** The results of the research that identified additional operational tasks are contained in the report "Use of the Human Patient Simulator to Train 91W MOS and Combat Life Saver Related Skills."

Table 1. Project Deliverables

ID	Task Name	Deliverables	SEP 2000	OCT 2000	NOV 2000	DEC 2000	JAN 2001	FEB 2001	MAR 2001	APR 2001	MAY 2001	JUN 2001	JUL 2001	Aug 2001	Status
1	Analysis/Development-CTPS Support of 91W/CLS Training														
2	Review of Training Objectives for 91/CLS (Task 2.1.1)	Monthly, Technical Report	X	X	X	X	X	X	X						complete
3	Identification and Selection of Additional HPS Supported Tasks fo Inclusion in CTPS4 (Task 2.1.2)	Monthly, Technical Reports			X	X	X	X	x						complete
4	Selection of Additional Medical Tasks (Task 2.5.2)	Monthly, Technical Report	X	X	X	X	X	X	X						complete
5	Selection of Operational Tasks (Task 2.5.1)	Monthly, Technical Report	X	X	X	X	X	X	X						complete
6	Triage Controller (TC)														
7	Enhancement of TC Federate (Task 2.2)	Monthly, Technical Reports Computer Program				X	X	X	X	X	X	x			complete
8	Implementation and Support of Selected 91W/CLS Training Objectives (Task 2.1.3)	Monthly, Technical Reports Computer Program				X	X	X	X	X	X				complete
9	Implement Interface for Management of Selected Operational Tasks (Task 2.5.3)	Monthly, Technical Reports Computer Program				X	X	X	X	X	X	x			complete
10	Implement Freeze/Restart/Save Capability in TC (Task 2.3)	Monthly, Technical Reports Computer Program					X	X	X	X	X	x			complete
11	CTPS TC Federate Version 4.1	Computer Program							X						complete
12	CTPS TC Federate Version 4.2	Computer Program									X	x			complete
13	After Action Review (AAR)														
14	Develop AAR Federate (Task 2.4)	Monthly, Technical Reports Computer Program				X	X	X	X	X	X	x			complete
15	Implement Freeze/Restart/Save Capability in AAR (Task 2.3)	Monthly, Technical Reports Computer Program					X	X	X	X	X	x			complete
16	CTPS AAR Federate Version 4.1	Computer Program							X						complete
17	CTPS AAR Federate Version 4.2	Computer Program									X	x			complete
18	Documentation, Installation, Training and Support														
19	Engineering Management Plan (Task 2.6)	Report	X	X	X	X	X	X	X						complete
20	Installation and Training (Task 2.6)									X	x	x	x		ongoing
21	Training at User Site (Task 2.6)													x	
22	Support (Task 2.6)									X	X	X	x		ongoing
23	System Documentation (Draft) (Task 2.6)	Documentation											x		complete
24	User Documentation (Draft) (Task 2.6)	Documentation									X	x	x		complete
25	System Documentation (Final) (Task 2.6)	Documentation											x		ongoing
26	User Documentation (Final) (Task 2.6)	Documentation											x		ongoing
27	Monthly Reports														
28	Monthly Report #1	Report	X												complete
29	Monthly Report #2	Report		X											complete
30	Monthly Report #3	Report			X										complete
31	Monthly Report #4	Report				X									complete
32	Monthly Report #5	Report					X								complete
33	Monthly Report #6	Report						X							complete
34	Monthly Report #7	Report							X						complete
35	Monthly Report #8	Report								X					complete
36	Monthly Report #9	Report									X				complete
37	Monthly Report #10	Report										x			complete
38	Final Report	Report													

2. Triage Controller (TC)

a. Enhancement of the Triage Controller Federate (Task 2.2)
Status: The Triage Controller (TC) user interface was completed in March and tested in April (version 4.1). Comments provided by a quality control review panel were incorporated. The interface was coded according to the METI-provided network specifications. Additional interface specifications were identified and implemented as required.

The TC is complete. The coding remaining as of the last report: implementation of additional interface features with the final networked (e.g. PATSIM), and the added additional treatments/examination activities, is complete (version 4.2). Revisions will be made as necessary throughout the implementation and testing phase.

b. Implementation and Support of Selected 91W/CLS Training Objectives (Task 2.1.3)
Status: Weekly integrated meetings between analysis and engineering teams continue. (This task is implementing the functional and content requirements from D.1.) Dr. Russ Dumire assisted with the implementation of selected casualty scenarios using the HPS system in late May.

c. Implement Interface for Management of Selected Operational Tasks (Task 2.5.3)
Status: **completed**.

d. Implement Freeze/Restart/Save Capability in TC (Task 2.3)
Status: **Completed**

Table 2. Project Timeline

ID	Task Name	Status	Responsible	Start	Finish
1	**Analysis/Development-CTPS Support of 91W/CLS Training**			**Thu 8/31/00**	**Fri 3/30/01**
2	Review of Training Objectives for 91/CLS (Task 2.1.1)	completec	Allely-Bayer	Thu 8/31/00	Fri 3/30/01
3	Identification and Selection of Additional HPS Supported Tas	completec	Allely-Bayer	Wed 11/1/00	Fri 3/30/01
4	Selection of Additional Medical Tasks* (Task 2.5.2)	completec	Allely-Bayer	Thu 8/31/00	Fri 3/23/01
5	Selection of Operational Tasks* (Task 2.5.1)	completec	Allely-Bayer	Thu 8/31/00	Fri 3/30/01
6	**Triage Controller (TC)**			**Fri 12/1/00**	**Thu 6/28/01**
7	Enhancement of TC Federate (Task 2.2)	completec	Rosene-Thompsor	Fri 12/1/00	Thu 6/28/01
8	Implementation and Support of Selected 91W/CLS Training (	completec	Rosene-Thompsor	Fri 12/1/00	Thu 5/31/01
9	Implement Interface for Management of Selected Operationa	completec	Rosene-Thompsor	Fri 12/1/00	Thu 5/31/01
10	CTPS TC Federate Version 4.1	completec	Rosene-Thompsor	Mon 1/29/01	Fri 4/27/01
11	CTPS TC Federate Version 4.2	completec	Rosene-Thompsor	Fri 6/1/01	Thu 6/28/01
12	Implement Freeze/Restart/Save Capability in TC (Task 2.3)	completec	Rosene-Thompsor	Fri 12/1/00	Thu 6/28/01
13	**After Action Review (AAR)**			**Fri 12/1/00**	**Thu 6/28/01**
14	Develop AAR Federate (Task 2.4)	completec	Rosene-Thompsor	Fri 12/1/00	Thu 5/31/01
15	Implement Freeze/Restart/Save Capability in AAR (Task 2.3	completec	Rosene-Thompsor	Wed 1/3/01	Thu 5/31/01
16	CTPS AAR Federate Version 4.1	completec	Rosene-Thompsor	Fri 4/27/01	Fri 4/27/01
17	CTPS AAR Federate Version 4.2	completec	Rosene-Thompsor	Fri 6/1/01	Thu 6/28/01
18	**Documentation, Installation, Training and Support**			**Thu 8/31/00**	**Fri 8/17/01**
19	Engineering Management Plan (Task 2.6)	completec	Tatem-Thompsor	Thu 8/31/00	Fri 4/13/01
20	Installation and Training (Task 2.6)	ongoing	Tatem-Thompsor	Mon 4/2/01	Mon 7/9/01
21	Training at User Site (Task 2.6)		Tatem-Thompsor	Mon 6/25/01	Fri 8/17/01
22	Support (Task 2.6)	ongoing	Tatem-Thompsor	Mon 4/2/01	Tue 7/31/01
23	System Documentation (Draft) (Task 2.6)		Tatem-Thompsor	Thu 3/1/01	Fri 7/13/01
24	User Documentation (Draft) (Task 2.6)		Tatem-Thompsor	Tue 5/1/01	Mon 7/9/01
25	System Documentation (Final) (Task 2.6)		Tatem-Thompsor	Fri 6/1/01	Fri 7/20/01
26	User Documentation (Final) (Task 2.6)		Tatem-Thompsor	Fri 6/1/01	Fri 7/20/01
27	**Monthly Reports**			**Mon 10/2/00**	**Mon 7/9/01**
28	Monthly Report #1	completec	Bayer-Tatem	Mon 10/2/00	Mon 10/2/00
29	Monthly Report #2	completec	Bayer-Tatem	Tue 12/12/00	Tue 12/12/00
30	Monthly Report #3	completec	Bayer-Tatem	Tue 12/12/00	Tue 12/12/00
31	Monthly Report #4	completec	Bayer-Tatem	Wed 1/3/01	Wed 1/3/01
32	Monthly Report #5	completec	Bayer-Tatem	Fri 2/9/01	Fri 2/9/01
33	Monthly Report #6	completec	Bayer-Tatem	Thu 3/1/01	Thu 3/1/01
34	Monthly Report #7	completec	Bayer-Tatem	Thu 5/3/01	Thu 5/3/01
35	Monthly Report #8	completec	Bayer-Tatem	Thu 5/3/01	Thu 5/3/01
36	Monthly Report #9		Bayer-Tatem	Fri 6/1/01	Fri 6/1/01
37	Monthly Report #10	completec	Kwast-Tatem	Mon 7/9/01	Mon 7/9/01
38	Final Report		Tatem-Thompsor	Mon 7/2/01	Fri 8/31/01

3. After Action Review (AAR)

a. Develop AAR Federate (Task 2.4)
Status The After Action Review (AAR) user interface was completed in March and tested in April (version 4.1). Comments provided by a quality control review panel were also incorporated. Tekamah then started testing the integration of the AAR data structures within the AAR interface. The code was updated in accordance with specified quality control standards (version 4.2). Revisions will be made as necessary throughout the implementation and testing phase.

b. Implement Freeze/Restart/Save Capability in AAR (Task 2.3)
Status: **Completed**.

4. "Documentation, Installation, Training and Support"

a. Engineering Management Plan (TASK 2.6)
Status: **Completed**.

b. Installation and Training (Task 2.6)
Status: Projected Start Date: Ongoing. Integration with METI provided software and training began with a site visit in May by Dr. Carl Rosene and subsequent visits in June by both Dr. Rosene and Dr. Eric Allely. This will continue at Ft. Gordon during the weeks of July 9th and July 16th.

c. Training at User Site (Task 2.6)
Status: Projected Date: **Aug. 13-17**

d. Support (Task 2.6)
Status: Projected Delivery Date: Ongoing.

e. System Documentation (Draft) (Task 2.6)
Status: Projected Delivery Date: In draft form – July 20th

f. User Documentation (Draft) (Task 2.6)
Status: Projected Delivery Date: July 9

g. System Documentation (Final) (Task 2.6)
Status: Projected Delivery Date: July 20th

h. User Documentation (Final) (Task 2.6)
Status: Projected Delivery Date: July 20th

5. Monthly Reports #1 – 10: Completed

6. Final Report

Status: Completion Date: Aug. 27th

*(not currently supported by HPS)

E. Travel, Meetings, Presentations, and Publications

Personnel	Description	Where	When
	Conducted a Series of Conference Calls with METI and project SMEs.		March-April
	"Use of the Human Patient Simulator to Train 91W MOS and Combat Life Saver Related Skills."		April
Carl Rosene	Implementation and Training	METI	May
Carl Rosene	Implementation and Training	METI	June
Eric Allely	Implementation and Training	METI	June

F. Administrative

No company holidays in June.

Appendix D: Analysis of the Human Patient Simulator to Support 91W MOS and Combat Life Saver Training

ANALYSIS OF THE HUMAN PATIENT SIMULATOR TO SUPPORT 91W MOS AND COMBAT LIFE SAVER TRAINING MARCH 2001

GRANT # METI100 – CTPS-TEK01

IN SUPPORT OF CONTRACT #N61339-99-3-0002 FROM THE U.S. ARMY SIMULATION, TRAINING AND INSTRUMENTATION COMMAND (STRICOM)

I. INTRODUCTION 1

I.A. Background Information 1

I.B. Purpose of the Report 3

I.C. Research Focus 3

II. THE HUMAN PATIENT SIMULATOR (HPS) AND COMBAT MEDICAL TRAINING 4

II.A. Overview of the Human Patient Simulator (HPS) 4
II.A.1. Review of Medical Attributes of the HPS 4
Table 1. HPS Attributes 5

II.B. HPS and Military Medical Training 6
II.B.1. The Combat Medical Environment Implications for Training with HPS 6
II.B.1a. Needs of Typical Combat Casualty 6
II.B.1b. Critical Tasks for Patient Resuscitative Care on the Battlefield 6
II.B.2. From the User's Perspective 7
II.B.3. HPS Support for Combat Military Medical Training Programs 8
Table 2. Training Programs Where HPS Can Be Used 8

III. ARMY TRAINING, THE 91W, AND IMPLICATIONS FOR HPS 9

III.A. Army Training 9
III.A.1. Army Training XXI Principles and Strategy 9
III.A.2. Analysis and Implications for HPS 10

III.B. Medical Career Management Field Change - 91W 11

III.C. Review of 91W Health Care Specialist MOS Training Requirements 11
III.C.1. Basis of 91W Skills 12
III.C.2. Training Required or Offered by Courses Related to the 91W MOS 13

IV. KNOWLEDGE AND SKILL OBJECTIVES FOR THE 91W 17

IV.A. Outline of 91W MOS Knowledge and Skill Objectives 17
IV.A.1. Module One - General Patient Assessment and Initial Management 17
IV.A.2. Module Two - Emergency Pharmacology 18
IV.A.3. Module Three - Advanced Airway Management and Ventilation 19
IV.A.4. Module Four - Fluids and Shock 20
Table 3. 91W Skills With HPS Support Skills Listed By Course 23

V. HUMAN PATIENT SIMULATOR (HPS) TECHNOLOGY SUPPORT OF 91W SKILLS AND TASKS 24

V.A. 91W Supported Skills 24

V.B. 91W Tasks Supported or Enhanced by HPS 24
V.B.1. HPS Capabilities and 91W Task List 24
Table 4. Echelon I & II Emergency Tasks and HPS Capabilities 26
V.B.2. Recommendations for HPS Enhancement 27
V.B.3. 91W Tasks Not Able to Be Performed on HPS Without Enhancements 27

V.C. Specific Recommendations for HPS to Enhance Support of 91W MOS 28

V.D. HPS Supported Skills Prioritized in Terms of Training Impact 30

V.E. Summary 30

VI. ARMY TRAINING, COMBAT LIFESAVER (CLS) COURSE AND IMPLICATIONS FOR HPS 32

VI.A. Combat Life Saver and Army Training 32

VI.B. Outline of CLS Knowledge and Skills Objectives 34
VI.B.1. CLS Course Version Three 34
Table 5. COMBAT LIFESAVER COURSE 34
VI.B.2. Review of CLS Skills 35
VI.B.3. Self Aid/Buddy Aid 35

VI.C. HPS Technology Support of CLS Skills 36
Table 6. CLS Skills and HPS Support 36

VI.D. Recommendations for Human Patient Simulator Enhancements 37
VI.D.1. MCTS Recommendations 38
VI.D.2. Other Recommendations 38

VI.E. CLS Skills Prioritized in Terms of Training Impact Supported by HPS 39
VI.E.1. CLS Knowledge Objectives for Shock 40
VI.E.2. CLS Tasks for Shock 40

VII. 91W AND CLS TRAINING SCENARIOS AND HPS 41

VII.A. HPS Supported Scenarios 41

VII.B. CTPS-HPS – Additional Medical Attributes That Could Enhance Future Scenarios 42

VII.C. CTPS-HPS – Additional Military Operational Attributes that Could Enhance Future Scenarios 44

VIII. PSYCHOMOTOR OBJECTIVES, SKILLS AND TASKS FOR 91W AND CLS ... 45

VIII.A. Review of Psychomotor Objectives, Skills and Tasks With Comments on HPS Support 45
VIII.A.1. Baseline Vital Signs and History Psychomotor Objectives: 45
VIII.A.2. Baseline Vital Signs and History - Psychomotor Skills: 46
VIII.A.3. Baseline Vital Signs and History - Psychomotor Tasks: 47
VIII.A.4. Lifting and Moving a Patient: Psychomotor Objectives 48
VIII.A.5. Lifting and Moving a Patient – Psychomotor Skills 48
VIII.A.6. Lifting and Moving a Patient – Psychomotor Tasks 49
VIII.A.7 Lifting and Moving a Patient -HPS Support/Needed Enhancements 51
VIII.A.8. Airway - Psychomotor Objectives 51
VIII.A.9. Airway – Psychomotor Skills 52
VIII.A.10. Airway – Psychomotor Tasks 53
VIII.A.11. Airway and HPS Support/Needed Enhancements 55
VIII.A.12. Scene Size Up - Psychomotor Objectives: 56
VIII.A.13. Scene Size Up – Psychomotor Skills: 56
VIII.A.14. Scene Size Up – Psychomotor Tasks: 56
VIII.A.15. Scene Size Up and HPS Support 57
VIII.A.16. Initial Assessment – Psychomotor Objectives: 57
VIII.A.17. Initial Assessment – Psychomotor Skills 57
VIII.A.18. Initial Assessment – Psychomotor Tasks 57
VIII.A.19. Initial Assessment and HPS Support/Needed Enhancements 58
VIII.A.20. Focused History and Physical Exam: Trauma -Psychomotor Objectives 59
VIII.A.21. Focused History and Physical Exam: Trauma - Psychomotor Skills 59
VIII.A.22. Focused History and Physical Exam: Trauma - Psychomotor Tasks 59
VIII.A.23. Focused History and Physical Exam: Trauma - HPS Support 60
VIII.A.24. Focused History and Physical Exam: Medical -Psychomotor Objectives: 61
VIII.A.25. Focused History and Physical Exam: Medical - Psychomotor Skills 61
VIII.A.26. Focused History and Physical Exam: Medical Psychomotor Tasks 61
VIII.A.27. Focused History and Physical Exam: Medical –HPS Support 62
VIII.A.28. Detailed Physical Exam - Psychomotor Objectives: 63
VIII.A.29. Detailed Physical Exam - Psychomotor Skills: 63
VIII.A.30. Detailed Physical Exam - Psychomotor Tasks: 63
VIII.A.31. Detailed Physical Examination and HPS Support Technology 64
VIII.A.32. Ongoing Assessment - Psychomotor Objectives 64
VIII.A.33. Ongoing Assessment – Psychomotor Skills 64
VIII.A.34. Ongoing Assessment – Psychomotor Tasks: 64
VIII.A.35. Communication - Psychomotor Objectives 65
VIII.A.36. Communication – Psychomotor Skills 65
VIII.A.37. Communication – Psychomotor Tasks 66
VIII.A.38. Communication and HPS Support Technology and Needed Enhancements 68
VIII.A.39. Documentation - Psychomotor Objectives: 68
VIII.A.40. Documentation – Psychomotor Skills: 68
VIII.A.41. Documentation – Psychomotor Tasks: 68
VIII.A.42. Documentation and HPS Support Technology 69
VIII.A.43. General Pharmacology - Psychomotor Objectives 69
VIII.A.44. General Pharmacology - Psychomotor Skills: 69
VIII.A.45. General Pharmacology - Psychomotor Tasks 69
VIII.A.46. General Pharmacology and HPS Support Technology 70

VIII.A.47. Respiratory Emergencies - Psychomotor Objectives 70
VIII.A.48. Respiratory Emergencies – Psychomotor Skills 70
VIII.A.49. Respiratory Emergencies – Psychomotor Tasks 70
VIII.A.50. Respiratory Emergencies and HPS Support Technology 71
VIII.A.51. Cardiac Emergencies - Psychomotor Objectives 71
VIII.A.52. Cardiac Emergencies – Psychomotor Skills 71
VIII.A.53. Cardiac Emergencies – Psychomotor Tasks 72
VIII.A.54. Cardiac Emergencies and HPS Support Technology 73
VIII.A.55. Diabetic Emergencies/Altered Mental Status -Psychomotor Objectives 73
VIII.A.56. Diabetic Emergencies/Altered Mental Status – Psychomotor Skills 74
VIII.A.57. Diabetic Emergencies/Altered Mental Status – Psychomotor Tasks 74
VIII.A.58. Diabetic Emergencies/Altered Mental Status and HPS Support Technology 75
VIII.A.59. Allergies - Psychomotor Objectives 75
VIII.A.60. Allergies –Psychomotor Skills 75
VIII.A.61. Allergies –Psychomotor Tasks 76
VIII.A.62. Allergies and HPS Support Technology 76
VIII.A.63. Poisoning Overdose - Psychomotor Objectives: 76
VIII.A.64. Poisoning Overdose – Psychomotor Skills: 77
VIII.A.65. Poisoning Overdose – Psychomotor Tasks: 77
VIII.A.66. Poisoning Overdose and HPS Support Technology 78
VIII.A.67. Environmental Emergencies – Psychomotor Objectives 78
VIII.A.68. Environmental Emergencies – Psychomotor Skills 78
VIII.A.69. Environmental Emergencies – Psychomotor Tasks: 79
VIII.A.70. Environmental Emergencies and HPS Support Technology 80
VIII.A.71. Behavioral Emergencies - Psychomotor Objectives 80
VIII.A.72. Behavioral Emergencies – Psychomotor Skills 80
VIII.A.73. Behavioral Emergencies – Psychomotor Tasks 81
VIII.A.74. Behavioral Emergencies and HPS Support Technology 81
VIII.A.75. OB/GYN - Psychomotor Objectives 81
VIII.A.76. OB/GYN – Psychomotor Skills 82
VIII.A.77. OB/GYN – Psychomotor Tasks: 82
VIII.A.78. OB/GYN and HPS Support Technology 83
VIII.A.79. Bleeding and Shock - Psychomotor Objectives: 83
VIII.A.80. Bleeding and Shock – Psychomotor Skills: 83
VIII.A.81. Bleeding and Shock – Psychomotor Tasks 84
VIII.A.82. Bleeding and Shock and HPS Support Technology 85
VIII.A.83. Soft Tissue Injuries - Psychomotor Objectives 85
VIII.A.84. Soft Tissue Injuries – Psychomotor Skills 85
VIII.A.85. Soft Tissue Injuries – Psychomotor Tasks 86
VIII.A.86. Soft Tissue Injuries and HPS Support Technology 88
VIII.A.87. Musculoskeletal Care – Psychomotor Objectives 88
VIII.A.88. Musculoskeletal Care – Psychomotor Skills 89
VIII.A.89. Musculoskeletal Care – Psychomotor Tasks: 89
VIII.A.90. Musculoskeletal Care and HPS Technology 90
VIII.A.91. Spinal Cord Injury - Psychomotor Objectives 90
VIII.A.92. Spinal Cord Injury – Psychomotor Skills 91
VIII.A.93. Spinal Cord Injury – Psychomotor Tasks 92
VIII.A.94. Spinal Cord Injury and HPS Support Technology 94

VIII.A.95. Infants and Children - Psychomotor Objectives 94
VIII.A.96. Infants and Children – Psychomotor Skills 94
VIII.A.97. Infants and Children – Psychomotor Tasks 95
VIII.A.98. Infants and Children and HPS Support Technology 96
VIII.A.99. Ambulance Operations – Psychomotor Objectives 96
VIII.A.100. Ambulance Operations – Psychomotor Skills 96
VIII.A.101. Ambulance Operations – Psychomotor Tasks 96
VIII.A.102. Ambulance Operations and HPS Support Technology 97
VIII.A.103. Gaining Access - Psychomotor Objectives: 97
VIII.A.104. Gaining Access – Psychomotor Skills: 97
VIII.A.105. Gaining Access – Psychomotor Tasks: 97
VIII.A.106. Gaining Access and HPS Support Technology 97
VIII.A.107. Overview - Psychomotor Objectives: 97
VIII.A.108. Overview – Psychomotor Skills: 98
VIII.A.109. Overview – Psychomotor Tasks: 98
VIII.A.110. Overview and HPS Support Technology 98
VIII.A.111. Advanced Airway – Psychomotor Objectives 98
VIII.A.112. Advanced Airway – Psychomotor Skills: 99
VIII.A.113. Advanced Airway – Psychomotor Tasks 100
VIII.A.114. Advanced Airways and HPS Support Technology 102

VIII.B. Tables of HPS Supported EMT-B Skills and Tasks 103
VIII.B.1. MOUTH-TO-MASK WITH SUPPLEMENTAL OXYGEN 103
VIII.B.2. AIRWAY MAINTENANCE OROPHARYNGEAL AIRWAY 104
VIII.B.3. OXYGEN ADMINISTRATION 105
VIII.B.4. CARDIAC ARREST MANAGEMENT/AED 106
VIII.B.5. PATIENT ASSESSMENT/MANAGEMENT MEDICAL 108
VIII.B.6. EPINEPHRINE AUTO-INJECTOR 111
VIII.B.7. PATIENT ASSESSMENT/MANAGEMENT TRAUMA 112
VIII.B.8. BLEEDING CONTROL/SHOCK MANAGEMENT 114
VIII.B.9. IMMOBILIZATION SKILLS LONG BONE 115
VIII.B.10. IMMOBILIZATION SKILLS JOINT INJURY 115
VIII.B.11. IMMOBILIZATION SKILLS TRACTION SPLINTING 116
VIII.B.12. SPINAL IMMOBILIZATION LYING PATIENT 117
VIII.B.13. SPINAL IMMOBILIZATION SEATED PATIENT 118
VIII.B.14. VENTILATORY MANAGEMENT ENDOTRACHEAL INTUBATION 119
VIII.B.15. VENTILATORY MANAGEMENT DUAL LUMEN AIRWAY DEVICE (PTL OR COMBI-TUBE) INSERTION FOLLOWING AN UNSUCCESSFUL ENDOTRACHEAL INTUBATION ATTEMPT 120
VIII.B.16. VENTILATORY MANAGEMENT ESOPHAGEAL OBTURATOR AIRWAY INSERTION FOLLOWING AN UNSUCCESSFUL ENDOTRACHEAL INTUBATION ATTEMPT 121

IX. CONCLUSION 122

REFERENCES 124

I. INTRODUCTION

This report documents the results of a study that examined training requirements for the Army 91W Military Occupational Specialty (MOS) and the Combat Life Support (CLS) Course for use in developing, enhancing and improving training supported by the Human Patient Simulator (HPS). The review process for this report included panel discussions, input from Individual Subject Matter Experts SME(s), and literature and document reviews. Members of the Medical Company Training Site (MCTS) at Indiantown Gap, Pennsylvania and others provided practical assessment of the use of the Human Patient Simulator in a training context and assisted in the review of program content for 91W and CLS.

I.A. Background Information

On 31 August 2000, Tekamah Corporation signed a contract (METI00-CTPS-TEK01) with Medical Education Technologies, Inc. (METI) for work covering the period 1 September 2000 to 31 July 2001. The work, in support of Combat Trauma Patient Simulation (CTPS) Phase IV, is authorized under contract number N61339-99-3-0002 from the U.S. Army Simulation, Training and Instrumentation Command (STRICOM).

CTPS is a Department of Defense (DoD) sponsored program initiated to provide an integrated military medical simulation system for training, testing, and evaluation. A major goal of the program is to more realistically assess the impact of battlefield casualties. CTPS capabilities include: simulating, replicating, and assessing injuries by type and category; monitoring the movement of casualties on the battlefield; capturing the time of patient diagnosis and treatment; and comparing intervention and outcome results at various levels (US Army STRICOM, n.d.). Human Patient Simulators (HPS) are full scale, fully interactive simulators used to train healthcare practitioners (US Army STRICOM, n.d.)

Tekamah was actively involved in the CTPS program during Phase III and is continuing its work during Phase IV by analyzing existing, and developing new training content, enhancing and improving federates, and by connecting other simulation assets to the CTPS program.

This report responds to the following contract requirements:

2.1.1 Analysis of 91W/CLS Training Objectives (METI 4.1)

Tekamah will conduct a review and analysis of the Training Objectives for the Army 91W MOS and the Combat Lifesaver (CLS) Course. The goal of this task will be to develop a list of the Terminal Learning Objectives that address critical training for both the 91W and CLS. The analysis will include recommendations for training modalities of the selected training objectives. Particular focus will be placed on psychomotor skills.

2.1.2 Development of 91W/CLS Task List Supported by Current HPS Technology (METI 4.2)

Based on the work done in *2.1.1 - Analysis of 91W/CLS Training Objectives*, Tekamah will develop a detailed task list and the related Enabling Learning Objectives for 91W and CLS Terminal Learning Objectives that are supported by the current HPS technology.

2.5.1 Analysis, Development and Selection of Operational Attributes for Inclusion in CTPS 91W/CLS Scenarios (METI 3.11.1)

Based on the work done in *2.1.3 - Implementation of Selected Patient Scenarios for 91W/CLS Training*, Tekamah will develop additional operational training attributes for the CTPS System. These attributes will focus on non-medical information critical to the 91W and CLS decision-making process. Particular emphasis will be given in areas where the direct care of the casualty changes with operational conditions.

2.5.2 Analysis, Development and Selection of Additional Medical Information not Currently Supported by HPS Technologies (91W/CSL related) (METI 3.11.2)

Based on the work done in *2.1.3 - Implementation of Selected Patient Scenarios for 91W/CLS Training*, Tekamah will develop additional medical training attributes for the CTPS System. These additional attributes will focus on medical information critical during the 91 W and CLS decision making process but not currently supported by the HPS technology.

I.B. Purpose of the Report

This report provides the framework for Tekamah Corporation to develop and implement Human Patient Simulator scenarios to support selected training tasks for 91W and CLS, to develop additional operational training attributes (focused on non-medical information critical to 91W and CLS decision-making process), and to develop additional medical training attributes for the CTPS System.

I.C. Research Focus

The research sought to:

- Outline the list of the skills necessary for 91W and Combat Lifesaver
- Identify how the current HPS technology can or could support these skills
- Prioritize Human Patient Simulator supported skills in terms of training impact
- Outline Human Patient Simulator scenarios to exercise selected 91W and CSL tasks
- Identify additional medical attributes to enhance the selected scenarios
- Identify operational attributes to enhance the selected scenarios (Minutes, Dec 2000).

The next section of this report describes the Human Patient Simulator, its relationship to combat military medical training and the implications for patient simulation applications.

II. THE HUMAN PATIENT SIMULATOR (HPS) AND COMBAT MEDICAL TRAINING

As part of the Combat Trauma Patient Simulation (CTPS), the Human Patient Simulator (HPS) provides an integrated approach to the training and evaluation of medical personnel. The creation of multi-use simulations within a realistic and complete battlefield environment based on HPS technology and capabilities is a key element of CTPS. This section briefly summarizes the capabilities of HPS, the combat military medical training implications for HPS, and the key training areas for HPS support of military medical training.

II.A. Overview of the Human Patient Simulator (HPS)

Initially created by the University of Florida in Gainesville, the HPS was further developed and marketed by Medical Education Technologies Inc. (METI)(British Medical Simulation Centre, n.d.). The HPS is an innovative life-sized computer driven mannequin that features realistic medical conditions responsive to provider interventions. The HPS has a heartbeat, a sophisticated breathing system, and a detailed modeling of physiological and pharmacological human responses. The system provides a number of pre-configured patients in which the model is tailored to duplicate a particular kind of individual. It is a hands-on "patient" and real clinical equipment is used to practice caring for various patient conditions (Medel, Brian and Yarmouth Bureau, Nov 2000). The components include the patient mannequin, a computer that executes physiological models, and an instructor's control station with a graphical user interface (The Veterans Administration, n.d.).

II.A.1. Review of Medical Attributes of the HPS

The HPS allows for the presentation of various clinical signs coupled with human physiological and pharmacological interventions. It is responsive to student actions and interventions. The HPS supports training for medical treatment decision-making and problem solving processes, (i.e., interventions for the pulmonary system, cardiovascular system, genitourinary system, peripheral nerve simulation, advanced cardiac life support, pharmacological therapy, trauma care, physical examination and patient clinical scenarios)(METI Human Patient Simulator User's Manual, 1998). (See Table 1.)

Table 1. HPS Attributes

Pulmonary System	Complete Airway Management with Simulated Respiration, Mask Ventilation, Endotracheal and Endobronchial Intubation, Cricothyrotomy and Transtracheal Jet Ventilation; Difficult Airway Management With Neck/Head Alignment, Incorporation of Intrapharyngeal Mass, and Laryngospasm; Electromechanical Computer Controlled Lungs - offers spontaneous breathing, supports hand or mechanically ventilation, supports respiratory gas analysis to quantify inspired and expired gases.
Cardiovascular System	Heart Sounds, ECG, Palpable Radial and Carotid Pulses, Blood Pressure; Supports placement of EKG leads at appropriate electrode locations.
Genitourinary System	Anatomic Models for Male/Female with Ability to Practice Catherization
Peripheral Nerve Simulation	Thumb that Can Be Stimulated by Simulated Real Clinical Conditions
Advanced Cardiac Life Support (ACLS)	Airway Management and Ventilation; Chest Compression, Cardiac Arrhythmias, Electrical Therapy
Pharmacological Therapy	Pharmacokinetic and Pharmacodynamic Models of More Than 75 Drugs; Drug Editor allows customization of drug default names, concentrations; Detects type and amount of drug administered.
Trauma Care	Computer Controlled Eye Reflexes, Pericardiocentesis, Needle Decompression of Tension Pneumothorax, Chest Tube Placement and Management, IV Therapy
Physical Examination	Life Sized and Anatomically Correct; Hemodynamic Data Capability
Predefined Clinical Interventions and Rare Events/Preconfigured Scenarios	Patient Editor, Hundreds of Possible Parameter Combination Options, Several Default Patients, Library of Pre-defined Abnormal Events; Ability to customize generic events and settings to trigger and resolve medical conditions is easily operated.

(METI Human Patient Simulator User's Manual, 1998)

HPS capabilities (as summarized in Table 1) can support various levels of military medical training ranging from CPR to ACLS to other more specialized professional courses. HPS software offers the flexibility of defining different patients with 80 pre-programmed attributes of human medical conditions (Sanchez, Kimberly, May 2000). Many clinical features can be practiced including complete airway management, fluid and electrolyte balance and drug therapy. Instructors can create an unlimited number of clinical situations by manipulating patient profiles and conditions. Patient simulation software is a network-based application designed to be physiologically similar to the HPS. The software can model and queue casualties to be treated on the HPS. With its ability to simulate the clinical environment and the patient as real physical objects, the HPS offers a high degree of training support for the combat medic (91W) and CLS.

II.B. HPS and Military Medical Training

The Human Patient Simulator provides a fresh look at how basic and advanced military medical skills training can be better practiced using a mannequin that can respond to verbal questions, physiological conditions, and pharmacological medications. It is a vital component of the Army's Combat Trauma Patient Simulation (CTPS) program aimed at integrating training and analysis of medical personnel tasks with force-on-force exercises (US Army, STRICOM, n.d.).

II.B.1. The Combat Medical Environment Implications for Training with HPS

II.B.1a. Needs of Typical Combat Casualty

The needs of the far forward wounded soldier necessitate different training considerations for clinical treatment with HPS. Partially this stems from the physical condition of the combatant and the type of care that should be provided in the combat area. Combat medics, in particular, may be required to provide immediate care during the confusion and chaos of war. For this reason, HPS-based training/scenarios should present scenarios that will be simple and focused on the most critical needs of the typical combat casualty.

II.B.1b. Critical Tasks for Patient Resuscitative Care on the Battlefield

The National Academy Press in Fluid Resuscitation: State of the Science for Treating Combat Casualties and Civilian Injuries (Pope, Andrew; French, Geoffrey; and Longnecker, David E., 2000) describes needs of the typical combat casualty. The critical tasks listed were the establishment of an adequate airway, control of massive hemorrhage, circulatory support by intravascular fluid replacement, detection and treatment of hemothorax or pneumothorax (including tension pneumothorax), and immobilization of fractures (Pope, et.al., 2000).

The Human Patient Simulator capabilities (Table 1) match very well with the needs of the typical combat soldier (establishing or ensuring an adequate airway and breathing; controlling external hemorrhage; and fluid resuscitation of hypovolemia and shock). Because of its problem-based learning format and structural control of the medical simulation process, HPS can easily be tailored to meet the requirements of the

critical tasks for patient resuscitative care on the battlefield.

II.B.2. From the User's Perspective

Anecdotal comments from a memo entitled Final Assessment of the Pre-Hospital HPS by the Medical Company Training Site (Begg, Douglas, Dec 1998) referred to HPS, "Stan", as a "vital asset" to the military. The memo stated that HPS allowed military healthcare providers to take advantage of the virtual reality world and the interactive age. Additionally, it stated that medical training, for the most part, lacked realism due to the treating of an inanimate object (mannequin) and not being able to assess and treat in real time. With "Stan", these shortcomings were improved dramatically by the real time responsive capabilities of the HPS. Further, the memo concluded that "Stan" is not a perfect replica of a patient, but HPS is the best tool the military has for training the health care provider for today and tomorrow's mission.

Similarly, the memo 60-Day Assessment of Pre-hospital Human Patient Simulator by the Medical Company Training Site (Begg, Oct 1998) reported an overwhelming positive response. It stated that the personnel who participated in demonstrations feel "Stan" is a great asset to the Echelon I & II healthcare provider. Their consensus was that the assessment, treatment, and response of the patient simulator were more comparable to human responses than any participant had seen from any other training tool. The memo highlighted that all of the HPS current features are necessary for Echelon I and II care. The memo termed the capability of creating scenarios and making "on the fly" changes in the difficulty of training as beneficial. It again described the versatility and realism of HPS as bringing military medical personnel into the virtual world of medicine.

Minutes from a CTPS Phase Four Content Meeting (Dec, 2000) stated that the group members felt the HPS does work well in filling gaps and evaluating the proficiency of skills as personnel move between units, change MOS or transition among courses or certifications. Using the HPS to evaluate personnel in exercise lanes also was said to be valuable.

However, it is important to support instructors to make full use of the HPS. CTPS Phase 4 Content Minutes (Dec, 2000) indicated that instructors did not make use of all parts of the HPS. The minutes stated that monitoring use of the HPS and then designing simulation models based on those specific areas of use would be helpful.

II.B.3. HPS Support for Combat Military Medical Training Programs

The versatility of HPS makes it an ideal support system for required training and evaluation at different echelons; from the initial individual MOS preparation, to ongoing assessment of MOS skills and tasks, and annual unit training (i.e., medical company training).

HPS can be used to leverage ongoing training activities for individual continuing education or annual unit training. Table 2 illustrates key training areas where HPS can be used to support military medical training.

Table 2. Training Programs Where HPS Can Be Used

Initial	Mass Cal
Transition	Unit
Ongoing	Med Unit
Scenario	Other

HPS is equally adaptable for:

- Initial 91W MOS training courses
- Transition classes for 91B's and others with an MOS that requires further training in order to qualify for the 91W MOS
- Ongoing/continuing education for CLS skills maintenance and 91W re-certification testing
- Reenactment of actual or potential combat related medical events for training purposes
- Mass casualty exercises
- Unit war/battle simulation exercises
- Medical unit training
- Other military medical training programs

This section briefly summarized the capabilities of HPS, the combat military medical training implications for HPS, and the key training areas for HPS support of military medical training. The next section will further develop this information as this document begins to review and analyze the Army 91W MOS and how CPTS fits into the 91W MOS training program.

III. ARMY TRAINING, THE 91W, AND IMPLICATIONS FOR HPS

In 1993, the Army embarked upon a redesign modernization effort. The current 21st century force (Force XXI) plans to ensure battlefield superiority envisions a dispersed, highly fluid battlefield using increased firepower and maneuverability, and improved situational awareness through digitized communications (US Army Fort Monroe, n.d.). As a consequence of this approach, the Army Medical Department redesigned its medical infrastructure to bolster first responder capabilities through the creation of the 91W MOS. This future combat medic is envisioned as a highly skilled emergency caregiver who is capable of providing ongoing care to critical casualties on long evacuation legs (Department of Medical Science, July 1999).

This section of the report offers:

- an overview of Army training within which the 91W MOS curriculum, the CTPS program and the HPS intersect;
- a review of the training requirements for 91W and;
- a summary of the course objectives that form the basis for 91W skills.

This section begins the process of reporting on actions required by the contract provision {*2.1.1 Analysis of 91W Training Objectives (METI 4.1)*} to review and analyze the training objectives for the Army 91W MOS.

III.A. Army Training

The goal of the Army Training XXI Campaign aims to effectively apply key enabling technologies to the training system that allows better planning, preparation, execution, and management of collective training and revolutionizes individual and institutional instruction (US Army Fort Monroe, n.d.).

III.A.1. Army Training XXI Principles and Strategy

FM 25-100 outlines the Army's training principles. These principles are:

1. Train as combined arms and services team.
2. Train as you fight.
3. Use appropriate doctrine.
4. Use performance-oriented training.
5. Train to challenge.

6. Train to sustain proficiency using multi-echelon techniques.
7. Train to maintain.
8. Make commanders the primary trainers (Department of the Army, Nov 1998).

These program principles are to be supported by state-of-the-art training tools and information and management support systems based on the following guiding principles:

1. User focused and user friendly for trainees, trainers, and training managers.
2. Interoperable systems (defined as the ability of systems to provide services to and accept services from other systems and to operate effectively together with full functionality of each system without an external interface. Information technology provides interoperable and mutually supporting training systems through industry-standard applications and network and internet technologies).
3. Features open architectures (continuous improvement incorporating emerging and new technologies).
4. Maximizes synthetic environment (developed in accordance with the Advanced Distributed Simulations construct directions for the development of future modeling and simulations systems to ensure optimum systems interoperability, fidelity, and resolution).
5. Save the trainer's time.
6. Support Army values (Department of the Army, Nov 1998).

The foundation of the Army Training XXI strategy is: Mission Essential Task List (METL) based, performance-oriented, battle-focused and realistic. The draft Army Training XXI Campaign Plan described a cyclical process that starts with a needs analysis, progresses through training implementation with continuous training management and evaluation throughout (US Army Fort Monroe, n.d.). For collective training, the cyclic process starts with a wartime mission assessment, progresses through planning, execution, and assessment.

III.A.2. Analysis and Implications for HPS

Military readiness depends upon continuous realistic, battle-focused training. Technological advances, such as the Human Patient Simulator (HPS) provide for a significant decrease in the time and expense of training design planning, preparation, management and reporting. The HPS provides the military with a realistic, timely, user-responsive, and cost-effective training support system. Using the HPS, military

trainers can strive to reduce the ratio of training preparation to training execution from 3:1 to 1:3 (US Army Fort Monroe, n.d.). Any time saved along with the enhanced training capabilities of the HPS provides more effective training for trainers, medical personnel, units, and individual soldiers. Principle #1 above (user performance oriented training) is exactly what HPS offers. It provides state of the art realistic, hands-on care of a simulated patient with life-like responses. Scenarios can also be linked to realistic combat situations, wounds, and injuries. Likewise, guiding Principle #6 above (support Army values) can be fulfilled as the content developers for the HPS program incorporate Army values into HPS computer simulated medical training scenarios. The Army transition into the 91W MOS provides a unique opportunity for HPS to facilitate, maximize, and integrate 91W MOS training into the CTPS program.

III.B. Medical Career Management Field Change - 91W

In September 1999, the Army announced a major change to DA Pam 611-21, E-0004-5, Revision of Career Management Field (CMF) 91 (Medical) to comply with the Force XXI and 21st Century initiatives (Rivas, L.M., Sep 1999). On 1 October 2001, the 91W Military Occupational Specialty (MOS) series implementation begins and MOS (s) 42E, 71G, 91A (grade PFC), 91B, 91C, Additional Skill Identifier (ASI)Y7 will be deleted. MOS (s) 91G, 91 H, 91W and ASI (s) M6 and M9 will be established for all CMF Active, National Guard, and Reserve soldiers (Rivas, 1999). The specifications, physical demands rating, positions and personnel in grades PFC-MSG of the 91B (Medical Specialist) and the 91C (Practical Nurse) will be transferred to the new MOS 91W (Health Care Specialist). Occupational Therapy Specialist, Physical Therapy Specialist, Orthopedic Specialist, Ear, Nose and Throat Specialist, Eye Specialist, Special Forces Combat Diving, Medical; Special Operations Combat, medic; Cardiovascular Specialist and those with ASI (s) 2B, 2S, and 4A in grades PFC-MSG will also be transferred to the 91W MOS (Rivas, 1999). SGM positions and personnel will be transferred to the new MOS 91Z {Chief Medical (NCO) Specialist}.

III.C. Review of 91W Health Care Specialist MOS Training Requirements

As noted above, on 1 October 2001, all 91B and 91C soldiers will be reclassified to the 91W MOS. Soldiers that are SFC promotable or above on or before 1 October will be grand-fathered and will not be required to obtain additional training.

Everyone else will be required to obtain further training to fully fulfill transition requirements. The timeline for transition training for active duty soldiers extends until 30 September 2007 for soldiers to finish the requirements and become fully MOS qualified (Department of Medical Science, Dec 2000). Reserve component soldiers will have until 30 September 2009.

Those soldiers who need to meet transition-training requirements must follow one of the two pathways listed below to fully qualify for the MOS (Department of Medical Science, Dec 2000).

Pathway 1 requires current National Registry Emergency Medical Technician - Intermediate (NREMT-I) or National Registry Emergency Medical Technician - Paramedic (NREMT-P) certification.

Pathway 2 requires current National Registry Emergency Medical Technician - Basic (NREMT-B) certification, plus:
One of two certifications:

1. Valid Basic Trauma Life Support (BTLS) for advanced providers certification, or
2. Pre-hospital Trauma Life Support (PHTLS) for advanced providers certification

And

One of these four courses/licenses:

1. Current state LPN/LVN license, or
2. Graduate of the AC BNCOC medical tract, or
3. Graduate of the RC BNCOC medical tract after 01 Oct 96, or
4. Completion of the Trauma AIMS course (required part of the transition for a group of soldiers, primarily 91Bs who have not been to BNCOC; optional for those who have completed BNCOC, possess an LPN/LVN license, or who hold a current NREMT-Intermediate or Paramedic certification)(Department of Medical Science Dec 2000).

III.C.1. Basis of 91W Skills

The combat medic (91W) is expected to provide competent far-forward care and evacuation off the battlefield, preserve the fighting strength through preventive medicine, and assist with the basic medical needs of the deployed soldier. Their training must also prepare them to provide care in fixed hospitals and clinics and in mobile hospitals, in such areas as general medical and surgical wards, intermediate care wards, and

ambulatory and emergency departments. The 91W who is LPN trained will be assigned to traditional practical nurse positions including intensive care units, intermediate care wards, and medical detachments, surgical areas, as well as regular 91W positions (Department of Medical Science, July 1999).

The 91W MOS has four major areas of emphasis or core competencies: emergency care, evacuation, force health protection, and limited primary care. 91W training is built on three equal platforms: medical skills, soldier skills, and clinical experience and reinforcement (Department of Medical Science, July 1999).

III.C.2. Training Required or Offered by Courses Related to the 91W MOS

All 91Ws are required to hold EMT-Basic certification throughout their careers. However, 91W skills surpass those of the EMT-B and resemble EMT-Intermediate. The skills required for the 91W are being extracted from the following courses: 91W Trauma AIMS, 91B, 91C, NREMT-B, EMT-I, PHTLS, and TNCC (Minutes, Dec 2000). While the courses have some common elements, there are differences.

To obtain the National Registry EMT-Basic certification, verification of CPR credentials is required. These skills include adult 1 & 2 rescuers, adult obstructed airway maneuvers, child CPR, child obstructed airway maneuvers, infant CPR, and infant obstructed airway maneuvers.

In addition to a written exam, a practical examination from a state approved source (includes EMT-B training programs approved by the US Army, Air Force, and Navy EMT Program Managers) that meets or exceeds the established criteria is required (Samuels, David, 1994). Skills that must be demonstrated are patient assessment (trauma and medical), cardiac arrest management, spinal immobilization, bag-valve-mask apnea patient with a pulse, long bone fracture immobilization, joint dislocation immobilization, traction splinting, bleeding control/shock management, upper airway adjuncts and suction, mouth-to-mask with supplemental oxygen, and supplemental oxygen administration (Samuels, 1994).

The Pre-Hospital Trauma Life Support Course teaches skills in kinematics of trauma, patient assessment, airway management, shock and fluid replacement, spine trauma, pediatric trauma, thoracic trauma, abdominal trauma, trauma in pregnancy, head trauma, musculoskeletal trauma, and thermal trauma (Defense Medical Training Institute, n.d.).

The Army Medical Department (AMEDD) Basic Noncommissioned Officer Course (BNCOC) trains combat medics in advanced lifesaving skills including intubation, needle decompression of pneumothorax and cricothyrotomy.

Emergency Medical Training (EMT-B manual) covers airway management; patient assessment; medical emergencies (pharmacology, respiratory, cardiac, diabetic and altered mental status, allergic reactions, poisoning and overdose, environmental, behavioral, and OB/GYN); trauma (bleeding and shock, soft tissue injury, musculoskeletal injuries, and injuries of head and spine); infants and children; operations; and advanced airway management (Samuels, 1994). [See Charts VIII.B.1-16 at the end of this document]

The 91B Medical Specialist (transitioning to 91W) training consists of contamination control, vital signs, emergency medical treatment, general medical, basic nursing services, respiratory dysfunction, venipuncture and IV therapy, casualty management, eye injuries, skeletal dysfunction, environmental injuries, chemical agent injuries, shock and anti-shock garment, urinary catheterization, nasogastric intubation, triage and evacuation, respiratory and cardiac treatment, medications, and general subjects (Department of Medical Science, Jan 2000).

The 91C (transitioning to 91W) training and position correlates to that of a licensed practical nurse (LPN). LPN's perform preventative, therapeutic and emergency nursing care procedures under supervision of a physician or nurse. This training includes an introduction to human systems, technical report writing, nutrition and diet therapy, fundamentals of nursing, medical-surgical nursing I, and II, pharmacology for practical nurses, maternal and child health nursing II, mental health and psychiatric nursing, pharmacology II, clinical experience I and II, psychology, topics in nursing and a social science (*Practical Nursing*, n.d.).

The Trauma Nursing Core Course (TNCC) covers biomechanics and mechanisms of injury, initial assessment, shock, and brain and cranial-facial trauma, thoracic and neck trauma, geriatric trauma, abdominal trauma, spinal cord and vertebral column trauma, musculosketetal trauma, burn trauma, trauma and pregnancy, pediatric trauma, psychosocial aspects of trauma care stabilization, transfer, and transport, battlefield triage, battlefield wounds, and additionally military aspects of trauma care in each area (Defense Medical Readiness Training Institute, n.d.).

The 91W MOS Web site (www.cs.amedd.army.mil/91w) stated that the NREMT-B is the first priority for 91W training. The options for obtaining this training are the full EMT-B course, or the bridge course. Second priority was the Trauma Aims course. The 91W Trauma Aims program is a stand-alone program designed by the AMEDD C&S to facilitate the soldier's transition to the 91W MOS. It teaches critical skills in patient trauma assessment and initial management, advanced airway management and ventilation, fluids (intravenous therapy), medications and emergency pharmacology, and shock management (*Knowledge Skills and Objectives*, n.d.). The knowledge skills and objectives of this course were used in this report as the basic 91W knowledge base. Based on these summarized courses, it is clear that the 91W Health Care Specialist will possess a wide array of skills and have competency in emergency care, evacuation, force health protection, and primary care.

A recent update of the 91W MOS Web site, listed 91W medical readiness proficiencies areas of basic and advanced airway skills, non-trauma assessment/medication administration, trauma assessment/control, bleeding/treat for shock/IV therapy, immobilization of bone and joint injuries (individual and team), NBC medical skills, CPR-one and two person, and extraction/evacuation. These areas focus on three goals:

1. Demonstrate 91W critical skills proficiency,
2. Facilitate EMT-B re-certification process
3. Provide impetus to sustain training in order to maintain readiness
   (Academy of Health Sciences, March 2001).

Possible EMT-B continuing education was listed as patient assessment (medical and trauma); airway management (oxygen administration, mouth to pocket mask with supplemental oxygen, use of airway adjuncts, advanced airway procedures); spinal immobilization (seated and supine); needle decompression of chest; shock management (control bleeding, apply a tourniquet, intravenous therapy); CPR (cardiac arrest and automated external defibrillator); obstetric/gynecologic skill/knowledge; and fracture management (long bone, joint injuries, apply a traction splint) (Academy of Health Sciences, March 2001).

From the context of Army training, this section of the report reviewed the training requirements for 91W and described implications for HPS in support of Army medical training. The Army transition into the 91W MOS offers a prime opportunity for the integration of HPS training and CTPS program process into the 91W training programs. The next section finishes the process

of reporting on actions required by the contract provision {*2.1.1 Analysis of 91W Training Objectives (METI 4.1)*} to review and analyze the training objectives for the Army 91W MOS. A review (based on the Trauma AIMS Course) of the knowledge and skill training objectives for the 91W MOS training programs follows.

IV. KNOWLEDGE AND SKILL OBJECTIVES FOR THE 91W

This section finishes the process of reporting on actions required by the contract provision {*2.1.1 Analysis of 91W Training Objectives (METI 4.1)*} to review and analyze the training objectives for the Army 91W MOS. Based on the Trauma AIMS Course, a review of the knowledge and skill training objectives for the 91W MOS training program was conducted by Tekamah Corporation. The Trauma AIMS Course was reviewed because it is a stand-alone program designed by the AMEDD C&S to facilitate the soldier's transition to the 91W MOS. From this process, an identification of basic knowledge and skills objectives necessary for the Army 91W MOS was accomplished.

IV.A. Outline of 91W MOS Knowledge and Skill Objectives

Knowledge and skill objectives for the 91W (based on the Trauma AIMS Course) are organized into four **training modules:**

1. General patient assessment and initial management;
2. Emergency pharmacology;
3. Advanced airway management and ventilation; and
4. Fluids and shock

(*Knowledge Skills and Objectives*, n.d.).

These knowledge and skill objectives include the core skills taught in the EMT-B course as well as the 91W bridge course.

IV.A.1. Module One - General Patient Assessment and Initial Management

1. Understand the importance of a step-by-step approach to high-quality pre-hospital intermediate life support.
2. Identify the information gathered in each phase of patient assessment.
3. Describe the type of information that can be obtained from a careful evaluation of the dispatcher's information.
4. List some of the potential scene hazards that need to be considered to ensure safe patient care.
5. Describe the steps of the primary survey.
6. Identify the life-threatening conditions that can be identified and corrected during the primary assessment.

7. Identify conditions and injuries that require immediate and rapid hospital transport.
8. Describe the methods of conducting a pre-hospital physical examination.
9. Identify the steps in conducting a head-to-toe physical examination.
10. Discuss the evaluation of the four pre-hospital vital signs.
11. Cite some of the differences in assessing the trauma patient.
12. List the steps in conducting a patient history.
13. Identify the questions that should be asked for a pertinent patient history.
14. Explain reasons for compiling a family/social history.
15. Realize the importance of effective communication to quality patient care.
16. Explain how to prepare verbal and written patient reports according to the SOAP format.
17. Perform a primary assessment.
18. Perform a secondary assessment.
19. Take a complete set of vital signs.
20. Give a pertinent patient report.
21. Document an assessment on an EMS run form.

IV.A.2. Module Two - Emergency Pharmacology

1. Identify references pertaining to drugs and pharmacology.
2. Classify a drug form into their general categories.
3. List the routes of administration, onset of action for drugs used by 91W.
4. List those factors that affect drug action and potential side effects on a patient.
5. Calculate the proper dose of medication for a patient.
6. List the general principles of medication administration.
7. List the profiles of the drugs listed.
8. Administers PO, SO, IM, and IV drugs:**

MORPHINE SULFATE
ACETOMINOPHEN/TYLENOL
ASA/ACETYLSALICYLIC ACID)/ASPIRIN
ATROPINE SULFATE / ATROPINE
2 - PAM CHLORIDE/PRALIDOXIME CHLORIDE
DIAZEPAM/VALIUM
ALBUTEROL/PROVENTIL
DIPHENHYDRAMINE HYDROCHLORIDE / BENADRYL
NALOXONE HCL/ NARCAN
NITROGLYCERIN / NITROSTAT
DEXTROSE 50% / D50W

CEFAZOLIN SODIUM / ANCEF
CEFTRIAXONE SODIUM / ROCEPHIN
DEXTROMETHOPHAN HYDROBROMIDE/DEXTROMETHOPHAN
CYANIDE TREATMENT / AMYL NITRITE
CYANIDE TREATMENT /SODIUM NITRITE
CYANIDE TREATMENT / SODIUM THIOSULFATE
EUGENOL
KAOLIN MIXTURE WITH PECTIN / KAOPECTATE SIMETHICONE
MYLANTA GAS
BACITRIACIN

***All the above drugs can be used with the HPS.*

IV.A.3. Module Three - Advanced Airway Management and Ventilation

1. Describe the anatomy of the upper airway, including the mouth, nose, pharynx, epiglottis, and larynx.
2. Name the three regions of the pharynx.
3. Identify the relationship between the larynx and the tongue, pharynx, epiglottis, esophagus, and vocal cords.
4. Discuss the following functions of the respiratory system: mechanics of ventilation, pulmonary circulation, gas exchange in the lungs, diffusion of the respiratory gasses.
5. Describe oxygen transport in the blood, and cite factors that affect it.
6. Discuss carbon dioxide transport in the blood, and list factors that affect it.
7. Describe the neurological control of respiration.
8. Describe the various measures of respiratory function, and give the average normal values for each.
9. Describe the common causes of airway obstruction, and detail the special considerations of each.
10. Describe assessment of the airway and the respiratory system.
11. Discuss pulse oximetry and end-tidal carbon dioxide detection, and describe the pre-hospital use of both.
12. Describe the procedures used to open the airway manually.
13. Discuss indications, contraindications, and methods of insertion of the following basic mechanical airways: oropharyngeal airway, nasopharyngeal airway.
14. Evaluate the advantages and disadvantages of each of the following advanced mechanical airways: esophageal obturator airway (EOA), esophageal gastric tube airway (EGTA), endotracheal tube, pharyngeotracheal lumen (PTL), esophageal tracheal combitube, (etc.).
15. List the equipment used to perform endotracheal intubation.
16. Recall the indications, contraindications, and alternatives of endotracheal intubation.

17. Explain the need for rapid placement of the endotracheal tube.
18. List and demonstrate the steps in performing endotracheal intubation.
19. Describe the methods used to assure correct placement of the endotracheal tube.
20. State the precautions that should be used when intubating a trauma patient.
21. Discuss the indications, contraindications, and methods of performing suctioning.
22. Discuss the various oxygen administration devices used in pre-hospital care, and describe the advantages and disadvantages of each.
23. Discuss indications, contraindications, and methods for using the following devices: pocket mask, bag-valve device, and demand valve resuscitator.
24. Perform manual airway maneuvers.
25. Insert oral and nasal airways.
26. Perform oropharyngeal and endotracheal suctioning.
27. Remove foreign body airway obstruction.
28. Perform EOA/EGTA insertion.
29. Perform orotracheal intubation.
30. Perform orotracheal intubation with EOA in place.
31. Perform digital intubation.
32. Perform transillumination intubation.
33. Perform endotracheal intubation in the trauma patient.
34. Perform endotracheal intubation in the child.
35. Perform nasotracheal intubation.
36. Demonstrate airway management with the PTL airway
37. Demonstrate airway management with the ETC airway
38. Perform transtracheal jet ventilation
39. Perform ventilation with the pocket mask.
40. Perform ventilation with the bag-valve device.

IV.A.4. Module Four - Fluids and Shock

1. Identify the body's major fluid compartments and the proportion of total body water they contain.
2. List the major electrolytes, and discuss the role they play in maintaining fluid balance within the human body.
3. Define diffusion, osmosis, active transport, and facilitated diffusion, and explain the roles that they play in human fluid dynamics.
4. Explain the ABO blood typing system, and discuss its significance to emergency medical care.
5. Identify the abnormal states of hydration, and describe their common causes and effects on the human system.

6. List various fluid replacement products, and describe the advantages and disadvantages of using each one in the field.
7. Describe the acid-base balance system, and assess its impact on the human body as it applies during shock.
8. Name common acid-base disorders, and identify their causes.
9. Define shock from a medical standpoint.
10. Describe the structure and function of the cardiovascular system.
11. Explain the shock process, and describe the body's various compensatory mechanisms.
12. Identify the three distinct stages of shock.
13. Describe and demonstrate the assessment of the shock patient.
14. Name pertinent vital sign readings that indicate a potential shock patient.
15. Explain the indications for, and the initiation of, intravenous therapy.
16. List the equipment commonly used for intravenous therapy, and explains the purpose and use of each item.
17. Identify the common complications of intravenous therapy, and describe the process of preventing or correcting those complications.
18. Identify the indications, contraindications, and application process for the PASG.
19. Understand the need for rapid transport of a shock patient, and name the steps taken if on the scene more than 10 minutes.
20. Perform hemorrhage control.
21. Apply the PASG.
22. Insert a peripheral IV line.
23. Assess and manage a patient in shock.

The above knowledge and skill objectives were taken from the course map list for the 91W Trauma AIMS Course (*Knowledge Skills and Objectives*, n.d.). Table 3 lists the 91W skills. Skills for the 91B and 91C are not listed separately as they correspond to others listed in Table 3. 91W skills performed on a child would require access to a pediatric HPS.

As specified in the contract requirements *2.1.1 Analysis of 91W/CLS Training Objectives (METI 4.1)*, this section of the report has identified basic knowledge and skills objectives necessary for the Army 91W MOS. An extensive summary particularly focused on 91W psychomotor skills and tasks will be provided in a later section of this report.

In order to fulfill the contract requirements of *2.1.1 Analysis of 91W/CLS Training Objectives (METI 4.1)* and *2.1.2 Development of 91W/CLS Task List Supported by current HPS Technology (METI 4.2)*, the next section analyzes the learning objectives to determine the highest priority objectives for critical 91W training. It identifies how the current HPS technology can (or could) support these skills, prioritizes HPS supported skills in terms of training impact, and lists the tasks for the 91W MOS. The analysis includes recommendations for HPS enhancements to support training modalities for selected training objectives.

Table 3. 91W Skills With HPS Support Skills Listed By Course

91W Trauma Course
Perform a primary assessment
Perform a secondary assessment
Take a complete set of vital signs
Give a pertinent patient report
Administers PO, SO, IM, and IV drugs
Perform manual airway maneuvers
Insert oral and nasal airways
Perform oropharyngeal and endotracheal suctioning
Remove foreign body airway obstruction
Perform EOA/EGTA insertion
Perform orotracheal intubation
Perform orotracheal intubation with EOA in place
Perform digital intubation
Perform transillumination intubation
Perform endotracheal intubation in the trauma patient
Perform endotracheal intubation in the child
Perform nasotracheal intubation
Demonstrate airway management with the PTL airway
Demonstrate airway management with the ETC airway
Perform transtracheal jet ventilation
Perform ventilation with the pocket mask.
Perform ventilation with the bag-valve device
Perform hemorrhage control
Apply the PASG
Insert a peripheral IV line
Assess and manage a patient in shock.
(*Knowledge Skills and Objectives*, n.d.)
91W Skills Can or Could Be Supported By HPS
Advanced airway management (ET, EET)
Patient assessment
Vital signs ascertainment
Basic life support
Patient assisted medications administration
End tidal C02 monitoring
Cardiac monitoring
Defibrillation
Fluid resuscitation/IV therapy
Needle decompression
Pediatric intubations
Needle cricothyrotomy)

V. HUMAN PATIENT SIMULATOR (HPS) TECHNOLOGY SUPPORT OF 91W SKILLS AND TASKS

Members of the Medical Company Training Site (MCTS) at Indiantown Gap, Pennsylvania provided practical assessment of the use of the Human Patient Simulator in a training context and assisted Tekamah Corporation in the review and analysis of program content for 91W and CLS (*Minutes*, Dec 2000). Based on the analysis and practical assessment, this section identifies how the current HPS technology can (or could) support 91W skills, prioritizes HPS supported skills in terms of training impact, and lists the tasks for the 91W MOS. It completes the 91W contract requirements under provisions *2.1.1 Analysis of 91W/CLS Training Objectives (METI 4.1)* and *2.1.2 Development of 91W/CLS Task List Supported by current HPS Technology (METI 4.2)*.

V.A. 91W Supported Skills

Based upon the practical assessment conducted with project SMEs, it was determined that HPS technology can (or could) support the 9IW skills of advanced airway management (ET, EET), patient assessment, vital signs ascertainment, basic life support, patient assisted medications administration, end tidal C02 monitoring, cardiac monitoring, defibrillation, fluid resuscitation/IV therapy, needle decompression, pediatric intubations, and needle cricothyrotomy) (*Minutes*, Dec 2000). See Table 4.

V.B. 91W Tasks Supported or Enhanced by HPS

Additionally, project SMEs have described the present features of HPS and listed tasks that are capable of being performed on HPS and/or are enhanced by using HPS during training. It is important to note that these HPS supported tasks are not capable of being performed on traditional mannequins.

V.B.1. HPS Capabilities and 91W Task List

The list of Echelon I and II emergency medical tasks derived from SME analysis are grouped by the capabilities of HPS (see Table 4). Fourteen capabilities of the Human Patient

Simulator are listed with task numbers referenced from STP 8-91B15-SM-TG
dated 3 October 95 and STP 8-91C25-SM-TG dated 17 July 90 (Begg, October 1998). The psychomotor tasks were developed from the selected training objectives relating to skills in fourteen areas.
HPS Capabilities:

1. vital signs
2. emergency medical treatment
3. general medical
4. respiratory dysfunction treatment
5. venipuncture and IV therapy
6. casualty management
7. environmental injuries treatment
8. chemical agent injuries treatment
9. shock treatment
10. nasogastric intubation
11. respiratory and cardiac treatment
12. general subjects
13. nursing assessment
14. auscultation of heart and lungs (SMEs viewed this capability of HPS to be extremely beneficial for conventional and NBC casualty training).

Table 4. Echelon I & II Emergency Tasks and HPS Capabilities

CLS & 91W Tasks	HPS Supported	EMT-B Psychomotor Section	Not HPS Supported
Vital Signs	X	VIII.A.1-3.	
Measure a Patient's Pulse (081-831-0011)	X	& VIII.A.32-34	Temperature
Measure a Patient's Respirations (081-831-0010)	X	& VIII.B.5	
Measure a Patient's Blood Pressure (081-831-0012)	X		
Emergency Medical Treatment	X	VIII.A.96-99	
Open the Airway (081-831-0018)	X	VIII.B.1	
Clear an Upper Airway Obstruction (081831-0019)	X	VIIIA.25-33	
Administer External Chest Compressions (081-831-0046)	X	& VIII.B.4	
Immobilize a Suspected Dislocated and/or	X	VIII.A.88-91 & VIII.B.9	
Fractured Ankle Using a Wire Ladder Splint (081-831-043)	X		
General Medical	X	VIII.68-71	
Treat Casualty for a Heat Injury (081-831-0038)	X		
Treat Casualty for a Cold Injury (081-831-0039)	X		
Respiratory Dysfunction	X	VIII.A.8-11	
Insert an Oropharyngeal Airway (081-833-0016	X	VIII.B.1-3	
Ventilate a Patient with a Bag-Valve-Mask (081-833-0017)	X		
Administer Oxygen Therapy Using a Face Mask or Nasal Prongs (081-833-0019)	X		
Venipuncture and IV Therapy	X		
Administer an Injection (Intramuscular and intradermal only (081-833-0089)	X	VIII.A.44 & 60	
Administer Medications by IV Piggyback (081-835-3002)	X		
Casualty Management	X	VIII.A.108-111	
Survey a Casualty (081-833-0015)	X	VIII.A.18 & 25	
Treat a Casualty with a Closed Chest Wound (081-833-0049)	X	VIII.A.87-89	
Treat a Casualty with an Open or Closed Head Injury (081-833-0052)	X	VIII.A.92-95	
Stabilize a Casualty with Inhalation Burns (081-833-0048)	X	VIII.A.84 &22	
Manage an Unconscious Casualty (081-833-0103)	X	VIII.A.92-95	
Environmental Injuries	X		
Initiate Treatment for Anaphylactic Shock (081-833-0031)	X	VIII.A60-63.	
Chemical Agent Injuries	X	VIII.A.17-19	
Treat a Nerve Agent Casualty in the Field (081-833-0084)	X		* *See below
Treat a Choking Agent Casualty in the Field (081-833-085)	X		
Shock	X		
Initiate Treatment for Hypovolemic Shock (081-833-0047)	X	VIII.A.80-83 & 19	
Nasogastric Intubation	X		
Insert a Nasogastric Tube (081-833-3022)	X	VIII.A.115	
Remove a Nasogastric Tube (081-833-3023)	X		
Respiratory and Cardiac Treatment			
Intubate a Patient (081-830-3016)	X	VIII.A.8-11	
Extubate a Patient (081-830-3014)	X	& 96-99	
Perform a Needle Cricothyroidotomy (081-833-3006)	X	VIII.A.112-115	
Perform a Surgical Cricothyroidotomy (081-833-3005)	X		
Perform Needle Chest Decompression (081-833-3007)	X		
Insert an Esophageal Gastric Tube Airway (081-833-3010)	X	VIII.A.113-115	
Manage Cardiac Arrest (081-833-3027)	X	VIII.A.52-55	
General Subjects	X		
Determine a Patient's Level of Consciousness	X	VIII.A.92-95	
Using the Glasgow Coma Scale (081-835-3030)	X	VIII.A.17-20	
Nursing Assessment	X		
Obtain an Electrocardiogram (081-835-3007)	X		
Monitor a Patient for Signs of Increased	X	VIIIA.10 & 26	
Heart and Lung Sounds.	X	VIII.A.32-34	
Ausculation of Heart and Lungs ***Need enhancements to HPS*** * * Initiate an Intravenous Infusion (081-833-0033) ** Treat a Blood Agent in the Field (081-833-0084) ** Insert a Urinary Catheter (081-833-3013) ** Perform a Gastric Lavage (081-835-3005) ** Insertion of Chest Tube (Begg, Douglas, Oct 1998)	X	VIII.A.17-20; 21-23	** Recommended As Needing HPS Enhancement

Based on a review of skills required for practice, an analysis of the EMT-B tasks revealed that there are 17 demographic related tasks, 93 assessment/care tasks, 30 operational tasks, and 76 intervention skills (Samuels, 1994). The tasks for EMT-B are separated into seven areas: airway and breathing, cardiology, trauma, medical, obstetric, pediatric, and operations. The difference in the number of EMT-B tasks and those selected by the SMEs is that the latter directly related 91W tasks to those required for Army echelon level I and II emergency medical care.

V.B.2. Recommendations for HPS Enhancement

In addition, the SMEs identified necessary tasks that are not capable of being performed on the HPS until/unless further enhancements are made (Chart 4). Again, task items are listed according to the category of HPS skill level support capabilities used above. 91W Tasks listed below could be supported by HPS, if HPS were modified as recommended/indicated below.

V.B.3. 91W Tasks Not Able to Be Performed on HPS Without Enhancements

1. **Skill:** Venipuncture and IV Therapy

Task: Initiate an Intravenous Infusion (081-833-0033) is one of the most vital and common tasks for Echelon I & II medical care. The task cannot be performed properly due to the lack of an IV arm.

2. **Skill:** Chemical Agent Injuries

Task: Treat a Blood Agent in the Field (081-833-0084) is a vital task considering the ever-changing battlefield. HPS formulary does not include sodium nitrite and sodium thiosulfate, which are the drugs of choice for treatment of blood agent poisoning.

3. **Skill:** Urinary Catheterization

Task: Insert a Urinary Catheter (081-833-3013) is a common practice with burn and abdominal injury patients. HPS lacks the genitalia and bladder that are necessary for the performance of this task.

4. **Skill:** Gastric Intubation

Task: Perform a Gastric Lavage (081-835-3005) is a vital task for advanced nerve agent treatment and treatment of other ingested poisons.

5. **Skill:** Insertion of Chest Tube

Task: This is a vital and common task of a PA or Doctor in the treatment of chest injuries. This is not a standard feature on the HPS. (Begg, October 1998).

V.C. Specific Recommendations for HPS to Enhance Support of 91W MOS

As a result of an assessment of the HPS in a training setting, MCTS personnel recommended other areas of potential concern and features that would enhance HPS's medical training capabilities. These are listed below.

1. Knowledge Area: Chemical Agent Training

Recommendation: The addition of visual signs of chemical agent poisoning such as secretions from nose and mouth, convulsions or twitching. (These are sure telling signs for medical personnel of chemical agent poisoning or recovery from poisoning).

2. Knowledge Area: Conventional Injuries and Treatment

Recommendations: The addition of cyanosis around lips, jugular vein distention, abdominal rigidity, and adjustable palatable pulse intensity (normal, weak, bounding). (These all are important signs when evaluating a casualty).

Recommendation: Adding an open (sucking) chest wound simulator for casualty evaluation and flutter valve assessment.

Recommendation: Modifying the teeth to indicate when improper intubation techniques are being utilized.

Recommendation: Creating a system that indicates when medical personnel have applied enough, not enough, or too much pressure to stop the bleeding with respect to a field/pressure dressing and/or tourniquet. Possibly accomplishable with a pressure plate on the thigh, which would control the distal pulse.

3. Knowledge Area: IV Therapy

Recommendations: The ability to start an IV and measure the flow rate. Modification of software to allow hemorrhaging and infusing simultaneously (currently, cannot have more then one fluid volume variable running at a time). Modification of fluid

volume variable that allows the student to choose electrolytes (non-oxygen carrying) or blood (oxygen carrying).

4. Knowledge Area: Medications

Recommendation: The addition of all the drugs on Echelon I & II formulary. The following drugs need to be added: Chlorpromazine, Aminophylline, Methylprednisol, Sodium Nitrite, Sodium Thiosulfate, Promethazine Hydrochloride, Hydrocortisone Sodium, and Pralidoxim Chloride. (Begg, October 1998).

V.D. HPS Supported Skills Prioritized in Terms of Training Impact

From its assessment of the clinical training conducted using HPS, the project's SMEs developed a list of HPS supported skills and prioritized these skills in terms of the 91W training and evaluation process.

For 91W, the use of HPS was seen to be most valuable in reinforcing existing individuals skills and in teaching caregivers within units and between echelons to better work together. Supported skills in terms of training and evaluation impact are:

- Closed head injury
- Blunt chest injury
- Blunt abdominal injury
- Spinal injury
- Excessive bleeding
- Pelvic fracture
- Penetrating chest injury (GSW with no exit) (*Minutes*, Dec 2000).

The 91W subject matter experts at MCTS prioritized these supported skills in order of highest priority as closed head injury, blunt chest injury, and blunt abdominal injury (*Minutes*, Dec 2000).

V.E. Summary

This section finished the contract requirements of *2.1.1 Analysis of 91W/CLS Training Objectives (METI 4.1)* and *2.1.2 Development of 91W/CLS Task List Supported by current HPS Technology (METI 4.2) for the 91W.* (The next section begins this same process for CLS). Based on an analysis and practical assessment of the learning objectives for the 91W, critical Echelon I and II skills and tasks were determined. The analysis recommended further HPS enhancements to support training modalities for the selected training objectives and prioritized HPS supported skills in terms of training impact. The next

section will review Combat Lifesaver knowledge and skills objectives, determine related critical skills and tasks, and provide an analysis of current HPS capabilities related to CLS training.

VI. ARMY TRAINING, COMBAT LIFESAVER (CLS) COURSE AND IMPLICATIONS FOR HPS

Combat casualties require immediate assessment and care far forward. Time, people, and facilities to care for these casualties may be limited. The Combat Lifesaver support training is an integral part of the Army medical training system aimed at providing the first responder medical care provider with required/necessary learning experiences for skill acquisition. In addition to war, the CLS trained soldier must be able to provide treatment in situations involving operations other than war (i.e., stability and support operations, etc).

In accordance with contract requirements of *2.1.1 Analysis of 91W/CLS Training Objectives (METI 4.1)* and *2.1.2 Development of 91W/CLS Task List Supported by current HPS Technology (METI 4.2)*, this section of the report summarizes general information about CLS and Army training, outlines CLS knowledge and skills objectives, describes how HPS technology supports CLS skills, lists CSL tasks, and recommends HPS enhancement pertinent to CLS.

VI.A. Combat Life Saver and Army Training

Army medical training, as described earlier in this report, focuses on support for wounded and injured combatants in a widely dispersed, rapidly-moving battlefield. As a result, battlefield constraints limit the number of trained medical personnel for immediate, far forward care. Accordingly, the Academy of Health Sciences developed the Combat Lifesaver role to increase far forward care to combat soldiers. There is a narrow window of opportunity available for care of serious wounds or injuries. About 90% of deaths in military operations occur in the first 30 minutes when often the only care comes from the casualty victim, a buddy, or the CLS (National Research Council, 1997). Therefore, adequate and thorough training is imperative. Current Army doctrine uses a medical care approach based on echelons of care. According to a Navy report, this approach in the future will be one that defines level of care in terms of time frames ranging from hours to days (National Research Council, 1997).

The execution for the provision of immediate care far forward in combat rests on three modules:

1. The Self-Aid/Buddy Aid

2. The Combat Life Saver
3. 91W MOS (replaces the combat medic 91B module)

The Combat Life Saver provides lifesaving measures beyond the level of self-aid or buddy aid, bridging the gap till the wounded soldier is in the medical treatment system (i.e., initially 91W and then to required levels of care)(US Army STRICOM, n.d.). The CLS is a bridge between the Self-Aid/Buddy training given to all soldiers during basic training and the medical training given to the combat medic (91W) (Department of Medical Science, n.d. CLS, general info web page). He does not replace the combat medic and is trained only in emergency medical care as a secondary mission (Department of Medical Science, n.d.).

A CLS is a non-medical soldier trained in providing far forward advanced first aid to wounded soldiers. In the Army, there is one CLS assigned per squad, team, crew or equivalent sized unit. The CLS provides care to members of his squad, team, or crew as the mission permits. When the CLS has no combat mission, he may assist the combat medic in provision of care and preparing casualties for evacuation.

The first mission of the CLS prepared soldier is combat. His second mission is to provide immediate care to wounded or injured soldiers in a widely dispersed and fluid battlefield to prevent soldiers from dying of wounds or injuries (Academy of Health Science, CLS, CD-Rom, n.d.). Medical personnel may not be able to reach and apply life saving measures so the CLS prepared soldier does this until further care can be obtained. The CLS has the capability of stabilizing many types of casualties. The goals of the Combat Lifesaver are to reduce the percentage of those wounded soldiers who die from their wounds on the battlefield, and to provide better treatment far forward.

Medical supplies carried by combat medics weigh 9 lbs and are .44 cubic feet in size. These supplies include 3 pairs of patient examination gloves, 14 inches of rubber constricting band, 6 packets of povidone-iodine impregnated cotton pads, 2 catheters and needles, 2 IV injection sets, 2 IV bags with sterile fluid (Department of Medical Science, April 1999).

The CLS Course is used to train both active duty and reserve component soldiers in combat arms, combat support, and combat service support units (Department of Medical Science, n.d. CLS web site). CLS training covers two knowledge areas: basic first aid and physical assessment. In addition to training that could make use of the human patient simulator, the course is offered

through correspondence utilizing the group study mode. Instructors selected by the unit commander provide classroom instruction (Department of Health Science, n.d. *US Army Combat Lifesaver Program Correspondence Course Option)*. The annual training edition of the Combat Lifesaver Course for active duty personnel takes approximately 5 days. The Inactive Duty Training edition is designed to take three days. One day tests the Self-Aid/Buddy Aid tasks and 2 days are used to teach and test CLS tasks. Annual re-certification for the CLS is required.

VI.B. Outline of CLS Knowledge and Skills Objectives

The following paragraphs delineate the CLS knowledge and skills objectives covered in the CLS course, Combat Life-Saver Final Version 3.0 CD-ROM. The seven knowledge areas for the CLS are listed in Table 5.

VI.B.1. CLS Course Version Three

The Combat Lifesaver Course covers the following knowledge/skills areas. (Department of Medical Science CLS Version 3, n.d.)

Table 5. COMBAT LIFESAVER COURSE

KNOWLEDGE AREA	SKILL
Fluid Replacement	Initiate an IV infusion
Monitor Vital Signs	Measure and monitor respirations
Monitor Vital Signs	Measure and monitor pulse
General Medical	Apply a SAM splint to a fractured limb
Maintain Airway	Insert an oropharyngeal airway
General Medical	Treat (First Aid) for chemical casualties
General Medical	Identify and treat cold injuries
General Medical	Manage a casualty with combat stress reaction
Medication	Administer acetaminophen and pseudephedrine hydrochloride tablets
Patient Evacuation	Transport a casualty
Patient Evacuation	Evacuate the casualty

The general information section of the CLS web site (http://www.cs.amed.army.mil/CLSP/GENINFO.htm) states that *Interschool Subcourse 0825, Combat Lifesaver Course: Medical Tasks* covers the following tasks:

1. Evaluate a casualty (an expanded version of the Self-Aid Buddy-Aid [SABA] task)
2. Initiate an intravenous infusion for hypovolemic shock
3. Measure and monitor a casualty's pulse
4. Measure and monitor a casualty's respirations,
5. Apply a SAM splint to a fractured limb
6. Insert an oropharyngeal airway into an unconscious casualty
7. Administer first aid to chemical agent casualties
8. Identify and treat cold injuries
9. Manage combat stress reaction
10. Administer acetaminophen and pseudoephedrine hydrochloride tablets
11. Transport a casualty using a military vehicle

In these two lists, some items are listed as skills on one list and as tasks on the other. The words skill and task sometimes are used interchangeably in the literature.

VI.B.2. Review of CLS Skills

Members of the Medical Company Training Site (MCTS) provided practical assessment of the use of the Human Patient Simulator in a training context and assisted Tekamah Corporation in the review and analysis of program content for CLS (*Minutes*, Dec 2000). From this review, MCTS determined the CLS skills listed in Chart 5. Based upon these skills, tasks were determined by MCTS and were combined with those of the 91W in Table 4. Further information about psychomotor tasks can be seen later in this document in Section VIII.

VI.B.3. Self Aid/Buddy Aid

Every military soldier has training in Self Aid/Buddy Aid. The tasks for Self Aid/Buddy Aid can be taught using HPS and are skills that the CLS soldier has acquired. The tasks for Self Aid/Buddy Aid include:

1. Clear object from throat of conscious casualty
2. Perform mouth to mouth resuscitation
3. Put on a field dressing, pressure dressing, and tourniquet
4. Apply dressing to: open chest wound, open abdominal wound, open head wound
5. Prevent Shock
6. Splint a suspected fracture
7. Give first aid for burns
8. Recognize/give first aid for heat injuries
9. Administer first aid to chemical nerve agent
10. Transport a casualty using one-man and two-man carry or improvised litter

11. Protect self from heat, cold, biting insects, diarrhea and dysentery
12. Practice personal hygiene to maintain fitness (Academy of Health Sciences, n.d. CLS, General Info web site)

VI.C. HPS Technology Support of CLS Skills

At a December 2000 meeting, subject matter experts at the Army National Guard Medical Company Training Site (MCTS) in Indiantown Gap, Pennsylvania stated that most of what the Human Patient Simulator could be used for in support of the CLS training program was to train and test diagnosis skills (*Minutes*, Dec 2000). See Table 6. Using the casualty's signs and symptoms,

Table 6. CLS Skills and HPS Support

CLS Skills	HPS Could/Can	Not HPS Supported	Recommended as Needed HPS Enhancement
1. Take preventative measures against disease and environmental conditions	X		
2. Clear an object from the throat of a conscious casualty	X		
3. Put on a field dressing, pressure dressing and tourniquet	X		
4. Perform mouth-to-mouth resuscitation		*	*Yes*
5. Apply a dressing to an open chest wound	X		
6. Apply a dressing to an open abdominal wound	X		
7. Apply a dressing to an open head wound	X		
8. Prevent shock	X		**See below*
9. Splint a suspected facture	X		
10. Immobilize a suspected spinal injury	X		
11. Give first aid for burns	X		
12. Recognize and give first aid for heat injuries	X		
13. Administer first aid to a nerve agent casualty	X		
14. Transport a casualty using a two-man carry or an improvised litter		*	
15. Transport a casualty using a one-man carry		*	
16. Initiate an intravenous infusion for hypovolemic shock	X		
17. Measure and monitor a casualty's pulse 18. Measure and monitor a casualty's respirations	X		
19. Apply a Sam splint to a fractured limb	X		
20. Insert an oropharyngeal airway in an unconscious casualty	X		
21. Administer first aid to chemical agent casualties	X		
22. Identify and treat cold injuries	X		
23. Manage a casualty with combat stress	X		
24. Administer Acetaminophen and Pseudoephedine Hydrochloride tablets	X		
25. Transport a casualty using a military vehicle			*
26. Evacuate the casualty			
* HPS Enhancement needed for support of chemical agent (blood agent)			
(Minutes, December, 2000)			

the caregiver would be able to determine, report, and start to mitigate injuries. Based on the HPS assessment by MCTS, the usefulness of the HPS to teach or evaluate a Combat Lifesaver was questioned primarily because of the limited psychomotor skill set required of a CLS. Some instructors suggested that many of the CLS skills could be as easily taught or evaluated on

a non-instrumented mannequin or using human subjects. They noted however that HPS could help teach or evaluate the following CLS skills:

1. Clear an object from the throat of a conscious casualty
2. Put on a field dressing, pressure dressing and tourniquet
3. Perform mouth-to-mouth resuscitation
4. Apply a dressing to an open chest wound
5. Apply a dressing to an open abdominal wound
6. Apply a dressing to an open head wound
7. Prevent shock
8. Splint a suspected facture
9. Immobilize a suspected spinal injury
10. Give first aid for burns
11. Recognize and give first aid for heat injuries
12. Administer first aid to a nerve agent casualty
13. Initiate an intravenous infusion for hypovolemic shock
14. Measure and monitor a casualty's pulse
15. Measure and monitor a casualty's respirations
16. Insert an oropharyngeal airway in an unconscious casualty
17. Administer Acetaminophen and Pseudoephedine Hydrochloride tablets (*Minutes*, December, 2000)

Skills for the CLS were not separated out when MCTS listed HPS technologies that can (or could) support the 9IW/CLS skill set. This list included:

1. Advanced airway management (ET,EET)
2. Patient assessment Vital signs ascertainment
3. Basic life support
4. Patient assisted medications administration
5. End tidal CO2 monitoring
6. Cardiac monitoring
7. Defibrillation
8. Fluid resuscitation/IV therapy
9. Needle decompression
10. Cricothyrotomy (*Minutes*, Dec 2000).

VI.D. Recommendations for Human Patient Simulator Enhancements

In a 29 October 1998 Memo, MCTS reported on a 60-day assessment of the Human Patient Simulator. This memo listed tasks pertaining to 91W/CLS that are not suited to HPS according to skill area: Venipuncture and IV Therapy - Initiate an Intravenous Infusion (081-833-0033) cannot be performed properly

due to the lack of an IV arm; and Emergency Medical Treatment (081=831-0048) perform rescue breathing, needs ability to disinfect after each use (Begg, Oct 1998).

VI.D.1. MCTS Recommendations

From the same Memo, MCTS suggested the following enhancements for HPS that have applicability to the CLS course:

1. Chemical Agent Training - Add visual sips of chemical agent poisoning such as secretions from nose and mouth, convulsions or twitching;
2. Conventional Injuries and Treatment - Add ability to have cyanosis around lips, jugular vein distention, abdominal rigidity, and adjustable palatable pulse intensity (normal, weak, bounding);
3. Add an open (sucking) chest wound simulator for casualty evaluation and flutter valve assessment;
4. Modify the teeth to indicate when improper intubation techniques are being utilized;
5. Create a system that indicates when medical personnel have applied enough, not enough, or too much pressure to stop the bleeding with respect to a field/pressure dressing and/or tourniquet;
6. V Therapy - Add the ability to start an IV and measure the flow rate;
7. Modify the software to allow hemorrhaging and infusing simultaneously (currently, cannot have more then one fluid volume variable running at a time); and
8. provide the ability to disinfect so rescue breathing(mouth to mouth) can be performed (Begg, Oct 1998)

VI.D.2. Other Recommendations

1. In *Lessons Learned from Operation Joint Guard*, it was recommended that training programs be packaged and deployed into an area of operations like Joint Guard, which was part of the UN Sustainment Force (SFOR)(Army Medical Department, n.d.). For Operations Other Than War, HPS could be deployed to an area of operations so that personnel on long deployments could be re-certified for CLS. Likewise, simulations should include these kinds of scenarios (i.e., car bombing a base camp, combined exercise with coalition medical assets, etc.). HPS enhanced scenarios should consider the enabling components of the military PIC system that will provide critical in-transit visibility of the patient from the battlefield throughout all the echelons of care once it is implemented Army-wide.

(http://www.cs.amed.army.mil/91w/pages/PIC.htm) MC4 capability will enable personnel to use communications to maximize medical specialty skills, diagnostic capability, and treatment regimens and the Human Patient Simulator should be able to fully integrate into the medical communications for Combat Casualty Care information/communications structure for training purposes. (http://www.cs.amedd.army.mil/91w/MC4.htm)

2. HPS technology should also keep up with other civilian innovations in virtual reality and simulation products such as the virtual human model for medical applications customized reality glove (University at Buffalo, June 2000).
3. Provide the ability for the skin to swell (i.e., simulate fracture area)(The Veteran's Department, n.d.).
4. Durability - Provide easy access for adjustment to the HPS. This recommendation is based on the 60-Day assessment by MCTS. They found that parts did not function properly, possibly as a result of assessment and treatment: left apex speaker not responding to volume adjustments and left side of chest not rising smoothly or evenly with right side, possibly a result of CPR compression damages; and right eyelid does not open fully, possibly a result of assessment damage from holding eyelid open. Additionally, the drug bar code reader occasionally took an excessive amount of time/swipes to read the bar code (Begg, Oct 1998).
5. Operations - Add patient variable icon control bar along the top of each window to allow easy and quick changes to other patient variables while running medical scenarios and doing "on the fly" training. Also, add to the event monitor a program that would give total PATIENT running time during the training to allow a more precise (rather than estimation) monitoring of gas usage (Begg, Oct 1998).

VI.E. CLS Skills Prioritized in Terms of Training Impact Supported by HPS

As presented in the previous section of this report, the MCTS training priorities supported by HPS were closed head injury, blunt chest injury, blunt abdominal injury, spinal injury, excessive bleeding, pelvic fracture and penetrating chest injury (GSW with no exit) (Begg, Dec 2000).

The care priority for the CLS is treatment and prevention of shock. (CLS, CD-ROM). This priority relates closely to the MCTS training priority, excessive bleeding. Although, shock could result from any of the injuries listed as training priorities. Early treatment for shock in the first hour increases survival

for the wounded soldier. Shock can be more dangerous than injury and the combat lifesaver tries to prevent shock if possible. As an example, *Operation Just Cause Lessons Learned* (May 1990) reported that many of the casualties in heavy fighting were from units that stressed training, individual medic competence and carried individual IV sets. Physicians at the collection point in this situation stated that most patients were volume resuscitated prior to arrival and could be taken immediately into surgery. The low mortality rate of less than 1% for casualties entering the medical system was attributed in part to emphasis on early volume resuscitation by the CLS (Army Medical Department, May 1990).

VI.E.1. CLS Knowledge Objectives for Shock

There are six knowledge objectives for shock: maintain airway, control severe bleeding, position casualty, maintain fluids, maintain body temperature, and monitor vital signs (CLS, CD ROM).

VI.E.2. CLS Tasks for Shock

Based on the identified CLS knowledge skills, specific tasks for the CLS are listed within each pertinent knowledge/skill area later on in this document with a detailed look at the psychomotor skills for 91W and CLS based on those found in EMT-B training.

This section of the report satisfied the contract requirements of *2.2.1 Analysis of 91W/CLS Training Objectives (METI 4.1)* and *2.1.2 Development of 91W/CLS Task List Supported by current HPS Technology (METI 4.2)*. It summarized general information about CLS and Army training, outlined CLS knowledge and skills objectives, described how HPS technology supports CLS skills, listed CLS tasks, and recommended HPS enhancement pertinent to CLS.

In fulfillment of contract paragraph *2.1.3 Implementation of Selected Patient Scenarios for 91W/CLS Training (METI 4.3)*, the next section uses the task lists developed in this report to develop and implement HPS scenarios to address the selected training tasks for 91W and CLS. It provides recommendations for additional medical and operational attributes to enhance selected scenarios.

VII. 91W AND CLS TRAINING SCENARIOS AND HPS

Two of the most common skill areas (decision making and problem solving) are fundamental for CLS/91W training and the use of simulated scenarios with the HPS. In CLS and 91W training, sensory motor and troubleshooting skills are also important. Additionally, memory skills (recall, recognition and retention) are vital. With HPS supported scenario training all of these areas come into play. In a Memo (Begg, October 1998), the Army National Guard Medical Company Training Site stated that the HPS system is exciting and beneficial to the military healthcare provider because of the ability to create medical scenarios. Further, it stated that scenarios force the health care provider to use medical knowledge and individual tasks learned and perfected over the years collectively on a virtual casualty.

MCTS (Begg, October, 1998) recommended the creation of accurate realistic scenarios accomplished with a team of experts from METI and Tekamah Corporation (HPS experts); STRICOM personnel (negotiations and implementation experts); and Echelon I and II Health care providers (medical requirement experts). Tekamah personnel and MCTS have been meeting to work on this issue. This section of the report discusses HPS support for scenarios, includes variables and problems (operational and medical) that could be added to enhance scenarios.

VII.A. HPS Supported Scenarios

MCTS personnel met with Tekamah representatives on 15 December 2000 to develop the program's scenarios content. The outlines of HPS based scenarios to exercise selected 91W and CLS tasks could not be determined, but it was suggested that Tekamah consider using the Basic Trauma Life Support (BTLS) training scenarios as a basis for further development. The scenarios recommended for use would be based on those providing the highest training impact. Prioritizing HPS supported skills in terms of training and evaluation impact were discussed. With these considerations new scenarios were created. Those determined to have the highest impact for training with the HPS were closed head injury, blunt chest injury and blunt abdominal injury (*Minutes*, Dec 2000).

The process for the creation and development of scenarios for the HPS is similar to *Criterion Referenced Instruction* (Mager, n.d.) where a comprehensive set of methods are used for

the design and delivery of the scenario training program. In order for Tekamah Corporation's programmers to develop a computer-based simulation, several critical aspects need to be accomplished. The information in this report provides considerations and goal/task analysis (what needs to be learned), specifications of outcomes (tasks) to be accomplished, and how they are evaluated and tested (evaluation of the knowledge/skills). The result of this kind of review process is the development of scenario learning modules tied to specific learning objectives that can be performed with the Human Patient Simulator. Thus, scenarios for the HPS reflect instructional objectives derived from job performance and reflect the knowledge/skills that need to be learned.

With computers and programming technology, the HPS programming can simulate exercises where the student can safely practice actual clinical patient treatment on the HPS. Also, suggested treatment is included for the instructor to evaluate and interact with the student's progress. With this in mind, a set of standard scenarios focused on Echelon I and II medical care can be created (91W and CLS). The number and kind of possible scenarios are unlimited. They could include battle injuries (conventional and chemical/biological) and non-battle injuries.

VII.B. CTPS-HPS – Additional Medical Attributes That Could Enhance Future Scenarios

In addition to the development of scenarios, there are some enhancements that have been recommended for HPS. Minutes of the Content Meeting of 15 December 2000, noted additional recommended attributes for HPS that could enhance future selected scenarios. Other enhancements should include the ability to see the "skin" swelling from an injury, especially where a bone has been broken.

The fifteen additional recommended attributes for HPS were:

1. Anaphylaxis shock management
2. OB emergencies
3. Changing Skin color
4. Diaphoresis
5. Battle signs
6. Pulse quality
7. Distension
8. Trachea Deviation
9. Pulsating mass
10. Fluid to ABG, CBC, (etc.) draw so know what getting

11. Timing more realistic

12. Twitching
13. Snot Box
14. Visible inflammation
15. Moveable HPS

VII.C. CTPS-HPS – Additional Military Operational Attributes that Could Enhance Future Scenarios

MCTS also recommended variables and problems (additional operational attributes) that could enhance selected HPS scenarios. These include:

Medical re-supply, receiving different casualties than expected, general wartime chaos, communications, transportation (evacuation), wrong deployment package, extreme heat and cold, NBC environments, various class 8 resources limitations, evacuation limitations, under-fire environments, changing prioritizations, and lack of fluids (*Minutes*, Dec 2000).

Two other recommendations have surfaced in this report: the inclusion of Army values, and stabilization operations with multinational forces. Additional research into lessons learned at the National Training Center and from recent deployments might also provide more operational attributes for future scenarios.

This section of the report discussed HPS support for scenarios, and listed operational and medical variables and problems that could be added to enhance scenarios. Based on the work done for *2.1.1 Analysis of 91W/CLS Training Objectives (METI 4.1)* and *2.1.2 Development of 91W/CLS Task List Supported by current HPS Technology (METI 4.2)*, the next section fulfills the contract requirements for focusing on psychomotor aspects of identified training objectives and task lists.

VIII. PSYCHOMOTOR OBJECTIVES, SKILLS AND TASKS FOR 91W AND CLS

This section reviews the psychomotor knowledge objectives, skills and tasks of EMT-B training to satisfy the requirement for this report to pay special attention to psychomotor skills. EMT-B is one of the basic requirements for the 91W MOS and contains many of the knowledge, skills and tasks of the CLS trained soldier. The US Army Emergency Medical Technician Program trains First Responders and EMTs at the Basic, Intermediate, and Paramedic levels. All Army EMS Training Programs meet or exceed Department of Transportation guidelines as outlined in the 1995 First Responder and 1994 EMT-Basic National Standard curriculum (http://www.cs.amedd.army.mil/91w/91W%20Training%Page/EMT%20Web%20Page.htm).

Although the *Emergency Medical Technician-Basic: National Standard Curriculum* (Samuels, 1994) divides the lesson components into three categories, only the psychomotor category was abstracted for this report. In the EMT-B course, the skills portion of the program is written as procedural (how) which differs somewhat from the way some military documents list skills. The task portion listed in Section VIII.A was described in the EMT-B manual as student activities and listed according to three types of learning methods: Objective, Skills and Tasks. This information is presented unchanged. In Section VIII.B. are tables listing activities that demonstrate proficiency of the EMTB content. HPS support capabilities for these skills and tasks are indicated where applicable.

VIII.A. Review of Psychomotor Objectives, Skills and Tasks With Comments on HPS Support

VIII.A.1. Baseline Vital Signs and History Psychomotor Objectives:

1. Demonstrate the skills involved in assessment of breathing.
2. Demonstrate the skills associated with obtaining a pulse.
3. Demonstrate the skills associated with assessing the skin color, temperature, condition, and capillary refill in infants and children.
4. Demonstrate the skills associated with assessing the pupils.

5. Demonstrate the skills associated with obtaining blood pressure.

6. Demonstrate the skills that should be used to obtain information from the patient, family, or bystanders at the scene.

HPS Support/Needed Enhancements

HPS supports training for all these areas with the exception of taking the temperature and obtaining information from bystanders and family. Current HPS technology would need enhancement for taking the temperature of the patient. Information from family and bystanders could be written into the HPS scenarios.

VIII.A.2. Baseline Vital Signs and History - Psychomotor Skills:

1. Demonstrate the skill of assessing breathing.

2. Demonstrate the skill of determining a pulse.

3. Demonstrate the skill of determining skin color, temperature, and condition.

4. Demonstrate the skill of determining capillary refill in infants and children.

5. Demonstrate the skill of assessing pupils for size, reactivity and equality.

6. Demonstrate the skill of assessing blood pressure

    a. Auscultation

    b. Palpation

7. Discussion on questioning techniques to obtain history.

HPS Support/Needed Enhancements

HPS supports training for these skills with the exception of determining capillary refill and determining temperature (See Chart 4). The Medical Education Technologies Human Patient Simulator Users Manual (METI,1998)states that temperature as a patient monitoring parameter is supported on HPS with arterial and core temperature monitoring.

VIII.A.3. Baseline Vital Signs and History - Psychomotor Tasks:

1. Students should hear normal and abnormal breathing.
2. Student should hear with a stethoscope and assess systolic and diastolic pressures.

Visual (See)

1. Students should see a simulated or actual patient's chest rise and fall and assess rate and quality of breathing.
2. Students should see appropriate areas of the body to assess the color and condition (and in infants and children < 6 years of age, the capillary refill).
3. Students should see pupils to assess size, reactivity and equality.

Kinesthetic (Do)

1. Students should practice methods for assessing breathing.
2. Students should practice methods for obtaining a pulse.
3. Students should practice methods for determining skin color, temperature, condition, (and capillary refill in infants and children < 6 years of age).
4. Students should practice methods for determining pupil size, reactivity and equality.
5. Students should practice methods for determining blood pressure by auscultation and palpation.
6. Students should practice methods for obtaining an SAMPLE history.
7. Students should practice completing a pre-hospital care report including vital signs and SAMPLE history.

HPS Support/Needed Enhancements

HPS supports training for all these tasks except for determining skin color for capillary refill and taking the temperature (See Chart 4). The simulated patient generates both normal and abnormal breath sounds, bilateral and unilateral, which are appropriately synchronized with the respective phases of respiration. Breath sounds are audible over the apex, axilla, and posterior of each lung with the use of a standard esophageal stethoscope. The simulated patient generates heart sounds

(including a range of pathological ones) which are synchronized to the cardiac cycle and are audible with a standard stethoscope over the left and right upper sternal border, left lower sternal border, and apex and through an esophageal stethoscope. Palpable carotid, radial, brachial, femoral and pedal pulses are provided. A standard blood pressure cuff and sphygmomanometer can be used to assess systolic blood pressure using the return to flow technique (METI, 1998).

VIII.A.4. Lifting and Moving a Patient: Psychomotor Objectives

1. Working with a partner, prepare each of the following devices for use, transfer a patient to the device, properly position the patient on the device, move the device to the ambulance and load the patient into the ambulance: Wheeled Ambulance Stretcher, Portable Ambulance Stretcher, Stair Chair, Scoop Stretcher, Long Spine Board, Basket Stretcher, and Flexible Stretcher

2. Working with a partner, the EMT-Basic will demonstrate techniques for the transfer of a patient from an ambulance stretcher to a hospital stretcher.

VIII.A.5. Lifting and Moving a Patient - Psychomotor Skills

1. Show examples of proper lifting.
2. Show examples of proper carrying.
3. Show examples of proper reaching.
4. Show examples of situations where emergency moves are appropriate.
5. Show examples of situations where urgent moves are appropriate.
6. Show examples of situations where non-urgent moves are appropriate.
7. Demonstrate emergency moves.
8. Demonstrate urgent moves.
9. Demonstrate non-urgent moves.
10. Demonstrate transfer of patient to stretcher.
11. Show examples of different types of carrying devices.

12. Demonstrate knowledge of appropriate selection of each carrying device.
13. Demonstrate carrying a patient on a stretcher.
14. Demonstrate loading a patient on a stretcher into an ambulance.
15. Demonstrate use of a stair chair.
16. Demonstrate use of a scoop stretcher.
17. Demonstrate positioning patients with different conditions.
    - Unresponsiveness
    - Chest pain/discomfort or difficulty breathing
    - Suspected spine injury
    - Shock (hypoperfusion)
    - Patients who are vomiting or nauseous
    - Pregnant patient

VIII.A.6. Lifting and Moving a Patient - Psychomotor Tasks

Visual (See)

1. The student should see proper lifting techniques.
2. The student should see proper carrying techniques.
3. The student should see proper reaching techniques.
4. The student should see situations where emergency moves are appropriate.
5. The student should see situations where urgent moves are appropriate.
6. The student should see situations where non-urgent moves are appropriate.
7. The student should see emergency moves.
8. The student should see urgent moves.
9. The student should see non-urgent moves.

10. The student should see a patient transferred to a stretcher. The student should see different types of carrying devices.

11. The student should see a patient carried on a stretcher.

12. The student should see a patient on a stretcher loaded into an ambulance.

13. The student should see a stair chair used.

14. The student should see a scoop stretcher used.

15. The student should see patients with different conditions positioned properly.

    a. Unresponsiveness

    b. Chest pain/discomfort or difficulty breathing

    c. Suspected spine injury

    d. Shock (hypoperfusion)

    c. Patients who are vomiting or nauseous

    d. Pregnant patient

Kinesthetic (Do)

1. The student should practice proper lifting techniques.

2. The student should practice proper carrying techniques.

3. The student should practice proper reaching techniques.

4. The student should practice determining whether emergency, urgent or non-emergency moves are appropriate.

5. The student should practice emergency moves.

6. The student should practice urgent moves.

7. The student should practice non-urgent moves.

8. The student should practice transferring a patient to a stretcher.

9. The student should practice carrying a patient on a stretcher.

10. The student should practice loading a patient on a stretcher into an ambulance.

11. The student should practice using a stair chair.

12. The student should practice using a scoop stretcher.

13. The student should practice positioning patients with different conditions.

    a. Unresponsiveness

    b. Chest pain/discomfort or difficulty breathing

    c. Suspected spine injury

    d. Shock (hypoperfusion)

    e. Patients who are vomiting or nauseous

    f. Pregnant patients

VIII.A.7 Lifting and Moving a Patient -HPS Support/Needed Enhancements

HPS can support positioning patients with different conditions, but could not be used for training in loading and transferring patients unless some future enhancements could be made. The simulated patient can be placed on standard operating room tables, ICU beds, the ground, or even in a vehicle and is fully operational in the supine, sitting, lateral and prone positions (METI, 1998).

VIII.A.8. Airway - Psychomotor Objectives

1. Demonstrate the steps in performing the head-tilt chin-lift.

2. Demonstrate the steps in performing the jaw thrust.

3. Demonstrate the techniques of suctioning.

4. Demonstrate the steps in providing mouth-to-mouth artificial ventilation with body substance isolation (barrier shields).

5. Demonstrate how to use a pocket mask to artificially ventilate a patient.

6. Demonstrate the assembly of a bag-valve-mask unit.

7. Demonstrate the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask for one and two rescuers.

8. Demonstrate the steps in performing the skill of artificially ventilating a patient with a bag-valve-mask while using the jaw thrust.

9. Demonstrate artificial ventilation of a patient with a flow restricted, oxygen-powered ventilation device.

10. Demonstrate how to artificially ventilate a patient with a stoma.

11. Demonstrate how to insert an oropharyngeal (oral) airway.

12. Demonstrate how to insert a nasopharyngeal (nasal) airway.

13. Demonstrate the correct operation of oxygen tanks and regulators.

14. Demonstrate the use of a nonrebreather facemask and state the oxygen flow requirements needed for its use.

15. Demonstrate the use of a nasal cannula and state the flow requirements needed for its use.

16. Demonstrate how to artificially ventilate the infant and child patient.

17. Demonstrate oxygen administration for the infant and child patient.

VIII.A.9. Airway - Psychomotor Skills

1. Show diagrams of the airway and respiratory system of adults, children and infants.

2. Show examples of inadequate breathing.

3. Demonstrate the head-tilt chin-lift method of opening the airway.

4. Demonstrate the jaw thrust method of opening the airway.

5. Demonstrate mouth-to-mouth artificial ventilation of a patient.

6. Demonstrate artificial ventilation of a patient with a pocket mask with oxygen.

7. Demonstrate assembly of a bag-valve-mask.

8. Use a bag-valve-mask to demonstrate artificial ventilation of a non-neck injured patient with and without assistance.

9. Use a bag-valve-mask to demonstrate artificial ventilation of a suspected spinal injured patient with and without assistance.

10. Demonstrate artificial ventilation of a non-neck injured patient with a flow restricted, oxygen-powered ventilation device.

11. Demonstrate artificial ventilation of a neck-injured patient with a flow restricted, oxygen-powered ventilation device.

12. Demonstrate insertion of an oropharyngeal (oral) airway.

13. Demonstrate insertion of a nasopharyngeal (nasal) airway.

14. Demonstrate how to check a suction unit.

15. Demonstrate the techniques of suctioning.

16. Demonstrate use of a nasal cannula.

17. Demonstrate use of a nonrebreather mask.

18. Demonstrate correct operation of oxygen tanks and regulators.

19. Demonstrate artificial ventilation of a patient with a stoma.

20. Demonstrate artificial ventilation of an infant or child patient.

VIII.A.10. Airway - Psychomotor Tasks

Auditory (Hear)

1. The student should hear abnormal airway sounds such as gurgling, snoring, stridor, and expiratory grunting.

2. The student should hear a bag-valve-mask being used on a patient with an open airway.

3. The student should hear a bag-valve-mask being used on a patient with an obstructed airway.

4. The student should hear a flow restricted, oxygen-powered ventilation device being used on a patient with an open airway.

5. The student should hear a flow restricted, oxygen-powered ventilation device being used on a patient with an obstructed airway.

6. The student should hear suction units being operated.

7. The student should hear an oxygen tank and flowmeter in operation.

Visual (See)

1. The student should see audio-visual aids or materials of the airway and respiratory system.

2. The student should see normal breathing in other students.

3. The student should see audio-visual aids or materials of abnormal breathing.

4. The student should see audio-visual aids or materials of patients with stomas.

5. The student should see different kinds of oral and nasal airways.

6. The student should see different devices for ventilating patients (pocket masks, bag-valve-masks).

7. The student should see different kinds of suction units.

8. The student should see different kinds of oxygen tanks, regulators, and flowmeters.

9. The student should see nonrebreather masks and nasal cannulas.

10. The student should see audio-visual aids or materials of various dental appliances.

Kinesthetic (Do)

1. The student should practice evaluating breathing for adequacy.

2. The student should practice opening the airway with the head-tilt chin-lift maneuver.

3. The student should practice opening the airway with the jaw thrust.

4. The student should practice mouth-to-mouth artificial ventilation.

5. The student should practice artificial ventilation of a patient with a pocket mask with oxygen.

6. The student should practice assembly of a bag-valve-mask.

7. The student should practice using a bag-valve-mask to artificially ventilate a non-neck injured patient (adult, child, and infant) with and without assistance.

8. The student should practice using a bag-valve-mask to artificially ventilate a neck-injured patient (adult, child, and infant) with assistance.

9. The student should practice artificial ventilation of a non-neck injured patient with a flow restricted, oxygen-powered ventilation device.

10. The student should practice artificial ventilation of a neck injured patient with a flow restricted, oxygen-powered ventilation device.

11. The student should practice insertion of an oropharyngeal (oral) airway (adult, child, and infant) with and without tongue blade.

12. The student should practice insertion of a nasopharyngeal (nasal) airway.

13. The student should practice checking a suction unit.

14. The student should practice suctioning.

15. The student should practice using a nasal cannula.

16. The student should practice using a nonrebreather mask.

17. The student should practice correct operation of oxygen tanks, regulators, and flowmeters.

18. The student should practice artificial ventilation of a patient with a stoma.

19. The student should practice artificial ventilation of an infant or child patient.

VIII.A.11. Airway and HPS Support/Needed Enhancements

HPS supports excellent platform training for airway management for adult and child (with a pediatric HPS). It supports direct laryngoscopy, oral and nasal tracheal intubation, right or left main stem endobronchial intubation, esophageal intubation,

swelling of posterior oropharynx (airway occluder) can be activated, tongue swelling hindering laryngoscopy and endotracheal intubation, laryngospasm actuator to close vocal cords and prevent ventilation and intubation, simulated cricothyroid membrane for needle cricothryotomy and transtracheal jet ventilation, retrograde wire techniques and cricothryotomy. The patient airway also supports the use of endotracheal tube, laryngeal mask airway, combitube, lighted sylets, and fiber-optic intubation tubes. The three modes of respiration can be supported (spontaneous, assisted, and mechanical)(METI, 1998). Enhancement would be needed to sterilize/clean the mannequin for mouth-to-mouth use (See Table 4).

VIII.A.12. Scene Size Up - Psychomotor Objectives:

Observe various scenarios and identify potential hazards.

VIII.A.13. Scene Size Up - Psychomotor Skills:

None

VIII.A.14. Scene Size Up - Psychomotor Tasks:

Auditory (Hear)

1. The student will hear simulations of various safe and unsafe scenes.

Visual (See)

1. The student will see simulations of various safe and unsafe scenes.
2. The student should see the flow chart from Appendix I. (not included in this report).

Kinesthetic (Do)

1. The student will practice role-playing the actions to take at various safe and unsafe scenes.
2. The student should use the flow chart from Appendix I. (appendix not included in this report)

VIII.A.15. Scene Size Up and HPS Support

HPS can produce different settings and scenarios for 91W(s) and CLS training programs for realistic role-playing and experience required to meet the scene size up learning objectives.

VIII.A.16. Initial Assessment - Psychomotor Objectives:

1. Demonstrate the techniques for assessing mental status.
2. Demonstrate the techniques for assessing the airway.
3. Demonstrate the techniques for assessing if the patient is breathing.
4. Demonstrate the techniques for assessing if the patient has a pulse.
5. Demonstrate the techniques for assessing the patient for external bleeding.
6. Demonstrate the techniques for assessing the patient's skin color, temperature, condition and capillary refill (infants and children only).
7. Demonstrate the ability to prioritize patients.

VIII.A.17. Initial Assessment - Psychomotor Skills

1. Review airway patency, breathing and oxygen delivery.
2. Review methods of assessing mental status.
3. Demonstrate obtaining radial, carotid, and brachial pulses.
4. Show assessment and control of major external bleeding.
5. Demonstrate assessment of skin color, temperature and capillary refill.

VIII.A.18. Initial Assessment - Psychomotor Tasks

Auditory (Hear)

1. Students should hear recordings of various patient situations to listen for clues concerning the general impression.
2. Students should hear normal and abnormal airway noises.

3. Students should hear breathing.

Visual (See)

1. Students should see audio-visual aids or materials of various patients' situations.
2. Students should see breathing while an initial assessment is being performed.
3. Students should see appropriate landmarks for assessing pulses.
4. Students should see examples of major bleeding.
5. Students should see normal skin color and condition.
6. Students should see how to control major bleeding.
7. Students should see the flow chart from Appendix I. (not included in this report)

Kinesthetic (Do)

1. Students should practice establishing mental status on programmed patients (fellow students) with various altered mental statuses.
2. Students should practice airway-opening techniques on manikins and each other.
3. Students should practice assessing breathing.
4. Students should practice assessing pulses.
5. Students should practice assessing for major bleeding.
6. Students should practice assessing skin color, temperature and condition.
7. Students should practice assessing capillary refill.
8. Students should practice recording assessment findings.
9. Students should use the flow chart from Appendix I. (not added to this document)

VIII.A.19. Initial Assessment and HPS Support/Needed Enhancements

HPS provides the 91W/CLS student with the ability to do all the tasks of an initial assessment to meet the training objectives

in this area. Two skill areas require enhancements to current HPS technology. Enhancements needed for HPS in this area are the ability to assess skin color and condition (pallor, etc.) and take the temperature (see previous comments above and Chart 4). 91W students would require access to both adult and child HPS(s).

VIII.A.20. Focused History and Physical Exam: Trauma -Psychomotor Objectives

Demonstrate the rapid trauma assessment that should be used to assess a patient based on mechanism of injury.

VIII.A.21. Focused History and Physical Exam: Trauma - Psychomotor Skills

Assessment is completed by visually inspecting, physically palpating, auscultation, and verbally communicating with the patient and family. The assessment is an input/output process, where the assessment findings are the input and the treatment is the output. (This works well with HPS simulated scenarios.)

1. Review of scene size-up.
2. Review of the initial assessment.
3. Students should be shown audio-visual aids or materials of various trauma scenes to evaluate the mechanism of injury.
4. Demonstrate a rapid patient assessment.

VIII.A.22. Focused History and Physical Exam: Trauma - Psychomotor Tasks

Auditory (Hear)

1. Students should hear information input from a simulated patient or others regarding signs and symptoms for patients that are unresponsive.
2. Students should hear the presence of breath sounds on fellow students.

HPS Support

HPS offers the 91W/CLS student and instructor another training aid for practicing the auditory part of the focused history and initial exam in meeting the trauma learning objectives.

Visual (See)

1. Students should see audio-visual aids or materials of various injuries.
2. Students should see the inspection and palpation of programmed patients for various injuries and patterns of injury.
3. Students should see landmarks for auscultation of breath sounds.
4. Students should see landmarks for palpation and inspection.
5. Students should see the sizing and application of cervical spine immobilization devices.
6. Students should see how the pupils of the eye normally react to light.

Students should see the flow chart from Appendix I. (not included in this report)

Kinesthetic (Do)

1. Students should practice performing the skills of inspection, palpation, and auscultation.
2. Students should practice measuring and applying cervical spine immobilization devices.
3. Students should practice recording assessment findings for a trauma patient.
4. Students should use the flow chart from Appendix I. (not included in this report)
5. The student should practice doing the focused history and physical exam learned in this lesson.

VIII.A.23. Focused History and Physical Exam: Trauma - HPS Support

The HPS provides 91W and CLS students with the opportunity to see, inspect and practice the skills of inspection, palpation,

and auscultation on a "realistic patient". HPS offers is an excellent modality for meeting the training objectives of a focused history and physical exam. The HPS is equipped with a number of features specifically targeted to support training for trauma care and assessment (METI, 1998).

VIII.A.24. Focused History and Physical Exam: Medical -Psychomotor Objectives:

1. Demonstrate the patient assessment skills that should be used to assist a patient who is responsive with no known history.
2. Demonstrate the patient assessment skills that should be used to assist a patient who is unresponsive or has an altered metal status.

VIII.A.25. Focused History and Physical Exam: Medical - Psychomotor Skills

1. Review methods of questioning to determine SAMPLE history.
2. Practice methods of questioning to determine history of present illness.
3. Review airway management.
4. Review size-up.
5. Review the initial assessment.
6. Review rapid patient assessment.
7. Review of general impression.

VIII.A.26. Focused History and Physical Exam: Medical Psychomotor Tasks

Auditory (Hear)

1. Students should hear input from the patient or others regarding signs and symptoms for patients that are unresponsive.
2. Students should hear the presence of breath sounds in fellow students.

3. Students should hear questions to assist in determining the SAMPLE History.

4. Students should hear questions to assist in determining the history of the present illness.

Visual (See)

1. Students should see the entire assessment completed for each patient category.

2. Students should see audio-visual aids or materials of various illnesses.

3. Students should see the inspection and palpation of programmed patients for various illnesses.

4. Students should see landmarks for auscultation of breath sounds.

5. Students should see landmarks for palpation and inspection.

6. Students should see the flow chart from Appendix I. (not included in this report)

Kinesthetic (Do)

1. Students should practice performing the skills of inspection, palpation, and auscultation.

2. Students should practice questioning programmed patients on SAMPLE histories.

3. Students should practice questioning programmed patients on the history of present illness.

4. Students should practice all components of the assessment including: Size-up, initial assessment and the focused history and physical exam.

5. Students should practice recording assessment findings on a medical patient.

6. Students should use the flow chart from Appendix I (not included in this report).

VIII.A.27. Focused History and Physical Exam: Medical -HPS Support

91W/CLS students who use the Human Patient Simulator can practice questioning programmed patients, all components of

assessment and recording data to meet the focused medical history/exam training objectives.

VIII.A.28. Detailed Physical Exam - Psychomotor Objectives:

Demonstrate the skills involved in performing the detailed physical exam.

VIII.A.29. Detailed Physical Exam - Psychomotor Skills:

The physical assessment is completed by visual inspection and palpation. The assessment is an input/output process, where the assessment findings are the input and the treatment is the output.

VIII.A.30. Detailed Physical Exam - Psychomotor Tasks:

Auditory (Hear)

1. Students should hear information (clues) from the responsive or altered mental status patient regarding symptoms.

Visual (See)

1. Students should see audio-visual aids or materials of various injuries.
2. Students should see the inspection and palpation of programmed patients for various injuries and illnesses.
3. Students should see landmarks for auscultation of breath sounds.
4. Students should see landmarks for palpation and inspection.
5. Students should see the flow chart from Appendix I. (not included in this report)

Kinesthetic (Do)

1. Students should practice performing the skills of inspection, palpation, and auscultation of the detailed physical exam.

2. Students should use the flow chart from Appendix I. (not included in this report)

VIII.A.31. Detailed Physical Examination and HPS Support Technology

HPS enables the 91W/CLS student to complete a detailed physical exam by visual inspection and palpation. The HPS based assessment is an input/output process, where the assessment findings are the input and the treatment is the output.

VIII.A.32. Ongoing Assessment - Psychomotor Objectives

Demonstrate the skills involved in performing the on-going assessment.

VIII.A.33. Ongoing Assessment - Psychomotor Skills

1. Review methods for determining mental status.
2. Review of the airway module for airway patency.
3. Review of the airway module for breathing.
4. Review of the airway module for oxygen delivery/artificial ventilation.
5. Review of obtaining radial, carotid, and brachial pulses.
6. Review assessment of skin color, temperature and capillary refill for infant and child patients.
7. Review patient priorities.
8. Review baseline vital signs.
9. Review SAMPLE history.
10. Review the focused history and physical examination.
11. Discuss intervention checks.

VIII.A.34. Ongoing Assessment - Psychomotor Tasks:

Auditory (Hear)

None identified for this lesson.

Visual (See)

1. The students should see the flow chart from Appendix I (not included in this report).

Kinesthetic (Do)

1. The students should practice establishing mental status on programmed patients with various mental statuses.
2. The students should practice airway-opening techniques on manikins and each other.
3. The students should practice on each other to determine breathing.
4. The students should practice determining pulses.
5. The students should practice determining skin color, temperature and condition.
6. The students should practice examining interventions to assure that they continue to be effective.
7. The students should practice completing an on-going assessment.
8. The students should practice recording assessment findings.
9. The students should use the flow chart from Appendix I. (not included in this report)

VIII.A.35. Communication - Psychomotor Objectives

1. Perform a simulated, organized, concise radio transmission.
2. Perform an organized, concise patient report that would be given to the staff at a receiving facility.
3. Perform a brief, organized report that would be given to an ALS provider arriving at an incident scene at which the EMT-Basic was already providing care.

VIII.A.36. Communication - Psychomotor Skills

1. Show how to initiate and terminate a radio call.
2. Demonstrate use of the radio in the different phases of a typical call. (To the scene. ! At the scene. ! To the facility.! At the facility. To the station. ! At the station.)

3. Demonstrate the proper sequence of patient information.

4. Demonstrate how to communicate with a patient.

5. Demonstrate how to communicate with a patient's family.

6. Demonstrate how to communicate with bystanders.

7. Demonstrate how to communicate with individuals from other agencies while providing patient care.

8. Demonstrate a brief, organized report that would be given to an ALS provider arriving at an incident scene at which the EMT-Basic was already providing care.

9. Demonstrate a simulated, organized, concise radio transmission

VIII.A.37. Communication - Psychomotor Tasks

Auditory (Hear)

1. The student should hear both sides of a radio transmission during the phases of a typical call: (To the scene. ! At the scene. ! To the facility.! At the facility. To the station. ! At the station.)

2. The student should hear initiation and termination of a radio call.

3. The student should hear patient information delivered in the proper sequence.

4. The student should hear communication with a simulated patient.

5. The student should hear communication with the family of a simulated patient.

6. The student should hear communication with simulated bystanders.

7. The student should hear communication with individuals from other agencies at a call.

8. The student should hear a brief, organized report that would be given to an ALS provider arriving at an incident scene at which the EMT-Basic was already providing care.

Visual (See)

1. The student should see examples of portable, mobile and base station radio equipment.

2. The student should see the communication skills used to interact with the family.

3. The student should see the communication skills used to interact with bystanders.

4. The student should see the communication skills used to interact with individuals from other agencies while providing patient care.

5. The student should see the components of the minimum data set.

Kinesthetic (Do)

1. The student should practice radio use procedures in the following phases of a typical call: (To the scene. ! At the scene. ! To the facility.! At the facility. To the station. ! At the station.)

2. The student should practice the proper methods of initiating and terminating a radio call.

3. The student should practice the proper sequence of delivery of patient information.

4. The student should practice the communication skills used to interact with the patient.

5. The student should practice the communication skills used to interact with the family.

6. The student should practice the communication skills used to interact with bystanders.

7. The student should practice the communication skills used to interact with individuals from other agencies while providing patient care.

8. The student should practice performing an organized, concise patient report that would be given to the medical staff at a receiving facility.

9. The student should practice performing a brief, organized report that would be given to an ALS provider arriving at an incident scene at which the EMT-Basic was already providing care.

10. The student should practice performing a simulated, organized, concise radio transmission.

VIII.A.38. Communication and HPS Support Technology and Needed Enhancements

Communications about the patient are easily written/abstracted from the computerized simulated patient history, treatment, and current condition. The radio aspect cannot be performed with the current HPS technology. However, HPS technology lends itself to easily interact with state of the art communications technology as the military determines for its training and education programs.

VIII.A.39. Documentation - Psychomotor Objectives:

Complete a pre-hospital care report.

VIII.A.40. Documentation - Psychomotor Skills:

1. Show the students the pre-hospital care report used locally.
2. Show the students the refusal form used locally, if there is one.
3. Show the students good examples of completed pre-hospital care reports.
4. If there is a quality improvement system in place locally, show the students a report generated by the system.
5. Show the students how trending information is used to aid in the future care of the patient.

VIII.A.41. Documentation - Psychomotor Tasks:

Auditory (Hear)

None identified for this lesson.

Visual (See)

1. The student should see the pre-hospital care report used locally.
2. The student should see the components of the pre-hospital care report.

3. The student should see good examples of completed pre-hospital care reports.

Kinesthetic (Do)

1. The student should practice completing the pre-hospital care report, given different scenarios.

VIII.A.42. Documentation and HPS Support Technology

HPS current technology offers excellent support for documentation and reports for the 91W/CLS students and instructors.

VIII.A.43. General Pharmacology - Psychomotor Objectives

1. Demonstrate general steps for assisting patient with self-administration of medications.

2. Read the labels and inspects each type of medication.

VIII.A.44. General Pharmacology - Psychomotor Skills:

Demonstrate reading labels and inspecting each medication that will be carried on the unit or assisted with by the patient.

VIII.A.45. General Pharmacology - Psychomotor Tasks

Auditory (Hear)

1. The student will hear information on medications they will use on the EMS unit.

Visual (See)

1. The student will see the instructor pick up each type of medication they will use on the EMS unit.

Kinesthetic (Do)

1. The student will practice inspecting and reading the labels of each type of medication they will use on the EMS unit.

VIII.A.46. General Pharmacology and HPS Support Technology

HPS provides the 91W/CLS student with the ability to give the patient appropriate medicines, observe patient responses and make adjustments as needed. As noted earlier in this report, some medications need to be added to the current HPS.

VIII.A.47. Respiratory Emergencies - Psychomotor Objectives

1. Demonstrate the emergency medical care for breathing difficulty.

2. Perform the steps in facilitating the use of an inhaler.

VIII.A.48. Respiratory Emergencies - Psychomotor Skills

1. Show students images of adults, children and infants with breathing distress.

2. Show students different types of inhalers.

3. Show students how to use a metered dose inhaler.

VIII.A.49. Respiratory Emergencies - Psychomotor Tasks

Auditory (Hear)

1. The student should hear noisy breathing on an audiotape of actual patients.

Visual (See)

1. The student should see signs and symptoms of respiratory emergencies using various audio-visual aids or materials of patients exhibiting the signs.

2. The student should see a demonstration of the proper steps in assisting in the usage of handheld inhalers.

Kinesthetic (Do)

1. The student should practice assessment and management of adult, child and infant patients having a respiratory illness who have been prescribed a handheld inhaler by their physician.

2. The student should practice the steps in facilitating the use of a handheld inhaler.

3. The student should practice role-play situations where appropriate and inappropriate assistance of the usage of handheld inhalers occurs.

VIII.A.50. Respiratory Emergencies and HPS Support Technology

HPS supports the 91W/CLS in performing assessment and emergency medical care for breathing difficulty. The unique integration of the HPS physical and mathematical respiratory models with its sophisticated cardiovascular models makes the HPS an extremely powerful tool for advanced airway and cardiovascular education (METI, 1998).

VIII.A.51. Cardiac Emergencies - Psychomotor Objectives

1. Demonstrate the assessment and emergency medical care of a patient experiencing chest pain/discomfort.

2. Demonstrate the application and operation of the automated external defibrillator.

3. Demonstrate the maintenance of an automated external defibrillator.

4. Demonstrate the assessment and documentation of patient response to the automated external defibrillator.

5. Demonstrate the skills necessary to complete the Automated Defibrillator: Operator's Shift Checklist.

6. Perform the steps in facilitating the use of nitroglycerin for chest pain or discomfort.

7. Demonstrate the assessment and documentation of patient response to nitroglycerin.

8. Practice completing a pre-hospital care report for patients with cardiac emergencies.

VIII.A.52. Cardiac Emergencies - Psychomotor Skills

1. Demonstrate the assessment and emergency medical care of a patient experiencing chest pain/discomfort.

2. Perform the steps in facilitating the use of nitroglycerin for chest pain using a substitute candy tablet and breath spray.

3. Demonstrate the assessment and documentation of patient response to nitroglycerin.

4. Demonstrate application and operation of the automated external defibrillator.

5. Demonstrate maintenance checks of the automated external defibrillator.

6. Demonstrate the assessment and documentation of patient response to the automated external defibrillator.

7. Demonstrate assessment, defibrillation, airway management, lifting and moving a patient, and transportation out of the training laboratory of a manikin in a simulated cardiac arrest situation in which a patient does not respond to defibrillation.

VIII.A.53. Cardiac Emergencies - Psychomotor Tasks

Auditory (Hear)

1. The student should hear computer voice simulations made by automated external defibrillators giving instructions on protocols or shocks.

2. The student should hear of actual cases where cardiac arrest resuscitation efforts were successful and unsuccessful and the reasons for the outcomes.

Visual (See)

1. The student should see an instructor team appropriately resuscitate a simulated cardiac arrest patient using an automated external defibrillator.

2. The student should see re-enactments of cardiac arrest resuscitation efforts by EMT-Basics using automated external defibrillators.

3. The student should see an instructor team appropriately administer a small candy or breath spray sublingually to a simulated patient presenting with chest pain.

4. The student should see re-enactments of EMS calls where a patient has been assessed and assisted in the administration of nitroglycerin.

Kinesthetic (Do)

1. The student should practice the assessment and emergency medical care of a patient experiencing chest pain/discomfort.

2. The student should practice the application and operation of the automated external defibrillator.

3. The student should practice maintenance checks of the automated external defibrillator.

4. The student should practice performing the steps in facilitating the use of nitroglycerin for chest pain using a suitable candy tablet and breath spray.

5. The student should practice the assessment and documentation of patient response to the automated external defibrillator.

6. The student should practice the assessment and documentation of patient response to nitroglycerin.

7. The student should practice assessment, defibrillation, airway management, lifting and moving a patient, and transportation out of the training laboratory of a manikin in a simulated cardiac arrest situation in which a patient does not respond to defibrillation.

8. The student should practice completing a pre-hospital care report for a patient with a cardiac emergency.

VIII.A.54. Cardiac Emergencies and HPS Support Technology

CLS and the 91W can practice and perform all the above cardiac emergency skills and tasks on HPS and several pre-configured scenarios (METI, 1998).

VIII.A.55. Diabetic Emergencies/Altered Mental Status -Psychomotor Objectives

1. Demonstrate the steps in the emergency medical care for the patient taking diabetic medicine with an altered mental status and a history of diabetes.

2. Demonstrate the steps in the administration of oral glucose.

3. Demonstrate the assessment and documentation of patient response to oral glucose.

4. Demonstrate how to complete a pre-hospital care report for patients with diabetic emergencies.

VIII.A.56. Diabetic Emergencies/Altered Mental Status - Psychomotor Skills

1. Demonstrate the steps in emergency care for the patient with altered mental status and a history of diabetes who is on diabetic medication.
2. Demonstrate the steps in the administration of oral glucose.
3. Demonstrate the assessment and documentation of patient response.

VIII.A.57. Diabetic Emergencies/Altered Mental Status - Psychomotor Tasks

Auditory (Hear)

None identified for this lesson.

Visual (See)

1. The student should see audio-visual aids or materials of patients with altered mental status with a known history of diabetes mellitus in the pre-hospital setting.
2. The student should see the administration of oral glucose (as a simulated paste) to a simulated patient.

Kinesthetic (Do)

1. The student will practice the steps in emergency care for the patient with an altered mental status and a history of diabetes and taking diabetic medication.
2. The student will practice the steps in the administration of oral glucose.
3. The student will practice documentation of assessment, treatment, and patient response to oral glucose.
4. The student will practice completing a pre-hospital care report for patients with diabetic emergencies.

VIII.A.58. Diabetic Emergencies/Altered Mental Status and HPS Support Technology

HPS offers full support for the 91W/CLS student to practice the care for patients with diabetic emergencies and altered mental status and some pre-configured diabetic scenarios are standard (METI, 1998).

VIII.A.59. Allergies - Psychomotor Objectives

1. Demonstrate the emergency medical care of the patient experiencing an allergic reaction.
2. Demonstrate the use of epinephrine auto-injector.
3. Demonstrate the assessment and documentation of patient response to an epinephrine injection.
4. Demonstrate proper disposal of equipment.
5. Demonstrate completing a pre-hospital care report for patients with allergic emergencies.

VIII.A.60. Allergies -Psychomotor Skills

1. Obtain medical direction.
2. Obtain patient's prescribed auto injector. Ensure:
    a. Prescription is written for the patient experiencing allergic reactions.
    b. Medication is not discolored, if visible.
3. Remove safety cap from the auto-injector.
4. Place tip of auto-injector against the patient's thigh.
    a. Lateral portion of the thigh.
    b. Midway between the waist and the knee.
5. Push the injector firmly against the thigh until the injector activates.
6. Hold the injector in place until the medication is injected.
7. Dispose of injector in biohazard container.

VIII.A.61. Allergies -Psychomotor Tasks

Auditory (Hear)

1. The student should hear the assessment findings differentiating minor and severe allergic reactions.
2. The student should hear the steps required to appropriately administer epinephrine using an auto-injector.

Visual (See)

1. The student should see various audio-visual aids or materials showing the assessment findings relative to minor allergic reactions.
2. The student should see an actual epinephrine auto-injector.
3. The student should see the instructor demonstrate the appropriate steps in using an auto-injector.
4. The student should see various audio-visual aids or materials showing the assessment findings of major allergic reactions and the appropriate use of the auto-injector.

Kinesthetic (Do)

1. The student should practice the correct way to use an epinephrine auto-injector.
2. The student should practice role-play treatment of a patient experiencing an allergic reaction.
3. The student should practice re-assessment and documentation relative to the use of an epinephrine auto-injector.

VIII.A.62. Allergies and HPS Support Technology

HPS provides support for the 91W/CLS student to assess and treat allergic reactions on a realistic patient.

VIII.A.63. Poisoning Overdose - Psychomotor Objectives:

1. Demonstrate the steps in the emergency medical care for the patient with possible overdose.
2. Demonstrate the steps in the emergency medical care for the patient with suspected poisoning.

3. Perform the necessary steps required to provide a patient with activated charcoal.

4. Demonstrate the assessment and documentation of patient response.

5. Demonstrate proper disposal of the equipment for the administration of activated charcoal.

6. Demonstrate completing a pre-hospital care report for patients with a poisoning/overdose emergency.

VIII.A.64. Poisoning Overdose - Psychomotor Skills:

1. Show the student examples of poisoning by ingestion.

2. Show the student examples of poisoning by inhalation.

3. Show the student examples of poisoning by injection.

4. Show the student examples of poisoning by absorption.

5. Show the student activated charcoal.

6. Show the student how to administer activated charcoal.

7. Show the student how to care for a patient with suspected poisoning or overdose

VIII.A.65. Poisoning Overdose - Psychomotor Tasks:

Auditory (Hear)

None identified for this lesson.

Visual (See)

1. The student should see audio-visuals aids or materials of examples of poisoning by ingestion.

2. The student should see audio-visuals aids or materials of examples of poisoning by inhalation.

3. The student should see audio-visuals aids or materials of examples of poisoning by injection.

4. The student should see audio-visuals aids or materials of examples of poisoning by absorption.

5. The student should see activated charcoal.

6. The student should see a demonstration of how to administer activated charcoal.

7. The student should see a demonstration of how to care for a patient with suspected poisoning or overdose.

Kinesthetic (Do)

1. The student should practice caring for a patient with suspected poisoning or overdose.

2. The student should practice the assessment and documentation of patient response to activated charcoal.

3. The student should practice completing a pre-hospital care report for patients with poisoning/overdose emergencies.

VIII.A.66. Poisoning Overdose and HPS Support Technology

Current HPS technology can be used to assist 91W/CLS soldiers to learn assessment and care of the patient with poisoning/overdose.

VIII.A.67. Environmental Emergencies - Psychomotor Objectives

1. Demonstrate the assessment and emergency medical care of a patient with exposure to cold.

2. Demonstrate the assessment and emergency medical care of a patient with exposure to heat.

3. Demonstrate the assessment and emergency medical care of a near drowning patient.

4. Demonstrate completing a pre-hospital care report for patients with environmental emergencies.

VIII.A.68. Environmental Emergencies - Psychomotor Skills

1. Show illustrations of signs and symptoms of cold injuries.

2. Demonstrate the steps in providing emergency medical care to a patient exposed to the cold.

3. Describe the various ways that the body loses heat.

4. Show illustrations of the signs and symptoms heat emergencies.

5. Demonstrate the assessment and emergency medical care of a patient with exposure to heat.

6. Demonstrate the assessment and emergency medical care of a patient with exposure to cold.

7. Demonstrate the assessment and emergency medical care of a near drowning patient.

8. Demonstrate how to remove a patient from the water who has a suspected spine injury.

VIII.A.69. Environmental Emergencies - Psychomotor Tasks:

Auditory (Hear)

1. The student should hear simulations involving the assessment, recognition and emergency medical care of cold, heat and water-related emergencies.

Visual (See)

1. The student should see audio-visual aids or materials of signs and symptoms of cold injuries.

2. The student should see a demonstration of the steps in providing emergency medical care to a patient exposed to cold.

3. The student should see an illustration or demonstration of the various ways that the body loses heat.

4. The student should see audio-visual aids or materials of the signs and symptoms of heat emergencies.

5. The student should see a demonstration of the assessment and emergency medical care of a patient with exposure to heat.

6. The student should see a demonstration of the assessment and emergency medical care of a patient with exposure to cold.

7. The student should see a demonstration of the assessment and emergency medical care of a near drowning patient.

8. The student should see a demonstration of how to remove a patient from the water who has a suspected spinal injury.

Kinesthetic (Do)

1. The student should practice the steps in providing emergency medical care to a patient exposed to cold.
2. The student should practice the assessment and emergency medical care of a patient with exposure to heat.
3. The student should practice the assessment and emergency medical care of a patient with exposure to cold.
4. The student should practice the assessment and emergency medical care of a near drowning patient.
5. The student should practice the skills involved in removing a patient from the water who has a suspected spinal injury.
6. The student should practice completing a pre-hospital report for patients with environmental emergencies.

VIII.A.70. Environmental Emergencies and HPS Support Technology

HPS supports training for 91W/CLS in providing assessment and treatment of environmental emergencies (heat injury, cold injury, and near drowning). One of the HPS standard pre-configured scenarios is a near drowning incident (METI, 1998).

VIII.A.71. Behavioral Emergencies - Psychomotor Objectives

1. Demonstrate the assessment and emergency medical care of the patient experiencing a behavioral emergency.
2. Demonstrate various techniques to safely restrain a patient with a behavioral problem.

VIII.A.72. Behavioral Emergencies - Psychomotor Skills

1. Demonstrate the assessment and emergency medical care of the patient experiencing a behavioral emergency.
2. Demonstrate the method of restraint.

VIII.A.73. Behavioral Emergencies - Psychomotor Tasks

Auditory (Hear)

1. The student should hear audio tapes of patients with behavioral emergencies.

Visual (See)

1. The student should see audio-visual aids or materials of behavioral conditions, patient interviewing, and use of restraints.

Kinesthetic (Do)

1. The student should practice physically restraining another student who is simulating moderate resist

VIII.A.74. Behavioral Emergencies and HPS Support Technology

Current HPS would permit the 91W/CLS student to practice use of restraints. It does not support restraining a person who is simulating resistance or acting violently.

VIII.A.75. OB/GYN - Psychomotor Objectives

1. Demonstrate the steps to assist in the normal cephalic delivery.
2. Demonstrate necessary care procedures of the fetus as the head appears.
3. Demonstrate infant neonatal procedures.
4. Demonstrate post delivery care of infant.
5. Demonstrate how and when to cut the umbilical cord.
6. Attend to the steps in the delivery of the placenta.
7. Demonstrate the post-delivery care of the mother.
8. Demonstrate the procedures for the following abnormal deliveries: vaginal bleeding, breech birth, prolapsed cord, and limb presentation.
9. Demonstrate the steps in the emergency medical care of the mother with excessive bleeding.

10. Demonstrate completing a pre-hospital care report for patients with obstetrical/gynecological emergencies.

VIII.A.76. OB/GYN - Psychomotor Skills

1. Demonstrate the steps to assist in the normal delivery.
2. Demonstrate necessary care procedures of the fetus as the head appears.
3. Demonstrate neonatal resuscitation procedures.
4. Demonstrate how and when to cut the umbilical cord.
5. Discuss the steps in delivery of the placenta.
6. Demonstrate the post-delivery care of mothers and neonates.
7. Demonstrate the procedures for the following abnormal deliveries: Breech birth, prolapsed cord, limb presentation.
8. Demonstrate the steps in emergency medical care of the mother with excessive bleeding.
9. Demonstrate the steps in the emergency care of the female patient with gynecological disorders.

VIII.A.77. OB/GYN - Psychomotor Tasks:

Auditory (Hear)

1. The student should hear a videotape of a mother in the final stages of labor, which provides samples of mother's actions during this painful process.

Visual (See)

1. The student should see audio-visual aids or materials of labor and delivery showing: Late stages of labor normal delivery, clamping and cutting umbilical cord, suctioning infant's head during delivery, assessment and initial care of neonate, normal bleeding with delivery, delivery and care of placenta.

Kinesthetic (Do)

1. Student should practice the steps to assist in the normal delivery.

2. Student should practice necessary care procedures of the fetus as the head appears during delivery.

3. Student should practice neonatal resuscitation procedures.

4. Student should practice how and when to cut the umbilical cord using simple pieces of rope.

5. Student should practice the post-delivery care of mothers and neonates.

6. Student should practice completing a pre-hospital care report for patients with obstetrical/gynecological emergencies.

VIII.A.78. OB/GYN and HPS Support Technology

Basic obstetrics skills are supported using a female simulated "stannette". Nine pre-configured basic obstetrics skills scenarios are currently available (METI, 1998).

VIII.A.79. Bleeding and Shock - Psychomotor Objectives:

1. Demonstrate direct pressure as a method of emergency medical care of external bleeding.

2. Demonstrate the use of diffuse pressure as a method of emergency medical care of external bleeding.

3. Demonstrate the use of pressure points and tourniquets as a method of emergency medical care of external bleeding.

4. Demonstrate the care of the patient exhibiting signs and symptoms of internal bleeding.

5. Demonstrate the care of the patient exhibiting signs and symptoms of shock (hypoperfusion).

6. Demonstrate completing a pre-hospital care report for patient with bleeding and/or shock (hypoperfusion).

VIII.A.80. Bleeding and Shock - Psychomotor Skills:

1. Review the methods of controlling external bleeding with emphasis on body substance isolation.

2. Review the methods used to treat internal bleeding.

3. Review the methods used to treat the patient in shock (hypoperfusion).

VIII.A.81. Bleeding and Shock - Psychomotor Tasks

Auditory (Hear)

1. The students should hear simulated situations to identify signs and symptoms of external bleeding, internal bleeding, and shock (hypoperfusion).

2. The students should hear normal systolic and diastolic sounds associated with taking a blood pressure.

Visual (See)

1. The students should see audio-visual aids or materials of the various types of external bleeding and various signs of internal bleeding and shock (hypoperfusion).

2. The student should see audio-visual aids or materials of the proper methods to control bleeding, and treat for internal bleeding and shock (hypoperfusion).

3. The student should see a patient to identify major bleeding and signs of internal bleeding and shock (hypoperfusion).

4. The students should see, in simulated situations, the application of direct pressure, elevation, splints, counter pressure devices, cryotherapy, and tourniquets in the treatment of external bleeding.

5. The students should see, in simulated situations, the treatment of the internal bleeding and shock (hypoperfusion).

6. The students should see audio-visual aids or materials with known amounts of blood on gauze pads, vaginal pads, clothing, floors, and humans.

Kinesthetic (Do)

1. The students should practice application of direct pressure, elevation, splints, and tourniquets.

2. The students should practice the treatment of internal bleeding and shock (hypoperfusion).

3. The students should practice completing a pre-hospital care report for patients with bleeding and/or shock (hypoperfusion).

VIII.A.82. Bleeding and Shock and HPS Support Technology

HPS allows practice for application of direct pressure, elevation, splints, and tourniquets, and assessment and treatment of internal bleeding and shock.

VIII.A.83. Soft Tissue Injuries - Psychomotor Objectives

1. Demonstrate the steps in the emergency medical care of closed soft tissue injuries.
2. Demonstrate the steps in the emergency medical care of open soft tissue injuries.
3. Demonstrate the steps in the emergency medical care of a patient with an open chest wound.
4. Demonstrate the steps in the emergency medical care of a patient with open abdominal wounds.
5. Demonstrate the steps in the emergency medical care of a patient with an impaled object.
6. Demonstrate the steps in the emergency medical care of a patient with an amputation.
7. Demonstrate the steps in the emergency medical care of an amputated part.
8. Demonstrate the steps in the emergency medical care of a patient with superficial burns.
9. Demonstrate the steps in the emergency medical care of a patient with partial thickness burns.
10. Demonstrate the steps in the emergency medical care of a patient with full thickness burns.
11. Demonstrate the steps in the emergency medical care of a patient with a chemical burn.
12. Demonstrate completing a pre-hospital care report for patients with soft tissue injuries.

VIII.A.84. Soft Tissue Injuries - Psychomotor Skills

1. Show diagrams of the various layers of the skin.
2. Show diagrams of the various types of soft tissue injuries.

3. Demonstrate the procedure for treating a closed soft tissue injury.

4. Demonstrate the procedure for treating an open soft tissue injury.

5. Demonstrate the necessary body substance isolation that must be taken when dealing with soft tissue injuries.

6. Demonstrate the proper method for applying an occlusive dressing.

7. Demonstrate the proper method for stabilizing an impaled object.

8. Demonstrate the proper method of treating an evisceration.

9. Show a diagram illustrating a superficial, partial thickness, and full thickness burn.

10. Demonstrate the proper treatment for a superficial, partial thickness, and full thickness burn.

11. Show the various types of dressings and bandages.

12. Demonstrate the proper method for applying a universal dressing, 4 X 4 inch dressing, and adhesive type dressing.

13. Demonstrate the proper method for applying bandages: self-adherent, gauze rolls, triangular, adhesive tape, and air splints.

14. Demonstrate the proper method for applying a pressure dressing.

VIII.A.85. Soft Tissue Injuries - Psychomotor Tasks

Auditory (Hear)

1. The student should hear simulated situations in which the signs and symptoms of soft tissue injuries and procedures for treating soft tissue injuries are demonstrated.

2. The student should hear the sounds made by open sucking chest wounds.

Visual (See)

1. The student should see diagrams of the various layers of the skin.

2. The student should see diagrams of the various types of soft tissue injuries.

3. The student should see demonstrations for the procedure for treating a closed soft tissue injury.

4. The student should see demonstrations for the procedure for treating an open soft tissue injury.

5. The student should see demonstrations for the necessary body substance isolation that must be taken when dealing with soft tissue injuries.

6. The student should see demonstrations for the proper method for applying an occlusive dressing.

7. The student should see demonstrations for the proper method for stabilizing an impaled object.

8. The student should see demonstrations for the proper method of treating an evisceration.

9. The student should see diagrams illustrating a superficial, partial thickness, and full thickness burn.

10. The student should see demonstrations for the proper treatment for a superficial, partial thickness, and full thickness burn.

11. The student should see the various types of dressing and bandages.

12. The student should see demonstrations for the proper method for applying a universal dressing, 4 X 4 inch dressing, and adhesive type dressing.

13. The student should see demonstrations for the proper method for applying bandages: Self-adherent, gauze rolls, triangular, adhesive tape, and air splints.

14. The student should see demonstrations for the proper method for applying a pressure dressing.

Kinesthetic (Do)

1. The student should practice the steps in the emergency medical care of closed soft tissue injuries.

2. The student should practice the steps in the emergency medical care of open soft tissue injuries.

3. The student should practice the steps in the emergency medical care of a patient with an open chest wound.

4. The student should practice the steps in the emergency medical care of a patient with open abdominal wounds.

5. The student should practice the steps in the emergency medical care of a patient with an impaled object.

6. The student should practice the steps in the emergency medical care of a patient with superficial burns.

7. The student should practice the steps in the emergency medical care of a patient with partial thickness burns.

8. The student should practice the steps in the emergency medical care of a patient with full thickness burns.

9. The student should practice the steps in the emergency medical care of a patient with an amputation.

10. The student should practice the steps in the emergency medical care of the amputated part.

11. The student should practice the steps in the emergency medical care of a patient with a chemical burn.

12. The student should practice the steps in the emergency care of a patient with an electrical burn.

13. The student should practice completing a pre-hospital care report for patients with soft tissue injuries.

VIII.A.86. Soft Tissue Injuries and HPS Support Technology

Combat Trauma pre-configured scenarios for the HPS include a soldier with a land mine injury, gunshot injury, and snakebite injury. Bandaging of soft tissue wounds can be accomplished.

VIII.A.87. Musculoskeletal Care - Psychomotor Objectives

1. Demonstrate the emergency medical care of a patient with a painful, swollen, deformed extremity.

2. Demonstrate completing a pre-hospital care report for patients with musculoskeletal injuries.

VIII.A.88. Musculoskeletal Care - Psychomotor Skills

1. Show diagrams of the muscular system.
2. Show diagrams of the skeletal system.
3. Show audio-visual aids or materials of signs of open and closed type bone and joint injuries.
4. Demonstrate assessment of an injured extremity.
5. Demonstrate splinting procedures relevant to the general rules of splinting using: Rigid splints, traction splints, pneumatic splints, improvised splints, and pneumatic antishock garments.
6. Demonstrate procedure for splinting an injury with distal cyanosis or lacking a distal pulse.

VIII.A.89. Musculoskeletal Care - Psychomotor Tasks:

Auditory (Hear)

1. The student should hear simulations on various situations involving musculoskeletal injuries and the proper assessment and treatment.

Visual (See)

1. The student should see diagrams of the muscular system.
2. The student should see diagrams of the skeletal system.
3. The student should see audio-visual aids or materials of signs of open and closed bone and joint injuries.
4. The student should see a demonstration of an assessment of an injured extremity.
5. The student should see a demonstration of splinting procedures relevant to the general rules of splinting using: Rigid splints, traction splints, pneumatic splints, improvised splints, and pneumatic anti-shock garments.
6. The student should see a demonstration of the procedure for splinting an injury with distal cyanosis or lacking a distal pulse.

Kinesthetic (Do)

1. The student should practice assessment of an injured extremity.

2. The student should practice splinting procedures relevant to the general rules of splinting using: Rigid splints, traction splints, pneumatic splints, improvised splints, and pneumatic antishock garments.

3. The student should practice procedure for splinting an injury with distal cyanosis or lacking a distal pulse.

4. The student should practice completing a pre-hospital care report for patients with musculoskeletal injuries

VIII.A.90. Musculoskeletal Care and HPS Technology

Splinting, assessment, and treatment of musculoskeletal injuries can be accomplished on the HPS.

VIII.A.91. Spinal Cord Injury - Psychomotor Objectives

1. Demonstrate opening the airway in a patient with suspected spinal cord injury.

2. Demonstrate evaluating a responsive patient with a suspected spinal cord injury.

3. Demonstrate stabilization of the cervical spine.

4. Demonstrate the four-person log roll for a patient with a suspected spinal cord injury.

5. Demonstrate how to log roll a patient with a suspected spinal cord injury using two people.

6. Demonstrate securing a patient to a long spine board.

7. Demonstrate using the short board immobilization technique.

8. Demonstrate procedure for rapid extrication.

9. Demonstrate preferred methods for stabilization of a helmet.

10. Demonstrate helmet removal techniques.

11. Demonstrate alternative methods for stabilization of a helmet.

12. Demonstrate completing a pre-hospital care report for Patients with head and spinal injuries.

VIII.A.92. Spinal Cord Injury - Psychomotor Skills

1. Show diagrams or illustrations of the nervous system anatomy.
2. Show diagrams or illustrations of the structure of the skeletal system as it relates to the nervous system.
3. Show audio-visual aids or materials of related mechanism of injury to potential injuries of the head and spine.
4. Show audio-visual aids or materials of potential signs and symptoms of a potential spine injury.
5. Demonstrate the method of determining if a responsive patient may have a spine injury.
6. Demonstrate the airway emergency medical care techniques for the patient with a suspected spinal cord injury.
7. Demonstrate methods for sizing various cervical spine immobilization devices.
8. Demonstrate rapid extrication techniques.
9. Demonstrate how to stabilize the cervical spine.
10. Demonstrate how to immobilize a patient using a short spine board.
11. Demonstrate how to log roll a patient with a suspected spine injury.
12. Demonstrate how to secure a patient to a long spine board.
13. Demonstrate the preferred methods to remove sports, motorcycle and various other helmets.
14. Demonstrate alternative methods for removal of a helmet.
15. Demonstrate how the head is stabilized with a helmet compared to without a helmet.
16. Demonstrate how the patient's head is stabilized in order to remove a helmet.
17. Demonstrate sudden airway emergency medical care with helmet on.

VIII.A.93. Spinal Cord Injury - Psychomotor Tasks

Auditory (Hear)

1. Simulations in which immobilization techniques are needed and performed.

2. Simulations in which patients present with head injuries.

Visual (See)

1. The student should see audio-visual aids or materials of the nervous system anatomy.

2. The student should see audio-visual aids or materials of the structure of the skeletal system as it relates to the nervous system.

3. The student should see audio-visual aids or materials of mechanism of injury related to potential injuries of the head and spine.

4. The student should see audio-visual aids or materials of signs and symptoms of a potential spine injury.

5. The student should see a demonstration of the method of determining if a responsive patient may have a spine injury.

6. The student should see a demonstration of the airway emergency medical care techniques for the patient with a suspected spine injury.

7. The student should see a demonstration of the methods for sizing various cervical spine immobilization devices.

8. The student should see a demonstration of rapid extrication techniques.

9. The student should see a demonstration of how to stabilize the cervical spine.

10. The student should see a demonstration of how to immobilize a patient using a short spine board.

11. The student should see a demonstration of how to log roll a patient with a suspected spinal injury.

12. The student should see a demonstration of how to secure a patient to a long spine board.

13. The student should see a demonstration of the preferred methods to remove sports, motorcycle and various other helmets.

14. The student should see a demonstration of alternative methods for removal of a helmet.

15. The student should see a demonstration of how the head is stabilized with a helmet compared to without a helmet.

16. The student should see a demonstration of how the patient's head is stabilized in order to remove a helmet.

17. The student should see various types of long backboards.

18. The student should see various types of vest type immobilization devices.

19. The student should see various types of short backboards.

20. The student should see various types of helmets.

21. The student should see a demonstration of immobilization of an infant or child patient on a long backboard.

Kinesthetic (Do)

1. The student should practice opening the airway in a patient with suspected spinal cord injury.

2. The student should practice evaluating a responsive patient with a suspected spinal cord injury.

3. The student should practice stabilization of the cervical spine.

4. The student should practice using the short board immobilization technique.

5. The student should practice the four-person log roll for a patient with a suspected spinal cord injury.

6. The student should practice how to log roll a patient with a suspected spinal cord injury using two people.

7. The student should practice securing a patient to a long spine board.

8. The student should practice helmet removal techniques.

9. The student should practice the procedure for rapid extrication.

10. The student should practice the preferred methods for stabilization of the helmet.

11. The student should practice alternative methods for stabilization of the helmet.

12. The student should practice preferred methods for stabilization of the head.

13. The student should practice alternative methods for stabilization of the head.

14. The student should practice completing a pre-hospital care report for patients with head and spinal injuries.

15. The student should practice the use of cervical immobilization devices, rolls and short boards for immobilizing the infant or child patient.

VIII.A.94. Spinal Cord Injury and HPS Support Technology

HPS supports extraction practice, stabilization of the head, evaluation and treatment of cervical and spinal injuries.

VIII.A.95. Infants and Children - Psychomotor Objectives

1. Demonstrate the techniques of foreign body airway obstruction removal in the infant.

2. Demonstrate the techniques of foreign body airway obstruction removal in the child.

3. Demonstrate the assessment of the infant and child.

4. Demonstrate bag-valve-mask artificial ventilations for the infant.

5. Demonstrate bag-valve-mask artificial ventilations for the child.

6. Demonstrate oxygen delivery for the infant and child.

VIII.A.96. Infants and Children - Psychomotor Skills

1. Demonstrate the techniques of foreign body airway obstruction removal in the infant.

2. Demonstrate the techniques of foreign body airway obstruction removal in the child.

3. Demonstrate bag-valve-mask artificial ventilations for the infant.

4. Demonstrate bag-valve-mask artificial ventilations for the child.

5. Demonstrate oxygen delivery for the infant and child.

6. Demonstrate the assessment of the infant and child.

7. Demonstrate in line cervical immobilization with and without artificial ventilation in infants and children.

VIII.A.97. Infants and Children - Psychomotor Tasks

Auditory (Hear)

1. Students should hear various infant and child airway sounds.

2. Students should hear the normal systolic and diastolic blood pressure sounds.

3. Students should hear parent information.

Visual (See)

1. Students should see audio-visual aids or materials of infant and child patients with common medical or traumatic complaints.

2. Students should see various infant or child equipment.

Kinesthetic (Do)

1. Students should practice working with the various infant and child devices that are available in their area.

2. Students should practice the techniques of foreign body airway obstruction removal in the infant.

3. Students should practice the techniques of foreign body airway obstruction removal in the child.

4. Students should practice bag-valve-mask artificial ventilations for the infant.

5. Students should practice bag-valve-mask artificial ventilations for the child.

6. Students should practice oxygen delivery for the infant and child.

7. Students should practice the assessment of the infant and child.

8. Students should practice in-line cervical immobilization and transportation of infant and child patients.

VIII.A.98. Infants and Children and HPS Support Technology

A pediatric HPS is available with features that fulfill all the requirements for training on the pediatric skills.

VIII.A.99. Ambulance Operations - Psychomotor Objectives

None identified

VIII.A.100. Ambulance Operations - Psychomotor Skills

None Identified

VIII.A.101. Ambulance Operations - Psychomotor Tasks

Auditory (Hear)

1. Students should hear audio tapes of actual dispatch conversations with callers to the 9-1-1 system.

2. Students should hear audio tapes of actual dispatch information.

Visual (See)

1. Students should see an ambulance.

2. Students should see actual equipment or audio-visual aids or materials of ambulance equipment.

3. Students should see audio-visual aids or materials depicting an actual ambulance run.

Kinesthetic (Do)

1. Students should practice receiving and sending information to dispatch.

VIII.A.102. Ambulance Operations and HPS Support Technology

When available, the new Army mobile ambulance should be used in conjunction with training that uses the HPS.

VIII.A.103. Gaining Access - Psychomotor Objectives:

None Identified

VIII.A.104. Gaining Access - Psychomotor Skills:

None identified

VIII.A.105. Gaining Access - Psychomotor Tasks:

Auditory (Hear)

None identified for this lesson.

Visual (See)

1. Students should see various crash scenes to determine if additional help will be necessary to remove the patient.
2. Students should see the various options of personal protective equipment.
3. Students should see patients being removed from vehicles.

Kinesthetic (Do)

1. Students should practice evaluating crash scenes to determine the need for complex rescue.
2. Students should practice removing patients from simulated crashed vehicles in the lab setting using short and long backboards.

VIII.A.106. Gaining Access and HPS Support Technology

HPS can be used to practice extraction from a vehicle.

VIII.A.107. Overview - Psychomotor Objectives:

Given a scenario of a mass casualty incident, perform triage.

VIII.A.108. Overview - Psychomotor Skills:

1. Demonstrate how to recognize hazardous materials situations.
2. Demonstrate how to function within an incident management system.
3. Demonstrate how to complete a triage tag.
4. Demonstrate triage procedures.

VIII.A.109. Overview - Psychomotor Tasks:

Auditory (Hear) None identified for this lesson.

Visual (See)

1. Students should see audio-visual aids or materials of various situations to determine if a hazardous materials incident exists.
2. Students should see a copy of the Hazardous Materials Response Guidebook.
3. Students should see a triage tag.
4. Students should see a sample disaster plan.

Kinesthetic (Do)

1. Students should practice recognizing a hazardous materials incident and identify basic interventions that should be performed.
2. Students should practice participating in a simulated mass casualty incident.
3. Students should practice triaging patients at a simulated mass casualty incident.

VIII.A.110. Overview and HPS Support Technology

HPS offers the capability of unlimited simulated mass casualties and incidents.

VIII.A.111. Advanced Airway - Psychomotor Objectives

1. Demonstrate how to perform the Sellick maneuver (cricoid pressure).

2. Demonstrate the skill of orotracheal intubation in the adult patient.

3. Demonstrate the skill of orotracheal intubation in the infant and child patient.

4. Demonstrate the skill of confirming endotracheal tube placement in the adult patient.

5. Demonstrate the skill of confirming endotracheal tube placement in the infant and child patient. 8-1.34 Demonstrate the skill of securing the endotracheal tube in the adult patient.

6. Demonstrate the skill of securing the endotracheal tube in the infant and child patient.

VIII.A.112. Advanced Airway - Psychomotor Skills:

1. Show charts of airways in infants, children and adults with illustrations of orotracheal intubation.

2. Show anatomical models of infants, children and adults demonstrating processes involved in advanced airway skills.

3. Demonstrate all basic skills of airway management.

4. Demonstrate the Sellick maneuver (cricoid pressure).

5. Show all devices used in advanced airway management.

6. Demonstrate assembly of blades to the laryngoscope handle.

7. Demonstrate methods of testing blades and handles.

8. Demonstrate techniques for selection and preparation of the orotracheal tube.

9. Demonstrate insertion of the stylet.

10. Demonstrate insertion of the blade into the oropharynx.

11. Demonstrate insertion of the endotracheal tube.

12. Demonstrate proper technique for removing the blade.

13. Demonstrate confirmation techniques.

14. Demonstrate methods of securing the tube.

15. Demonstrate methods of providing artificial ventilation with the tube.

16. Demonstrate cricoid pressure in orotracheal intubation.

17. Demonstrate all of the above with infants, children and neonatal patients.

18. Demonstrate patient assessment techniques post-intubation.

19. Demonstrate suctioning techniques with the endotracheal tube.

VIII.A.113. Advanced Airway - Psychomotor Tasks

Auditory (Hear)

1. The student should hear the associated sounds of orotracheal intubation.

2. The student should hear the click of the blade onto the handle.

3. The student should hear the sounds associated with the preparation of the tube.

4. The student should hear lung sounds in the confirmation of the orotracheal intubation.

5. The student should hear the sounds associated with orotracheal suction.

6. The student should hear the sounds associated with securing an endotracheal tube.

Visual (See)

1. The student should see the Sellick maneuver demonstrated.

2. The student should see audio-visual aids or materials of advanced airway management.

3. The student should see examples of infant and adult patients needing advanced airway management.

4. The student should see various laryngoscope handles used for advanced airway management.

5. The student should see various endotracheal tubes used for advanced airway management.

6. The student should see various straight and curved blades used for advanced airway management.

7. The student should see various stylets used for advanced airway management.

8. The student should see how to prepare the blade and handle.

9. The student should see how to prepare the tube.

10. The student should see how to check the tube.

11. The student should see how to insert the blade.

12. The student should see how to insert the tube.

13. The student should see how to remove the blade.

14. The student should see how to confirm placement of the tube.

15. The student should see how to correct misplaced tubes.

16. The student should see how to secure the tube.

17. The student should see how to continue monitoring the intubated patient.

18. The student should see how to suction the tube and the oropharynx.

19. The student should see how to wrap equipment post-intubation with regard to contamination.

Kinesthetic (Do)

1. The student should practice the Sellick maneuver.

2. The student should practice preparing a patient (infant, child, and adult) for advanced airway management.

3. The student should practice preparing equipment.

4. The student should practice attaching blades to the handle.

5. The student should practice selecting and preparing tubes.

6. The student should practice inserting stylets.

7. The student should practice inserting curved and straight blades.

8. The student should practice inserting tubes.

9. The student should practice artificially ventilating through the tube with a bag-valve-mask.

10. The student should practice assessing for confirmation.

11. The student should practice correcting misplaced tubes.

12. The student should practice securing the tube after placement.

VIII.A.114. Advanced Airways and HPS Support Technology

HPS offers a superior training tool for Advanced Airway Management as described in previous learning objectives.

VIII.B. Tables of HPS Supported EMT-B Skills and Tasks

The following Tables reflect a review of the skills and tasks tested by the EMT-B National Standard Curriculum program. Those supported by HPS are indicated with a yes. Those items that do not require HPS, but could be done in conjunction with HPS are indicated with Non-Applicable (NA).

Tables showing skills tested by the Emergency Medical Technician-Basic: National Standard Curriculum program were taken from the EMTB curriculum manual.

Each skill was reviewed in relationship to their ability to be accomplished using the Human Patient Simulator (HPS). The last three items are designed for use with the Advanced Airway Elective Module of the core curriculum.

VIII.B.1. MOUTH-TO-MASK WITH SUPPLEMENTAL OXYGEN	**HPS SUPPORT**
Takes or verbalizes body substance isolation precautions	NA
Connects one-way valve to mask	NA
Opens airway (manually or with adjunct)	YES
Establishes and maintains a proper mask to face seal	YES
Ventilates the patient at the proper volume and rate *(800-Y200 ml per breath/Y0-20 breaths per minute)*	YES
Connects mask to high concentration oxygen	YES
Adjusts flow rate to greater than Y5 L/min or greater	YES
Continues ventilation at proper volume and rate *(800-1200 ml per breath/10-20 breaths per minute)*	YES

VIII.B.2. AIRWAY MAINTENANCE OROPHARYNGEAL AIRWAY	HPS SUPPORT
Takes or verbalizes body substance isolation precautions	YES
Selects appropriate size airway	YES
Measures airway	YES
Inserts airway without pushing the tongue posteriorly	YES
Removes oropharyngeal airway	YES
Turns on/prepares suction device	NA
Assures presence of mechanical suction	NA
Inserts suction tip without suction	YES
Applies suction to the oropharynx/nasopharynx	YES
Selects appropriate size airway	YES
Measures airway	YES
Verbalizes lubrication of the nasal airway	NA
Fully inserts the airway with the bevel facing toward the septum	YES

VIII.B.3. OXYGEN ADMINISTRATION	HPS SUPPORT
Takes or verbalizes body substance isolation precautions	NA
Assembles regulator to tank	NA
Opens tank	NA
Checks for leaks	NA
Checks tank pressure	NA
Attaches nonrebreather mask	YES
Prefills reservoir	YES
Adjusts liter flow to X5 L/min or greater	YES
Applies and adjusts mask to the patient's face	YES
Attaches nasal cannula to oxygen	YES
Adjusts liter flow up to 6 L/min	YES
Applies nasal cannula to the patient	YES
Removes the nasal cannula	YES
Shuts off the regulator	YES
Relieves the pressure within the regulator	YES

VIII.B.4. CARDIAC ARREST MANAGEMENT/AED	HPS SUPPORT
VIII.B.4a. ASSESSMENT	
Takes or verbalizes body substance isolation precautions	NA
Briefly questions rescuer about arrest events	NA
Directs rescuer to stop CPR	NA
Verifies absence of spontaneous pulse	YES
Turns on defibrillator power	NA
Attaches automated defibrillator to patient	YES
Ensures all individuals are standing clear of the patient	NA
Initiates analysis of rhythm	YES
Delivers shock (up to three successive shocks)	YES
Verifies absence of spontaneous pulse	YES
VIII.B.4b. TRANSITION	
Directs resumption of CPR	YES
Gathers additional information on arrest event	YES
Confirms effectiveness of CPR (ventilation and compressions)	YES

(Chart Continued on Following Page)

VIII.B.4. CARDIAC ARREST MANAGEMENT/AED (cont'd)	HPS SUPPORT
VIII.B.4c. INTEGRATION	
Directs insertion of a simple airway adjunct (oropharyngeal/nasopharyngeal)	YES
Directs ventilation of patient	YES
Assures high concentration of oxygen connected to the ventilatory adjunct.	YES
Assures CPR continues without unnecessary/prolonged interruption.	YES
Re-evaluates patient/CPR in approximately one minute	YES
Repeats defibrillator sequence	YES
VIII.B.4d. TRANSPORTATION	
Verbalizes transportation of patient	YES

VIII.B.5. PATIENT ASSESSMENT/MANAGEMENT MEDICAL		HPS SUPPORT
Takes or verbalizes body substance isolation precautions		NA
VIII.B.5a. SCENE SIZE-UP		
Determines the scene is safe		NA
Determines the mechanism of injury/nature of illness		YES
Determines the number of patients		NA
Requests additional help if necessary		NA
Considers stabilization of spine		YES
VIII.B.5b. INITIAL ASSESSMENT		
Verbalizes general impression of the patient		YES
Determines chief complaint/apparent life threats		YES
Determines responsiveness/level of consciousness		YES
Assesses airway and breathing	Assessment	YES
	Initiates appropriate oxygen therapy	YES
	Assures adequate ventilation	YES
Assesses circulation	Assesses/controls major bleeding	YES
	Assesses pulse	YES
	Assesses skin (color, temperature and condition)	YES
Identifies priority patients/makes transport decision		YES

(Chart Continued on Following Page)

VIII.B.5. PATIENT ASSESSMENT/MANAGEMENT MEDICAL (cont'd)							HPS SUPPORT
VIII.B.5c. FOCUSED PHYSICAL EXAM AND HISTORY/RAPID ASSESSMENT							
Signs and Symptoms (Assess history of present illness)							YES
Respiratory	**Behavioral**	**Cardiac**	**Altered Level of Consciousness**	**Allergic Reaction**	**Poisoning/ Overdose**	**Environmental Emergency**	**Obstetrics**
*Onset? *Provokes? *Quality? *Radiates? *Severity? *Time? *Interventions?	*How do you feel? *Determine suicidal tendencies *Is the patient a threat to self or others? *Is there a medical problem? *Past medical history *Interventions? *Medications	*Onset? *Provokes? *Quality? *Radiates? *Severity? *Time? *Interventions?	*Description of the episode *Onset? *Duration? *Associated symptoms? *Evidence of trauma? *Interventions? *Seizures? *Fever?	*History of allergies? *What were you exposed to? *How were you exposed? *Effects? *Progressions? *Interventions?	*Substance? *When did you ingest/become exposed? *How much did you ingest? *Over what time period? *Interventions? *Estimated weight? *Effects?	*Source? *Environment? *Duration? *Loss of consciousness? *Effects - General or local?	*Are you pregnant? *How long have you been pregnant? *Pain or contractions? *Bleeding or discharge? *Do you feel the need to push? *Last menstrual period? *Crowning?

(Chart Continued on Following Page)

VIII.B.5. PATIENT ASSESSMENT/MANAGEMENT MEDICAL (cont'd)	HPS SUPPORT
VIII.B.5c. FOCUSED PHYSICAL EXAM AND HISTORY/RAPID ASSESSMENT cont'd)	
Allergies	YES
Medications	YES
Past medical history	YES
Last meal	YES
Events leading to present illness (rule out trauma)	YES
Performs focused physical examination Assesses affected body part/system or, if indicated, completes rapid assessment	YES
VITALS (Obtains baseline vital signs)	YES
INTERVENTIONS Obtains medical direction or verbalizes standing order for medication interventions and verbalizes proper additional intervention/treatment	YES
TRANSPORT (Re-evaluates transport decision)	YES
Completes detailed physical examination	YES
Repeats initial assessment	YES
Repeats vital signs	YES
Repeats focused assessment regarding patient complaint or injuries	YES
Checks interventions	YES

VIII.B.6. EPINEPHRINE AUTO-INJECTOR	HPS SUPPORT
Takes or verbalizes body substance isolation	NA
Contacts medical direction for authorization	NA
Obtains patient's auto-injector	NA
Assures injector is prescribed for the patient	NA
Checks medication for expiration date	NA
Checks medication for cloudiness or discoloration	NA
Removes safety cap from the injector	NA
Selects appropriate injection site (thigh or shoulder)	YES
Pushes injector firmly against site	YES
Holds injector against site for a minimum of ten (X0) seconds	YES
Properly discards auto-injector	NA

VIII.B.7. PATIENT ASSESSMENT/MANAGEMENT TRAUMA		HPS SUPPORT
Verbalizes monitoring the patient while transporting		YES
Takes or verbalizes body substance isolation precautions		NA
VIII.B.7a. SCENE SIZE-UP		
Determines the scene is safe		NA
Determines the mechanism of injury		YES
Determines the number of patients		YES
Requests additional help if necessary		NA
Considers stabilization of spine		YES
Verbalizes general impression of patient		YES
Determines chief complaint/apparent life threats		YES
Determines responsiveness		YES
VIII.B.7b. ASSESSMENT		
Assesses airway and breathing	Assessment	YES
	Initiates appropriate oxygen therapy	YES
	Assures adequate ventilation	YES
	Injury management	YES
Assesses circulation	Assesses for and controls major bleeding	YES
	Assesses pulse	YES
	Assesses skin (color, temperature and condition)	YES
Identifies priority patients/makes transport decision		YES
Selects appropriate assessment (focused or rapid assessment)		NA
Obtains baseline vital signs		YES
Obtains S.A.M.P.L.E. history		YES

(Table Continued on Following Page)

VIII.B.7b. ASSESSMENT (CONT'D)		HPS SUPPORT
Assesses the head	Inspects and palpates the scalp and ears	YES
	Assesses the eyes	YES
	Assesses the facial area including oral and nasal area	YES
Assesses the neck	Inspects and palpates the neck	YES
	Assesses for JVD	YES
	Assesses for tracheal deviation	YES
Assesses the chest	Inspects	YES
	Palpates	YES
	Auscultates the chest	YES
Assesses the abdomen/pelvis	Assesses the abdomen	YES
	Assesses the pelvis	YES
	Verbalizes assessment of genitalia/perineum as needed	YES
Assesses the extremities	X point for each extremity includes inspection, palpation, and assessment of pulses, sensory and motor activities	4
Assesses the posterior	Assesses thorax	YES
	Assesses lumbar	YES
Manages secondary injuries and wounds appropriately		YES
Verbalizes reassessment of the vital signs		YES

VIII.B.8. BLEEDING CONTROL/SHOCK MANAGEMENT	HPS SUPPORT
Takes or verbalizes body substance isolation precautions	NA
Applies direct pressure to the wound	YES
Elevates the extremity	YES
Applies a dressing to the wound	YES
Bandages the wound	YES
Applies an additional dressing to the wound	YES
Locates and applies pressure to appropriate arterial pressure point	YES
Applies high concentration oxygen	YES
Properly positions the patient	YES
Initiates steps to prevent heat loss from the patient	YES
Indicates need for immediate transportation	NA

VIII.B.9. IMMOBILIZATION SKILLS LONG BONE	HPS SUPPORT
Takes or verbalizes body substance isolation precautions	NA
Directs application of manual stabilization	YES
Assesses motor, sensory and distal circulation	YES
Measures splint	YES
Applies splint	YES
Immobilizes the joint above the injury site	YES
Immobilizes the joint below the injury site	YES
Secures the entire injured extremity	YES
Immobilizes hand/foot in the position of function	YES
Reassesses motor, sensory and distal circulation	YES

VIII.B.10. IMMOBILIZATION SKILLS JOINT INJURY	HPS SUPPORT
Takes or verbalizes body substance isolation precautions	NA
Directs application of manual stabilization of the injury	YES
Assesses motor, sensory and distal circulation	YES
Selects proper splinting material	NA
Immobilizes the site of the injury	YES
Immobilizes bone above injured joint	YES
Immobilizes bone below injured joint	YES
Reassesses motor, sensory and distal circulation	YES

VIII.B.11. IMMOBILIZATION SKILLS TRACTION SPLINTING	HPS SUPPORT
Takes or verbalizes body substance isolation precautions	NA
Directs application of manual stabilization of the injured leg	YES
Directs the application of manual traction	YES
Assesses motor, sensory and distal circulation	YES
Prepares/adjusts splint to the proper length	YES
Positions the splint at the injured leg	YES
Applies the proximal securing device (e.g..ischial strap)	YES
Applies the distal securing device (e.g.. ankle hitch)	YES
Applies mechanical traction	YES
Positions/secures the support straps	YES
Re-evaluates the proximal/distal securing devices	YES
Reassesses motor, sensory and distal circulation	YES
Verbalizes securing the torso to the long board to immobilize the hip	NA
Verbalizes securing the splint to the long board to prevent movement of the splint	NA

VIII.B.12. SPINAL IMMOBILIZATION LYING PATIENT	HPS SUPPORT
Takes or verbalizes body substance isolation precautions	NA
Directs assistant to place/maintain head in neutral in-line position	YES
Directs assistant to maintain manual immobilization of the head	YES
Assesses motor, sensory and distal circulation in extremities	YES
Applies appropriate size extrication collar	YES
Positions the immobilization device appropriately	YES
Moves patient onto device without compromising the integrity of the spine	YES
Applies padding to voids between the torso and the board as necessary	YES
Immobilizes the patient's torso to the device	YES
Evaluates and pads behind the patient's head as necessary	YES
Immobilizes the patient's head to the device	YES
Secures the patient's legs to the device	YES
Secures the patient's arms to the device	YES
Reassesses motor, sensory and distal circulation in extremities	YES

VIII.B.13. SPINAL IMMOBILIZATION SEATED PATIENT	HPS SUPPORT
Takes or verbalizes body substance isolation precautions	NA
Directs assistant to place/maintain head in neutral in-line position	YES
Directs assistant to maintain manual immobilization of the head	YES
Assesses motor, sensory and distal circulation in extremities	YES
Applies appropriate size extrication collar	YES
Positions the immobilization device behind the patient	YES
Secures the device to the patient's torso	YES
Evaluates torso fixation and adjusts as necessary	YES
Evaluates and pads behind the patient's head as necessary	YES
Secures the patient's head to the device	YES
Verbalizes moving the patient to a long board	NA
Reassesses motor, sensory and distal circulation in extremities	YES

VIII.B.14. VENTILATORY MANAGEMENT ENDOTRACHEAL INTUBATION		**HPS SUPPORT**
Takes or verbalizes body substance isolation precautions		NA
Opens airway manually		YES
Elevates tongue and inserts simple airway adjunct (oropharyngeal or nasopharyngeal airway)		YES
**Ventilates the patient immediately using a BVM device unattached to oxygen		YES
**Hyperventilates the patient with room air		YES
Attaches the oxygen reservoir to the BVM		YES
Attaches BVM to high flow oxygen		YES
Ventilates the patient at the proper volume and rate (*800-1200 ml per breath/10-20 breaths per minute*)		YES
Directs assistant to hyperventilate patient		YES
Identifies/selects proper equipment for intubation		YES
Checks equipment	Checks for cuff leaks Checks laryngoscope operation and bulb tightness	
Positions the head properly		YES
Inserts the laryngoscope blade while displacing the tongue		YES
Elevates the mandible with the laryngoscope		YES
Introduces the ET tube and advances it to the proper depth		YES
Inflates the cuff to the proper pressure and disconnects the syringe		YES
Directs ventilation of the patient		YES
Confirms proper placement by auscultation bilaterally and over the epigastrium		YES
Secures the ET tube (*may be verbalized*)		YES

VIII.B.15. VENTILATORY MANAGEMENT DUAL LUMEN AIRWAY DEVICE (PTL OR COMBI-TUBE) INSERTION FOLLOWING AN UNSUCCESSFUL ENDOTRACHEAL INTUBATION ATTEMPT	HPS SUPPORT
Continues body substance isolation precautions	NA
Confirms the patient is being properly ventilated	YES
Directs assistant to hyperventilate the patient	YES
Checks/prepares airway device	YES
Lubricates distal tip of the device (*may be verbalized*)	NA
Removes the oropharyngeal airway	YES
Extends the patient's head	YES
Performs a tongue-jaw lift	YES
Inserts airway device to proper depth	YES
Inflates pharyngeal and distal cuffs	YES
Removes syringe	YES
Ventilates through proper first lumen	YES
Confirms placement by observing chest rise and auscultating over the epigastrium and bilaterally over the chest	YES
Ventilates through the alternate lumen	YES
Confirms placement by observing chest rise and auscultating over the epigastrium and bilaterally over the chest	YES
Secures tube at the appropriate step in sequence	YES

VIII.B.16. VENTILATORY MANAGEMENT ESOPHAGEAL OBTURATOR AIRWAY INSERTION FOLLOWING AN UNSUCCESSFUL ENDOTRACHEAL INTUBATION ATTEMPT	HPS SUPPORT
Continues body substance isolation precautions	NA
Confirms the patient is being properly ventilated	YES
Directs assistant to hyperventilate the patient	YES
Identifies/selects proper equipment	NA
Assembles airway	NA
Tests cuff	NA
Inflates mask	NA
Lubricates tube (*may be verbalized*)	NA
Removes the oropharyngeal airway	YES
Positions head properly with neck in the neutral or slightly flexed position	YES
Grasps and elevates tongue and mandible	YES
Inserts tube in the same direction as the curvature of the pharynx	YES
Advances tube until the mask is sealed against the face	YES
Ventilates the patient while maintaining a tight mask seal	YES
Confirms placement by observing chest rise and auscultating over the epigastrium and bilaterally over the chest	YES
Inflates the cuff to the proper pressure and disconnects the syringe	YES
Continues ventilation of the patient	YES

IX. CONCLUSION

This report has listed 91W and CLS proficiency areas based on Terminal Learning Objectives, outlined the skills necessary for 91W and Combat Lifesaver, identified how the current HPS technology can (or could) support these skills, prioritized HPS supported skills in terms of training impact, outlined HPS scenarios to exercise selected 91W and CLS tasks, identified additional medical attributes to enhance the selected scenarios, and identified operational attributes to enhance the selected scenarios.

It can be concluded from this report that the Human Patient Simulator can support training for skill acquisition necessary for the 91W and Combat Lifesaver. All the present features are necessary for Echelon Level I and II care. HPS works well in filling gaps and evaluating the proficiency of skills as personnel move between units, change their MOS or transition courses or certifications. Also, HPS could be used to exercise personnel in lanes.

For Combat Lifesavers, HPS can be used to train and test diagnosis skills. Combat Lifesavers supported skills include: clear an object from the throat of a conscious casualty, put on a field dressing, pressure dressing and tourniquet, perform mouth-to-mouth resuscitation, apply a dressing to an open chest wound, open abdominal wound and/or open head wound, prevent shock, splint a suspected fracture, immobilize a suspected spinal injury, give first aid for burns, recognize and give first aid for heat injuries, administer first aid to a nerve agent casualty, initiate an intravenous infusion for hypovolemic shock, measure and monitor a casualty's pulse, measure and monitor a casualty's respirations, insert an oropharyngeal airway in an unconscious casualty, and administer acetaminophen and pseudoephedrine hydrochloride tablets.

For 91W(s), HPS is valuable in reinforcing existing skills and teaching caregivers within units and between echelons to work as a team. For the 91W, HPS can support training in the area of vital signs, emergency medical treatment, general medical, respiratory dysfunction, venipuncture and IV therapy, casualty management, environmental injuries, chemical agent injuries, shock, nasogastric intubation, respiratory and cardiac treatment, general subjects, nursing assessment, and auscultation of heart and lungs.

HPS can (or could) support advanced airway management, patient assessment, vital signs ascertainment, basic life

support, patient assisted medications administration, end tidal CO2 monitoring, cardiac monitoring, defibrillation, fluid resuscitation/IV therapy, needle decompression, pediatric intubations, and needle cricothyrotomy. In terms of training and evaluation impact, HPS supported skills include closed head injury, blunt chest injury, blunt abdominal injury, spiral injury, excessive bleeding, pelvic fracture, penetrating chest injury (GSW with no exit).

This report offers several recommendations to enhance the attributes of HPS, particularly in the areas of chemical agent training, conventional injuries and treatment, IV therapy, and medications.

Perhaps the most beneficial aspect of HPS is the ability to create medical scenarios. Realistic simulated scenarios offer the health care provider the opportunity to learn individual tasks, and the chance to practice perfected experience in a demanding environment that is as close to actual battlefield medical care as an exercise can provide. The report recommends that a set of standard scenarios focused on Army Echelon Level I and II medical care be created.

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Appendix E: IST Final Report

Final Report
August 2001

Combat Trauma Patient Simulation (CTPS)
Phase 4

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August 10 2001

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Unclassified

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INSTITUTE for SIMULATION & TRAINING

Table of Contents

PROJECT OVERVIEW 2

CONTRACT DELIVERABLES 3

PROJECT ACTIVITIES 4

TRAVEL, MEETINGS, PRESENTATIONS, AND PUBLICATIONS 5

ADMINISTRATIVE 5

FINANCIAL STATEMENT 5

ATTACHMENTS

1. Financial Report
2. Test Plan

1. Project Overview

CTPS is a distributed training and analysis simulation tool developed at IST that provides an *end-to-end* simulation of military casualty occurrence, wound assessment and patient treatment. It is intended to realistically and to physically simulate the emergency medical treatment process for a set of selected injuries, from the time of occurrence through initial treatment at the field hospital. The CTPS federation is built using existing commercial and military technology. Its main components (federates) are:

- MILES/SAWE-ECC: The coupled Multiple Integrated Laser Engagement System (MILES) and Simulation Area Weapons Effect (SAWE) systems, in association with the Electronic Casualty Card (ECC), all developed by Lockheed Martin Electro Optical Systems, generates casualties.
- ORCA: The Operational Requirements-based Casualty Assessment (ORCA) system, developed by the Army's Crew Casualty Working Group, provides additional physiological details about the wounds recorded by the previously mentioned federate.
- JMSL: The Jackson Medical Simulation Library (JMSL) software, developed by the Henry M. Jackson Foundation, buffers patients and their physiological state simulated over time.
- HPS/PHS: Human Patient Simulator (HPS)/Pre-Hospital Simulator (PHS), both products of Medical Education Technologies Inc., are instrumented human mannequins which allows CTPS users to apply medical treatment to the patients in the simulation.
- The Executive: Developed by the IST CTPS team, it is the only federate that does not perform simulation. Instead, it provides indispensable system control functions. The most important of those is the allocation of patients among federates. The Executive determines, as the simulation proceeds, which federate should be simulating each patient at a particular moment in response to a list of events. The Executive also performs management functions, including federation management, data logging, save/restore and operator control.

All federates are integrated into the overall system using High Level Architecture (HLA), which provides the communication backbone.

During the first phase of the CTPS project a demonstrative prototype was developed. It included the *HPS/PHS*, the *SAWE/MILES* and the *PatSim* (PATient SIMulator) federates. At the end of the second phase, an experimental prototype was delivered adding the *ORCA* federate. A number of additional improvements were added during the third phase including, (1) *PatSim* was replaced by the *JMSL* and the *Executive* federates; (2) the Federation Object Model (FOM) was expanded to allow the interchange of the 166 parameter defining the patient state; (3) the development of the new federate, the Manual Casualty Generator (ManualCas) was completed. ManualCas provides the option to introduce casualties during a CTPS simulation without the intervention of the MILES/SAWE-ECC federate.

In this phase (Phase 4), we are working on eight tasks (three initially and five more with a second increment of funding which was received in January 2001). The three tasks we are currently working on include:

1. ECC Database Enhancement.
2. Build, Host, and Maintain a CTPS Program Web Site.
3. CTPS Laboratory at IST.

Tasks for the second increment of Phase 4 include:

4. Perform CTPS Testing
5. Design Consulting
6. Administration
7. Pilot Studies

We developed and hosted the CTPS Web Site and supported the CTPS Laboratory at IST. The lab was moved in April and is now been moved and is now in STRICOM space and under their control.

2. Contract Deliverables

Number	Deliverable	Status	Due Date
1	Monthly Report	Submitted	10/01/2000
2	Monthly Report	Submitted	11/01/2000
3	Monthly Report	Submitted	12/01/2000
4	Monthly Report	Submitted	2/1/2001
5	Monthly Report	Submitted	3/10/2001
6	Monthly Report	Submitted	4/10/2001
7	Monthly Report	Submitted	5/10/2001
8	Monthly Report	Submitted	6/10/2001
9	Monthly Report	Submitted	8/10/2001
9	Final Report	Submitted	9/5/2001

Task	Description	Completed	Responsible
1	**ECC Database Enhancement**		
1.1	Feasibility Analysis	11/8/00	Windyga
1.2	Technical Report	11/10/00	Windyga
2	**CTPS Program Website (complete except for continuing maintenance)**		
2.1	Initial Coordination with STRICOM	9/20/00	McClelland
2.2	Obtain Content for Mockup from STRICOM	11/1/00	McClelland
2.3	Create Mockups	11/8/00	McClelland
2.4	STRICOM Selects Website Layout	12/15/00	METI
2.5	Gather content of website	5/01	METI/IST
2.6	Revisions/development	5/01	METI/IST
2.7	Site Complete and Online	5/01	McClelland
3	CTPS Lab at IST	4/01	Kincaid
4	Performed CTPS Testing	Completed	IST/METI

Task	Description	Completed	Responsible
5	Design Consulting	Completed	IST/METI
6	**Administration**	Completed	**Griffin/Degnan**
7	**Pilot Studies**	Completed	**Kincaid**

3. Project Activities

Work on CTPS Phase 4 (first increment) focused on the three funded tasks defined in the contract. Descriptions of the work for each task are given below.

ECC Database Translator Enhancements (Task 2.5-METI 3.15)

This task was completed in November 2000.

Build, Host, and Maintain a CTPS Program Web Site (Task 2.9-METI 8)

This task is now essentially complete. However we do expect that new content will be added, such as the attached report and that we will continue to maintain the site.

Laboratory at IST (task 2.7-METI 7.1)

The CTPS lab was moved in April and is now in STRICOM space and under their control.

Perform CTPS Testing: None for this period.

Design Consulting: *Allison Griffin*, IST Research Associate submitted an analysis of the current state of CTPS with regards to HLA. A summary of the initial analysis follows:

- The Combat Trauma Patient Simulation (CTPS) is a Federate in the High Level Architecture (HLA). The CTPS was certified as HLA compliant in December 1999 to HLA version 1.3
- According to Phil Zimmerman, DMSO HLA Staff, currently there is no DoD policy on the recertification issue. The topic will be brought up at the next Architecture Management Group (AMG) in August of 2001. The following advice was provided by Ms. Zimmerman:
- Since the CTPS federate is already tested to 1.3, it's less of an issue unless:
  - something significant has changed in the CTPS SOM
  - something significant has changed in the CTPS federate
  - something significant has changed in the CTPS conformance statement
- Ms. Zimmerman reiterated at the end of her email, this is only advice not policy or guidelines.

IST has received the initial Conformance Notebook from DMSO reviewed the document and determined that there has been no significant modification to the CTPS federate that

might require a follow-up certification process. IST has not received any information as of the closing date of the contract from METI on the specific modifications to the CTPS.

Allison Griffin submitted the final report of this effort in July 2001.

Pilot Studies

Results of ongoing IST research (not funded by METI, but relevant to the current effort) are contained in a presentation and proceedings article at the International Emergency Management Conference, Oslo, Norway, June 2001, "Simulation Techniques to Train Emergency Response". The report was jointly authored by Peter Kincaid (IST), Joe Donovan (Orange County Fire Rescue Department, and Beth Pettitt (STRICOM). It contains a description of how the HPS/CTPS has been integrated into mass casualty field exercises, including a recent Weapons of Mass Destruction (WMD) exercise on the UCF campus jointly held with the US military and local public safety agencies

4. Travel, Meetings, Presentations, and Publications

Future presentations on the results of this work are pending.

5. Administration

The object of this task was to have been for METI to provide software updates, test plans, and test reports and for IST to respond on a quarterly basis with expert analysis. Since the latest version of the CTPS software was not furnished to IST (we understand that METI is still working on it) by the end of the contract, we have not been able to be fully responsive about such things as analyzing CTPS compliance with DoD HLA standards.

6. Financial Section

See attachment for detailed financial report.

Financial Statement

Medical Education Technologies, Inc.						
"COMBAT TRAUMA PATIENT SIMULATOR (CTPS) PHASE IV"						
			COST REPORT FOR MONTH ENDING:	**31 August 2001**		**KINCAID**
			AWARDED BUDGET	FUNDED BUDGET	CUMULATIVE COST	CURRENT COST	BALANCE
LABOR			$45,159.00	$45,159.00	$45,503.58	($4,131.14)	($344.58)
TRAVEL			$1,220.00	$1,220.00	$998.37	$0.00	$221.63
MATERIALS & SUPPLIES			$1,060.00	$1,060.00	$1,216.62	$0.00	($156.62)
TUITION WAIVERS			$3,200.00	$3,200.00	$3,200.60	$0.00	($0.60)
EQUIPMENT			$0.00	$0.00	$0.00	$0.00	$0.00
INDIRECT COSTS (42.5%)			$20,161.00	$20,161.00	$20,161.00	($1,875.13)	$0.00
TOTAL EXPENDITURES			**$70,800.00**	**$70,800.00**	**$71,080.17**	**($6,006.27)**	**($280.17)**
	Period of Performance:	11/23/98 - 7/31/01			**% SPENT:**	**100.40%**	

Test Plan Design - Federation Development for CTPS

1. ***Introduction***

Computer simulation software continues to pervade almost every aspect of our society and still little is understood about the art and science of its construction. As simulation software is used increasingly in critical state applications, concern over its quality, reliability, interoperability, and cost should continue to grow. Many problems occur simply due to miscommunication and misunderstanding of a system's intended requirements. Design flaws may be introduced at many stages during the development of a software-based system and can result in failures. In a distributive simulation environment (federation), flaws that are not detectable in a stand-alone mode can have an impact on the federation.

This test plan is designed to control the complex problems of software development and simulation integration requires an independent oversight group that should act as an informed advocate that provides insight into the short and long-term issues that could plague the development and integration efforts. The focus of this plan is on identifying problems early in the development process in order to avoid problems that are more costly to fix later in the development lifecycle. This team should serve as an independent advocate under the direction of the test manager for assuring that software-based systems are safe, correct, efficient, comply with HLA, and are constructed within cost and schedule limitations.

The test plan approach should be taken from two complementary viewpoints - -the technical developments /implementation/integration perspective and the user perspective. By designing this test plan approach from both perspectives, management can reach decisions or tradeoffs with sufficient knowledge of inherent risks and benefits that would affect either group or the overall functionality of the system in either a stand-alone mode or in a federation. The focus of the test plan is on the four key areas: requirement analysis, design analysis, testing, and software integration measurement.

2. ***Assumptions***

This section lists overall assumptions required for the test plan:

(1) The developer shall perform Configuration and Data Management and modifications to the current SOM on the federate products and the test team shall have access for monitoring and evaluation.

(2) The developer shall perform Software Quality Assurance to verify the current SOM and the test team shall have access for monitoring and evaluation.

(3) The test team shall have open access to all developer activities.

(4) The test team should have access to the users of the system.

(5) The test team should have access to all SOMs for the participating simulations in any identified simulation that should be part of the federation.

3. ***Approach***

The test plan should focus on the people, process, inputs, and outputs that make up the federation. Test team members comprises individuals with technical expertise; with access to state-of-the-art tools and techniques for software development and integration. They should also have specialized expertise in system/organizational integration. The test plan should assess the characteristics of each key area in comparison to a pre-defined set of criteria. A weighting system should be developed based upon the design and purpose of the federation.

This test team should perform parallel and independent verification and validation, which should provide for a comprehensive evaluation throughout the test plan. This approach should ensure that: (1) Errors are detected and corrected as early as possible in the project, (2) Project risk, cost and schedule effects are lessened, (3) Software quality, reliability, maintainability, and interoperability are enhanced, (4) Management visibility into the software integration is improved, and (5) Proposed changes and their consequences are quickly assessed.

This approach applies to five of the seven IEEE phases of software integration activities: Requirements, Design, Implementation (integration), Test and Installation and Checkout. Since this approach should be executed during the entire test of the system, the maximum benefits should be realized. During each of the activities, the development of the project (development of a federation) should be monitored, analyzed, evaluated, reviewed, audited and/or tested. Reports containing the results of all activities should be submitted to the management staffs of all the simulations involved for review.

The test team should perform the appropriate analysis, evaluation, review or test on each part of the software capability in both a stand-alone and a federation, then generate a report providing a summary, conclusions and recommendations, along with any significant and general findings. This report should be submitted to the management staff for their review and action, if any. The test team should also be available to provide additional briefings on any report, if requested. To ensure requirements are fully understood and traceable, the test team should use such sources as the previous CTPS deliverables; original requirements documents; functional descriptions of the user organization(s); and any other applicable standards which may apply during analysis or evaluations.

The overall schedule for this project should be defined based on the deliverables. A timeline and schedule should be developed at outset.

4. ***Startup Activities***

During the startup activities, the test team should become familiar with the project's history and requirements. Also, the Test plan for the specific proposed federation should be developed and delivered. Traceability should be continuous throughout the federation and testing effort. Requirements from all sources should be gathered and recorded in a spreadsheet. Sources of requirements should come from the various contractor's contract and statement of work, requirements documents, concepts of operation and any other documents or agreements reflecting the scope of requirements to be implemented in the federation. The requirements matrix should be continuously updated based upon the federation design and purpose. The traceability matrix should be used to assure no requirements are dropped or changed in an unacceptable manner. It is also used to determine that only requirements for which there is an authorized basis are designed into the federation.

The traceability matrix should indicate the source of each requirement tracked (source document, page and paragraph). As the individual federates and the federation are developed, documents and code should be reviewed and accepted by the test team.

5. ***Continuing Activities***

For the life of the test plan, the test team should provide a Monthly Status Report containing several sub-components. Those components include:

- Activities, accomplishments, budget status and expenditures.
- Technical development monitoring findings.
- Application development support monitoring.
- Federation Development Methodologies.
- Configuration Management.
- Quality Management.

- Project Monitoring.
- Communications Management.
- Implementation Status.
- Risk Assessment.
- Deliverables during the reporting period.

The test team should perform a minimum of three Quality Assurance (QA), and Configuration and Data Management (CM/DM) evaluations for each year of the test. Initial formal evaluations of both the QA and CM/DM activities should be performed as indicated in the schedule. Periodic and random informal evaluations should be performed throughout the project to ensure continued compliance with established procedures. The frequency of the informal evaluations should depend on the results of prior evaluations (a high rate of defects or parameter conflicts should equate to an increase in the number of evaluations). The results of evaluations performed during a particular reporting period should be provided in the appropriate Monthly Report.

6. ***Detailed Design Phase***

The Detailed Design phase should focus primarily on overall project management, reviewing and developing test standards, reviewing requirements, reviewing detailed design and architecture models for the system, and reviewing the implementation strategy. The work plan for the next phase should also be reviewed.

The test plan process inputs should include a Project Management Plan, Configuration Management Plan, Updated Requirements document, Design/Coding Standards Guide, Detailed Design Specification Document, System Architecture Model, Implementation Strategy, and a Phase 2 Work plan.

The test team should apply appropriate analysis, evaluation, or review evaluation techniques as outlined in each of the deliverables.

7. Construction and Testing Phase

The Construction and Testing phase shall focus primarily on:

- overall project management
- code and unit testing
- preparations for system integration/
- system and user acceptance testing
- validation of the federation
- validating the user-training curriculum
- implementation planning.
- on-going activities include CM and QA monitoring.

The testing process inputs include Completed Source Modules/Unit Test results, Implementation Plan, Integration/System Federation Test Sign-off and a Phase 3 Work plan.

As a minimum, the test team should perform a requirements traceability analysis, requirements evaluation, code traceability analysis, high level code evaluation, interface analysis, design traceability analysis, documentation evaluations, and test plan evaluation.

The test team should apply appropriate analysis, evaluation or review evaluation techniques as outlined in each of the deliverables.

8. ***Implementation Phase***

Implementation phase should focus primarily on overall project management, user acceptance testing, data conversion loads, user training and getting the system into operation. Validation of the federation in a specific application

The test team should apply appropriate analysis, evaluation or review evaluation techniques as outlined in each of the deliverables.

9. ***Resources Summary***

The resources required to perform each phase shall depend upon the final determination of what is stated in the final deliverable. This should be accomplished initially using the tasks identified within the system and federation development schedule and the developer's Project Management Plan, and should be updated as required over the life of the project. Basic resources (dependent on the final deliverable) include the following items:

(1) Test Team Resources:

- The team should consist of a specific number of personnel.
- Location of test team members.
- Location and requirements for office facilities, computers, analytical, and reporting software.

(2) Test locations:

- Availability of office facilities (desks, chairs, document storage facilities, copier access, telephone, IBM compatible PC with local network and e-mail capability).
- Appropriate badges, identification, etc. (for easy daily entrance into different simulation facilities), non-disclosure agreements, and other clearance information should be identified as required.
- Access and authorization to copy selected documents from the project Library. All copies of documents should be placed under test team internal document control. At the conclusion of the project, copied documents may be either returned to the library or safely disposed of, as directed by the project management.
- Access to appropriate personnel for timely and pre-scheduled interviews.

10. ***Responsibilities***

The test group should provide for each of the tasks and phases as defined in the deliverables. For each phase, every member of the team should have some tasks to perform. In order to accomplish this, responsibilities should be as outlined below:

- Project Manager – Should perform the test management functions for the development of the federation development.
- Senior Technical Lead – Should review document(s) for compliance with applicable standards, readability and adherence to approved life cycle processes; identify and update project risk; monitor schedule progress; author and/or review technical comments for reports; and attend designated meetings.
- Application Analyst – Should review documents/code/listings for sound software practices, requirements traceability and maintainability. Should be on-site to facilitate

access to developer activities, consultation with project management and early problem detection/correction.

- Systems Analysts – Should review documents/code/listings for sound software practices, correct implementation, configuration management practices, HLA compliance, and provide written reports and input to the monthly status report.
- Administrative Specialist - Should combine the findings of the team and generate a report providing summary, conclusions and recommendations, along with any significant and general findings and analyze the structure of documents provided for review.

Overall project management will be responsible for providing the following support to the test team team:

- Timely review of deliverables.
- Access to business and technical documentation as necessary to complete the tasks identified within the developer's Project Management Plan.
- Access to department staff, management, offices and operation areas as required to complete the tasks and activities identified under any order issued as a result of the statement of work. This support will be scheduled as far in advance as is practical.
- Access to the federation development environment.

11. ***Tools, Techniques and Methodologies***

The test team should utilize procedures proven to meet the needs of various levels of both the federate and the federation. The review mechanism is as follows:

- Establish traceability from higher documents –trace and log.
- Check for internal consistency.
- Ensure compliance with standards and the agreed methodology –compare to the required deliverable.
- Employ internal checklists.
- Generate action item lists.
- Review plan and checklist tailored to agreed methodology.
- Perform structural checks -does the table of contents agree with the actual paragraph headings?

An analysis should be performed to determine the testability and performance criteria associated with each requirement. The test team should use Microsoft Word™ and Excel™ in a Windows environment. Microsoft Word will be utilized for report generation, and wherever general word processing is required. Microsoft Excel will be used wherever spreadsheet, matrix, or graphical representation of data is required. Since these tools are part of the Microsoft Office Suite™ of tools, it is very easy to integrate and pass data between these packages. The media used in deliveries will be compatible with current project storage devices.

All findings from participation in design or management reviews and walk-throughs, as well as federation development monitoring, analysis, evaluations, reviews and/or tests will be documented. The appropriate documents will be routed, with necessary informational copies, to the project staff. The timing of the reports will be linked to their function, audience, and the deliverable schedule developed by performing federate and federation development activities in parallel, delays will be minimized.

Appendix F: Feasibility Analysis for the Enhancements of the CTPS's Electronic Casualty Card Database Translator

Feasibility Analysis for the Enhancements of the CTPS's Electronic Casualty Card Database Translator

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TABLE OF CONTENTS

1. Introduction 1
2. Background 1
2.1 The MILES/SAWE system 1
2.1.1 MILES II/SAWE and CTPS 2
2.2 The Electronic Casualty Card 2
2.2.1 Generalities 2
2.2.2 Enhancements of the ECC 3
2.2.2.1 Rational 3
2.2.2.2 Enhancement objectives 3
2.3 The ECC Database translator 5
2.3.1 Enhancements of ECC Database Translator 5
2.3.2 ECC-DBT to ECC-DBT RTI Interface Communication 5
3. Unanswered questions 6
3.1 Current endeavors toward solving unanswered questions 8
4. Alternatives 9
5. Requirements 10
6. Conclusions 11
References 13

1. Introduction

This report gathers the outputs of IST's feasibility study about increasing the number of casualty types (scenarios) in the Combat Trauma Patient Simulation (CTPS) system [1] in order to upgrade CTPS's usefulness in military training by making it more suitable for the 91 "Whiskey" certification program [2]. Currently, CTPS only works with three different scenarios.

In order to work consistently with the current implementation of CTPS [3], the new casualty types should be introduced by shooting the Simulation Area Weapons Effect (SAWE) gear with the Multiple Integrated Laser Engagement II (MILES II) *God Gun*. The Electronic Casualty Card (ECC), coupled with the ECC Database Translator (ECC-DBT), should then be able to take the weapon code generated from this event and send it to the ECC Run Time Infrastructure (ECC-RTI) Interface, which can map that code to a CTPS scenario and eventually introduce a new patient in the simulation exercise. Additional modifications to the CTPS system would be needed to recognize and react to these new casualty types. However, since IST performed the system integration and possesses source code about the other CTPS federates, these changes are well understood.

Since there is not a good relationship between weapons type and casualty generated, and there is also no hit placement on the body information available from MILES, IST concluded that the best course to follow is to take the output's from the DBT and reprocess them based on an expanded set of casualty types and probabilities. Nevertheless, this alternative is not advisable due to the one computer per trainee and hardwire linkage between human and CTPS.

There are other courses of action that IST believes could be pursued. First, since the CTPS system is currently using MILES II/SAWE-ECC only to obtain a weapon code, it might be possible to bypass the ECC completely using the newer and currently available MILES 2000 and a new federate that would bridge it to the rest of the CTPS federation. Alternatively, IST could continue to pursue the information necessary to rewrite the ECC-DBT. Finally, the manual casualty generator (ManCasual) could be modified to introduce the new casualty types as a temporal solution.

We start our discussion with a background review that reflects not only the amount and type of documentation about ECC, ECC-DBT, and ECC-DBT RTI Interface but also part of the CTPS project history. Following this, we discuss the alternative solutions for achieving the targeted enhancement. We conclude with our recommendations, and mention the efforts that are still underway.

2. Background

2.1 The MILES/SAWE system

Developed by Lockheed Martin Electro-Optical Systems (LMEOS), the MILES/SAWE system provides a means to simulate in real time the effects of direct and indirect fire, mines and tactical nuclear weapons during tactical engagement simulation for force-on-force training. It

uses eye safe laser "bullets" to simulate the lethality and realism of the modern tactical battlefield. With MILES/SAWE, commanders at all levels can teach the skills required for surviving in combat and destroying the enemy. MILES/SAWE is adaptable to all hand-carried and vehicle-mounted weapons. Thus MILES/SAWE based training has been proven to dramatically increase the combat readiness and fighting effectiveness of military forces.

2.1.1 MILES II/SAWE and CTPS

In CTPS, the MILES II/SAWE system combines with the Electronic Casualty Card to introduce live action casualties to the system. First, MILES is set to a specific weapon type. The receivers on the soldier's vest are initially "shot" with a laser from MILES. This shot transmits the weapon code to the MILES II/SAWE equipment. This weapon code is used by the ECC to define a casualty. Finally, this casualty is sent to the ECC-DBT through a serial cable connected to a computer.

2.2 The Electronic Casualty Card

2.2.1 Generalities

The LMEOS's Electronic Casualty Card (ECC) was developed under a Broad Agency Announcement (BAA) contract administered by STRICOM [4]. It is software running in the Decoder Processor (DP) of the SAWE's Player Detection Device (PDD). The intent of the contract was to provide a means to simulate a physical deck of casualty cards that have different wound types and are distributed among the players prior to the start of a MILES exercise. The card method leads to cheating and lacks medical treatment verification. The ECC was developed with the understanding that an existing manworn system could be easily retrofitted with new software and support new casualty capabilities while supporting current functional requirements. The training equipment uses an event reporting system to inform other supporting equipment about the player status. This data is stored locally at the Combat Control System (CCS). There are currently other similar systems that support recording event data for post exercise After Action Review (AAR).

The ECC software in the PDD's Decoder Processor (DP) establishes links to various table types [5], conjointly called the ECC Medical Database (ECC MDB). The types of injuries are listed in the *injury table* which contains links to a second table, know as the *severity table*. The severity table contains timer-related information and a link to a third table known as the *immediate action table*. The *weapon* table is the entry point into the ECC database [qq]. When the DP decodes a valid wound inflicting MILES II weapon code, an event about the detection is reported and logged into the *event memory*. This event contains standard *hit event* data such that the existing systems are aware of the situation. Following the event reporting, the ECC initiates the respective survival timer. The DP alerts the player by sounding 10 beeps. The display starts cycling data to inform both the player and medic about the inflicted wound. A medic is called to treat the wounded player. When the medic arrives, a Medical Controller Device (MCD) is used to initiate treatment processing. This action then initiates a second timer that is used to ensure a selected treatment is applied within a given period. The medic may scroll though a list of

selectable treatments. Then to apply the treatment, the medic activates the MCD. After completing the treatment process, a third timer is started for player evacuation.

There are two conditions that cause a *casualty* event to be reported. They are listed below:

- A *treatment* event is generated when a player has been treated by the MCD.
- A *treatment failure* event is generated when a player has never received medical attention and the injury timer expires.

Whenever a player dies, a second event type is reported to inform existing system functions about the player's status. The time period between events is adjustable and can be configured for various demonstration scenarios.

The ECC was originally constructed as a *proof-of-concept prototype*. It is believed that the technology developed in the ECC will continue to be developed and used. Specifically, many of the capabilities of the ECC may eventually be built into the new MILES 2000 gear. However, the ECC itself is not currently in production.

2.2.2 Enhancements of the ECC

2.2.2.1 Rational

The previous medical database, from which all of the battlefield injuries are modeled in the ECC, consisted of a small database of 195 actual battlefield injuries. These injuries had a distribution of the most frequently occurring injuries over a representative number of affected body areas, a nominal spectrum of severity, and represented most of the trained for wound treatment scenarios.

As the medical database existed, it had several limitations for effective use in CTPS. First, the database was fixed, meaning that all MILES II players had to select injuries from the same tables. In addition, burn injuries, nuclear, biological and chemical (NBC) sicknesses symptoms were not broadly represented. Also, the patient codes contained in the database were not compatible with those handled by the HPS and other CTPS components, and a more dynamic interaction was indicated.

2.2.2.2 Enhancement objectives

To alleviate the aforementioned limitations, and move toward the goals, four enhancements were made under IST's auspices during an earlier phase of the CTPS project [6]:

- **Expansion of the ECC MDB:** The database was expanded to enlarge the population of injuries to represent more heavily the wounds associated with current battlefield weapon/ammunition types and wounds associated with cavalry, armored battle, and NBC

effects. The *weapon* table was expanded to support a larger variety of indirect injury types and their attributes. A *vital signs* table was created that contains numeric start values and can be adjusted according to time and treatment inputs. The enhanced database is now completely stored in RAM and entered into the unit by way of the ECC-DBT. Additionally, the upgraded ECC has a set of new message interface commands to support HPS data formats.

- **Configurability of the ECC Medical Database**: Injuries can be tailored into a unit's firmware to represent the scenario expected, according to the exercise planners. For example, a higher rate of burn victims resulting from vehicle casualties would be expected among players in cavalry units, than among outright dismounted troops who would be more vulnerable to small arms fire. Similarly, troops in a defensive position supporting counterattacks upon opposing cavalry units would have higher incidences of injuries from area weapons fired at them. The necessary changes to allow the enhanced database to be entered into the manworn unit from the ECC-DBT were performed. When a treatment has been selected and applied, the attributes concerning the injury remain viewable to the operator (*evacuation mode*). The timer mode operation has new features to control vital signs for a given injury and is also configurable via the ECC-DBT.

- **Addition of dynamic vital sign capability:** Cues were added that will inform a soldier of their vital signs (e.g., heart rate, respiration rate, and blood pressure) in the event of a hit during force-on-force training exercises. Each separate injury type is now linked to an affected area, the severity of an injury, and the associated amount of bleeding, representing a simple time-dependent model of the vital sign dynamics. The vital signs are updated every 5 seconds on the display. When a medic arrives to treat an injury, as signaled by the use of the MCD, the initial vital signs as well as the current vital signs are available for display. Together with the injury description and the other information displayed regarding the injury, the medic has a better insight into the proper application of aid. For the purpose of event storage, the vital signs applicable to the time of injury, the time of medic arrival/treatment time, and the subsequent evacuation time are stored in *event memory* along with the other related injury data. This allows predictions of attrition rates where large numbers of injuries occur, such as with large concentrations of artillery fire or other area weapons, as well as NBC.

- **Alignment of codes with CTPS capabilities:** The ECC *weapon* table was modified to be triggered/hit by three specific types of weapons: 1) M16/M60 Machine Gun, 2) M2/M82 Machine Gun, and 3) AT-3 SAGGER-NTC. The wounds caused by these three weapon types are Blood loss, Pneumothorax, and Anaphylaxis, respectively. The mapping function is implemented in the ECC-DBT RTI Interface.

This effort changed the DP's CSCI in the PDD to accommodate the database expansion and database capabilities, and the inclusion of dynamic vital signs, making it an entirely new version of the existing.

2.3 The ECC Database translator

The ECC-DBT captures casualty information from the ECC and sends this information to the ECC-DBT RTI Interface. In other words, the ECC-DBT bridges the ECC and the CTPS system. It is noteworthy mentioning that it is not required that patient state be held for transmission to the RTI. As a matter of fact, the only thing that can happen now is an immediate transfer of patient state after injury onset. The ECC-DBT is PC-based software developed by LMEOS. The ECC communicates with the ECC-DBT via RS-232. Using another serial connection, the ECC-DBT communicates to the ECC-DBT RTI Interface. This is another area limiting practical application of the initial research (e.g., the viability of data transmission with serial cables to a single computer per trainee.). The linkage of ECC to computer using cables and the 1:1 correspondence between trainee and computer is probably the more significant area affecting the use of the ECC. While precise documentation is available about this last communication, no documentation was found regarding the communication protocol between the ECC and the ECC-DBT.

2.3.1 Enhancements of ECC Database Translator

The ECC-DBT is software created specifically for the CTPS system. Its first version was a DOS application with limited capabilities. This application was created with limited funding to suffice requirements for the initial demonstration of CTPS. The current application is a Windows NT version that supports a two-way communication with the DP and supports real-time operation. The operator has the ability to configure the tables of the ECC database through menus.

The ECC-DBT now consists of a set of files. These files include the executable, a binary file from the MILES II DP, and a set of database files. The database files include the immediate action table, the injury table, the severity table, the weapons table, the *treatment table*, and the *vital signs table*, This database is implemented as a set of text files and represents the corresponding tables for using in defining a casualty.

The ECC-DBT has two modes of function: *real time operation* (RTO) and *read event file and send patient* (REFSP). The ECC-DBT presents a menu that allows selection of either of these modes and also the selection to quit. When RTO is selected the ECC-DBT receives *casualty events* from the ECC. When the REFSP is selected the ECC-DBT generates a patient from an *event file* and sends it to the ECC-DBT RTI Interface as usual. When a patient is generated from an *event file*, the patient is always a *pneumothorax* casualty type.

2.3.2 ECC-DBT to ECC-DBT RTI Interface Communication

The format for communication between the ECC-DBT and the ECC-DBT RTI Interface is a well-documented protocol. This was necessary in order for IST to build the ECC-DBT RTI

Interface. The ECC-DBT and the ECC-DBT RTI are installed on separate computers, connected via RS232 to allow messaging between these two sub-systems.

The sequence and formats of the various messages are well understood [7], which suggests the possibility of intercept signals and reformat them for a larger repertoire of casualties. The ECC-DBT RTI Interface first indicates its presence to the ECC-DBT with a six-byte *presence* message. The ECC-DBT then replies with an *acknowledge* message. The exact content of these messages is known. After this exchange, for each casualty created within the MILES II/SAWE-ECC system, the ECC-DBT sends an *electronic casualty* message to the ECC-DBT RTI Interface. The ECC-DBT RTI interface acknowledges this message by sending a 6-byte *casualty acknowledge* message.

The electronic casualty message is a 36-byte sequence that describes a casualty and provides some identification information. The fields with casualty information include data about the body area, wound type, amount of bleeding, severity, recommended action, blood pressure, respiration rate, and heart rate. This information is represented with hex values. The fields with identification information include player identification of attacker, player identification of casualty, weapon code, location, and time. Other fields include checksum, size, sync, and identifier information.

The values in this electronic casualty message are mapped to a specific predefined value. For example, the weapon type is mapped to one of 32 defined weapons such as grenades and NBC events. Also, the body area field maps to one of 14 wound locations of the body, such as the head, shoulder or chest. Other fields are mapped similarly to information describing a wound. The blood pressure nominator, blood pressure denominator, respiratory rate, and heart rate fields are defined simply by their values.

3. Unanswered questions

In order to modify or rewrite the ECC-DBT a number of questions about the system must first be answered. The questions that have not been answered yet are described below, the rational for why they need to be answered is also described, and finally, how each question might be answered is addressed. The difficulty in addressing these questions comes from the fact that Lockheed Martin (LM) has absorbed LMEOS. Since IST had very limited funds in CTPS 1, and was obligated, successfully so, to prove that we were able to connect simulators, and IST's desire to keep LM under contract for subsequent phases did not occur, IST did not purchase source code, our access is limited to the inner workings. However, IST sent LM a request for the code, resulting in informal discussions between IST and LM indicating that there are potential proprietary issues with LM providing us with the source code.

Question 1: ***What is the current content and capabilities of the ECC MDB?***
The PDD firmware has been modified for CTPS. However, there is no definite description about what or how it has been modified. According to the of the unmodified ECC, it can contain multiple tables used to select an injury, give detail about that injury, and simulate some simple

situations over time where medical intervention can be given. We know that these tables were modified to more closely match the CTPS functionality.

Comments on Question 1

To our understanding, the ECC Medical Database was implemented by modifying the PD CSCI inside of the PDD. IST is unable to determine if the modifications were actually implemented by a) reprogramming the PD CSCI, or b) replacing the ROM address space with a RAM address space and loading data into it from the ECC-DBT. Also, one document suggests that the ECC is limited to reacting only to the three weapon types that are mapped to CTPS casualty types. but the ECC-DBT RTI Interface code does not reflect this statement. If the ECC is capable of handling more than these three weapon types, it is still unknown if the correct corresponding casualty information is fully defined in the ECC for additional weapon types. Detailed documentation about the ECC and ECC-DBT is needed to answer this question.

Question 1a: ***How is the ECC-MDB loaded?***

If the MDB is stored in RAM, it should be loaded before operation, for which a map of its content should be used, as well as the syntactic and semantics rules applied to the data stored within.

Comments on Question 1b

The documentation available, which refers to the first version of the ECC MDB does not include information of paramount importance needed to access/modify the content of the ECC-MDB (e.g., address of tables). Detailed documentation about the ECC and ECC-DBT is needed to answer this question.

Question 1b: ***How to program the ECC DP CSCI?***

A different architecture of the ECC MDB could require modify the code running in the PDD DP.

Comments on Question 1b

No documentation is available about this issue (e.g., code running, type of processor). Detailed documentation about the PDD needed to answer this question.

Question 2: ***What is the communication protocol between the ECC and the ECC-DBT?***

It is evident that in order to communicate with the ECC, its communication protocol must be totally understood. There is some indication in the documentation that there may be more of an interaction between these two components than simply passing casualty messages. Specifically, the documentation suggests that database tables are loaded from the ECC-DBT to the ECC.

Comments on Question 2

If this interaction is complex, it may be impossible to decipher through simple observation (e.g., by using a bridge between the ECC and the ECC-DBT). If the ECC-DBT source code is located, it may be possible to reverse engineer this protocol in order to come to a full understanding of this communication.

Question 3: ***What does the ECC-DBT actually do?***
In order to reproduce the ECC-DBT behavior, we must know exactly what it does. It is unknown if all the ECC-DBT does is pass the patient messages through blindly or if it actually reproduces the functionality of the ECC on the computer. Furthermore, the ECC-DBT includes a number of database files. It is unknown how these files are used by it. Additionally, it is unknown how the ECC-DBT generates casualty information for a manually generated casualty (REFSP mode).

Comments on Question 3
There has been no authoritative documentation on this topic. The ECC-DBT source code is likely the only way to uncover this information. Hopefully it is well documented and follows a good programming style. Currently, the only information that CTPS uses from the ECC-DBT is the weapon code. If this continues, it would simplify matters in that the new ECC-DBT would only need to intercept and pass on this one piece of information. Nevertheless, there may be other even more complex interactions with the ECC.

Question 4: ***How can the information coming from the ECC more closely interact with the CTPS system?***
ECC generates sophisticated casualty information currently not used. What happens is that the CTPS system takes the weapon code generated in the combined MILES II/SAWE-ECC system and maps it to a completely unrelated casualty scenario code which does not provide a realistic entry-point for such a sophisticated simulation like the one that takes place in CTPS.

Comments on Question 3
In order to take a greater advantage of the ECC in CTPS, if it is even possible, it would take an additional amount of work in reengineering and redesigning the patient flow through the CTPS system. Detailed documentation about the ECC MDB is needed to answer this question.

3.1 Current endeavors toward solving unanswered questions

IST has contacted Mr. Robert Wolfinger who works at STRICOM. Mr. Wolfinger has had contact with the ECC project in the past. He has agreed to provide IST with documentation that he is able to locate. Since this documentation is government property, it must go through a third party to reach IST. IST is now working out the details of this with the help of Ms. Beth Pettitt.

Mr. Wolfinger also provided contact information for a former employee of LMEOS, Mr. Richard Escobedo. Mr. Escobedo is the engineer who actually built the first version of the ECC and is currently an employee of Rapitec Inc. IST has tried to contact Mr. Escobedo without receiving any response.

Finally, IST is in contact with Ms. Carla Powe at Lockheed Martin. Ms. Powe had suggested that she may be able to provide IST with the source code for the ECC-DBT, but then became aware of some proprietary issues that impede her from releasing the software.

4. Alternatives

During a CTPS simulation exercise, new patients are introduced in real-time through the MILES II/SAWE-ECC system. These patients are initially represented by a weapon code that is later mapped to a casualty type, and they eventually become totally defined patients. To upgrade the casualty repertoire, additional weapon codes need to be used to map to additional casualty types. The ECC-DBT must be able to recognize the new weapon codes and pass them on to the ECC-DBT RTI Interface. Three theoretical solutions can be suggested to achieve this upgrade:

Alternative 1: *Modifying the original ECC-DBT source code*

Comments on Alternative 1

The pre-requirement of this alternative is the availability of the ECC-DBT original source code, which is supposed to be written using a high-level language. This code could be studied to identify the sections that perform the key tasks related to the upgrade (e.g., acceptance of weapon codes) and rewrite/extend the involved instructions. Depending on the programming style used and the amount and quality of the documentation embedded in the source code, this alternative may require a relatively low level of effort that would also appliy to further modifications and/or migrations to other machines and/or operation systems. Moreover, this task can be performed without a full understanding of how the ECC-DBT actually works, since only enough of the code needs to be understood and worked to come up with the required upgrade.

Alternative 2: *Reverse engineering the ECC-DBT*

Comments on Alternative 2

The ECC-DBT executable code could be disassembled and then essentially the same activities described in *alternative 1* could be performed, this time at the level of the assembly language, to finally reassemble the code. Disassembly of the code can be easily done using commercial tools and also freeware. Nevertheless, since the current ECC-DBT is a windows application it would include lots of systems functions blended with the application code. Handling assembly code instead of high-level language code implies a significant increase in both difficulty and time required performing it. Since there is no hope to find any documentation in the obtained assembly source code, the first task would be to locate all sections of the code containing input/output instructions involving the serial ports. An analysis of the assembly code can begin from there. The same comments about the benefits of *alternative 1* in terms of ECC-DBT understanding and use of the source code apply to this one.

Alternative 3: *Writing a completely new ECC-DBT*

Comments on Alternative 3

The pre-requisite of this alternative is the full understanding of the ECC-DBT behavior. Two questions of paramount importance will needing to be answered are: a) how the ECC-DBT communicates with the ECC and b) what if any action the ECC-DBT takes on incoming events.

This alternative will require the highest level of programming effort, but on the other hand will solve all proprietary software issues for good. Also, it represents an opportunity to come up with comprehensive documentation about an important member of the CTPS federation. Most importantly, the RTI interfaces will need modification to recognize and deal the new casualty types.

Alternative 4: Reformatting ECC-DBT Output

Comment on Alternative 4
IST knows the format of ECC-DBT outputs going in to the RTI. IST could develop a software patch to capture the current output (1 of three injury codes) and expand them to additional or replacement codes. We feel that this approach is feasible because the relationship between weapon, injury location, and CTPS injury is not tight.

5. Requirements

METI provided IST with a list of requirements for the ECC-DBT enhancement. They are listed below, and additional comments and observations are included with each.

Requirement 1: *It must be a LINUX (Red Hat 6.2 or later) application*

Comments on Requirement 1
This will require a recompilation of the source code or a compilation of new source code. It may be possible that correct weapon code data is being passed through the ECC-DBT and could potentially be used to map to any new casualty scenarios in the ECC-DBT RTI interface. However, even if this were true, this requirement forces the ECC-DBT to be rewritten, in spite of what it's functionality is. IST suggests that this requirement be modified such that only a new interface component be written in Linux. A proof of principle might be beneficial but the use of different operating systems during run time make it impractical to implement in a production system because of the number of computers involved.

Requirement 2: *It must be an enhancement of or a replacement for LM's ECC-DBT.*

Comments on Requirement 2
IST believes that our recommended approach of capturing and reformatting ECC-DBT output provides the potential for enhancement over the current 3 casualty types. It must be noted, again, that the hardware linkage between human and computer coupled with the current strategy of one DBT per trainee limits the practicality of continuing this approach.

Requirement 3: *It must map ECC injury codes to patient/scenario sets.*

Comments on Requirement 3
CTPS already does this. Actually, it happens in the ECC-DBT RTI interface. This is known from examination of the code. This should not be a difficult part to do. However, it will be necessary to create new patient/scenario sets that the rest of the CTPS system can recognize and use, implying additional modification of various CTPS components.

Requirement 4: *A user must be able to configure code mappings.*

Comments on Requirement 4
It was not made clear if this needs to be done visually, through menus and a graphical user interface (GUI), or through reading a formatted text file can do it. In either case, given the comments from requirement 3, this should not be difficult. It can be done in the ECC-DBT RTI Interface. If the ECC-DBT is completely rewritten, it may be somehow done there. Though, that would require additional modification to the ECC-DBT RTI Interface. In fact, given the rigidly defined communication format between the ECC-DBT and the ECC-DBT RTI Interface, it is highly recommended that this functionality remain in the ECC-DBT RTI Interface.

Requirement 5: *User mappings must be stored and used by default*

Comments on Requirement 5
If this mapping is defined, as described in the comments in 4, by a formatted text file, there could be a specific file that is used by default. Other mappings in files with different names could be saved. Then switch to that mapping by renaming that file to the default one. If it is defined through a GUI, the results of the mapping defined through the GUI operation can be stores in a similar formatted text file.

Requirement 6: *The Database Translator must communicate with METI's ECC RTI Gateway via HIDEP over the TCP/IP interface, using the METI – supplied library*

Comments on Requirement 5
In theory, this would only translate into additional work. Currently the CTPS team does not have expertise in HIDEP since most of the member who participated in the previous phases of the CTPS project left IST.

6. Conclusions

METI requested IST to evaluate the feasibility of expanding the ECC-DBT to accept additional casualties. IST conducted essentially a bibliographical research on this goal. In addition, IST contacted several people to locate additional information formally, Carla Powe at

Lockheed Martin and Beth Pettit and Robert Wolfinger at STRICOM. By the time we write these conclusions, attempts to contact Richard Escobedo, a former employee of LMEOS who is currently working at Rapitec in California, in order to get further information about the ECC-DBT, have been unsuccessful.

Constrained by finite time and budget to conduct this enquiry, IST finally proposed four alternatives that would accomplish the ECC-DBT enhancement. The first would be modifying the source code. The second would be modifying the assembly code. The third would be completely rewriting the ECC-DBT. The fourth would be reformating ECC-DBT ouput. IST concluded that the last one is the most viable. Nevertheless, this alternative is not advisable due to the one computer per trainee and hardwire linkage between human and CTPS.

IST is still in the process of trying to contact Richard Escobedo from Rapitec Inc. However, beyond these sources, IST has not identified any other sources of information left to pursue. Thus, if these sources prove useless, the modification of the ECC-DBT would be at a standstill.

Another course of action, not necessarily exclusive of the other, would be to modify the Manual Casualty Generator federate to introduce the new casualty types. While the functionality of adding these casualties from a MILES II/SAWE vest would be lost for the additional casualties scenarios, the functionality of having the additional casualties in the system would be added.

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Appendix G: HLA Federate Certification of a CTPS System vs. Proposed CTPS Gateway

HLA Federate Certification

of a

CTPS System
vs
Proposed CTPS Gateway

Final Report

Submitted to: METI

CTPS Phase IV Project

07 August 2001

Program Manager: Dr. Peter Kincaid

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Acknowledgements to:
Robert Franceschini
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Piotr Windyga

Table of Contents

Introduction 3
CTPS Overview 3
Federate Certification of the Current CTPS System 3
Proposed CTPS System Architecture 4
Federate Certification of the Proposed CTPS Gateway 5
The HLA Federate Compliance Test Process 5
SUMMARY 6

Introduction

This report was developed in response to the request from Medical Education Technologies, Inc. (METI) to analyze the current Combat Trauma Patient Simulation (CTPS), status of the HLA federate certification of the CTPS RTI Interface as well as the proposed CTPS Gateway and HLA federate certification of the CTPS Gateway. This report contains an overview of the current CTPS system and status of certification as well as an overview of the proposed CTPS Gateway and the plans for HLA certification testing of the Gateway.

CTPS Overview

The CTPS system is considered by definition to be a HLA Federation. Each component of the system is considered by definition to be a federate. The CTPS federates combine to provide a complete simulation of the combat trauma medical treatment process. For the CTPS system to be considered certified as HLA compliant the CTPS RTI Interface of this system was tested and certified to version 1.3 of the HLA in December 1999. CTPS is made up of the following federates:

- MILESII/SAWE ECC - Lockheed Martin Multiple Integrated Laser Engagement System II and the Simulation Area Weapons Effect
- ORCA - Operational Requirements-based Casualty Assessment system.
- JMSL - Jackson Medical Simulation Library
- HPS/PHS - Human Patient Simulator and the Pre-Hospital Simulator.
- CTPS Executive – provides federation control.

Per the CTPS Phase 3 Final Report, the federates that make up CTPS are heterogeneous simulations "that are not interoperable or even designed to be interoperable." The current system architecture is shown in Figure 1. In this configuration, each federate in CTPS communicates with the RTI using a specific RTI Interface designed for that particular federate. Each of these federates also uses a common Federation Object Model (FOM) to insure data is communicated properly.

Federate Certification of the Current CTPS System

As stated, the CTPS system is currently certified as HLA compliant to Version 1.3. Per the HLA Certification Agent (MSIAC), there is a difference between Version 1.3 of the HLA Specification and the IEEE 1516 Version of the HLA Specification. But, unless the specification for the CTPS Project has changed then the current CTPS system is HLA certified and no additional certification is required at this time. The only time retesting is required is if you a) change specifications, or b) modify your conformance statement by adding services.

Both RTI 1.3v[1-7] and RTI-NG 1.3v[1-4] are RTI's that were implemented according to the version 1.3 of the HLA Specification. Therefore if testing was completed under RTI 1.3v6, and then the system is upgraded to RTI-NG, re-testing would NOT be required since CTPS would still be compliant the 1.3 Specification.

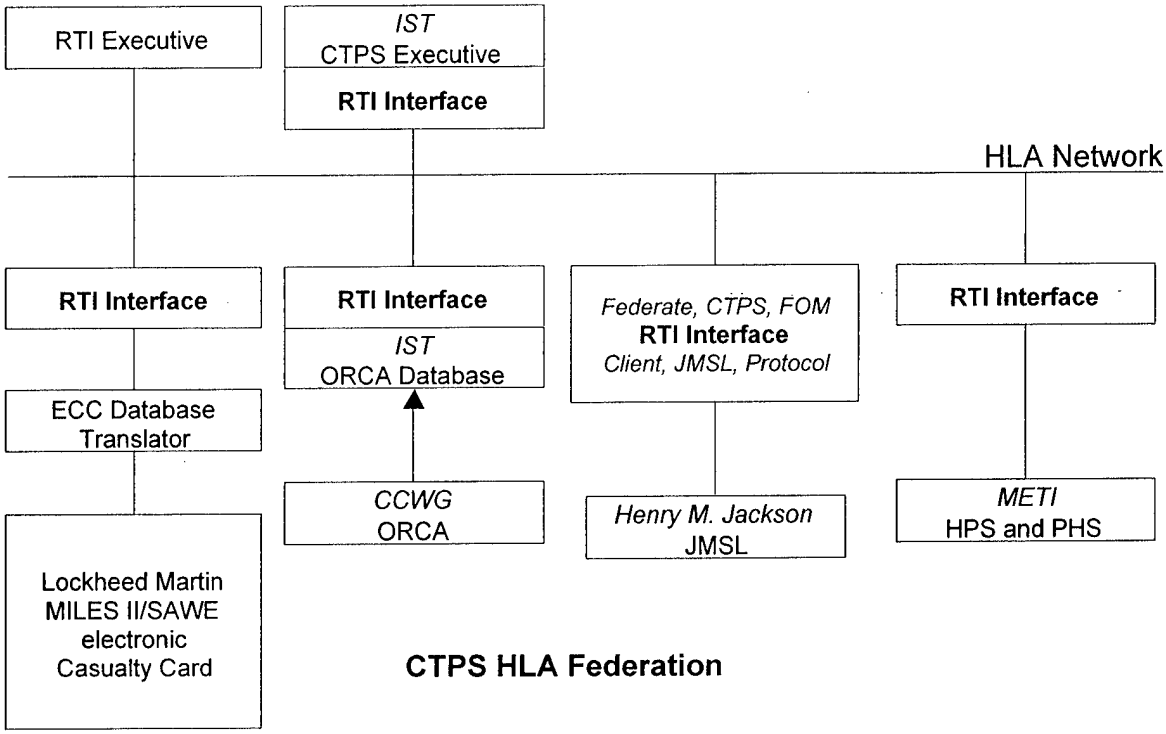

Figure 1: Current CTPS System Architecture

Proposed CTPS System Architecture

METI has proposed the development of a CTPS Gateway that would serve as a "super" RTI Interface. The CTPS Gateway must do the following as a minimum:

- Communicating with each node in the CTPS.
- Translate protocols from one node to the next.
- Handle Routing of Data from one node to the next.
- Interfacing with the RTI.

Careful analysis should be completed to insure the CTPS Gateway will in fact improve performance of the CTPS simulation system as compared to the current system architecture.

The paper "HLA Gateway 1999"[1] by Doug Wood and Mikel Petty discusses the use of a gateway as a good choice for a DIS Legacy Simulation. Wood states that the HLA Gateway is a good choice when the number of scenarios does not exceed 1000 and a time delay for the translation can be tolerated. One concern noted when using a Gateway with a DIS Legacy system is that when DDM is used it may effect the distribution of data in a DIS simulation.

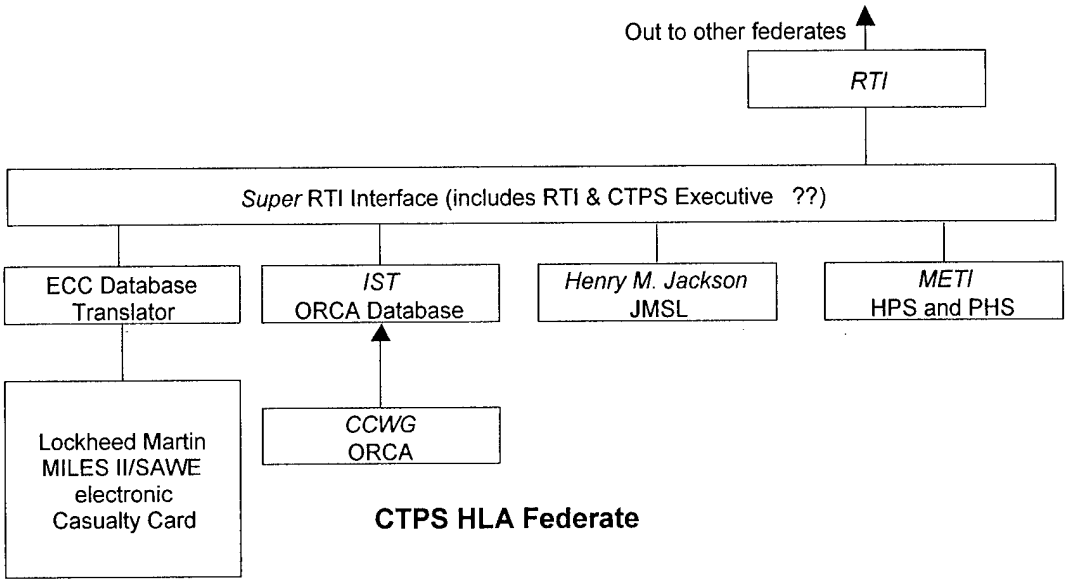

Figure 2: Proposed CTPS System Architecture

Federate Certification of the Proposed CTPS Gateway

HLA Certification of a DIS system using a Gateway is the same as for any HLA Federate. From the information currently gathered the Proposed CTPS Gateway system should not require HLA Federate Compliance testing. Re-testing of the CTPS system would only be required for the following reasons:

- Changes were made to the original Object Model Template (OMT)
- Additional information is being transmitted from the RTI Interface as compared to the original RTI Executive.

In other words, if the CTPS parameters have not changed then the system should not require re-certification. However, if a parameter has been added that was not in the original certification then it will require re-certification.

The HLA Federate Compliance Test Process

If HLA Federate Compliance testing must be completed then the following process should be followed. The process should take approximately 1 month to complete. Additional HLA Federate Compliance Test information can be found at the following URL[2]
http://hlatest.msiac.dmso.mil/compliant_feds.html

The steps in achieving Federate Certification are as follows:

1. Submit or Revise a Test Application
2. Provide a Conformance Notebook
3. Provide Test Environment Information
4. Interface Test & Certification Summary Report

Step 1 - CTPS Gateway developers initiate the testing process by completing a test application for an HLA Federate Compliance Test and submit it to the Federate Certification Agent. NOTE: a testing priority will be assigned to the test application.

Step 2 - CTPS Gateway developer submits the Conformance Notebook, which includes the following:

- Simulation Object Model (SOM)
    - SOM checked for conformance against OMT using SOM Conformance Test.
    - SOM also checked against the CS for consistency ("Conformance Cross-Check
- Federate Conformance Statement (CS)
- Scenario Data (optional).

NOTE: the Federation Planning Workbook (FPW) may be submitted to provide more information though this is not required for completion of the tests.

Test data returned to the CTPS Gateway developer.

Step 3 – CTPS Gateway developer reviews the Test Sequence generated by the Certification Agent and will submit test environment data to the Certification Agent. At this time the test date and time will be confirmed.

Step 4 – The Interface Test (IF) is executed by the federate developer and the Certification Agent and includes two parts:

- Nominal Test ensures that the FUT can invoke and respond to all services for which it is capable, per its CS;
- Representative SOM (RepSOM) test ensures that the FUT is capable of invoking and responding to services using a range of data contained in its SOM.

SUMMARY

The HLA federate certification of the CTPS simulation system is current. As stated the CTPS system is currently certified as HLA compliant to Version 1.3 and no additional certification is required at this time. Re-certification of the proposed CTPS HLA Gateway architecture should not be required either. Re-certification will only be necessary if the OMT is changed and/or the information flowing through the RTI Interface is modified.

Appendix H: User Test Report—Joint Trauma Training Center

Subject: Final JTTC evaluation of The METI Human Patient Simulator

Beginning in the month of October 1999, the JTTC (Joint Trauma Training Center) located at Ben Taub Hospital in Houston Texas began phase 1 of the development process of the Trauma simulation center. During this phase, the various Human patient simulators presently available are to be tested. Our evaluation began with the METI simulator. This final report will discuss our applications and reports of the utility of this unique device as it applies to the mission of the JTTC.

1.Target population: Military rotating forward surgical **Teams.** Members or these teams range from basic medics, respiratory therapists, nurses, and board certified surgeons. In addition, Baylor medical students rotating on the surgical service, physician assistant students, and Baylor surgical residents have enthusiastically participated in these initial evaluations. Also, NASA has expressed significant interest in utilizing this resource to train physician astronauts.
A total of 16 military trauma teams and approximately 130 medical students utilized the HPS during our evaluation period.

2. Goals: JTTC- To determine which HPS would provide the JTTC with the best ability to augment the experience of the rotating military teams. In particular, our primary focus will be on the multiple trauma patients; however, it must be expandable to other disclipines in order to allow training of all members of the team to include pre-hospital scenarios as well as ICU and annestesia capabilities.

3. Staff: Presently staffed by three members of the JTTC

Evaluation: Set-UP

A. Pre-installation: Initial communication with METI (Ron Carovano) was excellent. Pre-installation document was very helpful in insuring a smooth delivery and set up of the system.
B. Delivery of the system and coordination of delivery of the initial gasses to power the system was smooth and well orchestrated by Ron Caravono.
C. Set up of the system on the first day was accomplished without difficulty and in a professional manner. The system was evaluated and all non functioning components were replaced within 24 hours through overnight shipments
D. Site visit by the company president during this evaluation phase demonstrated a true commitment by the company.
E. The initial training on the use of the system was accomplished over three full days. Ron Caravono demonstrated through knowledge of the system during this phase and made the relatively complicated task of operating the system as well as creating pre-programed scenarios a fairly simple task.
F. The exchange for the newer model went without difficulty.

USE: There is definitely a significant initial learning curve with this product (especially for the computer-illiterate like myself); however, after about two weeks, the system began to make sense and was much easier to operate. Trouble shooting the system for the most part requires a call to the customer service dept. Over the time of the evaluation period I became much more comfortable in troubleshooting and have made fewer calls.

The only significant problem has been the drug recognition system, which ceased functioning about two weeks after installation. This problem was addressed and it has functioned well throughout the remainder of the evaluation period. The Bag in place of the pistons lend itself to being punctured and in general have been less reliable than the older piston models despite that the movement is slightly more realistic.

Also, it would be very helpful if you could pause the scenario in midstream and then resume or change on the fly.

Applications:

During this evaluation phase we have intentionally minimized the number of scenarios in order to standardize our presentations and to allow the staff to begin to develop the teaching tools required to fully utilize this unique teaching tool. As previously stated, our focus has primarily been on trauma recusations.

To date, the scenarios run have included airway, hemorrhage, tension pneumothorax, and a head injured scenario. All were easy to run once the programing was complete. The students enjoyed all and surprisingly took them quite seriously. The realistic appearance of the HPS aids in this attitude.

The staff quickly mastered running the scenarios; however, as of yet I have been the only one able to set up the scenarios on the computer.

The trauma aspects tested to include the airway, needle decompression, and chest tube have all functioned well.

Multiple critical care scenarios were run for the critical care air transport teams as well as anesthesia applications for our rotating CRNA's.

An expert group of trauma faculty was also evaluated in order to set the "Gold standard" for our complex trauma evaluations.

Pick-Up:

Although the untimely removal of the system had a severe negative impact on our ability to complete all of the data collection required to validate the HPS as an effective trauma evaluation tool (only about 1 more week was needed) and our ability to assist the working group in the scenario creation for the CTPS implementation at Ft. Gordon in July 2001, the pick up was well coordinated and went without difficulty.

Changes we would suggest:

1. The chest tube site in too small and not realistic. Make hole big enough to pass finger and path long enough to advance tube at least 12- 14 cm. Use the Teflon tape over the hole to get the feel of entering the pleura.
2. Put needle decompression site on same side as chest tube to be more realistic.
3. Add chest tube site to other side in order to place bilateral CT in patients who present in extremis.
4. Make some inserts for the neck and upper chest which might simulate sub- cutaneous emphysema(ie: bubble wrap under the plastic)
5. Some expandable device in neck to simulate hematoma and tracheal deviation
6. Could you make a tracheal-constricting device so that once the circ. is done you do not manually have to turn off the bronchial occlusion in order to ventilate.
7. The carotid pulses need to be a little more lateral.
8. Some way to simulate jugular venous distension in the neck veins.
9. Some way to do eye deviation to simulate intracranial bleeds and seizure activity.
10. At least upper arm motion to simulate seizures, both unilateral and bilateral.
11. Would like to see a trauma head. (Fractured mandible, skull fracture etc. in order to add to secondary survey.)
12. Trauma pelvis with rectal exam to include prostate abnormalities assoc. with pelvic Fx.
13. Trauma pelvis which external fixator could be applied ir C-clamp
14. A smart stethoscope which could hear heart and breath sounds in other places(no speakers under chest)

15. A trauma extremity to include fractures and a way to swell a calf and create a compartment syndrome.
16. Be able to do a fasciotomy on the swollen calf.
17. Abdominal module for abdominal ultra sound and fetal ultrasound
18. Add a saphenous cut down site and a femoral venous line insertion site.
19. Can you add an interosseous route on a pediatric model
20. Transesophageal ultrasound
21. Method to actually measure temperature (esophageal, tympanic, rectal)
22. Bladder reservoir to measure abdominal compartment pressures
23. Port to measure calf compartment pressures in lower leg
24. Bleeding traumatic amputation able to be stopped with properly applied tourniquet

Over all we have been pleased with the utility of the system and it has been very well received. The rotating groups consistently commented on the utility of the HPS in trauma care and consistently desired more time on the HPS. The medical students considered it one of their best experiences during their surgical rotation. There is a steep learning curve and possibly simplify the user interface. We look forward to the opportunity to finish our vital research in the application of the HPS and trauma training. We are currently involved in the development of the metrics required to evaluate the efficacy of this new and unique teaching tool as it applies to the complex and dynamic decision making processes in medical scenarios. The initial data collection was near complete when the system was removed from the JTTC and this data will be presented at several national surgical and trauma meetings in the next few months. Thanks for the opportunity to be involved in the initial user test phase.

Russell Dumire, LtCol USAF, MD
JTTC

EVALUATION OF TRAUMA TEAM PERFORMANCE USING AN ADVANCED HUMAN PATIENT SIMULATOR FOR RESUSCITATION TRAINING

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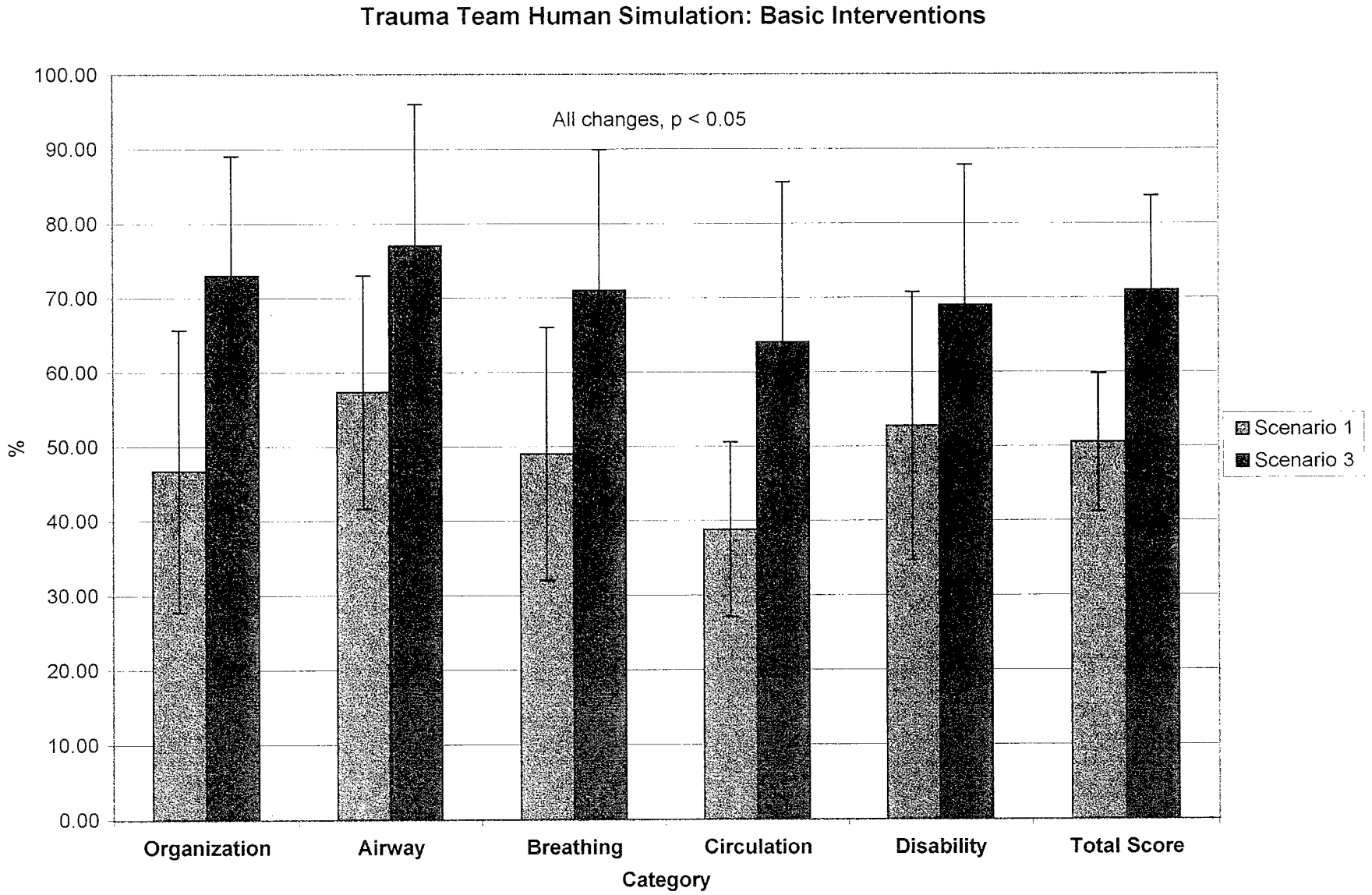
Background: Human patient simulation (HPS) has been utilized since 1969 for teaching purposes. Only recently has the technology advanced to allow application to the complex field of trauma resuscitation. The purpose of our study was to validate the advanced HPS as an effective evaluation tool of trauma team resuscitation skills. *Methods:* The pilot study evaluated ten 3-person resuscitation trauma teams from non-trauma centers that participated in a 28-day trauma rotation. Each group consisted of a mixture of physicians, nurses, and medics. Teams were evaluated using the HPS upon arrival and again upon completion of the rotation. Two standardized trauma scenarios were constructed to represent a severely injured multiple trauma patient with a calculated Injury Severity Score of 38. Performance was measured utilizing a unique human performance assessment tool that included 5 scored and 8 timed tasks that are universally accepted as critical to the initial assessment and treatment of a trauma patient. *Results:* All ten groups demonstrated significant improvement in the 5 scored ($p \leq 0.05$) and 8 timed ($p \leq 0.05$) tasks during the final scenario. This improvement reflects the cumulative didactic and clinical experience of the 28-day trauma experience as well as some degree of simulator familiarization. The degree of improvement was consistent between groups. *Conclusion:* No studies have validated the use of the HPS as an effective teaching or evaluation tool in the complex field of trauma resuscitation. These pilot data demonstrate the ability to evaluate trauma team performance in a reproducible fashion, and a significant improvement in performance following the 28-day trauma experience in groups with varying degrees of prior trauma experience


Trauma Team Human Simulation: Basic Interventions
All changes, p < 0.05
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
%
Scenario 1
Scenario 3
Organization
Airway
Breathing
Circulation
Disability
Total Score
Category

AUTOMATED MEASURMENT OF TRAUMA TEAM PERFORMANCE UTILIZING AN ADVANCED HUMAN PATIENT SIMULATOR

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Objective: Human patient simulation (HPS) has recently been validated for evaluating trauma team resuscitation skills. Current evaluation techniques require time intensive videotaping, scoring and expert review. The purpose of our study was to compare the validity of automated computer recorded physiologic data as a surrogate for the video taped scoring method.

Methods: The pilot study evaluated six 3-4 person multidisciplinary resuscitation trauma teams that participated in a 28-day trauma rotation. Teams were evaluated on two physiologically standardized trauma scenarios, upon arrival and completion of the rotation. Each scenario represented a severely injured trauma patient with a calculated Injury Severity Score of 39 (LD_{50}). Two different methods were utilized to evaluate each team: 1) 13 videotaped and scored metrics requiring a dedicated physician instructor and 2) computerized recording of the total time that systolic blood pressure (SBP) was < 90 mm Hg and pulse oximetry (SpO2) was $< 90\%$.

Results: All six groups demonstrated significant improvement in the video taped and instructor scored tasks, and the total time that SBP and SpO2 was < 90 ($p \leq 0.05$). The percentage of improvement was similar between the methods of measurement.

Conclusion: Previous studies have validated the HPS as an effective teaching and evaluation tool in the complex field of trauma resuscitation. However, current HPS evaluation techniques require laborious videotaping, expert observers and subjective assessments. These objective data support the validity of computer recorded physiologic data as surrogate markers of effective trauma team performance.

Appendix I: User Test Report—NASA Johnson Space Center

After-Action Report

Evaluation of the Human Patient Simulator® (HPS) for development of space medical systems

Purpose:
Determine the feasibility of the Human Patient Simulator® (HPS) as a means to assess, test, and validate the medical procedures, equipment, and resources needed to enhance the critical care capability of space medicine

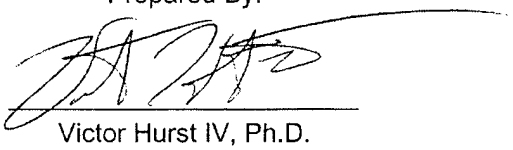
June 2001

Version 5.0

wyle laboratories

Space Medicine
Advanced Projects

Prepared By:



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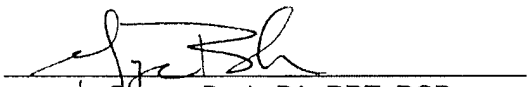

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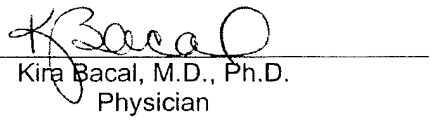

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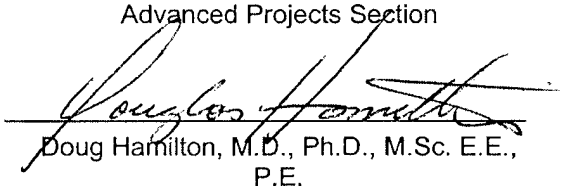

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TABLE OF CONTENTS

Purpose		1
Disclaimer		4
Executive Summary		5
I.	INTRODUCTION	6
II.	BACKGROUND	6
III.	PHASE 1 - HPS Training and Preparation	8
	Preliminary Patient Scenario Development	8
	HPS Training at METI	9
	Visit to the Houston Center for Advanced Patient Simulation (HCAPS)	9
IV.	PHASE 2 - NASA Safety Inspection	9
V.	PHASE 3 - Evaluation and Testing	10
	Anaphylaxis Scenario	10
	Urinary Retention	11
	Ventilators: Impact Eagle 754M vs. AutoVent 2000	12
	Stethoscope Auscultation	13
VI.	CONCLUSION	14
VII.	REFERENCES	16

Disclaimer

The content of this report should not be considered final and binding. Formal review and evaluation of all data collected will be the subject of final reports and publications when deemed appropriate. The content of this report should permit the reader to become familiar with the procedures followed and the preliminary observations and lessons learned. This document neither endorses nor rejects the performance of the Medical Education Technologies, Inc. (METI, Sarasota, FL) Human Patient Simulator® (HPS).

Executive Summary

This document summarizes the activities completed during the 4-month evaluation of the Medical Education Technologies, Inc. (METI, Sarasota, FL) Human Patient Simulator® (HPS). As a means to evaluate procedures and resources required for medical care aboard the International Space Station (ISS), the Medical Sciences Division of NASA Johnson Space Center (NASA-JSC) participated in a Department of Defense-sponsored program titled "Combat Trauma Patient Simulation" (CTPS). Participation in CTPS enabled Wyle Laboratories' Advanced Projects Section (AP) to utilize the HPS, a high-fidelity simulation device developed by METI. The HPS has multiple physiological and pharmacological models incorporated into its software and hardware and has various haptic interfaces for simulating the diagnoses and treatment of numerous clinical conditions [3,4]. The high fidelity of the HPS design is based on the multiple-modeling approach pioneered by Beneken and Rideout [5]. The implementation of these physiological models in the HPS has resulted in a simulator that responds in a physiologically appropriate manner to a user's intervention.

The AP investigation evaluated the use of the HPS for medical procedure development, clinical equipment evaluations, and as a training aid for crew, flight surgeons and biomedical engineers. Experiments were done to identify limitations (if any) with the ISS Medical Check List and the ISS Crew Health Care System (CHeCS).

The evaluation determined that the METI HPS would improve or enhance:

1. *Device Evaluation*
   Medical devices can be deployed and tested as they will be used under multiple clinical conditions.
2. *Procedure Development*
   Procedures specific to space medicine pathology can be developed and tested on the HPS using CHeCS hardware.
3. *Training*
   The HPS ensures standardization of clinical skill sets for space medical care providers (crew, flight surgeons and biomedical flight controllers).

I. Introduction

The NASA critical path road map (http://criticalpath.jsc.nasa.gov) categorizes "trauma and acute medical problems" as a clinical capability risk. Specific risks within this category include acute life threatening illness, major trauma, blunt head trauma, organ laceration or contusion, hemoperitoneum, pulmonary failure, pneumo- and hemothorax, burn, and penetrating injury. These medical risks during spaceflight can be mitigated by increasing proficiency in medical procedures with a commensurable increase in medical on-orbit resources. ISS medical systems were initially designed to support a "stabilize and transport" concept of operation using the Crew Return Vehicle (CRV) as a means for the rapid de-orbit of an injured crewmember. Use of the Russian Soyuz CRV for emergency evacuation, with its limited medical capabilities, requires that systems and procedures be altered to support a "stabilize and treat" on-orbit concept of operation. The Clinical Care Capability Development Project (CCCDP) of the Medical Informatics and Health Care Systems Office at NASA-JSC is tasked to address issues required to implement this new concept of operation.

As part of the CCCDP project plan [1], AP investigated strategies that would:

1. Increase the development and assessment of medical procedures for space flight.
2. Increase caregiver capability and proficiency in performing medical procedures in microgravity.
3. Assist in the evaluation and testing of medical technologies for medical care during flight.

II. Background

Significant medical contingencies during the past four decades of space exploration have been few and their impact on missions has been minimal. However, the increased man-hours in space required for ISS construction and operation increases the likelihood of a medical contingency requiring a de-orbit [2]. The ISS crew does not have the medical transport capability for a return to earth in the event of a medical contingency, thereby increasing the need for medical capabilities on orbit. In addition, the smaller ISS crew (at least during the initial phase of the program) reduces the number of potential caregivers during a medical event and thus, increases the need for an advanced medical system that supports both patient and care providers and allows flight surgeons and biomedical flight controllers to maximally augment on-orbit care.

The modeling of predicted medical events for crew training scenarios included the use of the CRV as a means of rapidly transporting a stabilized astronaut following injury to a definitive health care facility on earth. However, implementation of the CRV was recently placed on indefinite hold. This has resulted in elevating the medical requirements of the Russian Soyuz spacecraft from an evacuation vehicle to a transport "ambulance" for injured crewmembers during ISS expeditions. The limited medical capability of the Soyuz[a] necessitates a re-evaluation of the ISS medical capability with an

[a] The Soyuz only provides basic medical transport capabilities. This does NOT include supplemental oxygen, mechanical ventilation, IV therapy, physiologic monitoring, patient (continued on next page)

emphasis on patient stabilization and treatment on orbit. At present, the limited crew size, training, resources, and medical procedures, as well as limitations of transport, seriously reduce the degree of clinical care on orbit. The participation of NASA-JSC in CTPS enabled AP to utilize the HPS (Figure 1) as a means to evaluate procedures and resources required for ISS medical care.

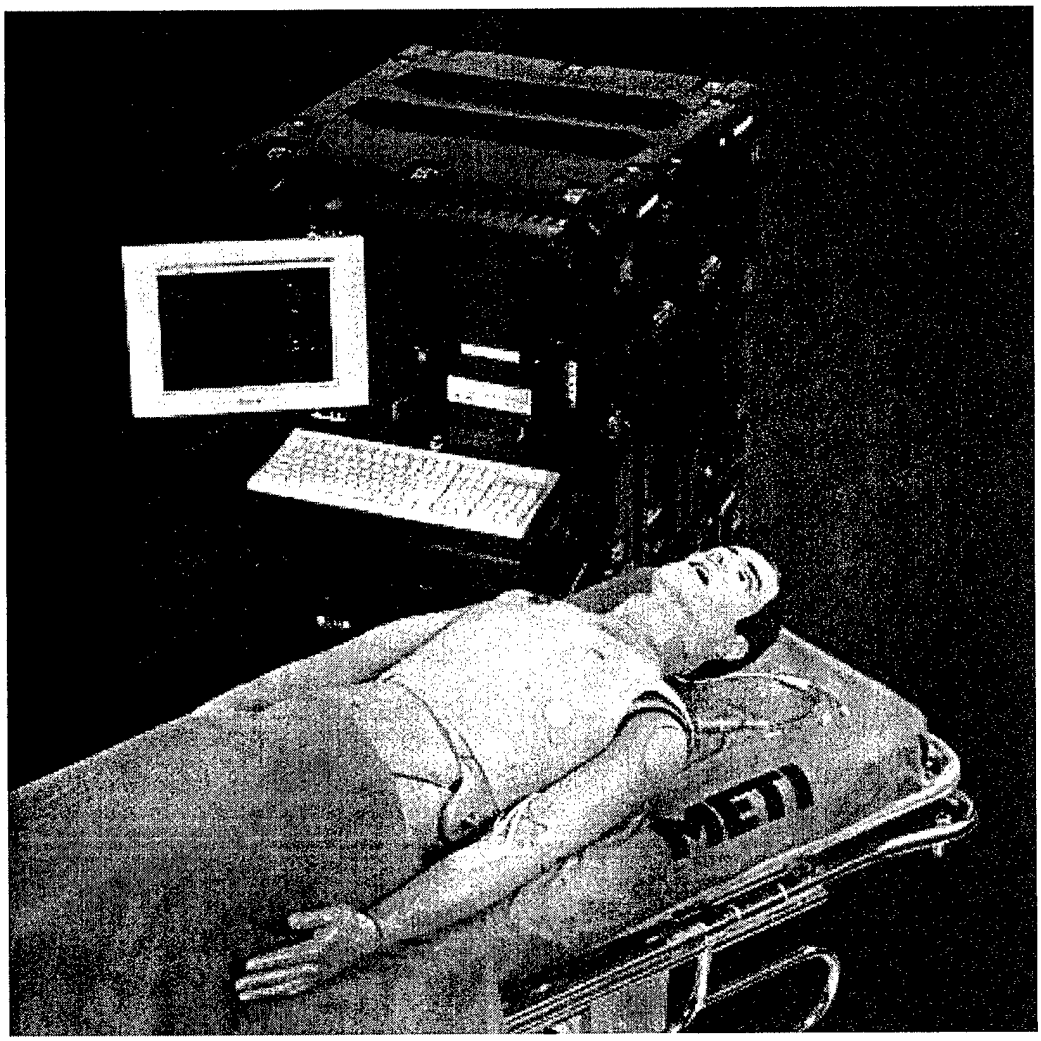

Figure 1

access, or airway management. In addition, the de-orbit parameters of the Soyuz (e.g. forces 8-10 times the force of gravity exerted on the body) may be deleterious to a medically compromised patient.

Use of medical simulators like the HPS has proven useful in evaluating medical procedures and enhancing a caregiver's clinical skills. Abrahamson, Denson and Wolf used SIM-1, the first high-fidelity computer-controlled medical simulator to augment the intubation skills of anesthesia residents [6,7]. A study by Chopra *et al.* used the Leiden anesthesia simulator to quantitatively demonstrate the efficacy of patient simulation in clinical crisis management [8,9]. The original version of the METI HPS, called the Gainesville Anesthesia Simulator, was used at the University of Florida to teach basic medical skills as part of the institution's continuing medical education program [10].

Preliminary studies with the HPS have shown that simulation training improves a trainee's medical competence, particularly in the areas of diagnosis, treatment and performance of medical procedures. Doerr *et al.* [11] demonstrated that anesthesiology residents had an increase in confidence, knowledge, performance and a decrease in reaction time through pre-clinical simulation training using the HPS. These results indicate that use of high-fidelity simulators can augment a caregiver's medical proficiency (in the diagnosis and treatment of an ailing patient).

Based on the above findings, an evaluation of the HPS was conducted by AP to determine its practical utility as a tool for:

1. Testing and validating ISS Medical Check List medical procedures.
2. Evaluating and testing present and proposed CHeCS equipment.
3. Refresher medical training for NASA-JSC flight surgeons.
4. Enhancing the medical skills of Crew Medical Officers (CMOs) and biomedical flight controllers (BMEs).
5. Communication skills training for crew, flight surgeons, and biomedical flight controllers.

The evaluation of the HPS was subdivided into the following phases:

Phase 1	Preparation and Training	November-December 2000
Phase 2	NASA Safety Inspection	December 2000-January 2001
Phase 3	Evaluation and Testing	January 2001-March 2001

III. Phase 1 – HPS Training and Preparation

Preliminary Patient Scenario Development *[October 2000]*

Development of clinically based scenarios applicable to space operations was critical to the evaluation of the HPS. Paper-based medical scenarios have been the traditional method used by groups tasked to address space medical care to develop and evaluate on-orbit care capability. In anticipation of the HPS evaluation, AP developed a burn scenario based on published medical literature and medical consultant experience that modeled both the clinical presentation and time course of a patient with ~20% partial thickness burns to the upper chest, neck and head with pulmonary thermal injury and smoke inhalation [12] (NOTE: AP chose to construct a burn patient scenario as a result of the fire that occurred the Russian Mir Space Station in 1997). The scenario was tested

by personnel with experience in burn treatment using the HPS at the Houston Center for Advanced Patient Simulation (HCAPS) at the Baylor College of Medicine.

HPS Training at METI *[November 2000]*

AP personnel received Level 1 training at METI Headquarters in Sarasota, FL. Level 1 training consisted of a two-day course instructing participants on the basic set-up and operation of the HPS. It also provided hands-on training on how to design, edit, and implement patient scenarios using the HPS programming software. Personnel were trained to orient, prepare, and troubleshoot the HPS under a variety of physiological modalities, including tension pneumothorax, pericarditis, chest tube drainage, drug recognition, urine output, and Foley catheterization.

Visit to the Houston Center for Advanced Patient Simulation (HCAPS) *[November 2000]*

AP personnel visited HCAPS to become familiar with the HPS. During the two-day visit, AP's physicians and engineers performed basic medical procedures in response to patient scenarios. Each scenario utilized a clinical problem related to space flight. Treatment of patient symptoms was carried out using either terrestrial medical resources (available from HCAPS) or space-based medical resources (Advanced Life Support Pack (ALSP) and the Respiratory Support Pack (RSP)). The work demonstrated several deficiencies with the procedures and resources for treating some medical events on orbit. Among these were the limitations of the ISS Medical Check List for management of acute conditions, particularly when used by non-physician caregivers. NOTE: Photographs and videos from several of the scenarios were collected for retrospective study of procedure performance.

IV. Phase 2 – NASA Safety Inspection

On 4 December 2000, the HPS was delivered to NASA-JSC Building 266. METI personnel assembled the device on 5-7 December 2000. Safety policy required an inspection of the HPS by the center's Occupational Safety and Institutional Assurance Division (NT). As part of the inspection, AP prepared a Test Plan and Hazard Analysis for the HPS based on Chapters 111 and 309 of the NASA-JSC Safety Handbook (Version H). Following review and approval of the plan by NT, the division's Pressure Systems Group (PSG) was contacted to review the HPS portable gas station to determine its compliance with JSC's safety standards for compressed gas systems. PSG requested the following:

1. Certification documents indicating that the station's tubing, regulators and valves had been pressure tested to manufacturer's specifications.
2. The HPS' portable gas station meet the JSC standard requiring compressed gas systems to have a relief valve downstream of the regulator.

In response to the first request, METI provided certification documents for the station's components. To clarify the second request, AP asked PSG to provide information on the relief valve design so as to assure compliance. PSG was unable to provide this documentation promptly and was uncertain whether it would be able to do so at all. Given the limited loan period of the HPS, AP discussed the time constraint with both

PSG and the Wyle Safety Office and provided an alternative design based on documented standards from the National Fire Protection Agency (NFPA), Chemical Gas Association (CGA), American Society of Testing and Manufacturing (ASTM) and American Society of Mechanical Engineers (ASME). PSG was not able to review or comment on the design proposal in a timely fashion and, as a result, all parties agreed that the HPS would be moved from Building 266 to the AP laboratory at Wyle Laboratories where it would be operated in a manner consistent with national standards.

V. Phase 3 – Evaluation and Testing

Phase 3 of the evaluation used a simulated patient-based approach, starting with identification of medical conditions that could be expected to arise during ISS operations. Inherent in AP's effort to augment the medical capabilities for ISS is the requirement to provide comprehensive system solutions. As a result, the scenario-based testing using the HPS was organized to address the following critical questions:

1. Can the HPS be used to assess the efficacy of medical procedures?
2. Can the HPS be used to evaluate present medical procedures and develop new medical procedures?
3. Can the HPS be used to evaluate present and proposed future medical hardware?

Can the HPS be used to assess the efficacy of medical procedures?

The current operational paradigm for providing care to an ailing astronaut on orbit is for the CMO to consult the ISS Medical Check List for diagnosis and treatment of the patient. Despite widespread acceptance of this paradigm, there is no current strategy for either validating procedure efficacy or for evaluating a CMO's medical proficiency.

AP programmed the HPS to present a proxy-CMO with a patient scenario that had pathology relevant to space operations. The HPS then required the care provider (either a proxy-CMO or flight surgeon) to diagnose and treat the patient through the condition's clinical course. This permitted AP to observe the performance and efficacy of both flight surgeons and personnel trained to CMO levels, as well as the utility of the Check List in a scenario-based paradigm.

Anaphylaxis Scenario

Anaphylaxis (a severe allergic reaction) is an immediate physiological reaction to a foreign substance causing severe bronchoconstriction, vascular permeability and a fall in blood pressure, resulting in shock [13]. Management of the subject's airway and blood pressure is critical for the patient's survival during the early stages of anaphylaxis. The short time course associated with anaphylaxis pathology (3-5 minutes) would require a CMO to respond quickly to the condition and operate independently without time for consultation with a flight surgeon or other experienced caregiver. This finding led AP to use an anaphylactic patient scenario with the HPS to assess the effectiveness of medical procedures from the Expedition 1-ISS Medical Check List. The exercise required two caregivers to manage an anaphylactic patient using only the Check List and the resources available from the ISS Advanced Life Support Pack (ALSP) and the Respiratory Support Pack (RSP).

The majority of personnel taking part in the exercise were unsuccessful in managing the anaphylactic patient. The participants found the ISS Medical Check List to be cumbersome, inefficient, and difficult to follow. All those who were successful in managing the patient had previous advanced medical training (e.g. physician, emergency medical technician (EMT)) and utilized that experience to treat the current scenario. In fact, these subjects were successful in managing the anaphylactic patient because they deviated from the Check List and treated the patient based on their specialist knowledge. They stated that the Check List interfered with their ability to treat the patient.

A majority of the subjects indicated that accessing resources from the ALSP was difficult. A lack of familiarity with the ALSP may have contributed to this opinion; however, the Check List did little to ameliorate the confusion. A lack of familiarity with the ALSP is possible for CMOs since their training with the ALSP is minimal.

The findings indicate that, despite having the technical capability to manage anaphylaxis on orbit, the ISS Medical Check List does not adequately assist a minimally trained caregiver in diagnosing and treating an anaphylactic patient experiencing a standard clinical course.

We conclude that the HPS has the capacity to assess the efficacy of medical procedures.

Can the HPS be used to evaluate present medical procedures and develop new medical procedures?

Expansion of clinical care capability for spaceflight depends on the development and streamlining of medical procedures. Traditionally, medicine has used animals as models to develop and validate medical procedures. However, the use of animals for scientific studies is not only costly but also does not completely reflect all aspects of human physiology. The human physiologic models programmed into the HPS [3,4] provide anatomic and physiologic fidelity for a lower cost than similar animal- or human-based studies. In addition, the HPS allows NASA to develop and evaluate operational medical procedures that have no terrestrial analogue. This capability led AP to use the simulator for medical procedure development.

Urinary Retention

Urinary retention is the involuntary withholding of urine in the bladder [14,15]. Treatment often requires urinary catheterization which entails the insertion of either a straight or Foley catheter into the bladder via the urethra. The catheter then acts as a conduit for the excretion of urine from the bladder. The anatomically correct HPS allows a user to practice this technique, as the simulator's genitourinary system consists of a working bladder attached to interchangeable male/female genitalia.

Urinary retention has occurred during previous space flights and has, on occasion, required placement of a catheter. An astronaut-physician working with AP expressed a common desire among crewmembers that they be able to catheterize themselves ("self-cath") rather than receive assistance from fellow crewmembers. Self-insertion is difficult under the best of circumstances. The procedure requires a certain amount of skill and

must be done in a sterile fashion. In this session, the astronaut-physician and AP clinicians evaluated different methods by which both male and female crewmembers might catheterize themselves using sterile technique. The group also identified ISS/Shuttle resources which could be used to support the procedure. The HPS was invaluable in that it allowed the group to experiment with an anatomically correct urinary system for both males and females. Development of the procedures without the HPS would have required the use of human subjects and an experimental plan approved by the NASA-JSC Institutional Review Board (IRB).

We conclude that the HPS can be used to evaluate present medical procedures and develop new medical procedures.

Can the HPS be used to evaluate present and proposed future medical hardware?

Evaluation and validation of new medical technologies in a space medicine environment is critical to expanding on-orbit clinical care capability. NASA has used human or animal models in earth- or KC-135-based settings, but this has resulted in testing limited to healthy human subjects or animal preparations that model the pathophysiology of an individual condition. Actual patient testing has been rare and, as a result, evaluating the appropriateness of a device for space medical contingencies has generally been the result of limited clinical experience with the flight-approved device.

The capacity of the HPS to respond in a physiologically accurate manner to pharmacologic, cardiopulmonary, and hemodynamic clinical interventions greatly improves an investigator's ability to assess the capability of medical equipment. In the course of the HPS study, AP utilized the simulator to evaluate a number of devices: mechanical ventilators, critical care monitors, artificial airways, and other medial hardware. The advantage of the HPS is that it:

1. Permits devices to be tested exactly as they would be used on an actual patient.
2. Allows evaluation of monitoring capabilities through a full range of clinical pathology.
3. Allows for testing to occur over prolonged time periods (e.g. hours).

Ventilators: Impact Eagle 754M vs. AutoVent 2000

The current ISS ventilator is the AutoVent 2000 (Life Support Products, Inc.) located in the ISS Respiratory Support Pack (RSP). The AutoVent is a pneumatically driven ventilator that supports control of the patient's breathing rate and tidal volume. The unit is designed to support a patient during transport during the pre-hospital phase. The AutoVent operates in demand or control modes only (assist modes are not available). In addition, there are no mechanisms for supplying variable FiO_2 (fraction of inspired oxygen), positive end expiratory pressure (PEEP), monitoring ventilation, or sounding alarms in the event of a patient disconnect. Prior to the arrival of the HPS, AP had identified the Eagle 754M ventilator (Impact Instrumentation Inc., West Caldwell, NJ) as a device that embodied the core functionality for a next-iteration space ventilator. The HPS was used to compare the AutoVent 2000 with the Eagle 754M in their abilities to manage varied pulmonary pathology.

The HPS was programmed to simulate the progressive pulmonary deterioration observed in various pathologies such as status asthmaticus, toxic gas/smoke inhalation, and pulmonary thermal injury (decreasing compliance, increasing resistance and shunting). The experimental set-up consisted of the patient (HPS) properly intubated and ventilated with either of the two ventilators while being monitored using a Datex-Ohmeda CS/3 M-COVX (Datex-Ohmeda Inc., Tewksbury, MA) airway monitor. The M-COVX provides real-time monitoring of resistance, compliance, airway pressures and flows, and end-tidal gases. As expected, the Eagle 754 M was able to ventilate the patient in the presence of significant pathology.

An incidental finding from this evaluation was that the physiologic parameters (ECG, SpO_2) currently available to ground-based flight surgeons during on-orbit medical contingencies are inadequate for managing patients who require mechanical ventilation. The available parameters did not reveal the patient's deteriorating pulmonary function until the patient was in status extremis. Ventilation with 100% oxygen masked the changes and maintained an SpO2 of 100% until lung compliance was severely reduced and the patient's condition irretrievable. In short, there is currently a severe deficiency in the ability to manage a mechanically ventilated crewmember and the HPS was instrumental in demonstrating this limitation. The device can play an equally important role in our efforts to address this shortcoming.

Stethoscope Auscultation

Auscultation of heart, lung, and abdominal sounds using a stethoscope in terrestrial environments is considered standard medical practice. However, auscultation on ISS can be affected by microgravity-induced fluid shifts and minor organ relocation [16], as well as ISS' high level of background noise (70-75 decibels). These factors suggest that auscultation in this environment will be difficult, if not impossible, with traditional stethoscopes. Digital stethoscopes filter background noise while enhancing sounds that originate from the heart, lungs or abdomen; additionally they offer the ability to record and transmit files so that serial exams can be compared. This capability also enables ground-based specialists to listen to exactly what the CMO hears on ISS.

The diversity of heart and lung sounds within the HPS led AP to consider using the simulator as a test-bed for evaluating the noise-filtering capabilities of the several different stethoscopes. However, when used on the HPS, some devices that are more sensitive than traditional stethoscopes acquired the noises of the simulator's internal mechanisms as well as the appropriate heart/lung sounds. This additional noise prevented a proper assessment of the stethoscopes capability to cancel background noise.

We conclude that the HPS can evaluate present and proposed future medical hardware.

VI. Conclusion

The purpose of this study was to determine if the METI HPS could act as a tool for AP to assess, test, and validate the medical procedures, equipment, and resources needed to enhance the critical care capability of space medicine. AP determined that the HPS can aid in assessing the effectiveness of medical procedures. This was demonstrated during tests using the ISS Medical Check List and ALSP/RSP for the management of an anaphylactic patient. The exercise showed that, although the medical equipment is sufficient to mitigate the condition, the format of the Check List does not support effective diagnosis and treatment of the condition when used by minimally trained care providers. Participants stated that the realism of the HPS scenario was superior to paper/pen models and computer-based training because it forced them to think and act as if they were treating a real patient.

AP concludes that the HPS would contribute to the development and improvement of medical procedures for space operations. This was clearly demonstrated during the astronaut-physician's review of the procedures for urinary catheterization. Performing the catheterization on the HPS allowed the astronaut-physician to confirm the effectiveness of the technique. It also facilitated the realization that alteration of the technique could lead to new approaches for performing self-catheterization. Overall, these findings demonstrate that the HPS supports the development of new protocols in addition to improving current procedures.

AP concludes that the HPS can evaluate, test, and validate new medical technology. This was demonstrated by comparing the ventilation capabilities of the current ISS ventilator, the AutoVent 2000, with a commercial-off-the-shelf transport ventilator (Eagle 754M, Impact Instrumentation, Inc., East Caldwell, NJ). The high fidelity of the HPS' respiratory system enabled AP to examine the ventilation characteristics of each device under varying degrees of airway and parenchymal disease. The data revealed that the Eagle was sufficient in managing a damaged airway while the AutoVent was not. These results have led AP to examine whether the Eagle can be utilized for existent ISS ventilation procedures. These findings demonstrated the utility of the HPS in evaluating new medical technology.

In addition, the HPS could play a role in expanding our capabilities in other areas of space medicine and medical operations:

1. *Flight Surgeon/Biomedical Flight Controller Training and Certification*
   During a spaceflight medical event, communication between ground-based controllers and the crew will be critical for patient management. To enhance medical communication skills, flight surgeons and biomedical flight controllers can practice directing caregivers in their management of medical conditions as displayed by the HPS. The simulator would provide a realistic clinical presentation while responding appropriately to caregiver interventions. In addition, an aptitude standard could be developed for certifying controllers for

Mission Control duty. Maintenance of a proficiency standard for all controllers could come via continuing education using the HPS.

2. *Certification of International Flight Surgeon*
   A proficiency standard could be developed for certifying international flight surgeons for Mission Control duty. The testing would be used to assess flight surgeon ability to respond to operationally relevant acute medical events and to standardize treatments across international lines.

3. *Astronaut Medical Training*
   Implementing space medical event scenarios with the HPS enables CMOs to practice medical procedures in a realistic setting, thus making them more comfortable treating the ailments that can occur during flight. In addition, the CMOs can work with ground-based controllers to improve communication during medical events.

4. *Medical Simulations with Flight Director and Mission Control Team*
   Medical scenarios with the HPS could be performed with the Flight Directors and other members of the Mission Control and Management Teams to familiarize all parties with medical decision-making, timelines, and procedures in medical contingency situations. Performance of these simulations would, most likely, lead to improved communication among the various groups and thus facilitate the development of requirements for such contingencies. In addition, the HPS could be integrated into the mission simulations run by the NASA-JSC Training division and provide for currently untested significant medical events. The simulations could model mission-based medical contingencies, such as a fire that has damaged both station and crew. In this way, other Mission Control Center (MCC) members could manage their own systems while the flight surgeon led the crew through the initial medical procedures on the HPS. At the current time, there are no Mission Control simulations that employ such broad based medical scenarios, yet the HPS has the capability of providing a high-fidelity way to realistically simulate these events.

   The benefits of such improved understanding on the part of flight surgeon, crew, Flight Director, and the rest of the MCC team would be significant in the event of an actual contingency.

The data from this evaluation indicate that the HPS is an effective device for expanding capabilities in multiple areas of space medicine, including procedures, equipment, resources, and training. Acquiring HPS technology would have immediate impact on present and short-term space medical projects and facilitate long-term planning for augmenting space medical care for future long-duration and exploratory missions.

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Appendix J: User Test Report—National Training Center

Trip Report, Observation of Military Medical Care in Battlefield Simulation at the National Training Center, Fort Irwin, California, February 18-21, 2001

Overview

On Sunday, February 18, Jim Azukas and I traveled to California for the purpose of observing a battlefield simulation at the National Training Center (NTC) at Fort Irwin, California. The object of this trip was to observe a military battlefield simulation and from information gained, obtain insight into the possible roles that METIs' human patient simulators might have in this environment.

Events

On Monday, February 19, discussion was held with SFC Randolph Nutt about the echelons of military care simulated at the NTC and possible roles for METI's simulators. After this discussion, we visited a Level 2 facility, and observed some incoming patients and the treatment they received.

Tuesday, February 20, we observed battle simulation from pre-dawn until mid-afternoon, riding with SFC Nutt and Lt. Col. Carey.

Background/Observations

We met with SFC Randolph Nutt on Monday morning, and had a discussion session wherein SFC Nutt explained the levels of military care, starting with the forward line and continuing to the rear elements such as the CSH (Combat Support Hospital). SFC Nutt indicated that his duties in the large scale (hundreds of sqare kilometers) simulation were twofold. The first is to act as an OC (observer/controller), to evaluate medical performance at the combat medic/CLS level, observe and correct safety violations, and to interact with the units in rotation so as to improve performance. A second duty performed by SFC Nutt and his colleagues is to act when real world casualties occur.

A small amount of background on the NTC and what happens there might be helpful. The NTC is a large area in the high Mojave desert in mid-California, larger in land area than Rhode Island. The terrain is desert with mountains interspersed within. Temperatures range from 110 plus in summertime to subzero and snow in wintertime. The dust in this environment has been crushed by tracked vehicles and is said to be about 10 microns in size, which is the consistency of talc, a ruggedization factor to keep in mind. At the fort is a detachment that act as the opposing force, complete with reconfigured tanks and armored personnel carriers (APC). This detachment tries to closely resemble an enemy in tactics and equipment. For example, the tanks are made to look like Soviet era tanks, and there is even a Soviet Hind helicopter gunship that flies in the simulation. A terrorist/insurgent/guerrilla force is also free-roaming anywhere in the fort. Anything that can happen in combat is allowed to happen. The force opposing this resident force are the troops in rotation. Combat units come from all over the US to train here against the opposing force in a three week rotation. The troops live mostly in the field or in a tent city while in rotation. The individual medical elements contained within the units in rotation are not trained by the OC's, but are evaluated by them.

When thousands of troops, APCs, tanks, and aircraft share the same space during wargames, accidents happen. SFC Nutt indicated that in any three week rotation, they can expect 6 – 8 vehicle rollovers (hummvees, mostly), a handful of traumatic amputations (fingers, hands) mostly due to tank hatches (300 pounds) slamming down because they were unsecured. Injuries range from hypothermia to heatstroke and heat exhaustion, to emergency appendectomies. This is important to keep in mind, as they only have a limited number of personnel and vehicles, and if they take up _ of an ambulance capability with METIs equipment, then that space cannot be used by a real world casualty that needs transport and treatment.

In the discussion section, the echelon of care was described by SFC Nutt. As an example, say that a soldier receives a gunshot wound to the chest at the Forward Line of Troops (FLOT). This soldier applies self-care if possible, or a Combat Lifesaver (CLS) does what he can to provide the basic medical care, such as stopping the bleeding, and ensuring that the wounded soldier can breathe. The wounded soldier, and his pack, if possible, are pulled out of the line and evacuated to a platoon casualty collection point (PLCCP), about 500 meters back. This is the point at which he will probably see a combat medic (91B or 91W when implemented). The care at this point stresses the ABC's of emergency care, with treatments to ensure a good airway, stop bleeding, treat for shock with IV fluids, and other basic lifesaving care. Some drug interventions may be started, primarily with morphine, atropine, and diazapam – the first for pain/relaxation, the others for combating the effects of chemical warfare. After this treatment, the medic should indicate interventions such as administering drugs, applying tourniquets, etc., on the notecard which travels with the casualty through the system so that subsequent medical personnel have a history of treatment. In practice, the patients are assessed at each stop in the chain of care because in the field, sometimes the medic is too busy to write down this information.

The soldier is assessed, treated to the extent possible, and evacuated to the Company Casualty Collection Point (CCCP). This point is from 500 m to 2 km behind the front line, and the soldier is transported there either in a conventional transport (ambulance hummvee, or ambulance armoured personnel carrier), or in unconventional transport (regular hummvee, or other). At this point, the patient would probably see a First Sergeant or Senior Line Medic, who will treat the casualty with the assistance of combat medics. At this level, evacuation options will be decided. Militarily, air evacuation at this level is not likely for an army on the offensive, due to the ability of the helicopter to compromise the position of operational elements. Ground evacuation is most likely at this point in either an M113 4 litter case tracked ambulance, or an M577 6 litter case tracked ambulance.

At this point, the casualty travels from the Company Casualty Collection Point to one of three points, depending upon how the medical force is structured, and also depending upon the tactical military situation. There are two medical teams, team A, called the Forward Aid Station (FAS), and team B, called the Main Aid Station (MAS). Each of these teams is usually comprised of 4 vehicles, with a Physician (MD) or a Physicians' Assistant (PA) in each team directing the efforts of 3 or 4 combat medics. If these two teams are located at the same point, they are called a Battalion Aid Station (BAS). This point is about 2.5 to 3 km from the FLOT.

Typically, the PA is attached to the FAS. The point where the Forward Aid Station (FAS) is located can vary according to tactical situation. If the attack is a breach of a fixed defensive line, then when the breach is made, every military asset possible is sent through the gap. It is important to note in this situation, that this is one-way traffic for 6 or more hours, depending on the battle. In this situation, the FAS can go through the breach, with the MAS staying on the other side. When this happens, casualties treated at the FAS are not evacuated back through the breach point for 6 hours, unless evacuated by air.

When the FAS and the MAS are separated, the casualty travels to the FAS first, then the MAS. Procedures are similar at the two. Typically, the MAS team, for example, is very mobile on the battlefield. When they arrive at a position suitable for setup, they setup in less than ten minutes by opening the rear of the M577 or opening the back hatch of the M113. Litter stands and medical supplies are set up and the team is ready to receive casualties. Triage of casualties occurs in front of the vehicle, where casualties are sorted according the the DIME principle – Delayed, Immediate, Minimal, and Expectant. Casualties are assessed, then carried to the rear of the vehicle and set down on two litter stands. Typically two casualties are treated simultaneously by the MD and the combat medics. After treatment, the casualty is carried to an area at the rear of the vehicle, where the evacuation urgency is prioritized according to URP – Urgent, Urgent Surgical, Routine, and Priority. Ambulances from the next level of care in the echelon come to pick up the casualties.

From the MAS, the casualties travel to the Ambulance Extraction Point (AXP), which is a brigade level asset. This element is from 5 to 30 km from the FLOT. These elements can go forward to support the

MAS and FAS if necessary, or if medical elements forward are destroyed (as we saw happen in the battle the next day – _ of the medical elements were destroyed by indirect artillery fire).

From the AXP, casualties flow to the Charlie Med (CMEDD) station, which is typically 30 to 60 km back from the FLOT. At this point, care changes from Level One care to Level Two care. At this level, the care of the casualty is overseen by a doctor, and a higher level of medical intervention can take place, but there is still no surgical capability, unless this facility is augmented by a Forward Surgical Team (FST). The casualty can be held for up to 48 hours at this facility, and this tented facility can move every 24 to 48 hours.

After treatment at the Charlie Med Facility, the casualty travels to a Level 3 facility, which is from 60 to 130 km from the FLOT. This facility is either a Combat Support Hospital (CSH), or a DEPMED, which are 600 bed units with surgical and intensive care capability.

Bill Waggener

Appendix K: User Test Report—National Capital Area Medical Simulation Center

EVALUATION OF THE M.E.T.I. HUMAN PATIENT SIMULATOR

NATIONAL CAPITAL AREA MEDICAL SIMULATION CENTER

USUHS/SIMCEN
4301 Jones Bridge Rd.
Bethesda, MD 20814

Phone: 301-295-8135/8158

Shipping Address: 2460 Linden Lane
Silver Spring, MD 20910

Prepared By:

Thomas S. Ritchie
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Evaluated By:

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Associate Professor of Surgery and Military Emergency Medicine
Director Surgical Simulation Laboratory

Mr. Thomas S. Ritchie
Simulator Operator/Operating Room Coordinator

EVALUATION OBJECTIVES

The M.E.T.I. Human Patient Simulator was evaluated for 90 days from April 2001 thru June 2001. In this time frame we attempted to evaluate the simulator for its educational value and the ability to perform tasks to further the needs of all and any medical education and training.

The evaluation was determined using the following criteria:

I. Device Evaluation
Medical devices= performance when used to train and educate medical students
II. Procedure Development
Produce certain scenarios to develop skills and knowledge of medical students
III. Training
Can the HPS ensure standardization of skills and teaching of the medical students?

I. DEVICE EVALUATION

The simulator was evaluated for its many different medical applications as well as its mechanical performance. We will attempt to breakdown the evaluation to show its weaknesses as well as its strengths. This will be done in a systematic forum using the methodology of the head to toe evaluation of the Human Patient Simulator.

1. HEAD: B/Good Airway and Eye lid movement and pupils very good.

2. NECK: B/Good! Pulse sites were good. Skin for cricothyrotomy good.

3. CHEST: A/Excellent Great chest movement (very life like) good breathe sounds Uses a great deal of compressed air if at all possible a compressor would save time and money verses bottled air. **The air compressor is recommended by M.E.T.I. and we find this to be sound advice**. The chest tube area works well, although there is some leakage around the chest tube, but adds to the experience. The decompression site works very well, good reaction from students. Very impressed with all the chest functions.

4. ABDOMEN/GU SYSTEM: B/Good

5. LOWER EXTREMITIES: B/Good! The servos were very loud; one can anticipate accelerated heart rate, which distracts students from performing the patient assessment. Good pulses.

6. DRUG AND IV RECOGNITION SYSTEM: B+/Very Good! This system functioned very well; we had no problem using the IV and Drug recognition system.

7. OPERATING SYSTEM: C/Fair This platform is based on DOS/windows 3.1. We found that the Windows operating system used with the M.E.T.I. HPS was obsolete compared with current forms of technologies. The system could have been user-friendlier. It was hard to open numerous windows at any given time, this in-turn made it hard to work on- the- fly. The Parameter Windows i.e. Heart Rate, Blood Pressure etc. were some what confusing, although the more one works with the system easier it becomes to operate.

*** With the knowledge of these findings we are aware that the New M.E.T.I. HPS Operating System, which addresses the above findings. It is understood that this is a greatly improved system with very user-friendly components.**

II. PROCEDURE DEVELOPMENT

We found that when building Scenarios, one needs to allow ample time to do so. We found this to be educational, and challenging to ones medical skills. The only down side of the development of scenarios would be the older application of Windows. We also found that working on- the- fly could be done faster if Windows (system) was setup in a more user-friendly application. **Again, we are aware that the new HPS System addresses any and all concerns stated above. We look forward to reviewing your new system at some point in time.**

III. TRAINING

Over the three-month period we trained 68 third year medical students using the M.E.T.I. System. We used the Scenario of a MVA VS a tree. The patient was taken to a small rural hospital and the students had to evaluate and discuss assessing and treating the patient. The Scenario is moved along in more of a teaching mode than a training mode. The scenario runs in this order:

- Patient arrives in E.R. in which the Vitals Signs are within normal limits
- Within 5 minutes, Vital Signs change (Pulse increase, minimal Blood pressure drops, SAO_2 is about 96-98.)
- Ten minutes into the scenario, Vital Signs drop, Students must respond appropriately, if not Patient worsens
- If Students make the correct action patients vital signs will stabilize

- At this point the patient now develops a pneumothorax. (Vital Signs change SA O_2 drops)
- If students do not react appropriately the patient will worsen and the patient will develop respiratory arrest and then cardiac arrest

***Overall, students were very positive about the M.E.T.I. System, the Scenario, and program.**

SUMMARY

To summarize, the overall evaluation of this system would be a positive one. We have discussed some discrepancies found throughout the evaluation, and you will find them referenced in this report. This system was very impressive with its= simplistic setup and break down. The system only booted up incorrectly one time. The overall reliability of this system was found to be very good. We also found your staff to be very professional and very helpful with any item or matter that occurred over the three-month time frame. Thank you for your support. If you have any questions with our findings please contact Mr. Tom Ritchie at 301-295-8135 and we will be happy to discuss any matter found in this evaluation.

Appendix L: IST CTPS Laboratory Demonstration Log

IST CTPS Laboratory Demonstration Log

The following table summarizes 27 demonstrations given from September 2000 through April 2001 at the CTPS Laboratory located at IST. In mid-April 2001, the lab was relocated to new STRICOM facilities and this log was closed.

Date:	Person/Organization:	Purpose:	Host:
9/12/2000	RADM T. Heely CAPT Gagnon Ray Malatino Lennie Burke	CO.NAWCAD NAWCTSD NAWCTST NAWCTSD	McBride/Smart
9/20/2000	Toshikazu Ichinoseki Kiyoshi Kayama Dr. Kazuo Uchiyama Yasuko Iwai	Fujitsu System Integration Laboratories LTD. Information System Laboratory	E. Smart
9/20/2000	UK Dignitaries Vice Air Marshal and Ministry of Defense	Tour of TDC	J. Norfleet
10/2/00	MG Lee and others from Taiwan	Tour of STRICOM's Training Development Center (TDC)	
10/13/00	Three groups from the Air National Guard, including three Generals	Tour of the TDC	J. Norfleet, STRICOM
10/19/00	Three people from the office of the Deputy Chief of Staff	Develop Technology Projection Plan	John Hart, STRICOM
10/24/00	Saudi Prince Khalid and others from Saudi Arabia	Overview of STRICOM program	John Hart, Beth Pettitt, STRICOM
11/9/00	Peggy Godwin/Seminole Community College Students	Simulation Technology Demonstration	John Hart, STRICOM
11/13/00	Dr. Jack Ferguson, Office of the Secretary of Defense (Science and Technology) John Mills, M. Zettler, NAWCTSD	Tour of IST and NAWCTSD	Dr. Peter Kincaid, Ernie Smart, IST
11/14/00	Deputy Asst. Secretary of Defense (Readiness) Thomas Longstreth	Simulation Technology Demonstration	John Hart, George Burmester, STRICOM
11/21/00	AMC VE Field Group Command	Simulation Technology Demonstration	John Hart, George Burmester, STRICOM
11/21/00	Leadership Orlando (50 people)	Simulation Technology Demonstration	J. Norfleet, STRICOM
11/31/00	Australian Deputy Director of Simulation and Training	TDC Tour	Jack Norfleet, STRICOM
11/15/00	CECOM Chief Scientist	TDC Tour	Beth Pettitt, Jack Norfleet, STRICOM
1/29/01	Dr. Pamela Dane, Florida Director of Tourism	TDC Tour	Beth Pettitt, Jack Norfleet, STRICOM
11/21/00	CECOM Deputy Commander	TDC Tour	John Norfleet, STRICOM
11/21/00	Boy Scouts	TDC Tour	J. Norfleet, STRICOM
2/1/01	Jack McClure, Associate Director, Mid-Florida Economic council	IST Tour	Peter Kincaid, Ernie Smart, IST
2/1/01	Army Science Board	TDC Tour	Jack Norfleet, STRICOM
2/6/01	German Dignitaries	IST Tour	Jack Norfleet, STRICOM
2/13/01	CSM, Army Materiel Command	TDC tour	Jack Norfleet, STRICOM
2/13/01	Federal Computer Week Reporter	TDC Tour	Jack Norfleet, STRICOM
2/15/01	Oak Ridge National Lab	TDC Tour	Jack Norfleet, STRICOM
2/16/01	Historically Black Colleges Representatives (2 groups)	TDC Tour	Jack Norfleet, STRICOM
3/9/01	JBM representative with Col. Godwin	TDC Tour	Jack Norfleet, STRICOM
3/14/01	James Skurka (Technical Director, STRICOM) with three SES's	TDC Tour	Jack Norfleet, STRICOM
4/3/01	Dr. M.J. Soileau (VP for Research, UCF) with representatives from HQ Department of the Army	IST Tour	Brian Goldiz, IST

Appendix M: CTPS Test and Evaluation Functionality Checklist

Appendix A: Assessment of individual components of the CTPS system

Triage Controller:

Capability # 1: Successfully assess multiple casualties:

[redacted]sualty Collection Point:

6 virtual casualties & 1 casualty on PHS unit	☐ Pass	☐ Fail	☐ N/A
12 virtual casualties & 0 casualties on PHS unit	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance:			
6 virtual casualties & 1 casualty on PHS unit	☐ Pass	☐ Fail	☐ N/A
12 virtual casualties & 0 casualties on PHS unit	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station:			
6 virtual casualties & 1 casualty on PHS unit	☐ Pass	☐ Fail	☐ N/A
12 virtual casualties & 0 casualties on PHS unit	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team:			
6 virtual casualties & 1 casualty on HPS unit	☐ Pass	☐ Fail	☐ N/A
12 virtual casualties & 0 casualties on HPS unit	☐ Pass	☐ Fail	☐ N/A
Air Ambulance:			
6 virtual casualties & 1 casualty on PHS unit	☐ Pass	☐ Fail	☐ N/A
12 virtual casualties & 0 casualties on PHS unit	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital:			
6 virtual casualties & 1 casualty on HPS unit	☐ Pass	☐ Fail	☐ N/A
12 virtual casualties & 0 casualties on HPS unit	☐ Pass	☐ Fail	☐ N/A

Capability # 2: Allow user to successfully perform triage:

Examine multiple casualties, virtually			
2 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
3 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
4 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
5 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
6 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
7 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
Determine classification of each casualty, virtually			
Minimal	☐ Pass	☐ Fail	☐ N/A
Delayed	☐ Pass	☐ Fail	☐ N/A
Immediate	☐ Pass	☐ Fail	☐ N/A
Expectant	☐ Pass	☐ Fail	☐ N/A
Apply immediate care, virtually			
Apply tourniquet	☐ Pass	☐ Fail	☐ N/A
Apply pressure dressing	☐ Pass	☐ Fail	☐ N/A
[redacted]-assess patient, virtually			
Airway	☐ Pass	☐ Fail	☐ N/A
Breathing	☐ Pass	☐ Fail	☐ N/A
Circulation	☐ Pass	☐ Fail	☐ N/A
Disability	☐ Pass	☐ Fail	☐ N/A
Vital Signs	☐ Pass	☐ Fail	☐ N/A
Pulse	☐ Pass	☐ Fail	☐ N/A
Blood Pressure	☐ Pass	☐ Fail	☐ N/A
Respiration Rate	☐ Pass	☐ Fail	☐ N/A
Temperature	☐ Pass	☐ Fail	☐ N/A
Inspection	☐ Pass	☐ Fail	☐ N/A
Auscultation	☐ Pass	☐ Fail	☐ N/A
Palpation	☐ Pass	☐ Fail	☐ N/A
Percussion	☐ Pass	☐ Fail	☐ N/A

Capability # 3: Successfully perform field lab tests: *(what are the doctrinally available field tests are these locations?)*

Forward Surgical Team:			
Chest x-ray	☐ Pass	☐ Fail	☐ N/A
Arterial blood gas analysis (ABG) pH, P_aCO2, P_aO2.	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital:			
Chest x-ray	☐ Pass	☐ Fail	☐ N/A
Arterial blood gas analysis (ABG) pH, P_aCO2, P_aO2.	☐ Pass	☐ Fail	☐ N/A

Capability # 4: Successfully extend the range of diagnostic and treatment options of the HPS unit:

Diagnostic options:			
Visual presentation of patient	☐ Pass	☐ Fail	☐ N/A
Text-based patient history	☐ Pass	☐ Fail	☐ N/A
Text-based responses to evaluation questions	☐ Pass	☐ Fail	☐ N/A
Text-based descriptions of visual inspection	☐ Pass	☐ Fail	☐ N/A
Text-based descriptions of auscultation (bowel sounds)	☐ Pass	☐ Fail	☐ N/A
Text-based descriptions of palpation	☐ Pass	☐ Fail	☐ N/A
Text-based descriptions of percussion	☐ Pass	☐ Fail	☐ N/A
Treatment options:			
Apply virtual tourniquet	☐ Pass	☐ Fail	☐ N/A
Apply virtual pressure dressing	☐ Pass	☐ Fail	☐ N/A
[redacted] Forward Surgical Team:			
Send patient to virtual operating room	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital:			
Send patient to virtual operating room	☐ Pass	☐ Fail	☐ N/A

Human Patient Simulator:

Capability # 1: Allowed the health care provider(s) to assess clinical signs:

Airway			
Swollen tongue	☐ Pass	☐ Fail	☐ N/A
Pharangeal swelling	☐ Pass	☐ Fail	☐ N/A
Larynogospasm	☐ Pass	☐ Fail	☐ N/A
Breathing			
Spontaneous Breathing	☐ Pass	☐ Fail	☐ N/A
Chest excursion	☐ Pass	☐ Fail	☐ N/A
Airflow into oropharynx	☐ Pass	☐ Fail	☐ N/A
Airflow out of oropharynx	☐ Pass	☐ Fail	☐ N/A
Circulation			
Carotid pulse	☐ Pass	☐ Fail	☐ N/A
Radial pulse	☐ Pass	☐ Fail	☐ N/A
Brachial pulse	☐ Pass	☐ Fail	☐ N/A
Femoral pulse	☐ Pass	☐ Fail	☐ N/A
Pedal pulses	☐ Pass	☐ Fail	☐ N/A
Disability			
Eyes open	☐ Pass	☐ Fail	☐ N/A
Eyes close	☐ Pass	☐ Fail	☐ N/A
Blinking	☐ Pass	☐ Fail	☐ N/A
Pupil dilation	☐ Pass	☐ Fail	☐ N/A
Pupil response to light stimulation	☐ Pass	☐ Fail	☐ N/A
Phonation (moaning, talking)	☐ Pass	☐ Fail	☐ N/A
Vital Signs			
Pulse	☐ Pass	☐ Fail	☐ N/A
Blood pressure (obtained by return to flow manual blood pressure cuff)	☐ Pass	☐ Fail	☐ N/A
Blood pressure (oscillometric non-invasive blood pressure)	☐ Pass	☐ Fail	☐ N/A
Respiration Rate	☐ Pass	☐ Fail	☐ N/A
Temperature	☐ Pass	☐ Fail	☐ N/A
Inspection			
Chest Distention	☐ Pass	☐ Fail	☐ N/A
Urinary Output	☐ Pass	☐ Fail	☐ N/A
Auscultation			
Breath sounds			
Synchronized with phases of respiration	☐ Pass	☐ Fail	☐ N/A
Audible over lung apex			
Right lung	☐ Pass	☐ Fail	☐ N/A
Left lung	☐ Pass	☐ Fail	☐ N/A
Audible over lung axilla			
Right lung	☐ Pass	☐ Fail	☐ N/A
Left lung	☐ Pass	☐ Fail	☐ N/A
Audible over posterior lung			
Right lung	☐ Pass	☐ Fail	☐ N/A
Left lung	☐ Pass	☐ Fail	☐ N/A
Normal Breath sounds			
Bilateral	☐ Pass	☐ Fail	☐ N/A
Unilateral	☐ Pass	☐ Fail	☐ N/A
Abnormal Breath sounds			
Bilateral	☐ Pass	☐ Fail	☐ N/A
Unilateral	☐ Pass	☐ Fail	☐ N/A
Palpation	see circulation		
Percussion	☐ Pass	☐ Fail	☑ N/A

Capability # 2: Allowed the health care provider(s) to apply diagnostic monitoring equipment:

5 lead ECG	☐ Pass	☐ Fail	☐ N/A
Invasive Blood Pressure			
Arterial blood pressure catheter	☐ Pass	☐ Fail	☐ N/A
Pulmonary artery pressure catheter	☐ Pass	☐ Fail	☐ N/A
Central venous pressure catheter	☐ Pass	☐ Fail	☐ N/A
Pulse Oximetry	☐ Pass	☐ Fail	☐ N/A
Thermodilution Cardiac Output	☐ Pass	☐ Fail	☐ N/A
Temperature			
Esophageal	☐ Pass	☐ Fail	☐ N/A
Arterial	☐ Pass	☐ Fail	☐ N/A
Respiratory Mechanics			
Respiratory Rate	☐ Pass	☐ Fail	☐ N/A
Tidal volume	☐ Pass	☐ Fail	☐ N/A
Ventilatory pressures and flows	☐ Pass	☐ Fail	☐ N/A
Respiratory Gas Monitoring			
O2	☐ Pass	☐ Fail	☐ N/A
CO2 (capnography)	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team			
Anesthetics	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital			
Anesthetics	☐ Pass	☐ Fail	☐ N/A

Capability # 3: Allowed the healthcare provider(s) to perform therapeutic interventions:

Airway Interventions			
Direct Laryngoscopy	☐ Pass	☐ Fail	☐ N/A
Oral Intubation	☐ Pass	☐ Fail	☐ N/A
Nasal Intubation	☐ Pass	☐ Fail	☐ N/A

Needle cricothyrotomy	☐ Pass	☐ Fail	☐ N/A
Transtracheal jet ventilation	☐ Pass	☐ Fail	☐ N/A
Retrograde wire techniques	☐ Pass	☐ Fail	☐ N/A
Tube cricothyrotomy	☐ Pass	☐ Fail	☐ N/A
Light wand intubation	☐ Pass	☐ Fail	☐ N/A
Fiberoptic intubation	☐ Pass	☐ Fail	☐ N/A
Suction	☐ Pass	☐ Fail	☐ N/A
oral airway devices	☐ Pass	☐ Fail	☐ N/A
nasal airway devices	☐ Pass	☐ Fail	☐ N/A
endotracheal tube devices	☐ Pass	☐ Fail	☐ N/A
combitube	☐ Pass	☐ Fail	☐ N/A
laryngeal mask airway	☐ Pass	☐ Fail	☐ N/A
tracheal airway	☐ Pass	☐ Fail	☐ N/A
rescue breathing	☐ Pass	☐ Fail	☐ N/A
bag-valve-mask	☐ Pass	☐ Fail	☐ N/A
mechanical ventilation	☐ Pass	☐ Fail	☐ N/A
Supplemental oxygen	☐ Pass	☐ Fail	☐ N/A
Cardiac and Circulation			
Antecubital IV	☐ Pass	☐ Fail	☐ N/A
Right internal jugular IV	☐ Pass	☐ Fail	☐ N/A
Femoral veins IV	☐ Pass	☐ Fail	☐ N/A
Fluid replacement therapy	☐ Pass	☐ Fail	☐ N/A
CPR	☐ Pass	☐ Fail	☐ N/A
Defibrillation	☐ Pass	☐ Fail	☐ N/A
Transthoracic cardiac pacing	☐ Pass	☐ Fail	☐ N/A
Pharmacological Therapy			
IV drug bolus	☐ Pass	☐ Fail	☐ N/A
IV drug infusion (e.g., syringe pump)	☐ Pass	☐ Fail	☐ N/A
Inhaled anesthetics (at FST and CSH)	☐ Pass	☐ Fail	☐ N/A
Trauma Procedures			
Needle Decompression of a tension pneumothorax	☐ Pass	☐ Fail	☐ N/A
Chest tube placement and management.	☐ Pass	☐ Fail	☐ N/A
Pericardiocentesis	☐ Pass	☐ Fail	☐ N/A

Capability # 4: Allowed the health care provider(s) to monitor casualty status:

ECG 5	☐ Pass	☐ Fail	☐ N/A
ECG 2	☐ Pass	☐ Fail	☐ N/A
Cardiac Output (CO)	☐ Pass	☐ Fail	☐ N/A
Heart Rate (HR)	☐ Pass	☐ Fail	☐ N/A
terial Blood Pressure (ABP)	☐ Pass	☐ Fail	☐ N/A
lmonary Artery Pressure (PAP)	☐ Pass	☐ Fail	☐ N/A
Central Venous Pressure (CVP)	☐ Pass	☐ Fail	☐ N/A
Temperature (Blood)	☐ Pass	☐ Fail	☐ N/A
Esophageal Temperature	☐ Pass	☐ Fail	☐ N/A
SP02	☐ Pass	☐ Fail	☐ N/A

Casualty Handler:

Capability # 1: Successfully instantiated casualties at any Casualty Treatment Station:

Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A

Capability # 2: Successfully develop, track, and execute scenarios that can be applied to a given casualty:

Scenario editor			
Create new scenario	☐ Pass	☐ Fail	☐ N/A
Edit scenario	☐ Pass	☐ Fail	☐ N/A
Save scenario	☐ Pass	☐ Fail	☐ N/A
Scenario player			
Start scenario	☐ Pass	☐ Fail	☐ N/A
Pause scenario	☐ Pass	☐ Fail	☐ N/A
Restart scenario	☐ Pass	☐ Fail	☐ N/A
Save physiology	☐ Pass	☐ Fail	☐ N/A
Observe physiological state by right mouse click	☐ Pass	☐ Fail	☐ N/A
Observe physiological state by heads up display	☐ Pass	☐ Fail	☐ N/A
Observe virtual geographic location by right mouse click	☐ Pass	☐ Fail	☐ N/A

Capability # 3: Successfully monitor the location and status of casualties across the battlefield:

Blunt abdominal injury			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
Blunt chest injury			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
mpound fracture of the left leg			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
Gunshot wound to the left chest			

Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
Gunshot wound to the right chest			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
Closed head injury			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A

Capability # 4: Successfully transfer casualties from one location to another

Casualty Collection Point to Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Casualty Collection Point to Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance to Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance to Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance to Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance to Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Air Ambulance to Battalion Aid Station*	☐ Pass	☐ Fail	☑ N/A
Air Ambulance to Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance to Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A

* This will not be evaluated as part of the conditions set by the scenario provided by the developer.

Capability # 5: Successfully pause/save/restart a simulation exercise:

Blunt Abdominal Injury			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Closed Head Injury			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A

After Action Review:

Capability # 1: Accurately recorded the time of the injury

Blunt Abdominal Injury	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest	☐ Pass	☐ Fail	☐ N/A
Closed Head Injury	☐ Pass	☐ Fail	☐ N/A

Capability # 2: Accurately record the location of the casualty in the battlespace

Blunt Abdominal Injury	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest	☐ Pass	☐ Fail	☐ N/A
Closed Head Injury	☐ Pass	☐ Fail	☐ N/A

Capability # 3: Accurately record the time of treatment performed at each casualty treatment station

Blunt Abdominal Injury at Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Blunt Abdominal Injury in Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Blunt Abdominal Injury in Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Blunt Abdominal Injury at Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Blunt Abdominal Injury at Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Blunt Abdominal Injury at Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury at Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury in Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury in Air Ambulance	☐ Pass	☐ Fail	☐ N/A

Blunt Chest Injury at Battalion Aid Station		☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury at Forward Surgical Team		☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury at Combat Support Hospital		☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	at Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	in Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	in Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	At Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	At Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	At Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest at Casualty Collection Point		☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest in Ground Ambulance		☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest in Air Ambulance		☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest at Battalion Aid Station		☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest at Forward Surgical Team		☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest at Combat Support Hospital		☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest	at Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest	in Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest	in Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest	at Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest	at Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest	at Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Closed Head Injury at Casualty Collection Point		☐ Pass	☐ Fail	☐ N/A
Closed Head Injury in Ground Ambulance		☐ Pass	☐ Fail	☐ N/A
Closed Head Injury at Battalion Aid Station		☐ Pass	☐ Fail	☐ N/A
Closed Head Injury at Forward Surgical Team		☐ Pass	☐ Fail	☐ N/A
Closed Head Injury at Combat Support Hospital		☐ Pass	☐ Fail	☐ N/A

Capability # 4: Accurately record the type of treatment performed at each casualty treatment station

Blunt Abdominal Injury			
Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury			
Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg			
Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest			
Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest			
Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Closed Head Injury			
Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A

Capability # 5: Accurately develop a tracability report of the evacuation and movement throughout the battlefield

Blunt Abdominal Injury			
Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A

Blunt Chest Injury

Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A

Compound Fracture of the Left Leg

Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A

Gunshot Wound to the Left Chest

Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A

Gunshot Wound to the Right Chest

Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A

Closed Head Injury

Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A

Capability # 6: Accurately record each casualty medical outcome

Blunt Abdominal Injury	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Right Chest	☐ Pass	☐ Fail	☐ N/A
Closed Head Injury	☐ Pass	☐ Fail	☐ N/

Every function detailed in the checklist has been tested successfully by the CTPS Development team. The items in yellow below are those which were witnessed by two CTA evaluators during the August 15 verification test. Items on the checklist pertaining to the HPS or PHS simulators were not demonstrated, as this is a COTS item, and the checklist items for the HPS/PHS units are the same as a feature verification of a purchased item. The time involved to check all the features of the HPS/PHS units exceeds the time allocated for system testing, so the checkoff concentrated on CPTS System specific elements, such as the Casualty Handler, AAR, etc.

Capability # 2: Allow user to successfully perform triage:

Examine multiple casualties, virtually

2 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
3 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
4 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
5 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
6 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A
7 simultaneous casualties	☐ Pass	☐ Fail	☐ N/A

Determine classification of each casualty, virtually

Minimal	☐ Pass	☐ Fail	☐ N/A
Delayed	☐ Pass	☐ Fail	☐ N/A
Immediate	☐ Pass	☐ Fail	☐ N/A
Expectant	☐ Pass	☐ Fail	☐ N/A

Apply immediate care, virtually

Apply tourniquet	☐ Pass	☐ Fail	☐ N/A
Apply pressure dressing	☐ Pass	☐ Fail	☐ N/A

Re-assess patient, virtually

Airway	☐ Pass	☐ Fail	☐ N/A
Breathing	☐ Pass	☐ Fail	☐ N/A
Circulation	☐ Pass	☐ Fail	☐ N/A
Disability	☐ Pass	☐ Fail	☐ N/A
Vital Signs	☐ Pass	☐ Fail	☐ N/A
Pulse	☐ Pass	☐ Fail	☐ N/A
Blood Pressure	☐ Pass	☐ Fail	☐ N/A
Respiration Rate	☐ Pass	☐ Fail	☐ N/A
Temperature	☐ Pass	☐ Fail	☐ N/A
Inspection	☐ Pass	☐ Fail	☐ N/A
Auscultation	☐ Pass	☐ Fail	☐ N/A
Palpation	☐ Pass	☐ Fail	☐ N/A
Percussion	☐ Pass	☐ Fail	☐ N/A

Capability # 3: Successfully perform field lab tests:

Forward Surgical Team:

Chest x-ray	☐ Pass	☐ Fail	☐ N/A
Arterial blood gas analysis (ABG) pH, P_aCO2, P_aO2.	☐ Pass	☐ Fail	☐ N/A

Combat Support Hospital:

Chest x-ray	☐ Pass	☐ Fail	☐ N/A
Arterial blood gas analysis (ABG) pH, P_aCO2, P_aO2.	☐ Pass	☐ Fail	☐ N/A

Capability # 4: Successfully extend the range of diagnostic and treatment options of the HPS unit:

Diagnostic options:

Visual presentation of patient	☐ Pass	☐ Fail	☐ N/A
Text-based patient history	☐ Pass	☐ Fail	☐ N/A
Text-based responses to evaluation questions	☐ Pass	☐ Fail	☐ N/A
Text-based descriptions of visual inspection	☐ Pass	☐ Fail	☐ N/A
Text-based descriptions of auscultation (bowel sounds)	☐ Pass	☐ Fail	☐ N/A
Text-based descriptions of palpation	☐ Pass	☐ Fail	☐ N/A
Text-based descriptions of percussion	☐ Pass	☐ Fail	☐ N/A

Treatment options:

Apply virtual tourniquet	☐ Pass	☐ Fail	☐ N/A
Apply virtual pressure dressing	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team:			
Send patient to virtual operating room	☐ Pass	☐ Fail	☐ N/A
Combat Support Hospital:			
Send patient to virtual operating room	☐ Pass	☐ Fail	☐ N/A

Casualty Handler:

Capability # 1: Successfully instantiated casualties at any Casualty Treatment Station:

Casualty Collection Point	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance	☐ Pass	☐ Fail	☐ N/A

Capability # 2: Successfully develop, track, and execute scenarios that can be applied to a given casualty:

Scenario editor

Create new scenario	☐ Pass	☐ Fail	☐ N/A
Edit scenario	☐ Pass	☐ Fail	☐ N/A
Save scenario	☐ Pass	☐ Fail	☐ N/A

Scenario player

Start scenario	☐ Pass	☐ Fail	☐ N/A
Pause scenario	☐ Pass	☐ Fail	☐ N/A
Restart scenario	☐ Pass	☐ Fail	☐ N/A
Save physiology	☐ Pass	☐ Fail	☐ N/A
Observe physiological state by right mouse click	☐ Pass	☐ Fail	☐ N/A
Observe physiological state by heads up display	☐ Pass	☐ Fail	☐ N/A
Observe virtual geographic location by right mouse click	☐ Pass	☐ Fail	☐ N/A

Capability # 3: Successfully monitor the location and status of casualties across the battlefield:

Blunt abdominal injury			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
Blunt chest injury			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
Compound fracture of the left leg			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
Gunshot wound to the left chest			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
Gunshot wound to the left thigh			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A
Closed head injury			
Locations	☐ Pass	☐ Fail	☐ N/A
Status	☐ Pass	☐ Fail	☐ N/A

Capability # 4: Successfully transfer casualties from one location to another

Casualty Collection Point to Ground Ambulance	☐ Pass	☐ Fail	☐ N/A
Casualty Collection Point to Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance to Battalion Aid Station	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance to Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance to Air Ambulance	☐ Pass	☐ Fail	☐ N/A
Ground Ambulance to Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A
Air Ambulance to Battalion Aid Station*	☐ Pass	☐ Fail	☑ N/A
Air Ambulance to Forward Surgical Team	☐ Pass	☐ Fail	☐ N/A
Air Ambulance to Combat Support Hospital	☐ Pass	☐ Fail	☐ N/A

* This will not be evaluated as part of the conditions set by the scenario provided by the developer.

Capability # 5: Successfully pause/save/restart a simulation exercise:

Blunt Abdominal Injury			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left thigh			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A
Closed Head Injury			
Pause	☐ Pass	☐ Fail	☐ N/A
Play	☐ Pass	☐ Fail	☐ N/A
Load	☐ Pass	☐ Fail	☐ N/A
Save Physiology	☐ Pass	☐ Fail	☐ N/A

After Action Review:

Capability # 1: Accurately recorded the time of the injury

Blunt Abdominal Injury	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left thigh	☐ Pass	☐ Fail	☐ N/A
Closed Head Injury	☐ Pass	☐ Fail	☐ N/A

Capability # 2: Accurately record the location of the casualty in the battlespace

Blunt Abdominal Injury	☐ Pass	☐ Fail	☐ N/A
Blunt Chest Injury	☐ Pass	☐ Fail	☐ N/A
Compound Fracture of the Left Leg	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left Chest	☐ Pass	☐ Fail	☐ N/A
Gunshot Wound to the Left thigh	☐ Pass	☐ Fail	☐ N/A
Closed Head Injury	☐ Pass	☐ Fail	☐ N/A

Appendix N: Equipment Loan Agreement

DEPARTMENT OF THE ARMY
US ARMY MEDICAL RESEARCH ACQUISITION ACTIVITY
820 CHANDLER STREET
FORT DETRICK, MARYLAND 21702-5014

REPLY TO
ATTENTION OF:

July 24, 2001

Deputy for Business Operation

Mr. Mark J. Klingel
Director Contracts
Medical Education Technologies, Inc.
6000 Fruitville Road
Sarasota, Florida 34232

Dear Mr. Klingel:

Enclosed is the fully executed Loan Agreement DAMD17-01-H-0004 between Medical Education Technologies, Inc. (Mr. Ron Corovano) and the U.S. Army Medical Research and Materiel Command (MCMR-AT/LTC Beverly Maultsby) for your records.

I am forwarding a copy of this letter to LTC Beverly Maultsby, U.S. Army Medical Research and Materiel Command, ATTN: MCMR-AT, 1054 Patchel Street, Fort Detrick, MD 21702-5012.

Sincerely,

Craig D. Lebo
Deputy for Business Operation

Enclosure

DEPARTMENT OF THE ARMY
US ARMY MEDICAL RESEARCH ACQUISITION ACTIVITY
820 CHANDLER STREET
FORT DETRICK, MARYLAND 21702-5014

REPLY TO
ATTENTION OF:

LOAN OF COMMERCIAL EQUIPMENT

AGREEMENT NO. DAMD17-01-H-0004

FROM

Medical Education Technologies, Inc.
ATTN: Ron Carovano, Deputy Director of Government Systems
6000 Fruitville Road
Sarasota, FL 34232

(Hereinafter referred to as the lender)

TO

U.S. Army Medical Research and Materiel Command
ATTN: MCMR-AT (LTC Beverly Maultsby)
1054 Patchel Street
Fort Detrick, MD 21702-5012

(Hereinafter referred to as the Government)

IN ACCORDANCE WITH ARMY REGULATION 40-61 THE PARTIES OF THIS DOCUMENT AGREE AS FOLLOWS:

1. Lender equipment, described below in paragraph 6, shall be loaned at no cost to the Government for the sole purpose of equipment technical feasibility testing and not for fulfilling mission requirements for an interim time frame. The examination of equipment will in no way, expressed or implied, obligate the Government to purchase, rent, or otherwise acquire the items tested and evaluated. The lender will have sole responsibility for furnishing the equipment and associated items required for this examination. Transportation to and from the testing facility, maintenance, and repair of loaned equipment shall be the responsibility of the lender. Government personnel will neither demonstrate nor endorse the lender's product. The contracting officer is the duly authorized representative of the Government for purposes of this agreement. A contracting officer representative will be designated by the contracting officer to provide technical direction of the project.

2. The Government shall report to the lender any unserviceable condition present, upon receipt of the lender-owned equipment, or during the term of this agreement, within 7 calendar days after discovery of the unserviceable condition. Lender equipment will be returned in as good condition as possible, considering the testing, evaluation and transportation. The Government assumes no cost or obligation, expressed or implied, for damage to, destruction of, or loss of such equipment while in the Government's possession, or for damages or injuries to third parties resulting from the submission to the Government of defective items for test and evaluation. The Government will not be held responsible for damage to lender equipment during any of the test and evaluation phases performed in accordance with the technical test and evaluation guidance for such equipment. The Government shall make no changes or alterations to the loaned equipment.

3. The lender understands that data derived from the test and evaluation of the loaned equipment becomes the property of the Government. A summary of the test results may be furnished to the lender for their device, but the Government by entering into this Agreement does not undertake any obligation to conduct any tests nor to provide results of any tests conducted. The Government makes no warranties concerning any test results. The lender agrees that no commercial use of the test results will occur. In no way should positive test results be construed, represented, or perceived as endorsement by the Government, or as an indication that the Government will later purchase such equipment. The lender will not make reference to the Government's test and evaluation for advertising or other promotional purpose unless the information has been published or presented through recognized professional media.

4. The lender will not file any claim against the Government or otherwise seek compensation for any equipment, material, supplies, information, or services provided, in connection with this examination.

5. The Government is not bound or obligated to follow any recommendation of the lender. The Government is not bound nor is it obligated in any way to give any special consideration to the lender on future contracts.

6. Equipment description (include nomenclature, including model and serial number, and national stock number as applicable):

Qty	Equipment	NSN
7	Carrier Litter Wheel	6530-01-220-7186
7	Litter Patient Carry	
4	Pole IV	

7. The borrower agrees to hold the Government harmless from any liability to anyone resulting from the borrower's use of the equipment.

8. The equipment and associated items are expected to undergo testing for a twelve (12) month period. The equipment and associated items should be delivered to the Government no later than 23 October 2000. They will be returned to the lender no later than 22 October 2001. Expenses for the return of the equipment will be borne by the lender.

AGREED:

LENDER:

MEDICAL EDUCATION TECHNOLOGIES, INC. (METI)
(Type or print company name of lender)

Mark J. Klingel
(Signature of authorized representative of the lender)

DATE: 7/12/01

MARK J. KLINGEL, CONTRACTS
(Type or print name & title of lender representative)

THE UNITED STATES OF AMERICA

(Signature of contracting officer)

DATE: 7/23/01

CRAIG D. LEBO, DEPUTY FOR BUSINESS OPERATIONS
(Type or print name & title of contracting officer)

Appendix O: Summary of Test Instrumentation Installed at the Center for Total Access, Fort Gordon, GA

CTPS Test Instrumentation Installed at the Center for Total Access, Fort Gordon, GA

This following CTPS Program equipment is delivered to the Center for Total Access CTPS Laboratory at Fort Gordon, GA.

Human Patient Simulators and Accessories

- 6 HPS's, serial numbers
  - PHS 35
  - PHS 36
  - PHS 39
  - PHS 40
  - HPS 101
  - HPS 107
- 6 HPS Tool Kits

Personal Computers and Accessories

- 7 PowerBook G4 Laptop Computers
- 1 PowerMac G4 Desktop Computer
- 6 Apple AirPort Base Stations
- 6 Wheeled Laptop Carts
- 1 Asante 24-port Switch
- 1 External CD-RW
- 1 External 3.5" Floppy Disk Drive

Other Equipment

- Compressed Gas Regulators for
  - Air
  - N2
  - O2
  - CO2
- Shipping Containers for All Equipment

Appendix P: CTPS User Documentation

Combat Trauma Patient Simulation

Phase 4

CTPS SYSTEM USER'S MANUAL

November 2001

Prepared by:

Medical Education Technologies, Inc.
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Agreement N61339-99-3-0002 (P00003)
Unclassified

TABLE OF CONTENTS

1.0 Overview of the CTPS System 3
1.1 CTPS System Scenario 3
2.0 System Diagrams and System Description 4
2.1 Medical Treatment Stations (Nodes) 12
2.2 Control Station 12
2.3 Other System Hardware Components 13
3.0 System Startup and Initialization of System Software Elements 19
3.1 Initialization Process 19
3.4 Power-On Procedure for one node in the CTPS System 20
3.5 Connecting to a Simulator 21
3.6 Stopping the Casualty Simulation 21
3.7 Initialization of System Simulation Software Elements 22
3.8 Initialize the Casualty Handler Engine Software 22
3.9 Initialize the After Action Review Software 22
3.10 Initialize the Triage Controller Software 22
3.11 Initialize the Casualty Handler User Interface Software 22
4.0 Starting and Running the CTPS Scenario 23
4.1 Instantiation of Casualties into the System 23
4.2 Instantiation of Casualties into the CTPS System 23
4.3 Assessment, Treatment and Evacuation of Casualties at the CCP Node 25
4.4 Movement of Casualties to the Human Patient Simulator 25
4.5 Movement of Casualties from the Human Patient Simulator 26
4.6 Movement of Casualties from the CCP Node to the Ground Evacuation Node 26
4.7 After Action Review of Simulation Activity 26
5.0 Powering Down the CTPS Simulation
6.0 Appendix A CTPS Scenario Description
7.0 Appendix B CTPS User Manual for Triage Controller and After Action Review
8.0 Appendix C Human Patient Simulator Maintenance Manual

Table of Exhibits

Exhibit 1	Military Medical Echelon of Care, and Patient Transfer Options within the Echelon	5
Exhibit 2	Description of Individual Node Architectures and Node Function Description	7
Exhibit 3	System Diagram Depicting Flow of Patient Objects (Data Flow) Through Nodes of CTPS System	9
Exhibit 4	Hardware Component Diagram for CTPS System	11
Exhibit 5	System Diagram Depicting Floorplan of System Installed at Fort Gordon, Georgia	14
Exhibit 6	Three Nodes in the CTPS System as Installed at Fort Gordon, Georgia	15
Exhibit 7	The Casualty Collection Point Node as Installed at Fort Gordon, Georgia	16
Exhibit 8	The Combat Support Hospital Node (CSH) in the CTPS System as Installed at Fort Gordon, Georgia	17
Exhibit 9	The Combat Support Hospital Node (CSH) in the CTPS System as Installed at Fort Gordon, Georgia	18
Exhibit 10	Casualty Handler User Interface	25
Exhibit 11	Simulation Log page of the Casualty User interface	27

1.0 Overview of the CTPS System

The CTPS system provides for distributed simulation of multiple casualties through the military medical echelon of care. This User's Manual describes the initialization, operation, and maintenance of the CTPS System.

The CTPS System contains several discrete modules that interact with each other to accomplish the distributed medical simulation of multiple casualties through the military medical echelon of care. These modules are the Casualty Handler, Triage Controller, PATSIM, After Action Review, and Human Patient Simulator.

The Casualty Handler is used to instantiate casualties, overlay specific scenarios onto those casualties, and transfer them to the Casualty Collection Point.

The Triage Controller at each node is used to assess the casualties, assign triage categories, apply treatments to casualties, detect evacuation assets, and evacuate casualties to other system nodes with continuity of simulation.

Each node in the system has PATSIM, a software simulation engine running for the continuous simulation of each casualty object.

The system AAR logs casualty activity and displays casualty status and node status as each casualty moves from node to node in the system.

The transfer of casualties from the Casualty Handler to the CCP Triage Controller, and from the TC of each node to the PATSIM engine of each node is accomplished through the use of Wireless Ethernet data transfer.

1.1 CTPS System Scenario

The CTPS System scenario was delivered with a specific scenario. This scenario (listed in Appendix A) was developed with six casualties: two gunshot wounds, and 4 motor vehicle accident injuries. The injuries represented are: blunt abdominal injury; blunt chest injury; compound fracture of the left leg (tibia); gunshot wound to the left chest; gunshot wound to the right thigh (femoral artery bleed); and closed head injury. The Casualty Handler User Interface instantiates the Casualties. Wound scenarios are overlayed onto the casualties, and then the casualties are electronically transferred wirelessly to the Triage Controller User Interface on the Casualty Collection Point Node on the system.

The triage capability of the system operates by moving casualties in and out of the examination/treatment windows, and their condition can be assessed and classified according to the DIME (Delayed, Immediate, Minimal, and Expectant) protocol. The scenario also demonstrates the system's ability to simulate situational awareness. In the scenario, the combat medic must consider evacuation assets and the evacuation times for

each kind of casualty, to provide for appropriate treatment. This kind of scenario adds a measure of situational awareness training, as it forces the medic to think outside of his section of the medical echelon in his triage process.

After the simulation exercise ends, an After Action Review can take place using the AAR software. In this AAR, the movement of casualties through the system can be tracked, and the interventions can displayed for each casualty at each node. The evaluation of casualties at different times and in differing nodes in the CTPS system is also made available through use of the AAR software.

2.0 System Diagrams and System Description

The following diagrams and their textural descriptions illustrate the architecture, operation and components of the Phase 4 CTPS System.

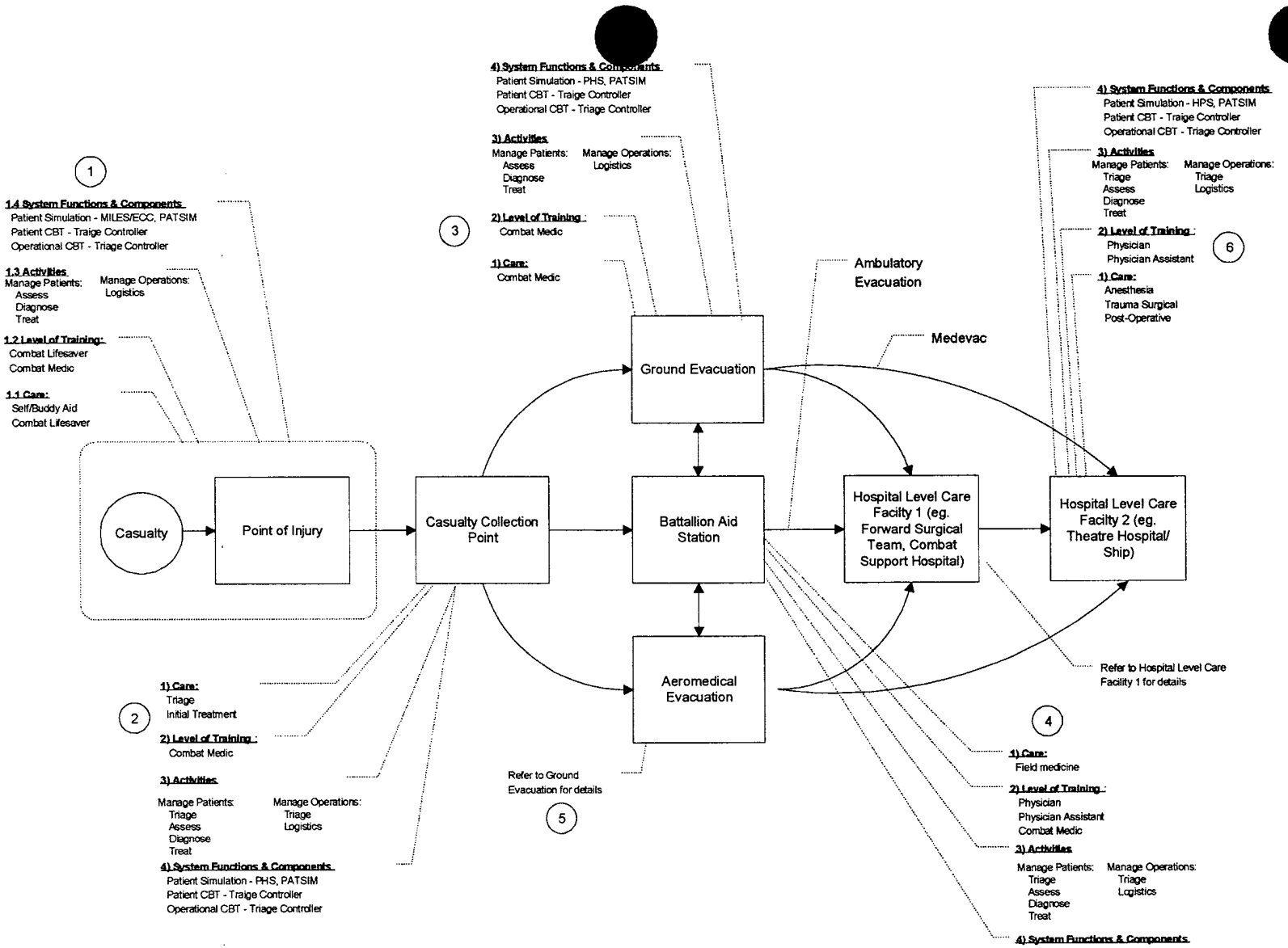


Exhibit 1: Military Medical Echelon of Care, and Patient Transfer Options within the Echelon

Exhibit 1: *Military Medical Echelon of Care, and Patient Transfer Options within the Echelon*

In this exhibit, the Military Medical Echelon of Care is described within the context of casualty simulation and casualty transfer. The mapping of the Military Medical Echelon of Care and the CTPS System is accomplished by introduction of the node concept. In this sense, a node is regarded as a CTPS asset or assets which simulate some aspect of the Echelon of Care. In the CTPS System fielded at Fort Gordon, the nodes which are simulated are listed below.

Casualty Collection Point (CCP) - This level of care is simulated by a Triage Controller Laptop computer, and a Pre-Hospital Patient Simulator (PHS).

Ground Evacuation (GEVAC) – This level of care is simulated by a Triage Controller Laptop computer, and a Pre-Hospital Patient Simulator (PHS).

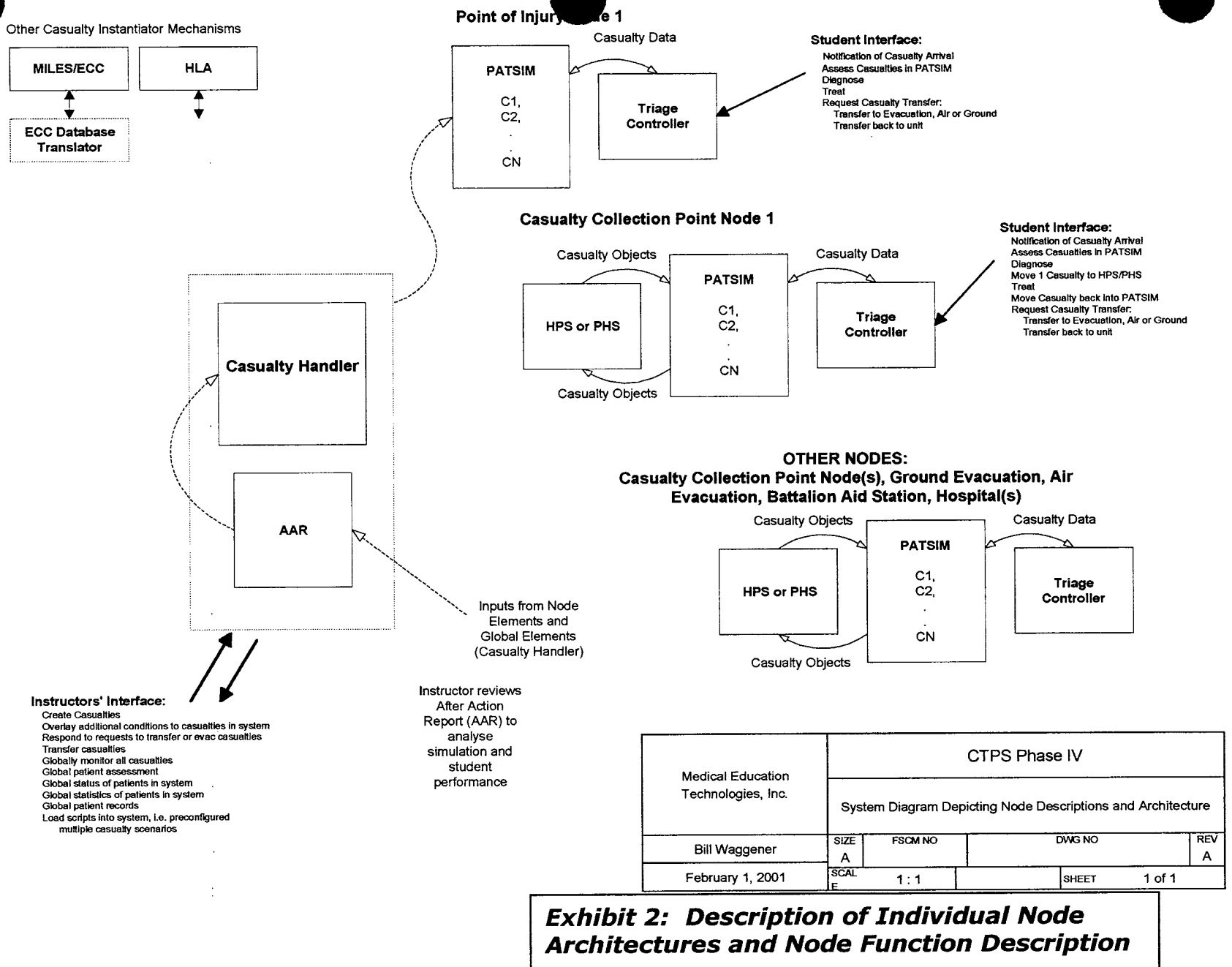
Battalion Aid Station (BAS) – This level of care is simulated by a Triage Controller Laptop computer, and a Pre-Hospital Patient Simulator (PHS).

Forward Surgical Team (FST) – This level of care is simulated by a Triage Controller Laptop computer, and a Human Patient Simulator (HPS). The HPS has more capability than a PHS unit (especially anesthesia delivery), which reflects the ability of personnel at an FST to perform surgical procedures.

Air Evacuation (AEVAC) – This level of care is simulated by a Triage Controller Laptop computer, and a Pre-Hospital Patient Simulator (PHS).

Combat Support Hospital (CSH) – This level of care is simulated by a Triage Controller Laptop computer, and a Human Patient Simulator (HPS). The HPS has more capability than a PHS unit (especially anesthesia delivery), which reflects the ability of personnel at a CSH to perform surgical procedures.

Just as the complexity and capability of each level of the Echelon increases as a casualty traverses the Echelon, the capabilities of the simulation assets at each node increases as the simulated casualty is transferred as a patient object from node to node. The nodes in the CTPS system are flexible, and configurable, such that the simulation assets at a node can be configured to be representative of a different node in the Echelon of Military Care. In this way, of the six nodes delivered as the CTPS System, with some configuration changes, one could configure a system with multiple Casualty Collection Points (CCPs) for example.

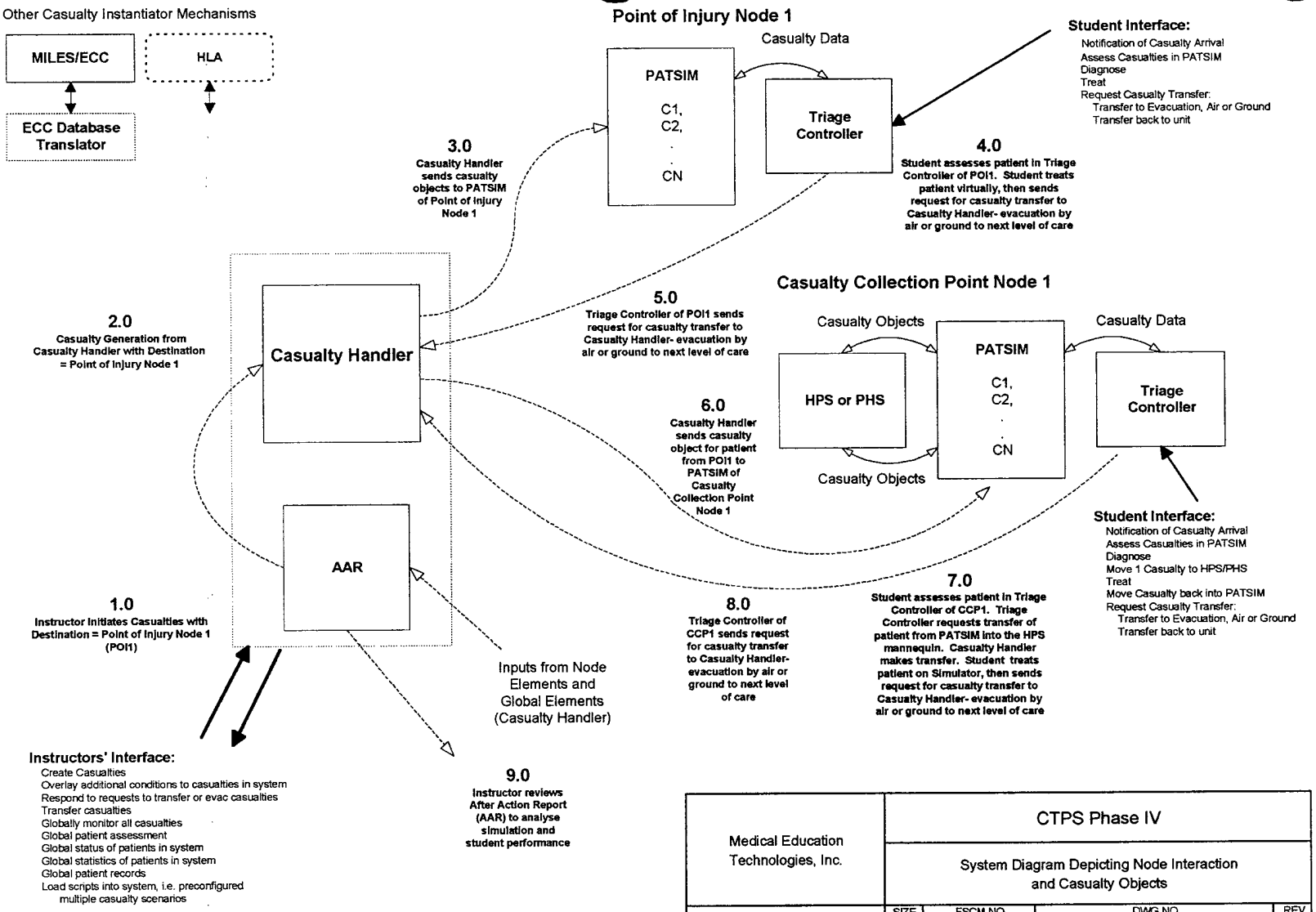


Medical Education Technologies, Inc.	CTPS Phase IV				
	System Diagram Depicting Node Descriptions and Architecture				
Bill Waggener	SIZE A	FSCM NO	DWG NO		REV A
February 1, 2001	SCALE 1 : 1			SHEET 1 of 1	

Exhibit 2: Description of Individual Node Architectures and Node Function Description

Exhibit 2: *Description of Individual Node Architectures and Node Function Description*

In this Exhibit, the Architecture of each Node is described, along with a description of which functions are performed by each Node. The assets residing at a node are the TC on a laptop, and a Human Patient Simulator. The system level assets are the Casualty Handler UI and Engine, and AAR.



Medical Education Technologies, Inc.	CTPS Phase IV				
	System Diagram Depicting Node Interaction and Casualty Objects				
Bill Waggener	SIZE A	FSCM NO	DWG NO		REV A
February 1, 2001	SCALE 1 : 1			SHEET 1 of 1	

Exhibit 3: System Diagram Depicting Flow of Patient Objects (Data Flow) Through Nodes of CTPS System

Exhibit 3: *System Diagram Depicting Flow of Patient Objects (Data Flow) Through Nodes of CTPS System*

This Exhibit has common elements with the previous Exhibit 2, but the flow of Casualties as Patient Objects (Data Flow) is diagrammed. If one follows the numbers, a casualty can be traced through two Nodes of the system. Note: The Point of Injury Node is not implemented physically in the delivered system at Fort Gordon, however, this node can be thought of as a CCP Node without a physical mannequin simulator.

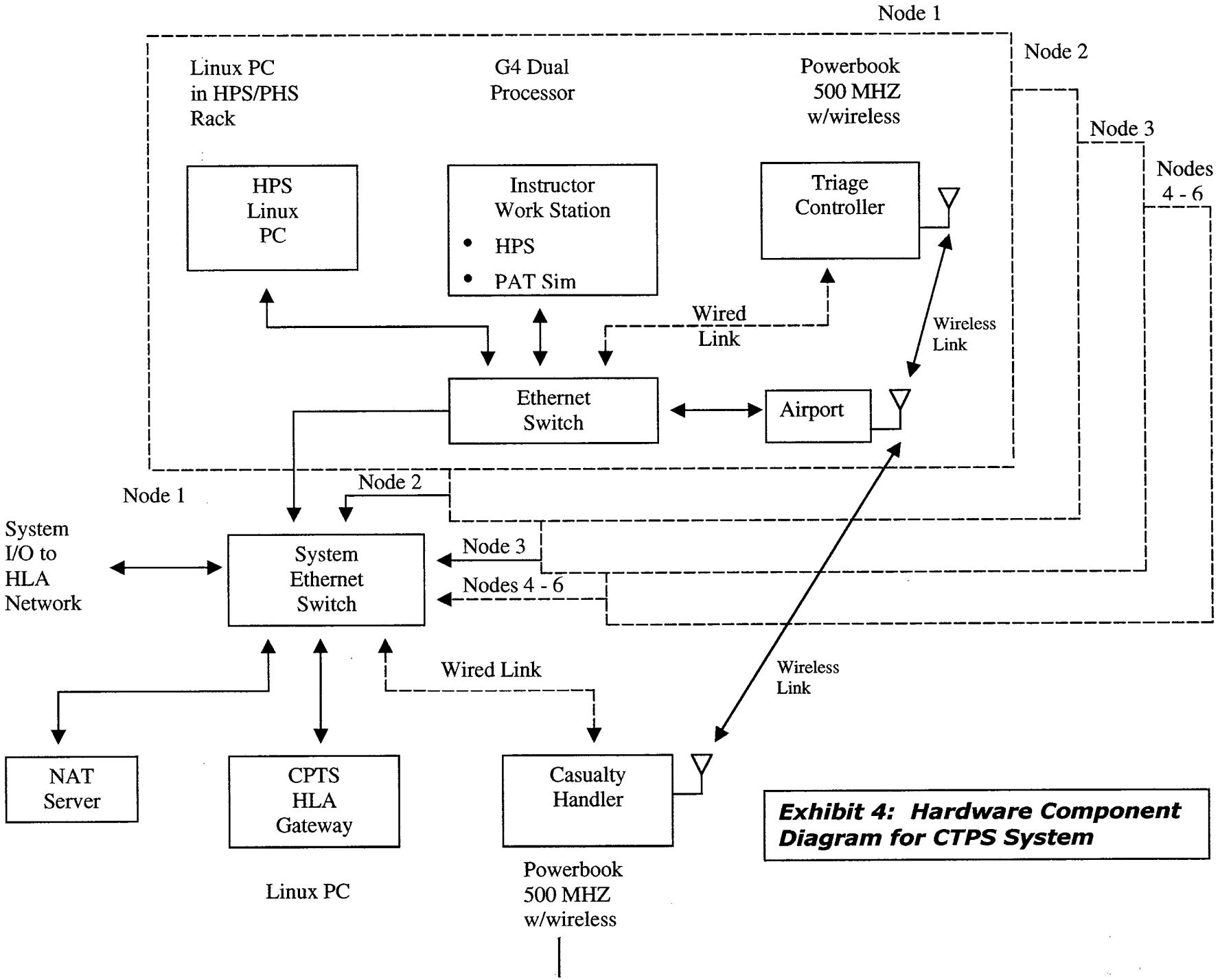


Exhibit 4: Hardware Component Diagram for CTPS System

Exhibit 4: *Hardware Component Diagram for CTPS System*
This Exhibit depicts the configuration of hardware elements in the CTPS System.

2.1 Medical Treatment Stations (Nodes)
Each Medical Treatment Station is called a node on the CTPS System, which consists of:

PATSIM *(Software residing on a Dual-Processor Mac G4 Desktop PC)*
- Multi-casualty simulation software
- Physiologically modeled
- Repository for virtual patients at a particular node

Human Patient Simulator *(Dual-Processor Mac G4 Desktop PC)*
- Physical instantiation of a single casualty on a patient mannequin
- Clinical assessment and monitoring
- Therapeutic interventions

Triage Controller *(Software residing on a Wireless Powerbook Laptop PC)*
- User interface to assess/triage casualties at a node
- Extends diagnostic and treatment options not available on HPS
- Operational supply capabilities
- Casualty evacuation

2.2 Control Station
The CTPS Control Station is a Mobile Master Controller Consisting of:

Casualty Handler *(User Interface Software resides on Wireless Powerbook Laptop PC-User Interface; Engine Software resides on Dual-Processor Mac G4 Desktop-Engine)*
- Simulation Director's user interface
- Initiate overall mass casualty simulation
- Instantiate individual combat injuries
- Monitor status and location of casualties across CTPS system
- System pause/play and save

After Action Review (AAR) System *(Software resides on a Wireless Powerbook Laptop PC)*
- Real-time log of treatment performed on each casualty, at each node
- Traces casualty evacuation and movement throughout CTPS system
- Objective record of individual, team, and collective task performance
- Treatment records captured

2.3 Other System Hardware Components

Gas Supply System

- Air compressor with water trap
- Compressed gas tanks (O2, N2, CO2)

Network Resources

- Private Ethernet Network
- Gateway to Public Internet
- Gateway to HLA Simulations

Clinical Equipment and Supplies

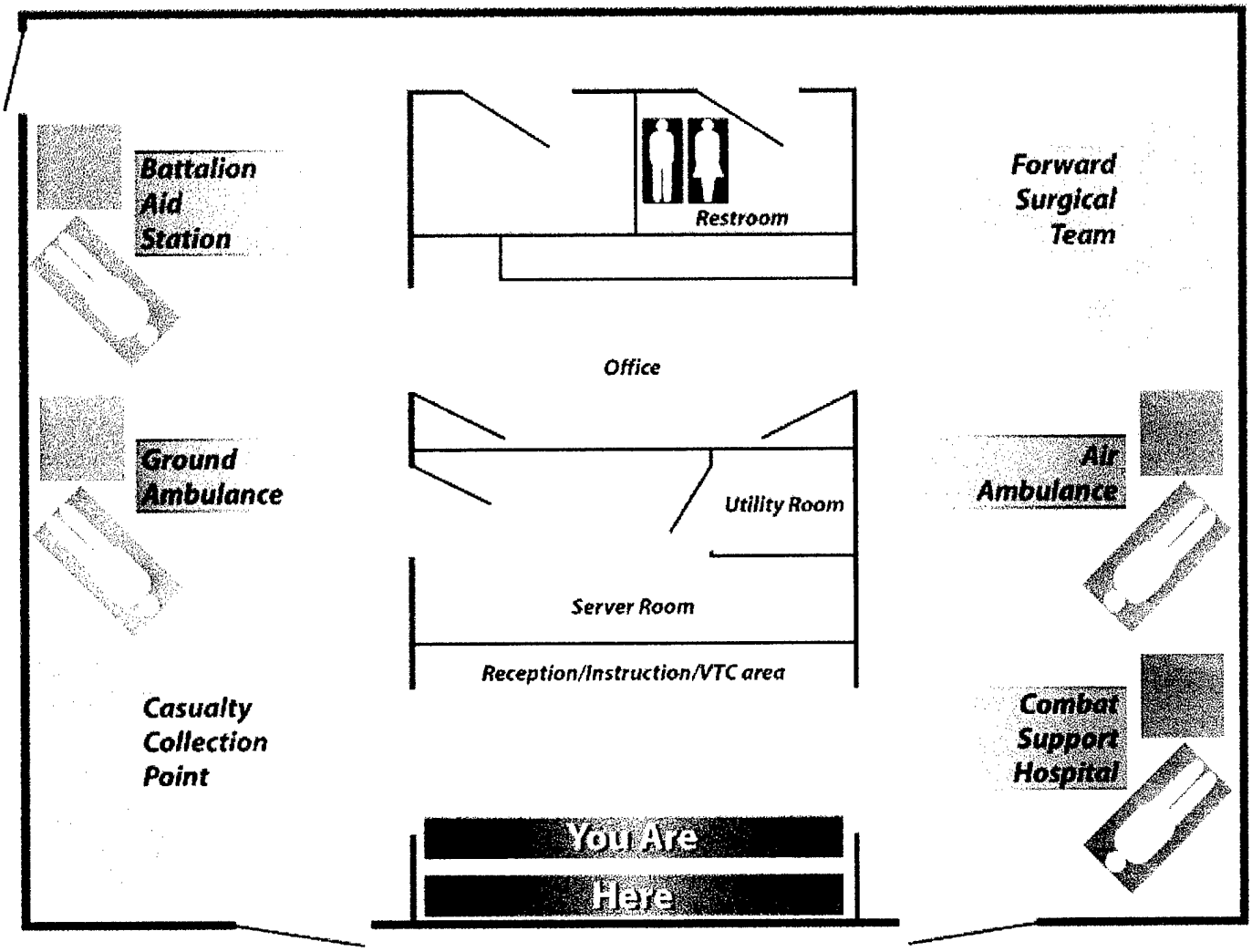


Exhibit 5: System Diagram Depicting Floorplan of System Installed at Fort Gordon, Georgia.

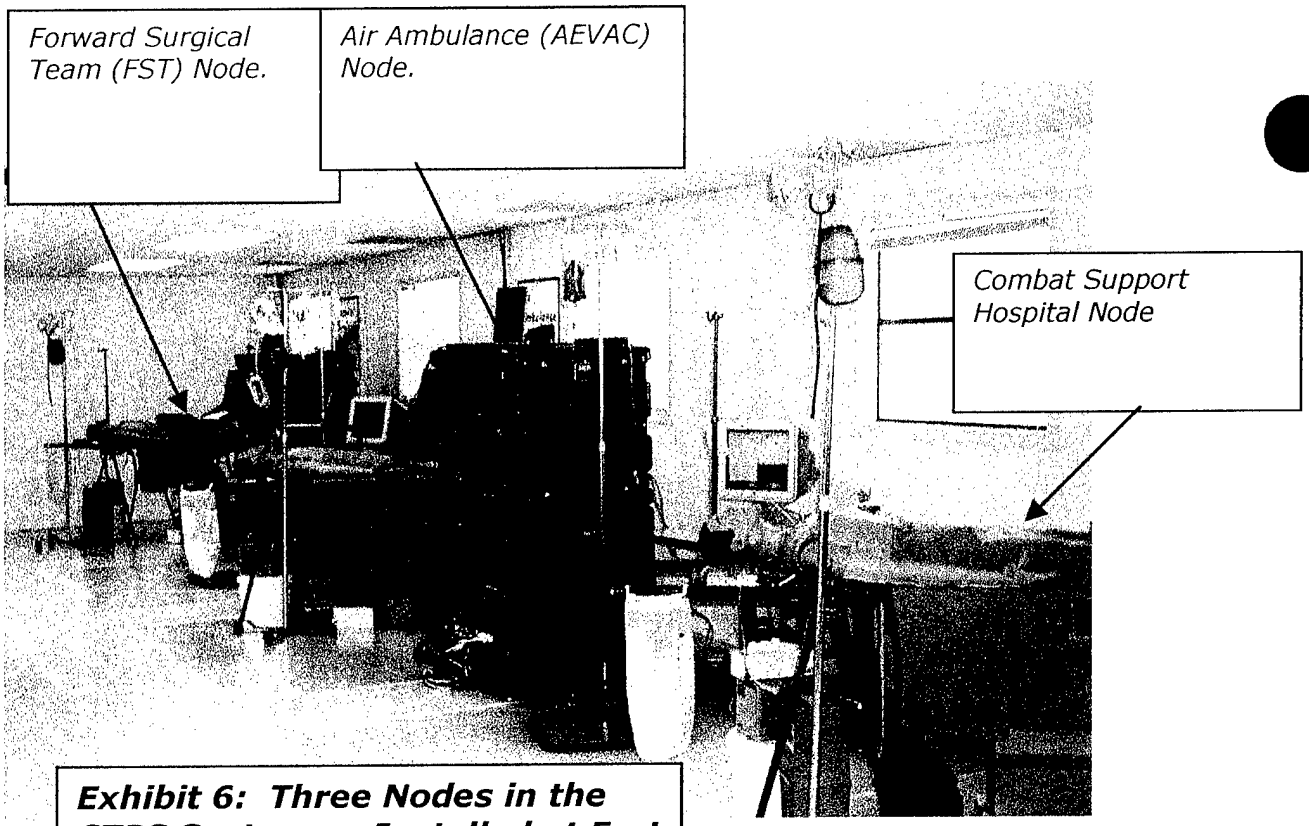


Exhibit 6: Three Nodes in the CTPS System as Installed at Fort Gordon, Georgia

***Exhibit 6**: Three Nodes in the CTPS System as Installed at Fort Gordon, Georgia*

This Exhibit depicts one half of the CTPS System as installed at Fort Gordon, Georgia. The nodes shown in the photo are the (from back to front) FST, AEVAC, and CSH Nodes. On the other side of the building reside the other three nodes, the CCP, GEVAC, and BAS nodes.

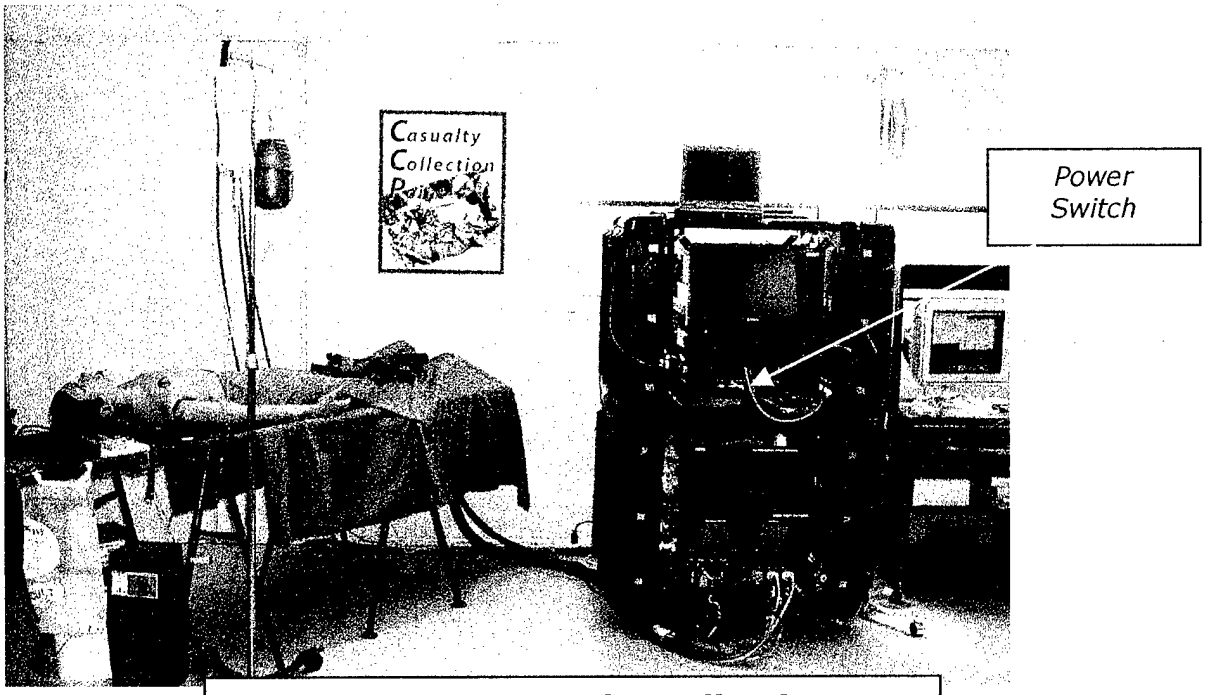


Exhibit 7: The Casualty Collection Point Node as Installed at Fort Gordon, Georgia

***Exhibit 7**: The Casualty Collection Point (CCP) Node in the CTPS System as Installed at Fort Gordon, Georgia*

This node is shown as a detailed depiction of the hardware installed at each node in the system. Each node consists of an HPS or PHS Patient Simulator, Equipment Rack, Desktop Dual Processor G4 Macintosh computer, monitor emulator laptop computer, and Powerbook Laptop computer. Each Macintosh computer is running the Mac OS X (pronounced "OS Ten") operating system, with the following application software loaded:

- Desktop Macintosh: PATSIM, METI Patient Simulation Software (Version 6), one node (presently AEVAC) has the Casualty Handler Engine software resident.
- Powerbook: Triage Controller (configured for that specific node) (Resides on a Roll Cart – not shown in photo – see Exhibit 9)

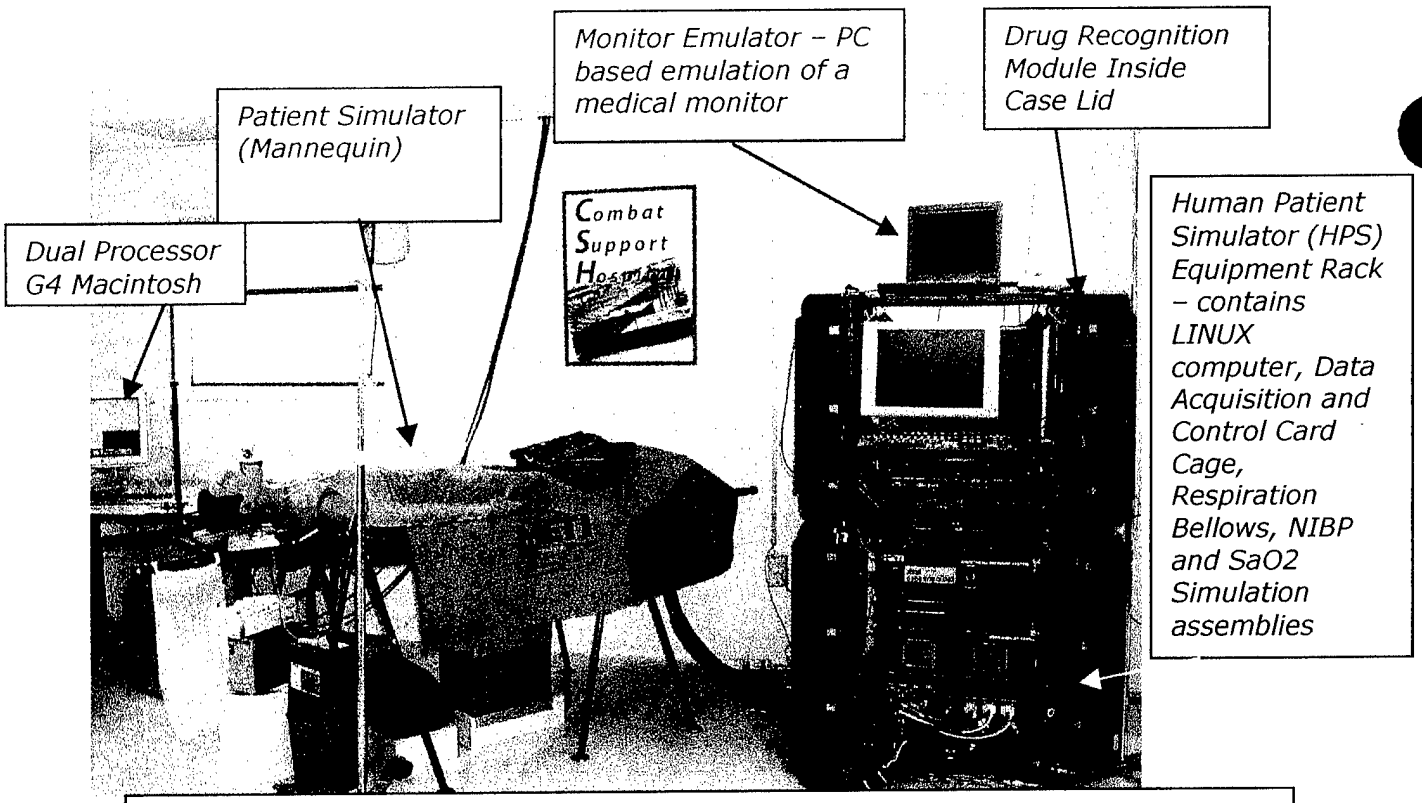


Exhibit 8: The Combat Support Hospital Node (CSH) in the CTPS System as Installed at Fort Gordon, Georgia

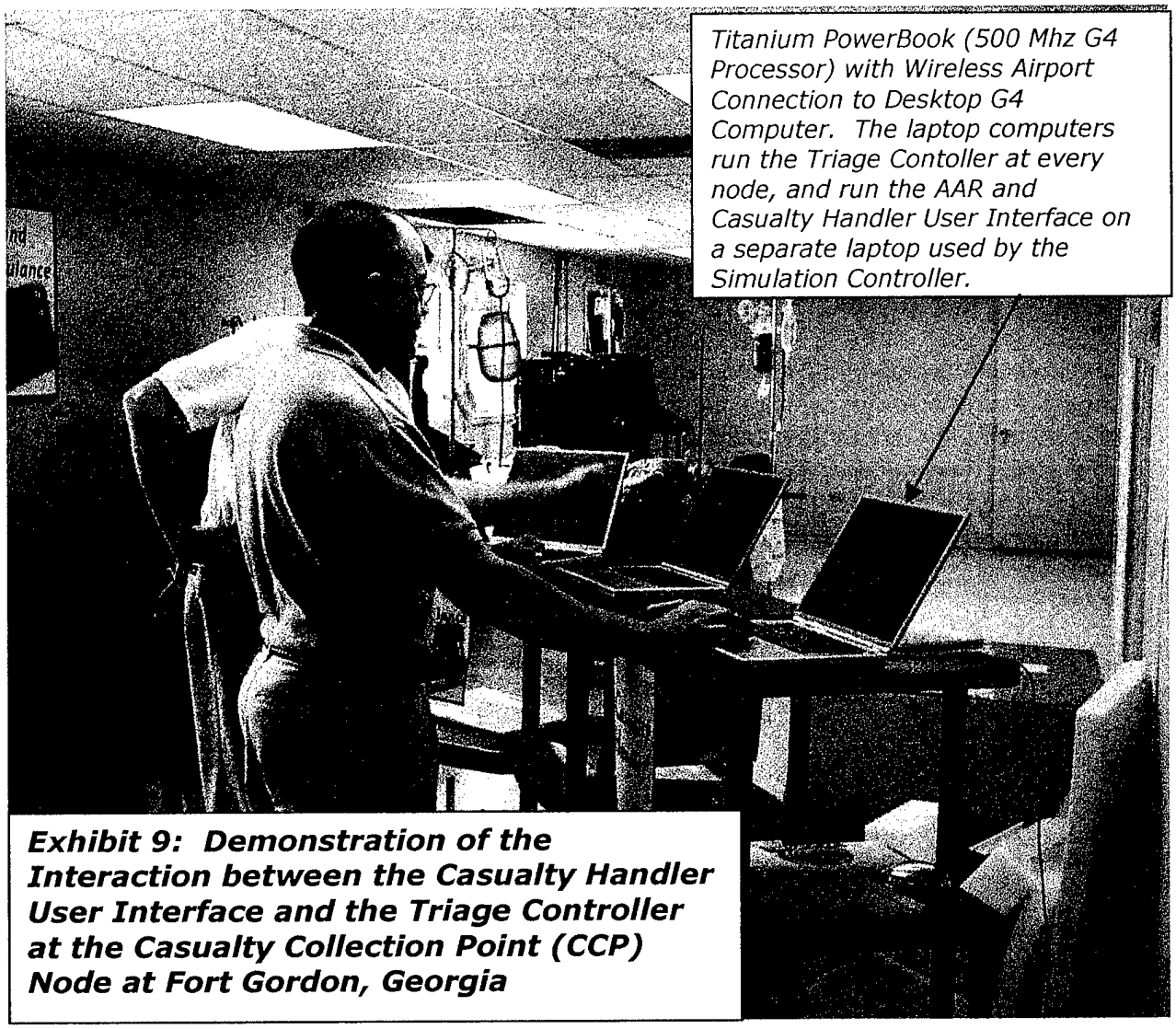
***Exhibit 8**: The Combat Support Hospital Node (CSH) in the CTPS System as Installed at Fort Gordon, Georgia*

This node is shown as a detailed depiction of the hardware installed at each node in the system. Each node consists of an HPS or PHS Patient Simulator, Equipment Rack, Desktop Dual Processor G4 Macintosh computer, monitor emulator laptop computer, and Powerbook Laptop computer. Each Macintosh computer is running the Mac OS X (pronounced "OS Ten") operating system, with the following application software loaded:

- Desktop Macintosh: PATSIM, METI Patient Simulation Software (Version 6), one node (presently AEVAC) has the Casualty Handler Engine software resident.
- Powerbook: Triage Controller (configured for that specific node) This resides on a Roll Cart – not shown in photo – see Exhibit 9.

Also installed in the system is a laptop which is used by a simulation director – the Casualty Handler node. This laptop has the following software loaded:

- Casualty Handler User Interface
- After Action Review (AAR) Display and AAR Logger



Titanium PowerBook (500 Mhz G4 Processor) with Wireless Airport Connection to Desktop G4 Computer. The laptop computers run the Triage Contoller at every node, and run the AAR and Casualty Handler User Interface on a separate laptop used by the Simulation Controller.

Exhibit 9: Demonstration of the Interaction between the Casualty Handler User Interface and the Triage Controller at the Casualty Collection Point (CCP) Node at Fort Gordon, Georgia

***Exhibit 9**: Demonstration of the Interaction between the Casualty Handler User Interface and the Triage Controller at the Casualty Collection Point (CCP) Node at Fort Gordon, Georgia*

In this photo, the way in which the user interacts with the laptop based Triage Controller, AAR, and Casualty Handler elements is displayed. The laptops for each node contain a wireless element which allow them to connect to a desktop or system based network to pass patient assessment data back and forth to the patient modeling and simulation elements of the system, i.e. PATSIM. The Casualty Handler User Interface is also resident on a laptop, and from there, the simulation director can instantiate multiple patients, overlay scenarios onto those patients, monitor their status, and transfer patients to other Nodes in the system. The rollaround carts which the laptops sit on facilitate easy interaction with Observer/Controllers and personnel who are undergoing training.

3.0 System Startup and Initialization of System Software Elements

3.1 Initialization Process

In order to run the CTPS System, an initialization procedure is needed to ensure that the system is powered up correctly. The procedure described below will illustrate how to power up the system in such a way that the gas resources are conserved as much as possible.

3.2 Initialization of Compressed Air for the System

Turn on the air compressor for the system. In the Fort Gordon Installation, this compressor is stored in the server room, which is the room closest to the entrance of the building. Wait until the pressure builds to 50 PSI as indicated on the output gauge. There are two gauges on the compressor – one indicates the pressure in the main compressor tank, and the other is the pressure which is provided to the system. The compressor, while actively running, is quite noisy, and it is recommended that the system user close the door to the server room to reduce the ambient noise level in the system area.

3.3 Initialization of System Gas Supply

While the compressor is building up pressure, the system operator can go to the gas room (the bathroom on the left side of the building, as seen from the front) and turn on the gases. The gases are Oxygen, Nitrogen, and Carbon Dioxide. The gases can be turned on in any particular order. Instead of having one gas bottle per gas type in the laboratory, backup bottles are provided, so as to reduce the frequency of replacement. In this configuration, only one bottle of each type should be turned on at a time, to reduce the possibility of one bottle backfeeding another. The gauges on the top of the bottles indicate the pressure in the tanks (indicating fullness of a tank), and also output pressure delivered to the system. When the tank fullness approaches zero, the gas contractor should be called to service and replace the gas tanks.

IMPORTANT SAFETY NOTE

Oxygen is a gas which can be dangerous if used or handled improperly. Any servicing of the gases should be only performed by a professional. There should not be any smoking, open flame, or sparks in the building occupied by the CTPS System.

In this initializaition procedure, the gas in the system can best be conserved by turning on the system nodes one at a time.

The procedure to **turn on a node** is described below.

3.4 Power-On Procedure for one node in the CTPS System

1.0 Turn on the main power switch of the HPS Mobile Unit (located at the bottom left corner of the transit case containing the computer). See exhibit 7.

2.0 Turn on the Mac OS X workstation. Turn on the Powerbook computer at each node which will run the Triage Controller software for that particular node. Turn on the PC on the top of the rack, which runs the monitor emulator software.

3.0 When prompted by the Mac Log In, enter the Name and Password. (**Note:** For the CTPS System The default Name is: **CTPS** and the default Password is: **CTPS**).

4.0 Click on the "**HPS6 Launcher**" icon in the dock. The application will load and an application icon will appear in the dock with a black triangle beneath the icon indicating that the application is open.

5.0 With the application open the **HPS6-UI** menu is activated. (**Note:** If the menu bar in the upper left corner of the Mac's Desktop does not show the **HPS6-UI** menu, click on the application icon in the dock)

6.0 On the **HPS6-UI** menu bar click on **File** then **Open** to start an existing (saved) patient. In this procedure, the CTPS standard patient is initialized.

7.0 Navigate to the directory in which patients are stored. The default directory for starting the CTPS standard soldier is: **/Applications/HPSVersion6CTPS/Patients**

8.0 Select the CTPS standard soldier from the list. Highlight the **Soldier.hps** patient and click on the **Open** button or double-click on the name.

9.0 The message **"Contacting Patient Model ..."** appears briefly and is followed by the message **"Preparing Patient Simulation ..."** as the User Interface loads.

10.0 After the selected patient has loaded the HPS User Interface displays the **Patient Overview** which shows the name of the patient selected and gives a *Background Summary*. The Vital Sign Display presents the patient's vital signs, and the *Simulation Time* shows how long the patient has been running. When the vital signs start changing, the casualty is under simulation.

At this point the underlying mathematical models are running in software only. Parameter changes will affect the patient's physiology and these changes will reflect as perturbations to the appropriate vital signs displayed on the User Interface. However, the simulator (mannequin) has not been connected to the physiological models and, therefore, will not display any "life" signs, i.e., spontaneous breathing, palpable pulses or eyes opening nor will any waveform rhythms be displayed on the monitor emulator. To "bring the mannequin to life" the simulator needs to be connected to the running software model.

3.5 Connecting to a Simulator

11.0 Complete steps 1-10 of the **Power-On Procedure** above.

12.0 Turn on the Monitor Emulator (PC on the top of the Rack).

13.0 Confirm that all necessary gases are turned on and set at the appropriate pressure (approximately 50 psig).

14.0 Remove any artificial airway devices from the patient (e.g. ET tube, Combitube or LMA).

15.0 On the HPS6 User Interface (Mac) click on the **Simulation** tab and open the *Simulator Connection* window.

16.0 Select the desired *Name* in the list of **Available Simulators** and click on the **Connect** button. **Note:** A valid IP address (ex. 10.127.127.127) must appear in the *Host* window prior to a connection attempt.

The "barber shop pole" will spin with the word "Connecting" shown below. When the connection between the HPS6 User Interface (Mac) and the Simulator (HPS Control Rack) is established the word "Connecting" will change to "Connected".

Once connected, the patient mannequin will "come to life" with the appropriate blood pressures, palpable pulses and breathing rhythm. The physiologic models which are running on the HPS6 User Interface (Mac) are now also running on the mannequin. User interventions (e.g. administered drugs, parameter changes) will alter the appropriate vital signs on the HPS Heads-Up Display (HUD) and are reflected on the patient mannequin (e.g. pulse rate increase or respiratory changes).

Now that the casualty is instantiated on the node mannequin, the gas flows are calibrated and are in the operating range, and so the user should now stop the mannequin simulation.

3.6 Stopping the Casualty Simulation

To stop a simulator session follow the following procedure:

1.0 Click on **File** on the HPS6-UI menu bar

2.0 Select **Close** from the menu list

3.0 Choose whether or not to **Save** or **Don't Save** the patient

4.0 If **Save** is selected, save the patient either by its existing name or give the patient a new name (see **Saving a Patient**)

To continue with the CTPS System Initialization, **repeat this node initialization procedure** for the other 5 nodes in the system. When this is completed, all six nodes in the system are ready to operate.

3.7 Initialization of System Simulation Software Elements

After all of the nodes in the system are initialized, the system simulation elements (i.e. software elements necessary for simulation) can be initialized. This procedure consists of initializing the AAR software, (so that the simulation which is about to be run can be logged), initializing the Triage controllers at each node, and starting the Casualty Handler Engine and Casualty Handler User Interface.

3.8 Initialize the Casualty Handler Engine Software

The Casualty Handler Engine software is a simulation engine which is a master repository for casualty simulation data. All nodes in the system report on the physiology of every casualty in that node. In this manner, data on every casualty is logged for review, and casualties can be transferred electronically from node to node while preserving the simulation physiology of the casualty while in transit.

The Casualty Handler Engine software currently resides on the Air Ambulance node G4 Macintosh in the system. To start the software, double click on the terminal window, and when the window comes up, press enter to start the pre-configured text script in the window. After this, the window can be minimized. There is no user interface to the Casualty Handler Engine. The Casualty Handler User Interface, which runs on the Casualty Handler (Simulation Director) Powerbook, provides a human interface to control casualty instantiation and movement through the system.

3.9 Initialize the After Action Review Software

The After Action Review (AAR) software was developed for the CTPS System by Tekamah Corporation. This software resides on the Casualty Handler Powerbook laptop. Tekamah has prepared a detailed User's Manual for the AAR, which is appended to this document as Appendix B. The user is referred to this manual to learn the details of the AAR operation. To start the After Action Review software, the user must first start the After Action Review Logger by clicking on its icon. After this is done, the Triage Controller software for each node must be started.

3.10 Initialize the Triage Controller Software

The Triage Controller (TC) software was developed for the CTPS System by Tekamah Corporation. This software resides on the Powerbook laptop for each node in the system. Tekamah has prepared a detailed User's Manual for the TC, which is appended to this document as Appendix B. The user is referred to this manual to learn the details of the TC operation. To start the Triage Controller software, the user must click on the icon for the Triage Controller at every node. After this is done, the Casualty Handler software for the system must be started.

3.11 Initialize the Casualty Handler User Interface Software

The Casualty Handler software resides on the Casualty Handler Powerbook laptop. This laptop

is the point at which the Simulation Director or Observer/Controller (OC) has visibility into all aspects of the simulation. This software starts with a double click upon the Casualty Handler icon.

4.0 Starting and Running the CTPS Scenario

With all of the system elements configured and operational, the simulation can start. The CTPS system is installed with a standard scenario, which is described in Appendix C. The first step in starting a casualty simulation is the creation or instantiation of casualties in the system.

4.1 Instantiation of Casualties into the System

There are two important steps to the instantiation of casualties into the system.

The first step is to start a casualty simulation running. This casualty is a standard soldier, and provides a constant base physiology for all casualties in the system.

The second step is to overlay a scenario onto this casualty. The CTPS System has six different casualty scenarios (wound types) which make up the system scenario. It should be stressed that there are many different casualties which can be instantiated, as the Human Patient Simulator can represent many types of physiologies, from female patients, to elderly and obese patients with cardiac problems. The standard soldier physiology is used in the CTPS System scenario to represent a standard, healthy soldier, to provide consistency with the scenario developed, which only uses soldiers in its simulation description.

Once a Casualty is loaded into the system with a specific scenario overlaid onto that casualty, the casualty is instantiated at the CCP node of the system. The instantiation procedure can be repeated 5 times to load the system with the casualties as prescribed by the CTPS System scenario.

The procedure to load the system with casualties corresponding to the CTPS System scenario is listed below.

4.2 Instantiation of Casualties into the CTPS System

To create casualties in the CTPS System, the user operates the Casualty Handler User Interface. To start this program, the Casualty Handler User Interface was started in the initialization procedures above. Follow the procedure below to create a casualty.

1.0 On the **HPS6-UI** menu bar click on **File** then **Open** to start the CTPS standard casualty (named Soldier.hps).

2.0 Navigate to the directory in which patients are stored. The default directory for starting the CTPS standard soldier is: **/Applications/HPSVersion6CTPS/Patients**

3.0 Select the CTPS standard soldier from the list. Highlight the **Soldier.hps** patient and click on the **Open** button or double-click on the name.

4.0 Question marks will appear in the left pane momentarily, and then the name Soldier1.hps will appear.

5.0 When the Vital Sign Display starts updating, then another casualty can be loaded into the system, or, a scenario can be overlaid on top of the Soldier.hps that has been loaded into the system. Since it takes longer to load a casualty than to overlay a scenario, it is suggested for the CTPS scenario, which has six casualties, that all six soldiers are loaded without overlaying a scenario. Then, when all six are ready and are simulating, the six wound scenarios can be overlaid quickly on them. When casualties are instantiated in the Casualty Handler, they are sent to the CCP node. This is configurable by configuration file input. By overlaying all of the scenarios at one time, the simulation ensures that the medic(s) at the CCP see casualties whose wound physiologies are changing after starting at a consistant, reproducible start time. According to this philosophy of instantiation, then, the user should load 6 standard soldiers into the system.

6.0 When all six are simulating, (i.e. the vital signs display is updating for *each* casualty), then the scenarios are overlaid. Select the first CTPS standard soldier from the list, by double clicking on the name in the left pane. Then, navigate to the directory in which casualty scenarios are stored. The default directory for CTPS scenarios is : **/Applications/HPSVersion6CTPS/Scenarios/CTPS.**

7.0 In the Scenarios/CTPS directory are the six CTPS scenarios which should be overlaid onto the six Soldier casualties which have been started. Click on the scenario which should be applied to this casualty. The scenario choices are:

CTPS_Blunt_Abdomen.hs6
CTPS_Blunt_Chest.hs6
CTPS_CompoundFX_Left_Leg.hs6
CTPS_Gunshot_Left_Chest.hs6
CTPS_Gunshot_Left_Thigh.hs6
CTPS_Head.hs6

8.0 When the scenarios are applied to the casualties, the physiology of the casualty starts changing according to the wound applied. The casualties show up at the Triage Controller of the CCP node.

The Casualty Handler User Interface is shown in exhibit 10, with a patient residing at the CCP node.

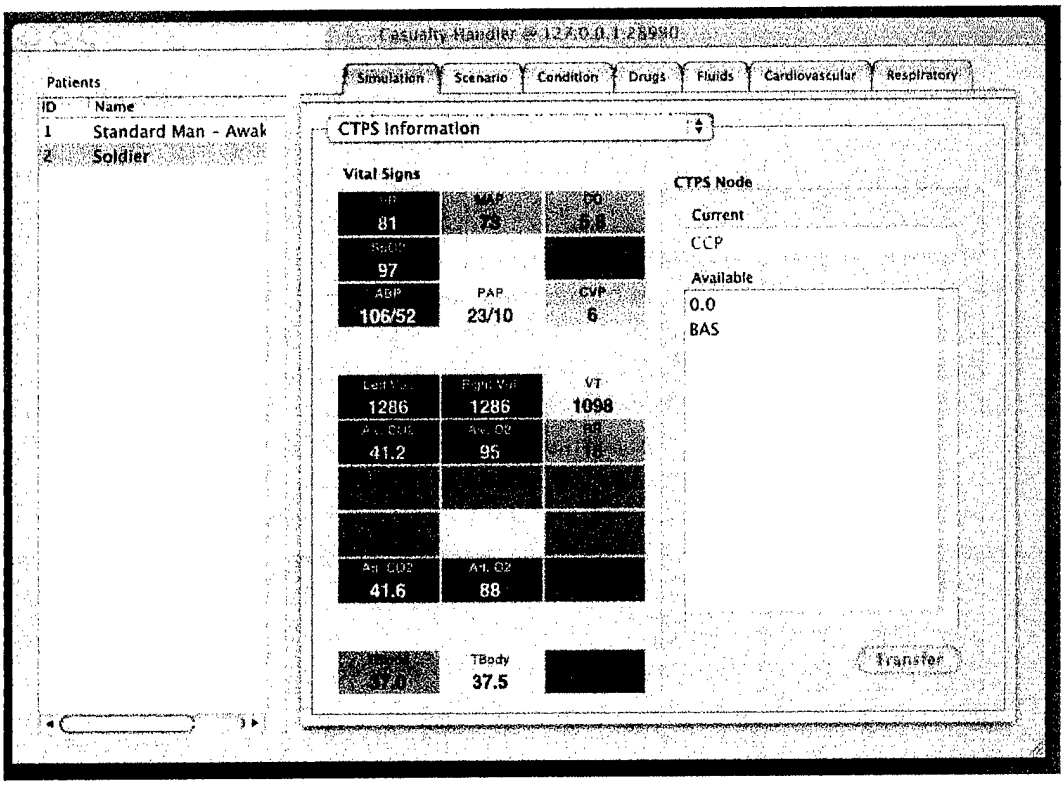


Exhibit 10: Casualty Handler User Interface

At this point the underlying mathematical models are running in software on the CCP node only. The Casualties are introduced into the system and can be viewed using the Triage Controller at the CCP node.

4.3 Assessment, Treatment and Evacuation of Casualties at the CCP Node

Once these six casualties are instantiated at the CCP node, the simulation is in free running mode. Actions, and lack of action by medical personnel will result in improvement or decline of the casualties in the system. The personnel at the CCP node can assess, triage, treat, and evacuate patients according to military doctrine. The detailed capability of the Triage Controller is described in the TC User's Manual, which is appended as Appendix B of this User's Manual.

4.4 Movement of Casualties to the Human Patient Simulator

The casualties at the CCP node, as they are assessed and triaged, can be moved to the Mannequin simulator for hands-on treatment and further assessment. The full capability of the HPS is described in the HPS User's Guide. One User's Guide for the HPS is provided for each node of the CTPS System. The procedure for movement of a casualty from the Virtual world of the Triage Controller to the physical world of the Mannequin is described in detail in the User's Manual for the Triage Controller and After Action Review, as provided by Tekamah Corporation, and appended as Appendix B of this User's Manual.

4.5 Movement of Casualties from the Human Patient Simulator

The casualty which has been moved to the HPS can be moved off of the HPS and sent back into the virtual world. The full capability of the HPS is described in the HPS User's Guide. One User's Guide for the HPS is provided for each node of the CTPS System. The procedure for movement of a casualty from the physical world of the Mannequin to the Virtual world of the Triage Controller is described in detail in the User's Manual for the Triage Controller and After Action Review, as provided by Tekamah Corporation, and appended as Appendix B of this User's Manual.

4.6 Movement of Casualties from the CCP Node to the Ground Evacuation Node

The casualties that reside within the TC of the CCP node can be transferred to the TC of the Ground Evacuation node (GEVAC). This is accomplished by selection of a casualty, and then pushing the Evacuate button on the TC. The evacuation can be selected to be either by ground to the BAS node or by Air to the CSH node. The process for evacuation from one node to another is given in detail in the User's Manual for the Triage Controller and After Action Review, as provided by Tekamah Corporation, and appended as Appendix B of this User's Manual.

Once the casualty is at the next node, the casualty can be assessed, triaged, treated and evacuated to other nodes as performed previously.

When the simulation has ended, either through decision of the Simulation Director (OC), or resolution of each scenario, the After Action Review can be activated to review the action in the simulation.

4.7 After Action Review of Simulation Activity

The process for activation and operation of the After Action Review is given in detail in the User's Manual for the Triage Controller and After Action Review, as provided by Tekamah Corporation, and appended as Appendix B of this User's Manual.

In this review, the users and Observer/Controllers can dissect the actions, and interventions which have taken place in the simulation. Casualty flow can be observed, and interventions and events can be analysed with respect to the overall CTPS System scenario. The Simulation log page is shown as exhibit 11. Users can select an Event Log, a Drug Log, or a Physiologic Data Log.

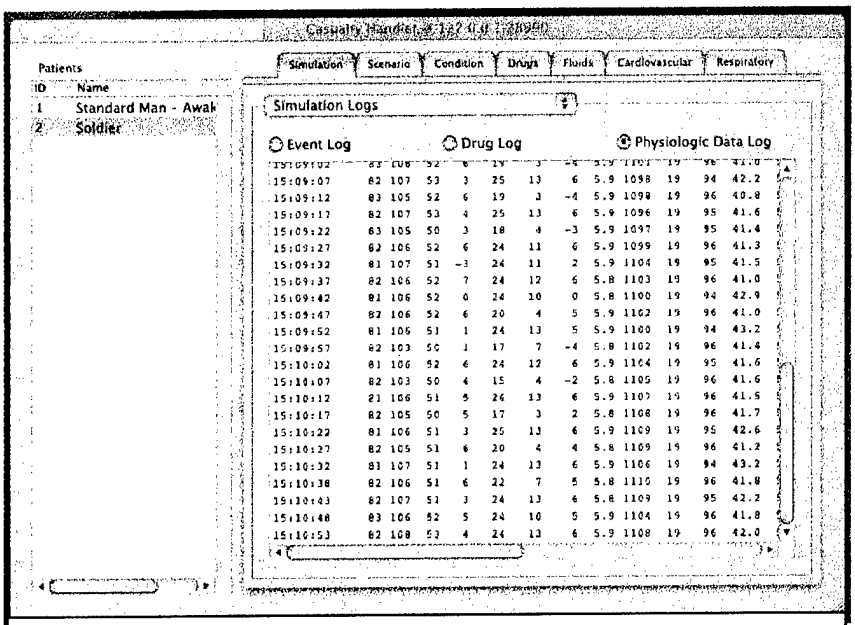


Exhibit 11: Simulation Log page of the Casualty User interface

5.0 Powering Down the CTPS Simulation

Power-Off Procedure

1.0 On the HPS patient window, click on the **Red "X"** to **Close** (Stop) each individual casualty in the system.

OR

On the **HPS6-UI** menu bar click on **File** then **Close** to stop each casualty individually.

2.0 When prompted, chose the **Save** or **Don't Save** option.

3.0 **Quit** the HPS Application by clicking on **HPS6-UI** on the **HPS6-UI** menu bar and then selecting **Quit HPS**.

4.0 Click on the **Blue** Apple menu to **Shut Down** or **Log Out...** (**Note:** Shut Down will turn the Mac computer off while Log Out finishes the session for the current User but leaves the Mac computer powered on).

5.0 Turn off the main power switch of HPS Mobile Unit (located at the bottom left corner of the transit case containing the computer). Repeat this for all of the nodes. Shut down all of the Powerbook computers at each node, as well as the PC's which are used for the Monitor Emulators on top of the racks.

6.0 Turn off all gas supplies.

7.0 Turn off the compressor, and drain the water trap.

6.0 Appendix A CTPS Scenario Description

CTPS Phase 4 Demonstration Scenario: Ft. Gordon, Georgia

OVERVIEW OF THE SCENARIO

Twelve soldiers were enroute to their garrison in two HUMMVs. They were driving on a dirt road when the lead vehicle ran over a mine. The explosion flipped the vehicle over killing two of the six occupants instantly. The other four survived the initial blast but were seriously injured. The trailing vehicle immediately pulled to the side of the road and its six occupants dismounted and rushed to render assistance. Immediately after dismounting, they began to take fire from a sniper concealed in the brush adjacent to the road.

One of the members from the trailing vehicle was hit by the snipers first shot. Two others began returning fire while a fourth radioed for assistance and the remaining two (one a medic) began attending to the injured soldiers. The exchange of gunfire lasted less than five minutes before the sniper was killed. In that short time he was able to inflict two gunshot wounds, raising the number of injured soldiers to six.

CASUALTY DESCRIPTIONS

Blunt Abdominal Injury (ruptured spleen)

The soldier riding in the front right seat was unbelted and was thrown out of the HUMMV, landing several yards from vehicle. Upon initial inspection he has a small laceration on his forehead and reports having a sharp pain in his left wrist. He is stoic when talking about his injuries and is very concerned about his fellow soldiers. Initial vitals reveal only a slightly elevated heart rate. With further examination he is tender on the left side of his torso where he apparently struck the ground. Breath sounds are normal. Abdomen is normal.

His underlying injury is a ruptured spleen. As he bleeds into his peritoneal space he becomes increasingly hypovolemic and has rebound tenderness upon examination. Volume replacement has little effect. His only hope for survival is prompt evacuation to a treatment facility with surgical capabilities. Without surgical intervention (splenectomy) this casualty will die in approximately 60 minutes.

Table 1. HPS States – Ruptured Spleen

Baseline	30 seconds then Class I Shock
Class I Shock	450 seconds then Class II Shock
Class II Shock	450 seconds then Class III Shock
Class III Shock	2400 seconds then Class IV Shock
Class IV Shock	Death in approx two minutes
Splenectomy	

This casualty does not respond to volume resuscitation unless splenectomy is done. He transitions to "splenectomy" after arriving at a treatment facility capable of a laporatomy *and* surgical intervention is selected.

Blunt Chest Injury (pericardial tamponade)

The blast arrested the vehicle's forward motion and flipped it over on its top. The driver's chest struck the steering wheel. Upon inspection he has a bruise on his chest over the lower half of the sternum as well as a bruise on his left leg where it stuck the side of the vehicle during the rollover. He complains of soreness where he struck the steering wheel and a sharp localized pain with inspiration. As time progresses he reports the chest pain becoming "sharper" with the pain radiating to his neck. His respiratory rate increases and he has trouble breathing. He is anxious and lightheaded.

The force of the impact of his chest on the steering wheel fractured ribs immediately over his heart. The impact with the heart caused a small bleed into his pericardial sac. As the fluid accumulates his condition becomes more severe eventually leading to unconsciousness. The problem can be managed (temporarily) at any location with staff capable of a pericardiocentesis. (BAS, FST, of CSH). With the pressure in the pericardium relieved, the bleeding stops on its own and does not require surgical correction.

Table 2. HPS States – Pericardial Tamponade

Baseline	60 seconds
Tamponade	1200 seconds
Unconscious	

Closed Head Injury

One of the soldiers riding in the rear of the first HUMMV was thrown against the metal frame of the vehicle. His head struck a metal post creating a small laceration and significant bruising. He suffered a brief loss of consciousness and reports both neck and head pain. After 5 minutes he loses consciousness.

His underlying injury is a cerebral contusion. The intra-cranial pressure increases over the course of the scenario. His best chance of survival is evacuation to a treatment facility with an intensive care unit.

Table 3. HPS States – Closed Head Injury

Baseline	300 seconds
Unconscious	300 seconds
Level I ICP	
Level II ICP	
Level III ICP	

Compound Fracture of the Left Leg (tibia)

One of the four passengers riding in the rear of the HUMMV had his left foot and ankle wedged between two pieces of gear during the rollover while his torso twisted 180 degrees. The twisting of his left leg resulted in a compound, spiral fracture of his tibia. He did not sustain any other injuries. Upon examination he has significant external

bleeding. His heart rate is elevated. His pedal pulse is absent on the left but he is neurologically intact.

The fractured tibia transected the popliteal artery. Without immediate application of a pressure dressing or tourniquet, he progresses through increasingly severe states of hypovolemic shock. Once the bleeding is properly managed, he responds well to volume replacement. Vascular repair is necessary to salvage the leg.

Table 4. HPS States – Compound Fracture of the Left Leg (tibia)

Baseline	30 seconds
Class I Shock	180 seconds
Class II Shock	300 seconds
Class III Shock	300 seconds
Class IV Shock	
Bleeding controlled	
Vascular repair	

Gunshot Wound to the Left Chest

The sniper hit one of the soldiers in the left chest. The bullet entered in the left upper quadrant. The entrance wound is not grossly bleeding. No exit wound is found. Pulse is normal. Diminished breath sounds on the left. He remains conscious and over time begins taking more rapid, shallow breaths and complains of difficulty getting enough air. The rapid breathing is followed by tracheal deviation to the right and jugular venous distension.

The bullet missed his heart and large blood vessels but destroyed a portion of the upper lobe of the left lung leaving a significant opening between several larger bronchioles and the pleural space. Over time intra-thoracic pressure increases causing a tension pneumothorax. Treatment (needle decompression) can be done at any echelon. Once decompressed, the needle kinks or is clotted off with each transfer of the casualty until the needle decompression is replaced with a chest tube.

Table 5. HPS States – Gunshot Wound to the Left Chest

Baseline	30 seconds
Pneumothorax	300 seconds
Tension Pneumothorax	
Needle Decompression	

Gunshot wound to the Right Thigh (Femoral artery bleed)

The sniper's first bullet hit one of the soldiers in the left upper thigh. The entrance wound located in the high anterior-medial portion the midline is bleeding profusely. An exit wound is found on the mid-portion of the left gluteus. Popliteal and pedal pulses are absent in the injured leg. The solider is initially coherent but becomes confused then loses consciousness as he becomes increasing hypotensive.

The bullet clipped the femoral artery. Direct pressure, a pressure dressing or tourniquet are not effective. He continues to bleed internally regardless of attempts to stop the bleeding externally and does not respond to volume resuscitation. His only chance of survival is to be evacuated to a treatment facility capable of surgical intervention (vascular repair).

Table 6. HPS States – Gunshot Would to the Right Thigh (Femoral Artery Bleed)

Baseline	600 seconds
Class I Shock	900 seconds
Class II Shock	900 seconds
Class III Shock	
Vascular repair	

EVACUATION RESOURCES AND SUPPORTING MEDICAL TREATMENT FACILITIES

The scenario has six treatment nodes each with its own HPS, Triage Controller and supporting equipment. Four of the nodes represent treatment locations that are in fixed position and two nodes represent evacuation vehicles. The four "fixed" treatment nodes are: a Casualty Collection Point (CCP), a Battalion Aid Station (BAS), a Forward Surgical Team (FST), and a Combat Surgical Hospital (CSH). The two evacuation vehicles are a ground ambulance and an air ambulance.

The CCP is set up by the medic at the site of the explosion.

Ground ambulance evacuation times are as follows: The BAS is 10-15 minutes away from the CCP, the FST is 15-20 minutes away from the BAS, and the CSH is 20 minutes away from the FST. The ground ambulance is capable of transporting four casualties at a time.

Air evacuation times are: CCP to CSH is 10-12 minutes; the BAS is situated in a wooded area without easy access to a landing site – air evacuation is not supported; CCP to FST is 7-10 minutes; and FST to CSH is 5-7 minutes. The air ambulance is only capable of transporting two casualties at a time.

The first evacuation asset on the scene is a helicopter capable of transporting two litter casualties directly to a Combat Surgical Hospital (transport time: 10-12 minutes). Second on the scene is a ground ambulance capable of transporting four litter casualties directly to a Battalion Aid Station (transport time: 10-15 minutes).

The graph on the following page shows the anticipated timing of the evacuation vehicles.

THE UNFOLDING SCENARIO

In addition to managing the casualties, each of the locations will need to have a working understanding of the capabilities at each node and the transit time between nodes. This situational awareness will be most important at the CCP. In addition to the first look and triage of the casualties, the medic will need to re-triage each of the casualties prior to making an evacuation decision. Those most in need of definitive surgical care may not be obvious initially. If one or more of the more severe cases is not loaded onto the air ambulance, the best course of action would be to hold the severe casualty at the CCP rather than evacuating to the BAS. Waiting for the second trip via air ambulance will get the casualty to definitive surgical care faster than sending them by ground.

Appendix B: Assessment of Individual Scenarios within the CTPS system

Scenario Name: Blunt Abdominal Injury
Time of injury: _____

Blunt Abdominal Trauma	Baseline (first 30 seconds)	Class I shock (30 seconds – 7.5 minutes) [pre-compensatory shock]	Class II shock (7.5 – 15 minutes) [compensatory shock]	Class III shock (15 – 55 minutes) [progressive shock]	Class IV shock (55 – 57 minutes) [irreversible shock]	Spleenectomy
Primary Survey						
Airway	Intact	Intact	Intact	Intact	Intact	Intact
Breathing	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations Until Dead	Spontaneous Respirations
Circulation	Pulse Normal	Pulse Normal	Pulse Normal	Pulse Normal	Pulse Normal	Pulse Normal
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Alert	Alert	Responds to verbal stimuli	Unresponsive	Unresponsive
Vital Signs						
Pulse / Heart Rate	71	84	113	125	145	
Arterial Blood Pressure (ABP)	115/51	113/55	110/60	92/52	73/46	
Palpable Blood Pressure	28/14	28/16	27/18	18/10	16/12	
Respiration Rate	19	19	20	18	15	19
Temperature	37.5	37.5	37.5	37.5	37.5	37.5
Secondary Survey						
Inspection	Abdominal contusions and abrasions Abdominal distention					
Auscultation	Diminished or absent bowel sounds					
Palpation	Tender upper left quadrant					
Percussion	Upper left quadrant dullness					

Scenario Name: Blunt Chest Injury
Time of injury: _____

Blunt Chest Trauma	Baseline (first 60 seconds)	Tamponade Onset (1 – 3 minutes)	Tamponade Severe (3 – 23 minutes)	Unconscious	Needle Decompression
Airway	Intact	Intact	Intact	Intact	Intact
Breathing	Painful	Labored	Labored	Shallow	Normal
Circulation	Pulse Normal	Pulse Diminished	Pulse Weak	Pulse Normal	
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Alert	Responds to Verbal Stimuli	Unresponsive	Alert
Vital Signs					
Pulse / Heart Rate	71	74	86 - 104	104	74
Arterial Blood Pressure	114/51	108/51	92/52 – 74/50	74/50	114/51
Palpable Blood Pressure	28/14	27/16	27/18	27/22	28/15
Respiration Rate	19	19	19	19	19
Temperature	37.5	37.5	37.5	37.5	37.5
Inspection					
Auscultation					
Palpation					
Percussion					

Scenario Name: Compound Fracture of the Left Leg (tibia)
Time of injury: _____

Compound Fracture of the Leg *tibia)	Baseline (first 30 seconds)	Class I Shock (30 seconds to 3 minutes)	Class II Shock (3 to 8 minutes)	Class III Shock (8 to 13 minutes)	Class IV Shock	Bleeding controlled	Vascular Repair
Airway	Intact	Intact	Intact	Intact	Intact	Intact	Intact
Breathing	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations
Circulation	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Bleeding Controlled	Vascular Repair
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Alert	Alert	Responds to Verbal Stimuli	Unresponsive	Alert	Unresponsive
Vital Signs							
Pulse/Heart Rate	72	86	113	125	114 – 151		
Arterial Blood Pressure	116/52	114/56	111/62	92/51	73/46 – 54/34		
Palpable Blood Pressure	28/15	28/15	27/18	18/10	17/12 – 10/6		
Respiration Rate	19	19	19	18	15		
Temperature	37.5	37.5	37.5	37.5	37.5	37.5	37.5
Inspection							
Auscultation							
Palpation							
Percussion							

Scenario Name: Gunshot Wound to the Left Chest
Time of injury: _____

Gunshot Wound to the Left Chest	Baseline (first 30 seconds)	Pneumothorax (30 seconds to 5.5 minutes)	Tension Pneumothorax	Needle Decompression
Airway	Intact	Intact	Intact	Intact
Breathing	Normal	Labored	Labored	Normal
Circulation	Pulse Intact	Pulse Intact	Weak Pulse	Normal Pulse
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Responds to Verbal Stimuli	Unresponsive	Alert
Vital Signs				
Pulse/Heart Rate	72	88	106	79
Arterial Blood Pressure	116/53	107/62	84/60	113/52
Palpable Blood Pressure	28/15	36/32	51/40	29/14
Respiration Rate	19	30	36	Normal
Temperature	37.5	37.5	37.5	37.5
Inspection				
Auscultation				
Palpation				
Percussion				

Scenario Name: Gunshot Wound to the Left Thigh (femoral artery bleed)
Time of injury: _____

Gunshot Wound to the Right Chest	Baseline (first 10 minutes)	Class I Shock (10 – 25 minutes)	Class II Shock (25 to 40 minutes)	Class III Shock	Class IV Shock	Vascular Repair
Airway	Intact	Intact	Intact	Intact	Intact	Intact
Breathing	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations Until Dead	Spontaneous Respirations
Circulation	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Vascular Repair
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Alert	Alert	Responds to Verbal Stimuli	Unresponsive	Alert
Vital Signs						
Pulse/Heart Rate	56	180	180	180		
Arterial Blood Pressure	88/74	85/72	83/71	62/50		
Palpable Blood Pressure	6/4	6/4	7/5	8/7		
Respiration Rate	19	19	18	19		
Temperature	37.5	37.5	37.5	37.5		37.5
Inspection						
Auscultation						
Palpation						
Percussion						

Scenario Name: Closed Head Injury
Time of injury: _____

Closed Head Injury	Baseline (first 5 minutes)	Unconscious (>5 minutes)	Level I ICP	Level II ICP	Level III ICP
Airway	Intact	Intact	Intact	Intact	Intact
Breathing	Spontaneous respirations	Spontaneous respirations	Spontaneous respirations	Rapid Shallow	Rapid Shallow
Circulation	Pulse Normal	Pulse Normal	Pulse Normal	Pulse Normal	Pulse Normal
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Unresponsive			
Vital Signs					
Pulse / Heart Rate	72	90	79	70	81
Respiration					
Arterial Blood Pressure	115/51	115/51	130/80	143/92	111/51
Palpable Blood Pressure	28/15	28/14			
Respiration Rate	19	25	24	40	40
Temperature	37.5	37.5	37.5	37.5	37.5
Inspection	Hemotympania		Unequal or non-responsive pupils		
Palpation	Tenderness or deformation of the skull				

7.0 Appendix B CTPS User Manual for Triage Controller and After Action Review

USERS MANUAL

TRIAGE CONTROLLER AND AFTER ACTION REVIEW

TEKĀMAH CORPORATION

August 2001

TABLE OF CONTENTS

PART I. PURPOSE AND BACKGROUND 1

PART II. TRIAGE CONTROLLER APPLICATION 3

II.1 Overview 3

II.2 Components 3

II.3 Getting Started 4

II.4 Station Status Panel 5
Figure 2. Station Status Panel 5
Figure 3. Resources Dialog 6

II.5 Patient View and Selection Panel 6
Figure 7. Set Triage Category 10

II.6. Evacuation Procedure 13

II.7. Examination and Treatment Panel 14
Figure 11. Examination and Treatment Panel 14
Figure 12. Vital Signs 16
Figure 13. Description Box 17
Figure 14. Examination and Treatment Menus 18
Figure 15. Test Results List 20

II.8 Examples 20

II.9. System Pause, Resume, Save, and Restore 21

II.10. Closing the Triage Controller 21

PART III. AFTER ACTION REVIEW 22

III.1. Overview 22

III.2. AAR Logger 22

III.3. AAR Viewer 23

III.4. Map Panel 23
Figure 16. AAR Map Panel 24

III.5. Station View Panel 25
Figure 17. Station View Panel 25

III.6. Patient View Panel 26
Figure 18. Patient View Panel 27

PART IV. APPENDIX A. TRIAGE CONTROLLER PATIENT SCENARIOS AND OPERATION ENVIRONMENT 28

IV.A.1. PATIENT SCENARIOS 28

IV.A.2. TRIAGE CONTROLLER OPERATION ENVIRONMENT 28

PART IV. APPENDIX B. CTPS PHASE 4 DEMONSTRATION SCENARIO: FT. GORDON, GEORGIA, JULY 2001 30

IV.B.1. OVERVIEW OF THE SCENARIO 30

IV.B.2 CASUALTY DESCRIPTIONS 30
Table 1. HPS States – Ruptured Spleen 30
Table 2. HPS States – Pericardial Tamponade 31
Table 3. HPS States – Closed Head Injury 31
Table 4. HPS States – Compound Fracture of the Left Leg (tibia) 32
Table 5. HPS States – Gunshot Wound to the Left Chest 32
Table 6. HPS States – Gunshot Would to the Right Thigh (Femoral Artery Bleed) 33

IV.B.3. EVACUATION RESOURCES AND SUPPORTING MEDICAL TREATMENT FACILITIES 33

IV.B.4. THE UNFOLDING SCENARIO 34

PART IV. APPENDIX C. CTPS SYSTEM OVERVIEW AND CONFIGURATION FILE FORMAT 35

Part I. Purpose and Background

This document is designed as a user manual for military health care providers and medical training facilitators. The manual is divided into four parts. Part I explains the purpose and background of the Combat Trauma Patient Simulation (CTPS) system and Triage Controller and After Action Review applications. Part II explains the use of the Triage Controller as an interactive computer based training program, and part III explains the use of the After Action Review (AAR) application system. Part IV consists of Appendices: A) Triage Controller Patient Scenarios and Operation Environment; B) CTPS Phase 4 Demonstration Scenario: Ft. Gordon, Georgia, July 2001; and C) Technical Overview and Configuration File Formats. It is the goal of this reference manual to show how the Triage Controller and After Action Review applications can enhance training for military medical personnel and thereby increase combat efficiency and reduce combat mortality.

To better understand how the Triage Controller and After Action Review Applications fit into the current military training program, information on several components of the program are included here. These are the casualty care echelon system; the change in 91W MOS requirements for the Army Health Care Specialist; the Human Patient Simulator (HPS); the Combat Trauma Patient Simulation (CTPS); and how the Triage Controller and After Action Review Applications fit within the CTPS system.

In 1979, a four-echelon system was created to facilitate casualty care in the combat theater. This system established levels of medical care not just by type of facility, distance and sophistication, but by the capability of delivering treatment based on the severity of injury and the capacity to handle numbers of casualties. In the late 1980's and early 1990's, a new time-based (rather than distance based) five-echelon model of casualty care was developed as part of the DoD Medical Readiness Strategic Plan 2001

In September 1999, the Army announced a major change to *DA Pam 611-21,* and changes mandated by the Military Occupational Specialty of the Army Health Care Specialist (including the Combat Medic) to the 91W MOS will become effective on 1 October 2001. These changes mean transition, and ongoing training of the Army's health care specialists, and underline the increased need for efficient, cost effective training tools.

Created in September 1996, Medical Education Technologies Inc.'s Human Patient Simulator™ (HPS™) addressed one of the highest priorities of the military medical community, improving casualty care through realistic medical training. The HPS is a computer-controlled mannequin that responds like a real patient.

Designed to provide assessment capabilities and training for faster and better treatment of wounded personnel on the battlefield, the DoD Combat Trauma Patient Simulator (CTPS) program uses the Human Patient Simulator and its Patient Simulation Software for realistic casualty medical training integrated with military force-on-force exercises. The HPS has already proven to be a successful tool and additional and expanded capabilities for CTPS are being sought. A complete military medical training system integrated with HPS can realistically simulate combat casualty situations including operational attributes such as resource management and evacuation decision-making.

The DoD sponsored Phase IV CTPS program integrates several systems using a network architecture. The Triage Controller and After Action Review are key parts of the integrated military medical simulation system for training, testing and evaluation.

The Triage Controller simulates realistic triage and patient situations under combat conditions and the After Action Review system has the ability to track and evaluate medical team performance.

The Triage Controller supports the implementation of selected patient scenarios for 91W/Combat Lifesaver (CLS) training, and provides interoperability training of Human Patient Simulator (HPS) casualties. The Triage Controller provides an interface for selected operational attributes developed for inclusion in CTPS 91W/CLS scenarios and selected medical information not currently supported by HPS technologies (91W/CLS related). These additional attributes focus on medical information critical during the 91W and CLS decision-making process.

The Medical After Action Review (AAR) comprises two parts: the AAR Logger (Logger) which collects and stores all the data from each student's session with the Triage Controller; and the AAR Viewer (Viewer) which presents the data and provides the user and instructor with feedback on the student's actions.

Together with the HPS, the Triage Controller and AAR provide CTPS with the ability to simulate multiple casualties, train users in casualty and resource management as well as evacuation decision making, and provide instructors the ability to review student performance.

Part II. Triage Controller Application

II.1 Overview

The Triage Controller simulates a casualty treatment station by providing a view of its patients and resources available for treatment. This station can be at the site of injury, the battalion aid station, the medevac helicopter, the ground ambulance, or any other military medical treatment facility.

The patients at the simulated location can be examined and treated from the Triage Controller. Alternatively, from the Triage Controller the user can select a patient to be simulated on an HPS. This full sized automated mannequin can be examined and treated much like a real patient using tools identical, or similar, to the tools and instruments that would be used on a real patient.

The Triage Controller provides additional support to simulations and training in the form of treatments to be applied to a simulated patient that cannot be performed at present on the HPS. As an example, consider the patient with a bilateral amputation below the knee where the student selects to control the bleeding with a tourniquet. When the action is selected in the Triage Controller, the Controller informs the Patient Simulation software so that the physiology of the patient changes and the bleeding stops. This cannot be accomplished on the HPS since it does not have the hardware to detect that a tourniquet has been applied to the injury. The instructor can define additional treatments by editing the configuration files of the Triage Controller and patient simulation models. See Appendix C.

In addition to supporting training in treatment decisions, the Triage Controller also supports training in decision making on the management of station resources and patient evacuation.

II.2 Components

The Triage Controller user interface is made up of three main components: the Station Status panel, The Patient View and Selection panel, and the Examination and Treatment Panel.

The Station Status Panel is a vertical panel on the left of the screen and provides information about the status of the simulation at a station level (Figure 2).

The Patient View and Selection Panel provides lists of the patients according to their position in the treatment process (treatment status); a quick view of any selected patient, and which if any patient is instantiated on the HPS (Figure 4). Triage and evacuation controls are provided here as well.

The Examination and Treatment Panel provides a detailed view of a single patient and allows more detailed examination (including lab tests) or treatment of the patient (Figure 10).

II.3 Getting Started

To start a triage training session, the following must be done:

1. Start the Casualty Handler (See separate documentation.)
2. Start Patient Simulation Software for all participating nodes. (See separate documentation.)
3. Start the After Action Review Log by clicking on its icon on the computer designated to collect the log.
4. After the After Action Review Log is started, start the Triage Controllers for all participating nodes by clicking on the Triage Controller icons on all the computers running the Triage Controller for the exercise.

When the Triage Controller first starts, it will display the CTPS logo. Depending on its configuration file, clicking the logo screen can display a video and or text briefing intended to introduce the exercise or scenario to the user and to provide the user with exercise or scenario specific information.

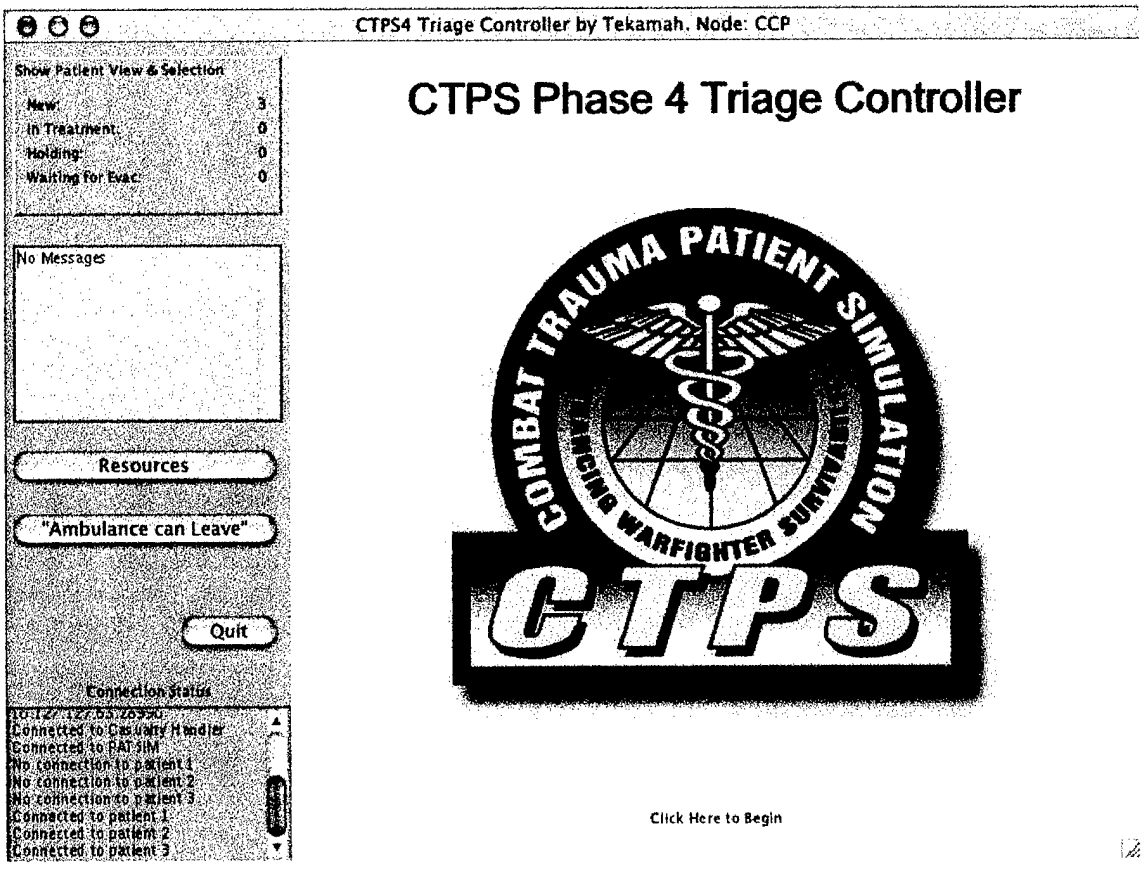
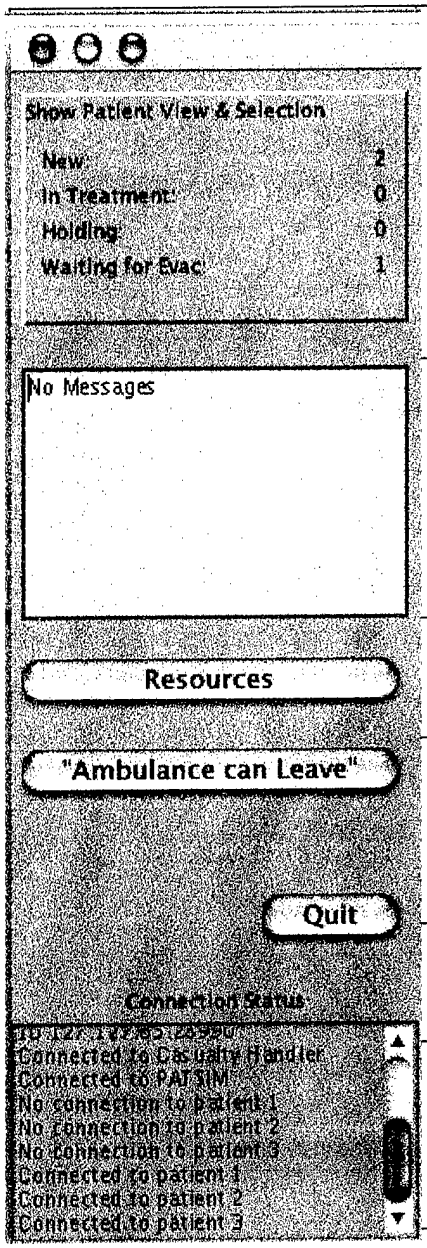


Figure 1. Opening Screen

II.4 Station Status Panel

Figure 2. Station Status Panel



Show Patient View & Selection Button
Summarizes the number of patients at the station and their treatment status. Click on this button and it brings up the Patient View and Selection Panel (Figure 4).

Message Box
An example of a message that might display in this box is "Ambulance AIR has arrived" indicating that the user should evacuate his patients to the ambulance.

Resources Button
This button brings up a dialog that displays the current level of selected resources and the time of the next scheduled re-supply. (e.g., Number of saline IV bags.) **(See Figure 3.)**

Ambulance Button
To inform the ambulance that you are done transferring patients, press this button (See Evacuation section.) For an ambulance's Triage Controller this button will be labeled "Depart" and will cause the ambulance to move to another node.

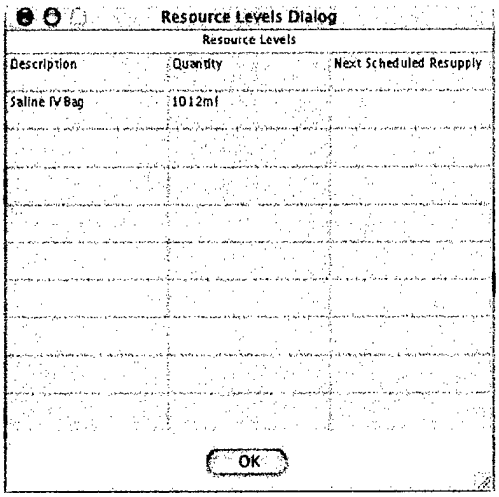
Quit Button
The Quit Button terminates the Triage Controller.

Connection Status Box
This box displays messages concerning the status of the network connections and simulation.

After starting the Triage Controller, the first screen contains the Station Status Panel (Figure 2). This panel serves as the main control panel for the application. It is visible at all times as a vertical panel on the left-hand side of the application's window. The Status Panel appears to the left of the Patient View and Selection Panel and the Examination and Treatment Panel when they are visible.

The Station Status Panel contains the "**Show Patient View and Selection**" button, "**Station Message**" box, "**Resource**" button, "**Ambulance...**" button, "**Quit**" button, and "**Connection Status**" display. See Figure 2 for an illustration and description of each of these components.

Figure 3. Resources Dialog



II.5 Patient View and Selection Panel

Pull up the Patient View and Selection Panel **(PVSP)** (Figure 4) by clicking on the **Show Patient View and Selection** button at the top of the Station Status Panel (See Figure 2).

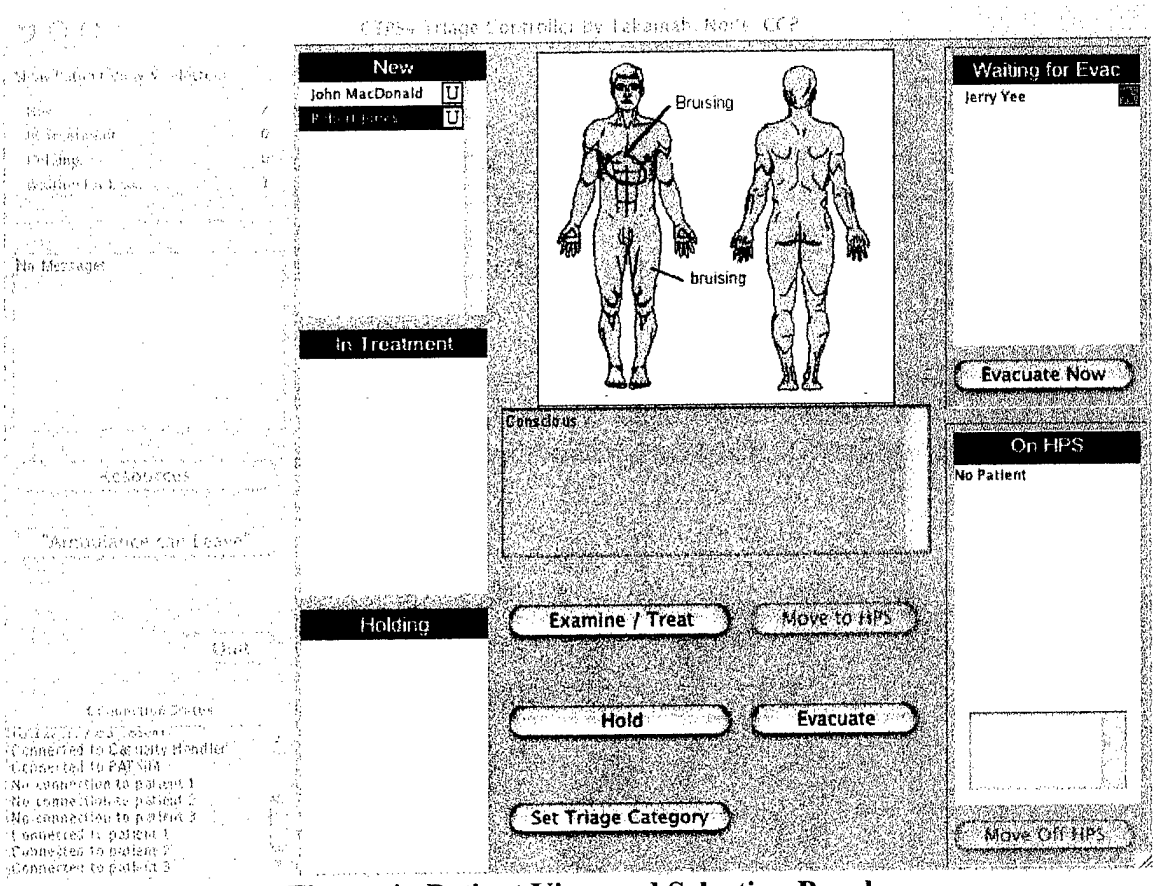


Figure 4. Patient View and Selection Panel

11.5.a. Patient List Boxes

The PVSP for a Triage Controller simulating a stationary medical station displays five window boxes that list the names of all the patients at the station divided into four treatment status categories and which patient, if any, is on the HPS. (See below for a description of the PVSP for an ambulance.) The four treatment status categories are:

1) **New** – patients that are waiting to be examined in detail;
2) **In Treatment** – patients currently being examined and treated;
3) **Holding** – patients that the medical officer is not currently actively treating or examining but have not been released for evacuation;
4) **Waiting for Evacuation** – patients that the medical officer has assigned for evacuation.

Next to the name of each patient is a symbol indicating the patient's triage status using color-coding as follows:

1. Minimal – green
2. Immediate – red
3. Delayed – yellow
4. Expectant – blue
5. Unknown – white

To View a patient, or select a patient for an action, click on his name in any of the Patient List boxes.

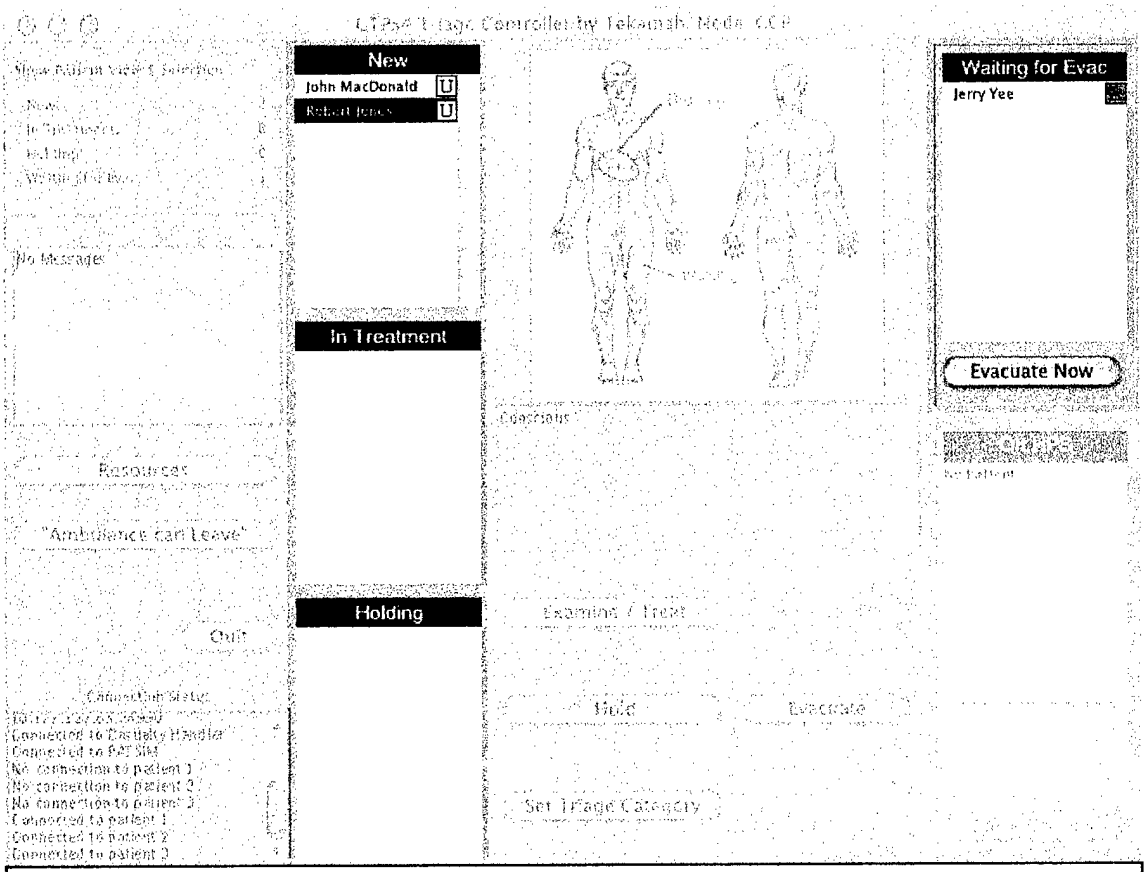


Figure 5. Patient List Boxes

II.5.b. Individual Patient's Field Medic Card

From the Patient View and Selection Panel, the user can select (highlight) any patient from any list to bring up his Field Medic Card (FMC) (Figure 6) to be displayed in the center of the PVSP as well as a short description of his condition (such as can be obtained without doing a detailed examination). For example, Figure 6 shows a man with bruising on his chest and leg. The patient is conscious.

To take an action on the patient, such as changing the patient's triage category or examining the patient, click on the appropriate button in the Patient Action Button Panel (a detailed description is given in II.5.c.). For instance, to examine the patient more closely, click on the "Examine/Treat" button to bring up the Examination and Treatment panel (Figure 11) that displays detailed information on the patient. A more detailed discussion of The Examination and Treatment panel follows in II.7.

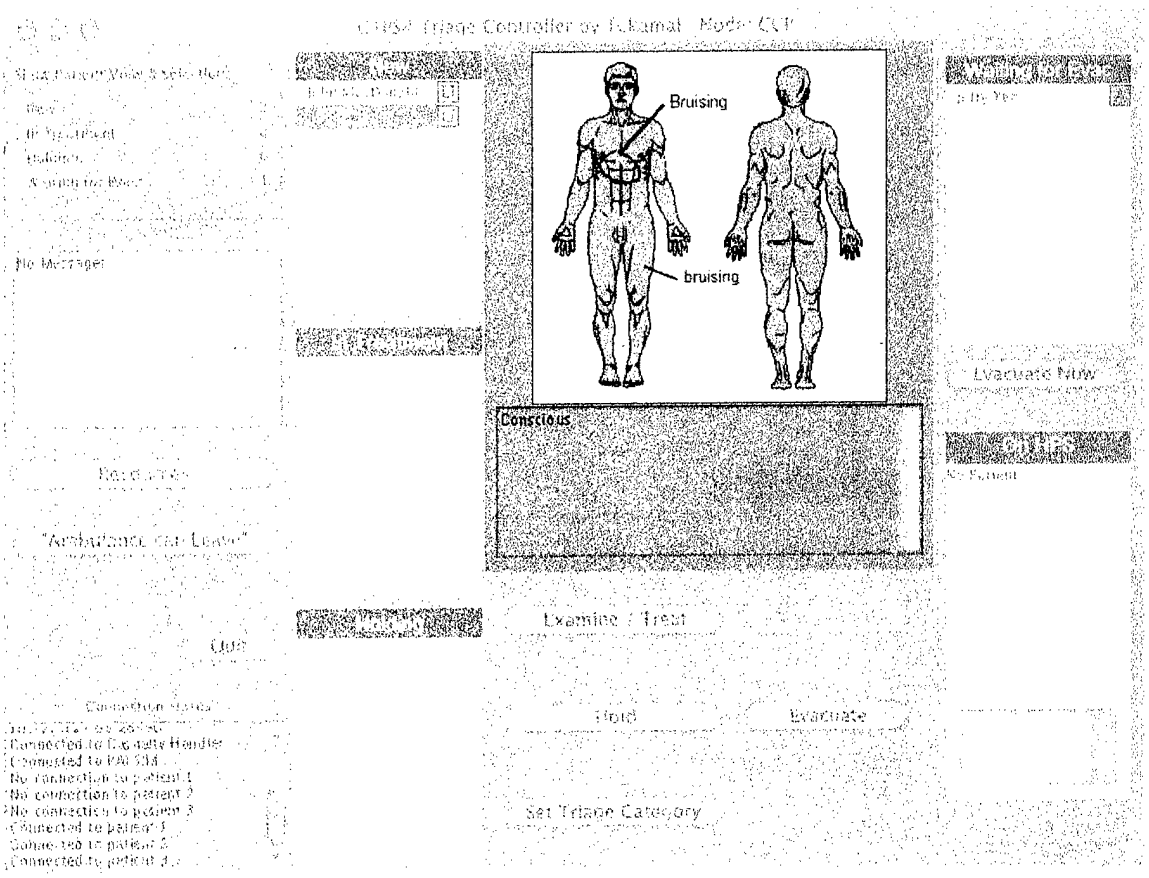


Figure 6. Field Medic Card View

At a point of injury or Casualty Care Point (CCP) there may be no Patient Field Medic Card because it would not have been created. This View could show instead a photograph and close up of an injury. This is under the control of the trainers or scenario writers.

II.5.c. Patient Action Button Panel

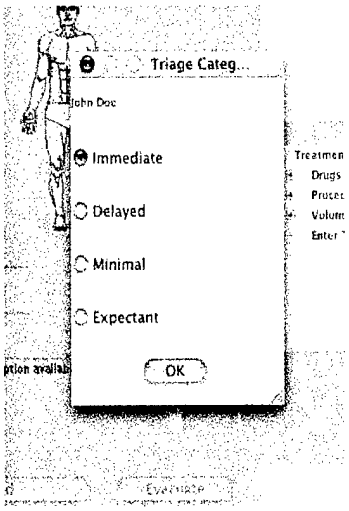
At the bottom center of the Patent View and Selection Panel is a collection of buttons allowing the user to take an action on the selected patient:

- *Examine Button* - Pressing the "Examine/Treat" button will bring up the Examination and Treatment Panel (described in II.7.) for the selected Patient and changes that patient's status to "In Treatment."

- *Hold Button* - Pressing the *Hold* button changes the selected patient's status to "Holding" and moves the patient's name to the "Holding" list.

- *Set Triage Category Button* - The user can assign a triage category by clicking on the "Set Triage Category" button. This will bring up the Triage Category dialog box (See Figure 7). Click on the appropriate option on the new screen: Immediate, Delayed, Minimal, or Expectant. To save the change and close this dialog box click "OK."

Figure 7. Set Triage Category



- *Move to HPS Button* – A simulated patient can be instantiated on a Human Patient Simulator (HPS), allowing the student to practice procedures on it. To do so, highlight the patient in one of the patient lists and click on "*Move to HPS.*" The patient's treatment status will be changed to "In Treatment," and the HPS will begin simulating that patient (this may take a minute or two). On the lower right is the **On HPS** (Figure 8) paneling showing which, if any, of the patients is on the HPS. At the bottom of the screen is a button allowing the user to empty the HPS, making it available for another patient.

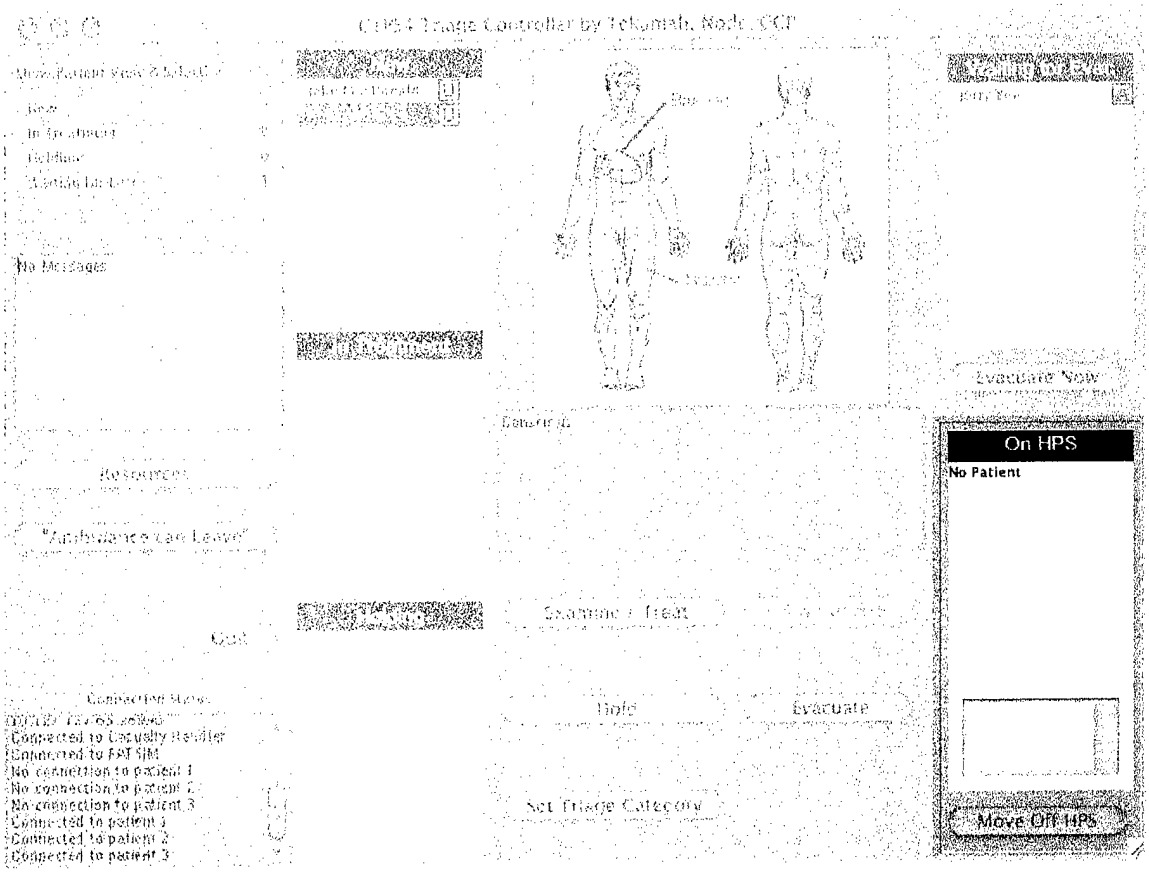


Figure 8. On HPS, Move Off HPS

- *Evacuate* Button - Evacuation procedures can vary slightly based on whether the station being simulated is stationary or mobile (e.g. a ground ambulance). For stationary stations, the user places a patient on the waiting to be evacuated list by clicking the "Evacuate" button (Figure 9). This brings up a dialog asking the user to select an evacuation category ("Air" or "Ground"). Clicking OK places the patient on the list of patients waiting to be evacuated and his evacuation category is displayed next to his name in the list.

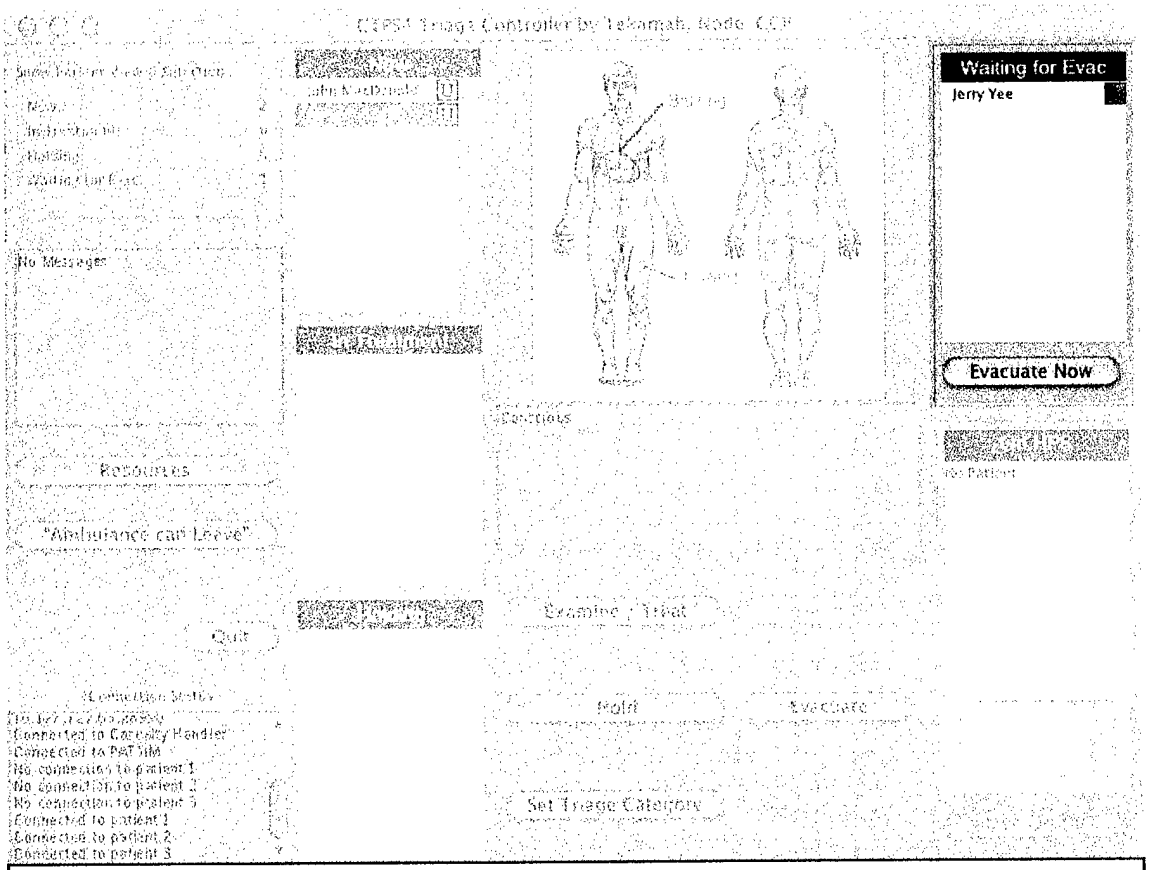


Figure 9. Waiting for Evacuation

II.5.d Ambulance PVS Panel Differences

The configuration file of the Triage Controller may determine that the Triage Controller should simulate an ambulance. In this case the Patient View and Select Panel will contain only one patient category list, "On Board".

In addition, the "Evacuate" button will be replaced by an "Unload Now" button. When the ambulance has reached its destination, clicking on this button will cause the highlighted patient to be moved from the ambulance to the medical station where the ambulance is located. (See "Evacuation Procedure" below.) The other controls on the PVS Panel work the same as for a stationary (non-ambulance) Triage Controller.

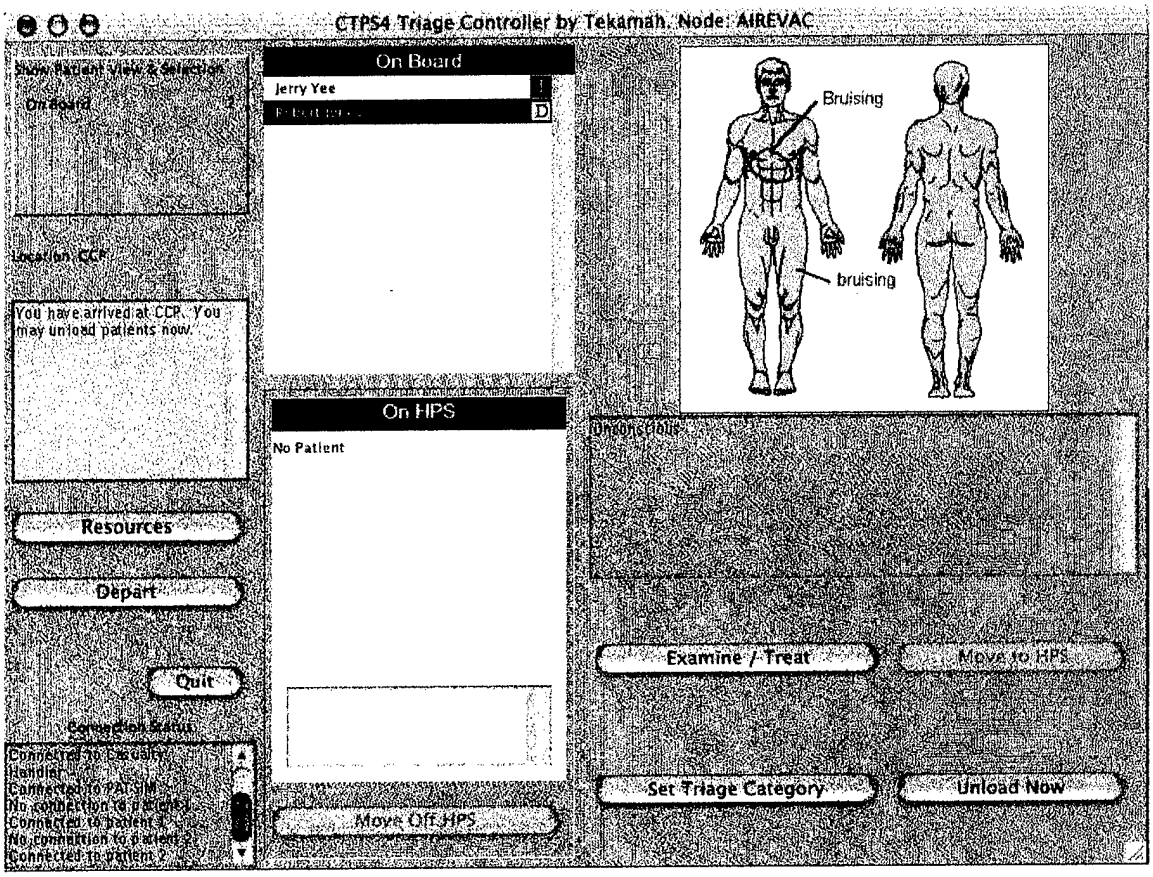


Figure 10. Ambulance Patient View and Select Panel

II.6. Evacuation Procedure

When an ambulance arrives at a station, a message to that effect will be displayed in the message boxes on the Station Status Panels of the ambulance and the destination station. To effect the movement of patients to the ambulance the user selects a patient in any of the category lists and clicks "Evacuate Now." This will move the patients to the node simulating the ambulance. To send a message to the ambulance that you done evacuating patients to it and that it can leave, the user should click the "Ambulance Can Leave" button. Similarly, an ambulance clicks "Unload Now" to leave any of his patients at the station.

An ambulance is responsible for its own travel. Clicking on "Depart" brings up a dialog box listing the stationary nodes it can get to. Selecting a node and clicking "OK" starts a timer dialog which will shut down when the ambulance arrives at the chosen station. To arrive at the station immediately, click "Arrive Now". Clicking "Cancel" cancels the trip but leaves the ambulance "in transit" until the "Leave Now" button is clicked and another destination chosen.

II.7. Examination and Treatment Panel

The Examination and Treatment Panel (Figure 11) graphically and textually displays the status of the patient currently being examined and treated, either from the Triage Controller display or the HPS. It is located to the right of the Status Panel.

At the bottom center of the Panel are three buttons. These buttons operate exactly like the identically labeled buttons in the Patient View and Selection Panel (PVSP), but the Hold and Evacuate Button replaces the Examination and Treatment Panel with the PVSP.

In the middle of the examination panel is a graphical and textual display of the patient and his injuries.

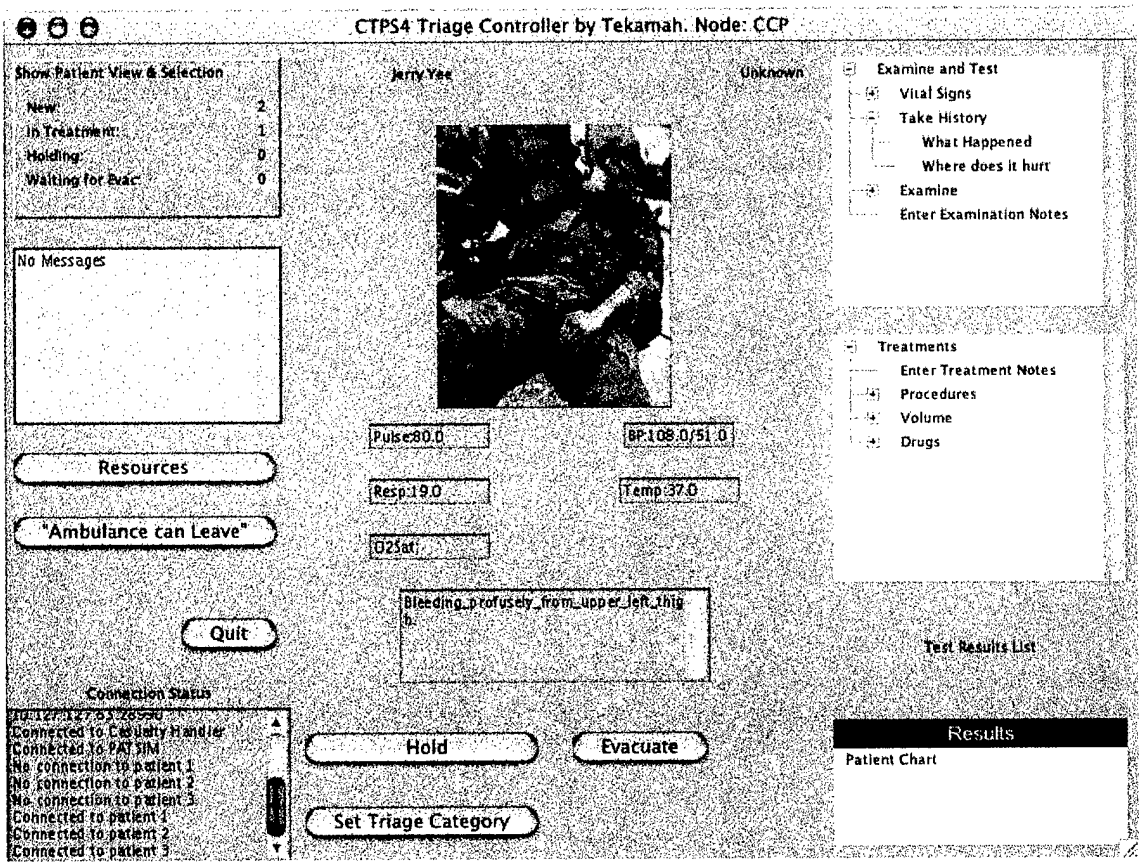


Figure 11. Examination and Treatment Panel

II.7.a. Patient View

In the middle of the Examination and Treatment Panel is a graphical and textual view of the patient. The graphic display represents what the trainee would see if looking at the patient on an examining table. This graphic may be a drawing or photograph, as determined by the training team and scenario writers.

Below the graphic are text fields displaying the patient's vital signs (Figure 12). These vital signs are updated only when the trainee takes the patient's vital signs by using the Examination menu (explained in more detail in II.7.e.).

Below the vital signs is a text box displaying a description of the patient's condition. This may display to the user a description such as "Screaming" or "Conscious and Alert". This box will also display the result of certain examination actions. For instance, answers to questions asked the patient would appear here, as well as textual descriptions corresponding to detailed examination actions.

II.7.b. Vital Signs Box

The Vital Signs Box (Figure 12) provides a recent look at the patient's heart rate, systemic blood pressure, respiratory rate, temperature, and oxygen saturation level (depending on the Triage Controller's configuration settings). Results of the actions under Vital Signs are displayed in the appropriate box below the graphical view of the patient located in the center of the Examination and Treatment Panel. Each time the user clicks on vital signs and takes the pulse, blood pressure, temperature, respiration, or oxygen saturation level; the results are shown in this box. *Once recorded, these numbers do not get updated until the vital signs are taken again.*

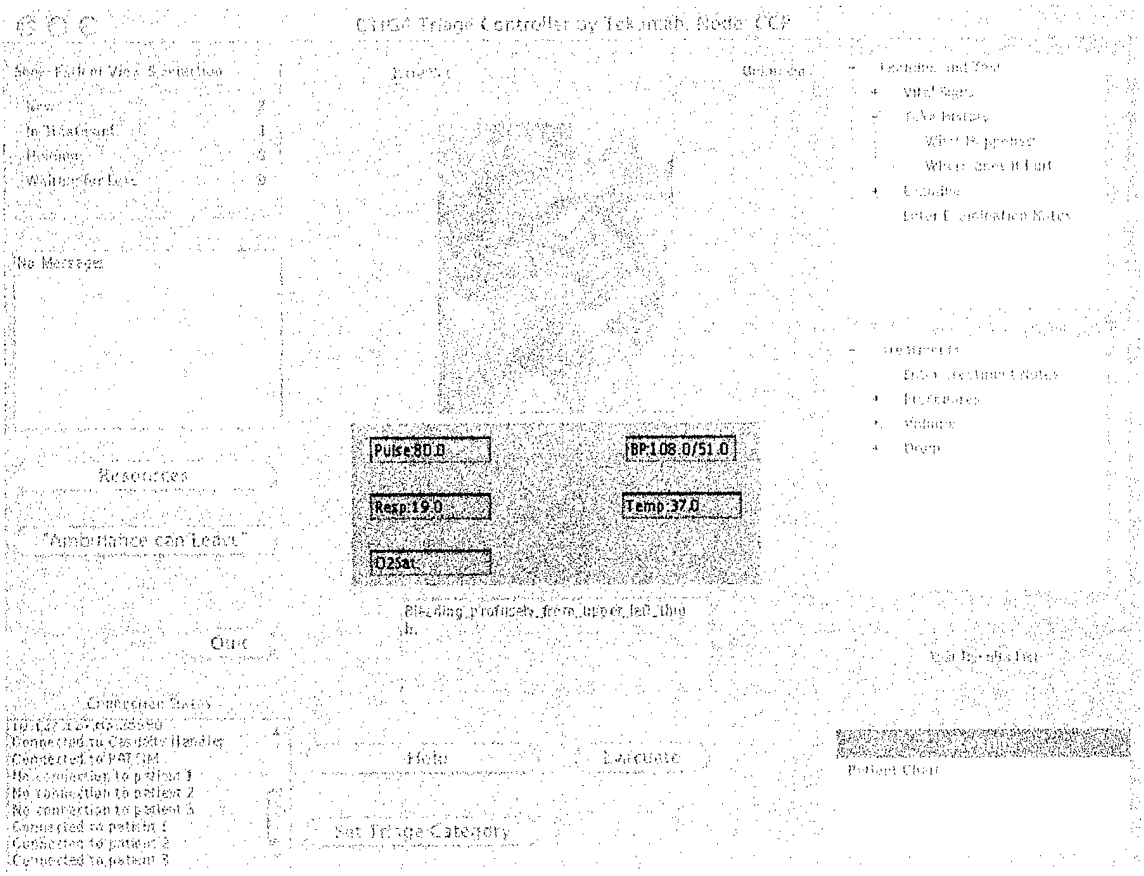


Figure 12. Vital Signs

II.7.c. Condition Box

Directly under the vital signs display is a text box where information about the patient is displayed (Figure 13). Initially, this should contain what could be obtained without examining the patient (e.g. "Conscious"). However, after various examination activities have been performed, the text may be replaced with additional information about the patient's condition.

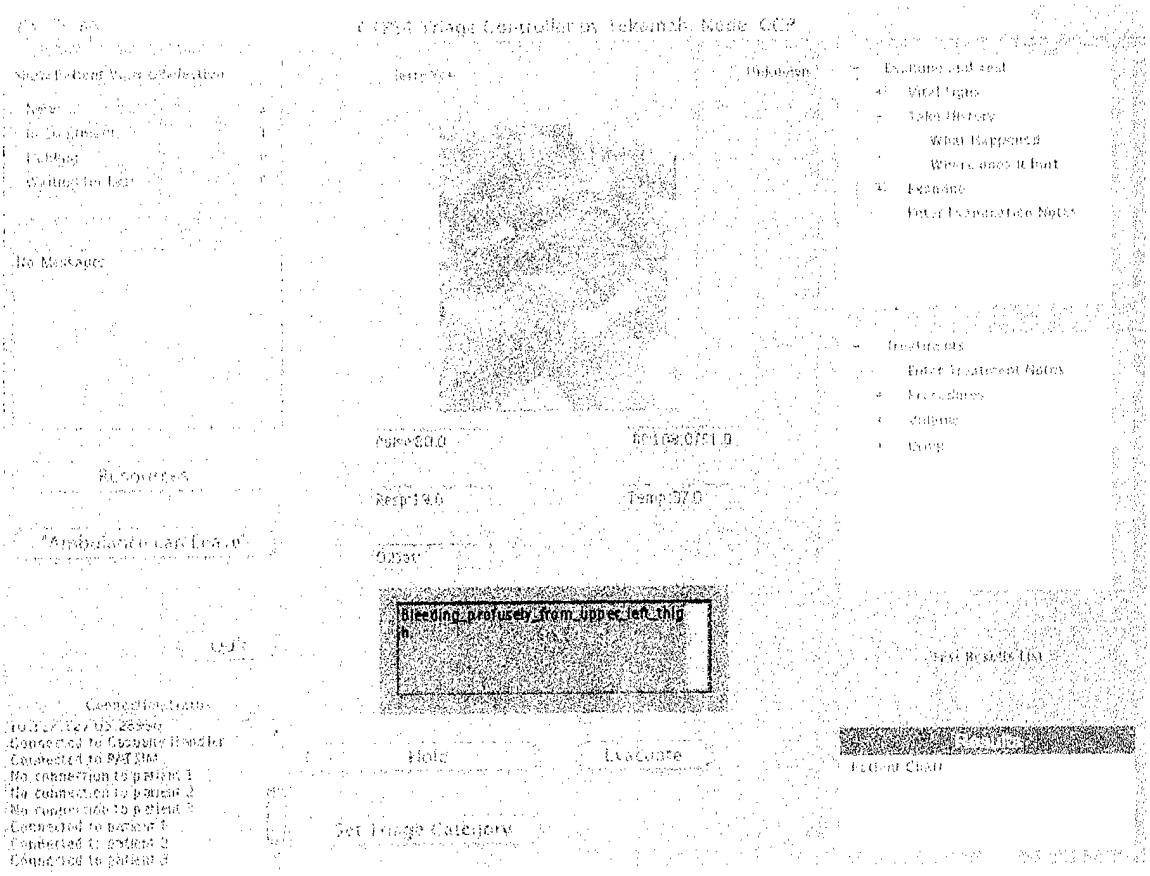


Figure 13. Description Box

II.7.d. Examine and Treatment Menus

To the right of the patient display on the Examination and Treatment Panel are two tree menus (Figure 14). The top menu is labeled "Examine" and the second menu is labeled "Treatments". These menus provide actions for the user to select to examine and treat the patient or to order tests.

The options available for patient treatment and ordering tests are tied to the capabilities and resources available to the station. These actions are tailored to the simulated station using the Triage Controller configuration file. For example, if the workstation simulated is a casualty collection point there will be fewer options for treatment and examination (e.g. no lab tests) than if the simulated station is a Battalion Aid Station or a Field Hospital. Also, just as tests, exams, and treatment are tailored to the workstation being simulated, so are the resources. For example, if the simulation were a casualty collection point, the resources would reflect those items available to the Combat Lifesaver. Once the CLS uses the IV bags, he will not be able to treat with IV's until more resources are provided.

II.7.e. Examine Menu

Under Examine (Figure 14), all actions are represented by labels naming the action to be taken during an examination. Use the scrollbar on the right of the Examine text box to scroll up and down the menu. Click on the plus ('+') sign to expand a sub-tree. Double click on an action name to take the action. The same procedure applies to the Treatments text box.

For instance, when the menu first appears, it may show the label "Examine Menu" with a plus sign to the left. Clicking on the plus sign replaces the plus sign with a minus sign and ('-') expands the tree to show "Vital Signs" and the options below it. Clicking on the plus sign next to "Vital Signs" further expands that subtree to reveal actions with no plus or minus sign next to them, such as "Pulse". Double clicking on "Pulse" results in the "Pulse" field in the Patient View being updated with the patient's current heart rate.

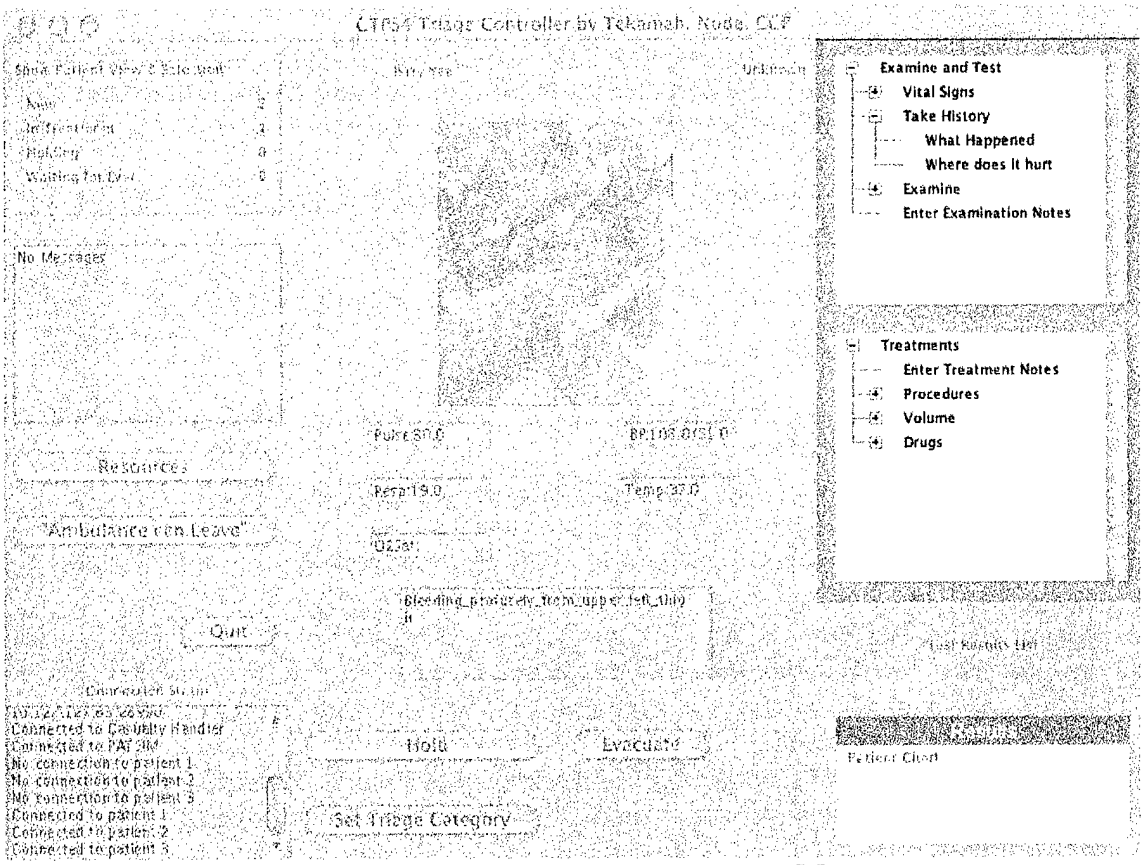


Figure 14. Examination and Treatment Menus

Some of the actions from the examination menu result in updating the information displayed in the Patient View, e.g. actions under "Vital Signs" and "Take History". Some other actions may result in bringing up a dialog to further refine the request. For instance, clicking on the actions below "Lab Tests" will bring up a dialog that may allow the user to select certain options. On clicking "OK", an item representing the lab test will appear in the Results list below

the Examine and Treatment menus. Double clicking on the item will bring up a dialog displaying the results of the test.

Which examination actions appear in the menu is configured from the Triage Controller configuration file.

II.7.f. Treatment Menu

Actions from the Treatment menus are selected in the same way as actions from the Examine menu. When a treatment action is selected by double clicking its label, a dialog will appear allowing the user to refine and confirm the treatment. For instance, if "Morphine" is selected from the Treatment menu, a dialog box will appear allowing the user to fill in the dosage of morphine to be administered. Clicking on "OK" will administer the treatment. Clicking on "Cancel" will cancel the treatment.

If a treatment is selected that requires a resource that the Triage Controller is tracking and there are insufficient resources to administer the treatment, then a message to that affect will appear and the treatment will not be given.

Which treatments are available, and their required resources, are configured for the simulated station from the Triage Controller's configuration file.

Example:

1. Start the patient triage by clicking on the Show Patient View and Selection button located on the Status Panel.
2. The Patient View and Selection Panel comes up on the screen.
3. Select a patient by highlighting his name.
4. The patient's Field Medical Card view comes on the screen in the middle of the Patient View and Selection Panel.
5. Click on Examine/Treat.
6. The Examination and Treatment Panel appears.
7. Click on the Vital Signs text under Examine (top right on Examination and Treatment Panel).
8. The screen reveals the options of taking pulse, blood pressure, temperature, respiration, and oxygen saturation (which of these appears can be determined by the Triage Controller's configuration file). Double click on any of the listed vital signs to have the current reading appear in its corresponding box.
9. To take the patient's history, click on History and chose the questions to ask to have the response appear in the description box.

II.7.g. Test Results List

On the lower right corner of the Examination and Treatment Panel is the "Test Results List" (Figure 15). This box displays the results of current and recent tests the user ordered. Double clicking on the name of a test will display a dialog box showing the results of that test.

Always present in the list is the item "Patient Chart". Double clicking on the item will bring up a dialog displaying the patient's medical chart.

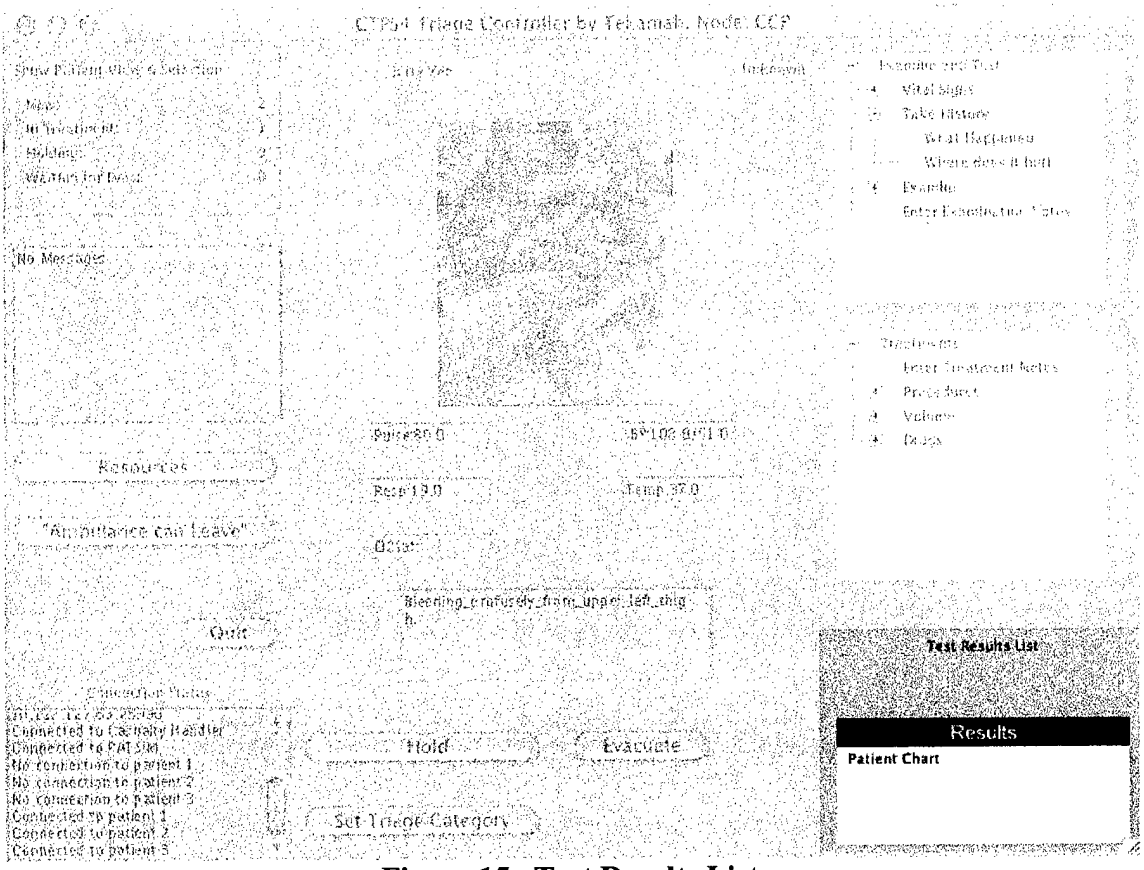


Figure 15. Test Results List

II.8 Examples

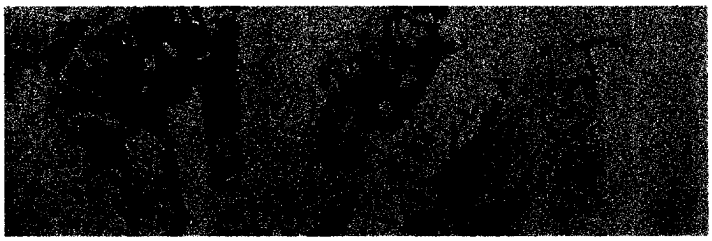
- While patient SSG Robert Jones is highlighted in the PVSP, clicking on the Examine/Treat button will replace the Patient View and Selection Panel by bringing up the Examination and Treatment Panel on patient Jones. It will also change SSG Jones' status to "In Treatment".

- Clicking on the "Move to HPS" button will additionally activate the HPS to simulate the Jones. The user can examine Jones from either the Examination and Treatment Panel or the HPS. If the user wants to examine and treat a different patient on the HPS, they must click on Move Off HPS so that the Jones simulation is terminated.

- Suppose the user selected the patient PFC Mike Freling by highlighting his name in the "New" treatment status box on the Patient View and Selection Panel, adequately resuscitated him, put in an airway that is patent, and decided Freling needed to be evacuated to Echelon III level care. From PFC Mike Freling's Field Medical Card screen view on the Patient View and Selection Panel, the user presses Evacuate. PFC Freling is added to the "Waiting for Evacuation" list of patients. The user also pressed the "Set Triage Category" and PFC Mike Freling is triaged as "Intermediate".

  When the message box on the Status Panel tells the user that the transport has arrived, the user highlights the patient (s) to be evacuated and presses "Evacuate Now". As the system moves the patient data to the Ambulance's node, the names will be deleted from the lists of patients. To tell the ambulance operator that he can depart, the user presses the Ambulance Can Leave button on the Status Panel.

- Suppose the user mistakenly sent a patient triaged as "Minimal" to be evacuated. To remove Jerry Yee from the "Waiting for Evacuation" status, highlight his name and click on "Hold".



II.9. System Pause, Resume, Save, and Restore

Under the control of the instructor(s) operating the Casualty Hander, the state of the training or simulation session may be saved to be restored later or the system may be paused to be resumed a short time later. The Triage Controller will display a message to that effect in its "Connection Status" box.

II.10. Closing the Triage Controller

When a training or simulation session is over, close the Triage Controller by clicking on the "Quit" button on the Station Status Panel.

Part III. After Action Review

III.1. Overview

The After Action Review utility records patient physiological data and station event information during a simulation and brings it up for review after the training simulation is over. The AAR provides a display of the actions that occurred while treating patients during a simulation or training exercise.

The AAR package comprises the AAR Logger (Logger) and the AAR Viewer (Viewer). The Logger records the changes in patient and station status in a specially formatted data file. After the simulation or training session is complete and the Logger closed, the Viewer may be used to read the data file and display the status of any patient or station at any given time.

III.2. AAR Logger

The Logger runs during a simulation to record patient and station data that may be viewed using the Viewer. The Logger should be started before starting the Triage Controllers. When the instructor-user wishes to save the information logged, clicking on the "Save" button on the Logger's window will bring up a dialog allowing the user to select the name to be used for the log file.

In order for the After Action Review Application to work with a training session, the instructor must start the AAR Logger The logger connects to the Casualty Handler to read state information about the patients and participating stations. When its "Save" button is pressed, the logger saves the file to be read by the AAR Viewer software. Steps involved in starting the training scenario follow:

1. Start the Casualty Handler. (See separate documentation.)
2. Start the Patient Simulation Software for all participating nodes. (See separate documentation.)
3. Start the After Action Review Logger by clicking on its icon.
4. After the After Action Review Logger is started, then start the Triage Controllers for all participating nodes.
5. The instructor selects patients and scenarios and then the Casualty Handler sends this information to particular nodes.
6. After the exercise or training session is finished and the instructor wants to assess the students' performance, the instructor clicks the "Save" button and closes down the AAR Logger.
7. To view the log file, click on the AAR icon and select the file name the log file was saved to. The Map Panel appears as the first After Action Review screen.

III.3. AAR Viewer

The Viewer provides the instructor with detailed chronological information about a simulated session including patient status, station events, and user actions associated with the patient care and evacuation. To start the viewer, click on its icon, select a log file from the file dialog, and click "OK". (Clicking "Cancel" from the file selection dialog will close the application.)

There are three panels on the viewer:

1) Map or Battlefield View
2) Station View
3) Patient View

These allow the user to view the overall simulation from including all the stations that participated, individual stations, and individual patients.

A timeline at the bottom of the various displays allows the user to select a point in time to view the simulation (Figure 15 & 16). Moving the diamond along the timeline, the user can see the changes in the patient, scenario, and status, in any of the views.

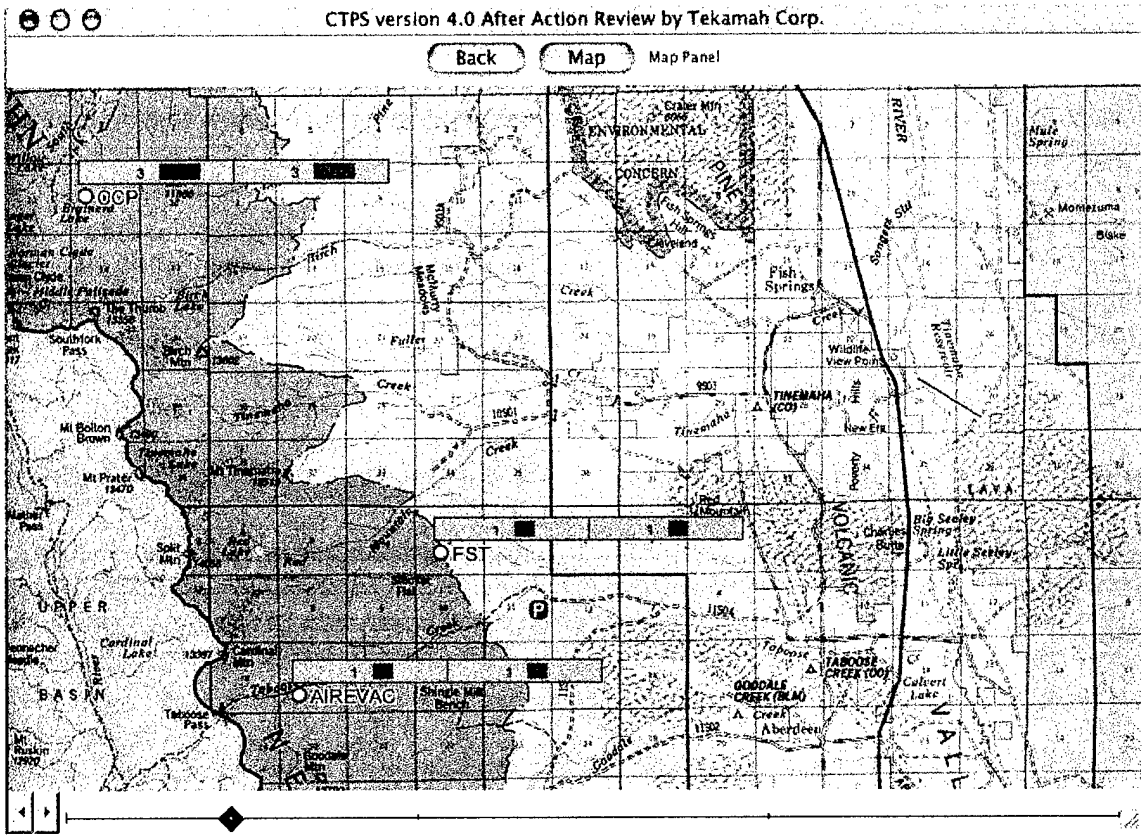
1. When the user turns on the After Action Review Application, the Map View appears (Figure 15).
2. Two buttons at the top of the displays allow the user to move between the Map Panel and the last panel they were viewing.

III.4. Map Panel

The Map Panel (Figure 15) provides a view of the battlefield and all the simulated stations including the ambulances. The map scale is determined from its configuration file. All participating station names and icons are clickable. Next to each symbol is a graphical and numerical display of the number of patients currently at that station and the number of patients under some type of physiological distress (e.g. heart rate too high or too low).

The map in Figure 15 shows a Casualty Collection Point (CCP), Field Surgical Team (FST), and an air ambulance (AIREVAC).

Figure 16. AAR Map Panel



III.5. Station View Panel

The top portion of the Station View Panel (Figure 16) displays a list of all the patients in the station along with their treatment status and triage category. Patients may be listed in as many as four columns. In the center of the screen in yellow and below the list of patients is a numerical display of the number of patients in each treatment status and below that a graphical display of the number of patients in the station over a given time period.

At the bottom of the screen is the timeline and the red diamond denotes the time period in view on the Station View Panel. The horizontal numbers under the blue graphical display line refer to the hours and minutes of the simulation over time. The vertical numbers refer to the number of patients. The blue graphical display line shows the patient load over a given time period.

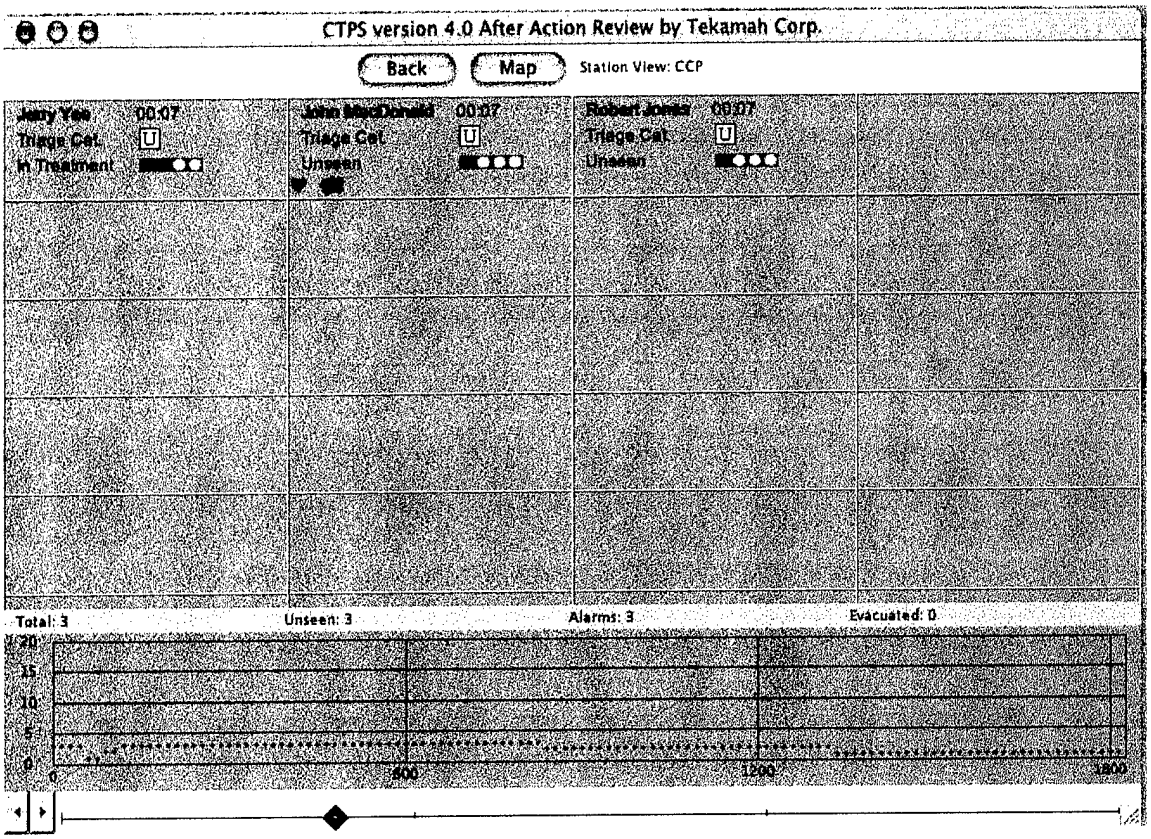


Figure 17. Station View Panel

The yellow horizontal line contains summary information and indicates the total numbers of patients for this station at this time. The total number of patients seen during the entire scenario is equal to the total at this time and those that have been evacuated. Basic summary information includes:

- The patient(s) not evaluated
- Patients in medical distress
- The number moved out of the station (evacuated).

Each entry in the four column list of patients at the top of the panel shows the name of the patient, the time, in minutes, the patient as been at the station, the patient's triage category, the patient's treatment status, and a graphical representation of the patient's alarm status.

In the example (Figure 16), the workstation has 3 patients, two who have not been seen but none have yet had their triage category set. John MacDonald is suffering both respiratory and cardiac distress.

Clicking on a patient name in the list on top of the screen will bring up the Patient View panel for that patient.

III.6. Patient View Panel

The Patient View Panel shows the condition of a patient at a particular point in time and selected vital signs over time. At the top are two panels, the first (upper left) displays basic information about the patient including his name, treatment status, triage category, and location. The second panel (upper right) displays the patient's current vital signs.

In the center of the Patient Chart is a text log of the treatment given to the patient. To the right of that is a list of all the available test results. Double clicking on a result in the results list brings up a dialog displaying the result.

At the bottom of the panel are selected vital signs over time. Click on the buttons to select a graphical view of the parameters (Pulse, Respiration, Oxygen Saturation, and Blood Pressure). The graphical representations act as a continuous patient monitor as these parameters are available graphically whether or not the student took the vital signs.

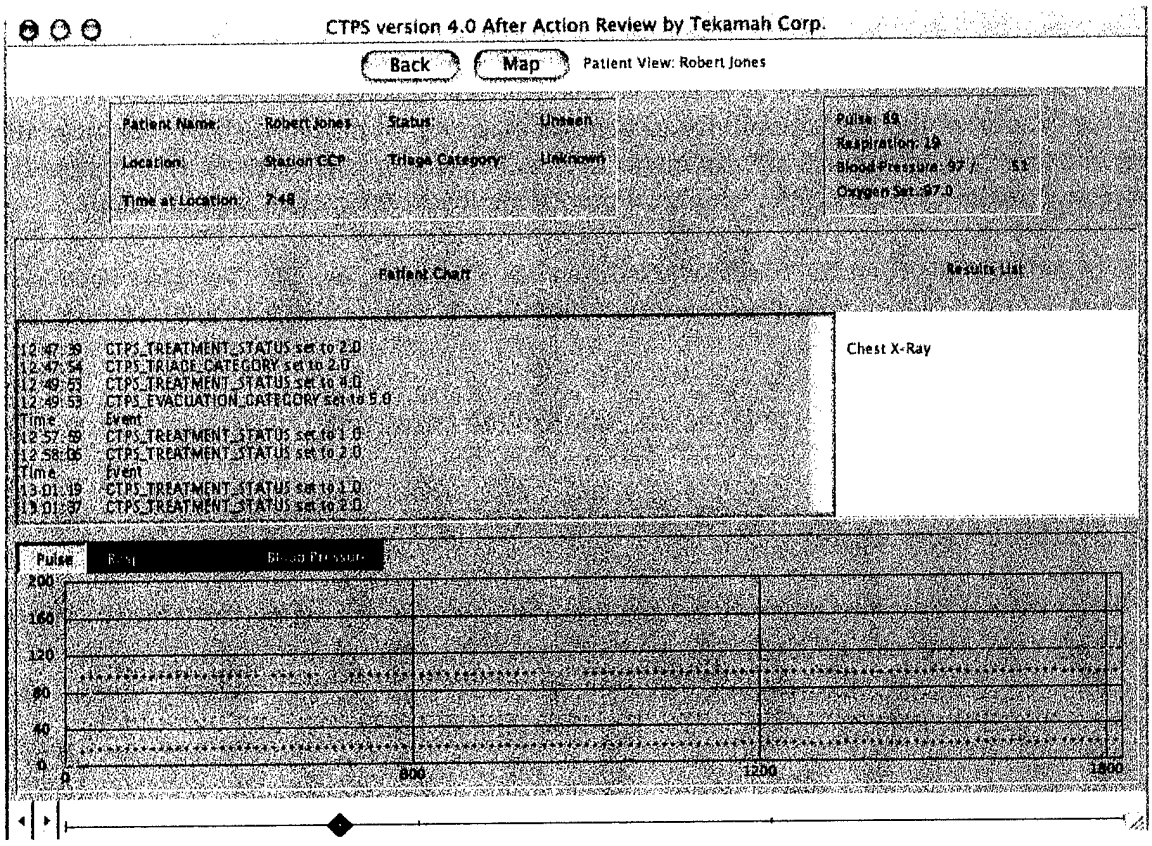


Figure 18. Patient View Panel

To close the After Action Review Application, click on the close symbol on the window title bar (a red circle with an "x" in it on the left hand side if running Mac OS, and a square with an "x" in it on the right side if running MS Windows.)

Part IV. Appendix A. TRIAGE CONTROLLER PATIENT SCENARIOS AND OPERATION ENVIRONMENT

IV.A.1. PATIENT SCENARIOS

The Triage Controller is a model driven, script controlled system. A patient file contains and sets the initial condition of the simulated patient's physiology, parameters, and variables. A scenario is used to give sets of instructions that change discrete physiological parameters.

The patient treatment and examination menus are written using a number of files. These data files include ".PAT", ".PRM", ".VAR" files for each patient and these reside, or are accessible, on the Casualty Handler. The instructor inputs information to the Casualty Handler using a real time interface. The input can be in the form of a patient file or scenario. In addition to these patient files, there is a ".GAS" file that is used to hold a partial scenario that can be applied to a patient. The scenarios and files are created by the instructor using the HPS 6 Scenario Editor application. Included are additional scenarios developed based on the Use of the Human Patient Simulator in 91W MOS/CLS Training Report (Tekamah, 2001).

Scenario files change the patient's physiological state and medical condition. For example, suppose a patient is losing blood. The scenario files can recognize the transition points to change the patient's state after a tourniquet is applied. The patient will keep losing blood until the tourniquet is done and physiological responses will be reflected. Variables assigned to the patient are located in defined defaulted files in module ".CFG" residing in the Casualty Handler. Variables associated with a particular patient or injury can be overridden by the Triage Control configuration file "TC.CFG". Patient profiles can be changed easily by the user by changing the physiological parameters from the HPS 6 Scenario Editor.

The instructor can choose to create a patient file and set the values of parameters on the Scenario Editor (See Human Patient Simulator's Users Manual for information about the HPS Scenario Editor).

IV.A.2. TRIAGE CONTROLLER OPERATION ENVIRONMENT

The Triage Controller operation environment requires a basic understanding of buttons, windows, and lists. If the user has experience using a Microsoft Windows-based PC, these operating environment concepts will already be understood.

- **The Mouse:** The mouse is a device that moves a cursor on the screen and gives the user the ability to point and click by positioning the mouse cursor over a selection and pressing the left mouse button.

- **Buttons:** The user activates the push button by clicking on it. In response to activating the button, a window opens that provides the response evoked from the system.

- **Radio Buttons:** Clicking on a radio button denotes a setting that will be taken into account in subsequent actions.

- **Windows and Scrollbars:** Windows are rectangular boxes that display a set or "window" of information. Several operations can be performed in the operating environment including the ability to move, resize, and scroll the contents of a window or "text box". Scrollbars are used to move to document and/or list information not currently displayed in the window. As the slider is moved down the scrollbar, the list or document information will scroll accordingly.

Part IV. Appendix B. CTPS Phase 4 Demonstration Scenario: Ft. Gordon, Georgia, July 2001

IV.B.1. OVERVIEW OF THE SCENARIO

Twelve soldiers were enroute to their garrison in two HUMMVs. They were driving on a dirt road when the lead vehicle ran over a mine. The explosion flipped the vehicle over killing two of the six occupants instantly. The other four survived the initial blast but were seriously injured. The trailing vehicle immediately pulled to the side of the road and its six occupants dismounted and rushed to render assistance. Immediately after dismounting, they began to take fire from a sniper concealed in the brush adjacent to the road.

One of the members from the trailing vehicle was hit by the snipers first shot. Two others began returning fire while a fourth radioed for assistance and the remaining two (one a medic) began attending to the injured soldiers. The exchange of gunfire lasted less than five minutes before the sniper was killed. In that short time he was able to inflict two gunshot wounds, raising the number of injured soldiers to six.

IV.B.2 CASUALTY DESCRIPTIONS

Blunt Abdominal Injury (ruptured spleen)

The soldier riding in the front right seat was unbelted and was thrown out of the HUMMV, landing several yards from vehicle. Upon initial inspection he has a small laceration on his forehead and reports having a sharp pain in his left wrist. He is stoic when talking about his injuries and is very concerned about his fellow soldiers. Initial vitals reveal only a slightly elevated heart rate. With further examination he is tender on the left side of his torso where he apparently struck the ground. Breath sounds are normal. Abdomen is normal.

His underlying injury is a ruptured spleen. As he bleeds into his peritoneal space he becomes increasingly hypovolemic and has rebound tenderness upon examination. Volume replacement has little effect. His only hope for survival is prompt evacuation to a treatment facility with surgical capabilities. Without surgical intervention (splenectomy) this casualty will die in approximately 60 minutes.

Table 1. HPS States – Ruptured Spleen

Baseline	30 seconds then Class I Shock
Class I Shock	450 seconds then Class II Shock
Class II Shock	450 seconds then Class III Shock
Class III Shock	2400 seconds then Class IV Shock
Class IV Shock	Death in approx two minutes
Splenectomy	

This casualty does not respond to volume resuscitation unless splenectomy is done. He transitions to "splenectomy" after arriving at a treatment facility capable of a laporatomy *and* surgical intervention is selected.

Blunt Chest Injury (pericardial tamponade)

The blast arrested the vehicle's forward motion and flipped it over on its top. The driver's chest struck the steering wheel. Upon inspection he has a bruise on his chest over the lower half of the sternum as well as a bruise on his left leg where it stuck the side of the vehicle during the rollover. He complains of soreness where he struck the steering wheel and a sharp localized pain with inspiration. As time progresses he reports the chest pain becoming "sharper" with the pain radiating to his neck. His respiratory rate increases and he has trouble breathing. He is anxious and lightheaded.

The force of the impact of his chest on the steering wheel fractured ribs immediately over his heart. The impact with the heart caused a small bleed into his pericardial sac. As the fluid accumulates his condition becomes more severe eventually leading to unconsciousness. The problem can be managed (temporarily) at any location with staff capable of a pericardiocentesis. (BAS, FST, of CSH). With the pressure in the pericardium relieved, the bleeding stops on its own and does not require surgical correction.

Table 2. HPS States – Pericardial Tamponade

Baseline	60 seconds
Tamponade	1200 seconds
Unconscious	

Closed Head Injury

One of the soldiers riding in the rear of the first HUMMV was thrown against the metal frame of the vehicle. His head struck a metal post creating a small laceration and significant bruising. He suffered a brief loss of consciousness and reports both neck and head pain. After 5 minutes he loses consciousness.

His underlying injury is a cerebral contusion. The intra-cranial pressure increases over the course of the scenario. His best chance of survival is evacuation to a treatment facility with an intensive care unit.

Table 3. HPS States – Closed Head Injury

Baseline	300 seconds
Unconscious	300 seconds
Level I ICP	
Level II ICP	
Level III ICP	

Compound Fracture of the Left Leg (tibia)

One of the four passengers riding in the rear of the HUMMV had his left foot and ankle wedged between two pieces of gear during the rollover while his torso twisted 180 degrees. The twisting of his left leg resulted in a compound, spiral fracture of his tibia. He did not sustain any other injuries. Upon examination he has significant external bleeding. His heart rate is elevated. His pedal pulse is absent on the left but he is neurologically intact.

The fractured tibia transected the popliteal artery. Without immediate application of a pressure dressing or tourniquet, he progresses through increasingly severe states of hypovolemic shock. Once the bleeding is properly managed, he responds well to volume replacement. Vascular repair is necessary to salvage the leg.

Table 4. HPS States – Compound Fracture of the Left Leg (tibia)

Baseline	30 seconds
Class I Shock	180 seconds
Class II Shock	300 seconds
Class III Shock	300 seconds
Class IV Shock	
Bleeding controlled	
Vascular repair	

Gunshot Wound to the Left Chest

The sniper hit one of the soldiers in the left chest. The bullet entered in the left upper quadrant. The entrance wound is not grossly bleeding. No exit wound is found. Pulse is normal. Diminished breath sounds on the left. He remains conscious and over time begins taking more rapid, shallow breaths and complains of difficulty getting enough air. The rapid breathing is followed by tracheal deviation to the right and jugular venous distension.

The bullet missed his heart and large blood vessels but destroyed a portion of the upper lobe of the left lung leaving a significant opening between several larger bronchioles and the pleural space. Over time intra-thoracic pressure increases causing a tension pneumothorax. Treatment (needle decompression) can be done at any echelon. Once decompressed, the needle kinks or is clotted off with each transfer of the casualty until the needle decompression is replaced with a chest tube.

Table 5. HPS States – Gunshot Wound to the Left Chest

Baseline	30 seconds
Pneumothorax	300 seconds
Tension Pneumothorax	
Needle Decompression	

Gunshot wound to the Right Thigh (Femoral artery bleed)

The sniper's first bullet hit one of the soldiers in the left upper thigh. The entrance wound located in the high anterior-medial portion the midline is bleeding profusely. An exit wound is found on the mid-portion of the left gluteus. Popliteal and pedal pulses are absent in the injured leg. The solider is initially coherent but becomes confused then loses consciousness as he becomes increasing hypotensive.

The bullet clipped the femoral artery. Direct pressure, a pressure dressing or tourniquet are not effective. He continues to bleed internally regardless of attempts to stop the bleeding externally and does not respond to volume resuscitation. His only chance of survival is to be evacuated to a treatment facility capable of surgical intervention (vascular repair).

Table 6. HPS States – Gunshot Would to the Right Thigh (Femoral Artery Bleed)

Baseline	600 seconds
Class I Shock	900 seconds
Class II Shock	900 seconds
Class III Shock	
Vascular repair	

IV.B.3. EVACUATION RESOURCES AND SUPPORTING MEDICAL TREATMENT FACILITIES

The scenario has six treatment nodes each with its own HPS, Triage Controller and supporting equipment. Four of the nodes represent treatment locations that are in fixed position and two nodes represent evacuation vehicles. The four "fixed" treatment nodes are: a Casualty Collection Point (CCP), a Battalion Aid Station (BAS), a Forward Surgical Team (FST), and a Combat Surgical Hospital (CSH). The two evacuation vehicles are a ground ambulance and an air ambulance.

The CCP is set up by the medic at the site of the explosion.

Ground ambulance evacuation times are as follows: The BAS is 10-15 minutes away from the CCP, the FST is 15-20 minutes away from the BAS, and the CSH is 20 minutes away from the FST. The ground ambulance is capable of transporting four casualties at a time.

Air evacuation times are: CCP to CSH is 10-12 minutes; the BAS is situated in a wooded area without easy access to a landing site – air evacuation is not supported; CCP to FST is 7-10 minutes; and FST to CSH is 5-7 minutes. The air ambulance is only capable of transporting two casualties at a time.

The first evacuation asset on the scene is a helicopter capable of transporting two litter casualties directly to a Combat Surgical Hospital (transport time: 10-12 minutes). Second on the

scene is a ground ambulance capable of transporting four litter casualties directly to a Battalion Aid Station (transport time: 10-15 minutes).

The graph on the following page shows the anticipated timing of the evacuation vehicles.

IV.B.4. THE UNFOLDING SCENARIO

In addition to managing the casualties, each of the locations will need to have a working understanding of the capabilities at each node and the transit time between nodes. This situational awareness will be most important at the CCP. In addition to the first look and triage of the casualties, the medic will need to re-triage each of the casualties prior to making an evacuation decision. Those most in need of definitive surgical care may not be obvious initially. If one or more of the more severe cases is not loaded onto the air ambulance, the best course of action would be to hold the severe casualty at the CCP rather than evacuating to the BAS. Waiting for the second trip via air ambulance will get the casualty to definitive surgical care faster than sending them by ground.

Part IV. Appendix C. CTPS System Overview and Configuration File Format

The CTPS Phase 4 Triage Controller works with other federates in the CTPS system to simulate a medical station. These other federates are 1) Casualty Handler and Scenario Processor, 2) A Human Patient Simulator (HPS), and 3) One or more PATSIMs (a Patient Physiological Model).

The Casualty Handler and Scenario Processor creates the patients and applies injury specific data according to a "scenario file". It tells a PATSIM to create the patient and sends it the current data to apply to the patient. In addition, the Casualty Handler holds a list containing variables containing information about the stations in the simulation. These variables on the list can be used to communicate between stations and to make information available to the federate creating the data log for the after action review.

The Triage Controller connects directly to one or more PATSIMs to retrieve the list of patients simulated on each PATSIM. These PATSIMs declare the name of the medical station they are helping to simulate and the Triage Controller connects to each PATSIM that declares the same name as the station the Triage Controller is simulating. The union of all the patients on all the PATSIMs declaring a particular is the set of patients on the simulated station with that name.

The Triage Controller can "transfer" a patient to a Human Patient Simulator by sending the appropriate command to the PATSIM currently simulating that patient. This results in the PATSIM transferring data to the machinery controlling the HPS and sending the start command to the HPS so that it will begin to exhibit the physiological attributes according to the PATSIM's physiological model.

In order for the Triage Controller to make the network connections to the Casualty Handler and the PATSIMs it must know their Internet address and a port number to request a connection on. It discovers these by listening on a particular Internet address and port numbers for broadcasts by the Casualty Handler, the PATIMs, and the HPS. Each of these federates broadcasts on a preassigned port number determined by its configuration file. These broadcasts include their names and an address and port number. The address and port numbers to listen to are likewise specified in the Triage Controller's configuration file.

When the Triage Controller receives a broadcast from one of these entities, it checks the name of the broadcasting entity and if it is the same as the expected name according to the Triage Controller's configuration file, it will use the address and port number contained in the broadcast to request a connection. In the case of the HPS, it does not request a connection, but rather, it stores the address and port number to be used to identify the particular HPS in the message to the PATSIM to transfer the patient.

Configuration File Format

The format of the configuration files conform to the following:
A series of lines containing
(keyname) = (value)
where (keyname) is a string holding the name of a key to be used to look up the value assigned to the key and (value) is the value to be assigned to (keyname) by the configuration file.
Key names and their values must conform to the format described below in order to be properly read and implemented.

Each keyname takes the form of "(category)...(item)" where ... can be replaced by additional subcategories. Each category will have its own convention for the semantics of the subcategories that may follow it in a key name and for the syntax and semantics of the value assigned to the key.

Triage Controller

The Triage Controller's configuration file is named tc.cfg and is formatted according to the following.

Key names representing high level information related to the station being simulated should be entered as "station.(item)". Keys for information relating to the network connection(s) should be lead by "connection." Subcategories identifying the particular entity should be included when appropriate, and the key name should be ended with a description of the item being assigned.(see below)

Treatments are added to the file by inserting lines with a keyname starting with "treatment.". "treatment." is followed by one of "drug.", "volume.", or "procedure." according to the type of treatment, then a name describing the treatment. (e.g. treatment.drug.morphine)
The value of a treatment should contain the following information in the following order separated by semicolons-
integer identifier,
string treatment name (to be displayed to a user),
string model variable name (used in the patient model to indicate the treatment--this may need to be added to patient model's model.cfg file as well) string unit name as applied,
integer required resource (-1 indicates no tracked resource used),
integer indicating the minimum amount of resource for the treatment, a series of string / string / integer triples containing the names of options that may be selected for the treatment, the patient model variable names corresponding to the options, and an integer indicating the additional amount of resource used for the option.

The addition of new procedure treatment variables will require the addition of lines to the patient simulation model and casualty handler configuration files naming the new procedure variable and specifying a default value for it.

Resources are added to the file by inserting lines with a keyname starting with "resource.". This is followed by the name of the resource. The value of the resource should contain the following information in the following order separated by semicolons
integer identifier,
string resource name,
string unit name as used up,
an initial amount of the resource

The ability of a station to measure a vital sign is indicated by a line beginning with "vitalsign." followed by the name of the vital sign, one of "PULSE", "RESPIRATION", "BP", "TEMP", and "OXSAT". The value of a vital sign should be one of "ON", "OFF", or "CONTINUOUS", indicating that the station has the ability to measure the vital sign, does not have the ability to measure the vital sign, or has continuous monitoring capability of the vital sign, respectively. (However, Triage Controller 1.0 does not support continuous monitoring. This is provided here for use with future versions.)

Tests and examination procedures are added to the file by inserting lines with a keyname starting with "test.". This is followed by one of "history.", "examine.", or "lab." and the name of the test. The value of a test description should contain the following information in the following order separated by semicolons
1) integer identifier (should be unique in the universe of treatments and tests),
2) string test name,
3) string model variable name (the patient variable holding the data used to calculate the test result--this may need to be added to patient model's model.cfg file as well) 4) one of "PHYSIOLOGIC", "FROMURL", or "PRECALCULATED", 5) one of "PERSISTENT" or "NONPERSISTENT", 6) one of "ALWAYSAVAILABLE" or "NOTALWAYSAVAILABLE", 7) one of "TEXTINVAR" or "TEXTINFILES" 8) integer required resource (0 or -1 indicates no tracked resource used),
9) for PERSISTENT tests, the name of a patient variable to hold the results of the test, "none" otherwise
10) for NOTALWAYSAVAILABLE tests, the name of a patient variable to indicate whether a test result is available, "none" otherwise
11) one of "USEALLOPTIONS" or "USESELECTEDOPTIONS" 12) a) for PERSISTENT tests, a series of quadruples containing an option name, a model variable, a graphic result variable, and a text result variable (all separated by semicolons). "none" should be entered where applicable b) for NONPERSISTENT tests, a series of option / model variable pairs.

Any new patient variables added to support a new FROMURL or PRECALCULATED test must likewise be added to the patient simulation models and casualty handler configuration files.

Resupply schedules are indicated by inserting lines starting with "resupply." This is followed by the name of the resource and a unique id of the resupply action. The value will be the id of the resource being resupplied, the name of the resource, the name of the units of the resource, the amount of the resupply, and the time (expressed in seconds from the start of the simulation), all separated by semicolons.

Evacuation schedules are indicated by inserting lines starting with "evacuate.". This is followed by the name of the evacuation vehicle (e.g. "air ambulance") and a unique id of the evacuation action. The value will be the name of the vehicle in the evacuation and a time (expressed in minutes from the start of the simulation) and the capacity of the evacuation vehicle separated by semicolons.

Patient information is entered by including lines starting with "patient.". This is followed by the identifier of the patient and the name of the attribute being assigned by this line. The value on the line is the integer patient ID, the name of the attribute, and its initial value, separated by semicolons. When a PATSIM associated with the Triage Controller is bound to a patient with an identifier identical to that in the value string, the Triage Controller will assign the initial value to a patient variable on the PATSIM with the name in the value string. A line with patient ID of 0 will match all patients. That is, an identifier of 0 will indicate that the assignment should be made for all patients entering the station.

Node names may be entered in the configuration file with lines beginning with "node.". (This is required to allow a Triage Controller of a mobile unit to move between nodes.) This should be followed by the name of the node. The value is the name of the node. Distances between nodes are entered via a separate line beginning with "distance.". This is followed in the key name by the name of a node. The value is a sequence of pairs with each item in the pair and the pairs separated by semicolons. The first items of a pair is the name of a node and the second is the distance between that node and the node named in the key.
Distances between nodes

Comments may be entered into the configuration file by placing a ";" in the first space of the line. The rest of the line will be considered a comment and ignored.

AAR Logger

The logger configuration file, named al.cfg contains the name and broadcast address and port of the casualty handler. In addition, it must contain lines describing any lab tests that may be performed. These lines follow the same format as the corresponding lines in the Triage Controller.

AAR

The AAR configuration file, named aar.cfg contains the map scale used for the battlefield map.

8.0 Appendix C Human Patient Simulator Maintenance Manual

Table Of Contents

Purpose of this manual 2

Calibrations and Adjustments..... 3

Maintenance.....11

Trouble Shooting.....17

Purpose of this Document

The HPS Maintenance Manual is intended as a guide allowing HPS customers proficient in the operation of the HPS system to perform basic calibration, adjustment, maintenance and troubleshooting procedures. In conjunction with the HPS Operator's Manual, it provides the reference material required to overcome basic problems associated with the operation of the HPS, perform required calibrations, adjust settings tailoring the HPS to the needs of individual customers and ensure proper function of the HPS system. The procedures documented in this manual can be performed using basic hand tools, a multi-meter, and certain test programs included with the HPS and the HPS system itself. The procedures and repairs documented herein are intended to be affected by a proficient unaided operator. Contact METI for further assistance as required.

Contact METI Customer Support at:

METI
Customer Support
c/o Mark McClure
Manager of Technical Operations

Or

Jim Azukas
Director of Engineering

6000 Fruitville Road
Sarasota, Florida 34232
USA

Telephone: **(USA Country Code 001): (941)342-5605**
FAX: **(USA Country Code 001): (941)377-5590**

Or visit the Customer Support section of METI's Web Page at URL: WWW.METI.Com

NOTE TO CTPS USERS:
The calibration and adjustment data presented here assumes that the HPS or PHS unit has been booted in the DOS operating system. To do this, power on the HPS rack, and watch the flat screen monitor mounted on the shelf in front of the rack. There will be a prompt for Linux or Dos. At this prompt, type DOS, and hit return. The unit will boot in DOS. If one desires to run the Version 5 Software, Type "hps5" at the DOS prompt. If it is desired to run the calibration programs, stay in DOS and follow the instructions given in this document. In general, except for the unit maintenance instructions, the calibration and adjustment data given in this manual is for the advanced user, and one should give METI customer support before attempting more than general maintenance of the unit.

Calibrations and Adjustments

Calibrating the Patient Monitor

About the interface

The Human Patient Simulator can be connected to standard patient monitors produced by all major manufacturers. The Monitor Interface allows for the viewing of six patient parameters:

- Arterial Blood Pressure (ABP)
- Pulmonary Artery Pressure (PAP)
- Central Venous Pressure (CVP)
- Intracrainial Pressure (ICP)
- Thermodilution Cardiac Output (CO)
- Body Temp (T1)

This is accomplished using a special interface that converts the voltage outputs from the HPS models to a resistive bridge that simulates a pressure or temperature transducer. Each brand of patient monitors has slightly different input characteristics. These differences and any non-linearity in the interface circuitry have to be compensated for. Performing a curve fit of each parameter for its full range does this. The program HPS_CAL will assist in this calibration by stepping through the ranges of each parameter and calculating the equation of the curve.

Running the Program

1. Ensure that all gas supplies to the Human Patient Simulator are turned off.
2. Switch on patient monitor.
3. Turn on the power switch on the front of the equipment rack.
   A fifteen-minute warm-up is recommended before starting calibration.
1. Upon initial power-up, your system may automatically execute the HPS control software. If so, exit the HPS program.
2. When "C:\HPS" appears on computer display screen, type "CD TESTSW" and press the RETURN key. Then type "HPS_CAL" and press the RETURN key.
3. While running this program please note that help is available anytime by pressing the F1 Hot Key.
4. At the Main Menu select "CALIBRATION".
5. Another menu will pop up and ask for a choice in monitors. Make the selection.
6. A Calibration menu will now appear. Select the parameter you wish to calibrate.
7. The program will now step you through the calibration procedure.
8. You will be asked to monitor the waveform of the parameter you have selected, make changes to its amplitude using the arrow keys and input the numerical data displayed on the medical patient monitor.
9. When the program has completed the calculations for the parameter, it will display the curve fit in the "EQUATION" box as well as putting it a file when exiting the program.
10. Select the next parameter to calibrate or press ESC to return to the Main Menu.
11. Note: Any parameter calibrated during current run will be marked with a smiley face.
12. Select "EXIT WITH SAVE" to save the data to the file HPS_CAL.DAT.

Updating the HPS Configuration File

After quitting the program, the prompt "C:\HPS\TESTSW" will appear on the computer. Type "EDIT HPS_CAL.DAT" and press RETURN key. This file contains the calibration data generated by the HPS_CAL program. See Figure PM1.

```
FLAG    VARIABLE                X^3          X^2          X
CONSTANT

[*]  Parterial_factor            0      0.0055892     -3.879      3197.9
[*]  Pcatheter                   0      0.0047328     -3.7426     3202.5
[*]  body_temp                   0      0.25984      -38.156      3596.6
[*]  therodilution               0      0.70632     -131.16       6585.1
[*]  Pvenous                     0     -0.0026523     -3.8165     3214.0
[_]  ICP_CHANNEL                 0      0.02093       -6.4724     3200.1


Put these values into the HPSxxx.CFG file using the DOS editor.

An  * appears before data updated during last saved program run.
```

Figure PM1. Contents of the HPS_CAL. DAT file.

This data needs to be copied from this file and inserted into the HPS5xx.CFG file. The safest way to accomplish this is by writing this calibration data onto a note pad and the inserting this new data, line by line, into the ". ADDA" region of the HPS5xx.CFG file as shown below.
Note: Before editing HPS5xx.CFG, be certain to create a back up of this file. Use extreme care in editing to ensure integrity of the file. Use the INSERT mode to type over the existing data and do not hit the "RETURN" key to move from line to line. Use the arrow keys instead. Data must remain in the column format shown. See figure PM2.

```
.ADDA:
#    ENABLED/DISABLED -- DISABLED will suspend all ADDA signals. This is
#                        useful when running HPS on a non-simulator PC.
DISABLED
#    The AD/DA signals are computed as follows:
#        value(x) = Ax^3 + Bx^2 + Cx + D  // A,B,C,D are constants
#    For AD, "value" is the value of the sampled signal after the above
#    conversion.
#    For DA, "value" is the integer constant that is sent to the DA
board.
#
#    SIGNAL              ADDR  CHAN      A       B       C            D
x_cmH2O                 0x200   0       0.0     0.0     0.1116
240.063
y_cmH2O                 0x200   1       0.0     0.0     0.1101
237.455
reservedChestComp       0x200   2       0.0     0.0     0.0          0
reservedN2O             0x100   0       0.0     0.0     0.0          0
reverved02              0x100   1       0.0     0.0     0.0          0
reservedCO2             0x100   2       0.0     0.0     0.0          0
reservedN2              0x100   3       0.0     0.0     0.0          0
open_channel_A          0x100   4       0.0     0.0     51.175
2047
EPR0_psig               0x100   5       0.0     0.0     81.9         80
EPR0                    0x100   6       0.0     0.0     81.9         0
open_channel_c          0x100   7       0.0     0.0     1            0
Parterial_factor        0x300   0       0.0     0.00559 -3.879
3197.9
Pcatheter               0x300   1       0.0     0.00473 -3.7426
3202.5
ecg_C                   0x300   2       0.0     0.0     20.47
2047
```

```
body_temp          0x300   3     0.0     0.25984 -38.156
3596.6
therodilution      0x300   8     0.0     0.70632 -131.16
6585.1
ecg_LA             0x300   5     0.0     0.0     20.47
2047
ecg_RA             0x300   6     0.0     0.0     20.47
2047
ecg_LL             0x300   7     0.0     0.0     20.47
2047
ecg_sync           0x300   13    0.0     0.0     819          0
DA8                0x300   4     0.0     0.0     1            0
DA9                0x300   9     0.0     0.0     68.956       -
774.1
Pvenous            0x300   10    0.0     -0.00265 -3.8165
3214.0
ICP_CHANNEL        0x300   11    0.0     0.02093 -6.4724
3200.1
DA12               0x300   12    0.0     0.0     1            0
DA14               0x300   14    0.0     0.0     1            0
DA15               0x300   15    0.0     0.0     1            0
.END
```

Figure PM2. Contents of HPS5xx.CFG file. ADDA region.

Calibrating Eyes for Ambient Light

Factory Settings

The pupil dilation is factory set to 4mm for average indoor ambient light conditions. Since light conditions vary at each location, a user could find that the simulator's pupil diameters are too large or small under ambient conditions. For some applications it may be preferred to recalibrate the eyes for the ambient light in the current simulator location. This will allow the full range of pupil dilation to be viewed during simulator sessions.

Re-calibration

1. Open the front door of the equipment rack and turn on the power switch.
2. Start the HPS program. After the self-test, lung cal and gas analyzer warm-up have been completed, select and start a patient.
3. From the *Other Parameters* window, set ***Blink Control*** to both blinking and ***Blink Speed*** to Slow.
4. Open the Card Cage access door using the two thumbscrews on the upper corners.
5. Locate the Eye Signs Board in slot A9 of the Card Cage.
6. Connect the positive lead of a voltmeter to test point TP1 (Left Sense) and the negative lead to TP3 (Gnd).
7. Adjust the upper potentiometer until 2.5V is displayed on the meter.
   Note: The amplitude will change briefly as the eye lids open and close. Make the measurements while eyes are open.
8. Move the positive lead of the voltmeter to test point TP2 (Right Sense).
9. Adjust the lower potentiometer until 2.5V is displayed on the meter.

Note: Under extreme ambient light conditions, 2.5V (4mm) may not be obtainable.

Adjusting Pneumatic Powered Clinical Signs

Pneumatic Overview

The mannequin is equipped with many pneumatic actuators and regulators that allow for the physical demonstration of various clinical signs and traumas:

- Carotid pulse
- Brachial pulses
- Radial pulses
- Femoral pulses
- Pedal pulses
- Occluded airway
- Laryngospasm
- Swollen tongue
- Tension pneumothorax
- Chest tube air leak

The air regulators, also located in the mannequin, allow for the adjustment of these functions.

Warning:

Use Caution When Adjusting any Pneumatic Powered Clinical Sign as Described in this Document. Large Adjustments to Factory Settings May Result in Damage to the HPS.

Pulses Adjustment

Although each palpable pulse location is controlled separately, the pulses have been divided into three groups. Each group has a separate regulator to adjust for the strength of the pulses.

- A regulator located in the mannequin's pelvis on the left wall controls the Carotid pulse. This regulator is assessable by lifting the stomach up. It is labeled "CRTD Pulse". To increase the pulse strength, turn the knob clockwise.
- A regulator located in the mannequin's right thigh controls the femoral and pedal pulse strength. This regulator is assessable by removing the access cover on the topside of the thigh. It is labeled "Femoral Pedal Pulse". To increase the pulse strength, turn the knob clockwise.

- Another regulator located in the mannequin's right thigh controls the brachial and radial pulse strength. It is labeled "Brachial Radial Pulse". To increase the pulse strength, turn the knob clockwise.

Tongue Adjustment

The mannequin also has a tongue that can swell to moderate or severe states.

- A regulator located in the mannequin's right thigh controls the semi-swollen tongue inflation. It is adjusted to a pressure of four psi at the factory. It is labeled "Semi Swollen Tongue".
- Another regulator located in the mannequin's right thigh controls the swollen tongue inflation. It is adjusted to a pressure of nine psi at the factory. It is labeled "Swollen Tongue".

Adjusting the regulators clockwise increases the pressure.
Note: A pressure in excess of ten psi is not recommended. The tongue may explode!

Chest Tube Leak Adjustment

A chest tube can be placed in the mannequin to drain the right intrapleural volume. During the therapy, the parameter ***Chest Tube Air*** can be used to simulate a continuing flow of air into the intrapleural space or a leak in the vacuum circuit.
To increase the volume of bubbles flowing through the vacuum circuit for any given value of the parameter ***Chest Tube Air***, adjust the regulator located in the mannequin's pelvis on the left wall clockwise. This regulator is assessable by lifting the stomach up. It is labeled "Chest Tube".

Airway Occluder Adjustment

The Airway occluder is used to simulate swelling of the posterior oropharynx. In its operation, a piston pushes the skin forward to block the view of the larynx. When released, the piston returns home and the airway returns to normal. If the piston does not return home when the parameter ***Airway visualization occluder*** is turned off, the "Diff. Airway Bottom" air regulator will need to be adjusted clockwise. This regulator is located in the mannequin's pelvis on the right wall. After turning the knob one revolution clockwise, turn ***Airway visualization occluder*** on and the off again. Check airway and repeat regulator adjustments until the piston returns home every time.

Adjusting Heart and Breath Sounds

Heart Sounds Overview

The mannequin generates heart sounds that are appropriately synchronized to the QRS complex of the ECG waveform. These heart sounds are broadcast from miniature speakers that are imbedded under the torso/chest skin. They are audible over the left and right upper sternal border, left lower sternal border and apex and through an esophageal stethoscope.

Amplitude Adjustments

1. Start the HPS program. After the self-test, lung cal and gas analyzer warm-up have been completed, select and start a patient.
2. Open the Card Cage access door using the two thumbscrews on the upper corners.
3. Locate the Heart sounds Board in slot A2 of the Card Cage.
4. Place a stethoscope over the Left Upper Sternal Border location.
5. Adjust the volume control R14 (Left and Right Upper Sternal Border, Esophageal) until the amplitude is at the preferred volume. Clockwise increases the volume.
6. Move the stethoscope to the Right Upper Sternal Border location. Verify amplitude.
7. If an esophageal stethoscope is available, verify esophageal amplitude.
8. Place the stethoscope over the Lower Sternal Border location.
9. Adjust the volume control R15 (Apex and Lower Sternal Border) until the amplitude is at the preferred volume. Clockwise increases the volume.
10. Move the stethoscope to Apex location. Verify amplitude.

Breath Sounds Overview

The mannequin generates breath sounds that are appropriately synchronized with the respective phases of respiration. These breath sounds are broadcast from miniature speakers that are imbedded under the torso/chest skin. They are audible over the apex, axilla and posterior of each lung with the use of a standard stethoscope and through the use of an esophageal stethoscope.

Amplitude Adjustments

1. Start the HPS program. After the self-test, lung cal and gas analyzer warm-up have been completed, select and start a patient.
2. Open the Card Cage access door using the two thumbscrews on the upper corners.
3. Locate the Breath sound Board in slot A3 of the Card Cage.
4. After the simulator begins spontaneous breathing, place a stethoscope over Left Apex location.
5. Adjust the volume control R11 (Left Apex, Left Esophageal) until the amplitude is at the preferred volume. Clockwise increases the volume.
6. If an esophageal stethoscope is available, verify Left Esophageal amplitudes.
7. Place the stethoscope over the Left Axilla location.
8. Adjust the volume control and R12 (Left Axilla, Left Posterior) until the amplitude is at the preferred volume. Clockwise increases the volume.
9. Move the stethoscope to Left Posterior location. Verify amplitude.
10. Place a stethoscope over Right Apex location.
11. Adjust the volume control R13 (Right Apex, Right Esophageal) until the amplitude is at the preferred volume. Clockwise increases the volume.
12. If an esophageal stethoscope is available, verify Right Esophageal amplitudes.
13. Place the stethoscope over the Right Axilla location.
14. Adjust the volume control and R14 (Right Axilla, Right Posterior) until the amplitude is at the preferred volume. Clockwise increases the volume.
15. Move the stethoscope to right Posterior location. Verify amplitude.

Adjusting Patient Voice

Patient Voice Overview

The Patient Voice subsystem consists of a wireless microphone, a receiver, internal amplifier and a speaker that has been installed behind the cricothyroid in the mannequin's head. This speaker broadcasts the transmitted voice of an operator to give the illusion that the mannequin can talk.

Amplitude Adjustments

1. Open the front door of the equipment rack and turn on the power switch.
2. Open the Card Cage access door using the two thumbscrews on the upper corners.
3. Locate the Heart sounds Board in slot A2 of the Card Cage.
4. Turn the wireless microphone on and set it to transmit.
5. Turn the receiver on and set the pre-amp volume control to the maximum. This component is located on top of the equipment rack.
6. Talk into the microphone and adjust the volume control R12 (Patient Voice) until the amplitude from the mannequin is at the preferred maximum volume. Clockwise increases the volume.
7. Reduce the pre-amp volume control on the receiver until the preferred normal volume is reached.

Note: This receiver does not have squelch control. Turn the receiver off before turning the microphone off to avoid the vacant channel noise. If an amplitude higher than what is available is required, contact METI customer support for possible solutions.

Changing Probe Manufacturers for SPO_2

Access the SmartSat control panel

1. Turn the rack Main Power Switch off.
2. Open the front door of the HPS equipment rack.
3. Remove the lower panel containing the two Liquid Crystal Displays (LCDs). This can be accomplished by rotating the four _ turn fasteners counterclockwise being careful not to let the panel fall. Place the lower edge of the plate on the ground and lean the plate against the rack. Take care not to pull on or disconnect the ribbon cables connected to the rear of the displays.
4. Identify the SmartSat unit. It is a beige colored box on the left side of the rack sitting on the first shelf above the Power Supply.

Changing default probe settings

1. Turn the rack Main Power Switch on.
2. A green LED will light under the SmartSat Power Button indicating the unit is now on. Verify the LCD located on the lower panel is now active. Wait until the self-test displayed on the screen is done before continuing.
3. Press the button on the SmartSat labeled **F1** (SPO_2 SIM).
4. Press the button on the SmartSat labeled **F2** (<SELECT). Keep pressing button until OXIMETER is highlighted.
5. Press the button on the SmartSat labeled **F4** (CHANGE+). Keep pressing this button until the probe manufacturer you desire is displayed and highlighted.
6. Press the button on the SmartSat labeled **PREV** twice.
7. Turn the SmartSat Power Button off and then back on. After the self-test is done, verify the NEW oximeter probe manufacturer is now displayed on the screen.

Reassemble Rack

1. Turn the rack Main Power Switch off.
2. Reinstall the lower panel containing the two LCDs back on to the rack. This can be accomplished by holding the plate against the rack and rotating the four _ turn fasteners clockwise being careful not to let panel fall.
3. Turn the rack Main Power Switch back on and verify the operation of the panel displays and oximeter setting.

Connect proper adapter

Connect one of the SPO_2 adapter cables supplied with the simulator between the rear rack I/O panel connector labeled SPO_2 and the monitor/monitor cable.
Standard adapters include: HP, NELLCOR, DATEX, and OHMEDA.

Changing NIBP Cuffs

Non-invasive Blood Pressure Monitoring Overview

The HPS Cardiovascular System has the capability to accurately drive both invasive and non-invasive hemodynamic monitoring packages. The cuff of a Non-Invasive Blood Pressure (NIBP) monitor correctly measures and displays the patient's systemic blood pressure on the patient monitor. In addition, a standard blood pressure cuff and sphygmomanometer can be used to assess systolic blood pressure using the return-to-flow technique.

Changing the NIBP Cuff

Many cuffs used by manufacturers of patient monitors differ from one another in charge line pneumatic connections. The simulator ships with three different "T" adapters that will allow the direct connection of most major brand cuffs without modification to the charge line. The cuff configurations supported in the shipment are those with HP, DATEX or SPACELABS style fittings. The "T" adapter gets connected inline with the cuff in the following manner:

- Long tube connects to the connector labeled "NIBP" under the mannequin's left arm.
- First short tube connects to the NIBP cuff connector.
- Second short tube connects to the NIBP charge line.

To use a standard blood pressure cuff and sphygmomanometer you will need to modify the hose so that the pressure in the cuff line also gets connected to the connector labeled "NIBP" under the mannequin's left arm. The same technique can be used to connect other brand Oscillometric NIBP monitor cuffs. Contact METI customer support for help in this matter.

Note: Wrapping the cuff very tightly around the mannequin's arm will produce the most accurate measurements.

Adjusting ECG Amplitude

ECG Overview

The HPS Cardiovascular System will drive a 5-lead electrocardiogram (ECG). The evoked potentials are emitted from the appropriate positions on the patient's chest for display on a standard patient monitor.

ECG Adjustments

1. Start the HPS program. After the self-test, lung cal and gas analyzer warm-up have been completed, select and start a patient.
2. Hook all five leads of the patient monitor to the contacts on the mannequin's chest.
3. Retrieve the ECG module from the pelvis area of the mannequin. This black box is assessable by lifting the stomach up.
4. Hold the box in your hand with the cable to the left and the four access holes facing up.
5. Insert a small screwdriver or "tweaker" in the left access hole and onto the potentiometer. Rotate the pot in a clockwise direction 20 complete turns. Then turn the pot back five complete turns.
6. Repeat step 5. For the three remaining potentiometers.
7. The waveforms are typically set for a 1-mV peak. The potentiometer on the far left will fine-tune the Lead V amplitude and the potentiometer on the far right will fine-tune the lead II amplitude. Turning the potentiometers counterclockwise will increase the waveform amplitude.

HPS Maintenance

Facility Maintenance

Electrical Power

The HPS requires a source of electrical power as specified below. It is configured to be compatible with a variety of local power specifications around the world. This configuration is accomplished by means of step down transformers integrated into the equipment rack. The requirements for standard HPS configurations are as follows:

One electrical power outlet rated at:

- Voltage Rating - 115 (+/- 10%) Volts AC
- Frequency - 60Hz.
- Power - 450 Watts
- Current Rating - 15 Amp

Or

One electrical power outlet rated at:

- Voltage Rating – 220/240 Volts AC
- Frequency – 50 Hz.
- Power - 450 Watts
- Current Rating - 15 Amp

Contact METI if any doubt exists concerning the configuration of a particular HPS system.

Note that the HPS system includes a power supply and various power converters which may fail to operate properly if input power to the HPS equipment rack does not meet specifications. Specifically, insufficient supply voltage may lead to failure of power converters and supplies to support sub-assemblies. The electrical power supplied to the HPS should be routinely checked to insure compliance with these specifications.

Note that the HPS is protected from electrical faults in a number of ways. The power entry module is protected by fuses as follows:

- 115 Volt Configuration – 8 Amp slow blow fuse
- 220/240 Volt Configuration – 4 Amp slow blow fuse

The main power supply implements short circuit and over voltage protection. In addition many sub-systems are protected by fuses. Contact METI for details regarding particular sub-systems.

Air and Gas Supplies

The HPS consumes oxygen, produces carbon dioxide, and physically uptake/eliminates anesthetic gases and vapors. To maintain a realistic alveolar gas mixture, **oxygen, carbon dioxide, nitrogen, and nitrous oxide** (for anesthesia models) are required. **Compressed air** is also required to drive the pneumatics mechanisms, such as palpable pulses and spontaneous breathing.

The air and gas supplies should be maintained as follows:

- Purity – Medical Grade gases are recommended but not required. Industrial grade gas supplies are sufficient.
- Pressure – 50 PSI +/-5 PSI
- Flow – Supplies or regulators supporting peak flows of 15 lpm are recommended.
- Filter – A standard industrial 10 micron filter should be used with all gas supplies of uncertain cleanliness. Industrial or Medical compressed supplies are usually sufficiently clean so as to require no filtering.
- Water Vapor and Condensation – Gases supplied to the HPS should be both clean and dry. Insufficiently dry gas supplies can cause condensation in HPS pneumatic lines and subsequently damage sensitive components. METI recommends using water traps on any questionable gas supplies.

The gas supplies should be examined regularly to ensure that the requirements outlined above are satisfied.

Ventilation

While the power consumption of the HPS equipment rack is minimal and the HPS equipment rack is well ventilated by fans mounted in the top of the rack, METI recommends that the base of the rack be kept clear of obstructions that may hinder the inflow of air. The following guidelines will insure proper ventilation:

- Keep the base of the equipment rack free of obstruction, such as OR drapes, which may prevent inflow.
- Do not purposefully block fan exhaust, at the top of the rack, or occlude inflow, at the base of the rack in attempts to quiet equipment noise.
- Do not purposefully unplug fans in an attempt to quiet equipment noise.
- To ensure proper flow of air to all components, particularly at the bottom of the rack, access panels should generally remain in place during operation.

Equipment Maintenance

Routine maintenance of the HPS is minimal. Performing the steps outlined below will ensure proper operation of the HPS system.

Checking the Airway

The HPS is equipped with an anatomically accurate airway, which supports airway management training and practice of difficult airway recovery techniques. In the process of performing these techniques improperly or aggressively, the upper airway can be damaged. While such damage may be readily apparent (manifest as breathing circuit leaks) during mechanical ventilation, it may not be obvious during spontaneous or bag and mask ventilation. As such, occasional visual inspection of the airway is recommended. Using the light of a laryngoscope blade or a flashlight, visually examine both the upper and lower airway. While tears in the upper airway resulting from intubation may be obvious, needle holes in the lower bronchus resulting from techniques such as transtracheal jet ventilation may not be readily apparent.

If damage to the airway is found, consult the section *Repairing Cuts and Abrasions to the Mannequin* below or consult METI.

Adjusting Laryngospasm

The HPS is equipped with a mechanism that occludes the airway by compressing the vocal cords thereby presenting laryngospasm. This mechanism is mounted inside the mannequin's neck and is attached to the outside of the airway by a flexible beryllium copper plate. Occasionally, this plate will become mis-aligned as a result of vigorous laryngoscopy. Such mis-alignment will be manifest through incomplete closure of the vocal cords during laryngospasm.

If this occurs, or occasionally as desired, the laryngospasm plate mentioned above should be adjusted. To do so, perform the following steps:

1. Unhook the chest skin flaps securing the chest skin to the shoulders of the mannequin.
2. Fold the chest skin back over the chest
3. Remove the neck skin by parting the velcro closure at the back of the neck.
4. Fold the skin of the neck upwards accessing the inner workings of the mannequin's neck.
5. Locate the brass colored plate mentioned above.
6. Note the crichothyroid cartilage and the trapezoidal cut out in the laryngospasm plate.
7. Adjust the position of the plate such that the crichothyroid cartilage is aligned with the cut out and protruding slightly through.
8. Replace the skin of the neck, tucking it in place between the mannequin's neck and shoulders.
9. Replace and secure the neck skin covering the oval opening in the mannequin's neck.
10. Secure the chest skin in its original position.

Setting the Manual Pressure Regulator

The compressed air supply connected to the HPS equipment rack provides a source of pneumatic power at two pressures. First, the inlet pressure is used to drive some mechanisms at 50 +/- 5 PSI as specified above. Second, the supply pressure is regulated to provide a backpressure to the cylinders driving the bellows of the HPS's mechanical lung. Regulation of the supply pressure to the second backpressure is accomplished by a manual pressure regulator located on the I/O panel at the rear of the HPS equipment rack. The backpressure should be adjusted to 25 PSI. To adjust this pressure, follow the steps outlined below:

1. Locate the I/O panel on the rear of the HPS equipment rack.
2. Identify the Manual Pressure Regulator Gauge on the rear I/O Panel. This is the only dial gauge on the panel.
3. Note the pressure indicated by the gauge. The pressure should be 25 PSI.
4. If the pressure is not 25 PSI, locate the regulator next to the gauge. The regulator has a hand wheel/knob attached to it.
5. Adjust the regulator until the gauge reads 25 PSI. Note that it may be easiest to approach the pressure from below 25 PSI.

Maintaining Trauma Features

In order to insure that the Trauma Features function properly during subsequent simulator sessions, they must be drained and flushed after each session.

Chest Tube

To drain and flush the chest tube trauma feature perform the following steps:

1. Remove the chest tube if it has not been removed already
2. Unfasten the upper body skin from the four hooks securing it at the shoulders by pulling the skin down and away from the mannequin.
3. Turn the mannequin over onto its left side and unzip the back.
4. Fold back the skin on the right side of the chest to reveal the chest tube drainage assembly.
5. Remove the four screws securing the plastic guide along with the guide and underlying skin. The chest tube drainage orifice should now be exposed.
6. Insert one end of the 1/4" id tube used to prime the feature (refer to the Operator's Manual for details) and place the other end in a receptacle.
7. Replace the Trauma IV bag with one filled with distilled water.
8. From the *System Options* window, select *Chest Tube* and *Prime*.
9. Flush the system with the distilled water.
10. Locate the trauma features drainage tube included with the HPS and attach it to the Chest Tube Drain fitting located in the mannequin's belly.
11. From the *System Options* window, select *PericardioCentesis & Chest Tube Disabled* and *Not Priming*. Using a syringe, force air through the system until no water is observed exiting the 1/4" id tube.
12. Re-assemble the chest tube drainage assembly components and replace the chest skin.

Warning: It is imperative that the system be cleaned in the prescribed way to prevent damage to the flowmeter!

Pericardiocentesis

To drain and flush the pericardiocentesis trauma feature perform the following steps:

1. Unfasten the upper body skin from the four hooks securing it at the shoulders by pulling the skin down and away from the mannequin.
2. Turn the mannequin over onto its left side and unzip the back.
3. Fold back the skin to reveal the pericardiocentesis assembly in the center of the mannequin's chest.
4. Remove the four screws securing the plastic guide along with the guide and underlying skin. The pericardiocentesis orifice should now be exposed.
5. Insert one end of the 1/8" id tube used to prime the feature (refer to the Operator's Manual for details) and place the other end in a receptacle.
6. Replace the Trauma IV bag with one filled with distilled water.
7. From the *System Options* window, select *Pericardiocentesis* and *Prime*.
8. Flush the system with the distilled water.
9. Locate the trauma features drainage tube included with the HPS and attach it to the *Pericardiocentesis Drain* fitting located in the mannequin's belly.
10. From the *System Options* window, select *PericardioCentesis & Chest Tube Disabled* and *Not Priming*.
11. Using a syringe, force air through the system until no water is observed exiting the 1/8" id tube.
12. Re-assemble the pericardiocentesis assembly components and replace the chest skin.

Warning: It is imperative that the system be cleaned in the prescribed way to prevent damage to the flowmeter!

Tension Pneumothorax

The tension pneumothorax trauma feature does not require maintenance or cleaning to insure proper function.

Maintaining Drug Recognition Flowmeters

After using the Drug Recognition System in a simulator exercise, it must be flushed and purged. Complete the following steps to ensure proper performance of the system during subsequent simulator exercises:

1) If distilled water was not used during the simulation exercise, flush the system with at least 1-liter of distilled water.
   a) Place the IV reservoir from the rear of the HPS equipment rack on the floor.
   b) Replace the IV supply with a 1-liter IV bag of distilled water. Prime the bulb of the IV stake and ensure that flow has started.
   c) While the distilled water is flushing the main access port, flush the unused access ports with a single 30-cc syringe of distilled water each. Make certain that the check valves and caps are in place upon completion.
   d) Run the IV supply of distilled water until the bag is empty.
2) Close the clamps on both the IV supply and reservoir.
3) Remove the IV bags from the stake sets and drain them appropriately.
4) Place the stake previously connected to the IV reservoir into an appropriate receptacle and open the clamp.
5) With a large syringe, flush the system with air (as though dispensing a bolus of air) until no water remains in the system.
6) The empty IV bags can be replaced in the system or stored appropriately.

Warning: It is imperative that the system be cleaned in the prescribed way to prevent damage to the flowmeter!

To prevent mold, mildew and fungus from fouling the Drug Recognition System, it should occasionally be flushed with a 1 liter IV bag of distilled water mixed with a few drops of bleach. Follow the procedure outlined above for flushing the system first using the bleach solution. Repeat the procedure using distilled water only. The system should be cleaned in this way about once in 2 months or as appropriate.

Warning: It is imperative that the system be cleaned in the prescribed way to prevent damage to the flowmeter!

While the barcode labels are waterproof, they will eventually become worn. Their life will be extended if they are kept as dry as possible. Contact METI for replacements or for information on printing the labels.

Maintaining the G/U System

After using the Genitourinary System in a simulator exercise, it must be flushed and purged. Complete the following steps to ensure proper performance of the system during subsequent simulator exercises:

1) If distilled water was not used during the simulation exercise, flush the system with at least 1-liter of distilled water.
   a) Replace the G/U supply IV bag with a 1 liter IV bag of distilled water. Prime the bulb of the IV stake and ensure that flow has started.
   b) Run the IV supply of distilled water until the bag is empty.
   c) Close the clamp on the G/U supply IV bag.
2) Remove the IV bag from the stake set and disconnect the stake set from the G/U fitting on the mannequin umbilical.
3) Drain both appropriately.
4) With a large syringe connected to the G/U fitting of the mannequin umbilical, flush the system with air (as though dispensing a bolus of air) until no water remains in the system.
5) Disconnect and drain the urine collection bag.
6) The empty IV bag can be replaced in the system or stored appropriately.
7) The Foley catheter and urine collection bag can be left in place or removed as desired.

To prevent mold, mildew and fungus from fouling the Genitourinary System, it should occasionally be flushed with a 1 liter IV bag of distilled water mixed with a few drops of bleach. Follow the procedure outlined above for flushing the system first using the bleach solution. Repeat the procedure using distilled water only. The system should be cleaned in this way about once in 2 months or as appropriate.

Colorings can be added to the G/U fluid supply without damaging the system so long as the system is flushed according to the above procedure.

It may be difficult to insert the Foley catheter. Make certain that silicone lubricant is used amply. If the difficulty persists, follow the steps outlined below (refer to the Using the Genital Urinary System section of the Operator's Manual as required):

- Remove the mannequin's "belly" and locate the genitalia.
- Remove the genitalia.
- Unthread the bladder and the threaded connector from the genitals.
- Locate the thin rubber webs, which create a low pressure seal on the inside of the threaded connector. There is one web at each end of the connector.
- Attempt to insert the Foley catheter through the threaded connector.
- If catheter insertion remains difficult, increase the length of the slits in the webs using a small knife blade (an "exacto" knife works well).
- Re-assemble and replace the genitalia.

Maintaining the Anesthesia Delivery System

The Anesthesia Delivery System requires no routine maintenance other then general cleaning of the syringe and needle after use. For additional information refer to the HPS Operator's Manual.

Repairing Cuts and Abrasions to the Mannequin

Cuts and abrasions to the HPS mannequin can be repaired easily using readily available materials. Perform the following steps if a cut is found:

- Clean the area around the cut thoroughly using alcohol swabs or liquid alcohol and cotton balls
- Allow the area to dry completely
- Apply a small bead of Superglue or other cyanoacrylate adhesive to the surfaces to be repaired.
- Wipe any excess glue away with a cotton swab.
- Firmly press the surfaces together taking great care not to touch the wetted areas.

The following tips may be useful in the procedure above.

- The repaired area may be gently "sanded" using a fine grit paper.
- A patch may be formed from the "skin" used to cover the crichothyroid cartilage to cover large cuts.
- Latex gloves are recommended to prevent inadvertent adhesion of skin.

Contact METI to effect permanent repair of damaged mannequins.

Cleaning the HPS Mannequin

METI recommends using alcohol and/or a citrus-based solvent to clean the mannequins.

Troubleshooting

While the HPS has been conceived, designed and manufactured with dedication to problem-free, reliable ease of use, it is nonetheless a complex and sophisticated simulation system. As such, it is METI's expectation that complications in the Human Patient Simulator's application and use will, occasionally, be encountered. This section will assist proficient HPS users to identify, troubleshoot and repair problems potentially encountered in operating the HPS.

METI encourages customers to avail themselves of its Customer Support and Applications Engineering Services whenever need arises. Please contact METI to report any concerns or problems regardless of their having been resolved without METI's direct assistance.

General

The following are recommended as preliminary steps to be undertaken when problems in proper operation and function of the HPS are encountered. If the HPS fails to operate as expected perform the following steps in accordance with context of the simulation and the judgement of the instructor:

1) Stop the current patient and scenario
2) Start the patient Standard Man Version 1.2
3) Assess the performance of Standard Man Version 1.2 with regard to documented clinical signs (refer to the Patient Profiles section of the Operator's Manual as required). This step is intended to establish conditions with which the operator, as well as METI technicians, are intimately familiar.
4) Repeat the actions that previously lead to the system's failure to perform as expected and assess the system's performance. This step is intended to recreate the events leading to failure under known conditions.
5) If the failure recurs, perform the following steps:
   a) Stop the current simulation.
   b) Quit the HPS software.
   c) Turn off the HPS System.
   d) Check the HPS installation for abnormalities
      i) Check gas supplies
      ii) Check Power Connections
      iii) Check Signal Connections at the HPS equipment rack's rear I/O panel.
      iv) Check relevant Clinical Monitoring Equipment
   e) Correct any problems observed above making sure that any disconnected signal and power connections are not re-established with the HPS system power on. For example, under no circumstances should connections within the HPS mannequin be re-established while power is on.
   f) Repeat the HPS Power On Procedure and proceed accordingly
   g) Refer to the specific sections below or contact METI as required.
6) If the failure does not recur, repeat the exact conditions, as accurately as possible, leading to failure and perform steps 5-a through 5-g.

Re-setting an HPS System Circuit Card

Occasionally, the hardware or software controlling an HPS system circuit card will stop functioning properly. For example, if a particular HPS feature will not respond to commands from the user interface, the circuit card controlling that function may have failed. In order to recover from such a failure, the circuit card can be re-set. Re-setting a circuit card is similar to re-booting a PC when, for example, a Windows application fails to respond. Note that the circuit cards are re-set each time the system is powered on. The procedure below presumes that the HPS is powered on and that the circuit card in question fails to execute a command from the user interface. Other sections in this document will assist in determining when re-setting a circuit card is appropriate. To re-set a circuit card, perform the following steps:

1) Open the front smoked glass door of the HPS equipment rack.

2) Open the panel at the top of the rack. This panel encloses the Circuit Card Cage in which circuit cards are located. The panel is secured with thumbscrews at the top corners and is hinged at the bottom.
3) Locate the appropriate circuit card. For assistance, refer to specific troubleshooting sections and the system block diagrams appended to this manual.
4) Locate the re-set button on the circuit card. All of the re-set buttons are in the same relative position on each circuit cards. The re-set button is small, round and black. It is the only button on any circuit card.
5) Momentarily depress the re-set button (as though pressing a doorbell).

Locating an HPS System Circuit Card

Occasionally in the troubleshooting process this document will instruct the user to locate a circuit card in order to observe LEDs or re-set the circuit card. To locate and identify a circuit card, access the Circuit Card Cage as described above and refer to the following or the labels on the inside on the card cage access panel. Note that circuit cards are numbered sequentially from left to right.

A1 - Monitor Interface
A2 - Heart Sounds
A3 - Breath Sounds
A4 - SPO2/PA Catheter
A5 - Drug Recognition
A6 – Actuator (Pulses)
A7 – Twitcher /G/U
A8 - Trauma (ATOS)
A9 - Eyesigns (ICU)
A10 – Stepper Motor Driver

Ventilator/Breathing Circuit Leaks

Ventilator and breathing circuit leaks may be encountered during simulator operations and may result from a wide variety of causes. Leaks will be most readily noticed during mechanical ventilation when, for example, the ventilator bellows does not return to baseline or a high fresh gas flow is required. To locate and address suspected leaks, perform the following steps:

1) If necessary, power on the HPS and begin Standard Man Version 1.2 normally.
2) Set the parameter *Fixed Neuromuscular Blockade* to 100%
3) Insure that the endotracheal tube cuff is intact.
4) Intubate the mannequin
5) Ensure that the endotracheal tube cuff is properly inflated.
6) Perform mechanical ventilation normally
7) If the leak persists:
   a) Check the breathing circuit and ventilator/Anesthesia machine.
   b) If the leak persists, suspect damage to the lower airway. Remove the ET tube and inspect as described in the maintenance section of this document. If a lower airway leak is discovered, repair as described in the Maintenance section of this document or contact METI.
   c) If the leak persists, contact METI.
8) If the leak is not observed continue as follows:
9) Remove the ET tube
10) Mechanically ventilate using a mask while insuring a good seal. Note that a mask with a contoured inflatable seal performs best.
11) If a leak persists, suspect an upper airway leak:
   a) Inspect the upper airway as described in the maintenance section of this document. If damage to the upper airway is discovered, repair as described in the Maintenance section of this document or contact METI.
   b) If no obvious damage is observed, contact METI.

Lung Calibration

The HPS system performs a calibration of the lung each time the system is powered on or at the discretion of the user. The calibration can be performed through the System Options window at any time that a patient is not running. To troubleshoot problems with the lung calibration, perform the following steps:

1) Confirm that the compressed air supply is properly connected to the HPS equipment Rack's rear I/O panel.
2) Confirm that the compressed air supply is open.
3) Confirm that the compressed air supply provides 50 PSI at sufficient peak flow (15 lpm)
4) Confirm that the Manual Pressure Regulator is set at 25 PSI (refer to the section Setting the Manual Pressure Regulator of the Maintenance section of this document).
5) Confirm that there is nothing obstructing the mannequin's airway.
6) Examine the mannequin umbilical cable and confirm that it is not kinked.

The HPS Lung & Control of Breathing

The HPS is provided with a pulmonary system, including both physical and mathematical models, which accomplishes an extremely accurate simulation of respiration. The simulated patient breathes spontaneously with a self-regulated rate and tidal volume sufficient to maintain a target arterial carbon dioxide partial pressure, typically 40mmHg, which can be adjusted by the instructor. The patient's lungs physically consume oxygen, produce carbon dioxide and uptake or excrete nitrous oxide, sevoflurane, isoflurane, enflurane and halothane in accordance with the principles of uptake and distribution. To troubleshoot problems with the HPS control of breathing, respiratory rate and tidal volume, blood gases or alveolar gases, refer to the following outline:

1) Confirm that none of the compressed gas supplies are empty. Absence of any of the required gases will cause the HPS to perform improperly.
2) Confirm that the gas supplies are open.
3) Confirm that the gas supplies are regulated to 50 PSI.
4) Confirm that the Manual Pressure Regulator is set at 25 PSI (refer to the section Setting the Manual Pressure Regulator of the Maintenance section of this document).
5) Confirm that the gas supplies are properly connected at the rear I/O panel of the HPS equipment rack. If any of the gases are connected to the wrong fitting, the HPS will not perform properly.
6) Remove the mannequin's abdomen.
7) Locate the connection labeled "MFC in" and confirm that it is secure.
8) Locate two connections labeled "Gas Sample" and confirm that each is secure.
9) Re-assemble the abdomen.
10) Open the HPS equipment rack rear access panel and confirm that the vane pump is connected and running. The vane pump is located under the shelf upon which the HPS PC sits and is a metal cylinder with two black plastic "caps", one at each end. Four tubes, two at each end, are connected to the vane pump. If the vane pump is not running, contact METI. Close the access panel.
11) Open the HPS' left and right side panels. They are secured by a single screw, at the top center of the panel and two pins in the lower corners.
12) Locate the gas analyzer. The gas analyzer is located directly behind the Circuit Card Cage.
13) Confirm that the electrical connection leading to the analyzer is secure.
14) Confirm that the gas sample line, a short length of napheon tubing, is connected to the gas analyzer and connected to a "tee" fitting at the other end.
15) Quit the HPS software.
16) Re-start the HPS software and perform the power on procedure.
17) View the Device Status window and note the gas analyzer status. If , after the warm up period (about two minutes) the status displays "??", contact METI.
18) If the Device Status window displays "OK", continue the power on procedure and begin Standard Man.
19) Contact METI.

The HPS Lung and Airway Pressures

If the HPS system manifests abnormal respiratory mechanics, such as unexpectedly elevated airway pressures, abnormal compliance, difficulty bag/mask ventilating, etc., perform the following steps:

1) Confirm that the compressed air supply is not empty.
2) Confirm that the air supply is open.
3) Confirm that the air supply is regulated to 50 PSI.
4) Confirm that the Manual Pressure Regulator is set at 25 PSI (refer to the section Setting the Manual Pressure Regulator of the Maintenance section of this document).
5) Confirm that the air supply is properly connected at the rear I/O panel of the HPS equipment rack.
6) Confirm that nothing is exerting pressure on the mannequin's chest.
7) Confirm that none of the difficult airway features including the Airway Occluder, Bronchial Resistances and Laryngospasm are activated via the user interface (refer to the User's manual for details). Visually verify this as well.
8) Confirm that compliances are set to the normal values.
9) Confirm that the mannequin's airway is not obstructed.
10) Re-set the Actuator and Trauma Features circuit cards (Refer to the Re-setting HPS System Circuit Cards above as required)
11) Re-start Standard Man Version 1.2 and assess the system performance.
12) If the problem persists quit the HPS software and power off the HPS system.
13) Perform the power on procedure normally and note the Actuator and Trauma circuit card status in the Device Status window.
14) If the status of either circuit card is "??", contact METI.
15) If the status is "OK", start Standard Man Version 1.2 and evaluate the systems performance.

The HPS Patient Fails to Desaturate Appropriately

If during the course of a simulation, the patient's condition is such that desaturation should occur but does not, refer to the following outline:

1) Exit the current simulation and begin the patient Standard Man Version 1.2.
2) Set the parameter Fixed Neuromuscular Blockade to 100%.
3) Re-set the SPO2 circuit card (refer to the section Re-setting an HPSA System Circuit Card above as required).
4) Observe the SPO2 and PaO2. If desaturation proceeds, attempt to recreate the conditions under which the failure occurred and re-test. Contact METI.
5) If desaturation does not proceed continue as follows.
6) Perform the checks outlined in the section The HPS Lung and Airway Pressures above. Noting the status of the SPO2 circuit card rather than others. If the SPO2 circuit card status is "??" after re-booting, contact METI.
7) Perform the checks outlined in the section The HPS Lung & Control of Breathing above. Noting the status of the SPO2 circuit card in addition. . If the SPO2 circuit card status is "??" after re-booting, contact METI.
8) After re-booting the HPS software appropriately, begin the patient Standard Man Version 1.2.
9) Open the glass door at the front of the equipment rack.
10) Observe the Pulse Oximeter Stimulator Display at the lower right of the equipment racks front panel.
11) Note the displayed SPO2 value and compare it to that displayed in the Vital Signs Monitor of the user interface. If these are not equal or another problem is apparent with the LCD display, contact METI.

The Anesthesia Delivery System

In order to control the direct exchange of anesthetic vapor in the HPS' lung, a supply of anesthetic is controlled just as analogous supplies of oxygen and carbon dioxide are controlled to create oxygen consumption and carbon dioxide production. The Anesthesia Delivery System supports this function. To troubleshoot problems with the delivery of anesthetic to the simulated patient regarding the Anesthesia Delivery System, refer to the outline below:

1) Review the section Delivering Anesthesia to the Simulated Patient of the HPS User's Manual and confirm proper set-up.
2) Start the HPS software and observe the Device Status window. Note the Status of the Isoflurane Syringe Pump (either "OK" or "??").
3) If the status is "??" perform the following tasks
   a) Open the left side panel of the HPS equipment rack. It is secured by a single screw, at the top center of the panel and two pins in the lower corners.
   b) Examine the Isoflurane Syringe Pump. Confirm that the power connector and signal connector are plugged in and secure.
   c) Confirm that the power switch at the back of the pump is on.
4) Repeat from step two if any discrepancies are located.
5) Begin the patient Standard Man Version 1.2 appropriately.
6) If the status is "OK", evaluate the operation of the Anesthesia Delivery System.
7) If the system does not perform correctly, contact METI.

The Drug Recognition System

The HPS Pharmacology and Drug Recognition Systems facilitate administration of IV Drugs and Anesthetic Agents in clinically, physiologically and pharmacologically realistic simulations through sophisticated mathematical models and tight integration of cardiovascular, respiratory and pharmacology systems. The pharmacology module contains pre-programmed pharmacokinetic and pharmacodynamic parameters for over fifty (50) intravenous medications. The Drug Recognition System utilizes barcode technology to identify the drug and its respective concentration and a flowmeter to quantify the dosage given by the trainee. To troubleshoot problems with the Drug Recognition System perform the following steps:

1) Review the Using the Drug Recognition Section of the HPS User's Manual and confirm proper set-up.
2) Confirm that the reservoir collecting the dispensed drug recognition fluid is not full.
3) Confirm that the clamps on the IV bags are open.
4) Observe the Drug Recognition status displayed in the Device Status window. If the status is "??", re-set the Drug Recognition circuit card (refer to the section Re-setting an HPSA System Circuit Card above as required).
5) Re-test the Drug Recognition System.
6) If the system does not operate properly, exit the HPS software.
7) Re-start the software to perform the power on self test.
8) Observe the Drug Recognition status. If the status is "??", contact METI.
9) If the status is "OK", re-test the Drug Recognition System.
10) If the system does not operate properly, contact METI.

Heart and Breath Sounds

The HPS mannequin is instrumented to recreate heart and breath sounds played through small speakers. If heart or breath sounds do not function properly, follow the steps outlined below:

1) If the sounds are inaudible:
   a) Adjust volume of the appropriate sounds according to the section Adjusting the Heart and Breath Sounds in the Maintenance section above.
   b) Unfasten the upper body skin from the four hooks securing it at the shoulders by pulling the skin down and away from the mannequin.
   c) Turn the mannequin over onto its left side and unzip the back.
   d) Remove the Chest Skin.
   e) Inspect the speakers for broken wires.
   f) If wires are broken, repair with standard soldering tools or contact METI.
   g) If wires are not broken, continue:
   h) Re-assemble the Chest Skin.

i) If the sound remains inaudible, continue:
j) Remove the mannequin's abdomen.
k) Locate the connection labeled Heart/Breath and confirm its integrity.
l) Contact METI.

2) If the sounds cannot be controlled from the user interface:
   a) Check the Heart or Breath Sounds status in the Device Status window.
   b) If the status is "??", re-set the appropriate circuit card.
   c) Re-evaluate the sound in question.
   d) If the sound cannot be controlled, exit the HPS software.
   e) Re-start the HPS software, if the sound card status remains "??", contact METI.
   f) Otherwise, re-evaluate the sound in question. If the sound cannot be controlled, contact METI.

The G\U System

The HPS Genitourinary System (G/U) provides for excretion of urine, with a flow rate that is controlled by the instructor or automatically by the scenario. The flow rate is controllable from either the main system PC console or the instructor's handheld remote control. In addition, the mannequin, provided with both male and female genitalia, allows for the insertion of urinary catheters. For a complete description of the system, refer to the Using the G/U System section of the User's Manual.
If the G/U System fails to function properly, perform the following steps:

1) Review the G/U system set-up procedure as described in the User's Manual and confirm proper set-up.
2) If the pump operates when a flow rate is set but fluid does not flow:
   a) Confirm that the clamp on the supply IV bag is open.
   b) Confirm that the peristaltic tubing is placed in the pump head such that the direction of rotation of the cam pushes fluid from the supply IV bag to the mannequin umbilical tubing and mannequin.
   c) Confirm that a foley catheter is properly inserted and that the cuff is properly inflated with water. If the catheter is difficult to insert, refer to the HPS User's Manual for instructions.
3) If the pump fails to operate when a flow rate is set:
   a) Locate and re-set the Twitcher circuit card (refer to the Locating an HPS System Circuit Card and Re-setting an HPS System Circuit Card sections above).
   b) Re-test the G/U system
4) Contact METI

Patient Voice

The HPS is equipped with a small wireless microphone, a receiver and a speaker in the mannequin's head, which allows a customer to speak as the simulated patient during situational simulations. Perform the following steps to trouble shoot the Patient Voice Option:

1) Locate the wireless microphone:
   a) Confirm that the switch is set to the "on" position.
   b) Remove the battery cover and battery. Confirm that the battery is charged.
   c) Locate the channel selector switch inside the battery compartment.
   d) Confirm that the channel selector switch is set for "H."
2) Locate the Receiver Module on the top of the HPS equipment rack:
   a) Confirm that the signal and power connectors are plugged into the module.
   b) Open the rear access panel of the HPS equipment rack and confirm that the power converter for the module is plugged in securely.
   c) Confirm that the power is on as indicated by the depressed power radio button and LED.
   d) Confirm that the volume is set to about mid-range.
   e) Confirm that the channel selector switch is set to "H." The channel selector switch is on the back of the receiver module.
3) Check the integrity of the patient Voice speaker.

a) Unhook the chest skin flaps securing the chest skin to the shoulders of the mannequin.
b) Fold the chest skin back over the chest
c) Remove the neck skin by parting the velcro closure at the back of the neck.
d) Fold the skin of the neck upwards accessing the inner workings of the mannequin's neck.
e) Identify the speaker located under the cricothyroid membrane and confirm that it is undamaged.
f) Re-assemble the mannequin's neck and chest skin.

4) Remove the mannequin's abdomen.
5) Locate the connection labeled "Voice" and confirm its integrity.
6) Locate the Heart Sounds (A2) circuit card (refer to the Locating an HPS System Circuit Card section of this document).
7) Locate the Patient Voice potentiometer (marked R12 on the circuit card and Patient Voice on the access panel label) on the front edge of the Heart Sounds circuit card.
8) Confirm that the volume is set to maximum by turning the potentiometer 20 turns clockwise. A small flat blade screwdriver or "tweaker" will be required.
9) Contact METI.

If the speaker volume cannot be adjusted with sufficient amplitude, contact METI.

Invasive Blood Pressures & Cardiac Output

The HPS stimulates unmodified clinical equipment such as physiologic monitors to display hemodynamic waveforms such as Arterial Blood Pressure, Central Venous Pressure and Pulmonary Artery Pressure. To troubleshoot difficulties displaying these waveforms, follow the outline below:

1) Confirm that the patient cables are properly connected to the clinical monitor.
2) Confirm that the clinical monitor is functioning properly.
3) Confirm that the patient cables are connected to the HPS monitor interface cable. These connections are made via phone jacks.
4) Confirm that the monitor interface cable is connected to the I/O panel at the back of the HPS equipment rack. The connector is labeled Monitor Interface.
5) Calibrate the HPS according to the section Calibrating the Patient Monitor above.

Water Leaks

If water is observed to be leaking or flowing from inappropriate locations of the HPS mannequin or equipment rack, perform the following steps:

1) Immediately stop the current simulation.
2) Turn off power to the HPS equipment rack. This will close any internal valves inadvertently left open.
3) Close the clamps on the IV bags associated with the HPS trauma features, drug recognition system and G/U system.
4) Disconnect the power from the rear panel of the rack.
5) Shut off and remove power from nearby equipment in accordance with sound judgement.
6) Review the proper set-up for the HPS trauma features, drug recognition system and G/U system and insure that these systems are set-up appropriately. Refer to the HPS Operator's Manual as necessary.
7) Remove the "abdomen" of the HPS mannequin.
8) Locate the connections listed below and confirm that each is secure:
   a) Drug Rec In
   b) Pericardio In
   c) Chest Tube In
   d) G/U
9) Confirm that the genitalia is assembled as described in the Using the G/U System section of the HPS Operator's Manual.
10) Remove the chest skin from the tabs securing it to the shoulders of the HPS mannequin.

11) Fold the chest skin down over the mannequin's chest and lift the chest plate underneath.
12) Examine the Chest Tube Feature's internal assembly. This is a _" OD section of soft latex tubing connected to the external chest tube fitting (refer to the Operator's Manual Trauma Features section as required) at one end and a section of hard brass tubing as well as fine gauge tygon tubing at the other.
13) Examine the Pericardiocentesis' Feature's internal assembly. This is a 5/8" OD section of semi-rigid tubing connected to the pericadiocentesis external assembly fitting (refer to the Operator's Manual Trauma Features section as required) at one end and a section of fine gauge tygon tubing at the other. Note that the semi-rigid tubing has two sensors attached to it, which are blue/green in color.
14) Soak up the water appropriately. Allow the mannequin to dry in accordance with sound judgement
15) Contact METI if no apparent source of the leak was observed or if permanent damage is suspected.

The Instructor's Remote PC

One of the optional components of the Human Patient Simulator is the Instructor's Remote PC, a pen-based computer. The Remote PC's light weight, portability, and full-size screen give the instructor the ability to control a simulation without having to interact with the instructor's console. Perform the following procedure to troubleshoot the Instructor's Remote PC:

1) Confirm that the Remote PC is securely plugged in to the rear I/O panel of the HPS equipment rack. The connector on the panel is clearly labeled.
2) Confirm that the remote PC cable is securely plugged in to the Remote PC.
3) Quit the HPS software on the HPS console.
4) Restart the HPS software on the main console in order to execute the power on self-test. Refer to the Power on Procedure section of the User's Manual for details.
5) Observe the Test Devices window and note the status of the Instructor's Remote PC. If the status is failed, indicated by "??", contact METI.
6) Refer to the Using the Instructor's Remote PC section HPS User's Manual to repeat and confirm that the power on procedure is followed properly.
7) Contact METI

Chest Excursion

The mannequin's chest excursions are synchronized with underlying respirations and are proportional to the tidal volume of the underlying lungs. If the mannequin's chest excursion fails to function properly, perform the following steps:

1) Remove the chest skin from the tabs securing it to the shoulders of the HPS mannequin.
2) Fold the chest skin down over the mannequin's chest and lift the chest plate underneath.
3) If necessary, power on the HPS and begin Standard Man Version 1.2 normally.
4) Confirm that the chest excursion pistons (silver colored pneumatic pistons located inside the mannequin's shoulders) contact the plates attached to the underside of the chest plate throughout each respiration. If this is not the case, adjust the pistons to do so as possible. Contact METI.
5) Confirm that the same pistons are oriented vertically and are secured by plastic bands. If this is not the case, adjust the pistons to do so to the extent possible. Contact METI.
6) Place the tip of one index finger on the top of each piston's shaft. Confirm that the forces applied by the shafts are approximately equal. If this is not the case, contact METI.
7) Remove the mannequin's abdomen.

Contact METI if these steps do not resolve the problem.

No Gastric Distension upon Esophageal Intubation

If the HPS abdomen fails to distend upon esophageal intubation, perform the following steps:

1. Remove the mannequin's abdomen.
2. Confirm that the tube leading into the underside of the abdomen is secure.
3. Confirm that the tubing attached to the mannequin at one end is attached to a small semi-transparent valve at the other end.
4. Confirm that the valve is connected to a similar tube running towards the mannequin' upper torso.
5. Confirm that all tubing described is undamaged. Contact METI if otherwise.
6. Replace the mannequin's abdomen
7. Remove the chest skin from the tabs securing it to the shoulders of the HPS mannequin.
8. Fold the chest skin down over the mannequin's chest and lift the chest plate underneath.
9. Confirm that the tube running from the mannequin's abdomen is secured to the mannequin's esophagus.
10. Confirm that the tube described is undamaged. Contact METI if otherwise.

Contact METI if these steps fail to resolve the problem.

Appendix Q: CTPS Scenario

CTPS Phase 4 Demonstration Scenario: Ft. Gordon, Georgia

OVERVIEW OF THE SCENARIO

Twelve soldiers were enroute to their garrison in two HUMMVs. They were driving on a dirt road when the lead vehicle ran over a mine. The explosion flipped the vehicle over killing two of the six occupants instantly. The other four survived the initial blast but were seriously injured. The trailing vehicle immediately pulled to the side of the road and its six occupants dismounted and rushed to render assistance. Immediately after dismounting, they began to take fire from a sniper concealed in the brush adjacent to the road.

One of the members from the trailing vehicle was hit by the snipers first shot. Two others began returning fire while a fourth radioed for assistance and the remaining two (one a medic) began attending to the injured soldiers. The exchange of gunfire lasted less than five minutes before the sniper was killed. In that short time he was able to inflict two gunshot wounds, raising the number of injured soldiers to six.

CASUALTY DESCRIPTIONS

Blunt Abdominal Injury (ruptured spleen)

The soldier riding in the front right seat was unbelted and was thrown out of the HUMMV, landing several yards from vehicle. Upon initial inspection he has a small laceration on his forehead and reports having a sharp pain in his left wrist. He is stoic when talking about his injuries and is very concerned about his fellow soldiers. Initial vitals reveal only a slightly elevated heart rate. With further examination he is tender on the left side of his torso where he apparently struck the ground. Breath sounds are normal. Abdomen is normal.

His underlying injury is a ruptured spleen. As he bleeds into his peritoneal space he becomes increasingly hypovolemic and has rebound tenderness upon examination. Volume replacement has little effect. His only hope for survival is prompt evacuation to a treatment facility with surgical capabilities. Without surgical intervention (splenectomy) this casualty will die in approximately 60 minutes.

Table 1. HPS States – Ruptured Spleen

Baseline	30 seconds then Class I Shock
Class I Shock	450 seconds then Class II Shock
Class II Shock	450 seconds then Class III Shock
Class III Shock	2400 seconds then Class IV Shock
Class IV Shock	Death in approx two minutes
Splenectomy	

This casualty does not respond to volume resuscitation unless splenectomy is done. He transitions to "splenectomy" after arriving at a treatment facility capable of a laporatomy *and* surgical intervention is selected.

Blunt Chest Injury (pericardial tamponade)

The blast arrested the vehicle's forward motion and flipped it over on its top. The driver's chest struck the steering wheel. Upon inspection he has a bruise on his chest over the lower half of the sternum as well as a bruise on his left leg where it stuck the side of the vehicle during the rollover. He complains of soreness where he struck the steering wheel and a sharp localized pain with inspiration. As time progresses he reports the chest pain becoming "sharper" with the pain radiating to his neck. His respiratory rate increases and he has trouble breathing. He is anxious and lightheaded.

The force of the impact of his chest on the steering wheel fractured ribs immediately over his heart. The impact with the heart caused a small bleed into his pericardial sac. As the fluid accumulates his condition becomes more severe eventually leading to unconsciousness. The problem can be managed (temporarily) at any location with staff capable of a pericardiocentesis. (BAS, FST, of CSH). With the pressure in the pericardium relieved, the bleeding stops on its own and does not require surgical correction.

Table 2. HPS States – Pericardial Tamponade

Baseline	60 seconds
Tamponade	1200 seconds
Unconscious	

Closed Head Injury

One of the soldiers riding in the rear of the first HUMMV was thrown against the metal frame of the vehicle. His head struck a metal post creating a small laceration and significant bruising. He suffered a brief loss of consciousness and reports both neck and head pain. After 5 minutes he loses consciousness.

His underlying injury is a cerebral contusion. The intra-cranial pressure increases over the course of the scenario. His best chance of survival is evacuation to a treatment facility with an intensive care unit.

Table 3. HPS States – Closed Head Injury

Baseline	300 seconds
Unconscious	300 seconds
Level I ICP	
Level II ICP	
Level III ICP	

Compound Fracture of the Left Leg (tibia)

One of the four passengers riding in the rear of the HUMMV had his left foot and ankle wedged between two pieces of gear during the rollover while his torso twisted 180 degrees. The twisting of his left leg resulted in a compound, spiral fracture of his tibia. He did not sustain any other injuries. Upon examination he has significant external

bleeding. His heart rate is elevated. His pedal pulse is absent on the left but he is neurologically intact.

The fractured tibia transected the popliteal artery. Without immediate application of a pressure dressing or tourniquet, he progresses through increasingly severe states of hypovolemic shock. Once the bleeding is properly managed, he responds well to volume replacement. Vascular repair is necessary to salvage the leg.

Table 4. HPS States – Compound Fracture of the Left Leg (tibia)

Baseline	30 seconds
Class I Shock	180 seconds
Class II Shock	300 seconds
Class III Shock	300 seconds
Class IV Shock	
Bleeding controlled	
Vascular repair	

Gunshot Wound to the Left Chest

The sniper hit one of the soldiers in the left chest. The bullet entered in the left upper quadrant. The entrance wound is not grossly bleeding. No exit wound is found. Pulse is normal. Diminished breath sounds on the left. He remains conscious and over time begins taking more rapid, shallow breaths and complains of difficulty getting enough air. The rapid breathing is followed by tracheal deviation to the right and jugular venous distension.

The bullet missed his heart and large blood vessels but destroyed a portion of the upper lobe of the left lung leaving a significant opening between several larger bronchioles and the pleural space. Over time intra-thoracic pressure increases causing a tension pneumothorax. Treatment (needle decompression) can be done at any echelon. Once decompressed, the needle kinks or is clotted off with each transfer of the casualty until the needle decompression is replaced with a chest tube.

Table 5. HPS States – Gunshot Wound to the Left Chest

Baseline	30 seconds
Pneumothorax	300 seconds
Tension Pneumothorax	
Needle Decompression	

Gunshot wound to the Right Thigh (Femoral artery bleed)

The sniper's first bullet hit one of the soldiers in the left upper thigh. The entrance wound located in the high anterior-medial portion the midline is bleeding profusely. An exit wound is found on the mid-portion of the left gluteus. Popliteal and pedal pulses are absent in the injured leg. The solider is initially coherent but becomes confused then loses consciousness as he becomes increasing hypotensive.

The bullet clipped the femoral artery. Direct pressure, a pressure dressing or tourniquet are not effective. He continues to bleed internally regardless of attempts to stop the bleeding externally and does not respond to volume resuscitation. His only chance of survival is to be evacuated to a treatment facility capable of surgical intervention (vascular repair).

Table 6. HPS States – Gunshot Would to the Right Thigh (Femoral Artery Bleed)

Baseline	600 seconds
Class I Shock	900 seconds
Class II Shock	900 seconds
Class III Shock	
Vascular repair	

EVACUATION RESOURCES AND SUPPORTING MEDICAL TREATMENT FACILITIES

The scenario has six treatment nodes each with its own HPS, Triage Controller and supporting equipment. Four of the nodes represent treatment locations that are in fixed position and two nodes represent evacuation vehicles. The four "fixed" treatment nodes are: a Casualty Collection Point (CCP), a Battalion Aid Station (BAS), a Forward Surgical Team (FST), and a Combat Surgical Hospital (CSH). The two evacuation vehicles are a ground ambulance and an air ambulance.

The CCP is set up by the medic at the site of the explosion.

Ground ambulance evacuation times are as follows: The BAS is 10-15 minutes away from the CCP, the FST is 15-20 minutes away from the BAS, and the CSH is 20 minutes away from the FST. The ground ambulance is capable of transporting four casualties at a time.

Air evacuation times are: CCP to CSH is 10-12 minutes; the BAS is situated in a wooded area without easy access to a landing site – air evacuation is not supported; CCP to FST is 7-10 minutes; and FST to CSH is 5-7 minutes. The air ambulance is only capable of transporting two casualties at a time.

The first evacuation asset on the scene is a helicopter capable of transporting two litter casualties directly to a Combat Surgical Hospital (transport time: 10-12 minutes). Second on the scene is a ground ambulance capable of transporting four litter casualties directly to a Battalion Aid Station (transport time: 10-15 minutes).

The graph on the following page shows the anticipated timing of the evacuation vehicles.

THE UNFOLDING SCENARIO

In addition to managing the casualties, each of the locations will need to have a working understanding of the capabilities at each node and the transit time between nodes. This situational awareness will be most important at the CCP. In addition to the first look and triage of the casualties, the medic will need to re-triage each of the casualties prior to making an evacuation decision. Those most in need of definitive surgical care may not be obvious initially. If one or more of the more severe cases is not loaded onto the air ambulance, the best course of action would be to hold the severe casualty at the CCP rather than evacuating to the BAS. Waiting for the second trip via air ambulance will get the casualty to definitive surgical care faster than sending them by ground.

Appendix B: Assessment of Individual Scenarios within the CTPS system

Scenario Name: Blunt Abdominal Injury
Time of injury: _____

Blunt Abdominal Trauma	Baseline (first 30 seconds)	Class I shock (30 seconds – 7.5 minutes) [pre-compensatory shock]	Class II shock (7.5 – 15 minutes) [compensatory shock]	Class III shock (15 – 55 minutes) [progressive shock]	Class IV shock (55 – 57 minutes) [irreversible shock]	Spleenectomy
Primary Survey						
Airway	Intact	Intact	Intact	Intact	Intact	Intact
Breathing	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations Until Dead	Spontaneous Respirations
Circulation	Pulse Normal	Pulse Normal	Pulse Normal	Pulse Normal	Pulse Normal	Pulse Normal
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Alert	Alert	Responds to verbal stimuli	Unresponsive	Unresponsive
Vital Signs						
Pulse / Heart Rate	71	84	113	125	145	
Arterial Blood Pressure (ABP)	115/51	113/55	110/60	92/52	73/46	
Palpable Blood Pressure	28/14	28/16	27/18	18/10	16/12	
Respiration Rate	19	19	20	18	15	19
Temperature	37.5	37.5	37.5	37.5	37.5	37.5
Secondary Survey						
Inspection	Abdominal contusions and abrasions Abdominal distention					
Auscultation	Diminished or absent bowel sounds					
Palpation	Tender upper left quadrant					
Percussion	Upper left quadrant dullness					

Scenario Name: Blunt Chest Injury
Time of injury: _____

Blunt Chest Trauma	Baseline (first 60 seconds)	Tamponade Onset (1 – 3 minutes)	Tamponade Severe (3 – 23 minutes)	Unconscious	Needle Decompression
Airway	Intact	Intact	Intact	Intact	Intact
Breathing	Painful	Labored	Labored	Shallow	Normal
Circulation	Pulse Normal	Pulse Diminished	Pulse Weak	Pulse Normal	
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Alert	Responds to Verbal Stimuli	Unresponsive	Alert
Vital Signs					
Pulse / Heart Rate	71	74	86 - 104	104	74
Arterial Blood Pressure	114/51	108/51	92/52 – 74/50	74/50	114/51
Palpable Blood Pressure	28/14	27/16	27/18	27/22	28/15
Respiration Rate	19	19	19	19	19
Temperature	37.5	37.5	37.5	37.5	37.5
Inspection					
Auscultation					
Palpation					
Percussion					

Scenario Name: Compound Fracture of the Left Leg (tibia)
Time of injury: _____

Compound Fracture of the Leg *tibia)	Baseline (first 30 seconds)	Class I Shock (30 seconds to 3 minutes)	Class II Shock (3 to 8 minutes)	Class III Shock (8 to 13 minutes)	Class IV Shock	Bleeding controlled	Vascular Repair
Airway	Intact	Intact	Intact	Intact	Intact	Intact	Intact
Breathing	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations	Spontaneous Respirations
Circulation	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Uncontrolled Vascular Bleed	Bleeding Controlled	Vascular Repair
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Alert	Alert	Responds to Verbal Stimuli	Unresponsive	Alert	Unresponsive
Vital Signs							
Pulse/Heart Rate	72	86	113	125	114 – 151		
Arterial Blood Pressure	116/52	114/56	111/62	92/51	73/46 – 54/34		
Palpable Blood Pressure	28/15	28/15	27/18	18/10	17/12 – 10/6		
Respiration Rate	19	19	19	18	15		
Temperature	37.5	37.5	37.5	37.5	37.5	37.5	37.5
Inspection							
Auscultation							
Palpation							
Percussion							

Scenario Name: Gunshot Wound to the Left Chest
Time of injury: _____

Gunshot Wound to the Left Chest	Baseline (first 30 seconds)	Pneumothorax (30 seconds to 5.5 minutes)	Tension Pneumothorax	Needle Decompression
Airway	Intact	Intact	Intact	Intact
Breathing	Normal	Labored	Labored	Normal
Circulation	Pulse Intact	Pulse Intact	Weak Pulse	Normal Pulse
Disability (Neurological) A = Alert V = Responds to verbal stimuli P = Responds to painful stimuli U = Unresponsive	Alert	Responds to Verbal Stimuli	Unresponsive	Alert
Vital Signs				
Pulse/Heart Rate	72	88	106	79
Arterial Blood Pressure	116/53	107/62	84/60	113/52
Palpable Blood Pressure	28/15	36/32	51/40	29/14
Respiration Rate	19	30	36	Normal
Temperature	37.5	37.5	37.5	37.5
Inspection				
Auscultation				
Palpation				
Percussion				