Award Number: W81XWH-07-2-0105

TITLE: "DISCOVERIES: Telemedicine Solutions for Emergency Care and Disaster Response."

PRINCIPAL INVESTIGATOR:
Elizabeth Lynch

CONTRACTING ORGANIZATION:
Loma Linda University
Loma Linda, CA 92354

REPORT DATE: November 2009

TYPE OF REPORT: Final

PREPARED FOR:
U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
01-11-2009	Final	7 SEP 2007 - 31 OCT 2009

4. TITLE AND SUBTITLE
"DISCOVERIES: Telemedicine Solutions for Emergency Care and Disaster Response."
Real-time Information and Emergency Services (DISCOVERIES).

5a. CONTRACT NUMBER

5b. GRANT NUMBER
W81XWH-07-2-0105

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Elizabeth Lea Walters MD, FACEP

Karla Lavin, MPH, DrPH (c)

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Loma Linda University
Loma Linda, CA 92354

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Research and Materiel Command
Fort Detrick, MD 21702-5012

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
N/A

14. ABSTRACT
A wealth of expertise resides in centralized tertiary medical academic centers. Unfortunately, few patients have access to these resources. The DISCOVERIES Project has developed a number of resources that can bring this expertise to where it is needed—to underserved and rural communities, into the field to be used by paramedics, or to communities affected by critical events such as disasters.

15. SUBJECT TERMS
N/A

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			USAMRMC
U	U	U	UU	63	**19b. TELEPHONE NUMBER** *(include area code)*

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

Table of Contents

Introduction

Background

Lack of Access to Medical Care

Providing emergency health care continues to be both a priority and challenge to the nation's medical community. While those in large urban areas may have easy access to medical "centers of excellence," most communities must rely on transfer to these referral centers in order to receive that level of care. Even within urban areas there can be numerous barriers to medical care. Barriers can include geographical obstacles, inadequate access to transportation, racial disparities, and socioeconomic status.

In many communities, hospitals function as a primary source of both emergency and preventive health care. For many, the emergency department (ED) is the point of access to the healthcare system. However, over recent years, there have been a number of closures in hospitals and emergency departments, while the number of patients utilizing these services has increased. According to a Centers for Disease Control and Prevention report, between 1993 and 2003 the number of Emergency Departments nationwide decreased by 12.3%, whereas the number of ED visits increased 26% (to 113.9 million per year.) [1] Similarly, a study of California hospitals from 1990 to 1999 demonstrated a 12% decline in the number of EDs, accompanied by a 27% increase in patient visits per ED. [2] When a hospital is closed, patients lose access to needed healthcare services. A 2009 report from the American College of Emergency Physicians gave the nation a D- overall for access to medical care. [21] This grade included subcategories of access to providers, access to treatment centers, financial barriers, and hospital capacity. Not surprisingly, lack of access to appropriate health care has been noted to have a negative effect on individual health status.[3]

Utilization of the emergency department as primary access to healthcare is especially noted in the poorer young and in the elderly. In 2003, 27% of children less than 6 years of age had an ED visit within the previous 12 months. Children living below the poverty level were more likely to have had an ED visit than children in families with income more than twice poverty level (34% versus 24%). In 2004, adults 75 years and older had a higher rate of visits to the ED than any other age group (58 visits per 100 persons, compared with 29-45/100 in other ages.) [4]

Patients that are not located near specialized hospitals may suffer delays in care. This can be critical when necessary therapies are time dependent. For example, treatment of stroke patients with a "clot-busting" drug should be initiated within a three-hour treatment window. If it takes one of those hours for stroke recognition, evaluation, and administration of the medication once the patient reaches the emergency department, only 120 minutes remain for transport of the patient to an appropriate facility.

The health care delivery system must find a way to meet the needs of the community it serves, providing access to all its members and eliminating health disparities. Technology now provides the potential solution by providing a virtual telemedicine consultation to anyone at any time.

Disaster Emergency Care

Disasters demand immediate response from medical resources and the ability to assess and treat hundreds, even thousands, of patients directly after the event. In 1995, sarin gas was intentionally released in a Tokyo subway. Within several hours of the incident, 5,510 people sought medical attention at more than 200 hospitals and clinics in the greater Tokyo area.[5] After the Northridge, California earthquake, approximately 1,500 people sought immediate emergency treatment, with 138 requiring hospitalization.[6] A randomized telephone survey conducted shortly after the earthquake estimated that 24,000 persons suffered at least a minor injury for which they sought medical attention.[7] Ambulatory patients with only minor injuries tend to be the first to arrive at the emergency department and can divert care from the more critically injured patients that require assistance to reach the hospital.[8] Hospital emergency departments can become rapidly overwhelmed by the "walking wounded" who may require medical care from a knowledgeable practitioner, but do not need treatment at the hospital. Telemedicine might allow less severely injured patients to be treated at the scene of a disaster, reserving transport for patients with more critical injuries. In this way, the critical health care resources might be saved for those that need them the most.

Recent disasters have highlighted the difficulty in providing timely medical care when the hospitals in an entire region may be unusable. Hurricane Katrina created enormous public health and medical challenges. Over 200,000 people with chronic medical conditions displaced by the storm and isolated by flooding, found themselves without availability of their usual medications and medical care.[9] Many of these relied on emergency departments for re-establishment of their care. Here in Southern California, earthquakes are a major concern with the potential to damage hospitals, in addition to other existing infrastructure. The 1994 Northridge earthquake resulted in evacuation of eight of the area's 91 acute care hospitals in the days following the earthquake, six within 24 hours.[10] Of note, some hospitals affected by Hurricane Katrina were without access to any outside resources for 72 hours or longer.[11] Telemedicine might bring outside expertise into an affected facility immediately after, or even during a disaster.

Infrastructure Damage Limits Access to Medical Care During Disasters

A disaster such as an earthquake, hurricane, flooding, or terrorist bombing can damage the infrastructure of a community, leading to disruption of transportation, power, and communication. During these incidents, traditional emergency response vehicles may be limited in the areas they can reach. Additionally, those seeking medical care may be unable to arrange transport on their own. Studies have shown that trauma deaths can be prevented by prompt diagnosis and treatment, often with simple in-field procedures.[12] However, inadequate resuscitation due to delay in medical care and long transportation times may result in increased mortality.

Farmer and colleagues have previously reported on the "lack of 'portability'" or inability to bring appropriate medical care to the patient during a disaster. They also noted that during a large-scale disaster, healthcare professionals who normally do not provide critical care will be expected to do so.[14] Fortunately, modern technologies have the potential to provide support for such a scenario when the medical infrastructure of a region is damaged.[15-20] To provide this type of care, however, the appropriate equipment and supplies must be thoroughly preplanned and tested prior to such an event.

Inadequate Surge Capacity

Emergency department overcrowding and lack of surge capacity have contributed to a growing concern that our nation's ability to respond to a disaster will be limited. Surge capacity planning is especially important for systems that are understaffed, overcrowded, and whose capacities are already stretched to the limit. Unfortunately, this might well describe most of the health care delivery systems in the United States. In January of 2009, The American College of Emergency Physicians (ACEP) published a "Report Card" for the nation's emergency care system. The overall grade across five categories was a C-. [21] An earlier ACEP policy statement stressed that "healthcare systems must develop and maintain a capacity for surge in order to anticipate care for patients during infectious disease outbreaks, public health emergencies, and mass casualty incidents." [22] The Health Resource and Services Administration (HRSA) and Joint Commission on Accreditation of Healthcare Organizations (JCAHO) recommend that each community be able to provide triage, treatment, medication, and transportation above the daily hospital staffed bed capacity for up to 500 additional patients per million population.[22] Other sources recommend 20-30% surge capacity[23]. However, this may be an unattainable goal based on a concern expressed by 91% of emergency department directors that overcrowding of their EDs is a major and frequent problem.[24]

There seems no doubt that there is little or no surge capacity available in most communities to deal with major or even moderate sized disasters.[25] It becomes imperative then to mobilize means to treat minor patients, identify patients that need transport for definitive care, and initiate care on the critically ill as soon as possible.

One solution to this challenge is the use of telemedicine at the site of injury, helping to address shortfalls in surge capacity, thereby reducing the number of patients transported to overwhelmed emergency departments. Telemedicine can also be invaluable for inaccessible or remote areas, where an alternative response vehicle can reach the patient.

Medical care can be provided remotely to the site of the incident, by utilizing physicians located at the hospital for transport and triage decisions, and by bringing an overall higher level of care to the disaster site. Further development of these methods will improve the level of emergency healthcare that can be provided to the community during emergencies and disasters.

DISCOVERIES

The first phase of the DISCOVERIES project included the creation of a regional Emergency Telemedicine Command Center (ETCC) and network. The ETCC established a telemedicine 'hub and spoke' system to maximize and leverage all the health care resources available at Loma Linda University Medical Center and provide real-time telemedicine consultation service to community hospitals, nursing homes, and community events.

The Emergency Telemedicine Command Center at Loma Linda University Medical Center

As one 'spoke' of this network, DISCOVERIES developed a Mobile Telemedicine Vehicle (MTV) prototype for emergency and disaster response. This vehicle, off-road capable and outfitted with state-of-the-art satellite communications and telemedicine connectivity, can connect the ETCC with field resources at disaster incidents. Additionally, the MTV has all the state-of-the-art technology of the ETCC, allowing it to function as a mobile command center in the event the emergency department or hospital is involved in a disaster. Included medical equipment provides the ability to assess and treat patients on scene and support triage activities. Disasters that result in multiple casualties, interruptions in transportation networks, communication infrastructure failures, and issues of contamination may create an environment where it is not possible to bring patients to the emergency department. Several authors[15-20] have recommended using telemedicine to assist with triage and provide care or consultation during such disasters.

The DISCOVERIES Project continues to improve the medical community's response to emergencies and disasters by building on its previous work, bringing the expertise of a tertiary care center directly to the point of injury. Targeting ways to enhance the initial contact with the patient can improve patient care, allow better decisions about life-saving resource management, and direct field personnel in more effective treatment and transport decisions.

Telemedicine for Prehospital Care

Just as telemedicine in the field during a disaster can be helpful in initiating timely care and providing guidance in appropriate transportation decisions and destinations, this same technology can be adapted for the EMS provider during routine operations and enhance care given in the field.

The 1996 document, the *EMS Agenda for the Future,* united the many professional groups involved with EMS in the common goal of improving system performance. The National Highway Traffic Safety Administration (NHTSA), which has been responsible for creating national standards for EMS education, operations and system development since the 1970s, supported the creation of this consensus-based national EMS strategic plan. It was clear to these experts that EMS must be integrated with other services and systems that are intended to maintain and improve community health and ensure its safety. The vision of the panel is that the EMS of the future

will have the ability to identify and modify illness and injury risks, provide acute illness and injury care and follow up, and contribute to treatment of chronic conditions and community health monitoring. It will help improve community health and result in more appropriate use of acute health care resources. [26]

By deploying telemedicine in the field, many of these goals are within our reach. It has been suggested that telemedicine can reduce the number of unnecessary transports to the emergency department, creating more appropriate use of acute health care resources. Researchers in New York tested this hypothesis by reviewing 2,135 consecutive emergency teleconsultations received in their emergency department from state correctional facilities. They found that 38% of the patients included in the study could have avoided transportation to the ED.[27] In Tel Aviv, subscribers to a telemedicine system allowing them to contact the service for assistance and undergo "transtelephonic" triage, 86% had their problems resolved without utilizing hospital facilities.[28] Emergency responders outfitted with telemedicine equipment that allows them to access medical control may be able to make better transport decisions, including the decision to not transport.

Telemedicine may be utilized to get "the right patient to the right place the first time", avoiding life-threatening delays in treatment. In 2004, the Telemedicine Center of Kaunas University of Medicine in Lithuania participated in a joint civilian and military mass casualty drill specifically to assess the use of telemedicine for distant consultations and sorting of victims directly at the event. They concluded that implementing telemedical control of triage allowed them to direct patients requiring specialty care to the correct facilities, while also giving them the ability to provide initial triage for hundreds of victims.[29]

Telemedicine also improves the emergency physician's ability to care for the individual patient, since "a picture is worth a thousand words." When the physician receiving the patient is able to remotely see what the paramedic sees, this allows the emergency department to be prepared with the necessary personnel and equipment upon the patient's arrival. Better preparation can result in better patient outcomes.

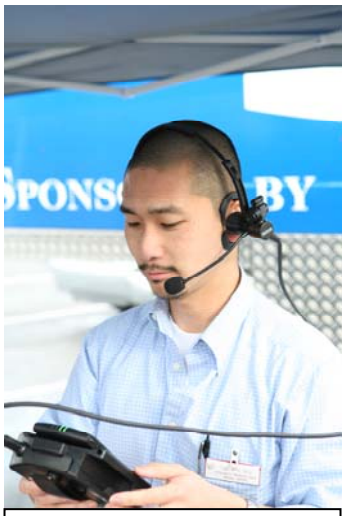
Alternative Response Vehicles

The health care system must respond to incidents of all types, regardless of the setting. After the Great Hanshin (Japan) earthquake of 1995, roads were impassable to cars and trucks, including traditional ambulances. However, volunteer motorcycle rescue groups were able to negotiate these obstacles, providing necessary communications and transportation of emergency supplies.[30] Anecdotal observations by EMS providers have suggested that many victims survive the initial impact, but succumb later to their injuries. Data reviewed by Preto and associates suggested that the rapid institution of enhanced prehospital care may be associated with significant potential for saving lives.[31] Lin, et al., demonstrated that using Emergency Medical Technician (EMT) staffed motorcycles significantly decreased the response time when compared with a standard ambulance.[32] Other sources show that in the urban setting, using EMS personnel on motorcycles to avoid traffic congestion allowed for earlier defibrillation of patients with cardiac arrest and faster provision of initial care to trauma victims.[33, 34] During a southern California sporting event that excluded cars, including ambulances, from the venue, paramedics on motorcycles were able to access patients quickly, providing advanced life support techniques that in one case saved a spectator's life.[35] Specialty vehicles, such as all-terrain vehicles, are invaluable at rough-terrain venues with limited access routes for ambulances.[36] Adding telemedicine capabilities to these alternative response vehicles brings all the advantages of telemedicine to those areas, and patients, that are inaccessible to traditional ambulances.

With these challenges in mind, the DISCOVERIES Project proposed research with the technical objectives of designing and implementing a telemedicine system that could be deployed by emergency personnel in the home or at the site of injury or illness, and to develop and implement one or more telemedicine solutions with the capability of providing telemedicine to 'difficult to access' areas using alternative response vehicles.

Task 1: Design an EMS telemedicine system that can bring telemedicine directly into the home via emergency responders.

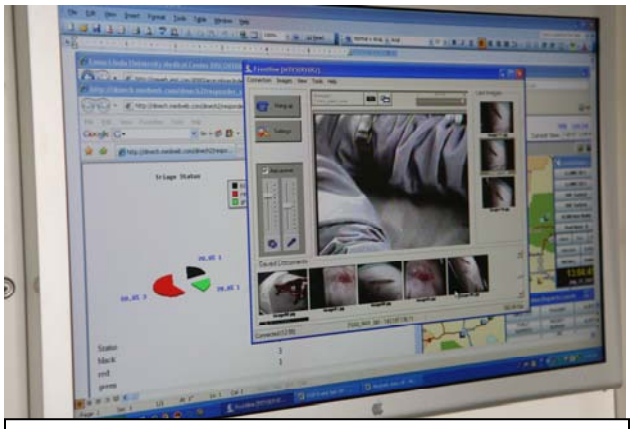
The DISCOVERIES team performed some initial studies regarding technical requirements for the telemedicine (TM) equipment that may be used by prehospital personnel. In an exercise that involved transmitting telemedicine images from both body-worn and handheld devices to the Telemedicine base station, we were able to evaluate current devices for resolution, ease of use, and image quality.



Tae Kim, MD uses a body worn device to transmit TM images

During this exercise, body-worn and handheld devices were employed to send images back to the TM base station. Physicians at the base station were then able to review the images for clarity and resolution, speed of transmission, and ease of use. This information was then recorded, comparing the various devices.

Tamara Thomas, MD reviews a transmitted image



Close up of transmitted image

Additionally, team members determined the clinical value of the use of telemedicine in various prehospital settings. This was performed initially as a questionnaire based on the exercise and then expanded during interviews with prehospital providers. The interviews sought to identify First Responders' perception of the utility of telemedicine in their daily practice. Over 70 paramedics were interviewed. A manuscript summarizing the results has been prepared and is being submitted for publication (Appendix A and B).

Design the telemedicine system for a specified response area.

After the initial testing was completed, the team initiated its work with the City of Loma Linda. The City of Loma Linda is unique in the area in that it is integrating a fiber optic network into all new construction.[37] This integration will allow it to become a "connected" city. Initial plans for the project included incorporating many of the planned nodes into a prehospital response system. The initial deployment was to be at a number of nursing homes within the city. Utilizing an e-Bridge device (such as the Rosetta-VC available from General Devices), field personnel can access a centralized controller that integrates the ambulance's monitors, medical devices, communications equipment, cameras, laptop computers, PDAs, etc. This approach merges conventional EMS activities with an emerging set of telemedicine-related patient-care activities. This hybrid network, utilizing mobile devices and tapping into the City's fiber optics, would allow the ambulance to transmit continuously from the field en route to the emergency department. Communication network designs were completed based on the proposed nodes that would be available. However, the City of Loma Linda has had limited deployment of their integrated fiber optic network to date. Although it will be possible to utilize the system when it becomes available, at this time an alternative solution was implemented. A mobile mesh network has been developed that will provide communication/telemedicine capability in a variety of environments (see below).

Develop protocols and guidelines for use of telemedicine in the field.

Protocols for providing medical care while deployed with DISCOVERIES response vehicles in the prehospital setting are attached (Appendix C). These protocols are in draft form pending acceptance by Loma Linda University Medical Center administration.

Demonstrate the capability of telemedicine transmission from the origin of the call back to the emergency department.

This task consisted of developing and organizing various exercises to test the capabilities of the telemedicine transmission systems from the operations, technology, administrative, and medical perspectives. Utilizing the mobile mesh network, TM images can be transmitted from the field to a variety of base stations, including the Mobile Telemedicine Vehicle (MTV), the Emergency Telemedicine Command Center (ETCC) in the emergency department, and any other TM-equipped station, which currently includes the Center for Prehospital Care, Education, and Research, the Department of Pharmacy, and Loma Linda Community Hospital.

Task 2: Develop the capability of providing telemedicine to "difficult to access" areas using alternative response vehicles.

Delineate the specific environments to which the alternative response vehicles (ARVs) will be responding.

Environments duplicating current theaters of operation for the military exist in the area surrounding Loma Linda University Medical Center. This includes desert, mountains, urban, and rural environments.

Assess the types and relative costs of the ARVs that meet the environmental requirements.

The Technical Manager and the Operations Coordinator conducted research into the various ARVs and vehicles required for completion of the project. As a result of their research, the ARV selected was changed from the Yamaha Rhino to the Polaris Ranger 6x6. This ARV has several advantages, both in the maximum load it can carry, and in the configuration of the load. An existing overhead rack can accommodate telemedicine and communications equipment, without interfering with medical equipment needed in the prehospital arena. The ARV can also be configured to carry a patient, if necessary, or additional personnel and can be outfitted for towing. Additionally, this model has a better safety profile than the Rhino, with a lower center of gravity, wider wheelbase, and standard occupant safety features that reduce the possibility of rollovers and associated injuries. Finally, the cost of the Polaris vehicles was less than that offered by Yamaha and the features of the newly available Polaris better suit our overall needs for this project with fewer modifications.

Describe the medical operations and patient care requirements for the responders.

Initial requirements were determined from our project exercises. Additionally, deployment of the MTV and medical trailer to various events to provide medical care allowed the investigators to develop medical equipment lists for the vehicles (see Appendix D).

Design a telemedicine solution for a variety of ARVs.

Our team met with officials from the City of Redlands Fire Department regarding the telemedicine capabilities for the motorcycle paramedics. Because cellular support for telemedicine is becoming limited, an alternative solution was developed. A mobile mesh network was designed that provides portable communications/telemedicine capability to a designated area. This network can be predeployed in anticipation of an event (such as the Redlands Bike Classic held annually in the city) or in response to an incident.

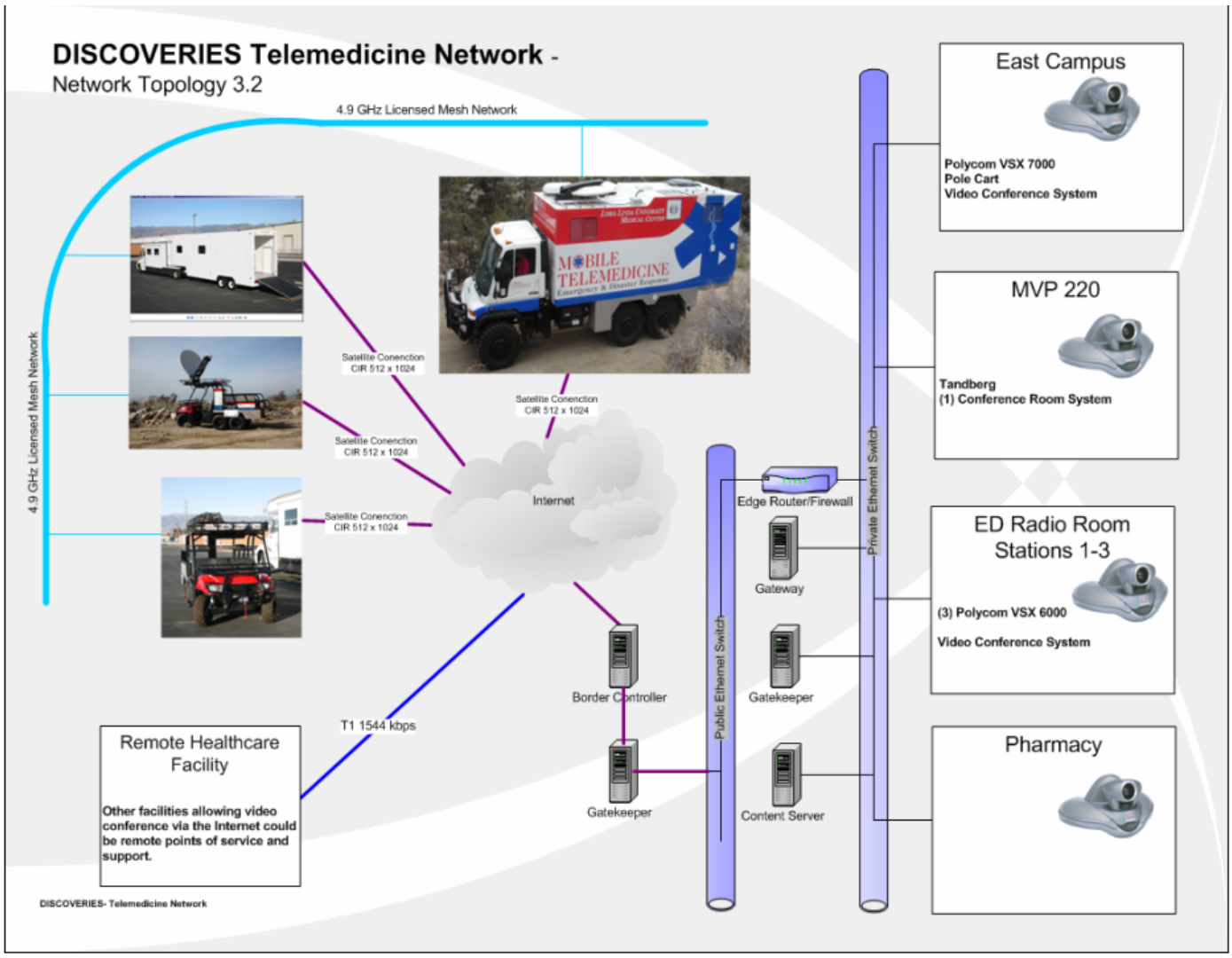
Mesh networks may involve either fixed or mobile devices. Wireless mesh architecture can provide high-bandwidth network over a specific coverage area. Signal strength is maintained throughout the system by breaking long distances into a series of shorter hops. Intermediate nodes not only boost the signal, but cooperatively make forwarding decisions based on their knowledge of the network, i.e., routing. An advantage of this property is that a mesh network can be "self-healing." Because each node is connected to several other nodes, if one node drops out of the network, due to hardware failure or any other reason, its neighbors can find another route using a routing protocol. Mesh networks are adaptable to difficult environments, such as emergency situations. U.S. military forces are now using wireless mesh networking to connect their computers, mainly ruggedized laptops, in field operations. It enables troops to

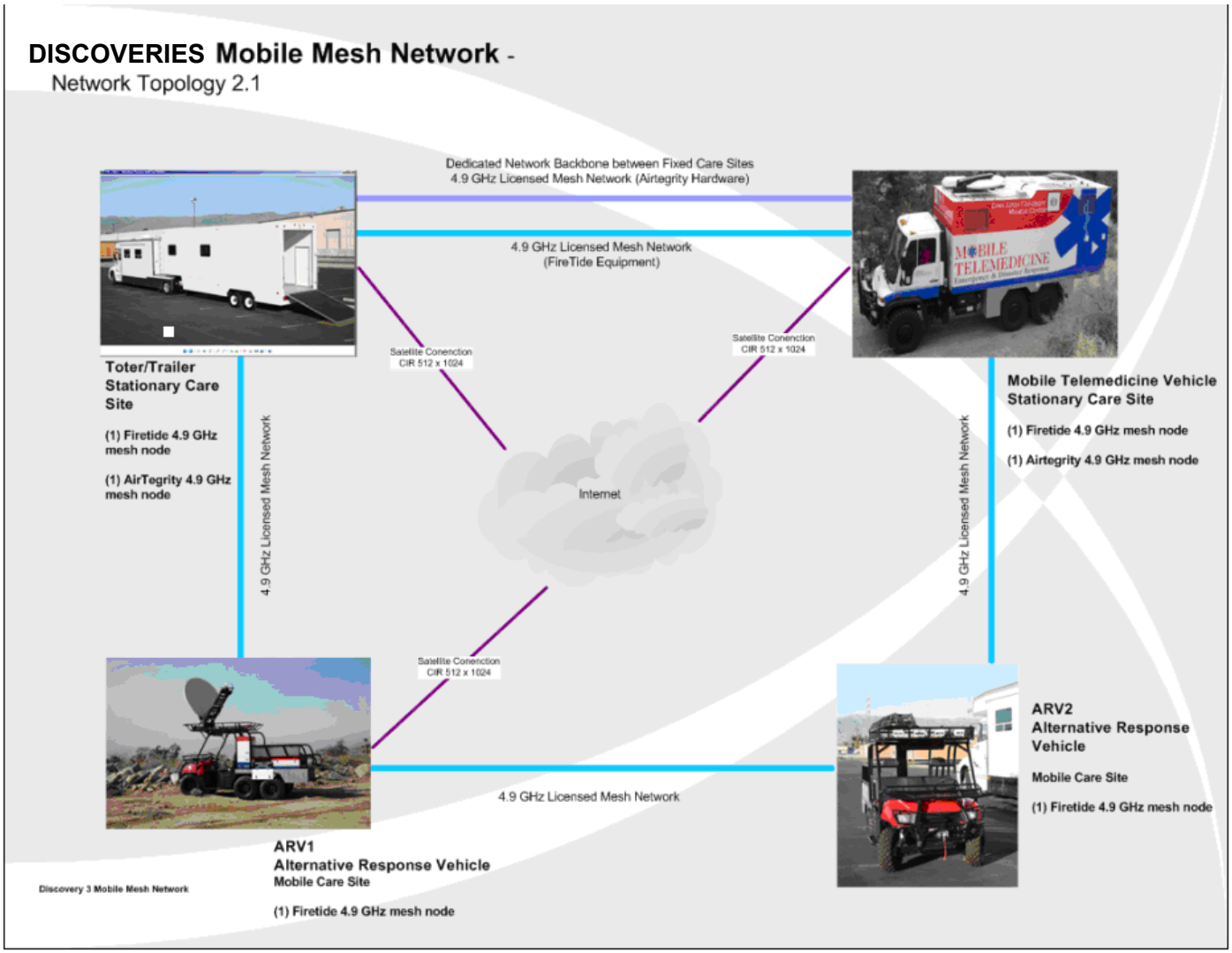
know the locations and status of every soldier or marine, and to co ordinate their activities without much direction from central command.

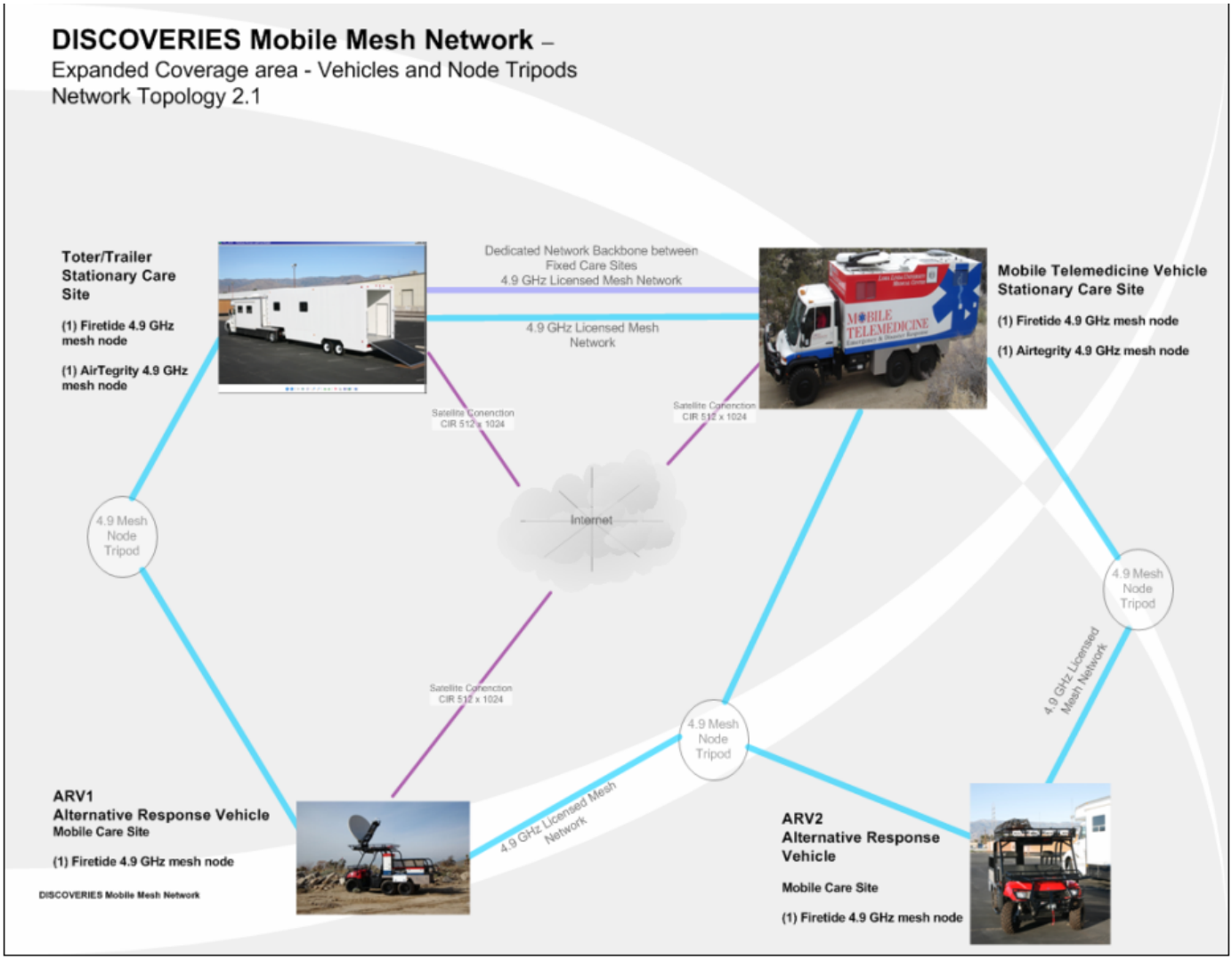
The components of the mobile mesh network are as follows:

- 4.9 GHz wireless ra dios (nodes), some are single radios while others ar e dual rad ios to allow hand off from one cell area to another, similar to cellular phone networks. Single radios are used as client end po ints in v ehicles, fixed sites, or for point-to-point communications.
- Transportable node tripods.
- Solar panels to support continuous mesh radio operations.
- DC power system (equipment box affixed to the tripod).
- Network software to manage mesh architecture.
- Array of radio antennas to support various communication solutions.

Examples of the mobile mesh network deployed in a variety of settings:


DISCOVERIES Telemedicine Network -
Network Topology 3.2
4.9 GHz Licensed Mesh Network
4.9 GHz Licensed Mesh Network
MOBILE TELEMEDICINE
Satellite Conenction CIR 512 x 1024
Satellite Conenction CIR 512 x 1024
Satellite Conenction CIR 512 x 1024
Satellite Conenction CIR 512 x 1024
Internet
Edge Router/Firewall
Gateway
Gatekeeper
Border Controller
Gatekeeper
Content Server
Public Ethernet Switch
Private Ethernet Switch
T1 1544 kbps
Remote Healthcare Facility
Other facilities allowing video conference via the Internet could be remote points of service and support.
East Campus
Polycom VSX 7000
Pole Cart
Video Conference System
MVP 220
Tandberg
(1) Conference Room System
ED Radio Room Stations 1-3
(3) Polycom VSX 6000
Video Conference System
Pharmacy
DISCOVERIES- Telemedicine Network


DISCOVERIES Mobile Mesh Network -
Network Topology 2.1
Dedicated Network Backbone between Fixed Care Sites
4.9 GHz Licensed Mesh Network (Airtegrity Hardware)
4.9 GHz Licensed Mesh Network
(FireTide Equipment)
Satellite Conenction
CIR 512 x 1024
Satellite Conenction
CIR 512 x 1024
Internet
Toter/Trailer
Stationary Care
Site
(1) Firetide 4.9 GHz
mesh node
(1) AirTegrity 4.9 GHz
mesh node
4.9 GHz Licensed Mesh Network
Mobile Telemedicine Vehicle
Stationary Care Site
(1) Firetide 4.9 GHz mesh node
(1) Airtegrity 4.9 GHz mesh node
4.9 GHz Licensed Mesh Network
Satellite Conenction
CIR 512 x 1024
4.9 GHz Licensed Mesh Network
ARV2
Alternative Response
Vehicle
Mobile Care Site
(1) Firetide 4.9 GHz mesh node
ARV1
Alternative Response Vehicle
Mobile Care Site
(1) Firetide 4.9 GHz mesh node
Discovery 3 Mobile Mesh Network



Assess the communications requirements required for the ARVs.

The level o f redundancy/autonomy necessary for the ARVs to acce ss differe nt areas was completed. The followin g list provides a detaile d breakdown of the communications equipment necessary for each project asset:

ARV 1 (LLUMC)

- Mesh Network Node – (4.9 GHz mobile mesh data network)
- Satellite Data Network – (Geostationary satellite data network)
- Dual WAN Router – (Allows automatic switching between available networks)
- Mobile Radios – (RF Voice communication)
  - o VHF
  - o UHF
  - o 800 MHz
- Local Data Network – (wired and wireless data network)
- ROIP/VOIP Gateway – (allows radio and voice communication integration with Toterhome-Trailer, MTV, and LLUMC ED)

- Tandberg Video Conference Station

ARV 2 (Loma Linda Fire Department)

- Mesh Network – (4.9 GHz mobile mesh data network)
- Mobile Radio
  - o VHF

Toterhome-Trailer

- Mesh Network – (4.9 GHz mobile mesh data network)
- Mesh Network Dedicated Backbone to MTV – (4.9 GHz mobile mesh data network)
- Satellite Data Network – (Geostationary satellite data network)
- Dual WAN Router – (Allows automatic switching between available networks)
- Mobile Radio's – (RF Voice communication)
  - o VHF
  - o UHF
  - o 800 MHz (3)
  - o 2M/440
  - o HF
- Local Data Network – (wired and wireless data network)
- ROIP/VOIP Gateway – (allows radio and voice communication integration with Toterhome-Trailer, MTV, and LLUMC ED)
- Tandberg video conference equipment
  - o Conference room system
  - o (2) mobile carts
  - o (2) telemedicine workstations

Purchase the necessary ARVs, telemedicine/communications equipment, toterhome, trailer, and medical supplies.

The Technical Manager and Operations Coordinator conducted research on all ARVs and telemedicine/communications equipment to ensure the most efficient, technologically advanced, and cost effective solutions were p urchased. To date, (2) Polaris vehicles, a Toterhome and Toterhome trailer, tele medicine/communications equipment, (2) communications trailers, an d medical supplies have all been purchased. These vehicles have a dual purpose—to be able to access areas during a disaster event, and to be able to provide telemedicine at the site. Each of these vehicles and their capabilities is described in detail in the following section.

Key Research Accomplishments

- Development of Prehospital and Telemedicine Protocols
- Fabrication of a variety of Telemedicine capable Alternative Response Vehicles including Two Polaris vehicles, a Toterhome and Toterhome-Trailer, and two communications trailers
- Design and development of a Mobile MESH Network for the support of telemedicine during disasters

Reportable Outcomes

1) EMS Provider Opinions of Telemedicine Utility (see Appendix A)

2) Toterhome-Trailer

3) ARV 1 (LLUMC)

4) Light Equipment Apparatus (L.E.A)

5) Transport Trailer

6) ARV 2 (Loma Linda Fire)

7) Mobile MESH Network (See aforementioned diagrams – pages 14-16)

DISCOVERIES ALTERNATIVE RESPONSE VEHICLES

Toterhome & Multiple Use Trailer

Toterhome & Multiple Use Trailer

Toterhome and Multiple Use Trailer
The Haulmark Toterhome is a fully self contained mobile home with rest facilities, a briefing center, kitchenette, and lavatory. It is capable of providing video conferencing and access to distant command and control. The Toterhome serves as the Tow vehicle for the multiple use trailer.

The Multiple Use Trailer provides a contained platform to transport the Alternative Response Vehicle (ARV) and serves as the access point for emergency medical treatment and telemedicine consults. The full height trailer provides additional areas for storage of equipment and medical supplies as well as area as for telemedicine consults and communications.

The access ramp in the rear provides easy access for storing the ARV as well as a raised platform for public address and briefings.

Multiple Use Trailer
When unoccupied, the rear portion of the trailer can be used as a mobile clinic or as a platform for medical simulation. Additionally, the telepharmacy can operate this location. It can be enclosed with access through a passenger side door for additional security or open to extend services to a wider group of participants.

Communications Control Module
A communications command module provides local interoperable communications. Included are 800 MHz, VHF, and UHF and HAM communication devices. A digital interface provides fully compliant VOIP communications that allow for distant command and control as well as communications to local entities through a network interface. The communications module also provides the link for video conferencing and telemedicine services through onboard satellite and network services.

ARV 1 – Loma Linda University Medical Center

Alternative Response Vehicle (ARV)
The Polaris Ranger 700 All Terrain Vehicle ATV (All Terrain Vehicle) is a 6X 6 platform in which passengers and driver sit side-b y-side. This vehicle has been modified to carry a medical provider and patient in the rear portion of the vehicle completely separated from the driver or ot her passen gers. The Polaris provides the additional w eight carrying capacity necessary to carry communications and r escue equipment into remote locations safely.

Satellite Communications Dish
ARV 1 is fitted with an advanced commu nications satellite dish and equipment necessary to pro vide video and data communications from the scene of injury back to a hospital or other designated care facility.

Overhead Equipment Rack
The Overhead rack provides the platform for the satellite dish, driving lights, and communications module. It also serves as a shading device and roof prote cting the driver and passengers from falling debris.

2-Way Communications Module
The ARV 1 module co ntains radio equipment for voice communications. Included are 800 MHz, VHF, and UFH capabilities to interface with local command and control as well as other deployed units and personnel.

Electrical Equipment Box
Power and Control Boxes. Equipment in ARV 1 requires 12-volt DC and 110-volt AC electricity to operate. A 2000-watt Honda Gen erator (shown here) is available on ARV 1 to supply 110-volt AC electricity to communications equip ment and 1 2-volt for re charging batteries. ARV 1 cont ains 4-100 amp hour batteries beneath the driver and passenger seats.

An Inverter/Charger in the box below the generator (not shown) inverts battery power to supply sh ort term electricity to equipment and to rech arge batteries when connected to an exte rnal electrical source or the generator.

Electrical p anels bene ath the g enerator allow the operator to select diffe rent power sources an d house fuses and breakers for electrical safety.

Satellite and Network Box
Satellite an d network equipment provided in ARV 1 allows dat a and video commu nications t o distan t locations without relying on local infrastructure. Here satellite control and interface equipment is shown.

Medical Supplies and Equipment Bags
General me dical equip ment and supplies are carried in blue Medical Bags (shown). The detachable bags contain medical equip ment and supplies necessary to provide emergency medical ca re. The b ags are replicated to provide additional supplies during extended medical efforts or multiple patients.

Front Rack Assembly
The equipment rack pr ovides a co nvenient location for storage and immediate access to n eeded supplies. The rack folds down for access to t he chassis battery , chassis electrical equipment, and air filters.

Winch
A 2500-lb winch is provided to assist in travel if necessary and to move light branches and debris that may be in the way of travel. This device can also be used to lower equipment to providers “over the side” and for light rescue.

Caregiver Seats and Safety Belts
Padded seats and safety belts are provided for the caregiver in the medical treatment areas in the rear of the ARV.

Hi-Lift® Jack (ARV 1)
A Hi-Lift® jack is provided in the ARV for those occasions where jacking the vehicle would be necessary.

Directional Off Road Tires
Directional tires on the ARV 1 provide improved traction in off road conditions. The offset of the rear wheels was increased approximately 8 inches overall to improve stability and overall weight distribution.

ARV 1 with L.E.A. 1
ARV 1 in a deployed condition showing the Satellite Dish and the Light Equipment Apparatus (L.E.A.). The L.E.A. can be deployed to carry additional equipment, supplies, or to provide logistical support between units. The L.E.A. carries an additional 10 gallons of fuel to supply the deployed ARV and generator.

Side Steps and Side Safety Panels
Side steps on the driver side (shown here) and the passenger side provide a step for entry into the vehicle as well as access to the equipment stored along the sides of the roof. The side panel provides a safety feature for the driver and passenger to keep feet in and obstructions encountered in off road travel out.

Light Equipment Apparatus (L.E.A.)

Light Equipment Apparatus (L.E.A.)
The L.E.A. utilizes the bed that was initially removed from the Polaris ARV. It supports field operations by providing an easily transportable trailer for equipment and other logistical supplies and 10 gallons of fuel for the generators and the ARVs. Off road wheels can serve as spares for the ARVs if needed. A lockable storage box provides a secure location for additional supplies or

Light Equipment Apparatus (L.E.A.)

equipment.

The L.E.A. can be outf itted with a dditional eq uipment such as a satellite d ish, network tripod, generator, communications equipment, repeater, etc., to su pport a mission and left in pla ce to provide a network cloud or access point for the command post or deployed units.

Transport Trailer

Transport Trailer
A flatbed trailer is provided to tra nsport an ARV and L.E.A. to a trailhead or command po st for deployment to remote locations. Shown is a 16-fo ot flatbed tr ailer with rear access ramps.

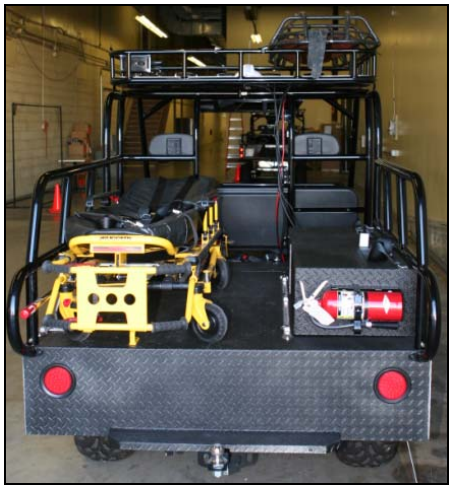
ARV 2 – Loma Linda Fire Department

Off Road Driving Lights
Off Road driving lights a re provided to improve visibility during off road travel i n dark conditions. This improves safety and identificat ion of hazards on the road at night. Future additions would include Code 3 lights and siren.

The communications pod is provided for additional communications equipm ent and as the control pod for the future addition of Code 3 Emergency Lights, Strobe, and Siren.

Side Steps and Side Safety Panels
Side steps on the driv er side (shown here) and the passenger side provide a step for entry into the vehicle as well as access to t he equipment stored along the sides of th e roof. The side panel provides a safety feature for the driver an d passenger to keep feet in and obstructions encountered in off road travel out.

ARV 2 – Loma Linda Fire Department



Patient Care Area and Caregiver Area
The rear of the ARV was extended to hold a Stryker Gurney, medical personnel, and storage without incursion into the passenger compartment. This provides additional safety for the driver as well as easy access to the patient by caregivers.

Patient Gurney
The patient gurney is affixed to the back of the ARV in the same manner as in an ambulance. Safety arms secure the gurney when positioned on the rear platform and a safety pin prohibits completely removing the gurney without first deploying the wheel structure.

The rear portion of the ARV provides additional storage space when not carrying a gurney and ample securing points allow tie downs for the Stokes basket when carrying a patient.

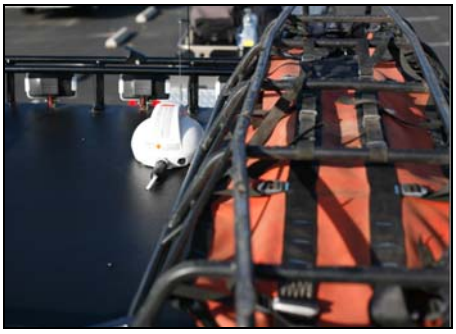
ARV 2 Fuel Tanks
A specially designed fuel tank was included in ARV 2 to increase the fuel capacity. It holds approximately 6 gallons more fuel than the standard fuel tank included in the Polaris Ranger, providing a much extended range over the stock fuel configuration. The original sending unit was adapted providing standard fuel level sensing by the driver/operator.

Upper Equipment Rack (ARV 2)
The upper equipment rack provides storage for rescue equipment. Here a Hi-Lift® Jack is shown.

ARV 2 – Loma Linda Fire Department

Patient Care Area and Caregiver Area ARV 2
The rear p ortion of A RV 2 was set up similar as an ambulance with the patient to the left configuration. The bed is covered with a s pray on mat erial that provides a glare free platform and prevents corrosion. It also provides a non-slip surface for caregivers or other personnel in wet conditions.

Rear Support Rails
Rear support rails provide a safety feature for equipment and passen gers inside t he rear of the vehicle. The rails help keep passengers from falling out of the vehicle an d provide a handle for th em while traveling in off road conditions. It is a lso a n attachment point for securing equipment to the in side of the vehicle or to a trailer fo r transport.



Upper Equipment Rack and Stokes Basket ARV 2
ARV 2 is fitt ed with a St okes Basket for light rescue and for carrying a patient who may be “over the side” or in an area that is inaccessible by the ARV.

Conclusions

Telemedicine has the potential to improve patient care in the prehospital setting. Specific applications include providing care in underserved or rural areas, initial triage and treatment decisions at disaster sites, and improved access to patients in difficult to access areas. Barriers to implementation of new systems often depend on the user's attitude. Interviews with prehospital providers in our region demonstrate that they are interested in using advanced telecommunication methods for the care of their patients. Although the technology exists to integrate these systems, most cities do not yet have the infrastructure to support the technology. Mobile mesh networks provide a method to set up these networks, either in anticipation of a planned mass gathering, or in response to a critical incident. Our research shows that with modification of existing available technologies, telemedicine technologies can be integrated into vehicles and portable communications systems that allow access to areas standard response vehicles would not be able to reach, thus improving patient access to the health care system.

References

1. McCraig LF, Burt CW. National Hospital Ambulatory Medical Care survey: 2003 emergency department summary. Advanced data from vital and health statistics; no.358. Hyattsville (MD) National Center for Health Statistics; 2005.
2. S. Lambe, D.L. Washington and A. Fink *et al.*, Trends in the use and capacity of California's emergency departments, 1990-1999, *Ann Emerg Med*. 2002; 39: 389–396.
3. Bindman AB, Keane D, Lurie N, A public hospital closes. Impact on patient's access to care and health status. *JAMA*.1990; 264(22):2899-2904.
4. National Center for Health Statistics, Health, United States, 2006, With Chartbook on Trends in the Health of Americans, Hyattsville, MD, 2006.
5. Sidell FR: Chemical agent terrorism. *Ann Emerg Med.*1996; 28: 223-224.
6. Peek-Asa C, Kraus JF, Bourque LB, Vimalachandra D, Yu J, Abrams J. Fatal and hospitalized injuries resulting from the 1994 Northridge earthquake. *Int J Epidemiol*. 1998 Jun;27(3):459-65.
7. Leonard RB, Stringer LW, Alson R. Patient-data collection system used during medical operations after the 1994 San Fernando Valley-Northridge earthquake. *Prehospital Disaster Med.* 1995; 10: 178-83.
8. Stratton SJ, Price Hastings V, Isbdll D, Celentano J, Ascarrunz M, Gunter CS, Betance J. The 1994 Northridge earthquake disaster response: The local Emergency Medical Services Agency experience. *Prehospital Disaster Med* 11(3):172-179, 1996.
9. The Federal Response to Hurricane Katrina: Lessons Learned. The White House Report, February 2006. Accessed at: http://www.whitehouse.gov/reports/katrina-lessons-learned.pdf
10. Schultz CH, Koenig KL, Lewis RJ. Implications of hospital evacuation after the Northridge, California earthquake. *N Engl J Me.d* April 2003; 348: 1349-55.
11. Ellis MS, Hurricanes provide impetus for health system reform in Louisiana. *Md Med.*, 2006. Autumn; 7(3):22-5.
12. Mattox KL, Wall MJ, Indeck M, et al: Blunt thoracic trauma. Analysis of 515 patients. *Ann Surg.* 1987; 206:200-205.

13. Yi-Szu W, Chung-Ping H, Tzu-Chieh L, Dar-Yu Y, Tain-Cheng W. Chest injuries transferred to trauma centers after the 1999 Taiwan earthquake. *Am J Emerg Med*. 2000 Nov;18(7):825-7.
14. Farmer JC: Providing critical care during a disaster: the interface between disaster response agencies and hospitals. *Crit Care Med* 2006; 34(3 Suppl): S56-9.
15. Ayyagari A, Bhargava A, Agarwal R, Mishra SK, Mishra AK, Das SR, Shah R, Singh SK, Pandey A: Use of telemedicine in evading cholera outbreak in Mahakumbh Mela, Prayag, UP, India: an encouraging experience. *Telemed J E Health* 2003; 9(1):89-94.
16. Teich JM, Wagner MM, Machenzie CF, Schafer KO: The informatics response in disaster, terrorism, and war. *J Am Med Inform Assoc.* 2002;9(2):97-104.
17. Houtchens BA, Clemmer TP, Holloway HC, et al: Telemedicine and international disaster response: medical consultation to Armenia and Russia via a Telemedicine Spacebridge. *Prehospital Disaster Med.* 1993;8(1):57-66.
18. Balch DC, West VL: Telemedicine used in a simulated disaster response. *Stud Health Technol Inform.* 2001;81:41-5.
19. Plischke M, Wolf KH, Lison T, Pretschner DP: Telemedical support of prehospital emergency care in mass casualty incidents. *Eur J Med Res.* 1999; 4(9):394-8
20. Garshnek V, Burkle FM Jr.: Applications of telemedicine and telecommunications to disaster medicine: historical and future perspectives. *J Am Med Inform Assoc.* 1999;6(1):26-37.
21. The American College of Emergency Physicians (ACEP). The National Report Card on the State of Emergency Medicine. Evaluating the Emergency Care Environment State by State. Jan 2009. Accessed at: http://www.emreportcard.org/default.aspx.
22. The American College of Emergency Physicians (ACEP). Health care system surge capacity recognition, preparedness, and response. Policy statement. *Ann Emerg Med.* February 2005; 45: 239.
23. Health Resources and Services Administration (HRSA): National Bioterrorism Hospital Preparedness Program: FY2004 Continuation Guidance. HRSA Announcement Number 5-U3R-05-001. Jul 2005. Accessed at: ftp://ftp.hrsa.gov/guidance/spb/hrsa05001.pdf
24. Koenig, K. L., Cone, D. C., Burstein, J. L., Camargo, C. A. Jr. (2006). Surging to the Right Standard of Care. *Acad Emerg Med.* 13: 195-198.
25. Derlet R, Richards J, Kravitz R. Frequent overcrowding in US emergency departments. *Acad Emerg Med*. 2001; 8:151-155.
26. National Highway Traffic Safety Administration. Implementation Guide. Emergency Medical Services: Agenda for the future. 1996. Accessed at: http://www.nhtsa.dot.gov/people/injury/ems/agenda/index.html
27. Ellis DG, Mayrose J, Phelan M. Consultation time in emergency telemedicine using realtime videoconferencing. *J Telemed Telecare.* 2006; 12(6):303-5.
28. Roth A, Malov N, Carthy Z, Golovner M, Naveh R, Alroy I, Kaplinsky E, Laniado S. Potential reduction of costs and hospital emergency department visits resulting from prehospital transtelephonic triage—the Shahal experience in Israel. *Clin Cardiol*. 2000 Apr; 23(4):271-6.
29. Paunksnis A, Barzdziukas V, Kurapkiene S, Vaicaitiene R, Sereika V. An assessment of telemedicine possibilities in massive casualties situations [abstract]. *Rocz Akad Med Bialymst.* 2005; 50:201-3.
30. Japan Automobile Manufactures Association. “Volunteer Motorcycle Groups Active in Disasters,”, News from JAMA Motorcycle, September 2005.
31. Preto EA, Angus DC, Abrams JI, Shen B, Bissell R, Ruiz Castro VM, Sawyers R, Watoh Y, Ceciliano N, Ricci E. An analysis of prehospital mortality in an earthquake. Disaster Reanimatology Study Group. *Prehosp Disaster med.* 1994 Apr-Jun; 9(2):107-17.

32. Lin C, Chang H, Shyu K, et al. A method to reduce response times in prehospital care: The motorcycle experience. *Am J Emerg Med.* 1998;16(7):711-713.
33. Fu tat EL, Chan KH, VanRooyen MJ. Emergency Medicine in Hong Kong. *Ann Emerg Med.*1998;32(1):83-85.
34. Lim SH, Anantharaman V. Emergency Medicine in Singapore: Past, Present, and Future. *Ann Emerg Med.* 1999;33(3):338-343.
35. Personal communication from City of Redlands (California) Fire Department Battalion Chief Mitch McKee.
36. Grange JT, Bock HC, Davis SC. Motorsports EMS: An Emerging Subspecialty. *JEMS.* 2004; 29(5):92-4.
37. Halloway D, Hettrick WJ. The Loma Linda Connected Community Project: Project Description. Accessed at: http://www.llccp.net/project_description.html.

Appendices

Appendix A

EMS Provider Opinions of Telemedicine Utility

Miller, Davi MD; McPherson, Brett RN, BSN; Walters, E. Lea MD, FACEP; Guldner, Greg MD, FACEP

Abstract: To assess the utility of telemedicine technology in the pre-hospital setting, the opinion of the providers already in the field is useful for determining likelihood of impact. Implementation of telemedicine may be more useful for certain patient presentations than others. The first responders and field medical care providers are the front line to manage patients in remote settings and their assessment is crucial to the productive implementation of telemedicine. By providing the ability to image patients from the field and discuss individual patient situations with a physician using live audio-video feedback, patient assessment and treatment can progress beyond limitations currently encountered. EMS personnel would be able to provide the physician with a visual image of the situation and the patient involved. The physician, in turn, could obtain data from the field prior to patient transport to the Emergency Department, if deemed necessary. The question we ask currently is whether EMS providers think telemedicine would be useful to their management of patients, and if so, in what situations.

We surveyed 72 personnel from the Redlands, Loma Linda, and Colton Fire Departments to assess EMS provider opinion regarding the utility of telemedicine. 78% of first responders in the survey, whether EMT or paramedic, recall situations where input from a senior medical provider would have been helpful. The situations specifically referenced were traumas and critical medical resuscitations such as respiratory/cardiac arrests. Patient management for traumas and other procedure-oriented situations could be optimized, and many participants in the survey reference the ability to discharge patients from the field after being "seen" by the physician using telemedicine technology.

Based on these survey results, EMS providers who are not in proximity to a tertiary care center do encounter situations in the field where they believe telemedicine technology would optimize patient care. The potential benefits and drawbacks of telemedicine are discussed.

Introduction: Telemedicine can be invaluable for remote areas, where only alternative response vehicles can reach the patient in a timely manner. Telemedicine might allow these patients to be treated at the scene of a disaster, reserving transport resources for more critical patients thereby saving critical healthcare resources for those that need them the most. Telemedicine might bring expertise into an affected area immediately after, or even during a disaster. Just as telemedicine may be helpful in initiating timely care and providing guidance during a disaster this same technology may be adapted for the EMS provider for use during routine operations and may enhance care given in the field.

The DISCOVERIES project currently underway at Loma Linda University Medical Center &

Children's Hospital proposes to develop and demonstrate a method of bringing telemedicine to the point of patient illness or injury. The goal is to provide the capability of 'reinventing the house call', and provide telemedicine response to areas that are inaccessible to traditional response vehicles, allowing earlier patient evaluation, treatment, and transport decision-making. The DISCOVERIES Project attempts to design an EMS telemedicine system that can bring telemedicine directly into the home via emergency responders. One major advantage of telemedicine is the ability to deliver means for EMS providers to contact physicians in tertiary care centers for assistance with critical patients and situations that deviate from standard protocols.

By deploying telemedicine in the field, many of these goals are within reach. Telemedicine can reduce the number of unnecessary transports to the emergency department, creating more appropriate use of acute health care resources.

Telemedicine also improves the emergency physician's ability to care for the individual patient. Using audio-visual equipment, the receiving physician can remotely see what the paramedic sees. EMS personnel would be able to provide the physician with a visual image of the situation and the patient involved. The physician, in turn, could obtain data from the field prior to patient transport to the Emergency Department. This allows the emergency department to be prepared with the necessary personnel and equipment upon the patient's arrival. Ultimately, better preparation can result in better patient outcomes.

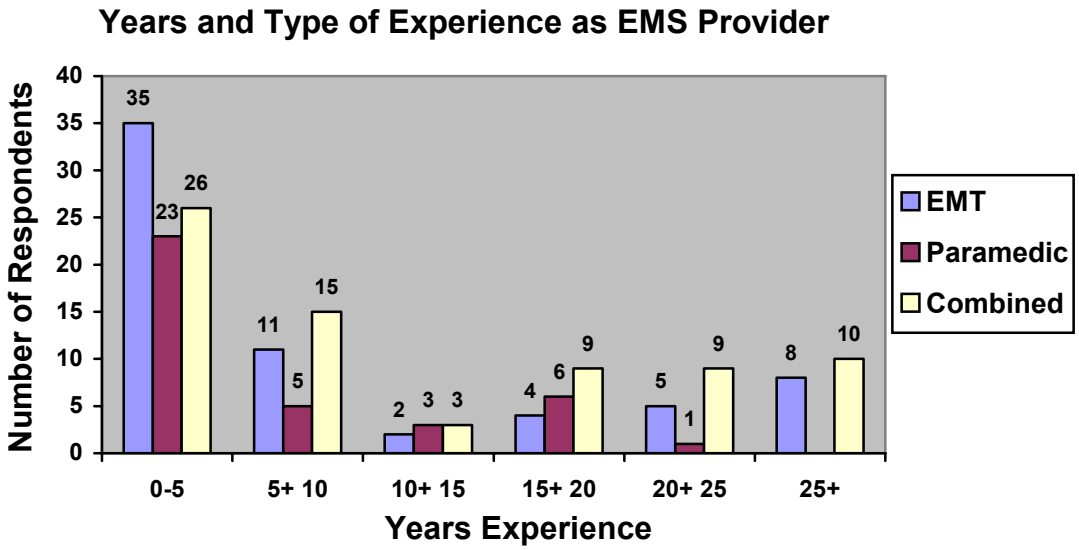
The opinion of the providers already in the field will help determine the likely impact of telemedicine technology in the pre-hospital setting.. Implementation of telemedicine may be more useful for certain patient presentations than others. The first responders and field medical care providers are the front line to manage patients in remote settings and their assessment and opinion is crucial to the productive implementation of telemedicine. We asked EMS providers their opinion of the utility of telemedicine in the management of their patients.

Method: Fire department personnel from the City of Redlands, City of Loma Linda, and City of Colton answered interview survey questions with responses transcribed by a liaison from the Loma Linda Medical Center for Pre-Hospital Care. The questionnaire results were collected over a 2 month period from July to August of 2008. 72 participants answered 5 questions with an open ended format. The fire department personnel were asked how long they had been an EMT or Paramedic, and if there had been any situations in their careers where another senior provider (medic, medical director, etc.) would have been beneficial to in caring for a patient in the field. Respondents who replied that they had been in such a situation were then asked how the input would have improved the situation, and how long they had been practicing when the incident occurred. The type of situation was classified as procedural or non-procedural. The final question inquired as to the benefit of audio-video communication in pre-hospital settings.

The responses were divided by years of training, as well as type of training (EMT vs. Paramedic)..Total years of experience as an EMS provider were used to categorize receptiveness to using telemedicine. Responses were grouped based on whether or not the provider believed additional input from a senior would have been beneficial. The type of situation referenced was divided into either trauma, cardiac arrhythmia/arrest, respiratory distress/arrest, and "dispatch error" (as termed by the respondents). The same categorization by 5 year increments of experience was also used to group responses regarding the benefit of audio-video communication. For this question, situation types fell into the categories of pediatric patients, patients signing out against medical advice (AMA), and discharges from the field.

Results: Most respondents had been an EMT or Paramedic for 5 years or less (Table 1). Note that some EMS providers start as EMTs and then become certified as paramedics, therefore only the combined years of experience reflects the 72 participants in the survey.

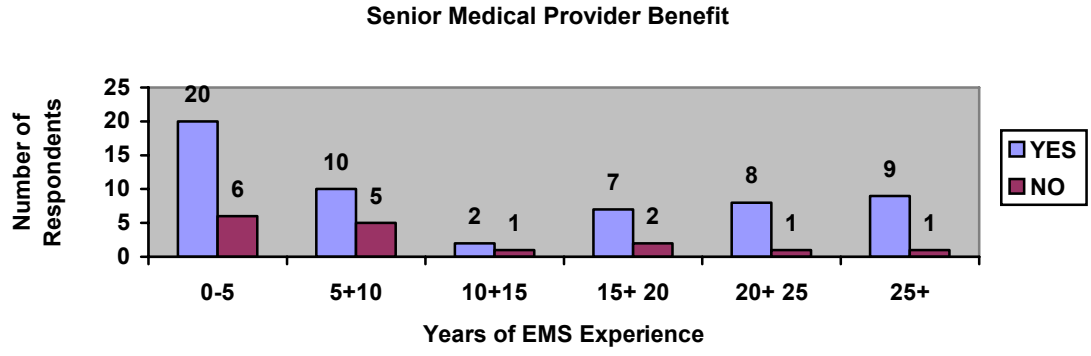
TABLE 1



7

7% of providers with 0-5 years of experience were involved in a situation where having a senior available would have been beneficial. For all respondents, 78% thought a senior would have been helpful. In each 5-year increment of experience as an EMS provider, the majority favored having input from a senior medical provider available (Table 2).

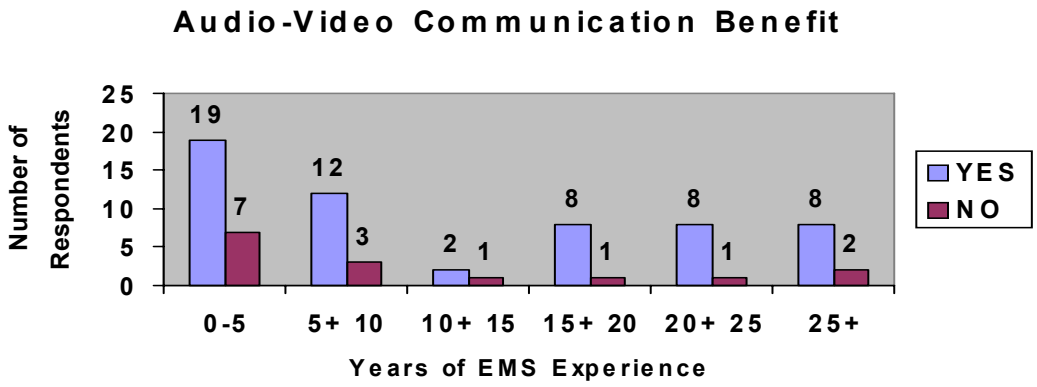
TABLE 2



27 respondents described 31 specific situations where a senior provider would have benefited the patient. 13 of the 27 respondents (48%) included cardiac arrhythmia/arrest, 9 (33%) included traumas, 7 (26%) included respiratory distress/arrest, and 2 (7%) included "dispatch error" where the EMS provider felt that a higher acuity transport would have been appropriate.

The majority of respondents also favored ha ving audio-visual input available in the pre-hospital setting. 73% of respond ents with 0-5 years of experience, and 79% of all responden ts favored audio-video communic ation for ce rtain circumstances to optimize patient care. See Table 3 below.

TABLE 3



51 respondents described 80 spe cific situations where audio-video communication would have improved t he situatio n in the f ield. 30 of the 51 respondents believed establish ing communication to a re ceiving physician would have been helpful. 18 (35%) respo ndents cit ed traumas, 9 (18%) inclu ded pediatric patients, 8 (16%) included disch arges from the field, 7 (14%) inclu ded criti cally ill medica l patients, 4 (8%) incl uded AMA's, and 4(8 %) included respiratory difficulty/arrest.

Of the 15 respondents who did n ot believe audio-video communic ation to be potentially beneficial, 2 stated th at their pro ximity to the tertiary care centers nullif ied th e benefits of telemedicine. 2 other re spondents in this group were concerned for the loss of autonomy of the EMS provider by bringing in a physician who would observe and instruct them in the field.

Conclusion: Few patients have access to the expertise lo cated in centralized ter tiary care medical cen ters. These resources may be hel pful to para medics on t he street, medics on t he battlefield, a nd search and rescue teams, as well as those in rural communities, underserved communities, and wilderness settings.

A method of bringing telemedicine to the point of patient illness or inju ry and to areas that are inaccessible to tradition al response vehicles w ould allow e arlier patien t evaluation, treatment, and transport decision making. Telemedicine, innovative response vehicles, and point-of-care testing and treatment technologie s will allow t he expertise of a terti ary referral emergenc y department to be delivered at the point of injury or illness during emergencies and disasters.

The 1996 *EMS Agenda for the Future* united the man y professional g roups involved with EMS in the com mon goal of improving system perfo rmance. The National Highway Traffic Safet y Administration (NHTSA) supported the creation of this consensus-base d national EMS strategic plan. These experts believed that EMS must be integrated with other services and systems that are intended to maintain and impro ve community health and ensure its safety. The vision of the panel is that the EMS of the future will have th e ability to identify and modify illness and injury

risks, provide care and follow-up, and contribute to treatment of chronic conditions and community health monitoring. It will help improve community health and result in more appropriate use of acute health care resources (Delbridge 251).

In 1995 sarin gas was intentionally released in a Tokyo subway. Within several hours of the incident, 5,510 people sought medical attention at more than 200 hospitals and clinics in the greater Tokyo area, with 75% of the patients showing no signs of exposure (Sidell 223). After the 1994 California earthquake in Northridge, 1,500 people sought care at hospitals in the immediate aftermath, with 138 patients admitted (McArthur 361). A randomized telephone survey conducted after the earthquake estimated that 24,000 persons suffered at least a minor injury for which they sought medical attention (McArthur 361). Hospital emergency departments can become overwhelmed by the "walking wounded" who may require medical care from a knowledgeable practitioner, but do not need treatment at the hospital. Ambulatory patients with minor injuries tend to be the first to arrive at the emergency department and can divert care from more critically injured patients that reach the hospital later because they required transport assistance (SEMP 2002). Emergency responders outfitted with telemedicine equipment that allows them to access medical control may be able to make better transport decisions, including the decision to not transport.

Based on the questionnaire results above, EMS providers do encounter situations where telemedicine technology would optimize patient care. The responses from 72 EMS providers indicate that most encountered at least one situation in which they believed additional input from a senior medical provider or physician would have benefited the patient or improved the situation in the field. Critically ill medical and trauma patients make up the majority (94%) of the cases referenced by the respondents. These complicated and critical patients require more resources, time, and higher levels of care from EMS providers who are the first responders. Both procedural and non-procedural assistance from a medical provider with more experience would have improved the critical situation according to 78% of the respondents in the survey. Most ambulance transports may not require critical resuscitative measures to be performed, but EMS providers prefer to have a senior medical provider available when encountering these patients.

The respondents to this questionnaire also believed the ability to make visual contact with receiving physicians in tertiary care centers would help patient outcome in certain situations. More than half of the respondents who believed audio-video communication would be useful stated that simply "painting a better picture of the scene" using these telemedicine capabilities might help optimize patient care. These respondents stated that audio-visual communication would provide the receiving facility with a better idea of the severity of certain situations, or even the lack thereof, such that a patient with improved condition might be discharged from the field rather than transported to the hospital. More than 10% of all respondents cited discharges from the field as a reason to establish audio-video contact with a physician to help optimize resource utilization and decrease hospital overcrowding.

Video telemedicine was the focus of a study in Taiwan to perform pre-flight screening of patients for air medical transports. The results of the study demonstrated a significant reduction of unnecessary air medical transports and consequent cost reduction (Tsai 504). An additional benefit of audio-video communication is the assessment of the potentially critically ill child - more than 10% of all respondents included pediatric patient calls in situations where they believed video contact with a physician would have benefited patient outcome.

While some respondents expressed concern for a loss of autonomy with the implementation of

telemedicine capabilities (3% of total participants), the overriding majority believed that access to discussion with a senior medical care provider can provide increased knowledge in critical situations. The telemedicine capabilities of the DISCOVERIES Project will allow specialty physicians at a command center to be "virtually" present in the field so that critical medical assessment and interventions can be started sooner. They can perform triage, ensure that patients are transported to the most appropriate destination, and supervise field personnel in procedures and treatments at point of contact in those circumstances where they are most needed. Telemedicine can bring the medical expertise of a tertiary care center to the site of injury anywhere in the world: local military bases, remote military hospitals, and combat zones. Using telemedicine will allow earlier diagnosis and treatment, which may decrease morbidity and mortality. In addition, telemedicine may help prevent hospital transfers that are not medically indicated, thereby decreasing emergency department overcrowding.

Implementing telemedicine technology in the pre-hospital setting depends heavily on the cooperation provided by the medical personnel in that setting. The perception of EMS providers regarding the usefulness of this technology will affect the ultimate impact of telemedicine capabilities.

Appendix B
First Responder Questionnaire

Note: These questions were conducted during individual interviews with the paramedics. Their responses were written down by the interviewer.

1. How long have you been an EMT/Paramedic?
2. Has there been any situation in your career where you feel another senior (medic, medical director) would have benefited you during care provided to a patient/s? If so what was the situation? How would their input have benefited the situation?
3. How long had you been practicing when this incident occurred?
4. What was it specifically related to? Procedural vs. Non-procedural? Or ask, Do you find when you are having difficulties or questions during the care of a patient, that it is a procedural issue vs. a Non-procedural issue? (#4 only needs to be asked if they describe a scenario that you're unsure whether it's procedural issues they wanted help with or non-procedural decision making.)
5. Do you believe there may be pre-hospital situations where audio and video would benefit the care you provide in the pre-hospital setting (other than those listed above)? If so, could you describe them?

Appendix C
Prehospital and Telemedicine Protocols

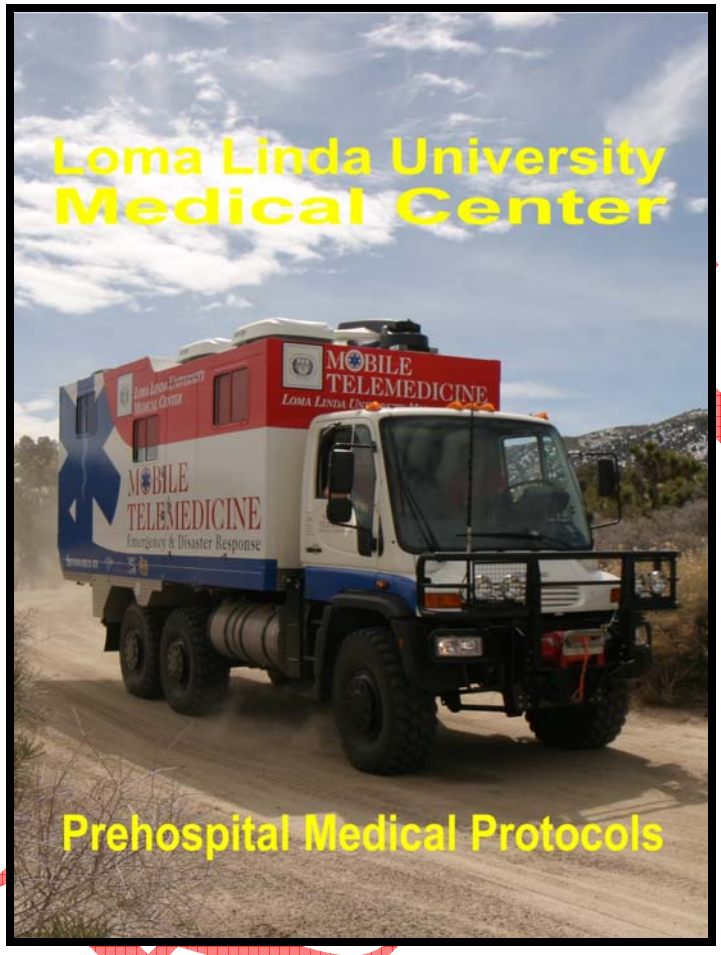


TABLE OF CONTENTS

MEDICAL TREATMENT PROTOCOLS
FOR LLUAHSC Prehospital Providers

These medical treatment protocols are provided as guidelines for the treatment of people requesting medical care.

Loma Linda University Adventist Health Sciences Center (LLUAHSC) medical personnel (including nurses, paramedics, EMTs, physician assistants, nurse practitioners, etc.) operate under the medical direction of the Loma Linda University Medical Center EMS Medical Director or their designee. Medical personnel are expected to provide care consistent with their training, expertise, experience, scope of practice and constraints of their licensure. Except as excluded by those constraints, staff may provide care consistent with current guidelines for basic prehospital care such as International Trauma Life Support (ITLS, PHTLS), basic life support (BLS), advanced cardiac life support (ACLS), advanced pediatric life support (APLS), pediatric advanced life support (PALS), advanced trauma life support (ATLS) and the Inland Counties Emergency Services Agency (ICEMA)protocols. Nothing in these medical protocols should be interpreted to supersede any relevant federal, state, local or other laws and/or regulations.

IN SOME CASES MEDICAL STAFF MEMBER LICENSURE MAY PERMIT TREATMENT BEYOND WHAT IS DESCRIBED IN THESE TREATMENT PROTOCOLS. THESE PROTOCOLS ARE NOT MEANT TO PRECLUDE THE USE OF SKILLS AND TREATMENT NOT LISTED HERE THAT ARE CONSISTENT WITH LICENSURE, EXPERIENCE, AND SOUND MEDICAL JUDGMENT.

LLUAHSC Prehospital personnel are directed to utilize these treatment protocols as guidelines for patient care unless specifically instructed to the contrary by the Base Hospital physician. LLUAHSC medical personnel are encouraged to make base hospital physician contact with Loma Linda University Medical Center when any questions arise as to the medical treatment to be provided to a patient.

Scope

The protocols contained in this document cover the rendering of first aid and care by LLUAHSC Prehospital personnel to patients outside the context of the hospital or other traditional clinic settings. This may include mass gatherings and public events, declared federal or state disasters, or situations where traditional medical care is adversely affected.

RESPONSIBILITY FOR PATIENT MANAGEMENT AT THE INCIDENT SCENE

Responsibility for patient management at the scene of an emergency and during transport is vested in the licensed or certified health care professional who is most medically qualified to render emergency medical care.

EXTENT OF SCENE TREATMENT

In the prehospital environment, scene safety and control can be a challenge. In all cases, the safety of the responding personnel, the patient, and bystanders must be considered prior to entering the scene to provide treatment. The use of appropriate personal protective equipment is required. Additional personnel or the assistance of fire, security, or law enforcement personnel may be required if personal safety can not be secured.

During actual medical emergencies (potentially life or limb threatening), care may be provided as appropriate to stabilize such patients. However, this should not interfere with rapid transportation of the patient to a hospital as soon as is practical via usual EMS system or by other appropriate and approved methods. Except for safety and airway concerns it is usually advisable during such scenarios to limit on scene assessment/treatment and provide necessary assessment/treatment while en route to the hospital. Patients without potential life or limb threatening injuries may be treated on scene utilizing these protocols. Every patient treated for more than basic first aid should be advised to follow up with their primary care or emergency department physician as needed.

An approved Prehospital Patient Care Record must be completed by treating personnel for all patient contacts. Patient consent to treatment must be signed and witnessed. Patient refusal of medical care must be documented utilizing the "medical Liability and Release Form" and the protocols included in this document.

UTILIZATION OF TELEMEDICINE FROM AN EMERGENCY TREATMENT SITE

If it is dete rmined that a Telemedicine Consu ltation will be required for the treatment of a patient, the following guidelines shall be observed:

PATIENT INFORMED CONSENT:
Obtain a signed con sent form from the patient immediately prior to the telehealth examination/consultation. If it is anticipated that photos or video of the Telemedicine Consultation may be recorded, obtain con sent for p hotos and/ or video (See *forms*). Examinations and consultations may not proce ed without a signed co nsent form on file. An original copy of the consent form will be kept in the patient's file.

INITIATING THE TELEMEDICINE CONSULTATION:
The Emergency Site representative should initiate the consult with the Emergency Department or other designated telemedicine site. If a consultant is available, the consultation may begin immediately. If the consultant is not immediately available, the Emergency Site representative should ascertain if the consultant is available at another telemedicine site, or at what time the consultant will be available. The Emergency Site representative should decide if the patient should be transported or if the patient is able to participate in the consultation at a later time.

PATIENT EXAMINATION:

1. Confidentiality
    a. The Emerg ency Site representative should explain to patie nts particip ating in a telehealth t hat the syst em is confidential; that no video taping of th e exam is done, unless spe cifically consente d, and that no one except the consulting provider and patient pr esenter will be in the ex am room at either the patient or consultant site, without the patient's knowledge and approval.
    b. The patient exam area at the emergency treatment site should be clea red of all personnel and observers, except th ose directly required for the consultation and specifically approved by the patient.
    c. The consulting provider will introduce himself or herself to the patient before the exam begins. The consulting provid er will ask t he patient' s permission to have any other p erson in the room to ob serve the exam. If the patient declines, the observer must leave the telehealth room.
    d. All patient information disclosed during a Telemedicine Con sultation is subject to Patient Privacy Protections, excep t for the e xclusions listed in the patient consent.
2. The telehealth patient exam ma y in clude an exam performed by Emergency Treatmen t Site medical staff, and any additional exam requested by the Teleh ealth Consultant. Additional information that may b e relayed to the Consultant may include specific historical a nd physical finding s, laboratory and other te st resu lts, and radiogr aphic images.

3. A patient may choose to decline any further Telemedicine Consultation at any time during his/her evaluation.

INFECTION CONTROL MEASURES:

1. Personnel at the Emergency Treatment Site will use Personal Protective Equipment as directed by standard policies and procedures.
2. Personnel at the Emergency Treatment Site shall ensure that the patient is provided necessary infection control equipment.
3. Personnel at the Emergency Treatment Site will ensure that all standard policies and procedures for infection control of the examination area are performed after completion of the Telemedicine Consultation.

MEDICATIONS

The use of medication and treatment guidelines listed here assumes you have checked to assure there are no contraindications to their use and no history of adverse reactions to them or similar forms of treatment.

MINOR MEDICAL PROBLEMS AND FIRST AID

LLUAHSC Prehospital medical personnel may provide basic first aid for minor illnesses and injuries consistent with their training, experience, scope of practice and level of licensure in accordance with accepted principles of basic first aid. Requests for acetaminophen (Tylenol), ibuprofen (Advil, Motrin), aspirin, Band-Aids, antacid, burn spray, suntan lotion, cotton ear plugs, and other simple first aid items or other over-the-counter medications may be complied with provided the person is over 18 years of age, there is no history of allergies or other contraindications, and no indication there is a more serious medical problem responsible for the request. These requests and the action taken must be recorded on the LLUMC Prehospital Patient Care Record or other approved form.

PRECAUTIONS:

1. Always check for allergies or a history of adverse reactions before giving any medication.
2. **Ibuprofen (Motrin/Advil)** should not be given to people with aspirin sensitivity or asthma unless they have taken it in the past without any adverse reaction.
3. **Aspirin and ibuprofen** should be avoided in people with ulcer disease, asthma, or a history of GI bleeding or anticoagulant use.
4. **Acetaminophen (Tylenol)** should not be given to patients with a history of liver disease or a predisposition to liver disease such as heavy alcohol use.

WOUND CARE

Uncomplicated wounds, not associated with other more serious injur ies, and like ly to heal without scar ring, disfigur ement, or lo ss of f unction, may be assessed by appropriately trained staff members (RN, NP, PA, MD).

1. Appropriate cleansing of the wound should be completed.
2. Wounds tha t will in al l probability heal with a g ood result without sutu ring may be steri-stripped or dressed (whichever is appropriate) after routine wound care.
3. Determine Tetanus immunization status and treat or refer as required.

GENERAL PROTOCOL

1. Confirm scene safety. Perform a quick, comprehensive patient asse ssment that ascertains the status of the airway/c-spine, breathing and circulation, taking action as needed to care for problems with the **ABCs**.
2. Determine t he chief complaint, me chanism of injury, past medical hist ory, allergies, current medications, etc. as applicable.
3. Initiate tran sport of patient via EMS sy stem o r by other a ppropriate a nd approved methods to the hospital as soon as possible an ytime there is a potentia l life or limb threatening injury.
4. Initiate treat ment as described in t hese protocols. Consid er cardiac monitor, high flow oxygen and IV access as clinically indicated.
5. Contact a b ase hospital for further d irection as needed. Re member, medical control for all med ical person nel (except physicians) comes u nder the b ase hospita l physician once base hospital contact is made.
6. Medical Oversight is established by ut ilizing the referenced protocols an d standards of practice, establishe d by the EMS Medical Di rector or their physicia n designee, and/or by an onsite physician approved b y the EMS Medical Director or their designee. Authorized physicians
7. Transport to most appropriate hospital.
8. Document every patie nt encount er on Loma Linda University Medical Cent er Prehospital Patient Care Record

RAPID SEQUENCE INDUCTION (RSI) & ET INTUBATION

PRIORITIES:

- ABCs
- Monitor changes in cardiac status
- Periodic reassessment of airway
- Consider early transport

FIELD ASSESSMENT/TREATMENT INDICATIONS:

- Non-responsive and no respirations present with rigidity of the jaw
- Respirations are failing, gag reflex present
- Head injured with Glasgow Coma Scale eight (8) or less
- Airway protection and/or adequate ventilation cannot otherwise be maintained.
- Severe inhalation injury with potential/actual airway compromise.

RELATIVE CONTRAINDICATIONS:

- This method of intubation is to be used cautiously on patients with obvious cervical spine injury
- Intubation may be initially contraindicated on pa tients that are known diabetics or h eroin overdose cases prior to administration of Narcan or Dextrose
- RSI endotracheal intubation shall only be used when adequate means of ventilating the patient are readily available and the airway ca n be maint ained post RSI if intubation attempt is unsuccessful

PROCEDURE:

- Ensure a p atent airwa y. Use in-li ne cervical immobilization as needed for susp ected head or neck injury
- Support ventilations with appropriate basic airway adjuncts.
- Place on cardiac monitor and pulse oximeter
- Ensure an open, secure, and functioning IV line
- Prepare and label medications for administration as appropriate
    - Lidocaine
    - Atropine
    - Etomidate
    - Succinylcholine
    - Vecuronium
    - Midazolam (Versed)
- Patient should be ventilated at lea st thirty (30) seconds with maxi mum deliverable O2 flow prior t o intubation attempt while the int ubator prepares patient and intuba tion equipment

Bag-valve-mask connected to oxygen delivery device
Suction
Oral intubation equipment
Alternative airway equipment

- Administer lidocaine 1.5mg/kg IVP for head injured patient to prevent increased intracranial pressure
- Position the patient, with head in sniffing position (or in-line cervical immobilization for possible neck injuries) and stop external cardiac compressions if CPR is in progress when necessary
- Begin Sellick maneuver (cricoid pressure should be applied prior to intubation to protect against regurgitation of gastric contents)
- For pediatric patients (< 5 years old), administer Atropine 0.01 mg/kg IVP (minimum 0.1mg, maximum 0.4mg)
- Administer Etomidate (Amidate) 0.3 mg/kg IV over 30 seconds (usual adult dose = 20mg)
- Administer Succinylcholine (Anectine) 1.5 mg/kg IVP for adults (usual adult dose = 100mg) or 2.0 mg/kg for children under 13 kg.
- Visualize the epiglottis and cords with the laryngoscope. Insert the endotracheal tube until the entire balloon is past the vocal cords. Inflate the balloon with air to the point where no air leak can be heard, and resume ventilation with 100% oxygen
- Assure correct tube position by observing chest expansion with ventilation and by noting adequate breath sounds and absence of gastric bubbles. An end tidal CO2 detector should be used as a secondary confirmation of tube placement. Release cricoid pressure
- Placement efforts must stop after thirty (30) seconds or for a decreasing pulse oximetry of 90% or less. Immediately rehyperoxygenate the patient for at least thirty (30) seconds before another attempt
- Reinsert an oral airway to prevent the patient's biting the endotracheal tube. Suction the trachea if necessary observing appropriate aseptic techniques
- Secure the endotracheal tube with tape or other device
- Consider restraining patients hands to prevent self extubation as appropriate
- Consider naso/orogastric tube placement
- Consider transport to closest most appropriate hospital

OTHER TREATMENT CONSIDERATIONS:

- If inadequate relaxation is present, repeat succinylcholine once. Remember it is always better to give a slightly higher dose of succinylcholine rather than too low of a dose.
- Treat bradycardia occurring during intubation with Atropine 0.01mg/kg IVP and by temporarily halting intubation attempts and hyperoxygenating the patient with the BVM and 100% oxygen
- If intubation is unsuccessful, ventilate the patient with the BVM until spontaneous ventilations return (usually 6-10 minutes)
- Re-evaluate the patient. If endotracheal intubation is unsuccessful and it is not possible to ventilate the patient with the BVM, consider an alternative airway such as a nasotracheal intubation, combitube, or other approved alternative airway device as indicated.

- Remember, if the patie nt who has been intub ated to pro vide airway control st arts to regain motor control and is in danger of dislodging the airway, it may be necessary to re-medicate.
- Maintenance of paralysis should be obtained, as appropriate, with Vecuronium (Norcuron) 0.1 mg/kg IV. (duration 15-30 minutes)
- If the patient's level of consciousn ess indicates the need, Midazolam (Versed) may also be administered as follows:

  Adults: 1 mg IV slowly q2-3 minutes up to 5mg while maintaining systolic b.p. >90
  Peds (6mo.-12yo): Initial dose 0.05 mg/kg IV, then titrated to max 0.4 mg/kg

CERVICAL COLLAR

Cervical spine immobilization will be applied to all trauma patients whenever cervical spine injury is a possibility. Cervical spinal immobilization should be applied to all intubated pediatric patients to limit mobility and prevent accidental extubation. All trauma patients are to be transported in full c-spine precautions unless c-spine has been definitively cleared by a transferring physician.

1. Check and document motor and sensation to the extremities before and after application. Manually immobilize during initial assessment.
2. In general, cervical spine immobilization optimally requires two people for application - one to maintain alignment/immobilization and the other to apply the collar.
3. Cervical spine immobilization is not considered complete until the patient is secured to a rigid board with a c-collar, head support, and straps.

PATIENT REFUSAL OF MEDICAL CARE

Sensitivity to the needs and concerns of the patient, crewmembers, law enforcement, family and friends is essential. A competent adult has the legal right to refuse care even though the refusal of care may be against the advice of the LLUAHSC Prehospital care provider and/or the base hospital physician. In the event a conscious, competent adult patient or legal guardian refuses treatment and/or transportation to a medically appropriate facility, the signature of the patient or legally responsible adult should be obtained on the "Medical Liability and Release Form" form. Care should be taken to explain the reasons care is recommended and the adverse outcomes that could result from refusal of care. Contact the base hospital physician if you feel additional intervention might be helpful in resolving the situation. The following documentation is required for patients refusing care:

1. Physical exam
2. Evidence that the patient was alert, oriented and appropriate for their age
3. Indications that there were no signs of significant impairment due to drugs, alcohol, organic causes or mental illness.
4. Anything else that made you believe that the patient was mentally capable.
5. The fact that you offered treatment and transportation.
6. What you told the patient about the nature of the illness/injury and the specific risks of refusal for the medical condition. (Use "quotes" as appropriate."
7. The indications that the patient understood the risks.
8. What the patient specifically said about why he/she is refusing treatment/transport. (Use "quotes" as appropriate.)
9. Your efforts to encourage the patient to seek care.
10. The person(s), if any, who remained to look after the patient.
11. The name of the interpreter, if applicable.

CARE OF MINORS

1. **Life-threatening Situations:** If a parent or qualified legal representative is not present, immediate treatment and/or transport to a medical facility should be initiated without delay.

2. **Non-life-threatening Situations:** If, in the opinion of the medical personnel, a minor requires treatment and/or further evaluation, one should make a reasonable attempt to contact a parent or other legally qualified representative before initiating treatment or transport. However, if a parent or legal representative cannot be reached, medical personnel should provide necessary care.

Parental consent is generally not needed for care in non-life-threatening situations when:

a. Minor is emancipated
b. Parent has given written authorization to procure medical care to any adult (over 18) taking care of minor
c. Minor 12 years or older is alleged victim of rape
d. Minor is victim of a sexual assault (applies to both boys and girls and has no age limit)
e. Minor seeks prevention or treatment of pregnancy.
f. Minor is 12 years or older and seeks medical or hospital care or counseling relating to diagnosis and treatment of drug or alcohol related problem

SITUATION IN WHICH MINOR REFUSES CARE

a. Contact the base station physician and apprise them of the situation
b. Attempt to contact the minor's parents or other legally qualified representative for permission to treat or transport the minor
c. Request to have the patient taken into custody by law enforcement in order that treatment or transport can be instituted when appropriate.

DENIAL OF PREHOSPITAL MEDICAL TEAM STATUS

PURPOSE: To establish policies for the denial of an application for initial or continuing to provide medical care with the Center for Prehospital Care, Education and Research

POLICY: The CPCER Medical Director shall adhere to the following guidelines in considering denial of an application to provide medical care with the Center for Prehospital Care, Education and Research.

1. General considerations for denial:

Any employee violating or attempting to violate any Policy and Procedure set forth by Human Resource Management as it pertains to employment by LLUMC.

- Gross negligence in providing prehospital care services.
- Repeated negligent acts in the provision of prehospital care services.
- Incompetence as a prehospital care provider.
- Conviction of any crime which is substantially related to the qualifications, functions, and duties of prehospital personnel.
- Violating or attempting to violate directly or indirectly assisting in or abetting the violation of, or conspiring to violate, any provision of the California Health and Safety Code or the regulations (Title 22, etc.) promulgated by the State EMS Authority pertaining to prehospital care personnel.
- Violating or attempting to violate any federal or state statute or regulation which regulates narcotic, dangerous drugs, or controlled substances.
- Addiction to the excessive use of, or the misuse of, alcoholic beverages, narcotics, dangerous drugs, or controlled substances.
- Functioning outside the supervision of medical control/protocols in the prehospital field care system
- Demonstration of irrational behavior or occurrence of a physical disability to the extent that a reasonable and prudent person would have reasonable cause to believe that the ability to perform the prehospital care duties normally expected may be impaired.

2. Specific cases where denial is strongly indicated:

- The applicant is required under Section 290 of the Penal Code to register as a sex offender for any offense involving force, duress, threat, or intimidation.
- The applicant habitually or excessively uses or is addicted to narcotics, dangerous drugs, or alcohol, or has been convicted during the preceding seven years of any offense relating to the use, sale, possession, or transportation of narcotics, addictive or dangerous drugs.

- The applicant has been convicted during the preceding seven (7) years of ANY offense punishable as a felony and involving force, violence, threat, or intimidation, or has been convicted of theft during that period.
- The applicant has knowingly falsified or failed to disclose a material fact in his/her application.
- The applicant is found to have more than one misdemeanor within the preceding seven (7) years on record which is substantially related to the qualifications, functions, and duties of prehospital care personnel.

3. Other considerations:

- The applicant fails to maintain his license, certification, required training, or other requirements as required by the Center for Prehospital Care, Education and Research. These requirements may be modified or amended from time to time as appropriate by the CPCER Medical Director.
- The applicant may be required to perform continuing education in areas deemed deficient prior to resuming medical care of patients.
- The applicant may be taken off active duty involving medical care at any time by the CPCER Medical Director or unanimous vote of the CPCER QI committee (minimum of 4 members present).

CONTROLLED SUBSTANCES

The Center for Prehos pital Care, Education and Research will have mechanisms in place to ensure all drugs are ma naged and stored consistent with manufacture recommenda tions in a secure environment.

Inventory – Expiration dates wil l be checked at least monthly. All medica tions will b e inventoried at least monthly to ensure adequate par levels. Manage ment should be notified of any expired medication s as soon as possible so they can be restocked as necessary. All medications should be stored in a secured and locked area.

All controlle d substance s will be do uble locked. They will be counted and signed for on the Controlled Substance Logs anytime a nurse, physician or paramedic begins or e nds a shift. Any discrepancies in th e controlled substance inventory wi ll be docum ented by the medical crew and reported immediately to the CPCER Medical Director and EMS Manager. All narcotic log entries will be signe d by both o n duty crew members except when the controlle d substance dose administered is equal to the entire contents of the vial.

Note: CPCER person nel are no t permitted to loan, t ransport, or resupply/restock any medications to any other EMS agencies.

PAIN CONTROL

Adult patients who have sustain ed an extremity injury or where there is a need for pa in control in the hemodynamically stable patient may rec eive 2-5 mg of Morphine IVP, then 2 mg I VP every 3-5 minutes titrating for effect and ma intaining a systolic blo od pressure >100, and avoiding respiratory depression. Pediatric pa tients should receive 0.1 – 0.2 mg/kg with a maximum initial dose of 5 mg, then titrate 0.1 mg/kg, with a maxi mum repeat dose of 2 mg IVP, every 3-5 minutes titrating for effect and mainta ining a systolic b lood p ressure app ropriate for age.

Document patient's allergies prior to administration of any medication.

APPENDIX A: MEDICAL STAFF REQUIREMENTS

PHYSICIAN REQUIREMENTS

Qualifications **prior to assuming the role** of a physician with the prehospital team include:

Emergency medicine (board certified/eligible) physician with current licensure in the state of California

OR

1. MD/DO with current licensure in the state of California
2. MD/DO with a minimum of two (2) years experience in critical care or an emergency department within the previous three (3) years.
3. Current BLS with AED and ACLS certification
4. Successful completion of an in-house orientation program
5. Endotracheal intubation training
6. Ability to demonstrate practical and written aptitude in areas consistent with the major emphasis of care
7. ITLS (or PHTLS) or 2 years prior paramedic experience
8. Successful oral interview with at least one team physician on panel

Evaluation of competency will be determined by the Medical Director (or designee) and members of the CPCER QI committee. Any exceptions to this policy must be approved by the Medical Director.

Qualifications which **must be maintained** for active status:

1. MD/DO with current licensure in the state of California.
2. Minimum of 500 hours of critical care or emergency department experience per year
3. Minimum of four (4) successful intubations per year
4. Ability to maintain proficiency in designated procedures as demonstrated by written or
5. oral testing, or demonstration of practical skills as determined by medical director

Certification in any of the following is desirable but not required: Advanced Trauma Life Support (ATLS), Pediatric Advanced Life Support (PALS), Wilderness EMT (WEMT)

NURSE REQUIREMENTS

Qualifications **prior to assuming the role** of a nurse with the CPCER team include:

1. RN with current licensure in the state of California
2. Minimum of two (2) years full time experience in an emergency department within the previous five (5) years.
3. Current BLS with AED and ACLS certification
4. Successful completion of an in-house orientation program
5. ITLS (or PHTLS) or 2 years prior paramedic experience
6. Successfully passing oral interview

Evaluation of competency will be determined by the CPCER Medical Director (or designee) and CPCER staff. Any exceptions to this policy must be approved by the CPCER Medical Director.

Certification in any of the following is desirable but not required: Advanced Trauma Life Support (ATLS); Pediatric Advanced Life Support (PALS); Certified Emergency Nurse (CEN); Critical Care Registered Nurse (CCRN); Mobile Intensive Care Nurse (MICN); Certified Flight Registered Nurse (CFRN); Wilderness EMT (WEMT)

RADIOLOGIC TECHNOLOGIST REQUIREMENTS

Qualifications **prior to assuming the role** of a Radiologic Technologist with the CPCER team include:

1. Successful completion of an AMA accredited Radiology Technologist Program
2. Current CRT, ARRT, Flouro License, CPR
3. Minimum 2 years full time experience required, Trauma Center experience preferred
4. Read and signed conditions for safe use guidelines of unit, and a copy filed with the CPCER and with the office of radiation safety
5. Personnel using the radiologic unit will wear proper dosimeters as provided by the office of radiation safety or as by their primary department
6. Operators will read and understand the operating conditions for high and low radiation workload conditions prior to working with the unit.
7. Successful completion of an in-house orientation program

Evaluation of competency will be determined by the CPCER Medical Director (or designee) and CPCER staff. Any exceptions to this policy must be approved by the CPCER Medical Director.

PARAMEDIC REQUIREMENTS

Qualifications **prior to assuming the role** of a paramedic with the team include:

1. Paramedic with current licensure in the state of California and accreditation with the local EMS Agency
2. Minimum of two (2) years full time experience with an ALS provider within the previous three (3) years.
3. Successful completion of an in-house orientation program
4. Ability to demonstrate practical and written aptitude in areas consistent with the major emphasis of care.
5. Successfully passing oral interview

Evaluation of competency will be determined by the CPCER Medical Director (or designee) and CPCER staff. Any exceptions to this policy must be approved by the CPCER Medical Director.

EMT REQUIREMENTS

Qualifications **prior to assuming the role** of an EMT with the team include:

1. Current EMT certification in the state of California
2. Minimum of five (5) years full time experience with an ALS provider within the previous five (5) years.
3. Current BLS with AED certification
4. Successful completion of an in-house orientation program
5. Ability to demonstrate practical and written aptitude in areas consistent with the major emphasis of care
6. Successfully passing oral interview

Evaluation of competency will be determined by the CPCER Medical Director (or designee) and CPCER staff. Any exceptions to this policy must be approved by the CPCER Medical Director.

APPENDIX B: FORMS

MEDICAL RECORD
PAGE 1 OF 2

EMERGENCY CARE AND TREATMENT

INCIDENT NAME/NO

TREATMENT SITE

PATIENT TO COMPLETE

PATIENT'S HOME ADDRESS

STREET ADDRESS

CITY | STATE | ZIP CODE

SEX

HOME PHONE: AREA CODE | NUMBER

AGE

PHONE: AREA CODE | NUMBER

INSURANCE

NAME OF INSURANCE COMPANY

SUBSCRIBER NAME

SUBSCRIBER NUMBER

ARRIVAL

DATE | TIME

TRANSPORTATION TO FACILITY
☐ PRIVATE ☐ AMBULANCE ☐ OTHER

TETANUS

DATE OF LAST SHOT

PRIMARY CARE DOCTOR NAME

ADDRESS

CURRENT MEDICATIONS

MEDICAL CONDITIONS

ALLERGIES

CHIEF COMPLAINT

TRIAGE

CATEGORY OF TREATMENT

☐ EMERGENT
☐ URGENT
☐ NON-URGENT

TIME

INITIALS

VITAL SIGNS

TIME					
PB					
PULSE					
RESP					
TEMP					
WT					

PROVIDER TO COMPLE

HISTORY OF PRESENT ILLNESS

PHYSICAL EXAM

	WNL	ABNL	COMMENTS
SKIN			
NEURO			
HEENT			
NECK			
CHEST			
HEART			
LUNGS			
ABDOMEN			
BACK/SPINE			
PELVIS			
EXTREM			
ADDL:			

ORDERS

☐ PULSE OX ☐ MONITOR ☐ ECG

TIME	ORDERS	BY	COMPLETED BY	TIME	PATIENT'S RESPONSE

LAB ORDERS

CBC			BHCG/URINE
CHEM		URINE DIP	

X-RAY ORDERS

	CXR PA & LAT/PORTABLE		EXT:
	ACUTE ABDOMEN/KUB		OTHER:
	CPSINE		FAST VS:
	TSPINE		
	LSPINE		

Loma Linda University Medical Center

PATIENT IDENTIFICATION

MEDICAL RECORD PAGE 2 OF 2	EMERGENCY CARE AND TREATMENT	INCIDENT NAME/NO

TEST RESULTS

CBC	WBC	SMAC		ABG/PULSE OX				RADIOLOGY	Check if read by radiologist ☐	
	H/H			SUP 02	PH	PO2		RESULTS		
	PLT			PC02	SAT	OTHER				
PT				U/A	DIP			EKG INTERPRETATION		
APPT		BHCG	HEMACUE	GLU	MICRO					

TELEMEDICINE CONSULTATION

CONSENT OBTAINED ☐ YES ☐ NO

CONSENT FOR VIDEO/PHOTO ☐ YES ☐ NO

CONSULT WITH	TIME	RECOMMENDATIONS

DIAGNOSIS

PATIENT/DISCHARGE INSTRUCTIONS

DISPOSITION

☐ HOME ☐ TRANSFERRED RECEIVING FACILITY

CONDITION UPON RELEASE

☐ IMPROVED ☐ UNCHANGED

☐ DETERIORATED

MEDICAL RECORDS USE ONLY

INJURY OR OCCUPATIONAL ILLNESS

ITEM	YES	NO	WHEN *(DATE)*
IS THIS AN INJURY?			WHERE
INJURY/SAFETY FORMS			

HOW

PROVIDER SIGNATURE DATE

PROVIDER NAME (PLEASE PRINT OR STAMP) DATE

CODES

Loma Linda University Medical Center

PATIENT IDENTIFICATION

Consent for Medical Treatment

I give my permission for a general emergency medical evaluation by Loma Linda University Medical Center Emergency Department personnel. I understand that this evaluation will include a physical exam. It may also include blood tests, x-rays, or other procedures that the doctor(s) or medical provider(s) recommend. I consent to nursing care and other services provided under the instruction of the Emergency Department physician(s) and the attending physician staff of other medical specialties.

I understand that Loma Linda University Medical Center is a teaching institution. I agree to participate in its medical education programs. If I do not wish to participate in the medical education programs, I will notify the Emergency Department staff. I understand every effort will be made by the Emergency Department staff to honor my wishes.

I also give the Emergency Department staff my permission to release my medical information to:

_____

I understand that the Emergency Department personnel may find it necessary to inspect myself and/or my possessions for items it considers dangerous to the safety and welfare of others or myself. I consent to such an inspection. I understand that if any potentially dangerous items are found during the inspection, these items may be removed and stored securely until my discharge.

I understand that after my medical screening examination, my doctor(s) or medical care provider(s) will determine if I have an emergency medical condition, and if admission to the hospital is recommended.

I understand that I may leave the Emergency Treatment Site prior to the completion of my care.

I understand that my signature below certifies that I have read the Consent for Medical Treatment, received a copy, and agree to its terms.

Patient or Responsible Party	Relationship	Witness	Date	Time

Consent by court system, power of attorney or other (attach copy of authorization)

Responsible Party	Title	Witness	Date	Time

Phone Consent

Responsible Party	Relationship	Contact Person	Date	Time

Consent for Telehealth Consultations

Health care services at this site may include two-way interactive video communications and/or electronic transmission of information. Referred to as "telemedicine" or "telehealth," this means that I may be evaluated and treated by a health care provider or specialist from a different location.

I understand and agree to the following:

1. The consulting health care provider or specialist will be at a different location from me. A physician or other health care provider ("presenting practitioner") will be at my location with me to assist in the consultation.
2. The presenting practitioner may transmit or share electronically details of my medical history, examinations, x-rays, tests, photographs or other images with the specialist who is at a different location.
3. Details of my medical history, examinations, x-rays, and tests will be discussed with the specialist who is at a different location.
4. I will be informed if any additional personnel are to be present other than myself, individuals accompanying me, the consultant and presenting practitioner. I will give my verbal permission prior to additional personnel being present.
5. Video recordings may be taken of the telehealth consultation, after I have given my written permission prior to recording. Video recordings and other data, including x-rays, images, and photos may be kept, viewed, and used for purposes including teaching, training, technical, scientific, research, or administrative purposes.

6. The physician or health care provider for whom the on-site examination or treatment is performed will keep a record of the consultation in my medical record.

Noting all the above, I understand that my participation in the process described (called "telemedicine" or "telehealth") is voluntary and constitutes a waiver of the usual right to physician-patient privacy and may possibly increase the risk of disclosure of my medical data.

I further understand that I have the right to:

1. Refuse the telehealth consultation, or stop participation in the telehealth consultation at any time.
2. Limit any physical examination proposed during the telehealth consultation.
3. Request that the presenting practitioner refrain from transmitting my information if I make the request before the information is transmitted.
4. Request that nonmedical personnel leave the room(s) at any time.
5. Request that all personnel leave the room(s) to allow a private consultation with the off-site specialist(s).

I acknowledge that the health care providers involved have explained the consultations in a satisfactory manner and that all questions that I have asked about the consultations have been answered in a manner satisfactory to me or to my representative. Understanding the above, I consent to the telehealth process described above.

Patient or Responsible Party	Relationship	Witness	Date	Time

Consent for Obtaining Photographs or Video

I authorize the Loma Linda University Medical Center and its designees to make video, audio, still images, or recordings and to use and/or publish these media for any educational or research purpose as deemed appropriate by the Loma Linda University Medical Center and agencies with which it is collaborating.

I consent to the use of my likeness, voice and any teaching or presentation materials for such purposes, and I release the Loma Linda University Medical Center officers, agents, and employees from all claim of liability with respect to the showing, use or dissemination of such material.

I understand that I can refuse to have photographs or video of any treatment session taken and that I may continue to receive standard medical care regardless of that decision.

Patient or Responsible Party	Relationship	Witness	Date	Time

Patient Refusal of Further Medical Care (Against Medical Advice)

I have been offered a medical screening examination by the Loma Linda University Medical Center Emergency Department. I have been offered this examination without regard to my ability to pay. I am choosing to terminate my care by the Emergency Department, and am refusing any further examination or medical treatment. I assume responsibility for my own care.

I have been informed of and understand the risks and consequences involved in my refusal of further medical care. I have also been informed of the potential benefits of allowing continued medical care. I understand that I am free to return at any time for further medical care.

Patient or Responsible Party	Relationship	Witness	Date	Time

Appendix D
Equipment Bag Medical Inventory

Qty	Medical
1bx	Small Gloves
1bx	Medium Gloves
1bx	Large Gloves
1bx	XL Gloves
2	Goggles
2	Mask
1	Hand Sanitizer - Small
1	Adult BP Cuff
1	Peds BP Cuff
1	Stethoscope
1	Pen Light
1	Sharps Container
1	Adult C-Collar
1	Peds C-Collar
1	1" Clear Tape
1	3" Kerlix Bandage
1	Scissors
2	ABD Pads
4	Krilex
	Assorted Dressings/Bandages
4	Tegaderm
4	Tegaderm Peds
4	4x4 Gauze
4	2X2 Gauze
1	SAM Splint
2	Ice Packs
1	Ace Bandage 3"
1	Ace Bandage 4"
1	Ace Bandage 6"
1	Adult Nasal Cannula
1	Adult O2 Mask
1	Peds O2 Mask
1	MedNeb
2	14g IV Catheter
2	16g IV Catheter
2	18g IV Catheter
2	20g IV Catheter
2	20g IV Catheter
2	24g IV Catheter
2	IO Needle
2	1" Tourniquets
2	1/2" Tourniquets
1	IV Tubing

Qty	Medical
1	IV Tubing (Micro)
2	Luer Lock (Regular and Small)
1	NS 1000cc
6	Alcohol Preps
2	5cc Luer Lock Syringe
2	10cc Syringe
2	TB Syringe
1	Ext Tubing
1	O2 Tank and Regulator
1	Laryngoscope
1	Blades, Assorted
1	Tube Holder
1	Magill Forceps Adult
1	Magill Forceps Peds
2	ET Tube 3
2	ET Tube 4
2	ET Tube 5
2	ET Tube 6
2	ET Tube 7
2	ET Tube 7.5
2	ET Tube 8.0
2	Stylet Adult
2	Stylet Peds
1	OPA 7 cm
1	OPA 8 cm
1	OPA 10 cm
1	OPA 11 cm
1	BVM Adult
1	BVM Peds
1	60 cc Syringe (Luer Lock)
1	60 cc Syringe (Catheter Tip)
1	NG Tube
5	BioHazard Bag
5	Ziplock Bag