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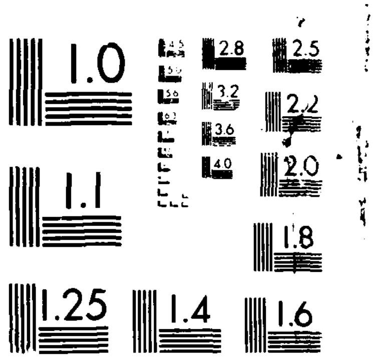

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Field Testing of the Combat Casualty Care Medical Information System (CCC/MIS)

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SUMMARY

To determine the Marine Corps requirements for the development of an automated combat casualty care system, Naval Health Research Center (NHRC) conducted a rigorous systems analysis of the current methods and procedures used by field medical personnel during combat. This resulted in the functional specifications for a casualty care system and a list of equipment necessary to make it operational. In order to determine the survivability and utility of the elements of the proposed system, it was determined that field testing in a rugged environment was essential.

A step-wise approach over an eight-month period allowed for the sequential evaluation and ultimate upgrade of the system and its components. The field tests culminated in a field demonstration where a completely automated system was set up, demonstrated, and subjected to a typical working environment. The system successfully handled patient processing, data transfers, and report generation in a manner superior to the current hand processing methods. The use of such an automated system could relieve between four and six medical personnel from administrative burdens, thus making them available for medical duties. Keywords: active duty; work elements, medical computer applications

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Introduction

The need to develop an information system for combat casualty care has been recognized by the Navy and Marine Corps[1,2,3]. Due to the lack of automation, it is currently necessary to hand process medical data during combat situations. As a result, information is frequently not collected, lost, or subject to error. This situation ultimately diminishes the effectiveness of military efforts. The implementation of an automated system during combat would allow complete and accurate field medical records to be maintained by fewer personnel, thereby reducing the administrative burden on medical personnel, which in turn is expected to lead to better patient treatment, better estimation of medical equipment and supplies, and better overall effectiveness of medical and combat personnel.

To explore the development of an automated combat casualty care system, personnel from the Naval Health Research Center (NHRC) conducted rigorous systems analyses of the current methods and procedures used by field medical personnel during combat[4]. These analyses were performed at Camp Pendleton under the guidance of the First Medical Battalion. Results of the analyses were used to produce an outline of the functional specifications for a casualty care system and the list of equipment necessary to make such a system operational. Using these specifications, a relatively simple prototype system was developed[5]. The successful operation of the prototype system demonstrated the feasibility of the design concept and justified assembling the complete Combat Casualty Care Medical Information System (CCC/MIS)[6]. The equipment identified for the CCC/MIS is shown in Figure 1.

Approach

System testing was carried out at Camp Pendleton during field exercises conducted by the First Medical Battalion and the Field Medical Training School. In an area named Box Canyon, the First Medical Battalion sets up a

- One IBM-AT compatible microcomputer (host)
  - 4 MB RAM expansion board
  - Radio frequency communications board
  - 20 MB hard disk drive

- Four ruggedized portable microcomputers
  - One containing a 20 MB hard disk drive
  - One containing a 5 MB removable hard disk drive
  - Two containing 1/2 MB bubble memory boards

Each of the microcomputers will have one or more of the following data input devices attached.

- Two electronically erasable programmable read-only memory (EEPROM) reader/writers
- One graphics digitizer tablet
- Eight hand-held microcomputers with built-in bar code reader
- One electronic mouse
- Four bar code wedge readers
- Voice recognition device
- Touch screen
- Radio frequency tag reader/writer
- RF tags for each patient
- An electronic identification tag (EEPROM) for each patient

Figure 1. Potential Equipment List for CCC/MIS Field Testing

representative field medical company roughly once every six weeks as part of an exercise in conjunction with the Field Medical Training School. During training sessions, some of the students of the school become simulated casualties, while others become observers. The exercises routinely continue over a three to four day period and are typical of medical procedures at the three echelons of treatment: the front-line corpsmen, Battalion Aid Stations and the Medical Company. Our research team arranged to participate in each field exercise. Their objective was to test various proposed system elements and evaluate input and display devices in typical field conditions to gain information concerning equipment utility and survivability.

A multi-phase approach was taken so a variety of objectives could be accomplished. First, by testing new features separately and then incorporating those that performed successfully into the working system, the system would evolve in an incremental fashion. Second, this approach allowed the number of tests planned for any one phase to be limited to the number that could be monitored by the staff available. Third, multi-phase testing provided the opportunity to observe system users and their reaction to each subsystem so that potential weak links could be identified. Finally, the six-week period between training exercises provided time to modify or change software, equipment, or the method of operation so that potentially beneficial features could be improved and retested. Therefore, the multi-phase approach allowed the system to evolve by correcting deficiencies as they were discovered. Sometimes features were modified and, occasionally, a complete new subsystem or an entirely new strategy was developed to resolve an especially complicated problem.

Test Setting

The physical layout of the Medical Company typically consists of two rows of general purpose military tents facing each other with one double-sized tent for Admitting and Sorting (A&S) between them and toward the front of the compound (see figure 2). Immediately adjacent to A&S is a partially covered area for Triage which might be considered the front door to the Medical Company. The tents facing each other are typically used for X-ray, Dental, Wards, Morgue, Supply, and the Medical Operations Center (MOC), along with spaces for the CO and XO. Pre-op and O.R. tents are often located strategically in the

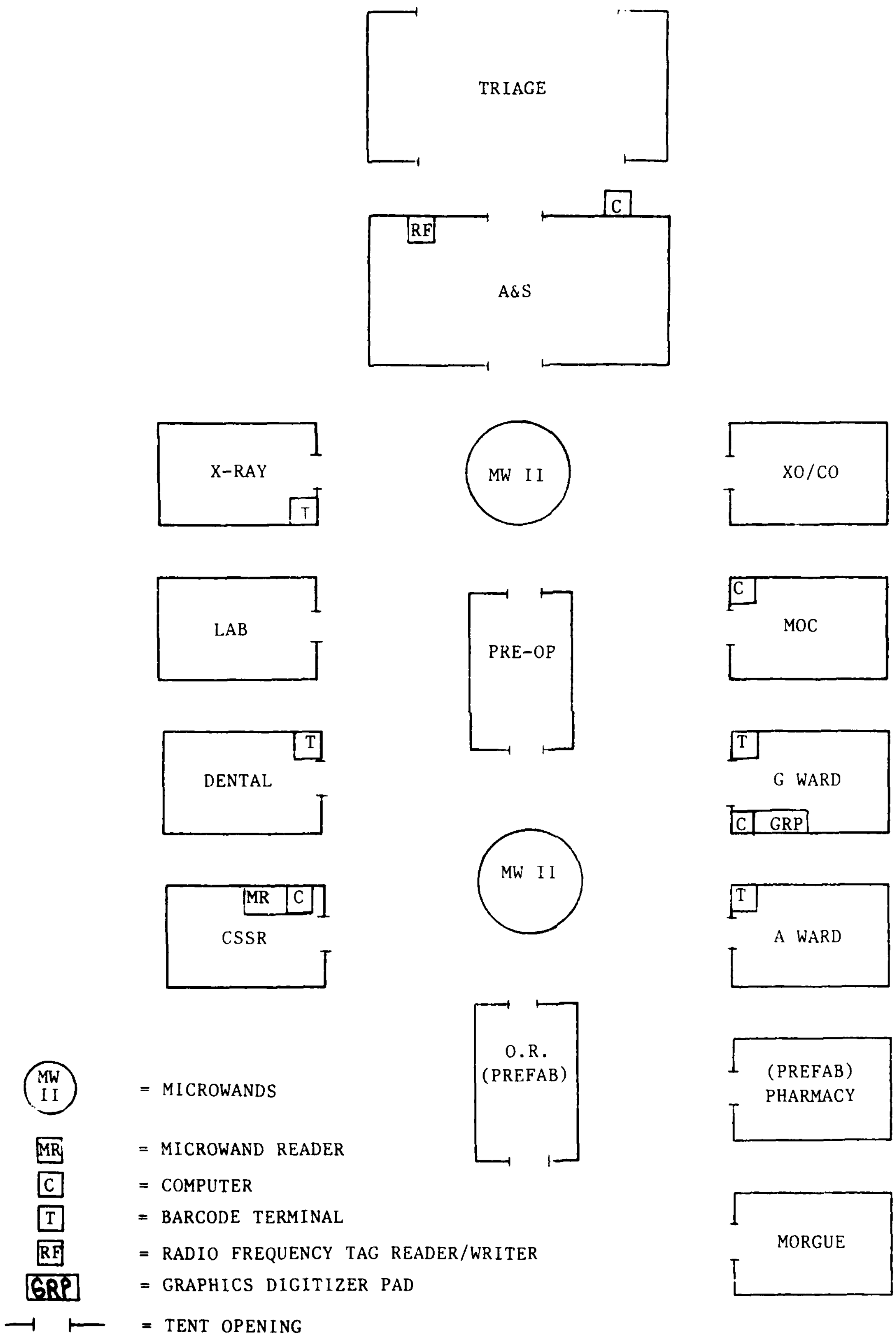

Figure 2. Typical Field Medical Company Layout

center of the compound, sometimes directly in the middle, other times among the other tents facing each other. The MOC is the hub of information for the entire compound. This tent contains all of the communications gear and personnel necessary for information processing and reporting. Here, status boards are maintained and decisions are made regarding patient movement.

During each field trip, the hardware or software driving specific procedures of the evolving system were tested. Field testing provided potential end-users (members of the medical company) the opportunity to participate in system development by providing feedback during, and after, the testing of components and software. Again the step-by-step approach seemed to be beneficial because, as successive field trips were made, field medical personnel could see how their input was being incorporated into the overall system design. Over the eight month period six testing sessions were used to prepare the hardware, software, and our team for a final comprehensive demonstration of the entire system.

Observations

During the series of field trips, a great deal was learned regarding the system design, the hardware needed to make it operational, and the software needed to link it together. Furthermore, we became increasingly aware of the need for truly ruggedized equipment. Dust, fog, rain, wind, and heat are natural elements which, if not controlled, can bring down an otherwise well designed system. Man-made conditions like shifting, jostling, dropping, kicking, and tripping over power cords add to the abuse the equipment must endure. Some pieces of equipment managed to survive far better than others. Among those showing a high survivability rate were the electronic identification tags, the hand-held microcomputers, and the radio frequency tags. These all have a few things in common which definitely gave them an advantage. They are all small, self contained, highly ruggedized units which have their own power source or plug into a unit which provides power. Equipment that did not fair too well included the "ruggedized" microcomputers and the bar code readers. The potential for problems in all of the equipment tested tended to increase with size. The lesson learned was "the smaller the better", even if it means reduced capability, because a system with reduced capability is clearly favorable to a system that has failed.

The final field trip was specifically designed to test the entire (CCC/MIS) system. The system consisted of four IBM ATs, each equipped with various peripheral equipment for entering or retrieving data. These machines were configured into a network with each machine located strategically within the medical company compound. The ATs had been substituted for the "ruggedized" microcomputers which had failed earlier due to dust and moisture problems. Each AT was completely covered with plastic until the actual start of the demonstration.

As patients arrived at the Medical Company Compound, they were registered automatically in Triage through the use of an electronic identification tag and subsequently tracked throughout the compound through the use of barcode readers and radio frequency tags which had been specifically selected for this purpose. It had been determined during previous equipment trials that barcoding was somewhat unsatisfactory. Even though there might be extremely high motivation and knowledge regarding the equipment, unavoidable situations still arise which reduce the effectiveness of this type of equipment. Failures were frequently encountered due to dust and moisture which accumulated on the barcode surfaces. Additionally, the recording of patient movement throughout the compound using barcoding was subject to low reliability due to an individual's attention being diverted and by problems in manipulating bar code equipment. Therefore, during the final demonstration a radio frequency tag system was evaluated as an alternative to bar coding. The Admitting and Sorting station was chosen for this portion of the demonstration and utilized a separate PC with a color monitor and the RF tag reader writers. It was found that a patient supplied with an RF tag (currently somewhat larger than the electronic identification tag) could be automatically tracked throughout the entire medical compound without the need for valuable personnel being involved in the logging and tracking process. Thus, it appears that a RF tag system is the most efficient and reliable mechanism for patient tracking. Unfortunately, the equipment required for the RF tag procedure is quite expensive when compared to bar coding.

Medical information was entered into the system by means of specially designed forms and a device called a graphics digitizer tablet which allowed quick data input by pointing to areas on the form which contain patient information. Patient data forms, originally filled out in the Admitting and Sorting area, were kept in a patient folder until the patient arrived at a patient ward. The form was then placed on the graphics tablet and the operator, using a stylus, pointed at the recorded data (see Figure 3). Medical company personnel who visited the General Ward where this procedure took place were encouraged to ask questions and actually try out the equipment. Eventually, the trained operator turned over the station to a person totally unfamiliar with the system and that person was allowed to enter data while results were monitored at the Medical Operations Center (MOC). No loss of information or reduction of system capabilities was noted. Allowing participation of the Medical Company staff during the demonstration provided a realistic test of the system components by showing that it can be effectively used by personnel with no computer training.

As patients moved throughout the compound, their status and location was monitored in the MOC by a microcomputer (AT) which constantly updated various status boards. These status boards were constantly displayed on a computer monitor which provided a window into the system for observers. The system software could be halted at any point in time (which did not effect the other system operations) and could be requested to produce various resource management and spot status reports. Observers commented that this type of information processing could prove to be an important asset by providing medical personnel with preliminary and post-operative patient status, breakdown of injuries incurred, and treatment provided at A&S. In order to accomplish this, it was suggested that a computer monitor be placed in O.R. which would provide a quick reference to number and types of injuries, as well as overall compound conditions like patient backlogs. MOC was also the area selected for patient discharge. The discharge process involved inserting the patient's electronic identification tag into the reader-writer device and downloading pertinent treatment data to the tag so that a permanent record is maintained with the patient. This provides a safeguard against accidental loss of information and also may be of value if additional medical treatment is required before the patient's medical record can be located.

LAST NAME	FIRST NAME	M I	SOCIAL SECURITY NUMBER

PATIENT MANAGEMENT

TREATMENT FACILITY	FIELD CORPSMAN		BATTALION AID STA		MED/HOSP CO		FLEET HOSPITAL	
ARRIVED	Date	Time	Date	Time	Date	Time	Date	Time
TREATMENT	Date	Time	Date	Time	Date	Time	Date	Time

VITAL SIGNS

DATE	TIME	TEMP	PULSE	BLOOD PRESSURE SYS / DIAS	RESP RATE	RESP EXPAN	CAP REFILL	EYE OPEN	VERBAL RESPON	MOTOR RESPON
				( )/						
				( )/						
				( )/						

INJURIES

TYPE OF INJURY

1. DISLOCATION
2. FRACTURE
3. LACERATION
4. PUNCTURE
5. TRAUM AMPUTATION
6. WOUND
7. CONCUSSION
8. WHITE PHOS BURN
9. OTHER BURN
10. OTHER INJ

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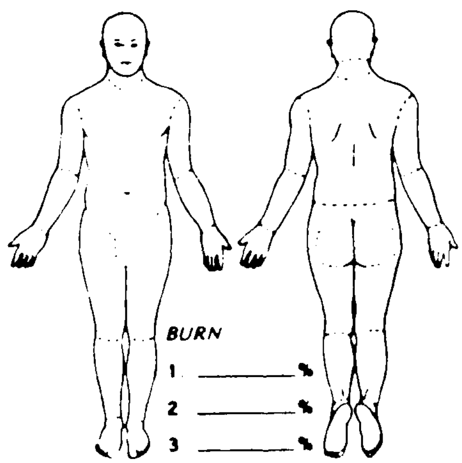

BURN

1. ________ %
2. ________ %
3. ________ %

TRAUMA SCORE

GLASGOW COMA SCALE

TRAUMA SCORE
COMA SCORE

TREATMENTS

1. BANDAGE
2. TOURNIQUET
3. SPLINT
4. APPLY HEMOSTAT
5. TRACHEOTOMY
6. SUTURES
7. OXYGEN
8. DECONTAMINATION
9. CAST
10. OTHER

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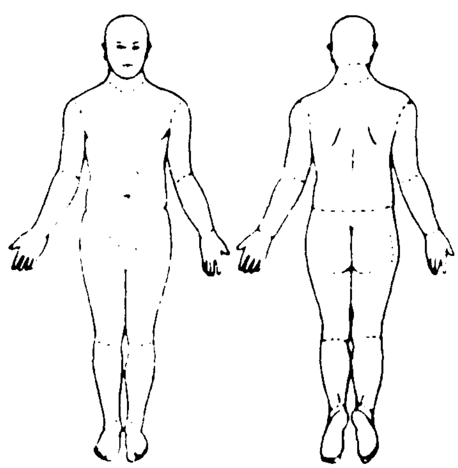

TUBES

1. ENDOTRACH
2. CHEST
3. N G
4. FOLEY CATH

ANESTHETICS

REGIONAL

1. SADDLE BLOCK
2. EPIDURAL
3. AXILLARY
4. I V

FIELD

1. XYLOCAINE
   - A W/EPI
   - B W/O EPI

Figure 3. Proposed Replacement for the Field Medical Data Card (DD 1380)

MEDICATIONS

	DOSE	ROUTE PO/IM/IV/SUBQ	DATE	TIME	DATE	TIME	DATE	TIME
NARCOTICS MORPHINE OTHER								
SEDATIVES DIAZEPAM OTHER								
ANTIBIOTICS PENICILLIN TETRACYCLINE SULFA OTHER								
ANTIDOTE ATROPINE OTHER								
TOPICAL SPECIFY								
IMMUNIZATIONS TETANUS TOXOID VACCINE OTHER								
OTHER MEDICATIONS								
IV SOLUTIONS RINGERS NORMAL SAL D5W OTHER		GAUGE NEEDLE ____						

TRIAGE CLASSIFICATION

1 MINIMAL
2 DELAYED
3 URGENT
4 EXPECTANT

FINAL DISPOSITION

☐ RETURNED TO DUTY
☐ EVACUATED - MODE
☐ AIR
☐ LAND
☐ SEA
☐ OTHER ____________

☐ DIED OF
☐ BATTLE INJ
☐ NON-BATTLE INJURY
☐ DISEASE
☐ BURNS
☐ SUICIDE

☐ CHEM AGENT
☐ BIOLOGICAL AGENT
☐ RAD AGENT
☐ OTHER ____________

PROVIDER NOTES

Conclusions

In general, the CCC/MIS team was able to demonstrate how quickly and effortlessly patient information could be updated and utilized within the Medical Company without using administrative personnel or having to pull medical personnel away from their important duties. The ability to efficiently and accurately locate any patient at a moment's notice, evaluate and report on resource usage, maintain an accurate and up-to-date medical file on each patient, and discharge patients with an attached electronically readable copy of the pertinent aspects of their treatment within the Medical Company was demonstrated. It is estimated that at least 4 to 6 medical personnel would be relieved from administrative responsibilities through the user of this type of system, thus making them available for the medical duties for which they have been trained. An evaluation of the computer records automatically kept during the demonstration showed that all the administrative data required to document patient movement and other essential reports had been faithfully maintained and accurately processed.

REFERENCES

1. American Institute of Biological Sciences, Report of the Naval Medical Research and Development Command and Office of Naval Research Technical Workshop on Combat Casualty Care, April 1976.

2. Headquarters U.S. Marine Corps (MED) and Naval Medical Research and Development Command, Proceedings of the FMF Medical Information Systems Definition Workshop, May 1982.

3. Gunderson, E.K.E., Congleton, M.W., and Ramsey-Klee, D.M. Proceedings of the Conference on Fleet Marine Force Combat Casualty Care Information Systems, Report No. 84-15, NHRC, 1984.

4. Congleton, M.W., Wilcox, W.W., Pugh, W.M., and Bartok, A. Information Flows at the Forward Echelons of Casualty Care, Report No. 86-23, NHRC, 1986.

5. Wilcox, W.W., Pugh, W.M. The Combat Casualty Care Medical Information System (CCC/MIS) Prototype, Report No. 87-32, NHRC, 1987.

6. Wilcox, W.W., Pugh, W.M. Design for a Combat Casualty Care Medical Information System (CCC/MIS), Report No. 87-36, NHRC, 1987.

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Following the prototype development and functional specifications for a combat casualty care information system, rigorous field testing was performed on critical system elements to determine utility and survivability under typical field conditions. The system successfully performed patient data processing and report generation in a manner superior to the current hand processing methods. Field test results indicate that between four and six medical personnel could be freed from administrative burdens.

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