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Summary

Problem

The limited medical capability and technology in forward echelons of care as well as the changing nature of the U.S. Marine Corps mission have placed unusual demands upon medical responders in the field. In an effort to address these demands, the U.S. Navy established the Mobile Medical Monitor (M3) Program in 1997 to improve the ability of military medical personnel to monitor and stabilize the sick and wounded in deployed settings. The Medical Workstation (MeWS) is the latest development in the M3 program. The MeWS is a functionally configured, network-based workstation equipped with clinical support tools for patient diagnosis and monitoring, interfaced with the patient's clinical record. It is intended to operate in environments typical of medical deployments and can be configured to support specific scenarios and missions.

Objective

The primary objective of the present report is to document the test and evaluation (T&E) of the MeWS that occurred during field-testing exercises carried out during Kernel Blitz (KB) '99, a joint service exercise conducted at Camp Pendleton, California. The T&E of the MeWS was performed to determine whether the system operates in environments typical of medical deployments, and to ascertain whether the system is configured properly to support specific scenarios and missions. This determination was based on whether the MeWS was effective at achieving the following high-level objectives: (1) to increase provider satisfaction, (2) to increase productivity and maintain medical readiness, and (3) to increase clinical capabilities at far forward and remote areas of care.

Approach

The T&E of the MeWS entailed the assessment of the system's ability to collect and transmit near-real-time far-forward medical data and improve patient care and management of medical information. Assessment of the MeWS was conducted during the Charlie Golf – 1 (CG-1) phase of KB '99, an amphibious assault exercise with a robust medical component. Data were collected via surveys and interviews from participants in each functional area of the forward surgical company (FSC) as laid out for the exercise. Questions and/or rating scales were specifically created for the interviews and surveys to determine whether the MeWS effectively met the aforementioned high-level objectives. Users were interviewed and/or surveyed in the surgical shock trauma tent (SST); the operating room (OR); the ward/intensive care unit (WARD/ICU); the ancillary services tents including the laboratory (LAB), x-ray (RAD), and pharmacy (PHR); and the administration/regulation (ADMIN) tent.

Results

MeWS T&E survey and interview findings were somewhat divergent. Survey results suggest that the MeWS met three of the four high-level objectives. Ratings from participants using the MeWS during KB '99 indicated that they were generally satisfied with the MeWS and

felt that the MeWS would be effective at increasing productivity and readiness as well as clinical capabilities in a FSC. These results are based primarily on responses provided by medical personnel in the SST and WARDs. Most of the participants in the other functional areas typically responded to the questions by choosing the category "Did Not Use."

Interview results for each high-level objective varied by functional area. Users interviewed in the SST tent and RAD tent spoke favorably about the MeWS's clinical capabilities and about their satisfaction with the system, whereas users in the ICU tended to speak negatively about the system's clinical capabilities and were very unsatisfied with the system. Responses made by ICU personnel may have been influenced by the LAN failure that occurred just prior to the interviews. Productivity and readiness were not discussed during the interviews.

Conclusion

The MeWS T&E was complicated by many difficulties that arose during field testing exercises carried out during the CG-1 phase of KB '99. These complications included, but were not limited to, power outages, participant's lack of realism, participant's resistance to change, and delayed receipt of training materials. While these difficulties appeared to have influenced medical care provider's survey and interview responses they led to many lessons learned.

Based on the results of the MeWS T&E, several recommendations are made including the integration of technology with FSC business practices. Technologies such as medical information and clinical support tools, assimilated and integrated into the day-to-day practices of medical care providers within a FSC, would enhance the capability to more rapidly and effectively diagnose and stabilize patients and possibly help users overcome their resistance to change. A reexamination of how the technology is incorporated into FSC business practices should be conducted, followed by a strategy for implementation.

Evaluation of the Medical Workstation During Kernel Blitz '99

Introduction

United States military trauma management has traditionally relied on a multi-echelon system of medical care that extends from the point of battlefield injury through theater medical treatment facilities and ultimately to continental U.S. hospitals. The forward echelons of care are highly mobile but have limited medical capability and technology, while higher level facilities toward the rear are less mobile but are highly capable. Consequently, military medical responders at forward echelons of care have been required to operate with limited patient information and diagnostic tools, making patient diagnosis and treatment sometimes difficult and problematic.

To compound these resource limitations, as expressed in Operational Maneuver From The Sea[1] and Joint Vision 2010[2], there is a growing need for medical support capabilities in remote environments because of the evolving nature of U.S. Marine Corps operations. For example, there are an increasing number of requests for the Marine Corps to provide drug interdiction, humanitarian support, and disaster relief assistance in addition to combat support operations.[3, 4, 5] Thus, in the future Marines are more likely to be highly dispersed and very mobile increasing the occurrence of casualties in scattered areas. In addition, the threat of chemical and biological weaponry in the theater increases the need for advanced medical support capabilities. The limited medical capability and technology in forward echelons of care as well as the changing nature of the U.S. Marine Corps mission have placed unusual demands upon medical responders in the field.

In an effort to address these demands, the U.S. Navy established the M3 Program in 1997 to improve the ability of military medical personnel to monitor and stabilize the sick and wounded in deployed settings. The aim of the program is to configure medical workstations in support of specific scenarios using flexible architecture and deployable, lightweight, portable, ruggedized clinical devices. The program also seeks to create local facility and global networks for accessing medical information in the theater. By equipping workstations with medical information and clinical support tools to automate data access, display, and transmission, as well as record keeping, the capability to more rapidly and effectively diagnose and stabilize patients may be enhanced.

The MeWS is the latest development in the M3 program. The MeWS is a functionally configured, network-based workstation equipped with information clinical support tools for patient diagnosis and monitoring, interfaced with the patient's clinical record. It is intended to operate in environments typical of medical deployments and can be configured to support specific scenarios and missions. For example, individual MeWS within a FSC can be configured with mission-tailored software to support activities performed at each functional area. A MeWS located in a SST tent, the point of entry for most casualties, would include software for patient registration as well as clinical capabilities to capture patient treatment documentation. Whereas, a MeWS located in the OR would be replete with all the available monitoring devices. Since the MeWS is designed for deployment in very austere environments, it offers clinical and information support capabilities not currently found at the edge of the battlefield and on ships at sea.

Objective

The purpose of this report is to document the evaluation of the MeWS that occurred during field-testing exercises carried out during KB '99. KB '99 was a joint service exercise conducted at Camp Pendleton, California which included a Joint Medical Operations-Telemedicine Advanced Concept Technology Demonstration (JMO-T ACTD) component. The MeWS T&E was a small but significant part of the overall JMO-T T&E activity.

This report also outlines the strategy used for measuring the effectiveness of the system in meeting its designed goal. Broadly defined, this goal is the demonstration of the ability to collect and transmit near-real-time far-forward medical data and to assess how this improved capability enhances patient care and management of medical information. Specifically, this goal can be defined by three objectives: (1) to increase provider satisfaction, (2) to increase productivity and maintain medical readiness, and (3) to increase clinical capabilities at far forward and remote areas of care.

Background

The M3 Program is a congressionally mandated U.S. Navy effort to integrate and deploy portable, lightweight, miniaturized technologies that promote more advanced emergency care in deployed settings. The M3 Program's initial prototype the M3(A) was evaluated in 1997 using an approach that integrated existing off-the-shelf technologies to meet the emerging requirements of field medical units. The M3(A) prototype included a suite of miniaturized diagnostic sensors - pulse oximetry, blood pressure sphygmomanometer and cuff, and an electrocardiograph (ECG) device - on a standard battlefield computer, the Lightweight Computer Unit (LCU). The LCU, manufactured by Litton Data Systems Division, is a lightweight, portable Intel Pentium-based computer. This computer served as the platform for all peripheral plug-ins, for the operation of all software applications, and for all transactions.

Results of M3(A) field tests, user feedback, and the availability of new medical technologies led to the design modifications that were used to create the M3(B).[6] The design guidelines were based on input gathered from a variety of sources including the KB '97 exercises at Camp Pendleton, California. The modified system supported an array of clinical sensors, digital imaging, global positioning, and automated record management functions. During development of the M3(B) the graphical user interface (GUI) was improved and refined to make it easier to use by medical personnel at forward echelons of care. In addition to GUI refinement, an array of clinical sensors was added including a rhinolaryngoscope and Doppler ultrasound. Fields tests of the M3(B) demonstrated the viability of the small, lightweight ultrasound with Doppler and endoscopic capabilities at the 2nd echelon of care, as well as the ability to record and transmit ultrasound, endoscopic and video images. GPS (Global Positioning System) and PIC (Personal Information Carrier) interfaces were also added to the M3(B) to transmit geographic location and automate patient identification and medical record access.

Operational testing of the M3(B) in 1998 by members of the 1st Medical Battalion at Camp Pendleton, California, and during Cobra Gold in Thailand, led to a reexamination of the basic architecture. This re-evaluation resulted in a shift from a "hardware-centric" emphasis using a single platform containing internally integrated medical devices to a more flexible "software-centric" approach offering multiple platform options with software interfaces to link a broader range of external devices.[7] Reflecting this architectural shift in concept, developers

created the Medical Workstation (MeWS) with a broader range of software applications and hardware plug-ins/peripherals that can be customized for specific functions and work in a network environment or used as a portable stand-alone unit.

MeWS Description

The MeWS is a functionally configured, network-based workstation equipped with clinical support capabilities, a consistent defense information infrastructure common operating environment (DII COE) compliant GUI, medical information support, and additional commercial and government off-the-shelf (COTS/GOTS) software to support patient registration, clinical documentation, multi-patient monitoring (MPM), and medical administrative activities. The MeWS interfaces with the patient's clinical record, accesses a searchable database, and provides PIC read implementation. It is designed to support both the clinical and information requirements of far-forward echelon providers ashore and afloat.

The MeWS utilizes a computer-based patient record (CBPR) comprised of patient demographics and clinical data. The CBPR represents the primary product of the MeWS. A set of patient demographics serves as the nucleus of a CBPR and provides access into the patient database for each patient. Patient demographics include data about the patient recorded either: (1) in an existing data store, (2) in a PIC, or (3) patient-supplied information entered manually. The MeWS also provides a mechanism for recording diagnostic information, the treatment performed, output of clinical instruments, and storing of that information on the CBPR for future use. Ideally, a CBPR can be transmitted from one MeWS to another (even at another echelon), and the MeWS operator will have the required information to review the treatment given at another facility, verify the patient condition, track changes in patient condition, and continue treatment without interruption.

Hardware

The MEWS is a desktop/laptop computer that requires the following environment to function satisfactorily:

- 200 MHz Pentium processor
- 64 MB EDO RAM
- 3 GB Hard disk
- 8X IDE CD-ROM drive
- Dual PCMCIA/PC network card reader
- PCI Video with 2 MB RAM
- 17-inch monitor with 1280 x 1024 pixel resolution
- Keyboard and Pointing device
- SoundBlaster compatible audio card with speakers
- CPU-compatible 100 MB Fast Ethernet NIC

In addition, the MeWS has external hardware interfaces (peripherals) including a PIC reader to read patient data from a plastic card and (though write not currently available) write information back to it and a MPM capability that allows the vital sign monitoring of multiple patients in one location. Modems, printers, and CD-ROM drives may also be attached as required for mission accomplishment.

Software

The MeWS runs Microsoft (MS) Windows NT Workstation 4.0 as its operating system and the defense information systems agency (DISA) COE 3.3 kernel. It is installed with Oceania WAVE 3.1 for clinical encounter entry and patient record retrieval; a web browser (Netscape Communicator 4.0.2.) and server (Netscape Enterprise Server v3.) for accessing patient records from a central database; and a component of the Composite Health Care System-NT Migration (CHCS-NT), modified to support the recording of laboratory test, x-ray, and pharmacy orders and results. The central database used for data storage is Oracle 7.3. This relational database management system (RDBMS) provides a single repository of information for all facility-networked MeWSs and supports the data needs of all MeWS functional modules, providing a source for data transmitted to other locations.

The modular architecture of the MeWS enables it to support a variety of additional functions beyond the tools mentioned above. For example, the MeWS supports Theatre Medical Core Services (TMCS), a powerful web-based business, data management and report generation application used to monitor facility status, and compile and transmit Annex Q reports. TMCS provides the MeWS with an input interface for medical command and control (C2) information and stores the data in the RDBMS for future use or transmission. The Annex Q reports generated by TMCS are medical management reports which provide information on facility status, casualties and hospitalizations, and patient tracking and "in transit visibility."

The MeWS also supports Pacific Medical Network (PACMEDNET) and the Field Medical Surveillance System (FMSS). The PACMEDNET system addresses the movement of medical information with the patients as they are evacuated across echelons of care, by providing the capability to find information on a specific patient from multiple locations and databases located throughout the PACMEDNET-wide infrastructure. The FMSS is a program that enables military environmental health officers and preventive medical officers to record and analyze data on diseases and illnesses that may occur during foreign deployments or conflicts. Together, these MeWS software elements provide data storage, archiving and retrieval; medical facility status reports; disease surveillance; supply updates; evacuation requirements; and more.

Kernel Blitz '99 Exercise

KB '99 was conducted in April 1999 and consisted of four distinct exercises: Fleet Battle Experiment-Echo (FBE-E), Urban Warrior (UW), Extended Littoral Battlespace (ELB), and KB Prime also known as the CG-1 phase. Assessment of the MeWS, as well as other JMO-T technologies, was conducted during the CG-1 phase, an amphibious assault exercise with a robust medical component. The deployed forces participating in CG-1 were three regimental landing force size units supported by appropriate medical forces both ashore and afloat. These medical forces consisted of: (1) two battalion aid stations (BAS), (2) two shock/trauma platoons (STP), (3) one FSC, (4) the USS ESSEX, which served as a casualty receiving and treatment ship (CRTS), (5) the USNS MERCY, a hospital ship with 1000 bed capacity with 250 beds available during KB '99, and (6) a fleet hospital (FH) with a maximum capacity of 500 beds with 100 beds available during KB '99.

The medical component of CG-1 spanned a 5-day period and involved approximately 1450 medical personnel who aided 510 casualties during the exercise, both live actors and mannequins. As part of CG-1, members of the 1st Medical Battalion were given a hands-on

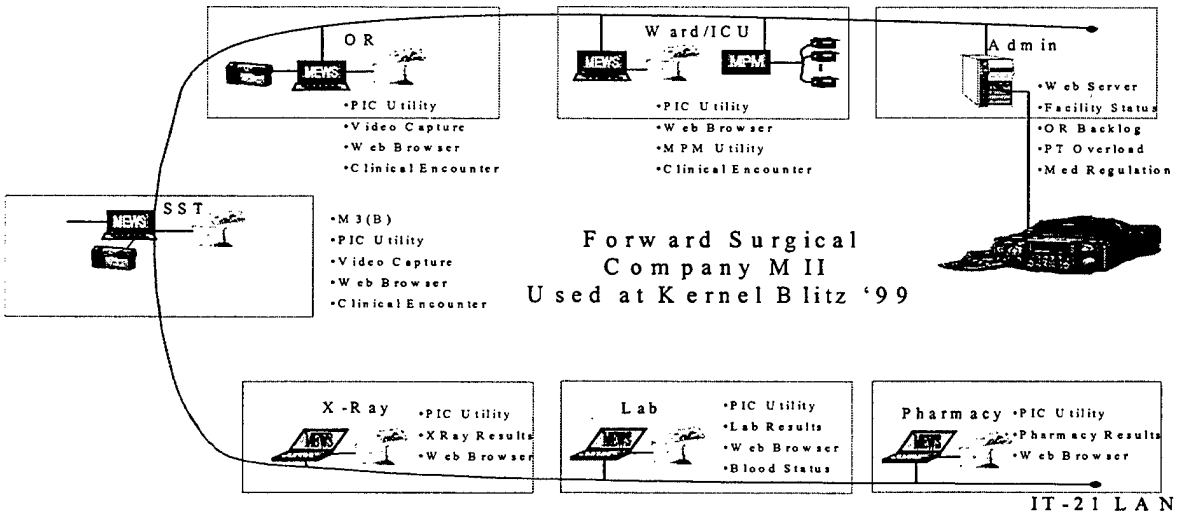

Figure 1. Forward surgical company used at Kernel Blitz '99

opportunity to work with the MeWS and its communications component known as the medical information infrastructure (MII). At the exercise, several MeWS were strategically placed across the FSC in various departments and aboard the hospital and casualty and receiving ships. In addition, a TMCS server was placed aboard the USS CORONADO, which also participated in the exercise.

Kernel Blitz '99 Forward Surgical Company

The primary purpose of a FSC, which is a ground-based echelon II medical treatment facility (MTF), is to sustain the combat force by providing initial resuscitative care and surgery, temporary hospitalization, and preventive medicine support. Its function is to diagnose, treat, and evacuate casualties in a timely manner. The FSC laid out for KB '99 shown in Figure 1 above consisted of a full complement of surgical and administrative tents. Within the FSC, MeWS workstations were networked together via ethernet and connected to a database and medical coding system supporting the capture and aggregation of a patient's data from various departments. This allowed the utilization of the PIC card to read and write patient information. At the time of patient disposition, the diagnostic data and treatments performed at the various stations were compiled into one integrated patient record and transmitted over the joint internet controller (JINC) network to the ships and to the fleet hospital.[8] Individual MeWS within the FSC and aboard the ships were configured with mission-tailored software to support specific activities performed at each area.

Triage/Surgical Shock Trauma

The triage/SST tent is the point of entry for most casualties in the FSC. During CG-1, the SST tent was outfitted with a MeWS equipped and configured with a PIC reader; web-browser software for patient registration; the Oceania WAVE software to document clinical information, diagnoses, and treatment plans; and an M3(B) to interface with the MeWS and provide clinical data.

Care rendered by medical care providers at this location during CG-1 involved examination and evaluation of the patient followed by emergency or life saving measures such as maintenance of airway, control of bleeding, and prevention and control of shock and further injury. Medical care providers utilized the M3(B) to capture patient vital signs, such as blood pressure and heart rate, and digital images of any wounds on the patients.

One of the most critical functions performed in the SST tent during CG-1 was the initial registration of new patients as they were brought into the FSC. For the purpose of CG-1, all casualties were issued a PIC card, pre-populated with demographic data for patient registration. Medical personnel at this tent were required to create a new patient record by copying demographic data stored on the PIC to the patient registration screen. They were also required to record clinical information by entering diagnostic and treatment data manually.

Operating Room

During the CG-1 phase of KB '99, no MeWS were installed in the OR. However, the critical nature of information gathered in the OR makes this functional area of the FSC one of the most important places for patient documentation. Patients that are injured and in need of surgery, are routed from triage to this tent.

A MeWS installed in the OR equipped with a PIC reader, web-browser software, the Oceania WAVE software, and an M3(B) unit would provide immediate information to the OR staff regarding the patient's condition and previous treatment, and make patient follow-up less time consuming. For example, clinical staff would be able to gather patient information by the touch of a button, rather than going from tent to tent to track the progress of a person who has recently had surgery.

During CG-1, clinical personnel in this functional area maintained records in accordance with traditional procedures. Care rendered in the OR was partially based on clinical information gathered from the other functional areas including the triage, laboratory, and radiology tents. Notes were recorded on paper during the surgical procedures and were entered into the system at a later time by the administrative or WARD personnel.

Ward/Intensive Care Unit

Once casualties are stabilized in the OR, they are routed to the WARD/ICU. In this functional area, patients' vital signs are continuously monitored as the patient awaits evacuation to another MTF. Medical staff is required to review patient laboratory and x-ray results, as well as pharmacy orders to treat the patient.

The MeWS installed in the WARD/ICU tents during CG-1 was configured in the same manner as the MeWS in the SST tent, with system emphasis on building a comprehensive and detailed clinical history. PIC readers were connected for automated registrations of new patients who bypassed the SST tent. The Oceania WAVE program was applied to generate new records and update existing ones. Furthermore, from this location, nurses and corpsmen were able to use the web browser to access and review laboratory and x-ray results, and pharmacy orders previously entered into the system.

MPM capabilities were demonstrated in one of the WARD/ICU tents during the CG-1 phase of KB '99. Five existing Navy-approved vital sign monitors, also known as Propaqs, were used to continuously measure the vital signs of up to eight patients, regardless of their location.

The vital sign information from the MPM devices was sent to an external monitor for review, and then manually keyed into the patient's record. The MPM devices transmit data wirelessly to the central station in real-time, and operate for long periods on battery power.

Ancillary Services: Laboratory, X-ray, and Pharmacy

Ancillary services occupied three separate tents: LAB, RAD, and PHR. Each of these tents contained an identically configured MeWS with PIC card capabilities and a web browser. X-ray, laboratory, and pharmacy orders and results are entered into the customized component of the CHCS-NT at each of these tents. Once these data entries are saved to the RDBMS, personnel in any functional area could examine specific patient results by accessing summary review screens through the browser application.

During CG-1, technicians in each of the ancillary service tents received orders either verbally or on paper for laboratory work, x-ray series, or medications. Results were noted with paper and pencil, and later entered into the CHCS via a keyboard. However, ancillary service data were not automatically recorded with the other clinical data because the MeWS architecture does not currently support full integration between CHCS-NT and the Oceania WAVE programs. FSC staff was required to manually add this information into the patient's file.

Administration/Medical Regulation

The ADMIN tent served as the administrative center of the FSC and the technical hub of its LAN. During CG-1, the system web server was installed here, which supported the more complex, multi-user applications on the network. The server also handled network administration functions, prioritizing access to shared files and resources, and maintaining database integrity and file structure. Software residing on the server gathered independent data records from each individual MeWS on the network then transferred it to the RDBMS, where the data records were distributed to the relevant patient record.

During CG-1, personnel at the ADMIN tent could query the RDBMS to generate situational reports from the resulting data on facility status, bed availability, medical supply status, patient overload, and other C2 functions.

The MeWS at this functional area was equipped with TMCS, so that personnel could generate Annex Q reports on medical situational data. Medical regulation personnel at this tent also had the functionality to prepare and transmit the Annex Q reports to remote locations and higher-level echelons over the JINC network.

Method

Scope of the Evaluation

The scope of the evaluation covers the data gathered from surveys and interviews during field testing exercises carried out during the CG-1 phase of KB '99. Questions and/or rating scales were created for the interviews and surveys to determine whether the MeWS met each of the following high-level objectives: (1) to increase provider satisfaction, (2) to increase productivity and maintain medical readiness, and (3) to increase clinical capabilities at far forward and remote areas of care. These data collection instruments were also used to determine

if the MeWS's ability to collect and transmit near-real-time far-forward medical data improved clinical capabilities and enhanced patient care and management of medical information within the FSC. Potential users of the MeWS from the 1st Medical Battalion were given hands-on MeWS training from the user manual.

The casualty flow during KB '99 was designed to reflect the types of patients expected in Navy/Marine deployments. Moreover, the patient flow followed the functional areas within the MTF. For example, patients were initially sent to the SST tent for triage and, if surgery was required, they were forwarded to the OR tent. Once the patient was stabilized, they were routed to the WARD. Approximately 250 casualties reflecting the illness and injuries commonly found in a battlefield environment were generated using the Ground Forces Casualty Forecasting System (FORECAS).[9] Care was administered and documented for each patient using the MeWS as the patient moved through the FSC.

Training

Two groups of personnel from the 1st Medical Battalion were trained at Camp Pendleton in the use of the MeWS. Each group of approximately 20 medical personnel received two days of training beginning February 16, 1999 and March 30, 1999, respectively. During the training, users were taught the tasks required to properly and effectively use the MeWS to support daily business operations. Users were familiarized with how the MeWS supports the FSC and its standard operating procedures. The training also addressed the benefits of automating patient registration and record keeping, and described the MeWS design and capabilities. Lastly, system demonstrations were conducted and hands-on practices were held to increase user comfort with MeWS operations. All medical personnel that attended these training sessions were provided with a *MeWS User Guide* and the *MeWS Training Presentation.* Additional groups of medical personnel aboard the U.S.S. ESSEX and the U.S.N.S. MERCY, and a medical augmentation group participating in KB '99 were also provided with the *MeWS User Guide* and the *MeWS Training Presentation.*

Data Collection

Interview and survey data were collected from MeWS users participating in the CG-1 phase of KB '99 on April 26 and 27, 1999. These data were analyzed and synthesized to form conclusions about the system's ability to meet its operational goal, specifically whether the system effectively meets the three aforementioned high-level objectives.

Interviews

Medical care providers in each functional area were interviewed during and/or after operating the MeWS. Interviews were used to gather users' perceptions of the system's user friendliness, productivity, and clinical capability. Information was also noted depicting the user's perceptions of: (1) the workflow processes, (2) computer patient record (CPR) versus paper patient record, and (3) problems and improvement. Ten medical personnel including the FSC commanding officer, surgeons, nurses, and corpsmen were interviewed in the SST after the first large quantity of casualties had been processed through the FSC. Ten laboratory technicians, 6 radiology technicians, and 1 pharmacy technician were interviewed in the ancillary services tents. Discussions with the radiology technicians were held on the first day of the KB

'99 exercise, whereas technicians in the LAB tent were interviewed on the last day of the exercise. Early on the second day of the exercise, 12 medical personnel consisting of doctors, nurses, and corpsmen were interviewed in the ICU. Lastly, 1 administrator was interviewed in the ADMIN tent and 1 nurse was interviewed in the OR.

Surveys

The MeWS's level of effectiveness at each tent was also evaluated via surveys that were specifically developed for assessing the MeWS capabilities at each functional area. The surveys are depicted in Appendix A. Questions assessed the effectiveness of MeWS capabilities as they related to user satisfaction, productivity, footprint, and clinical capability. For example, MeWS users in the SST tent were given a survey with questions regarding the PIC and PIC reader, Oceania Wave software, and the web browser. Users at each tent were required to rate the MeWS level of effectiveness by choosing one of the following options when answering the survey questions: (1) Excellent, (2) Good, (3) Fair, (4) Poor, (5) Did Not Work, and (6) Did Not Use. Users were advised to choose the response that most closely described their experience with the system. Twenty-five surveys were distributed among the functional areas. The numbers of surveys returned from each functional area are as follows: SST returned 7 surveys; ICU returned 6 surveys; LAB returned 4 surveys; RAD returned 3 surveys; PHR, OR, and ADMIN each returned 1 survey; and the WARD returned 2 surveys.

Results

Interviews

During KB '99, several power outages were experienced during the exercise resulting in communications problems and LAN failures. These problems were reflected in some of the users' responses. For example, the RAD tent had communications problems limiting the entry of patient information into CHCS NT. As a result of these interface problems between the MeWS and CHCS NT, the LAB technicians were also unable to enter patient information. Furthermore, a power failure early on the second day of the exercise, caused the LAN to go down for two hours, just prior to interviews with medical care providers in the ICU. Despite these setbacks, some of the users' responses were very positive especially comments regarding MPM capabilities. Medical care providers' responses are summarized under each of the seven topics listed below.

User Satisfaction

User satisfaction with the MeWS varied across the functional areas in the FSC. In the SST, the medical providers agreed that the concept of collecting and transmitting near-real-time far-forward medical data to enhance patient care and management of medical information was ideal. Although most of the medical providers had not operated the MeWS, they felt that the technology needed improvement to meet the needs of a FSC.

In the ICU, most of the medical care providers were not satisfied with the MeWS. Medical personnel felt that the lack of network and system reliability made the concept of moving away from paper inconceivable. ICU personnel's dissatisfaction with the MeWS system was offset by their extreme satisfaction with the Propaqs and the MPM capabilities. ICU

personnel's responses may have been influenced by the power outage-induced LAN failure that occurred just prior to the interviews. The LAN failure prohibited participants from using the MeWS, whereas the Propaqs, which are primarily battery powered, were unaffected. Users were still able to monitor patients' vital signs despite the power outage.

The technicians located in each of the ancillary service tents were unable to enter any information into CHCS throughout the duration of the exercise. However, most felt that the system would have worked well if they could have utilized some of the capabilities that were demonstrated during training.

Productivity and Readiness

Productivity and readiness was only discussed with medical personnel in the RAD tent. The technicians agreed that having the ability to put the radiology results online would be a benefit.

Clinical Capability

Very little clinical information was entered into the MeWS system during KB '99 due to communications problems. Thus, most participants stated that it was impossible to appraise the effect. Nevertheless, medical personnel in the SST and RAD felt that the system's clinical capabilities would have been enhanced if clinical information had been captured and entered into the system. In the ICU tent, medical providers felt that it was difficult to assess the clinical capabilities of the MeWS because it was only used for tracking transfers. However, nurses in the ICU were very enthusiastic about the MPM capabilities. One nurse commented, "They're pretty much always reliable and I can track all the patients from this monitor." In the LAB tent, the MeWS's clinical capabilities were not discussed.

Workflow Processes

Medical personnel in the FSC had differing opinions of the workflow processes during the KB '99 exercise. The SST physicians felt that new technologies, such as voice recognition software and an electronic whiteboard, were needed to meet the fast paced requirements, while personnel in the ADMIN felt that more people and terminals were needed. Participants in the ICU agreed that the exercise had not prepared them for the workflow processes required to utilize the MeWS, whereas LAB participants' biggest concern was the inability to register patients in their functional area. One technician said "We don't have enough patient information to register the specimen's here if they are not already in the system." The group felt that having the ability to register new patients was imperative as they receive specimens from patients that haven't been already registered. RAD participants were unable to assess the workflow processes due to the communications problems.

Computer Patient Record versus Paper Patient Record

The SST physicians and RAD technicians agreed that CPR technologies were needed in their respective tents. These medical personnel stated that eventually the CPR technology would be advanced enough to meet the needs of the FSC without having to rely on paper. Yet, one

nurse in the SST insisted that there would always be a need for paper in the FSC. In the ICU and the LAB, medical personnel all preferred paper because they felt that the telecommunications were too unreliable. Medical personnel in the ADMIN tent did not comment on the use of a CPR versus paper.

Problems and Improvement

Participants in each of the functional areas agreed that the biggest problem with the MeWS during KB '99 was the intermittent power failures with the wireless LAN. When asked how the MeWS could be improved, the surgical company commander thought the MeWS would be ideal if it had voice recognition software for capturing the patient's medical information and treatment plans. The commander also expressed an interest in having an electronic whiteboard to accompany the MeWS. Nurses in the ICU and WARD suggested that the MeWS should have functions interfaced like the MPMs, while participants in the LAB and RAD did not address this topic while being interviewed.

Surveys

Questions on the surveys for each high-level objective (e.g. user satisfaction, productivity, footprint, and clinical capability) were scored using the following point system. If respondents answered "Excellent" to a particular question, that question was given a score of 2. Likewise, if the options "Good", "Fair", "Poor", and "Did Not Work" were chosen for a particular question, the question was scored as 1, 0, -1, and -2, respectively. The option "Did Not Use" was not given a score, but merely noted.

An overall average score was produced for each high-level objective by first totaling the scores for a particular question and then dividing by the total number of surveys that were completed and returned. The resulting scores for each question were then averaged under each high-level objective producing a final score for that particular objective. This score was used to determine whether the MeWS met the objective. For example, a positive score indicated that the MeWS met the objective, whereas a negative score indicated that the MeWS failed to meet the objective. A score of 0, indicated that the MeWS did not necessarily meet the objective or fail to meet the objective.

User Satisfaction

The questions regarding User Satisfaction for each functional area are shown in Table 1. The overall average score for User Satisfaction was 0.49. This score suggests that users were generally satisfied with the effectiveness of the system. However, the score is based on only 4 of the 24 questions that were asked regarding User Satisfaction. Respondents answered 20 of the questions with "Did Not Use." This may have been due in part to the power failures and communication problems that were experienced during the exercise.

Participants in the SST and WARD were among those able to use the system and provide responses about their satisfaction with the system. SST participants answered 1 question, whereas WARD personnel answered 2. In the SST and WARD, respondents felt that screen commands, buttons, and tabs were easy to locate, understand, and operate. In addition, participants in the WARD felt that it was easy to generate patient medical summaries, whereas

participants in the SST thought recording clinical data using the SOAP notes screen was neither difficult or easy.

Productivity and Readiness

The questions regarding Productivity and Readiness for each functional area are shown in Table 2. The overall average score for Productivity and Readiness was 0.98. This score implies that medical personnel participating in KB '99 felt that the MeWS was effective at increasing productivity and maintaining readiness in a FSC. The score is based on 5 of the 13 questions that were asked. Personnel in the SSC answered 2 of these questions, whereas personnel in the WARD answered 3 of the questions. Participants from each functional area responded to 8 of the 13 questions with the option "Did Not Use."

Participants in the SST felt that it was extremely easy to access specific patient records using the MeWS, whereas medical providers in the WARD thought that it was neither difficult nor easy to access specific patient records. SST personnel felt that, if both systems had been connected, the M3(B) would have interfaced with the MeWS and LAN in a very efficient manner. Furthermore, participants in the WARD thought that the MPMs were very efficient in monitoring and recording multiple patients' vital signs.

Clinical Capability

Questions regarding Clinical Capability for each functional area are depicted in Table 3. The overall average score for Clinical Capability was 0.56. This score suggests that participant's using the MeWS during the KB '99 exercise felt that it was effective at increasing clinical capabilities within a FSC. The clinical capability score is based on 10 of the 22 questions that were asked of participants in each functional area. Medical personnel in the SST answered 6 of the questions, and participants from the WARD answered 4 questions. Participants responded to 12 of the questions with the option "Did Not Use."

Of the personnel that participated in the exercise, only personnel in the SST and WARD were able to utilize the MeWS in a manner that would allow them to answer the questions regarding clinical capability. Participants in the SST rated the performance of the PIC and PIC reader for registering patients as excellent, whereas WARD personnel stated that the PIC and PIC reader did not work. SST personnel also thought the SOAP notes screen was effective when recording clinical data, and that the menu choices performed well when describing and recording clinical data. SST and WARD personnel thought the MeWS was extremely helpful in reviewing patient location and determining the status of a patient's treatment procedure, while only the SST personnel rated the M3(B)'s performance as fair in terms of diagnostic function.

Discussion and Recommendations

The MeWS T&E was complicated by difficulties that arose during field testing exercises carried out during the CG-1 phase of KB '99. These complications included, but were not limited to, power outages, participant's lack of realism, participant's resistance to change, and delayed receipt of training materials. While these difficulties appeared to have influenced medical care provider's survey and interview responses, which are summarized below, they led to many lessons learned. The summary of interview and survey responses is followed by a discussion of

some of the problems as they related to the evaluation of the MeWS, and recommendations for improvement based on lessons learned.

Discussion

Survey and interview findings from the evaluation of the MeWS were somewhat diverse. Survey results suggest that the MeWS met three of the four high-level objectives. Ratings from participants using the MeWS during KB '99 indicated that they were generally satisfied with the MeWS and felt that the MeWS would be effective at increasing productivity and readiness as well as clinical capabilities in a FSC. These results are based primarily on responses provided by medical personnel in the SST and WARDs. Most of the participants in the other functional areas typically responded to the questions by choosing the category "Did Not Use."

Interview results for each high-level objective varied by functional area. Users interviewed in the SST and RAD spoke favorably about the MeWS's clinical capabilities and about their satisfaction with the system, whereas users in the ICU tended to speak negatively about the system's clinical capabilities and were very unsatisfied with the system. On the other hand, users in the ICU showed an extreme interest and liking for the MPM devices. Responses made by ICU personnel may have been influenced by the LAN failure that occurred just prior to the interviews. While the MeWS was inaccessible at this time, the LAN failure did not affect MPM capabilities. Productivity and readiness were not discussed during the interviews.

The survey and interview results are based on a relatively small sample of MeWS users. Indeed, most of the participants were unable or did not use the MeWS during KB '99. In some cases participants did not use the MeWS because of the lack of realism that occurred while treating patients at each of the functional areas. For example, participants knew that the casualties were not real and treated them as such. Medical staff would rush a patient into the SST, talk through what they would do to the casualty, put some medication next to the patient, and then have the patient moved to a WARD. As a result, physicians would not take the time to tell the clerk checking in the patient what they supposedly did to the patient, leaving a void in the patient's medical record. Sometimes, movement of the patient occurred before the clerks could get the PIC card off of the patient. Lastly, when there were power problems with the LAN, rather than pursue a solution to the problem, personnel simply pretended that they still had lights, defibrillators etc. working. This lack of realism influenced MeWS evaluation results, because participants proceeded with the exercise as if nothing had happened, continuing to document patient care without the use of the MeWS.

Survey and interview results were also complicated by the fact that medical care providers would not take the time to fill in the templates of the Oceania Wave for patient registration. They continued to use the "stubby pencil" and paper for documentation of care, and moved the patient out of the areas before any data could be captured electronically. Medical personnel's resistance to change or their lack of any attempt to use the CPR may have influenced results suggesting that medical personnel in the SST, ICU, and LAB preferred paper due to unreliable telecommunications.

While KB '99 provided an opportunity to test the MeWS, there was not enough time to adequately train the personnel to operate the equipment effectively. Too much technology was presented to the personnel in a short period of time. To complicate matters even further, participants received MeWS training material during the second day of training rather than before the training sessions. It is important to have the training material available before the

actual training is conducted so users may thoroughly prepare for the event. These inconveniences probably influenced participant's responses to some degree, possibly making them feel that they could not save time and better manage the care given to the causalities by using the equipment provided.

Recommendations

The integration of technology with FSC business practices is recommended. Technologies, such as medical information and clinical support tools, assimilated into the day-to-day practices of medical care providers within an FSC, would enhance the capability to more rapidly and effectively diagnose and stabilize patients and possibly help users overcome their resistance to change. A reexamination of how the technology is incorporated into FSC business practices should be conducted, followed by a strategy for implementation.

It is also recommended that future MeWS evaluations be conducted in a controlled environment or battle lab in addition to being carried out during exercises to assess military utility. There is also a need to better integrate the use of new technologies, such as the MeWS, into exercises, where possible making the use and evaluation of each new technology an exercise objective. Additional recommendations outlined below reflect changes that should be implemented based on the findings of the current evaluation.

Wireless Local Area Network

A wireless LAN is recommended for any future evaluations. While the wired LAN was operational on the second day and remained operational for seven days with only three short outages, a wireless LAN would have made the MeWS evaluation less problematic. With a wireless LAN, the time spent installing the LAN would be reduced, and LAN outages would be virtually eliminated. Furthermore, with wireless, the disconnection of a single machine, except for one server, would only affect the one machine, rather than multiple machines.

Training

In addition to a longer training period for future evaluations, it is recommended that users be provided with more hands-on opportunities to use the MeWS. When medical augmentation personnel are used for these exercises, it takes at least a week to work out the group dynamics before the unit can operate effectively. After this indoctrination time, it is possible to change some minds in the use of the equipment and programs. Without sufficient training time as well as an opportunity to actually use the MeWS before the exercise, training is lost in the scramble to assemble the unit out of military personnel who have not worked together before. The provision of software documentation, training manuals and abbreviated user manuals (Quick reference guides) is also recommended.

Personal Information Carrier Device

Results of the MeWS T&E suggest that the PIC card usage should be reexamined to allow for the capture of relevant data, quickly, at the appropriate location. The capability of the PIC device currently used to read patient demographic data from designated medical "smart

cards" should be expanded to include the ability to write basic clinical encounter data to fields within the card. For example, small, portable readers in the SST should capture name, rank, serial number, chief complaint, priority, MTF-ID, and disposition. Furthermore, these readers should be brought to the patient, rather than the card being brought to the reader. It is important that the card not be separated from the patient, since the card allows the provider access to the patient's medical record within the RDBMS. Lastly, it is suggested that the WARDS should collect the remainder of the patient's record, since time would allow longer reads under stressful conditions.

Multi-patient Monitoring

The MPM devices were well received by MeWS users in the ICU, particularly with the nurses. However, during the KB '99 exercise, the system was underutilized due to the necessity of dual patient registration since the MeWS and the MPM systems did not exchange patient information. In order to eliminate dual patient registration in the future, the capability to record and save data from multiple patients should be incorporated into the mobile medical data store (MMDS). This will allow MPM using existing single patient monitoring devices.

It is recommended that relevant vital sign information be incorporated from the MPM devices into the patient's medical record on the MeWS. The MPM devices are capable of gathering large amounts of data, not all of which is needed for patient documentation. Thus, a method for determining how blood pressure, pulse oximetery, and ECG data will be extracted and placed into the patient record from the output of automated measuring devices is needed. This method may include the selection of a subset of data points or the computation of an index or set of indices (e.g., mean value, or range). These data can then be automatically recorded in the patient's file in the MMDS. The user interface for identifying and capturing the relevant vital sign data for inclusion in the electronic patient record should also be designed and developed.

Clinical Encounter Program

A central feature of the MeWS is the ability to capture new data both manually and automatically; to receive data from other sources (e.g., PIC & MPM); to access data from other systems (e.g. CHCS); to store these data as a comprehensive patient based record; to retrieve patient data, and to forward patient records or extracts of records. It is recommended that a seamless interface be implemented to allow data to be rapidly accessed and processed. This interface should include the ability to use the PIC as a "key" to access a patient record. Additionally, the system should be modular so that only those segments needed at a medical facility can be selected and used as appropriate. This task is relatively straightforward and would instantly bring the ancillary areas on-line and increase the quantity and quality of all data captured by an order of magnitude.

Data Entry Tool

It is recommended that the data entry tool be further evaluated. This should include a determination of both the hardware and software requirements. An assessment should be made to determine the optimal hardware configuration for the field corpsman, the BAS, and the

echelon II facility (e.g., FSC). Also, the software appropriate for each of the above locations should be determined. The resulting capability should allow the data entry tool to be brought to the patient so that removing the PIC from the patient can be avoided. Finally, the software and hardware should be integrated to provide a functioning prototype for the field corpsmen, for the BAS personnel, and for medical providers at an echelon II facility.

Based on results of the MeWS T&E, a reexamination and modification of the unit's architectural design and a blueprint for expanding its capabilities and features is being initiated. Technologies for integrating existing, developing, and future medical information systems to support theater health services will continue to be developed in the context of the joint medical exercises.

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Table 1
Functional Area Questions for Provider Satisfaction

Functional Area	Questions
SST	2) How easy were screen commands, buttons, and tabs to locate, understand and operate?
	6) How easy was it to manually record clinical data using the SOAP notes screen?
WARD	2) How easy were screen commands, buttons and tabs to locate, understand and operate?
	6) How easy was it to manually record clinical data using the SOAP note screen?
	13) How easy was it to generate a patient medical summary?
	14) How easy was it to print patient clinical records?
RAD	3) How easily were you able to enter radiology orders on the MeWS?
	4) How easily were you able to enter radiology results on the MeWS?
	5) How easily could you navigate through the CHCS radiology screens using the MeWS?
	6) How easily could you review radiology results through the web browser?
LAB	3) How easily were you able to enter laboratory orders on the MeWS?
	4) How easily were you able to enter laboratory results on the MeWS?
	5) How easily could you navigate through the CHCS laboratory screens using the MeWS?
	6) How easily could you review laboratory results through the web browser?
OR	2) How easily were you able to use SOAP notes through the web browser?
PHR	3) How easily were you able to enter pharmacy orders on the MeWS?
	4) How easily were you able to enter pharmacy results on the MeWS?
	5) How easily could you navigate through the CHCS pharmacy screens using the MeWS?
	6) How easily could you review pharmacy results through the web browser?
ADMIN	2) How easily were you able to access clinical encounters through the web browser?
	3) How easily were you able to access laboratory results through the web browser?
	4) How easily were you able to access radiology results through the web browser?
	2) How easily were you able to access pharmacy data through the web browser?
	9) How easy was it to print records and reports from the MEWS?

Table 2
Functional Area Questions for Productivity and Readiness.

Functional Area	Questions
SST	3) How easily were you able to access specific patient records?
	10) How efficiently did the M3(B) interface with the MeWS and local network?
WARD	3) How easily were you able to access specific patient records?
	9) How efficient were the Propacs in monitoring and recording multiple patients' vital signs?
	11) How efficient were the CHCS review screens for adding this data to the patient's clinical record?
RAD	7) How efficient was the MeWS in collecting radiology results for the patient's clinical record?
LAB	7) How efficient was the MeWS in collecting laboratory results for the patient's clinical record?
OR	3) How easily were you able to access laboratory results through the web browser?
	4) How easily were you able to access radiology results through the web browser?
	5) How easily were you able to access pharmacy data through the web browser?
	6) How effective was the MeWS in providing an efficient method of viewing clinical data?
PHR	7) How efficient was the MeWS in collecting pharmacy results for the patient's clinical record?
ADMIN	6) How efficient was the MeWS in collecting laboratory results for the patient's clinical record?

Table 3

Functional Area Questions for Clinical Capability.

Functional Area	Questions
SST	1) How well did the PIC and PIC reader perform for registering and locating patients?
	4) How effective was the SOAP notes screen in recording clinical data?
	5) How well did the menu choices describe and record clinical data?
	7) How helpful was the MeWS in reviewing patient location?
	8) How helpful was the MeWS in determining the status of a patient's treatment procedure?
	9) How effective was the M3(B) in performing diagnostic functions?
WARD	1) How well did the PIC and PIC reader perform for registering and locating patients?
	4) How effective was the SOAP notes screen in recording clinical data?
	5) How well did the menu choices describe and record clinical data?
	7) How helpful was the MeWS in reviewing patient location?
	8) How helpful was the MeWS in determining the status of a patient's treatment procedure?
	10) How well did the MeWS perform in reviewing a patient's laboratory, pharmacy, and radiology results?
	12) How efficient was the MeWS in preparing patient disposition information?
RAD	1) How well did the PIC and PIC reader perform for accessing patient records?
LAB	1) How well did the PIC and PIC reader perform for accessing patient records?
OR	1) How well did the PIC and PIC reader perform for accessing patient records?
	6) How effective was the MeWS in providing an efficient method of viewing clinical data?
PHR	1) How well did the PIC and PIC reader perform for accessing patient records?
ADMIN	1) How well did the PIC and PIC reader perform for accessing patient records?
	7) How well did the MeWS perform in generating reports on medical treatment facility status?
	8) How well did the MeWS perform in compiling and generating Annex Q reports?
	10) How effective was the MeWS in tracking patient status?

Appendix A

MEWS SURVEY: KB'99 EXERCISE
Surgical Shock Trauma (SST)

The MeWS is designed to automate collection and storage of casualty information at forward echelons of care during combat conditions. The SST/triage is the point of data entry for most casualties. Personnel create a new patient record by copying demographic data stored on the PIC to the patient registration screen. Medical personnel then record clinical information, entering diagnostic and treatment data manually or by making appropriate menu selections.

In the table below, please indicate the MeWS' level of effectiveness in performing the functions described. Select the response that most closely describes your experience with the system.

QUESTIONS	EXCLNT	GOOD	FAIR	POOR	DID NOT WORK	DID NOT USE	COMMENTS
1. How well did the PIC and PIC reader perform for registering patients?							
2. How clearly identified were the various screen components that make up the SOAP note form?							
3. How easily were you able to locate SOAP note function buttons?							
4. How easily were you able to access a specific patient's records?							
5. How effective was the SOAP note screen in recording clinical data?							
6. How well did the SOAP note medical terms describe clinical data?							
7. How easy was it to type clinical data in the text pad of the SOAP note screen?							
8. How helpful was the MeWS in reviewing a patient's location?							
9. How helpful was the MeWS in determining the status of a patient's treatment procedure?							
10. How easy was it to review a patient's medical documentation?							
11. How effectively did the MeWS training you received prior to the exercise prepare you to use the system during Kernel Blitz '99?							
12. Did using the MeWS allow you to complete your activities with less supervision and aid from others?							
13. Did you find the MeWS allowed you to operate in less space than normal?							
14. How effective was the M3(B) in performing diagnostic functions?							

Job Title for this exercise: _____ Corps/Rating: _____

Rate/Rank: _____ Medical Specialty: _____

THANK YOU FOR YOUR TIME AND PARTICIPATION.

MEWS SURVEY: KB'99 EXERCISE
Operating Room (OR)

The MeWS is designed to automate collection and storage of casualty information at forward echelons of care during combat conditions. Individual workstations are configured with software and peripherals to support the specific business practices performed at the location where it is installed. Laboratory/radiology/pharmacy results and clinical encounters are entered into the MeWS system. The OR staff can access patient clinical data through the web browser.

In the table below, please indicate the MeWS' level of effectiveness in performing the functions described. Select the response that most closely describes your experience with the system.

QUESTIONS	EXCLNT	GOOD	FAIR	POOR	DID NOT WORK	DID NOT USE	COMMENTS
1. How well did the PIC and PIC reader access patient records?							
2. How easily were you able to access SOAP notes (clinical records) using the MeWS?							
3. How easily were you able to access laboratory results through the web browser?							
4. How easily were you able to access radiology results through the web browser?							
5. How easily were you able to access pharmacy data through the web browser?							
6. How effective was the MeWS in providing an efficient method of viewing clinical data?							
7. How effectively did the MeWS training you received prior to the exercise prepare you to use the system during Kernel Blitz '99?							
8. Did using the MeWS allow you to complete your activities with less supervision and aid from others?							
9. Did you find the MeWS allowed you to operate in less space than normal?							
10. How effective was the M3(B) in performing diagnostic functions?							

Job Title for this exercise: _____ Corps/Rating: _____

Rate/Rank: _____ Medical Specialty: _____

THANK YOU FOR YOUR TIME AND PARTICIPATION.

MEWS SURVEY: KB'99 EXERCISE
Ward/Intensive Care (WARD/ICU) Tents

The MeWS is designed to automate collection and storage of casualty information at forward echelons of care during combat conditions. Individual workstations are configured with software and peripherals to support the specific business practices performed at the location where it is installed. In the WARD/ICU tents, the MeWS allows input and modification/update of individual patient records, as well as review of patient status throughout the company. Also installed is a multi-patient monitoring (MPM) system, which monitors the vital signs up of to eight patients simultaneously.

In the table below, please indicate the MeWS' level of effectiveness in performing the functions described. Select the response that most closely describes your experience with the system.

QUESTIONS	EXCLNT	GOOD	FAIR	POOR	DID NOT WORK	DID NOT USE	COMMENTS
15. How well did the PIC and PIC reader perform for registering patients?							
16. How clearly identified were the various screen components that make up the SOAP note form?							
17. How easily were you able to locate SOAP note function buttons?							
18. How easily were you able to access a specific patient's records?							
19. How effective was the SOAP note screen in recording clinical data?							
20. How well did the SOAP note medical terms describe clinical data?							
21. How easy was it to type clinical data in the text pad of the SOAP note screen?							
22. How helpful was the MeWS in reviewing a patient's location?							
23. How helpful was the MeWS in determining the status of a patient's treatment procedure?							
24. How efficient were the Propacs in monitoring multiple patients' vital signs?							
25. How efficient were the Propacs in recording multiple patients' vital signs?							
26. How useful was the capability of monitoring multiple patients at one location?							
27. How effective was MPM in providing medical staff with more time to administer patient care?							
28. How easy was the MPM equipment to use?							
29. How essential is MPM in the WARD/ICU environment?							
30. How essential is MPM in the surgical company environment?							
31. How well did the MeWS perform in reviewing a patient's laboratory, pharmacy, and radiology results?							
32. How efficient were the CHCS review screens for adding data to the patient's clinical record?							
33. How effective was the MeWS in preparing patient disposition information?							
34. How easy was it to review a patient's medical documentation?							
35. How easy was it to print a patient's clinical record?							
36. How effectively did the MeWS training you received prior to the exercise prepare you to use the system during Kernel Blitz '99?							
37. Did using the MeWS allow you to complete your activities with less supervision and aid from others?							
38. Did you find the MeWS allowed you to operate in less space than normal?							

Job Title for this exercise: _____ Corps/Rating: _____

Rate/Rank: _____ Medical Specialty: _____

THANK YOU FOR YOUR TIME AND PARTICIPATION.

MEWS SURVEY: KB'99 EXERCISE
Radiology

The MeWS is designed to automate collection and storage of casualty information at forward echelons of care during combat conditions. Individual workstations are configured with software and peripherals to support the specific business practices performed at the location where it is installed. The radiology staff enters radiology orders and results into a modified Composite Health Care System (CHCS). These results are accessed through a web browser and are added to the patient's clinical record.

In the table below, please indicate the MeWS' level of effectiveness in performing the functions described. Select the response that most closely describes your experience with the system.

QUESTIONS	EXCLNT	GOOD	FAIR	POOR	DID NOT WORK	DID NOT USE	COMMENTS
11. How well did the PIC and PIC reader access a patient's records?							
12. How easily were you able to enter radiology orders on the MeWS?							
13. How easily were you able to enter radiology results on the MeWS?							
14. How easily could you navigate through the CHCS radiology screens using the MeWS?							
15. How easily could you review radiology results through the web browser?							
16. How efficient was the MeWS in collecting radiology results for the patient's clinical record?							
17. How effectively did the MeWS training you received prior to the exercise prepare you to use the system during Kernel Blitz '99?							
18. Did using the MeWS allow you to complete your activities with less supervision and aid from others?							
19. Did you find the MeWS allowed you to operate in less space than normal?							

Job Title for this exercise: _____ Corps/Rating: _____

Rate/Rank: _____ Medical Specialty: _____

THANK YOU FOR YOUR TIME AND PARTICIPATION.

MEWS SURVEY: KB'99 EXERCISE
Pharmacy

The MeWS is designed to automate collection and storage of casualty information at forward echelons of care during combat conditions. Individual workstations are configured with software and peripherals to support the specific business practices performed at the location where it is installed. The pharmacy staff enters medicine orders into a modified Composite Health Care System (CHCS). The filled prescriptions are accessed through a web browser and are added to the patient's clinical record.

In the table below, please indicate the MeWS' level of effectiveness in performing the functions described. Select the response that most closely describes your experience with the system.

QUESTIONS	EXCLNT	GOOD	FAIR	POOR	DID NOT WORK	DID NOT USE	COMMENTS
20. How well did the PIC and PIC reader access patient records							
21. How easily were you able to enter pharmacy *orders* on the MeWS?							
22. How easily were you able to enter pharmacy *results* on the MeWS?							
23. How easily could you navigate through the CHCS pharmacy screens using the MeWS?							
24. How easily could you review pharmacy results through the web browser?							
25. How efficient was the MeWS in collecting pharmacy results for the patient clinical record?							
26. How effectively did the MeWS training you received prior to the exercise prepare you to use the system during Kernel Blitz '99?							
27. Did using the MeWS allow you to complete your activities with less supervision and aid from others?							
28. Did you find the MeWS allowed you to operate in less space than normal?							

Job Title for this exercise: _____ Corps/Rating: _____

Rate/Rank: _____ Medical Specialty: _____

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13. ABSTRACT *(Maximum 200 words:* The primary objective of the present report is to document the test and evaluation (T&E) of the medical workstation (MeWS) that occurred during field-testing exercises carried out during Kernel Blitz (KB) '99, a joint service exercise conducted at Camp Pendleton, California. The MeWS is a functionally configured, network-based workstation equipped with clinical support tools for patient diagnosis and monitoring, interfaced with the patient's clinical record. The evaluation was performed to determine whether the MeWS met the primary objectives of increasing provider satisfaction, increasing productivity and maintaining medical readiness, and increasing clinical capabilities at far forward and remote areas of care. Data were collected via surveys and interviews from participants in each functional area of the forward surgical company (FSC) as laid out for the exercise. Survey ratings indicated that participants were generally satisfied with the MeWS and felt that the system would be effective at increasing productivity and readiness as well as clinical capabilities in a FSC. The majority of users interviewed spoke favorably about the MeWS's clinical capabilities and about their satisfaction with the system. It is recommended that technologies such as medical information and clinical support tools be integrated with FSC business practices.

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