Global Treatment Protocol Course for Emergency Medicine: Making It Happen

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ABSTRACT

The combination of emergency medical training and education can be effectively presented in an online, interactive format and can include scenario-based decision-making exercises. The integration of current technology coupled with the best medical knowledge and intelligent tutoring capabilities can assist the military first responder in gaining the knowledge needed to provide proper assessment and treatment for ill and injured patients and to make reasoned decisions regarding transport. Further enabling comes through the availability of just-in-time job aids that are accessible via palm computer type devices in an anytime, anywhere environment. Combining all of these capabilities and making them available through the JXT Medical Training Portal will improve accessibility to relevant training and related information and serve to minimize medical errors. The focus of this paper is on the process of developing a common set of standardized protocols for use by military and civilian emergency medical personnel, together with the job aids and web-based sustainment training that we call the Global Treatment Protocol Course (GTPC) to support them.

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INTRODUCTION

Development of standardized emergency medical protocols and accompanying training materials and job aids is the challenge presented in this Phase II Small Business Innovation Research (SBIR) effort. The initial usability and feasibility of the concept was demonstrated at the end of the six month Phase I project and presented at IITSEC '03 (Gearhardt, et. al. 2003). This paper will describe the process being used to develop standardized protocols, accompanying job aids, the Global Treatment Protocol Course (GTPC) and JXT Medical Training Portal, and the benefit of these to improving sustainment training for military and civilian emergency medical first responders. In addition to the GTPC Course, we will also address the other capabilities which are being developed for the JXT Medical Training Portal to provide information resources, simulation exercises with an embedded Intelligent Tutor and Community of Practice (CoP) features.

PROBLEM

Discussions with active duty medical personnel indicate that much of the current military sustainment training is done in a traditional classroom setting at specific military training centers or as unit training. This is labor intensive from an instructor standpoint and the travel, scheduling and expenses related to traditional training create difficulty in getting all medical personnel trained on a regular basis. Consistency can be achieved and costs markedly decreased by using non-traditional approaches including Web-Based Training (WBT) and Computer-Based Training (CBT) platforms for an anytime, anywhere training environment. In addition, there is no standardization of assessment and treatment protocols across military or civilian first responders to facilitate joint services operations. The frequency of joint military operations and operations involving military, civilian and Department of Homeland Security deployable teams is becoming more common, and is likely to increase in the future. Therefore, the standardization of emergency medical protocols is necessary to enable all entities involved in emergency operations to be fully interoperable and to minimize medical errors.

BACKGROUND

A review of existing military and civilian medical protocols shows a lack of standardization. This is further supported by reports from recently deployed medical personnel of difficulties encountered in theater during Operation Iraqi Freedom (OIF), Operation Enduring Freedom (OEF) and other recent conflicts and humanitarian operations. The injured and ill are cared for using different protocols and methods, sometimes based on unit specific protocols. This can create difficulties in multiagency response with inconsistency in treatment between units, communication mismatch regarding expectations of what care has or will be provided, and the differences in equipment and supplies required by each protocol. In addition, the military physicians we spoke with expressed frustration in not knowing what care is given to a patient prior to their arrival at a treatment facility because the physicians do not know what protocol a given unit is following. The wide variety of medications available for use by military medical personnel allows for inclusion or exclusion in each medic's kit according to the specific protocol that medic is following. Simply said, an Army Medic, Air Force Medic and Navy Corpsmen treat patients in different ways for the same set of symptoms.

Personal Digital Assistant (PDA)-based job aids are reportedly not commonly available to frontline medical personnel, but if available would allow protocols, resource information, drug calculations and job aids to be available to first responders at all times. We have been told by Air Force physicians that they are recommending these devices for frontline medical personnel. Devices and patient documentation software are being used by some Army medical personnel in Iraq as part of a trial being managed by the Telemedicine and Advanced Technology Research

Center (TATRC), an agency of the U.S. Army Medical Research and Materiel Command.

Recent Developments

Within the military, an increase in joint operations makes the standardization of protocols even more essential for improvement of intraoperability. Joint operations between the military, other government agencies and civilian entities are also becoming more common and reveal the disparity among agencies. Multiple agencies responded and interacted with one another in the aftermath of the 9/11 terrorist attack. In each venue, difficulties were reported with radio communications, division of responsibility and duplication of efforts among those involved. Each entity had its own policies and protocols to follow and these often conflicted with one another, resulting in confusion and delays in operations. Since 9/11, there has been a renewed emphasis on providing first responders the resources and training they need to do an even better job of saving lives and helping reduce the adverse effects of injuries whether working alone or in a joint operation. As military, other government and civilian agencies begin to work together under the umbrella of Homeland Security to respond to natural and man-made disasters, a continuity of procedures and protocols must be developed to improve the efficiency and effectiveness of these operations.

Accomplishments

In the first Phase I of this Small Business Innovation Research (SBIR) project a concept design was developed for an internet based GTPC. A sample lesson, accompanying job aid and web portal for course delivery were developed and presented as a proof of concept. Phase II includes development of a common set of standardized protocols to meet user requirements, the detailed course design, a fully functional prototype GTPC and job aids, and an intelligent tutor for scenario-based exercises.

PHASE II TECHNICAL OBJECTIVES

The overall work effort being performed in Phase II builds on the foundation laid in Phase I and consists of (1) collecting additional relevant information to establish a more complete and comprehensive set of user needs and requirements, (2) completing the standardized protocol set and the detailed development of all protocol modules, (3) completing the training tasks and objectives that are required to support the protocol and embedded job aids, (4) completing a detailed course design, (5) developing the lesson materials, (6) conducting internal testing, beta testing, evaluation and validation, (7) hosting periodic program and technical reviews, (8) developing supporting documentation, and (9) laying a proper foundation for product development in Phase III.

The primary focus of Phase II is on defining, developing and validating a standardized protocol and web-based course that supports the common requirements of all military branches. Unique requirements will be identified where they exist and accommodated in the protocol and course design. The common requirements have priority in lesson development, testing, evaluation and validation. The development of lessons to support unique requirements of some organizations will be accommodated to the extent possible, but may have to be deferred to Phase III. A secondary focus will be on adapting the results to meet the needs of civilian first responders.

APPROACH

The first step is to determine the user requirements. It is important that participation in the survey by members of all services and civilian organizations be achieved. The Phase I survey of potential military users yielded primarily Air Force Physician responses. We utilized the Emergency Medical Technician (EMT) responses that were received to determine the preliminary topics to be included in the training. For Phase II of this effort we combined quantitative and qualitative data collection methods also known as Triangulation. Blending and integrating methods of data collection can "...capture a more complete, *holistic* and contextual portrayal" of the subject under study, by eliciting data leading to new hypotheses or conclusions, for which single methods would be blind. In most research designs using triangulation methods, there is a hidden assumption that the weaknesses and limitations of each individual method will be counterbalanced by the other method, exploiting the assets, and neutralizing, rather than compounding, the liabilities.

The use of multiple methods in research has been applied for over a decade. Its introduction into the health field has been relatively recent. Phase II data collection methods include the following:

- On-line survey.
- Interviews - individual interviews will be conducted to clarify details arising from the survey and validate our conclusions.

- Observational study - Of particular interest are knowledge deficits which arose during recent deployments. It is important to note that making a useable, applicable course is of utmost importance

Initial Phase II data collection of military medical responders is ongoing with preliminary evaluation of the results shown in Table 1.

Determination of the specific needs for training and the protocols to be used will determine the final course requirements, content and delivery details. The most critical modules will be developed first. Of these, the Trauma and Weapons of Mass Destruction (WMD) modules are nearing completion in the content development phase and have been entered into the lesson design process. These were selected for development as they contain the most highly rated topics for development from the Phase I User Survey and were stressed as critical needs in discussions with active duty Air Force, Army and Coast Guard personnel. Development of standard protocols will be accomplished through comparison of current in-use protocols, research into current medical treatment recommendations, and assessment methodologies. Both military and civilian physicians experienced in emergency care will review all protocols for soundness and practicality. These protocols will be used within the lessons for recommended treatment and as a guide for the expert paths of the simulation exercises.

The final product will consider Human Factors design as well as the ARCS Model of Motivation for learning developed by Dr Keller of the University of Florida in the course design. This ensures the screens are stimulating, relevant, intuitive, and interactive. The ARCS Model consists of:

- **A**ttention – arouses and sustain the learner's interest and curiosity
- **R**elevance – connect the content to important goals and values of the learner (gives the learner a reason to care)
- **C**onfidence – promotes positive and realistic expectancies for success
- **S**atisfaction – maintain motivation: consistency between expectations and outcomes

We believe that the use of proper design principles, effective instructional strategies and stimulating visuals, in addition to current and job pertinent content will enhance the user's willingness to use the product, encourage their return to additional modules for future training, and improve the retention of the concepts learned. The detailed course design, using the Instructional Systems Design (ISD) process, will be completed for each training module. At the completion, storyboarding of the lessons, modules and intelligent tutoring scenarios will be accomplished. Each module of the course will be internally tested, beta tested by both military and civilian user groups, revised as necessary and validated before finalization. These steps will occur during the time period of December 2004 through mid 2005.

Survey Results

Preliminary survey results are as follows:

Table 1. Preliminary Phase II User Survey Results

Parameter	Results
Service	AF 98.4%
Rank	E-6 or below 82.2%
Experience	Most 10 years or more
Job Level	EMT Basic 66.1%
ED Experience	78%4 years or less
Current CE Method	85.5% Unit Training
Preferred CE Method	Unit Training/Conferences
CE Topics needed	Medical Emergencies, Pharmacology
Training Frequency	At least annually
PDA Use	21%
OS	Palm OS
PDA Tasks	Appointments, contacts, Tasks, Notes
PDA Memory	16-64 MB

In addition to the online survey, individual interviews are being conducted to clarify details arising from the survey and validate our conclusions. Of particular interest are knowledge deficits which arose during recent deployments. It is important to note that making a useable, applicable course is foremost.

The final product will also consider Human Factors in the course design; making certain the screens are stimulating, intuitive, and the interactivity within the course is acceptable to users. We believe that attractive visuals, in addition to current and job pertinent content will enhance the user's willingness to use the product, encourage their return to additional modules for future training, and improve the retention of the concepts learned.

STANDARDIZED PROTOCOLS

Development of standardized protocols for military and civilian first responders makes logical sense.

Current practice is gravitating toward joint operations, and making certain that all players are operating from the same play-book minimizes the potential for confusion in the operation. We understand that there will be unique protocols for each entity, but the common protocol set includes most of the necessary information for operating in most environments of care. Production of the first two protocols has been completed. Each includes the information and decisions which are required from the recognition of an emergency and continues until patient assessment, treatment and the evacuation of all casualties is accomplished. Each is a hybridization of the current protocols in use and with accepted medical practice. The protocols investigated were obtained from Air Force, Army, Navy and Coast Guard resources as well as civilian protocols. In addition, standardized course curricula were reviewed for current best medical practices. Those courses reviewed were the Army 91-W Course, Combat Casualty Care Course, Advanced HazMat Life Support, and Advanced Disaster Life Support Courses. We also reviewed relevant Centers for Disease Control Chemical, Biological and Radiation/Nuclear Agent Information. Each protocol has been reviewed and approved by our Chief Medical Officer prior to inclusion in the GTPC. Supplemental information is included in each protocol for rapid ramp-up of the providers when using them in a just-in-time environment. Detailed information is included in the GTPC modules to provide for more complete training to be done during less stressful times. It is expected that the users of the GTPC will complete the training modules in preparation for using the protocols.

COURSE DESIGN

The GTPC has been designed in modular format to allow for ease in making as-needed revisions and updating content. Initial modules have been developed for WMD and Trauma. The protocols for both of these topics have also been completed as described above. The third module, Mass Casualty Incident Response is currently in development. The content of additional modules will be determined in conjunction with the completion of the Final Protocol Set after all survey input has been received and evaluated. Designing the GTPC in modular format is also being done to shorten the lessons and make them easier to complete one at a time, rather than requiring that they all be done in one sitting. This format allows the on-duty student to stop and start as necessary to accommodate response to emergencies that may occur while training is being conducted.

Course Design/Development

Following verification of the standardized protocol and the corresponding training tasks and objectives, a detailed course design will be completed. It builds on the high level design and conforms to the modular structure of the standardized protocol. Once complete, the course design is subjected to internal, collaborator and customer review.

Following the completion of protocol and content development for each module, the training tasks and objectives are determined. These enable us to make certain that all content areas are adequately covered in the course and that the reusable learning objects are correctly identified. Because the course will be ADL/SCORM compliant, this task is critical to the overall course development. Training tasks and objectives are those items that guide final course content inclusion and delivery methodologies used in the training.

Following approval of the course design, the development process, consisting of lesson design, storyboarding and coding is initiated. We begin to prioritize the order in which the learning modules will be developed and tested based on the outcomes of the user survey and priorities expressed in our discussions with military first responders. Our intent is to make judicious use of the capabilities of current e-learning methods and available web technologies in the design, development and delivery of the GTPC. Internal and customer reviews at critical points throughout the course development process will ensure consistency with established user requirements, the incorporation of user friendly technology and applications, compliance with ADL/SCORM requirements, and the use of industry standard design procedures and documentation.

In order to assess the effectiveness of the modules, we will use a spiral development process. In this process, development and testing of course materials occurs by module. Completed modules will be subjected to internal testing and verification against an approved test plan currently being designed. Following the completion of internal testing the modules will be made available to our civilian and military collaborators for beta testing and evaluation. Once a module has completed beta testing and needed changes have been made, it will be subjected to a pilot mini-course to be taken by pre-selected users to assess its validity and usability in meeting their protocol training needs. A module that fails at any point in the process will be corrected and re-entered into the process until it

passes. A pilot course that includes all modules will be provided near the end of Phase II for a final assessment of the validity and usability of the integrated course to meet the common protocol training requirements of military emergency medical first responders.

Modules/Lessons

Each module of the GTPC is parsed into lessons containing 15-30 minutes of instructional content and that support the desired learning objectives. The lessons in each module flow from background information on the specified topic to specific disease or injury assessment and treatment details. Assessment and treatment protocols will be developed as individual knowledge objects and will be integrated into the content as well as available separately for student review.

Evaluation questions or exercises are written to determine the mastery of each learning objective and will be presented to the student throughout the module. The student must achieve at least 80% correct responses to be able to earn continuing education credit for module completion. Approval of the modules for awarding of continuing education hours will be sought, after the first few modules are complete and have successfully passed the testing and validation process, through the Continuing Education Coordination Board of Emergency Medical Services (CECBEMS) which is a National approving organization for distributed education programs.

Blended Learning Approach

To best meet the challenges of this program and the user, we are designing and implementing a blended learning model that combines the best features of e-learning, performance support, and information delivery methods via a web portal. Several of the methods we are integrating into this blended model are briefly described below.

Learning Management System (LMS)

The heart of any asynchronous distance-learning program is the LMS, which 1) automates the administrative tasks for the administrator, instructor and the student; 2) provides both the instructor and student the ability to instantly query the system for information to accomplish their individual instructional or learning objectives; and 3) provides the administrator the capability to track and record the progress of individual students, the effectiveness of the training program, and the workload of the instructional staff. The information gleaned from the LMS allows administrators to quickly assess and adjust resources to facilitate a more streamlined throughput. It also provides a quick response ability to the "what if" drills inherent in the planning and budgeting processes that challenge resource allocations and projected requirements.

Video Clips

A second program delivery method uses video clips embedded in the online course and performance support tools. The video clips present real-life situations as well as step-by-step instructions that reinforce the course content. The video clips are pre-loaded using Macromedia Flash MX to eliminate streaming delays.

Knowledge Objects

Reusable knowledge objects represent an alternative approach to content development. In this method, content is broken down into chunks or specific tasks. From a pedagogical perspective, each chunk might play a specific role within an instructional design methodology. Such chunks are called knowledge objects (Figure 1). These objects can be used as a stand alone object, within a course, as part of a performance support tool or as a reference within the web portal. There is no standard for the size (or *granularity)* of a learning object. Each object will have an objective and could include Flash animation files, video clips, html files or pdfs.

Online Documentation

A fourth technological delivery method is online documentation. Online documentation provides a central repository for current information such as manuals, processes, and procedures. A tool such as RoboHelp can produce an online user manual that is indexed, linked to similar topics, has natural language search capability, and is accessible to external documents in an easy to use interface. Hardcopies of the user manual can be easily exported from RoboHelp. One of the advantages of online documentation is for making updates to manuals. After updates are made there must be distribution of the updated manuals to the user community. With traditional training documentation, there is no way of knowing if all of the outdated manuals have been disposed and replaced with the new updated manuals. Consequently, online documentation provides the capability of controlling the information disseminated to first responder personnel.

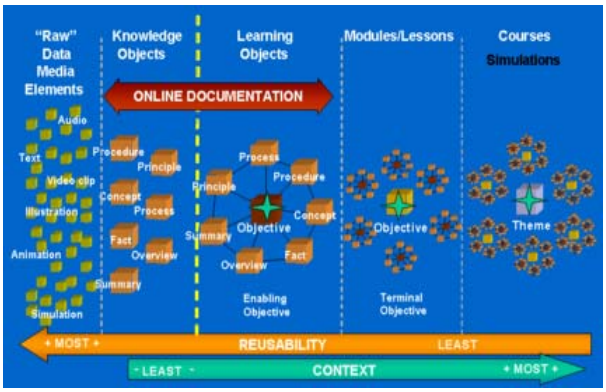

Figure 1. Knowledge Objects

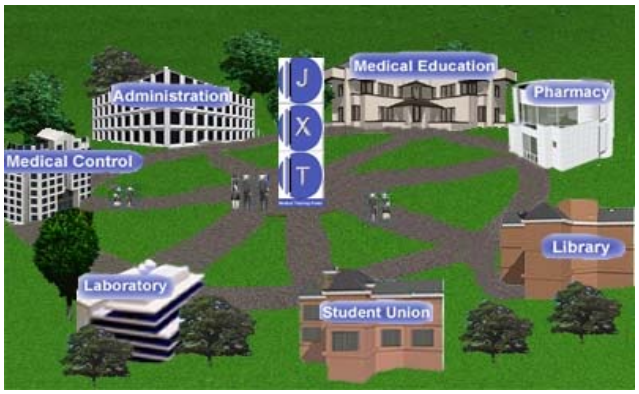

Figure 2. JXT Medical Training Portal

Handheld Technology

A fifth technological delivery method is the PDA; often known as a Handheld Computer, Pocket PC or Palm Pilot. The use of hand held devices such as PDAs is huge and growing everyday. These relatively inexpensive devices can play an increasingly important role on the battlefield, in the ambulance, fire truck, or other first response vehicle as well as in the pocket. Like desktop or notebook computers, the PDA requires an operating system (OS) to run the various applications. These devices can provide wireless Internet access from remote locations. They also provide information sharing from one PDA to another. Some of the ways first responders can use PDAs include:

- Electronic map of service area
- Taking and storing pictures from the scene
- Global positioning system to direct a medi-flite or other airlift support
- Online pharmacology guide
- First response protocols, algorithms and job aids
- Review of non-standard procedures

User Interface

A significant and beneficial feature of the course design is the Community of Practice (CoP) web portal approach taken to course organization, documentation, instructional delivery and learning management. We have designed the high-level virtual campus that we call the JXT Medical Training Portal shown in Figure 2. It will be accessible via the Internet and will support PDA accessibility. The blended learning model mentioned earlier is embodied in the JXT Medical Training Portal and will support the current and future training needs of military and civilian first responders. The Medical Training Portal interface has been deliberately designed to visually portray a college campus to the user when he/she logs on to the web site.

The user will navigate around campus using either a menu to help accomplish what he/she came for, or take a walking tour (as the mouse scrolls he will see himself as a person walking around campus) and check out the description of each structure that will be given when the mouse is rolled over it. A brief description of what we envision to be available at the JXT Medical Training Portal tower and in each building on campus is building is briefly described in the following list.

- JXT Medical Training Portal Tower: Campus center. Will provide general information, directions and campus tour.
- Administration: Students register here for course(s) by entering their information into the Learning Management System (LMS) that will track their progress and proficiency scores. It will contain student records, course completion information, etc. Provides information regarding campus navigation. A tour of the campus may also be taken from here.
- Student Union: Will provide a collaborative interface with chat rooms; bulletin boards, instant messaging, etc.
- Library: The library will always be open. It will provide on-line references, related CoPs, links to other support materials, medical organizations and related sites.
- Pharmacy: We will select and recommend COTS packages for drug interactions, dosages, etc.
- Medical Education: Will contain course curriculum, courseware, protocols, job aids.
- Laboratory: This area will contain normal and abnormal assessment and laboratory values for reference.
- Medical Control: Will contain course and site policies and procedures, and other related information.

The CoP approach provides tremendous capability for a variety of applications and includes significant

growth potential to accommodate emerging requirements. It is designed to be many things to many users. It will be appealing to the military and civilian personnel who use it, and it will further the commercial potential of the GTPC. We hope to use the Medical Training Portal as a catalyst for cooperation between military and civilian emergency responders. We believe it lays an excellent foundation for the inclusion of other web-based medical training since it can be easily adapted to a wide variety of needs and applications.

Intelligent Tutoring

Computer systems that emulate the methods of human tutors are called intelligent tutoring systems. These systems are capable of providing all of the interactive features of multimedia in addition to precise commentary on the student's performance and the selection of remediations that are appropriate to an individual student's needs. Simulation exercises that include embedded Intelligent Tutor capabilities are being designed for the GTPC. In contrast to standard computer-based training, Intelligent Tutoring does not follow a fixed set of responses to student errors. The "intelligence" is in figuring out the "cognitive malady" of the student in the context of instruction. Intelligent Tutoring attempts to deduce why the student is making a specific error. In GTPC the Intelligent Tutor would try to determine why a student was failing to follow the protocol correctly. It would use analysis rules to make instructional decisions related to the domain. For example, the student might not conduct triage in the correct order. They may attempt to seek a pulse prior to checking breathing, or perhaps not understand tag colors. The system reasons as a human tutor would about the causes of a student's problems and attempts to match this "diagnosis" to insightful tips and remedial commentary. The Intelligent Tutor will assess student performance in the scenario against that of an expert and provide feedback to the student. This allows the student to practice decisions required by each scenario in a no threat environment. Students will practice as they would be expected to act during a real situation, thereby creating the opportunity to improve retention of the lesson materials.

Technical Considerations

As we navigate our way through the GTPC solution there are a number of technical items to consider: response time, system complexity, database structure, delivery platforms, sustainment issues. All these items are still being analyzed to determine the best technical solution.

In general, we are not using nested tables, large graphics, JavaScript, Java, and CSS. Files are as small as possible (preferably less than 100K in size) and use high contrast text and background and follow the HTML 3.2 specifications.

Hardware and software on PDAs vary significantly. Designing content for PDAs need to take into account variability in hardware and software. Seasoned users are aware of the limited memory capability in their PDAs. This has an effect on the likelihood of the user downloading content, especially large amounts of it. By keeping the design of the tool clean and simple, file size is kept to a minimum.

Benefits

The expected benefits of GTPC and the Medical Training Portal are numerous. It allows users the opportunity to go to one place for all or most of their educational and sustainment training needs. Students can participate in the CoP and interact with others in their profession to ask questions and discuss solutions to common and unique problems encountered in their practice setting. It is a cost effective method by which to meet recertification requirements and allows for participation in an anytime-anywhere environment. Job aids are provided to simplify the recall of seldom used training and protocol information. This type delivery decreases the time and expense of traveling to participate in sustainment training and the scheduling difficulties inherent in that process.

Related Applications

In addition to GTPC, we are currently developing other related course materials which may be included in the JXT Medical Training Portal. These are military emergency responder initial and sustainment training courses for military and civilian agencies.

LESSONS LEARNED

Putting a comprehensive sustainment training program in place for military medical responders must involve the participation of the potential users of the end program. In today’s environment of multiple deployments, gaining access to the necessary personnel is difficult. The rapid changes in technology will affect the final prototype as well as the final commercial version of this program and entails staying on top of those changes to allow rapid integration of applicable new technologies.

CONCLUSIONS

Military medical personnel thirst for sustainment training that supports their job needs in the ever-changing environment in which they are expected to perform. They have definite ideas of what that training should include and are willing to embrace new methods of information delivery. As this prototype development continues, participation in the beta testing, usability and validation of the course modules and job aids, as well as the other JXT Medical Training Portal components should assist in getting buy-in of the users, both military and civilian, for eventual use of this course to meet their sustainment training needs.

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