OFE Research Project

Investigation of Human Patient Simulation for use in Training EMS Personnel

An applied project submitted to the Ohio Fire Chiefs as part of the Ohio Fire Executive Program

by

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ABSTRACT

The problem with the pre-hospital provider medical training at Washington Township Fire Department was that we lacked a program that specifically identified the areas of both individual and team performance needing improvement. Understanding whether to invest in Human Patient Simulation (HPS), whether to integrate the concept of HPS into our EMS training program and whether to use HPS in developing systems for improving our service delivery prompted this investigation. In preparing this research, the descriptive and evaluative research methodologies were used.

The following research questions were posed: (1) Are evaluation systems currently used for fire/EMS medical training that accurately define and document knowledge, ability and integrated skills performance using Human Patient Simulation? (2) Do any other departments similar to Washington Township Fire Department in size and budget within Region V of the Ohio Regional Physicians Advisory Board use HPS as part of their EMS training? (3) Are medical errors reduced following implementation of HPS training?

The procedures used in this project were designed to gather information on existing programs of similar size and budget using HPS, and review the literature pertaining to the use of HPS in training pre-hospital medical providers as well as to determine the efficacy of using HPS to enhance our current EMS training programs. Feedback was solicited from the 147 services providing EMS response within Region V via electronic and standard mail surveys. Final results of the survey indicate that few services, regardless of size and budget currently utilize HPS in training EMS personnel. Preliminary recommendations of this research are: (a) To include full-body HPS in training EMS personnel (b) Develop substantive assessment and feedback tools (c) Enlist

membership in the process of designing and administering an HPS program at Washington Township Fire Department.

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INTRODUCTION

As Washington Township Fire Department (WTFD) of Dublin, Ohio moves toward national accreditation and with respect to our continual process improvement program, the Emergency Medical Services (EMS) Division must continue to enhance the training program to ensure that all members are equally proficient in delivery of medical care. The EMS division maintains responsibility for ensuring that every member maintains proficiency in both cognitive and didactic performance yet our current training regimes do little to promote individual and team performance including such human factors development as confidence, critical thinking, and communication.

WTFD has tried numerous training methods in an attempt to excite the membership and improve both learning outcomes and knowledge retention. Classroom lectures seem to reach only a small percentage of members and skills labs using inanimate props and/or simulated patients such as Rescue Randy™ do little to improve life long learning outcomes.

Budgetary prudence limits the amount of overtime pay available to compensate replacements for personnel committed to both on-duty and off-duty training classes. We are therefore continually finding that offering training to on-duty crews who are often called away from class to respond on incidents reduces the impact of a speaker's presence, the tactile stimulus of hands-on training and also the opportunity to ask questions and refine motor skills. Our skills training tends to lack excitement and the members agree that it has become entirely too repetitious. The membership states their appreciation for any training, but deserve better.

The problem this study will address is the lack of interesting, reproducible and definable EMS training systems that provide consistent and impartial feedback. Our current system EMS training system using lectures and the occasional skill station lacks excitement, lacks the feedback mechanisms to adequately document individual or team knowledge, skill or ability and they not do

provide documentary evidence of personal or team improvement. The purpose of this study is to evaluate the efficacy of using Human Patient Simulation for training basic and advanced life support fire and EMS personnel. The EMS Division's search for better and more interesting training methods prompted this research into inclusion of HPS into our departmental training regime.

The research questions this study will investigate are:

1. Are evaluation systems currently used for fire/EMS medical training that accurately define and document individual ability and integrated skills performance using HPS?
2. Do any other departments similar in size and budget to WTFD within Region V use Human Patient Simulation as part of their EMS training?
3. Are medical errors reduced following implementation of HPS training?

Several types of human patient simulators are currently used in the medical field. One type is best described as PC-based interactive multimedia simulators using computers to produce scenarios in which the user typically uses a mouse pointer to "click" the desired response. The computer provides feedback for both correct and incorrect answers. This format, most familiar to those accustomed to interactive gaming, offers descent graphics and reasonable speed of response, however limits tactile interaction to use of a mouse. Skill development, short of demonstrating the ability to follow sequential steps in a process is absent. For users to develop skills using simulation other types of devices are necessary.

Part-task trainers provide for near-realistic representation for use in skill replication. One example familiar to most medical providers is that of an "IV arm". These life-like manikin arms utilize anatomically placed rubber-like tubing containing simulated blood for use in learning to place intravenous (IV) catheters.

Virtual Reality trainers are currently used in the aviation industry and are commonly known as flight simulators. These very expensive and technically complicated devices have yet to have achieved the level of cost-effectiveness and technical enhancement necessary to find a place in pre-hospital medicine. The forth type, digitally enhanced manikins, have however been developed that meet the needs of the pre-hospital environment.

Digitally enhanced manikins utilize computer-driven electromechanical components to simulate human functions such as pulses, blood pressures and breathing while allowing operators to manage scenarios and provide documentation of procedures performed. For purposes of this research the term HPS shall refer collectively to digitally enhanced manikins such as SimMan manufactured by Laerdal Medical Corporation and their application into scenario based prehospital skills training.

BACKGROUND AND SIGNIFICANCE

Since 1937 Washington Township Fire Department has served portions of three counties adjoining the northwest quadrant of Columbus in central Ohio. We currently provide services to a community of around 40,000 residents and over 150,000 visitors and commuters daily. Staffing consists of 148 full time and part paid line personnel working on a three-platoon system in four stations. An administrative staff of 12 includes the fire chief, an administrative battalion chief, a five-man fire prevention bureau, training and EMS managers and civilian administrative staff. The department provides fire suppression, emergency medical services, hazardous materials response, technical and heavy rescue, fire prevention and inspections, a Bike Medic team and such public safety education programs as CPR and First Aid, a Public Access Defibrillation (PAD) program, a Fire Safety House, Juvenile Fire Setters program and fire extinguisher education.

As our community grows, with EMS comprising nearly 70% of our total run volume, the EMS division is facing significant challenges. Maintaining compliance with state and federal laws,

mandates and policies requires particular diligence. Ensuring that the highest standards in service delivery are met requires that significant time is dedicated to assessment and training of personnel. Balancing the needs of the community, the department, the division and the personnel with limited manpower requires that the division continually enhance its training methodology to maximize results with minimal resources.

The medical community, of which our EMS division is the integral first link, is often reminded that the public demands uncompromising care and treatment; the legal system serves as the primary messenger of their demands through medical malpractice litigation. The eagerness of litigators to capitalize on any mistakes by the medical community is well documented. It therefore becomes apparent that, with increasing emphasis by the public, the legal profession, the medical community as well as the media, insurance companies and our own personnel on patient safety and outcome improvement, the inherent benefits of programs designed to improve the quality of our service delivery by quantifying training outcomes become increasingly important. Any action resulting in accident or injury such as a drug dosing error or a procedure that goes awry may be considered medical error and reduction of these errors is the goal of every care provider and medical educator.

According to Medical Error Prevention and Reporting System (MEPARS), a leading medical error reporting data source, a 1999 report entitled *The Chasm in Quality* by the Institute of Medicine, cites that from 44,000 to 98,000 people in the United States die each year as a direct result of medical mistakes (MEPARS, 2003) (IOM, 2003). MEPARS qualifies the statistics citing that these figures are extrapolations from two very small studies, Thomas et al., 2000 and Thomas et al., 1999, yet the media has paid particular attention to the results (IOM, 2003). Regardless of the accuracy of the findings, any medical error resulting in diminished outcomes is unacceptable. There

is also a growing awareness that the health care community, of which EMS is certain to remain an integral part, falls behind other high risk operations in its attention to ensuring basic patient safety and that a need exists to grasp the scale of the problem (Kohn, 2000).

Medical training has historically used live patients to hone the skills of health professionals. The obligation to provide optimal treatment and to ensure patients' safety and well-being while using live patients in training represents a fundamental ethical tension in medical education between doing nothing to harm the patient and in harming those who entrust their lives to us for the sake of training. According to Ziv, Wolpe, Small and Glick in their 2003 analysis of simulation use in the medical profession state that "Simulation-based learning can help mitigate this tension by developing health professionals' knowledge, skills, and attitudes while protecting patients from unnecessary risk" (Ziv, 2003). Use of simulation-based training has been utilized in other high-hazard professions, such as aviation, nuclear power, and the military, to maximize training safety and minimize risk. Health care has lagged behind in simulation applications for a number of reasons, including cost, lack of rigorous proof of effect, and resistance to change. Recently, the international patient safety movement and the U.S. federal policy agenda have created a receptive atmosphere for expanding the use of simulators in medical training, stressing the ethical imperative to "first do no harm" in the face of validated, large epidemiological studies describing unacceptable preventable injuries to patients as a result of medical management (Ziv, 2003). The use of simulation wherever feasible conveys a critical educational and ethical message to all: patients are to be protected whenever possible and they are not commodities to be used as conveniences of training (Ziv, 2003).

Use of patient simulation is considered by many to be an important part of the solution to medical errors in patient care. Using simulation, innumerable scenarios can be presented including

uncommon but critical situations where a rapid response is needed. Errors can be allowed to occur and reach their conclusion without any risk to a patient (Kohn, 2000). Team member interactions and leadership can also be explored and developed (Kohn, 2000). Another important part of the solution according to Kohn is to: "Use simulations whenever possible …Crew resource management techniques, combined with simulation, have substantially improved aviation safety and can be modified for health care use" (Kohn, 2000). The report continues by stating that it is paramount to: train in teams those who are expected to work in teams …health care organizations should establish team training programs for personnel in critical care areas (e.g. the emergency department, intensive care unit, operating room) using proven methods such as the crew resource management techniques employed in aviation, including simulation (Kohn, 2000). Crew Resource Managements techniques are worthy of review in the context of HPS.

The potential impact this study could have on the WTFD is to provide proof that HPS based training provides quantifiable evidence of the effectiveness of its use and provides definable quality improvement. This study may also support the implementation of a HPS program at WTFD. Furthermore, this study may provide evidence supporting the assumption that HPS helps to reduce medical error by improving both individual and team performance with the additional benefit of improving overall service delivery to our citizens and visitors.

Literature Review

A review of existing literature pertaining to Human Patient Simulation and its use in training provides significant insight into the broad history of simulation-based training. Simulation based training certainly began long before recorded history as our nomadic ancestors practiced hunting using primitive weaponry on inanimate representative targets. The earliest documented use of simulation by man for training occurred during the Roman era (CSCC, 2003) (IHRE, 2003). In

ancient drawings, foot soldiers are depicted using tree trunks upon which to practice sword strokes in preparation for battle. Military groups have continued to realize the improvement in skill resulting from simulated practice prior to battle, saving the obliteration of practice partners and allowing soldiers to exert their most aggressive efforts in vanquishing their imaginary foe. Simulator training progressed to practicing skills while tossing about in a boat and while on horseback. Practitioners of warfare soon developed a 6-foot wooden figure of an enemy soldier armed with a shield and sword providing the first life-like simulation of the enemy upon which to unleash their furry (CSCC, 2003). The military today places increasing emphasis upon simulation-based training.

Simulation for managing the intricacies of warfare first emerged under the guise of the board game of chess. A study the game pieces and how they are used, reveals that chess is a history of medieval times in miniature. The six different chess pieces on the board represent a cross section of medieval life with its many ceremonies, grandeur, and wars. Chess was played many centuries ago in China, India, and Persia although the origin of the game remains unclear. In the eighth century, armies of Arabs known as Moors invaded Persia. The Moors learned chess from the Persians. When the Moors later invaded Spain, the soldiers brought the game of chess with them. Soon the Spanish were playing chess, too. From Spain, chess quickly spread throughout all of Europe. Europeans gave chess pieces the names we know today; they probably had trouble pronouncing and spelling the Persian names, so they modernized them to reflect the way they lived. Today, the names certainly are not modern, but a thousand years ago represented the very way in which both ordinary people and persons of rank lived their lives (Mack, 2002).

One of the most innovative examples of simulation for military training is found in Multiple Integrated Laser Engagement System, MILES gear, a military weapons training system that allows

force-on-force training through a system of lasers and sensors and microcomputer technology. A laser transmitter is fixed to the muzzle of a weapon (typically an M-16 variant), and the sensors are attached to a harness that the soldier wears. The transmitter "fires" when the soldier shoots blanks through the weapon. Hits are recorded by the target's sensors which set off audible alarms. The system is fairly easy to use and it allows the use of the troops' own weapons for better familiarization. The range is around 300 meters with original MILES gear and about a thousand meters with MILES 2000. Once the initial equipment outlay is completed, the only remaining cost, apart from maintenance, is the cost of the blank ammunition (Pentagon, 2001). By employing computer based simulation, MILES gear, and simunitions, specially manufactured bullets that fit into a gun similar to the duty weapon but when fired only leave a red soap mark, the military has ensured that battlefield lessons can be practiced until perfected without jeopardizing human life.

In the Americas, possibly as early as the 1400's, stick games played by the native peoples became an important part of the culture. Aboriginal tribes across the North American continent avidly played games using a netted racquet with which to pick the ball off the ground, throw, and catch and throw it into or past a goal to score a point. The evolution of stick games in America led to the development of lacrosse as a form of recreation and perhaps more importantly, as a training ground for the art of war and to toughen warriors for battle.

In one particularly notorious historical reference to Lacrosse emanates from what is today's northern regions of Michigan. In supposed celebration of King George the Third's birthday, on June 4th, 1763, a game of lacrosse was arranged by the Sauk tribe just outside the palisades of Fort Michilimackinac. As the soldiers and civilians ventured outside the walls of the fort to better observe the game, the native players dropped their sticks, gathered weapons hidden in their women's blankets and attacked through its now open gates. Over 70 troops and civilians were killed

and many more taken prisoner. That the game of lacrosse simulated warfare and better prepared its participants for war remains undisputed. Modern day simulation has reached further into man's imagination than simple stick figures and games of skill and no known boundaries to this expansion exist. In our continuing quest for developing better ways to train, new systems are rapidly evolving.

Peacetime use of simulators plays an important role in safely preparing and educating future practitioners in their prospective craft. In the late 1980's SimCity, a video game about the decidedly un-heroic concept of city planning arose from the ashes of a more typical videogame, The Raid of Bungeling Bay. Bungeling Bay featured a heavily armed helicopter laying siege to equally heavily armed islands. Will Wright, the creator of SimCity, quickly discovered that he was having more fun creating the islands than with blowing them up with his helicopter. At the same time, Will cultivated a real love of the intricacies and theories of urban planning, particularly those of MIT professor Jay Forrester.

SimCity soon found its place as an educational tool, and made its way into more than 10,000 classrooms, a noteworthy feat for any commercial videogame, even today. System simulation games were such a new concept at the time that he also suddenly found himself fielding phone calls from governmental agencies, including the Central Intelligence Agency and the Defense Department. One can only imagine what creations have resulted from such a pairing of intellect and interest (SimCity, 2004).

Simulators are currently being used in the civilian sector to help in developing skills necessary to control aircraft and air traffic, automobiles and ships as well as to control intricate systems such as atomic power plants and anesthesia equipment (CSCC, 2003). Modern simulation has come to be known as a technique of imitating the behavior of some situation of a process by means of a suitable analogous situation or apparatus (CSCC, 2003). Airline pilots utilize simulators

and scenario simulations to practice their craft and experience hazardous and infrequently occurring events without ever having to leave the ground. Many National Guard and active duty military pilots complete up to 90% of their annual flight time requirements in simulators. Cost savings and scenario development are often sited as the primary reasons that simulators remain paramount in pilot training and in meeting recertification requirements.

Over the past decade, one of the most striking developments in aviation safety has been the overwhelming endorsement and widespread implementation Crew Resource Management (CRM), programs aimed at developing "Human Factors" to increase the effectiveness of crew coordination and well being of the crew and passengers. (Human Factor Digest, No.1, 1989) Wiener, Kanki and Helmreich (1993) have defined CRM as 'using all available resources - information, equipment, and people - to achieve safe and efficient flight operations'. Training in CRM involves communicating basic knowledge of human factor concepts that relates to aviation such as leadership, effective team formation and maintenance, problem solving, decision-making, and maintaining situation awareness.

One of the most important keys to good crew management, as in management and leadership, is communication among the crew members. Information must be requested, offered and/or given freely in a timely way to permit the leader to make accurate, effective decisions. It also requires an understanding of communication styles used by other members of the crew for interpretation and to determine the proper emphasis for a response. Finally, it requires an understanding and acceptance of the unique role and the leadership responsibility of each of the crew members. Therefore, the primary emphasis in CRM training lies in improving interpersonal communications (Jensen, 1995). Integration of CRM into HPS training is an important concept that will certainly enhance the effectiveness of services provided by individuals and teams.

Numerous devices are available for use in simulation of real-life patient events and according to Dr. Jeffrey M. Kleinwaks of Advanced Medical Simulations; three primary types of simulators exist in today's market for use in medical training. A part task trainer (PTT) provides simulation of a subset of functionality. An aviation cockpit procedures trainer is one such example, where the pilot trainee is taught operational procedures, such as engine restart, without the requirement for flight training. A medically related example would be a manikin arm used to train in the placement of intravenous lines and catheters. Part task trainers provide a lower cost training alternative to full environment simulators (Kleinwaks, 2003).

The second category is referred to as computer based training (CBT). These are software programs running on a PC or workstation. In general, CBT simulation is more cognitive in nature. In these types of simulations, trainees can learn the required lessons at their own pace, without the "real world" distractions of a full environment simulation exercise (Kleinwaks, 2003). A full environment simulator (FES) is the most complex and complete type of simulator system. One typical example of this is the operational flight simulator used to train pilots using visual and kinetic systems to provide information about the flight environment. The pilot is immersed in a complete replica of the cockpit environment.

A more recent and medically related example of a FES is the Patient Simulator. In this system the student interacts with a sophisticated manikin representing the patient. The "patient" breathes, responds to drugs, talks, and drives all the clinical monitors in the operating room, providing ECG, blood pressure, pulse oximetry, and capnography information to the student. (Kleinwaks, 2003) Of the three simulators, the FES is more representative of the human patient and therefore in the context of this research the focus shall remain on the use of FES in training EMS providers.

The medical field has thoroughly assimilated HPS into its training regimes. According to J. M. Weller, human factor development is an important benefit of HPS training. In her 2002 study using HPS, Weller cited that 61% of participating students identified improved teamwork skills as having improved and 33% felt they had learned a better approach to problem solving using a systems approach. (Weller, 2002) All of the students were positive about their experience with HPS and 36% felt they were better able to apply theoretical knowledge in clinical settings. The students stated their desire to mandate simulator training and also commented positively on the realism of the training. Ms. Weller concluded that medical students value simulator-based learning highly. In particular, they value the opportunity to apply their theoretical knowledge in a safe and realistic setting, to develop teamwork skills and to develop a systematic approach to problem solving (Weller, 2002).

Dr.'s Hammond, Berman, Chen and Kushins contend that the human patient simulator is a valuable tool in critical care education, identifying weaknesses both individual student performance and in program content. (Hammond, 2002) Their 2002 study incorporated computerized human patient simulation using a full-scale computerized mannequin to evaluate the performance of junior surgical residents. They found that none of the students successfully completed the first scenario noting reluctance to call for help when the scenario deteriorated, however subsequent performance improved in all areas previously neglected. The residents' acceptance of the simulation experience as a valuable teaching/learning tool was very positive (Hammond, 2002).

With the increasing frequency of patient contacts by fire departments providing advanced life support response, we may take lessons from medical schools using HPS. In the practice of anesthesiology, with some of the highest instances of medical error lawsuits, HPS bridges the gap between classroom lecture and clinical practice in a realistic and interactive environment without

exposing the patient to any risk. An Australian study by Dr.'s Owen and Plummer cited the importance of teaching endotrachael intubation, the act of placing a breathing tube into a patient's trachea during emergency situations or while under the effects of general anesthesia, using airway simulators in a laboratory setting.

Endotrachael intubation, which was developed by anesthesiologists as the most effective method of securing an airway, is a very complex skill requiring extensive practice which has traditionally been taught on patients. EMS use of endotrachael intubation has increased, yet complications in placement often go overlooked with dire consequences resulting. The practice of using real patients on whom to develop such invasive skills is fraught with liability and offers little or no scenario repetition. In their year long study using HPS, designed to determine the effectiveness of using HPS in teaching endotrachael intubation, Owen, et. al. found that with a 1:2 trainer to student ratio, most students were able to independently perform the procedure successfully within 70-90 minutes. All of the 135 students in the study commented positively on the learning experience and most commented on feeling more comfortable learning on the simulator than a real patient. The physicians concluded that learning clinical procedures on simulators is becoming an essential part of medical education (Owen, 2002).

The fire service has embraced the use of simulation training in the form of tabletop exercises to help fire officers develop the skills necessary to manage large incidents without having to burn entire city blocks. In support of the benefits of simulation and in an effort to enhance training programs, the United States Department of Commerce Technology Administration, the National Institute of Standards (NIS), the Federal Emergency Management Administration (FEMA) and the United States Fire Administration (USFA) met in San Antonio, Texas to gather input from the fire community and prepare a workable agenda to update and sharpen the National Fire Research

Agenda (NFRA) (NIS, 1999). During this 1999 meeting entitled *Fire Research Needs Workshop*, the group defined the need to "Utilize more effective ways of delivering training to firefighters and officers, including simulators and virtual reality." "There is a need for training and simulation take can take place in the station as well as in central locations." The committee commented, "Simulators have been successfully used to train pilots and law enforcement officers. The use of simulators is very limited in the fire service and there is substantial opportunity for enhancement" (NIS, 1999). While it is evident that the group supports use of simulation in training, it remains unclear whether they plan to support funding such projects through federal grants.

The Focus Group on Technology of the National Highway Traffic Safety Administration (NHTSA) identified several technology issues that could affect EMS patient safety and recommended possible strategies for making progress in this area (NHTSA, 2003). In support of the NIS position on the use of simulation, the NHTSA focus group stated; "there is limited access to simulation training technology. One way to promote widespread use of this technology is to fund regional initiatives to take simulation training to the field. This training should address human factors issues and team coordination training" (NHTSA, 2003). To date, NHTSA has yet to offer any funding opportunities for developing HPS. The assertion that simulation is needed to improve human factors and team coordination, and the realization that simulators are highly portable, provide sufficient evidence for consideration of HPS use in the fire/EMS service. An Englishman, Dr. David Gaba, may have best summarized the benefits of HPS (British Medical Journal, 2000):

- There is no risk to the patient
- Many scenarios can be presented, including uncommon but critical situations in which a rapid response is needed.

- Participants can see the results of their decisions and actions; errors can be allowed to occur and reach their conclusion (in real life a more capable clinician would have to intervene)
- Identical scenarios can be presented to different clinicians or teams
- The underlying causes of the situation are known
- With manikin based simulators clinicians can use actual medical equipment, exposing limitations in human-machine interface
- With full re-creations of actual clinical environments complete interpersonal interactions with other clinical staff can be explored and training on teamwork, leadership, and communication provided
- Intensive and intrusive recording of the simulation session is feasible, including audio taping, videotaping, and even physiological monitoring of participants (such as electrocardiography or electroencephalography); there are no issues of patient confidentiality–the recordings can be preserved for research, performance assessment, or accreditation.

The use of simulation and simulators to enhance medical education and more importantly to reduce medical error is currently undergoing increasing scrutiny in the medical community. Findings published in 2002 from a study by the Department of Anaesthesia, Wellington Hospital, New Zealand support the use of simulation in reducing medical error. Most interestingly however, the focus of the study was not skill development or procedure familiarization, but rather the study emphasized the role of teamwork in the management of both crisis and errors. Garden, et. al. found that stressing communication, leadership and delegation of workload is an effective tactical approach to enhancing medical education with the added benefit of preparing students to more effectively deal with crisis management in the clinical setting.

Researchers from the University of Florida in Gainesville chose to utilize HPS in place of using animal-based labs to demonstrate difficult physiological principles. They site ethical concerns and the ability to exactly replicate scenarios in choosing HPS as a viable replacement for teaching complex skills. The UF researchers used a full-scale human patient simulator for their workshops which accurately reproduced such physical findings as palpable pulses, breath/heart sounds, and blinking eyes and sophisticated mechanical and software models of the cardiovascular and pulmonary systems (Euliano, 2003). Using both pre and post workshop assessments that included student confidence in their answers, confidence improved in every area. In addition, the students gave these laboratory exercises superior evaluations.

One very popular course used to develop trauma management skills and instill confidence in surgical interns is Advanced Trauma Life Support (ATLS). The Department of Surgery from Penn State College of Medicine used HPS to assess trauma management abilities of three teams of interns using four different scenarios (Marshall, 2001). The teams completed two scenarios on the HPS before taking the ATLS course and two different scenarios after successfully completing the course. Post course evaluations included both confidence scores and management skill ratings which demonstrated that post course scores increased 23% for critical treatment decisions, 47% in team behavior and 25% in potential for adverse outcomes (Marshall, 2001). The researchers concluded that use of HPS in conjunction with ATLS appears to enhance the development of trauma management skills (Marshall 2001). The surgical interns participating in the study deemed HPS to be a worthwhile experience and a confidence-building tool. Perhaps the study's most important outcome was the realization that team behavior improved significantly after the ATLS/HPS experience.

A recurrent theme in the research is how participants feel about their experience as well as to quantifiably define and document individual ability and integrated skills performance using HPS. A particularly informative study conducted at the University of Pennsylvania from 1999-2001 attempted to determine the level of acceptance of HPS as a training tool and secondly to clarify its most useful aspects and find ways to improve the simulation experience (Bond, 2001). The study used a five question Likert scale (5 being the most favorable) and three questions that asked for qualitative feedback on the simulator experience (Bond, 2001).

With a response rate of 100%, the researchers concluded that there was a high level of acceptance among the diverse group. They also found that the participants felt that the simulator and the overall experience were very useful for patient assessment and response to treatment. The two most common positive comments were the ability to see (experience) the response to treatment. The nine negative comments all related to logistical issues of the simulation lab itself rather than the simulator itself such as temperature of the room and cramped space. Bond, et. al. concluded that in their sample, both pre-hospital and hospital-based health professionals were accepting of human patient simulation as a new teaching tool with multiple useful applications (Bond, 2001).

Researchers at the Harvard School of Medicine attempted to understand the responses of medical students and educators to HPS in a study which allowed "practice without risk" (Gordon 2001). Their study exposed the participants to HPS and assessed their experience using both multiple-choice and open-ended questioning. They found that overall, 85% of the students and educators rated the session excellent to very good. Over 80% of both groups thought that simulator–based training should be required for all medical students. The open-ended questioning revealed that the groups found the experience to be "very realistic", "generally a good experience", a "broad educational tool", and that it "promotes critical thinking" (Gordon, 2001). They asserted in

their conclusion that students' and educators' responses to HPS were very positive citing that the ability to "practice" without risk must be weighed against the cost of this new technology.

The research revealed very few references to pre-hospital studies on the use of HPS; however articles in pre-hospital trade journals do generally support an increasing interest in use of HPS to train providers. In a University of New Mexico study released in 1999, researchers using HPS in teaching trauma care to paramedic students demonstrated that quantifiable improvement in trauma care occurred. With the release of a new trauma care curriculum and over the course of the two year study, students were video-taped performing simulated on-scene trauma assessment and stabilization procedures such as spinal immobilization, application of military anti-shock garments, endotrachael intubation, and intravenous catheter placement on the same scenario. Physician assessors unfamiliar with the students concluded that with the use of HPS in the new paramedic curriculum improvements in multiple areas occurred after using HPS training, including reduced scene times, and decreased the number of inappropriate on-scene procedures.

PROCEDURES

This project used the evaluative method of research in an attempt to determine the effectiveness of Human Patient Simulation in the fire/EMS Service. This project also used surveys to gather information from representative organizations offering fire and/or EMS response in Region V of Ohio.

All of the agencies falling within the jurisdiction of Region V of the Ohio Regional Physicians Advisory Board (RPAB) were included in the survey. Physicians serving on the RPAB are appointed by the EMS Board of the State of Ohio to oversee pre-hospital care in each of 10 regions and are charged, through the Ohio Administrative Code 4765-3-04, with assisting in

developing EMS continuing education programs and identifying and develop strategies to address problems with the provision of EMS services in the region (RPAB, 2003).

In addition to an extensive review of literature on use of simulation-based medical training, a survey (Appendix A) was distributed electronically in January of 2004 to the 147 agencies within Region V responsible for providing EMS response. Of the 147 requests distributed electronically, only 17 agencies responded (11.56 %). No agencies offered comments on the process, the survey itself or the use of HPS were offered by the electronic respondents although space was included in the offering.

Due to the minimal response to the electronic offering, accuracy of the electronic (email) addresses held in the database remains in question. In order to access a greater cross-section of the survey population, an additional survey (Appendix B) was distributed using United States Postal Service First Class Mail. In addition to the original intention of gathering information on HPS use by regional fire and EMS services and building a resource list of organizations having successfully implemented HPS programs, the second issuance was also intended to determine:

1. If more accurate electronic mail addresses could be gathered
2. If the mailing addresses supplied by the RPAB were accurate
3. To gather information to update the RPAB database
4. To gather sufficient data necessary to compile survey results

To ensure that the survey data were representative of the population, the original, electronic survey results were judiciously and very carefully compared to paper responses from the same organizations. Interestingly, all of the departments that responded to the electronic survey also responded to the posted survey with exactly the same responses, therefore there were no data excluded from the original electronic survey.

Each department surveyed was requested to provide responses to both specific questions related to their experience with HPS as well as to provide demographic information about their response districts such as; the total number of customers served, the number of patients transported annually, the source of their funding, their annual budget and the total number of employees. The survey group was also asked to provide information on its EMS training program and familiarity with their use of HPS.

RESULTS

1. Are evaluation systems currently used for fire/EMS medical training that accurately define and document individual ability and integrated skills performance using HPS?

While available literature overwhelmingly supports the use of HPS in training medical students and therefore assumes the probability of benefit to fire/EMS, the review unfortunately failed to uncover any publications outlining systems for use in documenting provider performance during HPS driven scenarios. The reluctance of academia in sharing their costly and to date non-transportable proprietary documents, if indeed they do exist, is understandable, yet disappointing.

The majority of survey respondents, 63.6%, from Fire and EMS systems in Region V of Ohio do not use any form of HPS in their training of medical personnel. Of the 63.6% of respondents that had not used HPS in their training systems; none commented that they were actively considering employing HPS into their systems (Appendix C). The high cost of simulators, perceived high costs of systems maintenance and the reluctance to dedicate personnel to development and management of the programs were cited as reasons for having employed training tools other than HPS into their programs.

The intent of determining the existence of programs using HPS that also accurately define and document individual ability and integrated skills performance was to:

1. Use the evidence to support purchase of an HPS system for WTFD
2. Save time and effort by adopting existing ideas and systems into the WTFD program
3. Help gain initial user support for the programs benefits
4. Develop resource groups for further collective program enhancement

Unfortunately it appears that differences in the definition of HPS and of standardized evaluation tools exist among departments. Follow-up conversations with the 4 departments falling within the WTFD demographic group that currently use HPS indicate that their primary prop is a CPR manikin and their assessment tool is a written test or score card indicating the number of right and wrong responses given during the scenarios.

The respondents supported the use of enhanced evaluation tools for assessment of the effectiveness of EMS provider training in their respective departments. Of those indicating that evaluation tools are currently used in their organizations for assessing the effectiveness of EMS training, few offered any substantive evidence in support of their evaluation system. Nearly half of the responses provided evidence that their post-training evaluation consisted simply of a satisfaction survey. Several stated that training annually on each of the state mandated requirements for recertification adequately provided standardized evaluation and documentation of EMS training. Fully one-third cited that documentation of training on State of Ohio approved Scope of Practice skills, served as an effective tool for evaluating EMS training. No department provided documentation of an independently generated evaluation tool for assessing the effectiveness of training.

2. Do any other departments similar in size and budget to WTFD within Region V use Human Patient Simulation as part of their EMS training?

According to the survey results only 4 departments from the study group are within the same demographic range as WTFD. The inclusion criteria are:

Customer base:	30,000 - 40,000
Annual Transport Volume:	3.000 - 4,000
Funding Source:	Public
Annual Budget;	>$5,000,000
Number of Employees:	>100

Of the total 44 respondents, comments revealed that 98% of those having used some form of HPS, such as CPR practice manikins such as ResusciAnne ™. Only 2% had used simulators with any form of computerized enhancement citing having exclusively used ALS Skill Trainer ™ manikins from Laerdal Medical Corporation.

An overwhelming majority, 88.6%, of departments commented on their commitment to utilize HPS in their training regime by their responses to Survey Question 2. Several EMS Coordinators cited their desire to use HPS in training but asserted the reduced availability of funding necessary to purchase and maintain the products. Many offered suggestions such as utilizing the data gathered in this project in support for their soliciting public funds, grants and donations for developing their own simulation programs.

3. Are medical errors reduced following implementation of HPS training?" Of the departments that currently utilize HPS in their training programs, 62.5% (10 of 16) indicated that medical errors are reduced following implementation. All of these departments stated that they feel

medical errors are reduced following HPS implementation yet lack formal mechanisms that accurately document track medical errors. Without documentation that errors are reduced the anecdotal evidence suggests confidence in the potential of HPS yet lacks any substance.

DISCUSSION

A review of current literature fully supports the implementation of HPS programs yet fails to offer any tangible evidence that documents exist for assessing and recording performance success nor were guidelines on program development, design, process management or implementation to be found. One of the initial intents of the research was to assess other programs and apply lessons learned into the development of an HPS program for WTFD. The University of Pittsburgh proved to have the most progressive HPS program for EMS providers and is more than willing to demonstrate their program to others. They are however not prepared to share a detailed package to other agencies.

Several HPS vendors provide guidance on the physical design of simulation centers and are more than willing to host classes that provide little more than glimpses into the intricacies of software design, scenario development and program evaluation. Laerdal Medical, the manufacturer of SimMan™ references the availability of shared scenarios available for downloading from their "Users Group" web site. No shared scenarios are or have to date been available. This fact, found to be true of all HPS vendors attests to the need for owners of simulators to beware of the need "fend for themselves" in developing comprehensive training programs. Without diligent planning and sufficient, dedicated resource allocation, well intended simulator programs may lie idle or underutilized. It seems that the appeal of a concept that anecdotally appears to provide all of the

necessary tools for personnel and process improvement may outweigh the reality of the countless hours necessary to put a program into place.

No HPS products were found offering a comprehensive package of scenario, assessment and educational tools necessary for a turn-key HPS solution. It therefore remains incumbent upon fire/EMS agencies determined to employ HPS into their training regimes to commit money, talented personnel and most importantly the time necessary to design assessment tools and systems for use with HPS. With the understanding that program development requires dedicated resource allocation, preparation of systems to support HPS at WTFD must include funding, manpower allocation, facilities as well as purchase of an appropriate simulator.

The survey does little to support the use of HPS in fire/EMS training and does provide evidence that few fire/EMS agencies have experienced the benefits of simulation training as cited in the literature. All of the agencies surveyed stated that they would appreciate receiving a copy of this project upon its completion. This unanimous desire to learn more about simulators and simulation use in training our personnel suggests the desire to assess the efficacy of including HPS into our programs. The fire service appears to be increasingly receptive to emerging technologies and simulation is no exception.

With the high costs of manikins and personnel costs associated with administering HPS systems, those proposing their lease or purchase must prepare for the myriad of questions and justifications necessary to convince those empowered with budget approval that adoption of simulation is a necessary step in improving outcomes and performance. Without detailed documentation supporting the type and frequency of medical errors, the argument that HPS helps reduce errors is null. Without quantifiable evidence that HPS improves provider skills,

comprehensive understanding of detailed treatment modalities, teamwork and overall service delivery, any financial support may be hard won.

RECOMMENDATIONS

EMS practitioners currently accept human Patient Simulation programs as state of the art in training methodologies for developing systems that deliver the highest levels of care. Best practice dictates that we must embrace the best and most effective training delivery systems. Ethical and political mandates dictate the development of such programs with diligent research supporting their implementation. With respect to the needs of the community, the department and the individual members of WTFD, this research suggests the following recommendations.

1. Purchase a human patient simulator. To meet current and future training needs it is recommended that WTFD purchase a SimMan™ to use in development of a simulation program. This proven technology from Laerdal Medical is currently in use by many medical training organizations. The anesthesiology community has thoroughly assimilated this device into the training of their students worldwide. SimMan™ is a high fidelity computer driven anatomically correct full body manikin that incorporates important animation, tactile and auditory response and realistic physiological responses to student initiated care and procedures. The list of anatomic and physiological functions incorporated in the SimMan™ is seemingly endless, yet for the purposes of EMS medical training incorporates systems and processes that more than meet the needs of the EMS community today and in the distant foreseeable future. Pro-forma invoices indicate that costs for a fully functional SimMan™ range from $30-32,000.
2. Develop standardized evaluation tools for EMS training that allows for documentation of individual knowledge, ability and integrated team skills. Numerous EMS organizations

including the National Registry of EMTs, the National Transportation Safety Board, and the Department of Transportation all provide for or design curriculum based assessment tools that meet the intent of this recommendation.. Adapting pre-existing designs to meet the needs of WTFD will require detailed comparisons and realignment to become readily recognizable and familiar to our personnel while being customized to follow our medical protocols.

It becomes apparent that the scope of this recommendation is extensive and will require significant effort on the part of a fairly large group. Therefore, it is critical to form a Simulation Group of individuals interested in enhancing our training program through the use of simulation and empower them to develop systems necessary to complete the project..

3. One important component of a simulation program is the provision of a facility that meets the spatial and clinical needs of the program. The recommendation that follows is to design a space that is representative of commercial and residential interior space representative of about 60% of our EMS response. In addition, the need exists to design spaces that simulate highway and roadside environments similar to those faced during motor vehicle incidents. Perhaps more importantly, the need to include a space that exacts that found in the patient care compartment of our transport vehicles is critical to ensuring realistic representation of the actual working environments faced by our providers during transports.
4. By far the most important reason to implement HPS at WTFD is to reduce medical errors. In order to ensure that accurate, non-punitive data collection occurs, the first part of this recommendation entails development of an autonomous, intranet-based program that allows providers to enter information about perceived medical errors. Processes such as MEPARS, the Ohio based error-reporting system, provide an open forum for medical personnel to

publicize their experiences without fear of retribution. Mirroring such an effective, absolutely autonomous program is a technically simply, yet highly effective forum for disclosing medical error which is a mandatory component of an effective HPS program.

5. Integrate Crew Resource Management (CRM) training into our EMS training program. One of the most important keys to good crew management is communication among the crew members. Information must be requested, offered and/or given freely in a timely way to permit the leader to make accurate, effective decisions. Understanding of communication styles used by other members of the crew will certainly enhance our system and improve intrapersonal relationships. Understanding and acceptance of the unique role and the leadership responsibility of each of the crew members defines the primary emphasis of CRM training. Integration of CRM into HPS training is an important concept that will certainly enhance the effectiveness of services provided by individuals and teams.

SUMMARY

Human Patient Simulation using computer driven simulators has seen increasing interest in the EMS community. The State of Ohio EMS Board has recently issued grants to support simulation based training for EMS. HPS seems to have become an integral part of our training regimes. The future of HPS in Fire/EMS medical training requires EMS administrators to educate their members as well as their political support systems to the efficacy of HPS training. HPS does improve service delivery and appears, although anecdotally, to reduce medical errors. Given the financial support necessary to purchase the equipment, prepare a simulation space, design educational, assessment and feedback mechanisms, HPS program will benefit the membership they support and are certain to reduce medical errors. HPS is here to stay and WTFD will hopefully fully utilize the technology

to ensure that our delivery model remains among the highest in the industry. Our patient and providers all deserve the best systems available and Human Patient Simulation for the far distant future will remain the system of choice for Washington Township Fire Department.

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APPENDIX A- Electronic Survey

Human Patient Simulation Survey	Yes	No	Comments
Does your organization currently use any form of Human Patient Simulator? If so, please describe the make, model, etc.	○	○	
If you use Human Patient Simulation, are medical errors reduced following implementation of HPS training?	○	○	
Does your organization use any standardized evaluation tools for EMS training?	○	○	
Does your organization have a system in place that allows you to document individual knowledge, ability and integrated team skills?	○	○	
Have you considered using simulation-based training for your fire/EMS providers?	○	○	
Have you personally experienced Human Patient Simulation training?	○	○	
Would you like to receive an electronic copy of this project upon its completion?	○	○	

Customer Base: (number of residents/customers)	
Annual Transport Volume:	
Funding Source:	
Annual Budget:	
Total number of employees:	

Please take a few minutes to enter any further comments and/or questions!

Thank you for taking your time to complete this survey.

Appendix B- Posted Survey

Human Patient Simulation Survey	Yes	No	Comments
Does your organization currently use any form of Human Patient Simulator? If so, please describe the make, model, etc.	○	○	
If you use Human Patient Simulation, are medical errors reduced following implementation of HPS training?	○	○	
Does your organization use any standardized evaluation tools for EMS training?	○	○	
Does your organization have a system in place that allows you to document individual knowledge, ability and integrated team skills?	○	○	
Have you considered using simulation-based training for your fire/EMS providers?	○	○	
Have you personally experienced Human Patient Simulation training?	○	○	
Would you like to receive an electronic copy of this project upon its completion?	○	○	
Customer Base: (number of residents/customers)	Circle One		<10,000 10,000-20,000 20,000-30,000 30,000-40,000 40,000-50,000 >50,000
Annual Transport Volume:	Circle One		<1,000 1,000-2,000 2,000-3,000 3,000-4,000 4,000-5,000 >5,000
Funding Source:	Circle One		Private Public Not for Profit
Annual Budget:	Circle One		<$1,000,000 $1,000,000-2,000,000 $2,000,000-3,000,000 $3,000,000-4,000,000 $4,000,000-5,000,000 >$5,000,000
Total number of employees:	Circle One		<50 50-100 >100

Please enter your contact information and any additional comments below.

Name:_____
Title: _____
Street: _____
City: _____
Zip:_____
Email:_____
Phone: _____

Comments -
_____
_____
_____
_____
_____
_____

APPENDIX C- Survey Summary

Summary of Results	Number of Respondents	Yes	No
Does your organization currently use any form of Human Patient Simulator?	44	Total- 16 Percent- 36.3	Total- 28 Percent- 63.6
If you use Human Patient Simulation, are medical errors reduced following implementation of HPS training? (only positive responses from Q1 listed)	16	Total- 10 Percent- 62.5	Total- 3 Percent- 18.8
Does your organization use any standardized evaluation tools for EMS training?	44	Total- 23 Percent- 52.3	Total- 21 Percent- 47.7
Does your organization have a system in place that allows you to document knowledge, ability and integrated team skills?	44	Total- 17 Percent- 38.6	Total- 27 Percent- 61.4
Have you considered using simulation-based training for your fire/EMS providers?	44	Total- 39 Percent- 88.6	Total- 5 Percent- 11.4
Have you personally experienced Human Patient Simulation training?	44	Total- 22 Percent- 50.0	Total- 22 Percent- 50.0
Would you like to receive an electronic copy of this project upon its completion?	44	Total- 44 Percent- 100	Total- 0 Percent- 0

Demographics	Variables	# Respondents	% of Total
Customer Base:	<10,000	17	38.6
	10,000-20,000	9	20.5
	20,000-30,000	7	17.1
	30,000-40,000	5	12.2
	40,000-50,000	2	4.9
	>50,000	3	7.3
Annual Transport Volume:	<1000	20	45.4
	1000-2000	9	21.9
	2000-3000	6	14.6
	3000-4000	4	9.8
	4,000-5,000	1	2.4
	>5,000	4	7.3
Funding Source:	Private	3	6.8
	Public	39	88.6
	Not for Profit	2	4.9
Annual Budget:	<$1,000,000	15	34.1
	$1,000,000-2,000,000	5	12.2
	$2,000,000-3,000,000	8	19.5
	$3,000,000-4,000,000	4	9.8
	$4,000,000-5,000,000	2	4.9
	>$5,000,000	10	22.7
Number of employees:	<50	26	58.5
	50-100	12	29.2
	>100	6	12.2

APPENDIX D- COVER LETTER

Jack McCoy
EMS Manager
Washington Township Fire Department
6279 Shier Rings Rd.
Dublin, Ohio 43016

EMS COORDINATOR
WASHINGTON TOWNSHIP FIRE DEPARTMENT
6255 SHIER RINGS ROAD
DUBLIN, OH 43017

Dear EMS Coordinator,

As an integral component of the Ohio Fire Chief's Association, Ohio Fire Executive Program, I am conducting an applied research project to determine the efficacy of using Human Patient Simulation (HPS) (computer-based mannequins) in the training of EMS personnel.

Your participation in completing the enclosed survey will add significant impact to this process and the data gathered is intended to help our departments in developing HPS Programs and also to provide support in a proposal for additional EMS grant funding to use in developing a regional simulator program.

Please take a few minutes of your valuable time to complete the survey. The results will be published in a paper entitled: *Evaluation of Human Patient Simulation Medical Training for Fire/EMS Responders.* Copies of the research will be made available free of charge for your use.

Also included is a request for updating your agencies contact information to be used exclusively by Region V of the Regional Physicians Advisory Board of their use in updating their database. The information will not be shared or sold to other parties.

I appreciate your input into this very important project and look forward to sharing the data with you and your agency.

Sincerely,

Jack McCoy

Encl.
CC: Region V, RPAB

APPENDIX E

List of Organizations Surveyed

NEWTON TWP VOL FIRE DEPT	SAINT LOUISVILLE	OH
ALLEN TOWNSHIP FIRE DEPARTMENT	MARYSVILLE	OH
LEESBURG TOWNSHIP FIRE DEPARTMENT	MAGNETIC SPRINGS	OH
MARYSVILLE FIRE DEPT	MARYSVILLE	OH
NORTHERN UNION CO. FIRE & EMS DIST	RICHWOOD	OH
UNION COUNTY SHERIFF'S OFFICE	MARYSVILLE	OH
UNION TOWNSHIP FIRE DEPARTMENT	MILFORD CENTER	OH
UNITED STATES ENRICHMENT CORP.	PIKETON	OH
RURAL METRO AMBULANCE	COLUMBUS	OH
JEROME TWP. DIV. OF FIRE	PLAIN CITY	OH
PICKAWAY PLAINS AMBULANCE SERV, INC	CIRCLEVILLE	OH
HARTFORD VOLUNTEER FIRE DEPT.	CROTON	OH
WORTHINGTON FIRE DEPARTMENT	WORTHINGTON	OH
HARRISON TWP FIRE DEPARTMENT	ASHVILLE	OH
PIKE CO. EMERGENCY MEDICAL SERVICE	WAVERLY	OH
PLEASANT TOWNSHIP FIRE DEPARTMENT	GROVE CITY	OH
CRITICAL CARE TRANSPORT, INC.	COLUMBUS	OH
ADELPHI FIRE & RESCUE	ADELPHI	OH
CHILLICOTHE FIRE DEPARTMENT	CHILLICOTHE	OH
CLEARCREEK TWP E.M.S.	STOUTSVILLE	OH
COLERAIN TWP VOL FIRE DEPT	HALLSVILLE	OH
CONCORD TWP EMERGENCY SQUAD	FRANKFORT	OH
DEERFIELD TOWNSHIP E.M.S.	CLARKSBURG	OH
FRANKLIN TWP FIRE & RESCUE SQUAD	WAVERLY	OH
HARRISON TOWNSHIP FIRE DEPARTMENT	CHILLICOTHE	OH
HARRISON TWP VOL FIRE DEPT, INC.	LONDONDERRY	OH
HUNTINGTON TOWNSHIP VOL. FIRE DEPT.	CHILLICOTHE	OH
JEFFERSON TWP FIRE & RESCUE INC.	RICHMONDALE	OH
LIBERTY TWP. FIRE/RESCUE CO,INC.	LONDONDERRY	OH
MEDCARE AMBULANCE	CHILLICOTHE	OH
PAXTON TOWNSHIP AREA LIFE SQUAD	BAINBRIDGE	OH
SALTCREEK-TARLTON VOL FIRE DEPT.	TARLTON	OH
SCIOTO TWP.VOLUNTEER FIRE DEPT.,INC	CHILLICOTHE	OH
SPRINGFIELD TWP VOL FIRE & RESCUE	CHILLICOTHE	OH
TWIN TWP VOL FIRE & LIFE SQUAD	BOURNEVILLE	OH
UNION TWP. FIRE DEPT.	CHILLICOTHE	OH
LICKING TWP VOL FIRE DEPT	JACKSONTOWN	OH
HARLEM TWP VOL. FIRE DEPT.	GALENA	OH

MONROE TOWNSHIP FIRE DEPARTMENT	JOHNSTOWN	OH
BREMEN-RUSHCREEK TWP FIRE DEPT	BREMEN	OH
BATTLE RUN JOINT FIRE DISTRICT	PROSPECT	OH
FIRST CONSOLIDATED FIRE DISTRICT	CALEDONIA	OH
FORT MORROW CONSOLIDATED FIRE DEPT.	WALDO	OH
GREEN CAMP TOWNSHIP FIRE DEPT.	GREEN CAMP	OH
MARION CITY FIRE DEPARTMENT	MARION	OH
MARION TOWNSHIP FIRE DEPARTMENT	MARION	OH
MORROW COUNTY E.M.S.	MT. GILEAD	OH
NEW VISION FIRE & RESCUE INC.	MARION	OH
PLEASANT TWP FIRE DEPT	MARION	OH
SCIOTO VALLEY FIRE DISTRICT	LARUE	OH
STOFCHECK AMBULANCE SERVICE INC.	LARUE	OH
DELAWARE COUNTY SHERIFF'S OFFICE	DELAWARE	OH
UPPER ARLINGTON FIRE DIVISION	UPPER ARLINGTON	OH
BLOOM TOWNSHIP FIRE DEPARTMENT	LITHOPOLIS	OH
COURTESY AMBULANCE INC.	NEWARK	OH
CENTRAL OHIO JOINT FIRE DISTRICT	CENTERBURG	OH
WYANDOT CO. E.M.S.-HEADQUARTERS	UPPER SANDUSKY	OH
WYANDOT EAST FIRE DISTRICT	NEVADA	OH
WYANDOT LAKE ADVENTURE PARK	POWELL	OH
CIRCLEVILLE EMERGENCY MED SERVICES	CIRCLEVILLE	OH
CIRCLEVILLE FIRE DEPARTMENT	CIRCLEVILLE	OH
GREEN TOWNSHIP VOL. FIRE DEPARTMENT	KINGSTON	OH
PICKAWAY TOWNSHIP FIRE DEPARTMENT	CIRCLEVILLE	OH
WASHINGTON TOWNSHIP FIRE DEPARTMENT	DUBLIN	OH
GENOA TOWNSHIP FIRE DEPARTMENT	GALENA	OH
NORWICH TOWNSHIP FIRE DEPT	HILLIARD	OH
WILLIAMSPORT & DEERCREEK EMER SQUAD	WILLIAMSPORT	OH
GRANDVIEW HTS E.M.S.	COLUMBUS	OH
RICHLAND TWP FIRE DEPT	RUSHVILLE	OH
MEAD CORPORATION-AMBULANCE	CHILLICOTHE	OH
LIBERTY TOWNSHIP FIRE DEPT.	RAYMOND	OH
PORTSMOUTH AMBULANCE SERVICE	PORTSMOUTH	OH
URGENT CARE TRANSPORT, INC.	PORTSMOUTH	OH
PLEASANT VALLEY JOINT FIRE DISTRICT	PLAIN CITY	OH
NATIONAL TRAIL VOL FIRE DEPT	GRATIOT	OH
COLUMBUS FIRE DEPT.-MED TRAIN CTR	COLUMBUS	OH
CLINTON TOWNSHIP FIRE DEPT	COLUMBUS	OH
LIFE LINE MEDICAL AMBULANCE	FREDERICKTOWN	OH
HAMILTON TWP FIRE DEPT	COLUMBUS	OH

SCIOTO TOWNSHIP FIRE DEPARTMENT	COMMERCIAL POINT	OH
TRI-COUNTY JOINT FIRE DISTRICT	MT. STERLING	OH
AMANDA TOWNSHIP FIRE & EMS	AMANDA	OH
FAYETTE AMBULANCE SERVICE	WASHINGTON C.H.	OH
FAYETTE CTY EMERGENCY MED SERV INC.	WASHINGTON C.H.	OH
MINERVA PARK VOLUNTEER FIRE DEPT	COLUMBUS	OH
GRANVILLE VOLUNTEER FIRE DEPT INC	GRANVILLE	OH
PLAIN TWP FIRE DEPT	NEW ALBANY	OH
WESTERVILLE DIV. OF FIRE, CITY OF	WESTERVILLE	OH
MID-OHIO AMBULANCE SERVICE INC	LANCASTER	OH
CONCORD TOWNSHIP FIRE DEPARTMENT	DELAWARE	OH
DELAWARE CITY FIRE DEPT	DELAWARE	OH
DELAWARE COUNTY EMS	DELAWARE	OH
ORANGE TOWNSHIP DIVISION OF FIRE	LEWIS CENTER	OH
PORTER-KINGSTON FIRE DISTRICT	SUNBURY	OH
THURSTON-WALNUT TWP FIRE DEPARTMENT	THURSTON	OH
MADISON COUNTY EMER MED DISTRICT	LONDON	OH
BASIL JOINT FIRE DISTRICT	BALTIMORE	OH
MT. CARMEL CONNECTION	COLUMBUS	OH
COLLEGE TWP VOL F.D.-EMS	GAMBIER	OH
BERNE TOWNSHIP FIRE DEPARTMENT	SUGAR GROVE	OH
BUCKEYE LAKE VILLAGE VOL FIRE DEPT	BUCKEYE LAKE	OH
HANOVER VOL. FIRE DEPT. INC.	NEWARK	OH
HEATH CITY FIRE DEPT	HEATH	OH
HEBRON VOL. FIRE DEPT.	HEBRON	OH
LICKING TWP. FIRE COMPANY	JACKSONTOWN	OH
MADISON TOWNSHIP FIRE DEPARTMENT	NEWARK	OH
MARY ANN TWP VOLUNTEER FIRE DEPT.	NEWARK	OH
NEWARK FIRE DEPT	NEWARK	OH
NEWARK TOWNSHIP FIRE DEPARTMENT	NEWARK	OH
WSI/BOEING FIRE DEPARTMENT	HEATH	OH
DEFENSE SUPPLY CENTER COL FIRE DEPT	COLUMBUS	OH
MIFFLIN TWP FIRE DEPT-MEDIC 131	GAHANNA	OH
TRURO TWP FIRE DEPT	REYNOLDSBURG	OH
WHITEHALL DIVISION OF FIRE, CITY OF	WHITEHALL	OH
GREENFIELD TOWNSHIP FIRE DEPT	CARROLL	OH
VIOLET TOWNSHIP FIRE DEPT-UNIT 2	PICKERINGTON	OH
FRANKLIN TWP FIRE DEPT	COLUMBUS	OH
PRAIRIE TWP FIRE DEPT	COLUMBUS	OH
LANCASTER FIRE DEPARTMENT	LANCASTER	OH
PLEASANT TWP FIRE DEPARTMENT	LANCASTER	OH

BLADENSBURG FIRE DISTRICT	BLADENSBURG	OH
EASTERN KNOX COUNTY JOINT FIRE DEPT	DANVILLE	OH
FREDERICKTOWN JOINT COMM AMB DIST	FREDERICKTOWN	OH
MOUNT VERNON FIRE DEPARTMENT	MOUNT VERNON	OH
UTICA VOL EMERG MEDICAL SERVICE	UTICA	OH
MEDFLIGHT	COLUMBUS	OH
CLAY TOWNSHIP EMS - ROSEMONT SQ.12	PORTSMOUTH	OH
GREEN TOWNSHIP RESCUE	FRANKLIN FURNACE	OH
LIFE AMBULANCE	PORTSMOUTH	OH
MINFORD EMERGENCY AMB. SERVICE INC.	MINFORD	OH
NILE TOWNSHIP SQUAD 1	FRIENDSHIP	OH
PORTER TWP EMERG RESCUE ASSOCIATION	WHEELERSBURG	OH
RARDEN VOLUNTEER FIRE DEPT.	RARDEN	OH
SCIOTO AMBULANCE DISTRICT	MCDERMOTT	OH
SHAWNEE STATE UNIVERSITY	PORTSMOUTH	OH
SOUTH WEBSTER FIRE DEPARTMENT	SOUTH WEBSTER	OH
VALLEY TWP VOLUNTEER FIRE DEPT	LUCASVILLE	OH
VERNON TOWNSHIP EMERGENCY AND	WHEELERSBURG	OH
WASHINGTON TOWNSHIP E.M.S.	WEST PORTSMOUTH	OH
MILLERSPORT VOL FIRE CO., INC.	MILLERSPORT	OH
JACKSON TWP FIRE DEPT	GROVE CITY	OH
MADISON TWP FIRE DEPT-BUSINESS OFF.	GROVEPORT	OH
ALEXANDRIA/ST. ALBANS TWP. F.D.	ALEXANDRIA	OH
LIBERTY TOWNSHIP FIRE DEPARTMENT	POWELL	OH
STERLING JOINT AMBULANCE DISTRICT	MOUNT STERLING	OH
JEFFERSON TOWNSHIP FIRE DEPT	BLACKLICK	OH
WEST LICKING FIRE DISTRICT	PATASKALA	OH