EMS Field Telemedicine, Is it the right choice?

Sean Polster

Mount Weather Fire Department, Mount Weather, Virginia

CERTIFICATION STATEMENT

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Abstract

The fire service as a whole has always been resistant to change. The technology age has engulfed our society and the fire service needs to integrate technology to better serve our internal and external customers. The problem is that the potential application of medical telemedicine systems to the Mount Weather Fire Department has not been identified.

The evaluative research method was utilized for this paper. The author used a literature review and personal interviews in an effort to subjectively evaluate the field application of telemedicine. The author wanted to determine the benefits, barriers and available telemedicine equipment to the agency. While there were only two agencies found to be currently using this technology to its fullest.

Limited literature was found on the specific topic of pre-hospital telemetry as the use of telemedicine in the prehospital setting is still emerging technology. Personal interviews were also conducted with telemedicine experts and members of the medical community. As with the fire service it also seems that there may be a resistance in the medical community to the acceptance of field telemedicine. While many agencies are utilizing field telemedicine for the early recognition of ST segment elevation myocardial infarction (STEMI) there seems to be no movement towards large scale expansion of the technology.

This applied research paper determined that while additional research needs to be conducted, field telemedicine is an excellent tool if applied appropriately to provide emergency medical responders a “life line” when they encounter a situation where their

training is pushed to the limits. Doctor Potter explained that caution needs to be exercised when the provider in the field doesn't need to have the same expertise and training, but yet relies on somebody else to make those decisions. The emergency medical technicians need to recognize telemedicine as a tool not a crutch.

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Introduction

The problem is that the potential application of medical telemedicine systems to the Mount Weather Fire Department has not been identified. The purpose of this study is to identify the application of medical telemedicine systems to the Mount Weather Fire Department. The research questions for this study are; (a) How can existing medical telemedicine systems be used in the Mount Weather Fire Department? (b) What are the benefits to using field telemedicine in the Mount Weather Fire Department? (c) What are the barriers to using field telemedicine in the Mount Weather Fire Department? The evaluative research method will be utilized for this study.

Background and Significance

The Mount Weather Fire Department is a federal fire department located approximately fifty-eight miles West of Washington, D.C. along the Blue Ridge Mountains. The department falls under the auspice of the Department of Homeland Security, Federal Emergency Management Agency. The department employs thirty-five full time personnel that work forty-eight hour rotating shifts. The department utilizes its manpower to cross staff two engines, a ladder truck, two medic units, hazardous materials unit and brush truck. The department responds to approximately one thousand calls for service a year while also providing mutual aid response to neighboring counties.

The Mount Weather Fire Department has nine advanced life support providers and twenty-six basic life support providers. These medical providers operate within the medical protocols of the Lord Fairfax Emergency Medical Services Council and practice

a limited amount of advanced emergency medical skills. All emergency medical personnel currently operate under the medical license of the council's operational medical director. Within the current system, when a provider transports a patient to the hospital they contact medical control through the use of the radio or telephone for concerns with medications or approval of advanced practices. The communications technicians and physicians are familiar with the local medical protocols and can provide assistance to the emergency medical technicians and paramedics. The average transport time, calculated from time the unit left the scene to arrival at the hospital, for the Mount weather Fire Department was 35 minutes. This data was compiled by Captain Daniel Fritsch, Mount Weather Fire Department.

Within the next year the Mount Weather Fire Department will be transitioning to standardized medical protocols under the Department of Homeland Security. This will allow all agencies with operational emergency medical personnel under the Department of Homeland Security to perform seamlessly in the event of a nationwide or regional emergency. Unfortunately, this will supersede the use of the local medical protocols that Mount Weather currently operates under. Providers operating under the new medical protocols will be afforded the opportunity to perform numerous advanced medical procedures, but will be operating under the auspice of the Department of Homeland Security, Office of Health Affairs and not local physicians. The new EMS system will have five separate medical protocols (Austere, CBRNE, BLS, Tactical and BLS & ALS) for the emergency providers to operate within.

Operating within new medical protocols will also bring a new medical director that does not operate within the local hospital system. With the local hospitals not being well

versed with the new operational medical protocols, the Mount Weather Fire Department will need the ability to call into a central point that all other Department of Homeland Security emergency medical providers report to. Bringing the visual element to the verbal report will allow emergency physicians that are removed from the local hospitals to make timely medical decisions based on more than what they hear.

With the transition towards these new protocols and increased advanced medical procedures the emergency medical technicians and physicians need a better system to communicate the medical needs of the patient in an effort to get the best outcome possible. In the National Fire Academy Executive Fire Officer course titled Executive Analysis of Fire Service Operations in Emergency Management, emphasis was placed on integrated emergency management systems. The Department of Homeland Security is working to bring the emergency medical services community together for a common operating picture while remembering that emergency medical services is regulated at the state level. The Mount Weather Fire Department is looking for a better way to provide not only a verbal, but visual aspect to the medical perspective that physicians get from field emergency medical technicians and lead other agencies across the country in emerging technology.

Should the Mount Weather Fire Department find a reasonable solution to increase the communication capability of field emergency medical personnel it would (a) improve the fire and emergency services' capability for response to and recovery from all hazards and (b) improve the fire and emergency services' professional status, as stated on the U.S. Fire Administration website (USFA, 2012).

Literature Review

There are many articles written about telemetry in the medical field, but the author located several specifically about the pre-hospital emergency medical application of field telemedicine. An article in the journal entitled *Pre-hospital Intermediate Care* stated that:

> Telemedicine is defined as 'the use of information and/or communications technology to provide healthcare remotely'. It has been practiced for many years with variable success but since 1995 interest has been growing. Intuitively telemedicine and pre-hospital care seem a perfect fit. (Dricsoll & Navein, 2000)

The journal article further explains:

> Telemedicine is becoming increasingly clinically orientated so that technical solutions are being designed to meet clinical need rather than clinical practice being modified to accommodate technical innovation. The 'user requirement' should be the driver of a technical solution. The technology itself is not a problem for most projects, the real challenge lies in managing the change it brings with it and the people who have to implement that change. Furthermore costs have fallen considerably over the last few years and this trend will continue. There are now affordable solutions for most needs but there are also wide variations in the costs associated with different products addressing the same needs. (Dricsoll & Navein, 2000)

The journal article addresses on scene emergency care specifically with:

> Ambulances will have integrated on board decisions support software and telemedicine links from the vehicle that will enable the ambulance paramedic or nurse to provide appropriate care on scene. Training programmes will have been upgraded appropriately. They will be linked electronically to the on call pre-hospital care doctor for the area who may be physically at home or on the road and that link will enable extended powers of practice and real time virtual support. This may include more advanced care (as in thrombolysis) but will also include definitive care and discharge from the scene in appropriate cases. They will have defined prescribing to 'Boots Direct' for immediate collection or delivery. (Driscoll & Navein, 2000)

In 1998 two Australians, Brian Meade and Peter Barnett, conducted an experiment utilizing telemedicine. Their results were published in the *Journal of Telemedicine and Telecare* in 2002. This article was broken down into several areas as follows:

> Simulated Emergencies
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> Scenarios were designed to replicate the sorts of events which were most common in the trial area. These included road traffic and logging accidents, covering the usual traumatic events such as head injury, crush syndrome, fractures and tension pneumothorax. Medical emergencies included severe asthma, chest pain, acute myocardial infarction, anaphylaxis and rashes.
>
> The exercises were also designed to explore clinician guidance of first responders into expanded history taking, beyond the areas covered by the

‘AMPLE’ acronym (Allergies, Medications, Past history, Last meal, Events surrounding) and expanded physical examination (beyond cursory secondary survey).

Findings

The quality of sound and images was generally satisfactory according to clinicians at the receiving end. Lighting with a blue or green background enhanced colour reception.

When the satellite system was used, connection problems were rare. Focusing of the antenna on the satellite was achieved with a good signal within a few minutes. Using the auxiliary camcorder (JVC single-chip digital video-camera) enabled the zoom function to be used and a ‘freeze-frame’ mode was available on the videophone to enhance the resolution of, say, a lesion which needed closer inspection by the clinician.

In only one of the 10 simulations did the clinician have some concern (a trauma surgeon was not able to see the anatomical landmarks sufficiently clearly to be certain about needle decompression site). We believe that recent modifications to our system (notable the addition of ‘freeze-frame’ facility) will solve such problems.

In general, the clinicians were favourably disposed to the system. It was appreciated that the videoconferencing also lent itself to debriefing and clinical audit with the first responders. The latter were uniformly enthusiastic about the

system and expressed their enhanced confidence at having a specialist ‘virtually’ on the scene with them.

Discussion

Despite the great potential of telemedicine, its use is not routine. Three major factors which contribute to this situation have been identified: the high cost and high complexity of telemedicine systems, and limited access to consultants. We believe that our approach assists with the first two problems, and to some extent the third.

We have demonstrated the feasibility of a portable telemedicine system in simulated emergencies. If it works well for real emergency medicine, it should reduce mortality and morbidity in isolated areas.

This study shows the benefits of utilizing telemedicine to increase the communication between emergency medical technicians in the field and emergency room personnel/specialists. Additionally, their study also pointed out the potential limitations of the technology. This concept was again relayed in the September 2006 issue of *Journal of Emergency Medical Services* that relayed the story of telemedicine being utilized at a large scale event to triage patients for transport.

However, during large scale events, it can be difficult to determine which individuals definitely require extended services. Transports that end up being costly and unnecessary for patients may be avoided in some cases with additional resources-such as telemedicine. (Bender, Ghim, & Grange, 2006)

The article continued to say:

Previous studies and literature reviews suggest that telemedicine consultations with specialists may prevent unnecessary transports or provide earlier, improved medical care at a facility with fewer resources than a hospital. One such study showed that the use of EMS telemedicine ‘could result in an approximately 15% decrease in ambulance transports.’

On September 3, 2005, we had our first telemedicine case. A NASCAR team employee suffered a crush injury to his thumb and was evaluated by medical personnel at the Infield Care Center. To assess the need for immediate ED care via patient transport, we transmitted the patient’s medical information from the California Speedway to an emergency medicine physician consultant at the Loma Linda University Medical Center.

Specifically, we transmitted streamed real-time video as well as images from a handheld exam camera (using a Polycom Practioner Cart with VSX 7000 camera via a T1 line), and the emergency medicine physician consultant received the patient’s complaint, vital signs and visual images of the injuries (via a VSX 7000 camera in the consultation room at the LLUMC ED). The consultant was able to see with extreme clarity) two lacerations on the thumb, which created concern for a possible open phalangeal fracture requiring diagnostic X-rays. Thus, the recommendation was made to transport the patient to the ED. (Bender, Ghim, & Grange, 2006)

The article concluded with:

> Having the ability to consult with a physician is another important application in prehospital medical care in the future. This technology opens an arena with vast economical and medical consequences, which will require further study to assess for efficacy and cost effectiveness. (Bender, Ghim, & Grange, 2006)

While this 2002 article showed a success utilizing telemedicine it also pointed out that there is more research that needs to be conducted about this technology. A 2012 article in *EMS World* magazine online cited a new software application that brings the telemedicine capability to the forefront.

> Codeheart is the name of a wireless app that allows physicians to see ECG and other EMS instrument read-outs in real-time, using live video transmitted over secure cellular telephone channels. The app, which was developed by cardiologists at Washington Hospital Center working with AT&T, is designed to improve heart attack diagnoses in the field. But the technology that underlies could be adapted to serve all aspects of medical treatment by EMS providers on location and experts in remote locations. In fact, such is the scope of CodeHeart, that it literally could revolutionize the administration of first response medical care. (Careless, 2012)

The article goes on to point out that this software application meets all current security and legal requirements. The benefits of all emergency response providers having this technology is pointed out in the conclusion of this article.

> Consider the possibilities: With this app installed, every first responder will be able to link medical experts to emergency cases anywhere in the world, using real-time voice, video and data. Members of the public providing first aid will be able to provide this service as well.
>
> Moreover, because CodeHeart runs on consumer-grade technology and cellular networks, using it does not require substantial purchases of proprietary videoconferencing technology. This puts telemedical support within the reach of the smallest, most remote and least equipped first responders.
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> In this sense, CodeHeart is the ‘missing link’ between EMS in the field and the world’s most knowledgeable, best-equipped medical professionals. This is why this app will have uses far beyond its original intent, and why Dr. Satler and his team will one day be included among the medical greats of history. (Careless, 2012)

In 2007 the Tucson Fire Department in Arizona developed a pilot program that started a program called ER Link. The following is an excerpt from the article.

> ‘We're running two pilot programs: an Alpha truck, which is a social service-type program, and the ER Link program, which is a telemedicine unit,’ says David Ridings, assistant chief of the Tucson Fire Department's EMS Division. ‘The ER Link program is a groundbreaking exercise in placing live streaming video in the back of ambulances that will transfer to local hospitals. We're still in the secondary phase of equipping all the ambulances with the video and completing

the hospital equipment placement, and there is a training component for all the department's paramedics.' (Nordberg, 2007)

The assistant chief was also asked if telemedicine was the answer to so many shortcomings in emergency medical services, why is it now just coming to fruition.

'Much of it has to do with the communications infrastructure and computing power,' says Michael Smith, president of New Jersey-based General Devices, a producer of voice and data communications equipment and telemedicine systems for EMS. 'Three to four years ago, mesh technology was something people were playing with. Now, those systems are being sold in most U.S. cities and will become commonplace in a few short years. More than 300 large cities have bought broadband wireless, so it comes in at a fairly reasonable cost and it's enormously powerful. Being able to have 700 kilobits per second or 2 megabits per second come out of a moving ambulance is astounding. In Tucson, that means they can be connected anywhere they want to be. With the Internet, anywhere can be literally any place in the world. Second, the cellular system has gotten much better and people are starting to see the capabilities of their cell phones that have cameras in them.

'The other factor is computational powers,' Smith continues. 'You can now take a PC and shrink it down to a fairly small size so it becomes a hub inside an ambulance, and that's what we've done. Our CarePoint, which is intended to address EMS needs in the emergency department, can now do the same thing in an ambulance. The applications are limitless. Because it has a powerful

> computer, that telemedicine system can be used to send ED status reports and handle logistical and supply issues, as well.'
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> Because telemedicine deals with patients at a distance, it's easy to assume that its best application is in rural areas; however, technology, not distance, is what determines its use.
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> 'The issues really revolve around how long it takes to get a patient to where he's supposed to be,' says Smith. 'In telemedicine, that's known as the time-space barrier. We all tend to think of rural as being long transport times, but try to get an ambulance across Manhattan on a snowy day and it's no better. I don't think anyone will really know for a while where telemedicine will best serve. Stroke assessment is one area where telemedicine definitely fits, and I think it's just a matter of time before that becomes as routine within EMS as 12-lead ECGs.
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> 'EMS leaders are beginning to realize this is coming at them whether they want it or not,' Smith adds. 'Even those who don't agree with the technology are beginning to see it on their radar screens. Telemedicine is the future of EMS.' (Nordberg, 2007)

This article points out great uses for field telemedicine that are currently hot topics such as early stroke recognition and diagnosis. The use of this technology to rapidly address heart attacks and strokes would greatly benefit patients, the emergency medical providers and the hospital staff. Another article addressed the ongoing study in Tucson, Arizona and the future on prehospital telemedicine by saying:

The ER Link program places live streaming video in the back of ambulances that transfers to local hospitals and the regional trauma center attached to the University of Arizona. This entire program helps improve patient care by allowing the hospital to prepare for what they see with a trauma patient, as well as those that are non-urgent by allowing appropriate screening and disposition by paramedics in the field.

Another technology would allow a field medic to wear a set of glasses that contains a micro-camera that transmits through the EMS unit's radio system to a remote location anywhere in the world, the physician on duty is allowed to view the patient. The paramedic's glasses contain a micro screen that allows the paramedic to view an on screen display of questions from the physician without transmitting voice questions over the airwaves, follow-up orders can be administered and the paramedic documents the patient care electronically and returns to service. Imagine the number of transports that can be eliminated in both urban systems and rural systems with the long transport times if just one or two transport ambulances were converted to Quick Response Vehicles with one paramedic utilizing these off the shelf technologies.

While some of these technologies seem far from reality, much of the technology is already here with the video games that are on the market. We just have to adapt them for real purposes.

> As we continue building on technology and expanding the scope of practice within the prehospital profession, who knows where the next round of telemedicine will take us. (Dean, 2010)

It seems that many authors find that prehospital telemedical technology to be the future of the emergency medical system, but there are hurdles. In January 2007 the headline read *Tucson shuts down ambulance-based telemedicine network*. The article explained:

> One of the first attempts at a citywide ambulance-based telemedicine network is offline, a casualty of funding shortfalls.
>
> The city of Tucson, Ariz., has taken ER-Link offline after about $3.8 million in federal grant money ran out. '[There is] no operational funding available to maintain the system,' Tucson Fire Department Assistant Chief Dave Ridings, who heads emergency medical services for the city, explains in an e-mail to MobiHealthNews. 'All department budget funding [has been] concentrated in core service functions only.'
>
> Tucson had been the first municipality the nation to set up a WiFi network specifically for mobile teletrauma care. The mesh network, run by the city's transportation department, covered 227 square miles, reaching 95 percent of the city's residential population. Tropos Networks set up the mesh in partnership with the city.

Videoconferencing equipment on all 18 city-owned ambulances transmitted over the system to University Medical Center, providing live telemedicine services between the vehicles and the emergency department at the only Level 1 trauma center in southern Arizona.

ER-Link, launched in 2007, allowed emergency and trauma physicians to triage cases remotely, before patients arrived at the hospital. The system did have limitations, notably the range and reliability of WiFi, so consultations generally happened in 20- to 30-second transmissions when the ambulances were not in motion.

Ridings says there are about four or five operational ambulances that are able to connect to ER-Link, but the system is not used much anymore. ‘Essentially it’s non-operational,’ says Mary Ann Matter, director of emergency medical services at UMC.

It costs UMC at least $5,000 to activate a Level 1 trauma team. ER-Link not only helped prevent unnecessary activations, it saved lives by giving trauma specialists the opportunity to make remote preliminary diagnoses and triage decisions.

UMC is where Rep. Gabrielle Giffords (D-Ariz.) and some of the other victims of the January 8 shooting rampage were taken. But the Safeway where the shooting took place, at Oracle and Ina roads, is outside the city limits in an unincorporated part of Pima County, so any Tucson Fire Department

ambulances that transported victims would not have been able to conduct telemedicine from the scene.

Matter, a registered nurse, says ER-Link was not activated during that mass emergency.

For now, Tucson Fire Department EMTs still transmit electronic patient care reports over the network, but otherwise the infrastructure sits mostly unused. ‘There are no current plans to rejuvenate ER-Link unless grant funds are located, either in the transportation or EMS arena,’ Ridings says.

He also says that Tucson won’t dismantle the network, even though newer technologies like WiMAX and cellular broadband Internet are more reliable and have longer range than WiFi. ‘The mesh network is being supported and enhanced by the city and [Department of] Transportation grant funding,’ Ridings adds. (Versel, N. 2011)

Another article reported about the cessation of the Tucson Fire Department ER Link program. This article echoed the previous article problems with funding, but also pointed out a potential problem with the technology.

Doctors using video monitors worked with paramedics in ambulances to assess the severity of injuries and determine whether a patient needed to be taken to the emergency room.

But the program did not help as much as some people had thought.

Doctors at UMC used it once a week, at most, said Dr. Terence Valenzuela, professor of emergency medicine at the University of Arizona and medical director for the Tucson Fire Department.

‘It had a minor role,’ Valenzuela said.

Emergency-room doctors were too busy with other tasks to spend time around the video monitors, he said.

‘They didn't have the time, so that's why they didn't do it,’ he said. ‘It just wasn't feasible.’

The hospital's current way of doing things proved to be the best method, he said.

The nurse intermediaries communicate with ambulances from a radio room and use certain guidelines to decide if a trauma team should be alerted, he said.

Paramedics in the ambulances contact the hospitals by radio or cellular signals, Ridings said.

Advanced cellular technology has also contributed to the system's demise, he said. ‘You can do the same thing on a smart phone,’ he said.

Officials involved with the project still accomplished a lot from implementing the program, he said.

> ‘Everyone has an idea of what the potential could be,’ he said. ‘If we did it again, we could do it with smaller, better and more mobile technology.’ (Younger, J. 2011)

While the Tucson ER Link program was deactivated due to funding, telemedicine was still a winner as was also showed in an original study. The study showed that application of telemedicine to difficult field intubations was a success. The paper concluded with the following:

> Emergency airway management is one of the most fundamental aspects of the care of patients in the prehospital and emergency setting. Unfortunately, many healthcare providers in these settings do not have an opportunity to practice the skill of emergency intubation often and, thus, may not feel comfortable performing the procedure. If they do attempt to perform an emergency intubation and have difficulty, there is usually no one to turn to for assistance due to the environmental limitations. The use of a telemedicine network and a videolaryngoscope has the potential to provide real-time assistance to healthcare providers that do not have the opportunity to intubate frequently. An airway expert not physically present at the site of intubation can effectively view the intubation real-time and provide audio assistance to the operator to help them properly complete the intubation. We believe that this has great potential for improving the success and minimizing the complications of remotely performed intubations. Tele-intubation is a novel concept and technique that has the potential to greatly improve patient care during emergency intubation. Further research is needed in this area. (Sakles et al., 2011)

Another study was found that used prehospital telemedicine in an effort to speed prehospital diagnosis of acute myocardial infarctions. This study found that:

> Patients carried in telemetry equipped ambulances had 12-lead electrocardiograms (ECGs) acquired as soon as possible. En route to the local hospital the ECGs were transmitted to a remote university hospital, by use of the GSM-system. The physician on call at the university hospital interviewed the patients, who were provided with cellular phone headsets, and alerted the local hospital if signs of AMI(STelev), bundle-branch-block-AMI or malignant arrhythmia were detected. Patients transported by traditional ambulances were included in a prospective control group.
>
> In 214 (86%) of 250 patients prehospital diagnosing was successful. Geographically related transmission problems were the primary reason for failure. Ninety-eight per cent of transmitted electrocardiograms and obtained history takings were technically acceptable for diagnostic purposes. Door-to-needle times were shorter amongst patients with AMI(STelev) who were subjected to prehospital diagnosing (n = 13) as compared with patients transported by traditional ambulances (n = 14) (38 vs. 81 min) (P = 0.004).
>
> It was technically feasible to use telemedicine for remote prehospital diagnosing of patients suspected of AMI. Patients subjected to prehospital diagnosing had shorter door-to-needle times compared with a prospective control group. (Terkelsen, C.J., et al., 2002)

The East Baton Rouge Parish, Louisiana emergency medical services have began to employ telemedicine in the field. The article stated;

> The current network is fine for data such as 12-leads, and all the service's trucks can send those. The BR Med-Connect system, supplied by New Jersey-based General Devices, allows bidirectional voice and data among all system partners, including hospitals. 'We saw it as a link between everybody,' says Guillot, 'not just an EMS unit and a particular hospital.' It consists of the company's Rosetta-DS laptop/tablet data solution in ambulances; CAREpoint Workstations to receive and integrate information in area ED's; e-Bridge mobile telemedicine components to allow hospital-to-hospital connections; and a e-Net Messenger system for exchanging voice, text and data among players. (Erich, J. 2012)

The new concept not mentioned in previous articles is that the information can be shared not only from unit to hospital, but also hospital to hospital. This opens another avenue of communication for this technology. The other aspect of telemedicine that hasn't been address is the acceptance of emergency medical services providers field reporting methods. The article continued to say:

> The system also provides a benefit to quality review. Previously, medics would drop off the traditional static paperwork with patients, which couldn't always capture everything that happened on a call. Now docs get detailed electronic records, plus audio recordings of interactions between crews and doctors/burses. 'What's really neat is that if you have a question, you can go back and listen,'

> says Herbert, ‘Did the patient get aspirin? Yes, they said it right there: ‘Patient gets aspirin.’ So it’s a checks and balance to happen.’
>
> What’s more, typing the prehospital data electronically in to hospital records also goes a long way toward legitimizing it as a part of the care continuum. It’s a rare EMS provider who hasn’t been frustrated by having their reports and assessments underappreciated at the ED. BR Med-Connect ties it institutionally into the record.
>
> ‘Many times, ERs would run their own tests and things once we got there,’ says Guillot, ‘and what we did in the field wasn’t looked at real well. This gives us an opportunity to better share that data and make it more meaningful to patient care.’ (Erich, J. 2012)

Recent literature has suggested that advanced airway practice such as endotracheal intubation and rapid sequence intubation should not be performed in the field anymore. In an article entitled *Adult Prehospital Intubation: More Harm than Good?* the author stated:

> The high rate of tube misplacement found in this study — consistent with rates reported in other systems — is unacceptable. The key prehospital intervention is oxygenation, not necessarily intubation; other airway management methods, such as use of laryngeal mask airways, may be preferable to intubation. (Koenig, K. 2007)

These concerns could be addressed with the utilization of prehospital telemedicine. An article explained how the University of Arizona utilized telemedicine to assist with the intubation of a patient outside the hospital. The article concluded with:

> In addition to the remote hospitals, there is also an EMS component set up. 'The only test we did was to intubate a manikin in a moving ambulance to make sure the system works,' says Sakles, 'We were able to successfully intubate the manikin with a GlideScope Ranger and send it wirelessly to the hospital.' (Nordberg, M. 2012)

Doctor Raymond Fowler was quote in *EMS World* saying:

> 'EMS telemedicine has the promise of opening the door to many opportunities that will broaden the assessment, diagnostic and management capabilities of prehospital providers. Recruiting a distant physician specialist to enhance the medic's ability to employ increasingly advanced diagnostic analyses—from complex electrocardiographic interpretation to parsing through difficult patient medical scenarios—can only result in a higher level of professionalism and improved patient care. I am looking forward to seeing EMS cross this new frontier.' (Bashford, C. 2011)

While telemedicine has many applications throughout the medical community, this literature shows that it does have a place in the prehospital environment. This literature review emphasizes the need for field emergency medical agencies to stay abreast of new technologies that can better assist them in caring for their patient and potentially improving their post hospital outcome.

The literature has shown both sides of implementing a telemedicine program. There is not adequate or conclusive information to support whether the Mount Weather Fire Department should or should not implement telemedicine program. As new technology emerges each agency needs to ensure that they maintain the most cost effective and financially responsible program in an effort to better serve the public.

Procedures

In an effort to answer the research questions posed in the applied research paper an initial literature review was conducted. The literature review had several articles that supported the uses of field telemedicine for field emergency medical service personnel. The Mount Weather Fire Department should look at implementing telemedicine within the department. This would enable audible and visual communication between field personnel and the hospitals or medical control in an effort to paint a clearer picture than audible communication alone. The department should also review the lessons learned from other departments in an effort to successfully learn from others pitfalls.

There aren’t any national standards, policies or procedures for prehospital field telemedicine. The author was only able to locate one agency currently employing telemedicine in a field setting. East Baton Rouge Parish, Louisiana is currently field testing this technology, but unfortunately several calls for information were not returned. More information about this agency is found in the personal interview with Mr. Curt Bashford.

Due to the lack of overwhelming data to substantiate or refute a medical telemedicine program, interviews were conducted with experts in the field. The author chose Doctor Jack Potter, the current medical director for the Lord Fairfax Emergency Medical Services Council and Rick Patrick, Director of the Workforce Health and Medical Service Division the Department of Homeland Security, Office of Health Affairs. Both were asked the same questions, but interviewed separately about their perspectives of the application of telemedicine to the prehospital environment.

Additionally, there is a business in the Washington, DC metropolitan area that utilizes telemedicine to care for its exclusive clients. Doctor Sean O'Mara, the owner and founder of this company, was interviewed about telemedicine and its application in the prehospital setting.

Limitations of this study included the lack of overwhelming data to substantially support an agency decision to implement or not implement a prehospital telemedicine program. Additionally, this research paper didn't address the different types of hardware or software available in the prehospital realm, but this should also be further researched.

While the author was writing this paper a smart phone application, Codeheart, was introduced by another company to provide telemedicine for the emergency services community. With the rapid growth of the technology sector and new software and hardware being developed regularly, any technical data printed today could potentially be outdated within a year.

Results

Interview with Doctor Potter

Dr. Jack Potter, Medical Director for Emergency Department at Winchester Medical Center Winchester and Medical Director for the Lord Fairfax Emergency Medical Services Council, has had years of experience with medical telemedicine. He advised that field telemedicine is challenging in that the sheer logistics of pulling it off are not worth it. Most competent medics can adequately describe patient diagnostics and in doing that there isn't a high yield in the implementation of a field telemedicine program. If we look at sending 12 lead EKG's from the field to the emergency department, that is telemedicine. Transmitting EKG's to the emergency department is still challenging to many agencies.

The idea years ago were for scene personnel to click a few pictures of the trauma scene and send to via e-mail to the trauma center or emergency room. This created a potential breach of personal security information and many agencies don't do it anymore. With the introduction of the social networks and social media there may be a shift in the acceptance of this and society may be adapting to it. Does field telemedicine really add that much to the information received?

Another hurdle is getting medical control to come to screen for every consult, it is time prohibitive. When you are on the scene and every minute counts, do you really have the time to do a field telemedicine consult? In the hospital when we do a telemedicine consult it typically isn't time sensitive, whereas field application would be. 12 lead EKG transmittal is now the best application of field telemedicine. Having the

ability to compare an old EKG to a new EKG is a big advantage prior to the patient's arrival.

The logistics of training personnel to utilize telemedicine in a diverse population of emergency medical service providers adopting a new telemedicine system is also a challenge. This would be much more easily controlled if it was an all career system where the training and application could be made mandatory and instituted in a controlled setting.

In most of America it would be too difficult to implement this as a standard of information management for if the information is mismanaged, a liability exists. The University of Virginia experimented with the application of video cameras in the field several years ago. They had state patrols video tape trauma scenes while the emergency responders were providing patient care and then the tapes would be taken to the hospital and be viewed by emergency physicians. They found that the tapes didn't provide an accurate image of care provided and created more misinformation than good for the emergency physicians.

Telemedicine is catching on for emergency medical providers that have a choice of going to a specialty center such as an incidence of stroke. There then it again loses its utility. Any physician that looks at a potential stroke patient is always going to error on the side of caution and have them sent to a stroke facility. Point decisions need to be made at the scene and can't be made by a provider that can input objectivity and emotions. This would occur if there is a significant transport time to a specialty care facility and the provider doesn't want to travel the extra distance for that facility. Well

trained emergency medical service professionals need to make a reasonable assessment and communicate that back to an emergency room physician.

The highest utilization of this technology would be in remote areas where there is more dirt between light posts. Those locations where there is a difference of 50-75 miles between the scene and hospital and an hour or longer transport time. Many of these remote areas also utilize aeromedical transport due to transport times in which field telemedicine might also have a place. There is more utility in those environments than ours.

Field 12 lead EKG's provide objective hard evidence to help make better decisions. This is the best application of field telemedicine right now for our local system. Caution needs to be exercised when the idea that the provider in the field doesn't need to have the same expertise and training, but yet relies on somebody else to make the medical decisions. (Dr. Jack Potter, personal interview communication, July 13, 2012)

Interview with Dr. Sean O'Mara

Doctor Sean O'Mara is a former White House physician and the founder and owner of Guardian 24/7, a concierge medical company located in Leesburg, Virginia. The company provides discrete medical services to clients on their yachts, aircraft or estates. The company utilizes telemedicine to connect it clients with its network of on call physicians and specialists twenty-four hours a day. They also provide discrete medical coverage to federal agencies in austere environments and utilize telemedicine to communicate from remote locations.

He stated that most physicians say that field telemedicine doesn't work due to limitations of low video resolution, quality and practicality. With the emergence of technology there are now handheld high resolution cameras that can provide a video image similar to that of being there in person. With the emergence of more affordable, direct and practical solutions for field telemedicine many more physicians are sure to adopt and support the prehospital diagnostic modality as we at Guardian 24/7 do.

Right now telemedicine is a bit impractical for many agencies due to cost, but in a system such as ours we have favorable financial channels to operate sophisticated field telemedicine systems. We currently have the ability for a trained medical provider (paramedic or nurse), to perform an advanced medical procedures on a client and have the information transmitted to a physician real time for analysis. Throughout the entire process the client, medical professional and physician are connected via a video teleconference. We currently employ this capability on a mobile platform as well as in fixed facilities. Right now it is a bit impractical as not every emergency medical services agency has favorable financial channels to operate a sophisticated telemedicine system, but this is an up and coming tool for prehospital medical management.

This technology would be best not utilized on routine calls, but complicated, challenging and uncertain medical scenarios where the benefits of others with higher expertises could be more effectively leveraged. Telemedicine has the ability to offer advantages in those situations. Also, in the setting of a mass casualty incident or emergency medical management at the scene of a complex environment or circumstances when telemedicine would offer the logistical benefits of a subject matter expert to medical managers/clinical managers (i.e.-extra eyes and ears at scene).

Bringing a higher level of care or expertise in a timely manner to the patient rather than having to wait until the patient reaches a specialist is an advantage in using telemedicine. In some cases telemedicine would also increase efficiency of emergency medical services. There would be a large cost in the implementation of any telemedicine program and without the sustained funding this program will not succeed. The training of telemedicine operators in the field and emergency room would also need to be considered as to when telemedicine and video management should be deployed.

Should an agency employ a telemedicine program they should develop recommended metrics from the onset of the program to help evaluate and assess the utility. This would gauge the contributions as well as the potential drawbacks to the system as a means to track and gauge the ethicacy and value to the agency employing this technology. (Dr. Sean O'Mara, personal interview communication, July 13, 2012)

Interview with Mr. Curt Bashford

Curt Bashford is the President of General Devices, Incorporated. This company has provided voice, data and information management solutions to the prehospital providers for over twenty years and mobile telemedicine for emergency medical services agencies for the past ten years. They have developed and tested systems that have been field trialed in several areas of the country.

General Devices operates the CAREpoint telemedicine system that is currently deployed in Baton Rouge, Louisiana. This system has terminals in all local hospitals and in two ambulances. He stated that unfortunately one of the ambulances with the

system installed is down right now, but the agency is seeking for funding to equip all of their ambulances with the CAREpoint system.

He further stated that his company has completed a request for proposal for the state of Mississippi who seeking prehospital telemedicine to be installed in all of the states ambulances and hospitals. This request is currently being held up at the federal level as they are awaiting approval to utilize the 700mhz D block spectrum for connectivity. The company also provided the system in Tucson, Arizona which is currently not in use due to the lack of funding.

This technology has broad application and there isn't a right or wrong answer at to its potential application. Should it be used in a rural versus urban environment? The experience of the provider is a factor for its use as is the patient transport time to a definitive facility.

The state of New Jersey is conducting a project for patient burn assessments in the field. The study found that emergency medical service field providers over assess the severity or percentage of burns a patient has. This causes patients to be transported to a burn facility that may be further away when the patient can be better served at a closed definitive care facility. EKG transmittal is now a recognized modality for the early recognition of STEMI presence in the field. These same modalities are being applied to the stroke assessment. A stroke assessment is a highly visual assessment and telemedicine provides a decision making tool for the emergency physician. It has been said that a picture is worth a thousand words and in this case it could save a life.

The prehospital telemedicine systems are also capable of assisting triaging in the field, assessing the mechanism of injury, and rapid assessments. This technology still requires an intuitive gut. While there is not a lot of documentation supporting its potential application many healthcare professionals understand its application. The system is going to be trial and error and we will have to wait and see where the pendulum will swing. The system also provides an additional way for EMS to document patient refusals as they can utilize telemedicine to further document a gray area. The system can also be used as a tool to keep people out of emergency departments and to ease overcrowding by providing prehospital triage for patients in the field.

There are drawbacks to prehospital telemedicine if this technology is not applied properly and becomes too difficult for the users to apply. The telemedicine system needs to add benefits to the system and not prohibit the users, but also needs reliability.

The state of New Jersey recently passed a law prohibiting emergency medical providers and first responders from taking pictures at the scene of accidents using smart phones and other unsecure devices. The emergency response agencies have to provide safeguards and the appropriate HIPPA protection for the patient. Their companies system, CAREpoint, provides that to the client. Utilizing a secure system the e-net messenger program allows the transmittal of pictures and other data within a predefined network of users. This prevents the pictures obtained from being sent to an outside system and protects the patient’s medical information. There is also not a need for full video in every application of telemedicine. In many cases a picture will also suffice and be less costly than full video clips. As broadband becomes more adapt it can be applied deeper.

The application of telemedicine in the inter-facility setting provides a controlled environment which provides an easier solution. The emergency medical service realm is another world and the system is not designed for that application. Cautions need to be applied and agencies shouldn't try to apply standard telemedical equipment for mobile use.

The other problem is with setting expectations. In this day and age of smart phones and other devices we are use to high definition streaming videos and data. You will not get that while traveling in the back of an ambulance and that needs to be understood by the users. Again you need to assess what is needed for the treatment case. The importance of all users and stake holders is very important as well. The paramedics should not perceive this technology as a threat, but yet as a tool to enhance their care, it's an adjunct. Up until now patient reports have all been based on verbal scription and we can do better. (Mr. Curt Bashford, personal interview communication, July 14, 2012)

Interview with Mr. Rick Patrick

Richard Patrick currently serves as the acting director for the Department of Homeland Security, Office of Health of Affairs, Workforce Health and Medical Support Division. He has served as an emergency medical technician paramedic for the past thirty-four years.

Mr. Patrick prefaced the conversation with the fact that he has very little telemedicine experience with the current technology, but decades of experience with online telemedicine. He advised that right now the Department of Homeland Security does

employ telemedicine where personnel, outside the structure of Mount Weather have the capability to talk to a physician if needed.

He further stated that telemedicine is absolutely the future of medical direction and you can't conceivably do your patients justice if we steer away from it. There are challenges to telemedicine though. Implementation will require a change of culture in the medical arena. The legality of telemedicine broaches the 10th amendment; all things not assigned to the federal government are the rights of the states. This is where the states specifically say that all things medical, the licensing of emergency medical technicians and nurses, are a states responsibility.

Thus a doctor in the District of Columbia talking to a deployed paramedic in Texas raises a question of whether he can give medical direction as he isn't licensed to practice in that state. As a Mount Weather paramedic deployed to Arizona, legally you cannot practice as a prehospital provider, the same applies to telemedicine.

The Department of Homeland Security employs approximately 3,500 emergency medical technicians and paramedics within seven operational components. To put it in perspective, the states set policies for the states and then the state EMS offices has oversight for the program within the state. The Office of Health Affairs has the responsibility within the Department of Homeland Security. They set the dynamic plan for the agency.

Mr. Patrick says that the agency has a diverse operational system that could support and justify telemedicine when they department has assets deployed in dozens of countries that may have to perform emergency medical technician skills. He advised

that his agency was light years behind other countries in the delivery of emergency medical services such as Australia.

He stated that the best application of telemedicine is in the area remote resource management. He explained that you could do more with telemedicine medical direction in the prehospital arena with fewer physicians. It is economically efficient no matter where you are. You would also save money from a treatment perspective. It uses broad scope oversight with medical protocols. This is an efficient system utility that others haven't thought of to cut down on travel and broader integration of physicians into telemedicine.

Drawbacks are that there are controversial discussions on whether a physician needs to be physically present and be required to hold licensure from the authority having jurisdiction, which would be the states. The fundamental challenge is that this responsibility is linked to the constitution. The ability to practice and be licensed is the states. There are others that argue the other way. Any jurisdiction could demonstrate prominent legal interpretations and count on two hands that respond in the field.

Mr. Patrick recommended that agencies contemplating telemedicine crawl before you walk and strongly urge agencies to do their homework. He said that agencies should also look internationally for ideas and do research. He ended with hurdles and walls will come into play.

Discussion

The research that was conducted for this applied research project led the researcher to the following conclusions concerning the research questions.

How can existing medical telemedicine systems be used in the Mount Weather Fire Department? In Meade & Barnett's (2000) study they demonstrated the feasibility of a portable telemedicine system in simulated emergencies. If it works well for real emergencies, it should work reduce mortality and morbidity in isolated areas. Mount Weather Fire Department's location and average transport times of 35 minutes would lend itself well to this technology.

The use of telemedicine for early recognition of a heart attack would prove extremely beneficial the Mount Weather Fire Department as it was technically feasible to use telemedicine for remote prehospital diagnosing of patients suspected of AMI (Terkelsen, C.J., et al 2002). EMS telemedicine has the promise of opening the door to many opportunities that will broaden the assessment, diagnostic and management capabilities of prehospital providers (Bashford, C. 2011).

Doctor O'Mara (2012) pointed out during a personal interview that telemedicine has advantages in the setting of a mass casualty incident or emergency medical management at the scene of a complex incident environment or circumstance. In this ever changing world fire departments are responding to events not dreamed of years ago such as terrorist attacks and mass shootings.

The other aspect of telemedicine that would benefit the Mount Weather Fire Department is that it would bring a higher level of care or expertise in a timely manner to

the patient rather than having to wait until the patient reaches a specialist is an advantage in using telemedicine (O'Mara, S. 2012)

What are the benefits to using field telemedicine in the Mount Weather Fire Department? There are several applications that this technology could be applied to within the Mount Weather Fire Department. The obvious use would be to increase the bidirectional voice and data communication between all system partners (Erich, J. 2012). By closing the communications gap and utilizing emerging technology we can ensure that our emergency responders have the best tools at their disposal when needed.

During the personal interview of Doctor Sean O'Mara (2012), he made the comment that telemedicine is best utilized on complicated, challenging and uncertain medical scenarios. He also said that it was well suited for settings such as mass casualties, a scene of a complex environment or when telemedicine would offer logistical benefits. With the every present threat of terrorism, both foreign and domestic, telemedicine could provide medical subject matter experts during a situation when they are not readily available on the scene.

Some cases such as in burn care management, telemedicine would have great advantages. The state of New Jersey is looking to implement prehospital telemedicine in an effort to curb the misclassification of burn patients and their unnecessary transport to a burn center rather than a closer definitive facility by emergency responders (C. Bashford, personal communication, July 14, 2012). With the closest burn center to the Mount Weather fire department being in Washington, D.C., 65 miles away, this

technology could be used to triage burn patients, but potentially trauma and medical patients as well.

In Barnett & Meade's (1998) scenario based study they found that the field assessment of both a trauma and medical situation could be transmitted from a rural area to a hospital. The study was an overall success as the receiving facility was able to view the entire assessment process and interact throughout. The shortfall of this study was the availability of technology capable of supporting clear video and audio. Fourteen years later and with the introduction of new technology such as the CAREpoint system we are able to increase the video and audio effectiveness of telemedicine.

Many emergency medical technicians also feel their reports and assessments are under appreciated by the emergency room staff. Utilizing telemedicine as a way to type the prehospital data electronically in to hospital records also goes a long way toward legitimizing it as a part of the care continuum (Erich, J. 2012).

It has been pointed out that telemedicine should be used in complicated, challenging and uncertain medical scenarios such as difficult airway management commonly found in the emergency medical field (O'Mara, S. 2012). One study from the University of Arizona showed that the use of field telemedicine was used to successfully intubate the manikin with a GlideScope Ranger and sent it wirelessly to the hospital (Nordberg, M. 2012). The use of telemedicine network and a videolaryngoscope has the potential to provide real-time assistance to healthcare providers that do not have the opportunity to intubate frequently (Sakles et al., 2011).

Data collected by the author agrees that telemedicine is essential in early STEMI recognition and treatment. Patients subject to prehospital diagnosing had shorter door-to-needle times compared with a prospective control group (Terkelsen, C.J. et al 2002). The fact is that field 12 lead EKG's provide objective hard evidence to help make better decisions (J. Potter, personal communication, July 13, 2012).

Physicians at the Washington Hospital Center in Washington, D.C. worked with AT&T to design smart phone application. Codeheart is the name of a wireless app that allows physicians to see ECG and other EMS instrument read-outs in real-time, using live video transmitted over secure cellular telephone channels (Careless, 2012). Innovations like this are making it easier for emergency service providers to better facilitate telecommunications in the prehospital setting.

Stroke assessment is one area where telemedicine definitely fits, and I think it's just a matter of time before that becomes as routine within AEMS as 12-lead ECG's (Nordberg, 2007. This statement was reinforced during a personal interview with Curt Bashford when he said a stroke assessment is a highly visual assessment and telemedicine provides a decision making tool for emergency physicians.

One approach in the utilization of telemedicine that hasn't been widely documented is that the system can also be used as a tool to keep people out of emergency departments and to ease overcrowding by providing prehospital triage for patients in the field (Bashford, C. 2012). If this system can assist in the easing of overcrowding of emergency rooms then its benefits are just now being discovered.

What are the barriers to using telemedicine in the Mount Weather Fire Department? The cost of the system is a hurdle that the Mount Weather Fire Department will need to consider. The ER-Link program in Tucson, Arizona was taken offline after about $3.8 million in federal grant money ran out. There is no operational funding available to maintain the system (Versel, N. 2011).

While monetary cost could be a death sentence in many localities you also need to have a buy in from the stake holders as well. Referencing the Arizona ER-Link program, the program did not help as much as some people thought. Emergency-room doctors were too busy with other tasks to spend time around the video monitor (Younger, J. 2011). This was echoed in a personal interview with Doctor Potter (2012) when he said that a hurdle of telemedicine is getting medical control to come to the screen for every consult.

The logistics of training personnel to utilize telemedicine in a diverse population of emergency medical service providers adopting a new telemedicine system is also a challenge (Potter, J. 2012). While the Mount Weather Fire Department may institute this system, we are a one component of the Department of Homeland Security. The application of this technology across the numerous Department of Homeland Security agencies would pose a significant challenge.

Mr. Bashford (2012), President of General Devices, says that there are drawbacks to prehospital telemedicine if this technology is not applied properly and becomes too difficult for the users to apply. The telemedicine system needs to add benefits to the system and not prohibit the users, but also needs reliability.

The Mount Weather Fire Department would also need to evaluate the medical legal ramifications of implementing a telemedicine program. With the Health Information Patient Portability Act (HIPPA) agencies need to be cognizant of electronically transmitting confidential patient information.

Mr. Bashford (2012) explained that expectations are important when looking to implement a telemedicine program. He said that in this day and age of smart phones and other devices we are used to high definition streaming videos and data and you will not get that in the back of an ambulance. We need to understand this and have reasonable expectations when evaluating a telemedicine program.

Recommendations

The researcher is making the following recommendation to the Fire Chief of the Mount Weather Fire Department. The recommendation is an effort to ensure that there is a program in place to assist emergency responders when they are faced with an incident or scenario that is beyond their skills set or they need an expert consult.

The Mount Weather Fire Department needs to secure annual funding for a telemedicine program. This funding must encompass the software, hardware and required service contracts to ensure longevity of the program. In order to ensure the program has sustainability, and to support funding, the department must obtain buy in from all stakeholders affected by this program. This would include the senior management at Mount Weather, the Department of Homeland Security, Office of Health Affairs, the Lord Fairfax Emergency Medical Services Council and the emergency medical service users.

The department should also seek input from the Mount Weather Information Technology section for the best approach in implementing this technology within the existing system and one that complies with departmental security regulations. They can provide the Mount Weather Fire Department with the required Department of Homeland Security requirements and assist in writing a request for proposal for the telemedicine technology.

With the expansion of the skills emergency medical technicians at the Mount Weather Fire Department can perform, there needs to be a system in place that when an unforeseen situation or incident occurs, telemedicine is available. Doctor Potter (2012) said caution needs to be exercised when the provider in the field doesn't need to have the same expertise and training, but yet relies on somebody else to make those decisions. The emergency medical technicians need to recognize telemedicine as a tool not a crutch.

In conclusion this report show that technology is moving forward quickly and we in the emergency service field need to keep pace with it. Agencies will always need to analyze and evaluate new technologies, but we should always do what is best for the customer that we serve.

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