**Chapter 43
Telemedicine and emerging telecommunications**

**David G. Ellis, Kaori P. Tanaka, and Brian M. Clemency**

**Introduction**

Telemedicine/telehealth is the use of medical information exchanged from one site to another via electronic communications to improve a patient’s clinical health status [1]. EMS, with its pioneering use of radio for medical oversight and transmission of ECG telemetry in the 1960s, has and continues to have a leadership role in the use of telecommunications technology to provide medical care at a distance. This chapter will review the applications of telemedicine in EMS and the technologies which facilitate the provision of emergency prehospital care at a distance, discuss the effect of telemedicine on prehospital practice both in the emergency department (ED) and in the field, and provide a platform of knowledge which EMS providers can use as they develop solutions to current health care problems using telemedicine technologies.

**EMS telemedicine applications**

In the book *Essentials of Telemedicine and Telecare,* Norris categorized the practice of telemedicine into four types: teleconsultation, tele-education/telementoring, telemonitoring, and telesurgery [2]. The different types of information being transmitted can include voice, video, and data. Any part of those types of communications can be one-way, two-way, or in multiple directions with multiple participants. The transmission of information can occur in real time (synchronous) or be interacted with at a later time (asynchronous or store-and-forward). In some instances, the exchange of medical information is between an EMS provider and physician, an expert EMS resource, or subject matter specialists; between a patient and a provider in an EMS setting; or between a patient and a provider in a health care setting that may significantly affect the utilization of EMS services.

**Teleconsultation**

The most prevalent example of teleconsultation is voice-only communication over telephone or radio. In the hospital, this is commonly seen when a physician consults another physician for a second opinion via telephone or when a radiologist reads a patient’s imaging that is in a digital format. Outside the hospital, it is commonly seen when EMS providers contact a base station physician for advice and instructions. With the advancement of technology, teleconsultation now allows for patients, physicians, and EMS providers to have video in addition to audio communication with a physician in real time; for example, as in a telestroke consultation helping EMS determine patient destination and prearrival preparation for the ED [3]. Recent review of the evidence base reveals a number of avenues from which a patient or EMS provider may benefit with the use of telemedicine.

**Prehospital medications: thrombolytic use in cardiac events**

The 2013 ACCF/AHA guidelines for ST-elevation myocardial infarction (STEMI) transitioned “door to balloon time” of ≤90 minutes to the more rigorous “first medical contact to device time” of ≤90 minutes [4]. First medical contact is typically defined as the first EMS provider on scene who can perform a 12-lead ECG, though some consider it to be the dispatcher answering the 9-1-1 call. It also describes the ability to reduce delay from symptom onset to treatment by administering prehospital fibrinolytics either by an EMS unit with a physician on board or in direct contact with a hospital-based physician. Multiple randomized controlled trials have demonstrated the safety and feasibility of prehospital fibrinolytics [5–8]. The majority of these studies were performed in the UK or Europe and the use of thrombolytics in the prehospital setting for STEMI patients in the US is rare.

Many EMS systems use telemedicine to obtain a 12-lead ECG in the field and transmit, usually by cellular phone to fax, to a receiving hospital in an effort to prenotify the hospital and activate the cardiac catheterization lab. Mavrogeni et al. reported the success of using telemedicine (remote transmission of ECGs) to supervise the administration of thrombolytics in six rural medical centers in Greece [9]. Björklund et al. showed that with the assistance of telemedicine (ECG transmission to hospital CCU and telephone review of indications with cardiologist), they were able to administer prehospital thrombolytic therapy and in doing so not only reduced time delay of treatment by approximately 1 hour but also reduced 1-year mortality by 30% compared to those STEMI patients who received in-hospital thrombolytics [10]. Similarly in Scotland, Pedley et al. were able to use telemedicine equipment (mobile telemetry link with radio to emergency physicians) to assist in making decisions to administer prehospital thrombolytics to STEMI patients, and decrease time delay of treatment by 73 minutes in comparison to patients who received in-hospital thrombolytics [11].

**Telestroke**

Reports from the TeleBAT (Telemedicine for the Brain Attack Team) program at the University of Maryland in 2000 and 2004 demonstrated the feasibility of performing stroke evaluations by remote neurologists using cellular narrow bandwidth videoconferencing (one image every 2 seconds) in ambulances [12,13]. A more recent pilot study has looked at the feasibility of prehospital transmission of real-time streaming video, vital data, and still picture transmission facilitating neurological evaluation. Initial conclusions have established the feasibility of teleconsultation while raising concerns over delays in care with patients managed using this system [14]. An article by Liman et al. also raised concerns over the technical implementation and clinical usability of a typical telestroke “evaluation in the ambulance” system [15]. A recent German study has shown that EMS stroke response with a computed tomography (CT) scanner equipped ambulance with an onboard neurologist and teleradiological support can potentially shorten times to stroke treatment with thrombolytics [16]. It remains to be seen how the latest generation of telemedicine systems specifically designed for use in the ambulance setting, such as LifeBot DREAMStm [17] and e-Bridge from General Devices[18], perform in facilitating examinations while preserving or enhancing timeliness to indicated thrombolytic care. Additionally, in the absence of a CT scanner in the field, the question arises whether telemedicine examinations by emergency physicians or neurologists are superior to examinations and decision making over stroke center referrals by EMS personnel with training in stroke assessment.

**Refusal of medical care/treat and release**

Throughout the United States, it is common practice to have prehospital providers contact direct medical oversight physicians for further direction in situations where patients refuse medical care or would like to be released after having had some form of medical treatment in the field. Studies have shown that when a patient was able to speak to a physician, there was a higher likelihood (35%, versus 3% when the patient spoke only to the EMS provider) that the patient would ultimately be transported to a hospital [19,20]. Other studies focused on the physician’s assertiveness and showed that if the physician was concerned with the patient’s clinical status, he or she was likely to be more assertive when talking to the patient, which would ultimately improve the patient transport rate [21]. In the manner of Cukor et al., the addition of video promises to enhance these interactions by creating a “social presence” in which the patient and provider can better discuss these complex issues [22].

**Patient transport decision making**

Air medical transport is an integral component of the EMS system, allowing patients to be moved quickly to a suitable facility for appropriate medical care. Its introduction into the civilian world began in the 1970s after military air medical evacuation experiences during the Vietnam War had shown the effectiveness of helicopters for removing wounded soldiers from the battlefield. There is growing controversy about the overutilization and cost-effectiveness of air transport over ground transport [23]. A retrospective analysis by Shatney et al. of 947 trauma patients transported by air in an urban setting showed that although transport time was decreased when using a helicopter, only 22.8% of the population benefitted from the quicker transport [24]. Similarly, Bledsoe et al. performed a metaanalysis of 37,350 trauma patients transported by helicopter from the scene of injury. They measured the severity of the injuries using Injury Severity Score, Trauma Score, and Trauma Score Injury Severity Score and found the majority of the patients had minor or non-life threatening injuries (60.0%, 61.4%, and 69.3%, respectively) [25]. In order to determine if the routine use of helicopter EMS is cost-effective, Delgado et al. developed a decision-analytic Markov model to compare the costs and outcomes of helicopter versus ground EMS. Based on the model assumptions, the study showed that helicopter transport is cost-effective only if it reduces the relative risk of death in seriously injured trauma patients by at least 15%. This implies that the best way to increase cost-effectiveness of helicopter transport would be to reduce the overtriaging of minor injuries to helicopter EMS [26].

Telemedicine should have a role in reducing overutilization, in concert with stricter guidelines for utilization. In Taiwan, Tsai et al. performed a prospective cohort study showing that when using video telemedicine to screen the patient, there was a 36.2% reduction in the use of air transport, resulting in a total annual savings of US $448,986 [27]. Similarly, in a study of interhospital burn transfers with relevance to a prehospital setting, Saffle et al. completed a review analyzing whether the use of telemedicine in evaluating burn patients would have altered the need for air, ground, or no transport from a community hospital. Of the 225 burn patients who were air transported, only 60% were deemed necessary for air transport, while 18% could have been treated at the outlying facility. In addition, 34% of the patients had air transport charges that exceeded their total charges for hospitalization [28]. Telemedicine appears to be effective in reducing the overutilization of air transport and by doing so, increasing its cost-effectiveness and helping reduce unnecessary health care costs or risks to air medical crews.

**Community paramedicine**

Community paramedicine has been defined as an organized system of services, based on local need, provided by emergency medical technicians and paramedics, that is integrated into the local or regional health care system and overseen by emergency and primary care physicians [29]. In these mostly pilot programs, EMTs and/or paramedics may be dispatched to calls not likely to need acute paramedic-level EMS intervention to assess for possible in-home treatments or interventions, find alternative modes of transport, or arrange referral to non-ED settings such as the patient’s primary care provider. A recent review of the literature concludes that while the evidence suggest that paramedics are capable of learning and applying medical competencies, there is not yet consensus on what they should do or evidence supporting safety and effectiveness [30]. There appears to be consensus on the importance of medical oversight for these programs [31], creating a tremendous opportunity for additional research into the role of telemedicine to fully realize the capabilities of these systems of home-based response and health care.

**Telemonitoring**

Telemonitoring is a form of telemedicine that uses computerized technology to track a patient’s medical data, such as vital signs or electrocardiography, from a remote setting. The first case of direct transmission of patient data was that of an ECG in 1905 by the inventor of the ECG, Einthoven [32]. However, the routine use of telemonitoring began in 1961, when the ECG, respiratory rate, electrooculogram, and galvanic skin response of the first human in space, Yuri Gagarin, were continuously monitored by doctors on earth [33]. In 2000, Satava et al. described the use of telemonitoring of climbers on Mount Everest. They were able to monitor heart rate, three-lead ECG, skin temperature, core temperature, activity level, and GPS location in real-time from Yale University with minimal technical difficulty [34].

Ideally, any physiological parameter that can be measured can be telemonitored and currently, there are a significant number of parameters ranging from vital signs to intracranial pressure monitoring, fetal heart rate, and pacemaker settings that are being telemonitored in a range of settings including homes, hospital intensive care units (ICUs), clinics, and in the prehospital setting [35].

From the late 1970s onwards, EMS personnel started to use prehospital ECGs. At first, they were limited to the transmission of a single-lead ECG but as technology advanced, 12-lead ECGs were able to be transmitted to the receiving hospital using cellular technology to assist in initiating appropriate care for STEMIs [36]. In a similar fashion, portable telemetry monitors were developed specifically for EMS providers able to display vital signs (heart rate, respiratory rate, blood pressure, pulse oximetry) and 12-lead ECGs, with the capability to defibrillate or pace a patient. Several commercial telemedicine platforms designed for EMS environments have been developed in collaboration with and tested by the military that offer the capability for real-time monitoring and transmission of heart rate, blood pressure, respiratory rate, pulse oximetry, glucose, end-tidal CO2, and ECG [17,37]. Using a simple method of inputting vital signs data and transmitting electronically to the hospital, Anantharaman concluded that real-time monitoring of patients in ambulances helped reduce the time to initiate appropriate treatment and allowed the receiving physician and staff to be better prepared for the patient’s arrival [38]. Hu [39] and Chi [40] have both demonstrated significant hypoxemic and hypotensive episodes occurring in trauma patients transported by helicopters and ambulances in a state-wide trauma system. Despite a demonstration of the capability to remotely monitor for hypoxemic and hypotensive episodes in head trauma, both proven to be associated with worse outcomes, the ability to show improved outcomes with remote telemonitoring has been elusive [40]. Where the evidence base is limited is making the connection between the capability to monitor remotely and a proven benefit in outcomes, for example with brain injury, myocardial infarction, or stroke.

**Telementoring**

As applied to EMS, telementoring can be described as the aspect of telemedicine where an experienced provider (emergency physician or surgeon) assists or directs another less experienced provider (EMT or paramedic) who is performing a procedure at a distance. It was originally developed for use in the field of surgery (telesurgery) and practiced in two ways. The first, similar to what was just described, involved a specialist surgeon assisting another surgeon who was in a remote location with audio and video communication in real time. The second way, better known as telepresence surgery, involves the surgeon, assisted by on-site support teams, guiding robotic arms to carry out a procedure from a distance, either in the same room or across an ocean. Nevertheless, with the advancement of technology using real-time video and audio communications, telementoring can be used in any field that involves performing any medical procedure, including emergency medicine and EMS settings.

**Airway management**

One of the most important skills that paramedics learn is the ability to manage the patient’s airway. From the basic nasal cannula to full endotracheal intubation, airway management is a crucial aspect of prehospital care. If the patient cannot maintain a patent airway, the paramedic may be required to secure the airway. This is often accomplished through oral tracheal intubation, a high-risk, low-frequency skill. Moreover, if the paramedic chooses to use rapid sequence intubation (RSI) and still has a failed intubation, the patient is now apneic and can succumb to hypotension, hypoxemia, hypercarbia, regurgitaton, and cardiac arrest. Lossius et al. conducted a comprehensive metaanalysis of the intubation success rates of EMS providers (physician versus non-physician) and found that physicians have fewer prehospital endotracheal intubation failure rates than non-physician providers. The same held true when RSI was used and raised a concern for patient safety in the prehospital setting when managed by a non-physician provider [41]. More specifically, a study done by Davis et al. showed that patients with severe traumatic brain injury who were intubated in the field had a 9% greater mortality and a 12% lower rate of “good outcomes” when compared to patients with in-hospital intubations [42].

Video laryngoscopy has become a vital tool for the intubation of patients with potentially difficult airways, and Bjoernsen et al. reviewed the usefulness of video laryngoscopes in the prehospital setting and suggest that they have the potential to become the primary modality of intubation for patients with cervical spine injury or limited jaw or spine mobility, and for difficult-to-access patients [43]. Given that the procedure is performed in a video environment, video-assisted intubation lends itself well to telemedicine.

In Korea in 2007, Chung et al. developed a tele-airway management system (TAMS) that allowed emergency physicians to remotely guide intubations performed by novice intubators. They showed that the success rate of intubation within 2 minutes was 94% in the group who were remotely assisted with telemedicine compared to 63% in the group only using videolaryngoscopy [44]. More recently, the University of Arizona has established two telemedicine programs that have implemented the use of videolaryngoscopy and in 2007, they were able to demonstrate remote telemedicine assistance of a difficult intubation in a chronic obstructive pulmonary disease (COPD) patient in a remote emergency department. With video telementoring by an experienced trauma airway physician, the remote physician was able to achieve a Cormack-Lehane “Grade I” view of the airway with a videolaryngoscope which allowed for a quick intubation on the first attempt [45].

In order to determine the feasibility of transmitting live video and audio data, Mosier et al. performed several intubations using different voice over internet protocol (VoIP) clients over both wifi and cellular networks. It was determined that VoIP over 4G networks or wifi allowed for superior audio and video images with the least data lag and image decay, further proving its usability in the prehospital environment [46]. Whether “telebation”, as coined by Mosier, is used for remote training of paramedic intubation skills with videolaryngoscopy or direct telementoring of intubation skills in remote locations, it has the potential to improve the success of prehospital airway management.

**Ultrasound**

The use of point-of-care or bedside ultrasound has gained wide popularity in emergency medicine over the last few decades, demonstrating its ability to reduce morbidity and mortality while adding efficiency to the patient’s medical care. In the past few decades, this tool has been brought to the prehospital setting with the military using ultrasound in the combat environment in an effort to assist in triaging, diagnosing, and treating the wounded soldier quickly.

A recent review done by Sayed et al. described the current applications of prehospital emergency ultrasound. In the trauma patient, the most useful sonogram is the prehospital focused abdominal sonography for trauma (PFAST) and thoracic ultrasound to look for a pneumothorax. In cardiac arrest, prehospital providers used the focused echocardiographic evaluation in life support (FEEL) protocol to look for cardiac motion, ventricular function, right ventricular dilation, or pericardial collection. Echocardiography was also used to differentiate between true pulseless electrical activity (PEA) and pseudo-PEA [47]. Ultrasonography can make accurate diagnoses but has variability secondary to user skill. If the prehospital provider does not have appropriate training in obtaining images, he or she could potentially miss life-threatening diagnoses. However, multiple studies have shown that it is feasible for prehospital providers to acquire the necessary skills to obtain and recognize ultrasound images for life-threatening conditions [48,49]. Sibert et al. looked at the feasibility of using ultrasound in a mobile telemedicine consult and found that the majority of the evaluators estimated that they could telementor an abdominal ultrasound examination, as long as there were no technical complications [50]. As described in a study by Su et al., Taiwan is currently using an intricate telemedicine platform that aims to use tele-ultrasound in an effort to prediagnose and provide appropriate medical care to a patient who sustains a multisystem trauma [51].

It remains to be shown whether, with continued advancement in technology, telemedicine will give prehospital providers, with the added mentoring of the ultrasound-competent physician, yet another more accurate tool in diagnosing the patient in the field in an effort to provide efficient and appropriate medical care.

**Combat and tactical EMS**

Around the world, the military has always been at the forefront with advances in remote, paramedical care and also telemedicine. A significant portion of prehospital medicine is adapted from what is being done on the battlefield. Academic centers, commercial companies, and different areas of the government have collaborated over the years in an effort to bring modern medicine to wounded soldiers overseas. In the civilian world, combat medicine is being applied to the police forces through tactical EMS. Examples include a tactical telemedicine project (Tac-Tel) developed in Palm Bay, Florida, in partnership with the regional trauma center that allowed the tactical medic to have direct audio and video communication with the trauma or acute care surgeon at the hospital. The surgeons were able to gain real-time information from the scene of the event and not only provide direct medical oversight to the medic on field, but also gain information on the patient status and circumstances of the injury [52].

**Mass casualty incidents/disaster medicine**

In any mass casualty incident (MCI) or disaster, after assessing scene safety and setting up incident command, the first priority is to triage patients. The majority of triage systems have used a paper triage system, where patient information, including basic assessment of Glasgow Coma Scale and vital signs, is hand-written and attached to a patient’s wrist or clothing. As the patient is sent to a different triaging area and reassessed, the tag can be checked and updated information can be written. Over the years, there has been concern about the idea of having a paper-based triage system. Not only are the tags susceptible to harsh weather conditions, but there is often a redundancy in collecting patient information and the concern that illegible handwriting will make the initial triage information useless to the treating physician.

Telemedicine provides a way to not only collect patient information electronically, but also track the patient and transmit all data wirelessly to downstream medical facilities. In Germany, Plitschke et al. described the development of a system using bar-coded triage tags that allow all the information collected to be transmitted wirelessly to the incident command center, telemedicine centre, or receiving hospital [53]. This reduces the redundancy of collecting the same information as the patient goes from the scene to the ambulance and finally to a receiving hospital. It also can help notify the receiving hospital staff of the patient’s status as they are able to see all the vital signs and initial treatment started in the field.

More recently, Gao et al. have developed a platform known as the miTag (medical information tag) in an effort to enhance triaging and remotely monitor patients in an MCI or disaster event. The miTag is an electronic RFID tag that is placed on the patient with an initial triage priority number that allows all patient data collected to be wirelessly uploaded to a PDA/laptop to automonitor patients [54].

Wireless blood pressure cuffs, ECG leads, and pulse oximeters have been developed that can be placed on a critically injured patient and automatically collect and transmit the data to the triage coordinator or incident commander’s PDA/laptop. A pilot study with this platform showed that the group using this system was able to track and triage patients with effective communication of information more efficiently than in the paper group.

All these developments in telemedicine allow a more efficient way to collect patient information, and triage and track patients as they go through each process of the disaster or MCI.

**EMS telemedicine technologies**

Telemedicine technology has evolved dramatically over the almost 50 years since EMS began using radio for medical oversight and transmission of ECG telemetry. Stand-alone CODEC (compression-decompression) digital video devices costing $150,000 apiece and from occupying half a room in the early 1990s, have evolved to software digital video algorithms making high-quality video transmission from cellphones and hand-held tablets possible. The last 5 years have seen the evolution of telemedicine equipment specifically designed for the EMS setting, incorporating features that support transmission over multiple modalities, many of which have already been mentioned in this chapter. Systems designed for the prehospital environment must also navigate different telecommunications modalities including public safety 700–800 mHz systems, cellular, and even satellite transmission. Applications using videoconferencing and data transmission in areas such as urban environments with ubiquitous 4G cellular coverage may differ markedly from those in remote environments such as disaster response in areas where satellite or temporary mesh wireless are the only options.

The efforts to advance EMS telemedicine and particularly videoconferencing have benefited greatly from the recent growth of wireless networking options fueled by consumer demand for mobile data. Bandwidth refers to the speed of transmission of data or the “size of the pipe” and speeds of at least 300 kilobytes per second on the wireless uplink and downlink are required for two-way videoconferencing. A streaming, one-way video link may be valuable in situations where only a view of the patient will suffice for evaluation, such as in telestroke. The current implementations of so-called fourth-generation wireless technologies (long-term evolution or LTE cellular and WIMAX wifi) may offer transmission speeds up to 100 megabytes per second to moving objects and up to a gigabyte per second to stationary objects, well within the range for high-quality videoconferencing. Public safety communications networks in the 700 and 800 megahertz range of the electromagnetic telecommunications spectrum may vary in their implementations of data transmission speeds capable of supporting videoconferencing. The most recent telemedicine systems designed for the EMS environment support the flexibility to use whatever communications networks are locally available, whether it be cellular, wifi, or 700–800 mHz. In addition, more portable networking concepts such as mesh networking where devices deployed over a geographic area act as additional transmission nodes to other devices along with an increasing availability of satellite communications options enhance capabilities in remote or disaster situations.

In July 1996, Dr Stephen Joseph, Assistant Secretary of Defense for Health Affairs, in a speech entitled “Telemedicine in the Military Health Services,” stated that “As an innovating factor for the military health services system, telemedicine will modify our conduct of operations, regardless of where we happen to be. The expanded capabilities facilitated by telemedicine will result in our combat medics being very different people than they are today. Their training will include use of helmet cameras to offer clear visuals of wounded or injured soldiers, readers to gain vital statistics from personnel status monitors, communication devices to send descriptive details and receive specific direction on how to handle each patient” [55]. Since then, portable, rugged telemedicine systems have been developed and deployed with several combat units. LifePro5 and Tempus IC Pro are both specifically designed for the military with civilian applicability [17,37]. Each offers the entire telemedicine platform in a single unit that has the capability to wirelessly transmit data back to the hospital. The combat medic wears a video camera strapped to his or her head and a Bluetooth headset allowing direct communication with the physician on base. As the medic arrives on the field, the physician can see and hear everything that the medic sees and hears. These units provide remote physiological monitoring, telebation, telesonography, infrascanner technology (to look for intracranial bleeding) and electronic tactical combat casualty cards (TC3) which is all transmitted in real time to the physician at the base hospital. Not only can the physicians see the injuries and what kind of treatment was performed prior to arrival, but they can also offer further advice or direction so that the appropriate initial treatment is not delayed.

At the same time, there has been an explosion of powerful tablet computers and hand-held devices designed to operate on 4G LTE networks and support high-quality videoconferencing and data integration including mobile applications. Health care providers including those in EMS are asking the question every day whether these devices which support connectivity in everyday life are applicable to their own specialty area of medicine such as the prehospital environment.

The concept of a telemedicine-capable, video-equipped ambulance moved toward reality with federal grant support in 2002 from the Telemedicine and Technology Research Center (TATRC) and the Department of Defense. The DREAMS (Disaster Relief and Emergency Medical Services) concept ambulance was first deployed with the Liberty County Texas EMS and underwent 6 years of field testing. At the same time, a similar project with the University of Vermont Telemedicine Program, the FAST STAR (Fletcher Allen Specialized Telemedicine for Supporting Transport and Rescue), evaluated the systems in rural settings for airway management and ultrasound with prolonged EMS transport times in poor weather conditions [56]. In 2007, Tucson AZ deployed a city-wide wifi mesh network allowing videoconferencing from ambulances to the university medical center that was ultimately limited by the wifi technology, in that the ambulances had to be stationary while transmitting video [57].

LifeBot recently became the licensee for distributing the DREAMS ambulance technology as the state of the art in mobile ambulance telemedicine systems. Key components include ceiling-mounted cameras, continuous audio-videoconferencing communications, physiological monitoring, and a flexible communications hub that allows it to leverage available 3G, 4G, wifi, WiMAX, LTE, satellite, and military data radio [58]. The ambulance contains three interior cameras which are remotely controlled by physicians in a hospital and a fourth portable camera worn by the prehospital provider, allowing live transmission of audio and video data during a teleconsultation. In addition, the ambulance offers full telemonitoring of the patient in real time as well as telementoring of both ultrasound and videolaryngoscopy to the prehospital providers. During Hurricanes Rita and Katrina, DREAMS was used to assist in triaging patients over 375 miles away in New Orleans from the Memorial Hermann Trauma Center in Houston [17].

**Conclusion**

While the near future promises to be an exciting time now that we have telemedicine systems designed specifically for the EMS environment, there are very limited data on the effectiveness of these systems and on the performance metrics for telemedicine in general [59]. It is important to think about telemedicine not just in a videoconferencing sense but also with the transmission of telemetry, ECG, voice, and store-and-forward contexts. Questions to answer include whether these systems are effective in improving the efficacy of prehospital airway management, preventing secondary insults of hypoxemia or hypotension in traumatic brain injury, enhancing the early identification of internal hemorrhage and shock, preventing patient deterioration over longer transport times, improving the management of stroke and myocardial infarction, and improving survival in MCIs and disasters, to name a few. These are exciting times for telemedicine with personal technology development and telecommunications, ubiquitous videoconferencing, and near-constant connectedness but it remains to be proven whether this is just technology in search of medical applications or a new age of connected patient care and medical effectiveness in the prehospital arena.