



The use of telemedicine in the care of the pediatric trauma patient

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ABSTRACT

Telemedicine is increasingly becoming an important part of the health care system as it has the potential to help deliver quality medical care to underserved areas. When implemented correctly, it can be a cost-effective way of expanding access to excellent medical care. However, because it is a relatively new and quickly changing field, there are multiple issues and challenges that need to be addressed. This article reviews the current literature on various modalities of telemedicine, evidence for teletrauma, and challenges and barriers related to telemedicine.

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Background

Telemedicine is quickly becoming an important part of the modern health care system with the increasing interest in expanding access to quality health care to remote areas. This interest has been fueled by the implementation of the Affordable Care Act that encourages and rewards the use of telemedicine to promote efficiency and the rapid advancement of available technology. So, more and more hospitals and physicians are becoming attracted to the idea, but what is telemedicine? Telemedicine can be defined as the electronic exchange of medical information to provide remote clinical care for a patient. Telehealth is another term often used concomitantly and refers to a broader scope of providing remote health care and is not restricted to providing clinical care to a patient but can also include education or administrative collaborations.^{1,2} As a result, telemedicine in a sense can be dated as far back as late 1800s when the telephone was first used to reduce office visits. However, along with rapidly changing technologies, telemedicine is also evolving bringing with it both new opportunities and challenges.

When implemented correctly, telemedicine has the potential to greatly advance health care by decreasing costs, increasing access, and improving quality in areas of need. But, because it is an evolving field, there are technology, legal, licensing, and reimbursement issues that need to be addressed in order to deliver sustainable quality care to the patients.^{3–5} Utilizing the care of the pediatric trauma patient as a backdrop, some of these opportunities and challenges will be described below.

Telemedicine in trauma

Over the years, as medicine, technology, and patients' needs have become more sophisticated, telemedicine has adapted and become more complex. Telemedicine now comprises multiple modalities for delivering various aspects of clinical care. In trauma, these modalities can be classified based on various phases of trauma care: pre-hospital (field evaluation and transport), in-hospital (emergency department, inpatient/ICU), and for follow-up and rehabilitation within the home/community.

In the pre-hospital field setting, telemedicine can be a useful tool to assist early evaluation, diagnosis and intervention. For instance, one study looked at the feasibility of a portable ultrasound available with a transmission equipment backpack that can transmit live images in healthy volunteers (Figure 1). The machine was able to transmit live images without issue through local cellular network or via satellites in remote locations.⁶ Such a tool can certainly help in early diagnosis especially in rural areas, but it does require some ultrasound proficiency of the first responders. However, Kirkpatrick et al. demonstrated the possibility of utilizing pre-hospital Focused Assessment with Sonography for Trauma (FAST) examinations by the first responders with guidance through telemedicine. In the study, 101 ultrasound novice fire fighters were remotely guided through the FAST examination with 97% accuracy for detecting fluid in a simulated setting.⁷ In addition, the Defense and Veterans Brain Injury Center is attempting to improve field diagnosis of traumatic brain injury through electronic cognitive assessment that medics or emergency medical service personnel can use for early identification of the injury, which then can be reviewed remotely via telemedicine.⁸

In a similar fashion, telemedicine support during transport can improve patient care. Charash et al. showed, in simulated trauma

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Fig. 1. Portable SonoSite ultrasound machine with transmission equipment backpack.⁶

patients, that having an ambulance equipped with real-time video and vital sign monitoring that is wirelessly transferred to a physician workstation at a trauma center, significantly improved vital signs of the patients upon arrival secondary to pre-hospital interventions, the diagnosis rate of critical events, and successful therapeutic interventions performed. Of note, through telemedicine guidance, the emergency medical technicians (EMTs) were able to perform needle thoracostomies and pericardiocentesis successfully in 22 of 24 cases compared to 0 in the control EMT group.⁹ Bergrath et al. then demonstrated applicability and feasibility of such monitoring system in real life. The ambulances were equipped with technology for real-time vital sign, EKG, and video transmission (Figures 2 and 3). In 35 emergency cases, including trauma, where teleconsultation occurred, correct pre-hospital

diagnosis was made in 34 cases with timely medication administration or therapeutic intervention such as intubation occurring in 21 cases without any medical complications. The authors concluded that the telemedicine system can be a great support for the paramedics especially in emergency cases.¹⁰ Although these studies to date have focused on adult patients, the applicability to the pediatric trauma patients, a group that pre-hospital providers have less experience and comfort, will be even greater. Such technology will likely demonstrate the greatest benefit for the transport of injured children longer distances to pediatric trauma centers for care.

In the hospital setting, many studies have demonstrated beneficial effects of having telemedicine capabilities between a local community hospital and a trauma center. A demonstrated advantage of pediatric trauma center is access to the pediatric expertise of both the pediatric emergency medicine provider and the pediatric surgeon. Utilizing virtual presence of these experts in remote rural and critical access hospitals to assist in the care of the injured child is, therefore, likely to improve outcomes as well. In the study by Rogers et al., a simple two-way videoconferencing was utilized for teleconsult. There were 26 total adult trauma consults where two cases were considered lifesaving. The trauma surgeons were able to aid in early evaluation, resuscitation, and stabilization of the patients, as well as guide providers in invasive procedures such as cricothyroidotomy or thoracotomy. Six patients were able to be treated in the referring facility, thus saving transfer costs.¹¹

Latifi et al. also demonstrated benefits of teleconferencing in their retrospective study of 59 teleconsults among a level I trauma center and rural hospitals. In six patients, the teleconsults were considered lifesaving where critical interventions (intubation, control of hemorrhage, etc.) were teleproctored and mistakes were found and corrected. Importantly, the telemedicine support prevented 17 transfers with an average savings of \$19,698 per air transport or \$2055 per ground transport. Authors reasoned that with these cost savings, technology for teletrauma can be easily implemented and justified.¹² Building upon this success, a pilot study was performed using smartphone technology for videoconferencing instead of the stationary system used previously. Prior to the study, operational policy was developed and training

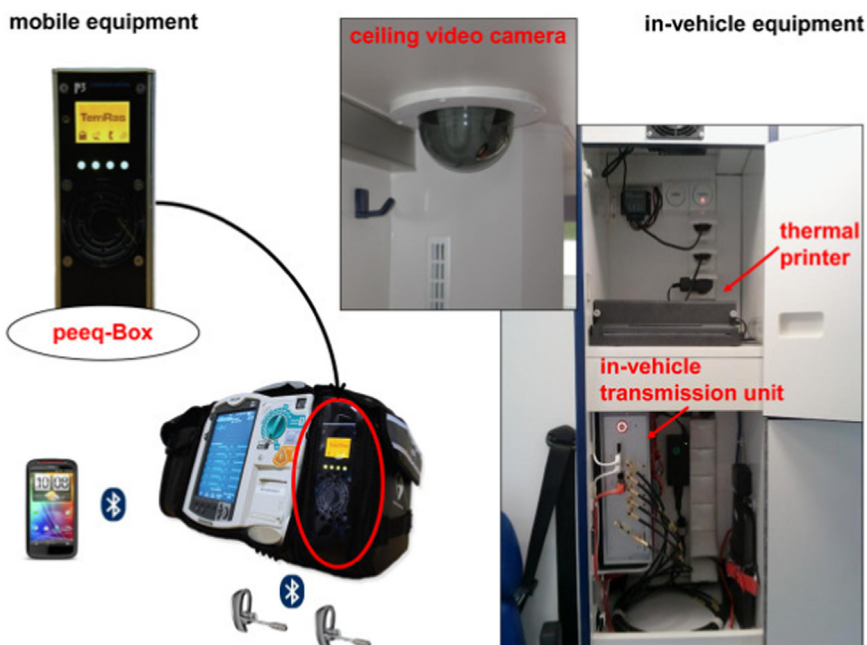


Fig. 2. Examples of telemedicine devices equipped in the ambulance.¹⁰

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