Rural Teletrauma
Applications, Opportunities, and Challenges

Preston “Pret” Bjorn, RN, BS

ABSTRACT
Conditions favoring telemedicine in rural acute trauma care are increasingly outnumbering barriers against it. This article is a review of current considerations in teletrauma, with examples from an established rural system.

Key words: telehealth, telemedicine, telepresence, teletrauma

THE successful treatment of major trauma is utterly dependent on the alignment and integration of all phases of treatment. Rescue, local stabilization, critical care transport, and tertiary hospitalization share nearly equal importance and urgency, and treatment strategies must facilitate transition from one phase to the next. Because trauma care systems are necessarily centralized, the importance of these crucial relationships is sharply magnified. Especially in rural trauma systems, providers must be as mindful of the distance as they are of the disease. For many rural trauma victims, geography is destiny.

Eastern Maine Medical Center (EMMC) in Bangor is one of the state’s three regional trauma centers. Its service area covers about two thirds of the landmass of Maine—roughly equivalent to that of New Hampshire, Vermont, and Massachusetts combined—and comprises more than 20 community-level trauma system hospitals with ground transit intervals from under 10 min to more than 4 hr. Throughout the history of the state trauma system, it has been clear that optimal alignment of care requires optimal communication between providers. With this in mind, EMMC has experimented for several years with various methods of clinical telemedicine for trauma management. An early analysis of our efforts points to the promise of teletrauma (Grossmann Zamora, Sorondo, Holmberg, & Bjorn, 2010). This article reflects and expands on that experience.

HISTORY
Although most telecommunications technologies long predate organized trauma care, conventional clinical telemedicine—live audiovisual interaction—has been regularly applied to civilian trauma only since the turn of the 21st century. Owing mostly to consumer forces, products designed for interactive, multimedia communications have become increasingly accessible, reliable, and affordable. A Pew Research survey in 2010 revealed that nearly 20% of Americans had used video conferencing or chat via the Internet or cell phones, and that Internet videoconferencing had doubled over the previous 12 months (Rainie, 2010). As early as 1998,
Aucar et al. (1998) noted in assessing the potential for video consultation in trauma that “the technological demands are not necessarily extensive and our technological achievements are progressing faster than our ability to use them” (p. 399).

Unsurprisingly, recent years have seen a gradual proliferation of applications for emergency teletrauma (Latifi et al., 2007; Ricci et al., 2003; Rogers et al., 2001), paralleling efforts in psychiatry, stroke, and adult and pediatric intensive care. In 2004, our hospital began a trial of telemedicine services at three remote sites, offering emergency consultation for both trauma surgery and pediatric intensive care (PICU) medicine. Although variously supported by online electronic medical records and Picture Archiving and Communications Systems (PACS) for remote radiology, our implementation of telepresence has focused chiefly on live audiovisual conversations and consultation. Our experiences have been sufficiently encouraging that 11 other sites have since been added, and we envision a gradual normalization of the process, perhaps eventually eclipsing conventional telephony for these purposes. An inventory of our successes and challenges, as follows, seems a fair and reasonable means of justifying this vision and recommending further improvements to existing practices.

**BENEFITS OF TELEMEDICINE IN RURAL TRAUMA CARE**

Providers at every level can be forgiven the assumption that teletrauma systems primarily enable immediate, heroic, life-saving advice or instruction from the urban center to the rural provider (perhaps fostered by case reports; Campana, Jarvis-Selinger, Evans, & Zwimpfer, 2004); but even a rudimentary understanding of rural trauma care belies this misconception. Although there are stark differences in resources and experience that recommend the ultimate trajectory of major injuries to trauma centers (Garwe et al., 2010; Mackenzie et al., 2006), these have little or nothing to do with the quality of primary hospital care or its vital importance to optimal patient outcomes (Helling, Davit, & Edwards, 2010). Cases in which the trauma center consultant’s telepresence has an immediate survival impact are anecdotal and vanishingly rare in our observation. Indeed, telemedicine may provide convincing proof that, rather than performing insufficient or substandard assessments and treatment, rural providers may be compelled by their general expertise and relative isolation to do too much. A majority of the clinical advice given by our providers essentially amounts to permission for remote hospitals to defer time-consuming and low-yield tests and treatments in favor of expedient transfer. By participating in the initial assessment process, the trauma surgeon can, for example, safely discourage dated concepts such as “spine clearance” in favor of immobilization and transfer or recommend against other time-consuming plain radiographs and computed tomographic scans that offer little or no proximal benefit while potentially prolonging the interval to transfer (Gupta, Greer, & Martin, 2010). Consultants may also offer decision support for airway or fluid management in meta-stable patients or advice for addressing complex comorbidities (i.e., current practices of reversal for therapeutic anticoagulation). And, because our trauma center provides critical care transport services, these can be initiated by the consultant while the remote partners focus on immediate stabilization.

The advantages of “bringing the surgeon forward” in the patient care cascade are difficult to exaggerate. Traditional referral via telephone is by nature a sequential and linear endeavor: The community hospital provider receives, examines, tests, treats, and prepares the patient for transfer—a process of unpredictable complexity and duration, which then must be recollected and reported to the receiving surgeon post hoc. Live multimedia enables the trauma center clinician to actively observe and augment the early far-end care process to a degree unimaginable via audio-only technology.

What is perhaps less obvious is the power of telemedicine to unify providers of all levels,
across immense distances, to common purposes (Bolle, Larsen, Hagen, & Gilbert, 2009). Participants in both our teletrauma and tele-PICU projects routinely express a previously unknown sense of collaboration and partnership, consistent with our conceptualization of the virtual service area as a “130 million square-foot trauma room.” These enhanced relationships encourage other value-added phenomena that we did not anticipate at the outset, including just-in-time review of clinical procedures such as thoracostomy; “reverse-teletrauma,” wherein referring providers rejoin the acute care management after arrival at the trauma center; and informal but universally popular debriefings between community hospital and trauma center providers after emotionally charged cases or unfavorable outcomes.

Clearly, the most striking and least-expected benefit of teletrauma is its enormous potential for reducing costs, chiefly by reducing unnecessary transfers and air medical transportation. The most conspicuous examples can be traced to the established utility of cameras in assessing burn injuries (Mertens, Kagan, & Warner, 2006). An early case is illustrative:

A rural hospital emergency department requested teletrauma consultation for a pediatric patient with burns. The referring emergency medicine clinician confided that he expected little from the exercise, as Maine pediatric burn cases are almost invariably transported to a specialty center in Boston, MA, approximately 250 miles (400 km) to the south. Nonetheless, he felt that this would be a good chance to “play with the cameras” while awaiting the arrangement of helicopter transport. After examining the patient’s wounds and conferring with parents and providers, the trauma surgeon suggested that the child could safely be managed without the risk and expense of a flight to Boston—or, for that matter, any urgent transfer. Instead, the burns were treated locally under the advice of the consultant, and follow-up was scheduled at the trauma center’s outpatient clinic.

Although this example may seem extreme, it is representative of many burn and other trauma cases that have been safely and properly managed by local providers as a direct result of enhanced triage made possible by telemedicine. It is sobering to consider that any single case in which a transfer can be safely reorganized or avoided may represent many thousands of dollars in cumulative cost reductions. Where various expenses can be eliminated (e.g., critical care transfer, second hospital admission, redundant consultations and diagnostics, family travel and time loss, and subsequent commutes for follow-up), teletrauma systems are intuitively and immensely cost-responsible.

Finally, any evaluation of a presumably value-added process should be inclusive of user satisfaction, which in the case of our program has been highly favorable overall. Users on either end of any given teletrauma consultation typically describe the exercise as beneficial to patient care and report a high likelihood of using the system repeatedly in the future. And, although early concerns were raised that patients and families might regard teletrauma as a sign of the shortcomings of the local facility as compared with the trauma center, unsolicited comments suggest quite the opposite. A focused survey of patient and family satisfaction is pending, but our impression thus far is that teletrauma is rightly seen as a mark of sophisticated and state-of-the-art patient care and a credit to all involved.

CHALLENGES AND BARRIERS TO TELETRAUMA

From the outset, implementation of acute clinical telemecine in the United States has been discouraged by a seemingly inexplicable regulatory paradox: Although there is no apparent analogue for telephone consultation, advice given over audiovisual media—notwithstanding its intention or interpretation—carries the presumptive weight of a physician’s order. As such, telemecine services can be legally provided only by clinicians with active hospital privileges at the remote facility. For those familiar with the intricacies and effort of medical staff credentialing, this by itself might represent a prohibitive burden for any telemecine
program. Fortunately, recent relaxations in the regulatory environment provide for streamlining the traditional vetting process via a simple agreement between the participating facilities (Lowes, 2011).

Because telemedicine is inherently more complicated, interactive, and time-consuming than the traditional role of the trauma consultant, and especially given that teletrauma is likely in fact to reduce overall admissions for participating trauma centers and consultants, it is little surprising that reimbursement for such services has become a matter of increasing importance. No consistent pattern of reimbursement has emerged among the myriad possible permutations of providers, payers, policies, and applications of telemedicine. Fair payment will ultimately determine the sustainability of this vast array of important services, and all providers share the responsibility of advocacy in this regard.

As with any emerging technology, the underlying costs and complexity of teletrauma are gradually improving since its introduction. At EMMC, our initial system (in 2004) was constructed using corporate teleconferencing equipment and software over a rural integrated services digital network to three remote hospitals, with start-up costs totaling nearly $70,000, plus more than $1,000 in monthly charges for access and maintenance of the hardwire network, which was otherwise reserved for public telephony. Since 2006, conversion to Internet provider-based services has enabled essentially cost-free transmission, but hardware and encryption requirements have necessitated grant funding for the purchase of additional devices, each costing several thousand dollars.

Such highly sophisticated hardware systems provide undeniable value for many applications of telemedicine. They feature large-screen, high-resolution video with maneuverable optics, and reliably good response to remote control. These features have been of distinct use to our parallel programs in telepresence for PICU and neurology (stroke) and are indispensable to our virtual intensive care unit service; however, use by our trauma clinicians has been inconsistent and below expectations. This is, at least in part, a function of their size, limited numbers, and fixed locations: Although trauma surgeons are on campus 24/7, they are unlikely to be in proximity of a dedicated camera at the moment of need. Moreover, the cameras are controlled by computers, which must be activated and interconnected by a series of actions and menus frankly ill suited to clinical environments and providers. The resulting collision of crisis and complexity adversely affects the ease and immediacy of telepresence to a degree that many providers revert to telephone consultation when time or convenience is at issue.

This lingering preference for telephony seems to suggest a reconsideration of hardware: that is, that teletrauma can thrive only to the extent that the camera compares favorably (in the user’s opinion) with his or her cell phone. It is our good fortune, then, that the consumer electronics industry is practically erupting with competitive solutions.

In early 2011, EMMC began a trial of handheld cameras for teletrauma using the iPod Touch, and we are currently investigating commercial applications that enable secure, device-agnostic communications to accommodate an array of camera-equipped tablets and smartphones. Our early experience suggests that the video quality of these retail devices is adequate for most of our goals, at a fraction of the cost of their larger and more elaborate predecessors. Furthermore, we expect that the convenience, portability, and familiarity of such devices will contribute to their everyday use.

In the transition to retail electronics for telemedicine, protection of privacy is an inescapable and absolute prerequisite. Patients, providers, and health care organizations expect and deserve the assurance that clinical consultations and conversations will not find their way onto the infinite landscape of publicly accessible media. Using devices and methods specifically designed to facilitate media sharing and social networking, such as smartphones, is inherently risky.
In the United States, the Health Insurance Portability and Accountability Act (HIPAA, 1996) features a privacy rule that prohibits disclosure of protected health care information (PHI) without the patient’s permission. Detailed review of the HIPAA Privacy Rule is impractical in this forum; but it will suffice to note that multimedia streaming of patient care activities over the Internet risks previously unimaginable disclosures of PHI. Potential users of telemedicine are reminded that, with respect to HIPAA and a host of other practical and civil considerations, telemedicine systems must be designed and implemented with exhaustive input from colleagues experienced in health information technologies and compliance. Clinicians in isolation, for example, may accept a manufacturer’s assurances of a product’s HIPAA compliance, via layers of encryption when used over a Wi-Fi connection—until an information systems expert reminds them that subsequent transmission over the public Internet carries no such guarantee.

A variety of commercial applications and services have been considered at EMMC, where we continue to search for an optimum balance of security, reliability, and efficiency. Nonetheless, we remain optimistic on the basis of our experience that solutions will suggest themselves among the fast-approaching generations of consumer electronics. Modest modifications to existing wireless technology may not only transform interhospital communications but also enhance communication and collaboration in the prehospital phase (Charash et al., 2011).

SUMMARY

Teletrauma consultation holds the potential to revolutionize rural trauma management by comprehensively integrating care between all phases of treatment. Modern health care is approaching a tipping point, where communications technologies will become sufficiently affordable, accessible, durable, and intuitive to permit immediate, widespread multimedia communication equal to the challenges of rural emergency care. Health care organizations and providers should prepare for the expansion of trauma care systems from physical into virtual realms.

REFERENCES


