
Use of Telemedicine to Improve Burn Care in Ukraine

Gennadiy Fuzaylov, MD,* Justin Knittel, MD,† Daniel N. Driscoll MD‡

Global burn injuries have been described as the “forgotten public health crises” by the World Health Organization. Nearly 11 million people a year suffer burns severe enough to require medical attention; more people are burned each year than are infected with human immunodeficiency virus/acquired immunodeficiency syndrome and tuberculosis combined. Telemedicine has the potential to link experts in specialized fields, such as burn care, to regions of the world that have limited or no access to such specialized care. A multilevel telemedicine program was developed between Massachusetts General Hospital/Shriners Hospital in Boston, Massachusetts, and City Hospital #8 in Lviv, Ukraine. The program should lead to a sustainable improvement in the care of burn victims in Ukraine. The authors helped establish a Learning Center at City Hospital #8 in Lviv, Ukraine, through which they were able to consult from Shriners Hospital in Boston, on a total of 14 acute burn patients in Ukraine. This article discusses two case reports with the use of telemedicine and how it has allowed the authors to provide not only acute care consultation on an international scale, but also to arrange for direct expert examination and international transport to their specialized burn center in the United States. The authors have established a program through doctors from Massachusetts General Hospital/Shriners Hospital in Boston, which works with a hospital in Ukraine and has provided acute consultation, as well as patient transportation to the United States for treatment and direct assessment. (*J Burn Care Res* 2013;XX:XX-XX)

Telemedicine has been increasingly used in a host of settings for over 20 years, from radiology and dermatology to infectious disease, psychiatry, cardiology, critical care, and burns.¹⁻²¹ It allows for experts in specialized fields of medicine to reach people and areas of the world, which have limited or no access to such specialized care. As technology improves and is embraced throughout health care, and as the cost of providing health care continues to rise worldwide, expanding the capabilities of subspecialized experts is becoming more important. In the field of burns, telemedicine allows for triage and virtual examination of the specific injuries

through digital photography and video, as well as vital signs and radiologic and laboratory results that can help shape a patient’s management. A recent survey of American burn centers showed that 74% of those surveyed routinely used telemedicine, incorporating it into consultations of acute burns and triage needs as well as follow-up care.²² As the number of burn centers in the United States and the rest of the world decreases and this specialized health care becomes more consolidated, the allocation of these health-care resources becomes increasingly important. By allowing experts to more easily reach and assess patients at distant locations, telemedicine has the potential to allow for more accurate assessment of a patient’s injury and aid in the decision of who should be triaged and transported to more specialized centers for treatment. In 2004, a study by Saffle et al,²³ which examined patients transported to a tertiary burn-care facility found that 92 of 169 patients transported to their facility might have had care substantially altered by a telemedicine consult before transport, based on the patient’s burn size and airway needs. A later study by the same group²⁴ found that patients who received telemedicine consults required transportation to a specialized burn center less often than those who did not undergo a telemedicine consult.

*From the *Harvard Medical School, Massachusetts General Hospital, Shriners Hospital for Burn Children, Boston, Department Anesthesia, Critical Care and Pain Medicine, Boston, Massachusetts; †Resident in Anesthesia, Department Anesthesia, Critical Care and Pain Medicine, ‡Harvard Medical School, Massachusetts General Hospital, Boston, Massachusetts.*

Abstract was accepted for The 16th Congress of the International Society for Burn Injuries (ISBI) in September, September 2012 at the Edinburgh, United Kingdom.

Address correspondence to Gennadiy Fuzaylov, MD, MGH, 55

Fruit Street, Gray Jackson 409, Boston, MA.

*Copyright © 2013 by the American Burn Association.
1559-047X/2013*

DOI: 10.1097/BCR.0b013e3182779b40

Although the majority of studies on telemedicine revolve around care within national borders, there has been much work done that stretches across international telemedicine. Munoz et al²⁵ recently published on their experience consulting cardiac intensive care unit at Children's Hospital of Pittsburgh with a hospital in Colombia, where they provided consultations on 53 complex cardiac pediatric patients. A pediatric anesthesia team in Philadelphia, Pennsylvania, used telemedicine to consult live with an intraoperative team in Bengaluru, India, regarding two elective pediatric liver transplants, during which they were able to monitor not only the patient via camera, but also live streaming of vital signs and laboratory results.²⁶ Syed-Abdul et al²⁷ recently published a case report on their experience working with burn patients on the island nation of Sao Tome and Principe off the coast of Africa; they arranged transport of three patients to Taiwan for reconstructive plastic surgery. In this article, we present our experience from Shriners' Hospital and Massachusetts General Hospital in Boston, Massachusetts, in not only providing acute burn and critical care consultation on pediatric and adult burn patients in Lviv, Ukraine, but also with the triage and transport of critically ill patients from Lviv, to a tertiary care facility in the United States for further management.

METHODS

With the support and funding of Doctors Collaborating to Help Children, Corporation (www.dctohc.org), and the Ukrainian National Women's League of America, Inc., a new Learning Center has been opened in Lviv City Hospital #8. The center is equipped with a high-speed local area network connection, a large-screen television, a high-definition camera, personal computers, multiple speakers, microphones, and seating for 60 people (Figure 1).



Figure 1. The Learning Center, Lviv Hospital #8, Ukraine.



Figure 2. Teleconference between Boston doctors and Lviv Burn Unit, Ukraine.

The Learning Center provides the Burn Unit in Lviv with the opportunity to become more effective by educating medical personnel and keeping them up to date with medical innovations. Additionally, the interactive nature of the center allows for telemedicine consultations from Boston to physicians in Ukraine, regarding challenging patients (Figure 2).

Skype, an Internet-based communication tool, has been used in communication with the burn center in Lviv.²⁸ Radiographic images were scanned and digitalized using an electronic scanner and stored in a standard personal computer. We used JPEG image compression to facilitate the transmission of radiographic images and patient charts. We followed informed consent and HIPPA rules in transmitting any patient-related information. In total, we have provided consultation on 14 patients in Lviv, ranging in age from 15 months to 63 years (Table 1). After the initial presentation, each patient was reviewed on a daily basis by doctors in Boston, with an average of six consultations per patient. Multiple difficulties were overcome in implementing the system between two countries, including time zone differences, language barrier, and different approaches to patient care. One of the Boston physicians, who speaks Russian, was able to facilitate effective communication with the Lviv burn center. Physicians and nurses in Boston spent much of their time and expertise to this project.

RESULTS

Since the establishment of the Learning Center in Lviv, and the implementation of telemedicine capabilities, physicians in Boston, have provided consultations on 14 patients admitted to the burn center in Lviv (Table 1).

Table 1.

Patient (#)	Age (yrs), Sex	Type of Burn	TBSA (%)	Number of consultations (N)	Disposition	Outcome
1*	1.2, male	Scald	40	18	Treated locally	D/C from local hospital 25 d after admission. Follow-up at Shriners Outreach Clinic in September 2012, in Lviv, Ukraine.
2	63, male	Flame	95	2	Treated locally	Died within 24 hrs after admission to local hospital.
3	22, female	Flame	90	1	Treated locally	Died within 1 hr of admission to local hospital.
4**	11, male	Flame	87	24	Transported to Boston in 5 d	Died from sepsis, ARDS at Shriners Hospital, Boston 26 d after injury and transport.
5	3, male	Flame	55	12	Candidate for transport	Died 4 d after admission to local hospital, before transport to Boston.
6	14, female	Flame	90	9	Treated locally	Died 2 d after admission to local hospital.
7	56, female	Flame	95	1	Treated locally	Died within 1 hr of admission to local hospital.
8	9, male	Flame	55	4	Transported to Boston in 24 d	Current patient at Shriners Hospital, Boston.
9	45, male	Flame	40	5	Transport to burn center in Ukraine	D/C from hospital after 3 d .
10	36, male	Flame	45	5	Transport to burn center in Ukraine	D/C from hospital after 45 d.
11	37, male	Flame	85	3	Transport to burn center in Ukraine	Died 5 d after injury.
12	13, female	Flame	35	5	Treated locally	Follow-up at Shriners Outreach clinic in September 2012 in Lviv, Ukraine.
13	35, male	Flame	45	5	Treated locally	D/C from hospital 1 mo after admission
14	35, male	Flame	50	3	Transport to burn center in Ukraine	D/C from Hospital 3 d after admission

D/C,

Case Scenario 1

A 15-month-old girl suffered a scald burn and was taken to the Lviv burn center, where it was determined that she had a 40% TBSA burn injury. A telemedicine consultation was held immediately by three doctors from Shriners Burn Hospital for Children, Boston, along with two doctors from the Lviv Burn Center through telecommunication in April 2012. The physicians in Boston were able to view the infant's vital signs, lab results, radiological studies, and discuss the case and pertinent details with the physicians in Ukraine, providing a primary acute assessment of the child. Repeat consultations were held over the next week with the same physicians in Ukraine, providing updates and allowing the child's care to be tailored by the consultants. A fellow burn surgeon from the United States happened to be present in Eastern Europe for personal reasons during this time, and he was contacted by the physician group in Boston. With the telemedicine capabilities, he was able to access the patient's chart and radiographical images, and he was able to travel by train to Lviv and examine the child first-hand and provide direct consultation. The patient survived this

acute stage of injury and was discharged from the local hospital in Lviv 25 days after the initial injury. A direct follow-up assessment is scheduled in the near future through a Shriners Outreach clinic in Lviv later this year.

Case Scenario 2

In February 2012, a fire occurred overnight in a family home in the village of Dolynivka in the Skole district of Ukraine. Three generations of the family that lived there were critically injured. A grandmother and mother, both of whom suffered 80% TBSA burns as well as inhalational burns, died in the fire. A grandfather who suffered 90% TBSA burns and respiratory injury was admitted into the Lviv City Hospital, but soon also died of his injuries. Three children were admitted to Lviv City Hospital: a 13-year-old girl suffering 80% TBSA burns, toxic smoke inhalation, and respiratory burns; an 11-year-old boy who suffered 87% TBSA burns, respiratory burns, and carbon monoxide poisoning; and a 2-year-old boy who had 50% TBSA burns with respiratory burns and toxic smoke inhalation. It quickly became clear that resources in the Ukrainian

hospital would not be adequate to treat the surviving victims. A telemedicine consultation was scheduled immediately between our physicians at Shriners Hospital and the Lviv City Hospital. The initial consultations revolved primarily around the airway status of the three younger patients, and as a direct result of the consultation, the decision was made to intubate and mechanically ventilate all three patients because of their injuries. As it became clear that all three victims were in need of care from a specialized burn center, planning began for transportation to Shriners Hospital for further management. Unfortunately, the 13-year-old girl and 2-year-old boy died of their injuries at the Lviv hospital before transportation. The 11-year-old boy was the only survivor who could be transported. Between the Lviv regional government and the U.S. Embassy in Kiev, emergency visas were prepared and transportation from Lviv to Boston was arranged through air ambulance. Funding for this trip was raised in Ukraine via a 2-day telethon run by the hospital and local government. Significant hazards in the 2-day transport included the process of transporting the unstable patient from the hospital to the plane through subfreezing temperatures. A specialized heated tunnel was prepared with the help of the military, which ran from the hospital entrance to the ambulance and then to the plane at the Lviv Airport to provide adequate warming for the patient during transportation. Telemedicine was used to stay in contact with the MedFlight 911 team and provide consultation throughout the transport to Shriners Hospital in Boston. Unfortunately, despite the transportation to Boston, the patient died from a combination of sepsis and ARDS stemming from the original injuries after 26 days at Shriners Hospital.

DISCUSSION

Telemedicine allows for the reach of modern health care into areas around the world, which had limited or no access in the past. By using modern advances in technology and communications, health-care experts can now provide insight and advice on patient management in multiple areas around the world simultaneously. Because of the highly specific care and expertise needed in certain fields, such as burns, medical care in these areas has been concentrated in a number of medical facilities around the world. Telemedicine works extremely well for such fields. Our telemedicine program with Massachusetts General Hospital/Shriners Hospital in Boston has been able to provide acute consultation on burn patients in hospitals in Ukraine, as well as arrange

transport of these patients to the United States for further treatment and provide for direct assessment by expert colleagues closer to the region.

In our first case scenario, telemedicine was instrumental in the primary assessment of this patient soon after the injury, allowing her care to be guided by burn experts from the start. It allowed for follow-up consultations and updates, as well as a means to arrange a direct assessment from a burn surgeon. Direct follow-up will be through outreach clinic in Lviv. In our second case scenario, we expanded these capabilities to not only provide a consultation and guide care, but also to triage multiple patients at once and arrange their transport to specialized burn facilities in another country. Clearly, in certain fields where there are specialized free-standing hospitals and experts, such as those for trauma and burns, telemedicine could play a valuable role in getting expert opinions to reach more clinicians and to better allocate available resources, such as transportation. Duchesne et al⁴ examined the use of telemedicine in arranging triage and transportation of trauma patients from multiple rural hospitals in Mississippi to a regional trauma center. They found that although patients who were transferred after a telemedicine consultation had significantly higher Injury Severity Scores, and received more blood transfusions, they did not have an increase in mortality.²⁸ By triaging and transporting only those patients who truly require specialized care, resources can be better spent and can be made more available when truly needed, and can reduce costs because of more appropriate use. In our experience, telemedicine has allowed us to triage and transport even critically ill burn patients on an international scale, thus helping to improve their care.

Telemedicine does have significant limitations. First and foremost, it is dependent on intact communications, which may not be available in certain situations, such as natural disasters or accidents. Furthermore, at this time, there is no system that can completely assess patient care from a distant location. In our experience, working with hospitals in Lviv, we were able to provide our consultative expertise, whereas the primary care of the patient remained under care of the physicians in Ukraine. With the present health-care shortages and those projected for the near future, the medical field may be heading toward a situation where even primary patient care may be undertaken by physicians not physically able to examine their patients directly. Local hospitals, such as the one in Lviv, often lack the training, resources, and infrastructure to handle and properly manage those patients with severe burn injuries,

which initially led to this telemedicine partnership with our program in Boston. Our program shows the capabilities of telemedicine to quickly link medical professionals around the world and arrange for a direct assessment and examination of the acutely burned patient.

CONCLUSION

Telemedicine is developing into an invaluable resource in the medical field, especially in the more specialized fields such as burns. We have established a program through doctors from Massachusetts General Hospital/Shriners Hospital in Boston, which works with hospitals in Ukraine and has provided acute consultation, as well as patient transportation to the United States for treatment and direct assessment of patients by nearby experts.

ACKNOWLEDGMENTS

We thank our colleagues at Massachusetts General Hospital, Shriners Hospital, Washington Hospital Center. We especially thank Drs Philip Chang, Robert Sheridan, Shawn Fagan, Erik Shank, Philip Fidler, and staff of Med-Flight911 for their helpful assistance in telemedicine, teleconferences, and air lift of critical patients.

REFERENCES

1. Anker SD, Koehler F, Abraham WT. Telemedicine and remote management of patients with heart failure. *Lancet* 2011;378:731–9.
2. Backman W, Bendel D, Rakhit R. The telecardiology revolution: improving the management of cardiac disease in primary care. *J R Soc Med* 2010;103:442–6.
3. Armstrong AW, Dorer DJ, Lugin NE, Kvedar JC. Economic evaluation of interactive teledermatology compared with conventional care. *Telemed J E Health* 2007;13:91–9.
4. Duchesne JC, Kyle A, Simmons J, et al. Impact of telemedicine upon rural trauma care. *J Trauma* 2008;64:92–7; discussion 97–8.
5. Rogers FB, Ricci M, Caputo M, et al. The use of telemedicine for real-time video consultation between trauma center and community hospital in a rural setting improves early trauma care: preliminary results. *J Trauma* 2001;51:1037–41.
6. Glaser M, Winchell T, Plant P, et al. Provider satisfaction and patient outcomes associated with a statewide prison telemedicine program in Louisiana. *Telemed J E Health* 2010;16:472–9.
7. Fox KC, Whitt AL. Telemedicine can improve the health of youths in detention. *J Telemed Telecare* 2008;14:275–6.
8. Arora S, Thornton K, Jenkusky SM, Parish B, Scaletti JV. Project ECHO: linking university specialists with rural and prison-based clinicians to improve care for people with chronic hepatitis C in New Mexico. *Public Health Rep* 2007;122(Suppl 2):74–7.
9. Jameson BC, Zygmunt SV, Newman N, Weinstock RS. Use of telemedicine to improve glycemic management in correctional institutions. *J Correct Health Care* 2008;14:197–201.
10. Berkebile BL, Goldfarb IW, Slater H. Comparison of burn size estimates between prehospital reports and burn center evaluations. *J Burn Care Rehabil* 1986;7:411–2.
11. Hammond JS, Ward CG. Transfers from emergency room to burn center: errors in burn size estimate. *J Trauma* 1987;27:1161–5.
12. Wallace DL, Smith RW, Pickford MA. A cohort study of acute plastic surgery trauma and burn referrals using telemedicine. *J Telemed Telecare* 2007;13:282–7.
13. Nguyen LT, Massman NJ, Franzen BJ, et al. Telemedicine follow-up of burns: lessons learned from the first thousand visits. *J Burn Care Rehabil* 2004;25:485–90.
14. Massman NJ, Dodge JD, Fortman KK, Schwartz KJ, Solem LD. Burns follow-up: an innovative application of telemedicine. *J Telemed Telecare* 1999;5(Suppl 1):S52–4.
15. Wallace DL, Jones SM, Milroy C, Pickford MA. Telemedicine for acute plastic surgical trauma and burns. *J Plast Reconstr Aesthet Surg* 2008;61:31–6.
16. Smith AC, Youngberry K, Mill J, Kimble R, Wootton R. A review of three years experience using email and videoconferencing for the delivery of post-acute burns care to children in Queensland. *Burns* 2004;30:248–52.
17. Redlick F, Roston B, Gomez M, Fish JS. An initial experience with telemedicine in follow-up burn care. *J Burn Care Rehabil* 2002;23:110–5.
18. Saffle JR. Telemedicine for burns. In: Latifi R, editor. *Telemedicine for trauma, emergencies, and disaster management*. Norwood, MA: Artech House; 2011. p. 280–1.
19. Jacobson PD, Selvin E. Licensing telemedicine: the need for a national system. *Telemed J E Health* 2000;6:429–39.
20. Cwiek MA, Rafiq A, Qamar A, Tobey C, Merrell RC. Telemedicine licensure in the United States: the need for a cooperative regional approach. *Telemed J E Health* 2007;13:141–7.
21. Yamamoto LG, Elliott PR, Herman MI, Abramo TJ. Telemedicine using the internet. *Am J Emerg Med* 1996;14:416–20.
22. Holt B, Faraklas I, Theurer L, Cochran A, Saffle JR. Telemedicine use among burn centers in the United States: a survey. *J Burn Care Res* 2012;33:157–62.
23. Saffle JR, Edelman L, Morris SE. Regional air transport of burn patients: a case for telemedicine? *J Trauma* 2004;57:57–64; discussion 64.
24. Saffle JR, Edelman L, Theurer L, Morris SE, Cochran A. Telemedicine evaluation of acute burns is accurate and cost-effective. *J Trauma* 2009;67:358–65.
25. Munoz RA, Burbano NH, Mota MV, Santiago G, Kleve-mann M, Casilli J. Telemedicine in pediatric cardiac critical care. *Telemed J E Health* 2012;18:132–6.
26. Fiadjoe J, Gurnaney H, Muralidhar K, et al. Telemedicine consultation and monitoring for pediatric liver transplant. *Anesth Analg* 2009;108:1212–4.
27. Syed-Abdul S, Scholl J, Chen CC, et al. Telemedicine utilization to support the management of the burns treatment involving patient pathways in both developed and developing countries: a case study. *J Burn Care Res* 2012;33:e207–12.
28. Brecher DB. The use of Skype in a community hospital inpatient palliative medicine consultation service. *J Palliat Med* 2012;