Project Narrative

1. Project Purpose

Over one million burn injuries occur in the United States each year. Although not all of these are life threatening, nearly 75% result in emergency department visits and 20% in hospital admissions.[i,ii] Approximately 4,500 deaths annually are caused by burns, making burns the fourth leading cause of death from unintentional injury[iii]. In fact, out of all the industrialized nations in the world, the United States has the highest per capita burn death rate.[iv] Burns are consistently listed as one of the top ten causes of injury and death for children less than 5 years and adults older than 34 years[v]. Rural communities have at least double the burn death rate than urban areas[vi]. Also on a national basis, Native American children are 2.8 times more likely to die as a result of fire than white children[vii].

Access to state of the art medical care is limited in many areas of the country by time and distance. The Intermountain West is a prime example of this where population is sparsely distributed and distances are vast. There are significant geographic barriers with a rugged topography that requires some people in the region to travel over 100 miles for health care. Accurate evaluation of burn injuries is difficult for many physicians, resulting in over- and under-triage. Inappropriate referrals are extremely costly, inconvenient and, in some situations, pose a threat to patient welfare.

One impetus for this proposal came from a recent study we conducted of patients referred to our burn center from within our region[viii]. We reviewed 225 air transports of burn patients to our center during the years 2000-01; these transports comprised almost half the referrals to our facility, from a mean distance (one-way) of 246 air miles. This fact alone underscores the vastness of our region, our status as a regional resource, and the remoteness of many patient referrals. We documented a significant number of problems with the evaluation of patients by these facilities. Almost 40% of patients were judged by us to have burns sufficiently minor that either ground transport (21%) or even family transport (18%) would have been feasible, distance and logistics permitting. For the entire group of referred patients, mean burn size estimation by referring physicians was 29 percent total body surface area (%TBSA), compared to 19% TBSA by Burn Center physicians. In 92 cases, over/under-estimation of burn size by referring physicians of as much as 560% of the total burn size, or overly-aggressive performance of endotracheal intubation, suggested that telemedicine evaluation of patients prior to transport might have significantly altered transport decisions or care. In addition, in 21 cases *air transport charges exceeded total hospitalization charges*, strongly suggesting that more resource-efficient methods of patient evaluation could have resulted in substantial savings for these patients. In fact, the cost of one unnecessary air transport (often in excess of $15,000) could buy a reasonably good telemedicine "studio" for a referring hospital.

In addition, the events of 9/11 underscore the resource-intensive nature of burn care and the limited resources currently available[ix]. Burns are one of the most likely injuries to occur with mass casualty or terrorist events, and the ability to triage and treat large

numbers of patients is extremely limited. The interdiction of air traffic that can occur after such events can further compound the ability to treat large numbers of patients.

All of these facts underscore the need for an immediate system of *acute* burn evaluation and treatment. Such a system could:

- Expand the availability of state of the art acute care to patients at remote medical facilities;
- Allow immediate evaluation of patients in mass casualty situations to optimize resource utilization and the efficiency of patient evaluation and treatment; and
- Realize substantial savings in transport costs and patient follow-up.

The Intermountain Burn Center (IBC) at the University of Utah Health Sciences Center is a 13-bed adult and pediatric intensive care and rehabilitation unit, directed by Jeffrey R. Saffle, MD, FACS. It includes a physical therapy department, rehabilitation area, operating room, hydrotherapy room, skin bank, outpatient wound care and medical clinic. The center has more than 5,000 outpatient visits annually and admits over 300 burn patients, of which approximately one-third come from other states. For almost thirty years, the IBC has been the major referral center in the Intermountain area for the treatment of both adult and pediatric thermally injured patients. It is the only American College of Surgeons-verified burn unit in the Intermountain West and has a five state referral region that encompasses one-fifth of the geographical U.S., the largest geographical area of any burn facility in the nation.

We anticipate that the **Telemedicine in Acute Burn Care** (TABC) Project will demonstrate the effectiveness and cost-efficiency of providing acute care for burn patients using telemedicine. Our goals for the project are; (refer to Appendix for measurable objectives for each goal):

- **Goal 1:** Provide equipment and protocols to expand use of telemedicine in acute burn care.
- **Goal 2**: Provide ongoing educational outreach to support and encourage the use of telemedicine in acute burn care.
- **Goal 3**: Expand the use of telemedicine for all burns at participating hospitals.
- **Goal 4**: Evaluate the effectiveness and impact of the TABC project.

2. Innovation

This demonstration project will pioneer the use of telemedicine for the immediate evaluation and treatment of acute burn injuries in the Intermountain West. Currently, on a national basis, telemedicine related to burn injuries is limited to professional health-related education and non-acute follow-up visits after burn units discharge patients. It has never been done systematically for the **initial** evaluation of burn injuries. A substantial number of patients transported to IBC have relatively *minor* injuries, and there are frequent errors made in the evaluation and initial treatment of these patients at referring hospitals. Just as important is the need for immediate assessment and treatment of *large* burn injuries. If we could use teleconferencing to evaluate real-time pictures of patients before transport, we may be able to expedite necessary transfers, avoid unnecessary ones,

and institute appropriate treatment prior to transfer. This improved triage could save substantial time, money, and in some cases, lives.

We anticipate the TABC Project will demonstrate that the use of telemedicine is economically sustainable. During this project, the IBC will not charge for telemedicine training or burn patient consultations. This provides the local physician with both added revenue for initial evaluation – and perhaps for care of patients who they would otherwise refer – while simultaneously providing substantial "backup" and liability protection. In addition, when transports are indicated, burn center physician evaluation helps justify these expensive procedures, facilitating insurance reimbursement.

3. Community Involvement

The hospitals that are participating in this project are all established "customers" of our referral network and have worked with us for years using phone consultations. In each institution, physicians and administration has expressed interest in participating in this project. Letters expressing this are included in the appendices. There are also Memoranda of Agreement from the hospitals in the appendices specifying what support they will receive and what they are committed to providing to the project.

Here is a brief description of these three hospitals:

- *St. Alphonsus Regional Medical Center*, Boise, ID – a 381 licensed medical-surgical/acute care bed facility; serves over half a million people, and is the leading trauma center in Idaho and the only verified Level II trauma center of southwestern Idaho, eastern Oregon and northern Nevada. This hospital began telemedicine to some extent in 2002.
- *St. Peter's Hospital*, Helena, MT – an independent community based sole provider, non-profit, licensed 99-bed facility. St. Peter's offers a continuum of care including services such as home health, hospital and extended services.
- *St. Vincent Healthcare*, Billings, MT – the network hub for the Partners in Health Telemedicine Network (PHTN). PHTN provides telemedicine consults to patients in rural communities without the added burden of travel and missed work and/or school. In 2001, there were over 18,000 emergency and trauma patients. On a typical day, the hospital helicopter makes two trips and two patients are transported by airplane.

Ongoing and varied training is essential for the success of this project:

- We will kickoff the project with a one-day Project Orientation at the IBC. Each partner hospital will send a physician, a nurse, and an IT support person. Participants will meet one another, become oriented to the facilities and personnel at the IBC, and begin learning about the equipment, clinical protocols, and processes for gathering project data.
- Next, the TABC Project Research Coordinator and IT Support person will visit each partner hospital for initial on-site protocol training of Emergency Room personnel. The one-day trip will also allow Salt Lake City-based personnel to understand more fully how each partner hospital is configured and what support personnel exist.
- The Project Director, Dr. Saffle, will visit each partner hospital for on-site protocol training of physicians. One of the main barriers identified by other hospitals to

telemedicine is physician acceptance. Dr. Saffle has received several awards for his effective teaching methods and we anticipate this doctor-to-doctor communication will be foundational for the project. The trip will also allow him to understand more fully how each partner hospital is configured and what support personnel exist.

- We will conduct a quarterly review of all patient cases with each site via teleconferencing. Images captured during the initial patient evaluation will be used in the discussions.
- Once a quarter all participants will meet via teleconferencing for a project review. This will provide opportunities to discuss ways to improve the quality of the processes and protocols. We will also discuss recommendations for additional support to the three sites.

Another form of support collaborating hospitals will receive is the technology. Each of the sites will receive equipment targeted for telemedicine of acute burn care. Refer to *Technical Approach*, page 7, in the Project Feasibility section and the schematic drawing of the equipment on page 12 of the appendices. The Utah Telehealth Network (UTN) is another partner on this project. They will provide IT technical training and support for the hospitals.

Typical scenario of how end users interact with the technology
Tommy Smith, a five-year old patient, arrives at the emergency room of St. Alphonsus in Boise, Idaho around 8 p.m. with burns to his head and upper body. His anxious parents who bring him in explain that their son pulled a pot of hot soup off the stove. Tommy has two of the most potentially dangerous burn injuries. First, the severe scalding to his head raises concern about airway trauma and the need for ventilation. Second, pulling the pot from the stove caused burn injuries that are circumferential to his hand and can potentially swell and affect circulation.

The emergency room personnel contact the doctor who calls the IBC; an IBC physician will be available 24/7. Personnel at St. Alphonsus wheel in the VSX 7000 and activate the teleconferencing equipment with the HIPAA-approved embedded AES encryption software that ensures secure communication via the internet. The doctor begins collecting and transmitting images of the burn injuries, alternating between the "room view" of the VSX 7000 and the close-ups from the AMD-2500 with a 1-50x zoom. The images are also recorded on a secure DVD recorder to allow for re-evaluation and follow up discussions during quarterly teleconferences; they will then be destroyed. Consistent, robust audio is relayed through the VSX 7000, so no phone is necessary.

Meanwhile the on-call IBC physician who is at home, sets up his laptop to securely receive the remote images using the internet and ViaVideo camera with teleconferencing software. Viewing the same images in real-time, the two physicians consult over the phone. Part of the call is additional telemedicine training and part of the call is additional burn training. These activities are not services normally delivered in a non-network environment. There is not a single point of contact at the site with whom IBC will communicate. Instead, there are a variety of hospital doctors and personnel at St. Alphonsus; it is likely that they will need assistance, especially after hours when no IT

support is available, using appropriate settings and getting familiar with the equipment. Constant and readily available assistance from IBC is essential to cultivate acceptance and use of this technology. The IBC physician will fill out detailed assessment forms for evaluation.

Based on established protocol, the physicians can more accurately triage the patient. The IBC physician will make recommendations. The decision to transport Tommy will be made by the physician at St. Alphonsus.

4. Evaluation

We will evaluate this project in several ways. We will conduct process evaluations, examining program efficiency issues – how many classes, how much training, who participated, what steps were followed, how much did it cost in terms of time and money, etc. We will also conduct outcome evaluations, examining program effectiveness – clinical impact, type of change made, etc. As can be seen on the Timeline for Goals and Objectives, appendices page 10, evaluation will be ongoing for the duration of the project to ensure timely feedback and opportunities for improving the performance and decision making within our project.

Key evaluation questions include:

- What are clinical outcomes of patients treated? What are the rates of over- and under-triage? How well were the protocols followed? We will track all patients treated in this system, and a report will be prepared on the outcomes, treatment, and costs of their care, for presentation at the annual meeting of the American Burn Association, and/or the American Telemedicine Association.
- How does using telemedicine for acute burn care compare with conventional healthcare methods? How sustainable is this project? How do patient referral patterns compare with previous patterns? How do morbidity rates compare? What costs have patients/families incurred in terms of transport, time, convenience, etc? The information we gather on patients evaluated by this system can be directly compared to the data we obtained during our retrospective review of burn transports cited previously, to demonstrate directly the cost-effectiveness of the telemedicine project.
- What have we learned that can improve burn care? We hope to obtain a great deal of additional information on the etiology, demographics, and circumstances of rural burn injuries, to enhance our understanding of these serious injuries, and direct further efforts in burn prevention and treatment.
- How satisfied are project participants? What recommendations do clinical personnel have regarding various educational outreach activities? What are their reactions to the telemedicine procedures and equipment? How satisfied are patients and families with their experience? This feedback will help us improve the program before it is propagated to other sites and regions.
- How has the equipment used in this project performed? How robust was it? Describe its ease of use. How does a less expensive camera, such as the Hitachi DVD, compare with the AMD-2500?

- A demonstration project will be performed to determine the accuracy of such remote imagery in assisting with assessment/diagnosis of burn extent and depth. On-call IBC burn surgeon will advise physicians at collaborating hospitals and will obtain video and still photographs of burn injuries. Later, the other IBC burn surgeon will view the images and provide assessment/diagnosis. The real-time and delayed assessment/diagnosis from the two surgeons will be compared.

Data collection methods will include surveys of all participants after Regional Conferences and on-site training visits, incident forms filled out by IBC physicians after each burn call, brief focus groups during quarterly teleconference project reviews, individual interviews of healthcare participants, and patient satisfaction surveys.

Except for the final evaluation report, these studies will be conducted by Burn Center staff. Ms. Linda Edelman, who is thoroughly experienced and well trained in the required methodology, will design the clinical evaluation and perform data analysis. Physicians will fill out detailed incident assessment forms for each burn call. Ms. Lou Theurer will coordinate collection of survey data, focus groups, and interviews. Dr. Rebecca Raybould, an independent evaluator and consultant, will be responsible for the final evaluation report. Her experience includes working as a Program Evaluator for a project funded by Howard Hughes Medical Institute in 2002 and attending several workshops at The Evaluator's Institute on NSF scholarships. Funds for evaluation are included in the salaries/ benefits of IBC staff and fees for Dr. Raybould.

In years 2 and 3 of this project, two people will attend national conferences (i.e., American Burn Association, or the American Telemedicine Association Conference) to present outcomes data. Attendees will include one person from IBC and one person from each of the three partner hospitals.

5. Project Feasibility

Technical Approach

Each of the hospitals collaborating on this project currently belongs to telemedicine networks in their regions. We are not proposing to deploy a new network; we will utilize the networks that exist. Our partnership with UTN provides the expertise necessary to implement the technology immediately. We anticipate that at the completion of the project, IT personnel at each site will have experience and confidence to provide whatever support is necessary to maintain the project technology. Sites may also choose to continue purchasing 24/7 maintenance for the VSX 7000.

We have selected equipment that is optimal for the locations, situations, and personnel associated with this project. A schematic drawing of the equipment is on page 12 of the appendices; a description of end-user interaction with the equipment is on page 5 of the proposal. Emergency rooms are limited in space; a conventional teleconferencing system is too large and immobile to be readily accepted and used by ER personnel. Instead, each site will receive a VSX 7000 teleconference system specially mounted on a pole with wheels to make it extremely compact and mobile. Also on the pole will be a high-resolution TV plasma screen monitor with progressive scan to eliminate "shaking"

images. There will also be a progressive scan DVD recorder to capture images for future review of patient data.

An AMD-2500 General Examination Camera will plug into the VSX 7000 allowing an alternative way to capture burn images. Unlike the pole-mounted VSX 7000, the AMD-2500 is hand-held and can be moved around the patient to capture images from different angles. Its 1-50x *optical* zoom and other features, e.g., the polarization button to eliminate unwanted reflection from the skin, are designed to make it specialize imaging equipment needed for special close-up examination of the skin. It has an auto-focus feature requiring only point-and-shoot to capture diagnostic images.

Comparisons with other cameras show that the high quality optical zoom lens adds substantially to the price of the AMD-2500; the extra clarity of burn images is warranted in this demonstration project. The zoom provides close-ups that enhance the ability to see from a distance. Most other cameras have an optical zoom of 10x with additional *digital* zoom capabilities. As the Telehealth Deployment Research Testbed (TDRT) website explains: "Optical zoom is like fitting a telescope to the camera or camcorder. It increases the focal length optically. It permits close-ups of the patient to be taken without moving the camera or camcorder closer. Optical zoom narrows the field of view but the resulting magnification is without any loss of image clarity. Digital zoom tries to achieve the same magnification, but by magnifying the pixels captured at one standard camera focal length. Digital zoom rapidly produces pixilation, and such magnification degrades the picture. In general, go for optical zoom and ignore the digital zoom value claimed by the manufacturer."

Applicant Qualifications

Jeffrey R. Saffle, MD, FACS (Principle-Investigator) is Professor of Surgery and Director of the IBC at the University of Utah Hospitals and Clinics and a nationally recognized leader in burn care. He has been an investigator on eight federally funded grants, and sits on nine editorial review boards. Saffle is the author of 8 book chapters and over 100 publications in peer-reviewed journals. Saffle has received many awards for his effective teaching methods. He is actively involved in outreach education for health care providers, including increasing awareness about the nature and severity of burn injuries.

Deb LaMarche, (Co-Investigator) is Program Manager for the Utah Telehealth Network (UTN). LaMarche oversees the day-to-day operation of the UTN and serves as business manager. In addition, she focuses on strategic planning and the development of new services and sites for UTN. LaMarche has been the project manager for six state and federally funded grants. She will be available to provide advice as needed and will attend the 2004 & 2005 Regional Conferences.

Linda S. Edelman, MPhil, RN, (Research Assistant) has over fifteen years of research experience in both basic science and clinical research. For the past seven years, she has been the research coordinator for the IBC, responsible for research design, implementation, and data analysis of a variety of studies involving burn patients

including power analysis, parametric and non-parametric descriptive tests, analysis of variance (ANOVA), and linear regression. In addition, she maintains the burn database that collects information on the demographics, etiology, hospital course, and outcome of every patient admitted to the IBC.

Lou L. Theurer, (Project Coordinator) has almost fifteen years of program coordination experience at the University of Utah Health Sciences Center including budgeting and communication. Her research skills will be utilized during program evaluation activities. Ms. Theurer's also has experience in educational outreach, including course design, teaching, and evaluation. She joined the American Telemedicine Association in 2003.

Project implementation and completion

We have planned all the steps necessary to set up the equipment and protocols, train participants, use telemedicine in "real time" acute situations, and conduct ongoing evaluations. Pages 10 and 11 of the appendices list specific, measurable objectives with timeframes for each goal along with a three-year timeline. We are confident that we can achieve the objectives and successfully complete the project as described.

Privacy and Security

Data shared between collaborating hospitals and IBC physicians will use HIPAA-approved software that creates a virtual private network (VPN) on the fly. The VSX 7000 has embedded encryption (AES) software that provides secure communications for video conferencing.

Sustainability

Several factors support the long-term sustainability of the project after the federal grant period.

1. The partnering hospitals appreciate that this project presents them with both an opportunity to provide enhanced patient care services, and to "market" their advanced technology to the community. This in turn enhances their prestige, and that of their community, and provides a valuable resource for their referral area.
2. Equipment will stay on-site after completion of the project. After using telemedicine for all burn cases during the project and seeing the benefits, sites will be able to justify the cost of equipment maintenance contracts.
3. We think it is likely that this project will increase the receptivity of these hospitals to using telemedicine for other types of traumas. As with acute burn care, access to other trauma healthcare via telemedicine allows these hospitals to treat patients and bill them rather than transporting patients and their associated reimbursements.
4. As stated in the executive summary, we intend to use this technological linkage as an opportunity to increase communication with our partner hospitals, to provide ongoing educational information in burn care, patient care conferences, lectures, etc. We hope to use these linkages to provide burn prevention education, particularly to the "at risk" groups represented by these hospitals – Native Americans, the elderly, children, and the poor. For example, the American Burn Association's Advanced Burn life

Support class has been delivered to some of these facilities, and can be done largely by telemedicine in the future.

5. Each of the collaborating sites is currently linked to different telemedicine networks in their areas. For example, there are nine healthcare facilities in the Eastern Montana Telemedicine Network. We hope this demonstration project will spark interest among the other network participants linked to the collaborating hospitals. Part of our evaluation process will include the publication of brief reports outlining cost-effectiveness and revenue capture of telemedicine for acute burn care. In addition, the Utah Telehealth Network (UTN) currently provides 20 sites throughout Utah with access to clinical healthcare services including education and information services. There is a strong probability that the partnership with UTN will expand upon successful demonstration of this project to include telemedicine for acute burn care at the 20 UTN sites.

Dissemination

We plan to share results of this project in a variety of ways. Initial results will be shared with participants during teleconferences. Annual reports will be distributed and discussed with administrators at participating sites. We anticipate they will be particularly interested in the brief reports outlining cost-effectiveness and revenue capture of telemedicine for acute burn care. As stated previously in the Evaluation section, a report will be prepared on the outcomes, treatment, and costs of patient care, for presentation at the annual meeting of the American Burn Association, and/or the American Telemedicine Association. If appropriate, program results may also be included on our web page and on the web pages of the collaborating hospitals.

[i] National Hospital Discharge Survey, 1995-1998 Data.

[ii] *National Hospital Ambulatory Medical Care Survey (1992-1995 Data).*

[iii] Baker SP, O'Neill B, Ginsburg MJ, Li G. *The Injury Fact Book*. 2nd ed. New York: Oxford University Press; 1992.

[iv] Pruitt B, Goodwin CW, Mason A. Epidemiological, demographic, and outcome characteristics of burn injury. In: Herndon DN, ed. *Total Burn Care*. 2nd ed. London: Harcourt Publishers; 2002.

[v] *10 Leading Causes of Nonfatal Injury, United States*: Office of Statistics and Programming, National Center for Injury Prevention and Control, Center for Disease Control; 2000.

[vi] *Residential Fire Injury Fact Sheet*: Connecticut Children's Medical Center.

[vii] The Prevention of Unintentional Injury Among American Indian and Alaska Native Children: A Subject Review (RE9908). *Pediatrics.* 2000;104(6):1397-1399.

[viii] Saffle, JR, Edelman, LS, Morris, SE. Regional air transport of burn patients: A case for telemedicine? J Trauma (in press).

[ix] Saffle, JR. What's new in General Surgery: Burns and Metabolism, J Amer Coll Surg, 196:267-289, 2003.