TIIAP FY 1999
Project Narrative

University of Vermont and
State Agricultural College

Grant # 50-60-99024
Health
Burlington, Vermont

Improving Rural Trauma Care, Education and Prevention through Telemedicine

Primary Application Area: **HEALTH**

Secondary Application Area: **PUBLIC SAFETY**

Executive Summary

Victims of trauma in rural regions like Vermont and Northeastern NY State die at higher rates because of discrepancies in access to care at specialized trauma centers. We will use a desktop-PC-based two-way interactive video telemedicine system to reduce disparities in clinical care and medical education by: (1) providing 24-hour access to trauma center specialty surgeons, at work and at their homes, (2) educating rural ambulance personnel and doctors, who have a low volume and limited access to educational opportunities, and (3) instituting trauma prevention projects (that have proved successful at the Trauma Center) in rural areas.

The goals of the project, beyond establishing the technology for everyday use for trauma care, include evaluating the impact of telemedicine interventions upon mortality for rural trauma, complications of trauma, transfer rates, and the costs of care, including telemedicine system costs. It is expected that the use of this system will reduce all of these parameters.

The project innovations include (1) the use of portable, inexpensive but high-quality desktop-PC-based videoconferencing systems, (2) use of systems in the surgeons' homes, (3) delivery of Level 1 Trauma Center care to the rural emergency rooms, and (4) multi-purpose use of systems for clinical care, physician and ambulance personnel education, and public education in trauma prevention.

The partners in this project include: the University of Vermont College of Medicine, Fletcher-Allen Health Care, the main teaching hospital of the College of Medicine and the Level 1 Trauma Center, Copley Hospital, Canton-Potsdam Hospital, Alice Hyde Hospital, and Massena Memorial Hospital.

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IMPROVING RURAL TRAUMA CARE, EDUCATION AND PREVENTION THROUGH TELEMEDICINE

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Project Definition

Although only one third of the population of the United States resides in rural areas, over one half (56.9%) of deaths due to motor vehicle accidents (MVA) occur in rural areas.[1] In fact, both adults *and* children die at nearly twice the rate of their urban counterparts from MVAs, homicides, falls, and suicides. Yet, trauma centers, which offer the highest levels of care and lower mortality rates for trauma victims, are concentrated in urban areas. Fletcher Allen Health Care (FAHC) is the only Level 1 trauma center serving Vermont and Northeastern New York (Appendix 1).[*] Victims of trauma in our region cannot take advantage of the specialties and skills of the staff at the trauma center until transfer is accomplished. Emergency Departments (ED) in this area are staffed by providers (MDs or PAs) who are not specially trained in the care of the multi-trauma patient, particularly the injured child. Long transport times to the trauma center, particularly in winter, can delay significant and life-saving care. [3] A comprehensive review of rural trauma from our institution [3] highlighted additional problems in rural trauma care: volunteer emergency medical technicians (EMT) who do not receive advanced education and training, lack of continuing medical education (CME) for rural providers who experience a low volume of trauma, problems with unnecessary transfers, and a lack of projects to prevent rural trauma.

This project will address many of these access problems for rural patients and providers by: (1) providing 24-hour access to "tele-trauma" consults from adult and pediatric trauma surgeons, as well as vascular surgeons, at the Level 1 Trauma Center via interactive video workstations in the Trauma Center and the surgeons' homes, (2) providing education for rural ambulance personnel as well as physician CME by the use of interactive video conferencing, and (3) institute trauma prevention projects for rural participants utilizing the video system for public educational sessions. The key personnel on this project have worked together previously and are all qualified to implement and conduct this project (Appendix 2).

This project will involve partnerships between the University of Vermont (UVM) College of Medicine and FAHC, in Burlington, VT, Copley Hospital (CH) in Morrisville, VT, Canton-Potsdam Hospital (CPH) in Canton, NY, Alice Hyde Hospital (AHH) in Malone, NY and Massena Memorial Hospital (MMH) in Massena, NY (map, Appendix 1).

At FAHC, the basic structure exists to provide trauma care and education utilizing a state-of-the-art interactive video telemedicine system (Appendix 3). [4] Adult and pediatric trauma surgeons as well as specialists in vascular surgery will be immediately available for video assistance and consultation to the rural hospital site when major traumas arrive in their ED. [†] In this way, patients will have the benefit of the experience and expertise that comes with the trauma center as well as the application of standardized trauma protocols from the moment they enter a

[*] FAHC, the major teaching hospital at UVM, is the only *rural* Level 1 pediatric *and* adult trauma center in the US.
[†] Only selected urban trauma centers have in-hospital trauma surgeons 24 hours per day. This is not the case in rural trauma centers nationally. Thus, it is necessary to connect to the surgeons' homes to provide immediate, 24-hour access.

hospital. It is this time factor that is most critical since the care delivered immediately after trauma (the so-called "golden hour") [5] is the most significant factor relating to survival. In some circumstances though, less critically injured patients will be evaluated and will safely stay in their local hospital, obviating transfers altogether.

Outcomes from trauma may be quantified with standard approaches. [6] Each patient entering a trauma center is assigned an ISS score that quantifies the level of injury. Each patient entered into this project will be similarly assigned an ISS score. This allows the comparison of outcomes in comparably injured patients. [6] A few prior studies of telemedicine use in trauma have documented that its use can reduce adverse events, [7] improve transportation times, [7] and help keep more patients in their local hospitals. [8] In this project, the impact of the telemedicine system will be assessed primarily by clinical outcomes including length of stay (LOS), mortality, post-injury complications, transfer time, and hospital costs. Provider and patient attitudes towards the system and usability will serve as secondary analysis measures.

Training of rural pre-hospital providers is also a problem. Volunteers not only have to take personal time to train, but also often have to pay for the training themselves because of lack of community funding. Requirements for training for pre-hospital providers vary between states but most require at least 100-110 hours of training for Basic EMT, an additional 80-100 hours for Intermediate EMT, and between 500 and 1800 hours for Paramedic Training. [7] This represents a substantial time commitment for training and service, as well as a significant cost. Since populations and personnel are sparsely distributed, educational programs are often centralized, necessitating significant travel distances that require participants to be unavailable for extended periods. Additionally, the exposure to trauma victims for rural volunteer ambulance personnel remains low. In this project, the telemedicine system will be used to correct deficiencies in education of rural ambulance personnel as well as providers by offering interactive educational conferences, including review of resuscitation tapes (routinely created in the FAHC Trauma Center for *every* trauma). Teleconferencing will increase accessibility of the rural provider to educational programs so that training will be provided in their home area, decreasing costs and alleviating travel time and time out of service for their communities.

Motor vehicle accidents are the most common cause of rural death (29.5deaths/100,000 population) while falls are the second most common cause of death from injury in a rural population (6.71deaths/100,000 population). [3] Suicides, industrial/farm accidents, and recreational accidents are also leading causes of death and injury in a rural population. [3] Yet, public education about safety issues can impact most of these areas (e.g., seat belt use). At FAHC, we started an aggressive countywide outreach program on fall prevention that included 30-minute presentations, TV and radio public announcements, bulk mailings and visits to nursing homes. Hospital admissions for falls in the elderly were tracked before and after institution of prevention interventions. After institution of the fall prevention program there was an overall 33% decrease in hospital admissions ($p=.15$) with a 50% decrease in mortality ($p=.24$). This TIIAP project would convert the fall prevention program for use over the telemedicine system (for public awareness presentations) in addition to local media announcements, web pages, and mailings on the topic. In addition, similar educational programs would be developed in other areas of public safety mentioned above, depending on the need of the individual communities.

Evaluation

The following five domains will be evaluated: (1) Clinical Outcomes, (2) Technical Acceptability, (3) Health Systems Interface, (4) Costs and Benefits, and (5) Patient/Provider Acceptability.

Clinical outcomes will be assessed by evaluating the usefulness of immediate connection to the trauma surgeons with transmission of video images of the patient's care, injuries, and test results during treatment of trauma victims by: 1) correlating the ISS score [6] and outcomes (survival, complications, length of stay) in trauma patients managed with telemedicine to those patients managed without telemedicine (by using historical data and data from the start-up period), and 2) assessing both referring and consulting physicians perceptions of the usefulness of telemedicine management through survey questionnaires and in-person observations and interviews. The time of day of the consult, length of time in the rural ER, transport time, and total time to definitive care will all be recorded and analyzed. Current transfer data (Appendix 4) from the partner institutions indicate that sufficient volume will be accrued for a meaningful analysis.

Outcomes for prevention projects would be tracked in a similar fashion as the FAHC fall prevention project described above. Admission and mortality rates for the problem studied as well as individual's attitudes after participation as secondary measures will be evaluated.

(1) *Technical Acceptability* will be assessed generally by consulting trauma surgeons and rural emergency providers. Additional assessments of patient data obtained from observational technologies, such as document cameras, close-up cameras, and otoscopes/ophthalmoscopes will be done. The reliability of the telecommunications will be closely monitored.

(2) The *health systems interface* will be evaluated by examining provider workflow with telemedicine, the applicability of standard trauma protocols to telemedicine trauma care, and the learning curve for mastery of the telemedicine system. In addition, the adequacy of training with this medium for rural providers will be assessed by surveys.

(3) Costs and Benefits of tele-trauma care will be examined in detail, including direct and indirect costs for hardware and start-up costs (e.g., wiring), transaction costs, and general system costs vs. prorated specialty costs for use by trauma services. Additionally, the impact upon admissions and transfers, the number of diagnostic tests and therapeutic interventions (per diagnosis and ISS score) with telemedicine vs. without will be examined.

(4) *Provider Acceptability* will be evaluated by assessing their anxiety with the technology, confidence in the diagnosis and value of telemedicine assistance, perceptions of the efficiency of telemedicine, and perceptions of the usability of telemedicine. Both educational and clinical participants will be surveyed.

Evaluation will include historical information from the FAHC Trauma Registry, which includes demographic, injury, and outcomes data on all trauma admissions. Data will be collected during the start-up phase of this project and after implementation. During the first six months of the project, the evaluation team will develop and initiate appropriate sampling schemes, quantitative and qualitative data collection procedures and a range of comparative and correlational analytical schemes, in conjunction with the investigators at FAHC and each outreach site. To date, there are no peer-reviewed publications addressing these outcomes in trauma care.

In particular, data will be collected through the following methods: (1) *Evaluation software* (Appendix 5) has been developed and utilized by FAHC which records answers to evaluation

questions (while the call is connecting and again at completion) as well as time of day, length of call, etc., (2) *Questionnaires* will be developed for in-depth assessments of providers' attitudes, perceptions of the technology, and behaviors of themselves and others who interact with those systems, (3*) Interviews and observations* with providers and ambulance personnel will be conducted by the evaluators. These will also be used to develop qualitative case studies that will compliment the results of quantitative measures. (4) *The FAHC Trauma Registry* will be examined to assess historical utilization and transfer information at FAHC from outreach sites.

Data analysis will proceed by examining the data descriptively to detect any unusual values or other data anomalies. Outcomes for patients seen via telemedicine will first be compared to outcomes in the controls using chi square tests, t tests, or Wilcoxon rank sum tests, depending on the type of variable. Multivariable models will then be used to control for ISS score and other potential confounding differences between patients managed with and without telemedicine. To examine survival, for example, a logistic regression model will be constructed with survival status as the dependent variable, telemedicine status as the primary independent variable of interest, and covariates such as ISS score, age, gender, type of trauma, etc. Such models allow examination of possible interactions between variables, such as if telemedicine is only beneficial for patients with certain levels of injury severity.

Stephen Doheny-Farina, PhD, will serve as the principal project evaluator (Appendix 2). He is presently the Project Evaluator for another telemedicine project at FAHC in which he designs data collection instruments and analyzes data for both clinical and educational applications of telemedicine at FAHC. He has designed and conducted quantitative and qualitative studies of educational enterprises, with particular emphasis on studies in networked communication environments. In addition, he has conducted lengthy evaluative case studies in health care and computer software industries.

Peter Callas, PhD, will serve as the primary biostatistician on this project (Appendix 2) under the direction of the Project Director and Dr. Doheny-Farina. He has designed numerous telemedicine evaluations and conducted analyses at FAHC, which have resulted in national presentations and peer-reviewed publications (Appendix 6).

Significance

Unfortunately, trauma centers have not routinely applied advanced telemedicine technologies to reduce disparities in care. By providing immediate access to rural adult and pediatric Trauma Center surgeons, 24 hours a day, rural physicians and victims will have unique access to highly skilled and experienced specialists in trauma care. To our knowledge, no system exists that takes the rural provider into the trauma surgeons' home. In addition, advanced telecommunications will allow us to address discrepancies in education for rural ambulance staff, rural health care providers, and public education. The trauma care and education proposed in this application will provide a *comprehensive solution* for the problems of rural trauma and its consequences.

This *dedication to trauma* is the prominent aspect of this proposal. While trauma centers provide these clinical and educational services, it is typically restricted to their immediate service region. This technology applied on a widespread basis will allow trauma centers to extend the care and training they do now to many more communities, ultimately reducing rates of injury, death from injury, and health care costs.

From a technical standpoint, this project is a model program because of the (1) desktop-PC-based system on a roll-about cart, and (2) the use of ISDN as the transmission modality. The

PC-based systems used at FAHC are inexpensive, easy to install and support, reliable, physically unobtrusive in clinical spaces, and portable (Appendix 3). [4] Portability allows multiple uses, adding to its cost-effectiveness, [4] unlike the room-based systems used by most telemedicine programs. The open architecture of our system and the widespread availability of ISDN transmission will allow this to be a model program for other rural areas. Dedicated, high-speed networks (T1, ATM) are expensive and not available everywhere. Satellites are expensive, have significant technical support needs, and also require a line-of-sight to the satellite (which may not exist in mountainous areas) making them impractical for widespread use. Cellular technology is reasonably inexpensive but topography like that in our region makes the service unreliable. Because ISDN is basically a "phone line", service can be extended anywhere there is phone service (in our region, 98% of health care sites can be reached with ISDN).

Project Feasibility

Videoconferencing technology is desktop PC-based (Appendix 3). [4] Transmission is via 3 digital ISDN lines (384 kbps). ISDN-based video conferencing allows users flexibility to call anywhere, at anytime, without the need of special hardware devices to call "outside the network". Each hospital ED and the trauma surgeons' homes will be wired and equipped with telemedicine systems. Other on-campus sites which can be utilized are numerous, including the FAHC ED, operating rooms, and a specially equipped "telemedicine room". In this way, none of the FAHC Trauma Center's surgeons will be more than minutes away from a system *at any time*. In addition, FAHC uses "bridging" hardware capable of handling six simultaneous calls which will be used for educational sessions and public prevention campaigns.

Vermont was among the first states to explore methods of providing health care at a distance. The system now provides a tool for daily consults around the region. In addition, FAHC provides teleconsults to Argentina and is in the midst of a telemedicine project with Vietnam. The FAHC approach to telemedicine has earned the system recognition as one of the United States' top ten telemedicine programs by *Telemedicine and Telehealth Networks* Magazine two years in a row and, this year, has been placed in their "Hall of Fame". Numerous presentations and publications have originated from FAHC's telemedicine program (Appendix 6).

Because events occurring in ED with multi-system trauma are often sudden and dramatic, effective use of telemedicine will need to be effortless so that the provider is not drawn away from patient care. Protocols set up at FAHC and operational for the last 5 years allow for a single phone call to be made with subsequent initiation of the video call from the trauma surgeon to the local ED. An example of how the system works and its utility, drawn from our experience, [4] is a case in which a 6-month old child was brought to a remote ED in full arrest. The hospital's single pediatrician was called to the ED and a phone call placed to FAHC. Within minutes, the pediatric intensivist from FAHC was in the remote ED by placing a video call to the rural hospital. That specialist was able to converse with the pediatrician and participate in therapeutic decision making based upon the on-site provider's descriptions of physical findings, transmission of test results, and images of the patient. The pediatrician in the ED, at all times, maintained contact with the patient, never having to leave the room or even hold a telephone with one hand. When the transport team arrived from FAHC, the specialist was able to have an informed discussion about the patient's problem and requirements for transport with those individuals. Continuity of care was enhanced by participation in the resuscitation from the

earliest phases. Unfortunately, both at FAHC and other telemedicine programs, use of the system in this fashion for trauma has not been widespread.

The example above is the model we will use for this project, with the assistance of pre-established protocols (e.g., when to call for tele-trauma care). Existing FAHC criteria for trauma alerts (e.g. GCS ≤ 12 , Hypotension, Respiratory compromise, Amputation above the wrist or ankle, Penetrating injury) will be modified with input from the rural providers. When a trauma patient arrives in the rural ED meeting those criteria, a phone call will be placed to the trauma surgeon who will then place a video call to the hospital ED. Care will be rendered by the rural physicians with observation and consultation by the trauma surgeon.

The budget and narrative describe the costs associated with the project in detail. In brief, TIIAP funds will help support personnel to develop and implement this project and equipment. FAHC will contribute matching funds in the form of personnel, equipment, and telecommunications charges. The supplemental funds from TIIAP will allow the implementation of this project, which as indicated by Mr. Montgomery and Dr. Shackford (letters, Appendix 9), will be expanded to other hospitals in our region. As indicated, several aspects of this model project can be transported to any rural locale. The budget is sufficient to complete the project.

Administratively, the Project Director will be responsible for all aspects of the project while the Project Medical Director will be responsible for developing the trauma protocols as well as educational and prevention programs. They will head an "Executive Committee" consisting of site coordinators, ED Directors, and participants from nursing, ambulance crews, and community representatives. This group will meet together in person at the start and mid-point of the project. The telemedicine system will be used to conduct monthly meetings of this committee or selected portions of it, to determine educational and community needs on an ongoing basis. In this way, content development for educational sessions and prevention projects, under the direction of the Project Medical Director, will be based on the needs of the rural hospitals and communities.

Implementation of the project will proceed with a "start-up period" (Appendix 7). During that time, installation of ISDN lines and equipment as well as training will take place. Prospective data regarding transfers and outcomes will be collected. The clinical consults to the four surgeons' homes will begin first, as soon as protocols are in place and surgeons are connected and trained. The weekly trauma review will begin shortly after that with additional conferences to be developed and scheduled during the second six months. The prevention projects will be planned and one will be implemented by the end of Year 1, two more by the end of Year 2.

The strategy for FAHC since 1995 has been to develop an integrated delivery system that would blend the education and research goals of the College of Medicine with the patient care goals of the tertiary care center. By 2005, it is projected that most of the care in this region will be financed under capitation. FAHC will be organized to take the capitation risk on large populations across the region. Facing full risk capitation contracts, telemedicine was positioned as an important new strategy offering efficiencies in care. In fact, our existing telemedicine network has demonstrated cost savings in a variety of specialty areas (Appendix 5). VTMEDNET was a the first statewide effort to connect every provider in Vermont to e-mail and text-based web browsing. This network has been in place and functional for 4 years and a regional expansion is planned that will connect every doctor's office and hospitals in this region (625 sites) with a connection supporting multimedia e-mail and telemedicine capabilities. We are currently engaged in designing and developing this large intranet with regional implementation

beginning in 2000. At that time, each local hospital will become a community hub for individual providers' offices while FAHC will remain a tertiary care hub for the network.

Community Involvement

This project developed from the need for trauma support expressed by rural hospitals and ambulance organizations in meetings with the Dr. Rogers and Dr. Ricci. This project will include the UVM College of Medicine and FAHC, the Level 1 Trauma Center, Copley Hospital, Canton-Potsdam Hospital, Alice Hyde Hospital, and Massena Memorial Hospital (Appendix 1). Each of these entities have shown their commitment to this project as expressed in their letters of support (Appendix 9). Each partner will also contribute to the dissemination and prevention plans by utilizing their existing Public Relations and Wellness groups. In addition, each of the ambulance organizations serving the region will participate (Appendix 9).

Each site currently has a site coordinator who serves as the primary end-user support. This involves setting up equipment, placing calls, and occasionally assisting with patient care. The telemedicine system will reside in the ED primarily. If needed in a different site, the site coordinator is responsible for moving and setting up equipment, as well as returning it to the ED. Though each ED physician will be trained in operation of the system, the scenario described above will not require the treating physician to operate the system. Hardware and software support will be provided by FAHC (Ben Weber, technical support).

Privacy and confidentiality are key issues for electronic medical care. FAHC has existing policies in place that address these issues during teleconsults and tele-conferences. These will be particularly emphasized during this project, particularly during tele-trauma care. In short, existing standards for confidentiality exist for all providers, nurses, and students caring for patients, whether in-person or over telemedicine. Only those individuals who have a direct interest in the consult or conference will be allowed in the rooms. The FAHC network is secure.

Reducing Disparities

Vermont, 49th in the US in population, has the largest percentage of its population (68%) living in rural areas. In NY, the 1990 census lists the population of St. Lawrence County (which MMH and CPH serve) at 111,974 and Franklin County (which AHH serves) at 46,540. The region served by this proposal is clearly rural.

Travel distance from the partner hospitals to the Trauma Center is as much as 160 miles. The Green Mountains, Adirondack Mountains, and Lake Champlain are natural barriers. In addition, severe weather much of the year can also delay transport efforts. Roads can be difficult to travel, especially in the winter months (1 of the 2 major roads into Morrisville is closed with the first snowfall each November). None of the hospitals has direct highway access to Burlington. Though helicopter transport might be perceived as a way to improve transportation, in fact added time to assemble a volunteer squad (in NY State) or to fly from out of State (VT has no instate helicopter service) can negate faster flight times. In addition, weather conditions in our region can prohibit transport by air up to 30% of the time.

At the FAHC Trauma Center, as many as 40-60% of both adult and pediatric patients treated are transferred in from outlying facilities.[10,11] (Appendix 4.) Although it would seem intuitive that patients transferred from rural settings are those that are most critically ill, this is not always the case. The most frequent reason for these transfers is the lack of personnel or resources at the local facility (e.g., surgeon, ICU, blood bank, or specialty care). [12] Patients transferred to a rural

trauma center were very similar to those admitted directly in a study from our institution. [11] Additionally, time to definitive care remains high for rural trauma patients. Rogers *et al* [11] found that on average patients spent an average of three hours in local emergency rooms prior to transfer to the trauma center. Patients also spent an additional hour or more in transport from one facility to another. At least one study has suggested that telemedicine can reduce these times. [7]

While we cannot eliminate the need for transport in all instances, immediate access to trauma surgeons via telemedicine will eliminate delays in access to those skills. Working together with the local physicians, FAHC trauma surgeons will *help* to determine the need for transfer, ensure that standardized trauma protocols are enacted, supplement the knowledge base or rural providers, and stabilize the patient. In turn, the trauma surgeon will have continuity of care, having participated in the resuscitation from the start. Martin *et al* [14] examined care of patients transferred from rural environments and found departure from standards of care in 96% of patients. Life threatening or major departures from these standards were observed in 80%. Yet, when rural hospitals meet the stringent criteria of American College of Surgeons Committee on Trauma, survival improves. [13] While the partner hospitals in this project could not meet that criteria because of a variety of logistical, physical, and personnel issues, it is our belief that this project will improve survival by bringing the trauma center to the patient through telemedicine. The same barriers to trauma care also exist for ambulance personnel and physicians who need access to education and this will be overcome through telemedicine.

For public education, it is unlikely that rural inhabitants would travel to Burlington to participate. The FAHC telemedicine system was utilized for public service projects on lymphedema and stroke, requiring participants to travel to their local hospital. In all, 259 individuals participated in a stroke education project at 5 different sites and 130 people took part in a lymphedema project at 6 locations. Based on this experience, we believe the use of the telemedicine system to promote trauma prevention will be well accepted and utilized by the communities.

Documentation and Dissemination

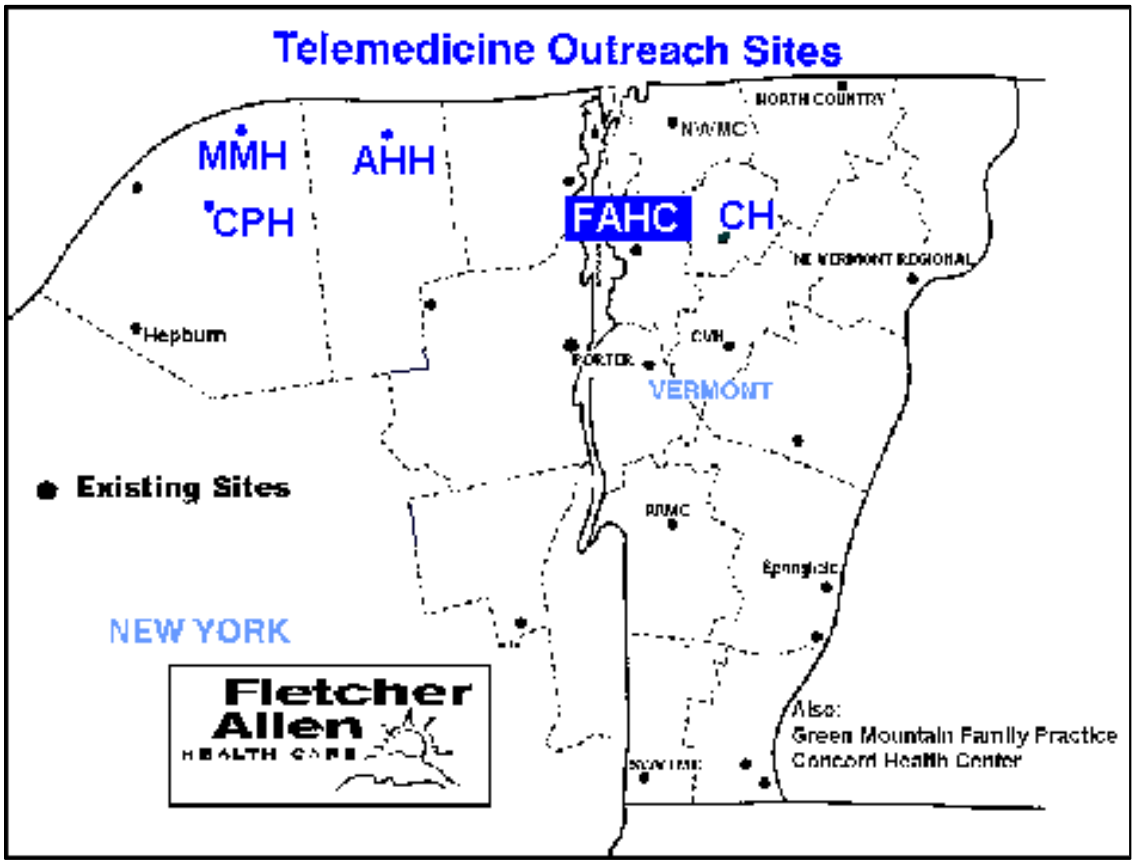
Dissemination includes communications with (1) participants in the project, (2) providers at network sites, and (2) national audiences. Routine communication with site coordinators will be done over the telemedicine system and via e-mail. The FAHC Telemedicine Program produces a monthly newsletter that is sent to all providers at network sites and maintains a World Wide Web site. Both of these will devote sections to the activities of this project. Information about the project will be presented at medical staff meetings and in public relations publications by all the partners. Likewise, partners will issue press releases to local and regional news organizations to disseminate information to patients. The FAHC telemedicine program has produced a unique hands-on educational program called “How to Build a Telemedicine Program” on an annual basis for 4 years. This program will also be used to familiarize course participants with the results of this project and the potential for application in their area. It is also expected that this project will result in scientific presentations and peer-reviewed publications suitable for both telemedicine, surgery, and trauma organizations. It is anticipated that, as a minimum, presentations would occur at the American Telemedicine Association meeting and the Eastern Association for the Surgery of Trauma meeting. The project organizers have a successful track record (Appendix 2, Appendix 6).

References Cited in this Document

Appendix 7

Appendix

Appendix 1 – Site Map and Community Information



FAHC = Fletcher Allen Health Care, Adult/Pediatric Level 1 Trauma Center, Burlington, VT

CH = Copley Hospital (43 beds), Morrisville, VT
Distance to Burlington, 50 mi.
Lamoille County, VT – population 19,735

CPH = Canton-Potsdam Hospital (94 beds), Canton, NY
Distance to Burlington, 157 mi.
St. Lawrence County, NY – population 111,974

AHH = Alice Hyde Hospital (78 beds), Malone, NY
Distance to Burlington, 111 mi.
Franklin County, NY – population 46,540

MMH = Massena Memorial Hospital (78 beds), Massena, NY
Distance to Burlington, 158 mi.
St. Lawrence County, NY – population 111,974

Appendix 2 – Personnel and Abbreviated Curriculum Vitae

Michael A. Ricci, MD ***Project Director***

EDUCATION:

1974-78	BA	Hamilton College	Majors: Chemistry, English
1978-82	MD	State University of New York Upstate Medical Center	

TRAINING:

1982-83	Internship	General Surgery	St. Joseph's Hospital (Syracuse, NY)
1983-87	Residency	General Surgery	Guthrie Clinic (Sayre, PA)
1987-1989	Fellowship	Vascular Surgery	McGill University (Montréal, PQ)

CURRENT ACADEMIC APPOINTMENTS:

1992-present	Graduate Faculty, University of Vermont
1996-present	Associate Professor of Surgery, UVM College of Medicine

HOSPITAL APPOINTMENTS:

1989-present	Fletcher-Allen Health Care
1994-present	Alice Hyde Hospital (Consultant)
1997-present	Boston VA Medical Center (Consultant)

SELECTED PUBLICATIONS:

(Total, 86 peer-reviewed publications, 24 abstracts, 4 book chapters,14 posters)

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81. Bergerson LJ, Kiernan MS, McFarlane G, Case TD, **Ricci MA**: Prevalence of aortic aneurysms in patients undergoing coronary artery bypass: Preliminary results of a screening program. *Ann Vasc Surg* 12:101-105, 1998.
82. Pilcher DB, **Ricci MA**: Vascular ultrasound. *Surg Clin No Amer* 78:273-293, 1998.
83. Strindberg G, Nichols P, **Ricci MA**, *et al*: Experimental Modifications to a canine infrarenal aortic aneurysm model for the validation of endovascular stent-grafts: An exploratory study. *J Invest Surg* (accepted), 1998.
84. Dixon D, **Ricci MA**, Reid JG, *et al*: Is impedance plethysmography a safe test after total joint replacement? *Vasc Surg* 32:255-61, 1998.
85. Winstead-Fry P, McGowan JJ, Rimmer JM, Sussman M, **Ricci M**: Evaluation of a Telemedicine Supported Rural Dialysis Clinic: Quality of Care, Acceptance, Return on Investment, Quality of Life *J Am Med Informatics Assc* (accepted).
86. **Ricci MA**, Knight SJ, Nutter B, **Callas PW**: Desktop telemedicine in vascular surgery: Some preliminary findings. *Telemed J* 4:279-285, 1999.

Frederick B. Rogers, MD *Project Medical Director*

EDUCATION:

1972-76	BA	Williams College	Majors: Chemistry
1977-81	MD	University of Vermont	
1983-85	MS (Surgery)	University of Illinois at Chicago	

TRAINING:

1981-83, 1885-88	Residency	General Surgery	University of Illinois at Chicago
1983-1985	Fellowship	Trauma	Cook County Hospital

CURRENT ACADEMIC APPOINTMENTS:

1990-present	Director of Trauma, Fletcher Allen Health Care / University of Vermont
1996-present	Associate Professor of Surgery, UVM College of Medicine
1999-present	Chief, Division of Trauma, Burns, and Critical Care, FAHC

HOSPITAL APPOINTMENTS:

1990-present	Fletcher-Allen Health Care
1994-present	Alice Hyde Hospital (Consultant)
1997-present	Boston VA Medical Center (Consultant)

COMMITTEES:

1990-present	Vermont Committee on Trauma
1990-present	Editorial Consultant for The Journal of Trauma
1992-present	Vermont Trauma System Development Committee Definitive Care Task Force, Chairman
1996-present	Eastern Association for the Surgery of Trauma (EAST) Practice Management Guidelines for Trauma
1997-present	EAST Multi-institutional Trials Committee

SELECTED PUBLICATIONS:

(Total, 56 peer-reviewed publications, 15 abstracts, 5 book chapters)

34. **Rogers FB**, Simmons R, Hoyt DB, Shackford SR: In-House Board Certified Surgeons Improve Survival in Severely Injured Patients: A Comparison of Two University Centers. *J Trauma* 34:871-877,1993.
35. **Rogers FB**, Shackford SR, Wilson J, **Ricci M**, *et al*: Prophylactic Vena Cava Filter Insertion In Severely-Injured Trauma Patients: Indications and Preliminary Results. *J Trauma* 5:637-642,1993.
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37. Camp PC, **Rogers FB**, Shackford , *et al*: Dismal Outcome from Blunt Thoracic Aortic Laceration (TAL) in Elderly Patients: A Study of Two Rural Trauma Centers. *J Trauma* 36:151, 1994.
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39. Wilson JT, **Rogers FB**, Wald SL, Shackford SR, **Ricci MA**: Prophylactic Vena Cava Filter Insertion in Patients with Traumatic Spinal Cord Injury: Preliminary Results. *Neurosurgery* 35:234-239, 1994.

40. Camp PC, **Rogers FB**, Shackford SR, *et al*: Blunt Traumatic Thoracic Aortic Laceration in Elderly: An Analysis of Outcome. *J Trauma* 37:418-425, 1994.
41. Sartorelli KH, Pilcher DB, **Rogers, FB**: Patterns of Splenic Injuries in Skiers: The Mogul Injury. *Injury* 26:43-46, 1995.
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43. **Rogers FB**, Shackford SR, Keller MS: Early Fixation Reduces Morbidity and Mortality in Elderly Patients with Hip Fractures From Low Impact Falls. *J Trauma* 39:261-265, 1995.
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45. Archer L, **Rogers FB**, Shackford SR: Selective Non-operative Management of Liver and Spleen Injuries in Adult Patients with Neurological Impairment. *Arch Surg* 131:309-315, 1996.
46. **Rogers FB**, Osler TM, Shackford SR, *et al*: In Hospital Trauma Deaths in Mature Urban vs. Rural Trauma System: A Comparison *Arch Surg* 1997;132:376-382
47. **Rogers FB**, Osler TM, Shackford SR, *et al*: Financial Outcome of Treating Trauma in a Rural Environment. *J Trauma* 1997;43:65-73
48. **Rogers FB**, Shackford SR, **Ricci MA**, *et al*: Prophylactic Vena Cava Filter Insertion in Select High Risk Orthopaedic Trauma Patients. *J Orthop Trauma* 1997;11:267-272.
49. **Rogers FB**, Reese J, Shackford SR, Osler TM: The Use of Veno-Venous Bypass and Total Vascular Isolation of the Liver in the Surgical Management of Juxtahepatic Venous Injuries in Blunt Hepatic Trauma. *J Trauma* 1997;43:530-533.
50. Sugerman HJ, Wolfe L, Pasquale MD, **Rogers FB**, *et al*: Multi-Center Randomized Prospective Trial of Early Tracheostomy. *J Trauma* 1997;43:741-747.
51. Shackford SR, Bourguignon P, Wald S, **Rogers FB**,*et al*: Hypertonic Saline Resuscitation of Patients with Head Injury: A Prospective, Randomized Clinical Trial. *J Trauma* 1998;44:50-58.
52. **Rogers FB**, Strindberg G, Shackford SR, *et al*: Five Year Follow-up of Prophylactic Vena Cava Filters in High Risk Trauma Patient: Complications and Results. *Arch Surg* 1998;133:406-412.
53. Possidente CJ, **Rogers FB**, Osler TM, Smith TA: Elevated amylase and lipase values after extended administration of propofol: Case report. *Pharmacotherapy* 1998;18:653-655.
54. Pasquale M, Fabian TC, and the EAST Ad Hoc Committee on Practice Management Guideline Development: Practice management guidelines for trauma from the Eastern Association for the Surgery of Trauma. *J Trauma* 1998;44:941-57
55. Barie PS, Fabian TC, Pasquale M, **Rogers FB**: The development of diagnostic and therapeutic practice management guidelines for trauma patients. *Contemp Surg* 1998;52:413-430.
56. Osler TM, Shinozaki T, Glance L, **Rogers FB**, *et al*: Predicting Survival, Length of Stay and Cost in the Surgical Intensive Care Unit: APACHE II vs. ICISS *J Trauma* 1998;45:234-238.

Stephen Doheny-Farina, PhD Project Evaluator

EDUCATION:

1976	BS	Indiana University of Pennsylvania	Communication Education
1981	MA	University of Maine	English
1984	PhD	Rensselaer Polytechnic Institute	Communications and Rhetoric

CURRENT ACADEMIC APPOINTMENTS:

1997-present Professor, Technical Communications, Clarkson University
Courses taught: TC210 Introduction to Rhetoric, TC217 Public Speaking, TC 310 Mass Media and Society, TC313 Professional Writing, TC410 Theory and Philosophy of Communication, TC427 Video Production.

HONORS:

Best Article Reporting Formal Research, 1987 (National Council for Teachers of English) NCTE Awards for Excellence in Scientific and Technical Communication; for "Writing in an Emerging Organization: An Ethnographic Study," in *Written Communication.*

Best Collection of Essays, 1988 NCTE Awards for Excellence in Scientific and Technical Communication; for "Legal and Ethical Aspects in Technical Communication: A Special Issue," in *IEEE Transactions on Professional Communication.*

Best Collection of Essays, 1989 NCTE Awards for Excellence in Scientific and Technical Communication; for *Effective Documentation: What We Have Learned from Research*, MIT Press, 1988.

John W. Graham, Jr., Faculty Research Award, Clarkson University, 1992. Given "for outstanding research accomplishments by a young faculty member and promise of future achievements."

SELECTED PUBLICATIONS:

Books:

Effective Documentation: What We Have Learned From Research. S. Doheny-Farina, ed., Cambridge, MA: MIT Press, 1988.

Rhetoric, Innovation, Technology: Case Studies of Technical Communication in Technology Transfers. Cambridge, MA: MIT Press, 1992.

The Wired Neighborhood. New Haven: Yale University Press, 1996.

Guest Edited Journal Issues:

"Networked Virtual Realities (MOOs, MUDs, and MUSHs, etc) and Communication." *Electronic Journal of Communication*, Volume 5, Number 4, November 1995. Available at http://cios.llc.rpi.edu/www/ejc/v5n495.html

Book Chapters:

"Ethnographic Research on Writing: Assumptions and Methodology," co-written with Lee Odell, *Writing in Nonacademic Settings*, Lee Odell and Dixie Goswami, eds., New York: Guilford Press, 1985, pp. 503-535.

"Studying Usability in the Field: Qualitative Research Techniques for Technical Communicators," Co-written with Emilie Gould, *Effective Documentation: What We Have Learned From Research*, S. Doheny-Farina, ed., MIT Press, Cambridge, MA, 1988, pp. 329-343.

"Research as Rhetoric: Issues in Research on Writing in Nonacademic Settings." *Research on Writing in Nonacademic Settings*, R. Spilka, ed., Southern Illinois Univ. Press, 1993, 253-267.

Journal Articles:

"Writing in an Emerging Organization: An Ethnographic Study," *Written Communication*, v.3, n.2, April 1986, pp. 158-185.

"Directions and Issues in Technical Communication Research," *Technical Communication*, 3rd Quarter, August 1989, pp. 188-194. Co-written with J.D. Beard and D.Z. Williams.

"A Case Study of the Role of Instructional Texts in the Transfer of Technology," *Technical Communication*, v. 38, n. 3, 1991, 403-407.

"Rhetoric, Community, Cyberspace," co-written with James P. Zappen, and Laura J. Gurak. *Rhetoric Review*, forthcoming, Spring 1997.

Michael P. Caputo, Jr., MS is the project o**perations coordinator**. He is also the Director of Telemedicine Operations for FAHC. Mr. Caputo has extensive experience in the design, implementation, operation, and evaluation of regional and international telemedicine systems. Prior to this, he was the Project Executive of the C. Everett Koop Institute and a Project Scientist at NASA's Johnson Space Center. During his service to NASA, he developed hardware and protocols for telemedicine operations during U.S. Space Shuttle missions. He is the Treasurer and a Member of the Board of Directors of the *American Telemedicine Association*, and an editorial advisor for *Telehealth* magazine and *Telemedlaw*. Mr. Caputo's work has earned him numerous awards including NASA Certificates of Recognition and a Leadership Award from the NASA Administrator. He received his BS degree from the Rochester Institute of Technology and his MS degree from the University of Houston.

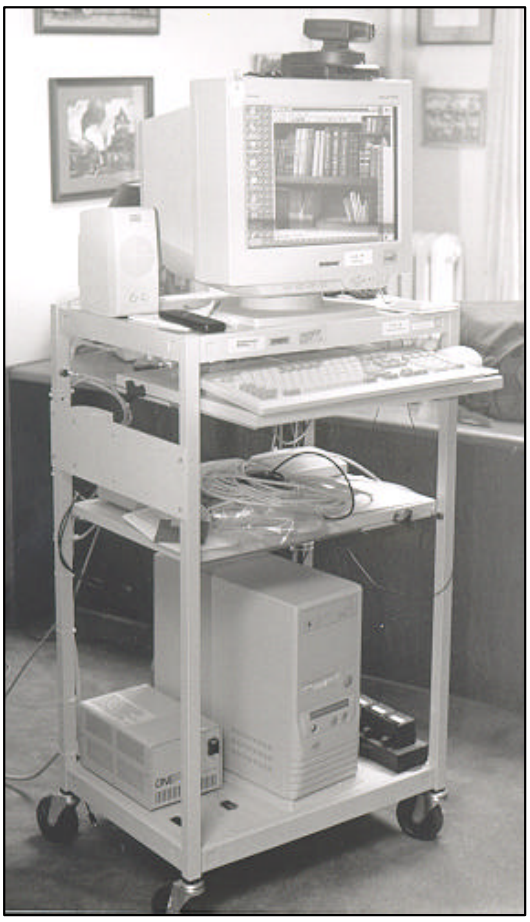
Peter W. Callas, PhD, will serve as the **primary biostatistician** on this project. He studied diagnostic accuracy and provider acceptance of the FAHC telepathology network, and developed a system for tracking telemedicine use and obtaining user feedback when the program was expanded to other clinical applications in 1996. He has also studied the use of telemedicine to increase availability of continuing medical education for health care providers in rural areas of Vermont and upstate New York. Dr. Callas has presented these findings in peer-reviewed publications and at national meetings. Dr. Callas received his BA from California State University, Fullerton and his PhD from the University of Massachusetts.

Judith Amour, MA is the g**rant administrator** for this project and for FAHC Information Services at FAHC. She is currently responsible for project coordination and fund management of a $1.8 million federally funded grant. She handles the billing processes for employees, contractors and subcontractors as well as equipment, travel, and other expenses. Prior to joining FAHC, Ms. Amour supervised research projects for hospitals, public schools, child psychiatric clinics, and residential adult psychiatric facilities.

Ben Weber will provide the **technical support** for this project and has been working with the FAHC Telemedicine program since March 1998. Besides technical support, Mr. Weber has also been responsible for educating users on the use of this technology and has developed a training manual for this purpose.

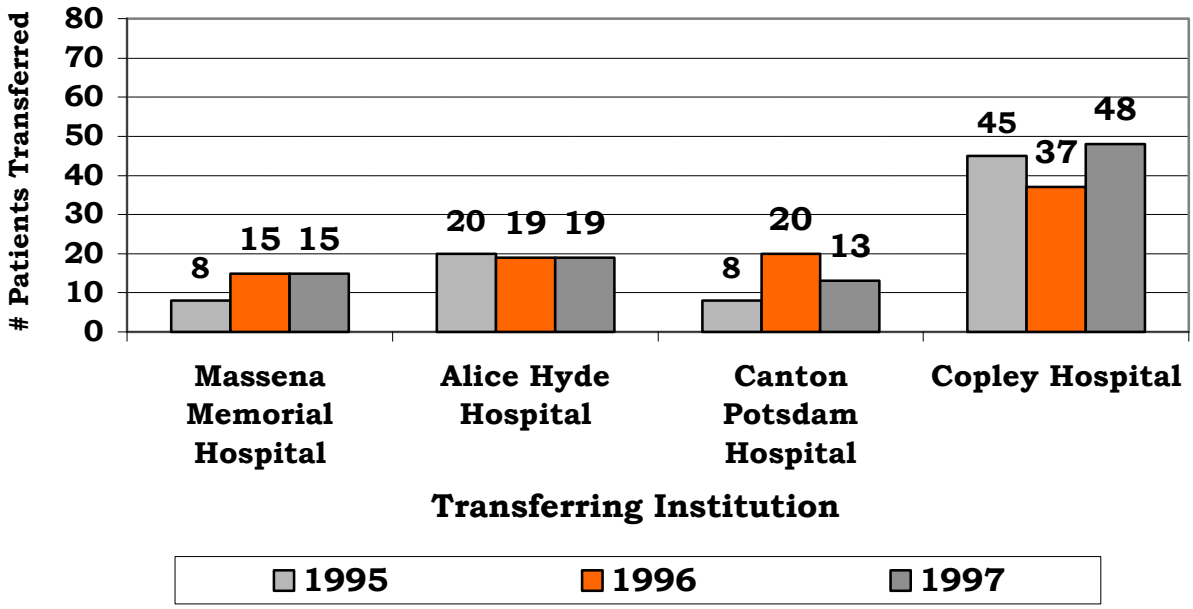
Appendix 3 – Desktop Telemedicine System Description

Pentium PC and 17" Monitor	- $3,100
Zydacron Z350 video conferencing card	- $1,496
Zydacron Z206 multiplexor card	- $1,120
Cannon VC-C3 Video Camera	- $1,500
Motorola NT-1 (X3)	- $ 465
Oneac Power Conditioner	- $ 385
Speakers	- $ 50
Shure Microphone	- $ 260
Miscellaneous Cables and Connectors	- $ 152
Privacy Phone	- $ 34
Custom Cart	- $ 456
TOTAL	**- $9,018**



Appendix 4 – Transfer Data from Partner Hospitals to FAHC

FAHC TRAUMA REGISTRY
Trauma Patients Transferred to FAHC
For the Calendar Years 1995, 1996, 1997

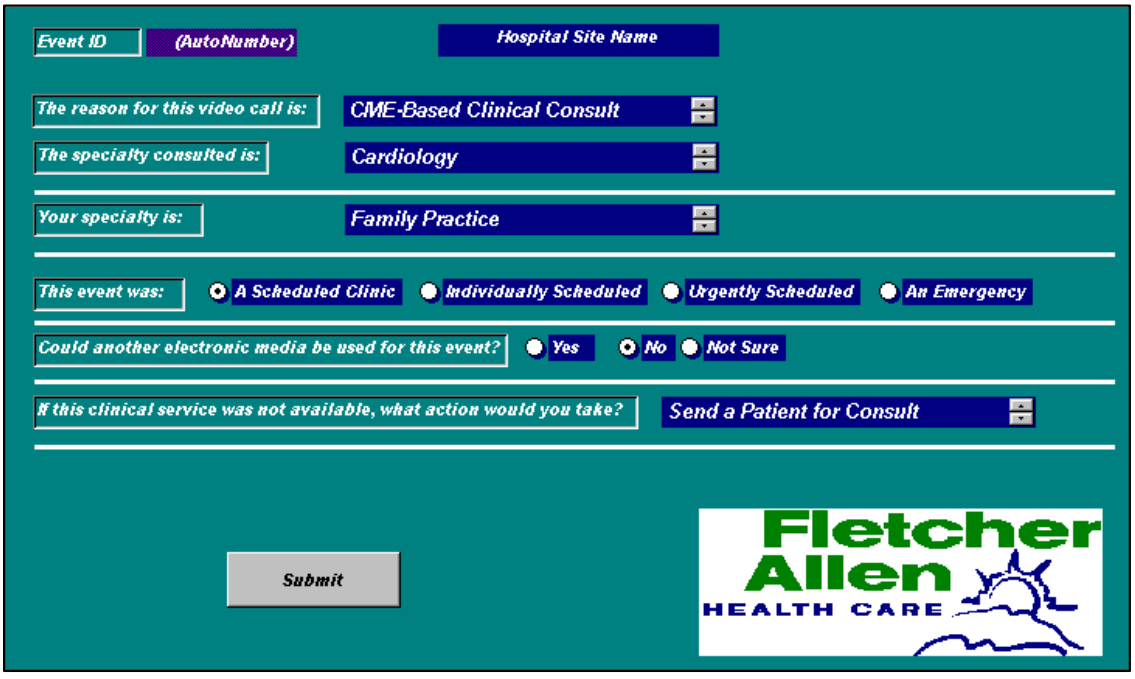


Appendix 5 – Evaluation Software

In order to capture information for video calls using the Zydacron hardware/software, the Zydacron Development Kit (ZDK) was purchased, which allows program modifications to the Zydacron software. Using the ZDK, the Zydacron software has been modified to require users to enter information in customized forms prior to placing a call (see sample form below) and after completing a call.

The calling PC (near end) executes the ConnectCall code, which has been modified to call an FAHC specific routine. This routine sets focus to the first FAHC specific form and generates a PC specific event id. This form determines the reason for the call. If the reason for the call is Clinical Consultation, additional questions are displayed to determine whether the clinician is the referring or consulting clinician. Next, login evaluation questions display which are specific to the referring or consulting clinician. Once the questions have been answered, the call will finish connecting. A similar set of events will occur on the called PC (far end) when the Zydacron_CCIncommingCall routine executes.

When the call is disconnected, the Zydacron_CCDisconnectionComplete code has been modified to call an FAHC specific routine. This routine sets focus to the logout evaluation form, specific to the referring or consulting clinician. The data collected from the initial forms and the logout form is then written to the PC's local hard drive. The Zydacron_ZVCMsg routine has been modified to trap FAHC specific data. This data is used to build a consistent header record on both PCs. The data is collected in a file corresponding to each month of the year on each PC. For each header record, a record is written corresponding to each question on each form. This information will be downloaded monthly and collected into a single database for analysis.



Appendix 6 – Fletcher Allen Telemedicine Bibliography

JOURNAL ARTICLES:

1. **Callas PW**, McGowan JJ, Leslie KO*, et al: Pr*ovider Attitudes Toward a Rural Telepathology Program, *Telemed J*, 2: 319, 1996
2. **Ricci MA**, Moses PL, **Callas PW**, Daum W W, Eary RE: Tele-endoscopy demonstrates potential for remote diagnosis. *Telemed Telehealth Networks* 3:15, 1997.
3. **Ricci MA**: Telemedicine in Vermont: The telemedicine project at Fletcher Allen Health Care. *1997 Proceedings of IEEE Dual Use Conference* May, 1997.
4. **Callas PW**, Leslie KO, Mattia AR, *et al*: Diagnostic Accuracy of a Rural Live Video Telepathology System, *Am. J Surg Path*, 21:812, 1997
5. Moses PL, McGowan JJ, **Ricci MA**: Efficacy of tele-endoscopy in a rural capitated market. *J Am Med Informatics Assc* 398, 1997.
6. Reid JG, McGowan JJ, **Ricci MA**, McFarlane G: Desktop teleradiology in support of rural orthopedic trauma care. *J Am Med Informatics Assc* 403, 1997
7. Winstead-Fry P, McGowan JJ, Rimmer JM, Sussman M, **Ricci M**: Evaluation of a Telemedicine Supported Rural Dialysis Clinic: Quality of Care, Acceptance, Return on Investment, Quality of Life *J Am Med Informatics Assc* (accepted).
8. **Ricci MA**,Knight SJ, Nutter B, **Callas PW**: Desktop telemedicine in vascular surgery: Some preliminary findings. *Telemed J* 4:279-285, 1999.

ABSTRACTS:

1. McGowan J, **Callas P**: Evaluation of a telepathology program: The consultants' perspective. 1996. American Medical Informatics Association: Final Program and Abstract Book, 1996 Spring Congress, 1996.
2. **Ricci MA**, **Callas PW**: The Vermont Telemedicine Project: The First Six Months. *Telemed J* 3: 94,1997.
3. **Ricci MA**, **Callas P**, Montgomery W: The Vermont Project: initial implementation phase. *Telemed J* 3: 197-205,1997.
1. **Ricci MA**, McKnight JM, Montgomery W: Telemedicine for Surgeons. *Telemed J* 3:108,1997.
2. Moses PL, Cataldo PA, Vecchio JA, Ferrentino N, Spaulding L, Hyman N, Hebert J,
3. McGowan J, **Callas P**, **Ricci M**: Validation of tele-endoscopy as a diagnostic tool. *Gastroenterology* 112:A30, 1997.
4. Parrish S: The use of telehealth to provide nurse to nurse instruction, 1997.
5. **Ricci MA**, **Callas PW**, Knight S: Desktop telemedicine in vascular surgery. *Telemed J* 4:86, 1998.
6. Moses PL, Vecchio J, **Callas P**, **Ricci MA**: Long distance real-time tele-endoscopy. *Telemed J* 4:84, 1998.

POSTERS:

1. "Telemedicine for Surgeons*",* 2nd Annual meeting of the *American Telemedicine Association*, Atlanta, GA, April 3-6, 1997.
2. "Validation of Tele-endoscopy as a Diagnostic Tool", *American Gastroenterological Association*, April, 1997.
3. "Continuing Medical Education via Telemedicine in Vermont and New York", *American Telemedicine Association*, Orlando, FL, April 5-8, 1998.

Appendix 7 – Timeline/Project Plan

Appendix 8 – References Cited

1. Rural Emergency Medical Services: Special Report US. Washington, DC: Congressional Office of Technology Assessment; 1989. Publication OTA-H-445.
2. Norwood S, Myers MB: Outcomes following injury in a predominantly rural-population-based trauma center. *Arch Surg* 129:800-805, 1994.
3. Rogers FB, Shackford SR, Osler TM, *et al*: Rural Trauma: The Challenge for the Next Decade.
4. Ricci MA, Callas PW, Montgomery WL: The Vermont telemedicine project: Initial implementation phases. *Telemed J* 3:197-205, 1997.
5. Mueller BA, Rivara FP, Bergman AB: Urban-rural location and the risk of dying in a pedestrian-vehicle collision. *J Trauma* 28:91-95, 1988.
6. Baker SP, O'Neill B, Haddon W Jr, Long WB: The Injury Severity Score: a method for describing patients with multiple injuries and evaluating emergency care. *J Trauma* 14:187-96, 1974.
7. Messick WJ, Rutledge R, Meyer AA: The association of advanced life support training and decreased per capita trauma death rates: an analysis of 12,417 trauma deaths. *J Trauma* 33:850-855, 1992.
8. Goh KYC, Tsang KY, Poon WS: Does teleradiology improve inter-hospital management of head injury? *Can J Neurol* 24:235-239, 1997.
9. Lambrecht CJ: Telemedicine in trauma; Description of 100 trauma teleconsults. *Telemed J* 3:265-268, 1997.
10. Vane DW, Shackford SR: Epidemiology of rural traumatic death in children: a population-based study. *J Trauma* 38:867-870, 1995.
11. Rogers FB, Osler TM, Shackford SR, *et al*: A study of the rural trauma transferred patient: Is Darwinism recreated? Presented at the Annual Meeting of the New England Surgical Society; September, 1997; Lake George, New York.
12. Cone JB: Tertiary trauma center in a rural state. *Am J Surg* 160:652-654, 1990.
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Appendix 9 – Letters of Support / Commitment