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PRINCIPAL INVESTIGATOR: Jay B. Roberts

CONTRACTING ORGANIZATION: Saint Francis University, Loretto, PA 15940

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**13. SUPPLEMENTARY NOTES**

**14.** Saint Francis University's Center of Excellence for Rural and Medically Under-Served Areas (CERMUSA) dedicates its resources to identify and address difficulties facing the rural communities in the regions of western Pennsylvania. CERMUSA researches off-the-shelf technologies and finds unique ways to incorporate them to deliver telemedicine and distance education to those in need. In 2009, an American Institute of Biological Scientists (AIBS) review panel evaluated CERMUSA's research portfolio. Since then, CERMUSA has incorporated key recommendations, such as employing a biostatistician to assist researchers to plan, collect, and analyze data and its presentation. A research advisory committee and the exploration of establishing a regional telemedicine network with regional partners into the research process to help the researchers maintain high research standards and make CERMUSA a valuable and relevant asset for its sponsors has also been incorporated. In 2008, CERMUSA conducted research studies in Medical Simulation, Autism and Percussion Therapy, and Quality of Life & Assistive Technologies for the returning wounded soldiers and elderly to enhance their living experience, among other projects. In the future, CERMUSA will continue to use the "best research practices" in newly-undertaken studies such as PTSD/TBI, the importance of physical activity for cancer survivors, and remote woundcare management using handheld wireless devices.

**15. SUBJECT TERMS**
Telemedicine, Telehealth, Distance Learning, Distance Education, Autism, Medical Simulation, Quality of Life, Wellness, Wellness Promotion, Veterans, Traumatic Brain Injury, Neurocognitive, Cancer Survivor, Wireless Technology, Information Technology

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# FY08 Research Summary

This report encapsulates and highlights the major accomplishments of Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA) during the period May 5, 2009 to July 31, 2010. The research results presented here are in line with CERMUSA's tradition of identifying and addressing the difficulties facing the communities residing in western Pennsylvania in accessing quality healthcare and education. This applied research helps CERMUSA to re-assess its strategy and procedures, thereby directing its efforts to guide future studies.

This past year, CERMUSA conducted studies related to PTSD/TBI, Autism, Medical Simulation, Quality of Life, and Distance Learning. Although in few instances minor challenges such as contract approvals or timely completion of administrative paperwork delayed the timeline, CERMUSA staff was able to carry out and complete most of the studies. Despite these difficulties, CERMUSA staff has maintained its efficiency and efficacy in identifying potential problems with plausible solutions. Three departments, namely Telehealth, Distance Learning, and Information Technology, work hand-in-hand to design and execute the research.

General wellness, maintenance of the quality of life, and promotion of health-related knowledge are the common elements of CERMUSA's research projects, which use commercial off-the-shelf technologies in all of its studies. The purpose of CERMUSA's project work is to identify novel delivery mechanisms and reach out to the medically underserved populations of our region. Pennsylvania is home to one of the largest contingents of returning warriors in the country, making it an ideal test bed for new approaches and methodologies to serve these individuals and their dependents. In addition, Pennsylvanians suffer disproportionately from illnesses such as diabetes and chronic wounds, conditions that are further exacerbated by the lack of access to acute and specialty care. In June 2009, the review panel of the American Institute of Biological Sciences visited and evaluated CERMUSA's research. This panel praised some of the studies for their ambitious and worthy goals and recommended continued execution of other projects. This panel also recognized CERMUSA's role in providing solutions for rural settings and made a series of recommendations to improve the relevance and robustness of this research. CERMUSA has incorporated these recommendations in its operations and procedures related to research.

Cancer is a global health problem. There are reportedly over 10 million cancer survivors in the United States alone, and the population of long-term cancer survivors continues to grow. The difficult nature of cancer treatment can often lead to a poor quality of life for patients and their families. Physical activity (PA) has shown to be an important health behavior in almost any population, with documented benefits for cancer survivors. In some cancer survivors, exercise programs have appeared to reduce the risk of cancer recurrence and extend their expectancy. As such, a number of reports promote and recommend physical activity for cancer survivors. CERMUSA has initiated a two-phase study to determine the benefits of physical activity among rural cancer survivors and ways to deliver PA regimen and promote compliance. This study is intended to include all cancer survivors regardless of prognosis. During the precursory phase of this study, CERMUSA scientists have established working relationships and are working to complete the required paperwork, such as protocol designs and IRB applications.

The purpose of the Telehealth Test Bed-Neurocognitive and Neurophysical Studies protocol is to determine what tools and approaches could best be used to assess brain and concussive injuries immediately after incidents. Beginning with assessment of Saint Francis University students and athletes, this project could eventually have a significant impact on the way the readiness of soliders to return to the combat zone is determined. Although several tests are available to determine the ability of an athlete to get back onto the playing field minutes after a concussion takes place, there is no co-relational data among these assessments. CERMUSA and SFU faculty members are attempting to establish a benchmark that will yield a portable and reliable test that can be applied to an athlete and determine if he or she is ready to return to play immediately following a potential concussion. Timely assessment and evaluation of concussions in the field could potentially circumvent more serious morbidities and disabilities for the individual in the future. If proven successful, a similar test can be developed for the battlefield.

Last year's Quality of Life study progressed well with an establishment of a "utility index" that could be used to identify assistive technologies which may be used to make homes more accessible for persons with disabilities. The incorporation of high index utility items can help a person with disabilities or an older individual to retain independence, self-reliance and self-respect while remaining in close contact with their friends and the family. The results of this study will be extended into living quarters. CERMUSA hopes that these findings will lead to a portable box that could potentially transform any home into a "smart house" to enable a person to remain in touch with family and care providers while remaining independent. This project could have positive implications in the way returning warriors live self-reliant lives while maintaining the privacy they need and deserve.

Educating individuals located in rural areas is embodied by several studies which allow the subject matter experts (SMEs) that are located in urban areas or distant sites to provide much-needed medical education to the target population: emergency responders, patients and healthcare providers. The economic conditions, distance travelled to reach or access the education centers, and time required to get there are the major reasons for embracing these methods of education. The Telehealth Test Bed-Autism Studies protocol provided remote training for occupational therapists to deliver percussion-based music therapy and the to gauge the effects of such therapy on their clients. The Telehealth Test Bed-Wellness Studies project evaluated ways to deliver up-to-date and relevant information to the patients or families visiting the medical centers. The educational modules conveyed the importance of exercise, physical activity and good nutrition. Similarly, the Continuing Distance Education for Health Sciences protocol examined the facilitation of effective medical education for healthcare practitioners through the use of distance education technologies that result in improved knowledge and increased safety adherence according to cognitive and affective assessments conducted in the study. Finally, the Medical Simulation at Distance (MSAD) protocol extended the reach of SMEs located at an urban simulation center, enabling these individuals to control remote manikins and to supervise and critique medics in the performance of advanced life-saving techniques. This project also provided participants with a hands-on opportunity to maintain their skills and certifications, and gain experience in procedures that are used only on rare occasions. For all of these studies, CERMUSA's information technology division served as the technological conduit for content delivery.

Two other project areas, the Technology Test Bed and Wireless Test Bed, are CERMUSA's in-house proving grounds where devices and equipment are tested for their usefulness before they are used to carry out their function in appropriate studies. These "laboratories" also test the wireless networking and communications devices to make sure they function in remote areas where cell phone coverage may not be optimum. These two projects play important roles in all other studies and make sure that the CERMUSA's research does not fail because of "mechanical malfunction." During the past year, CERMUSA's Technology Test Bed has evaluated a variety of handheld and mobile devices and applications, such as Google Droid and iPhone hardware and software, for use in quality of life and assistive technology capacities. The groundwork laid by this project work will likely serve as the basis for CERMUSA's upcoming Wound Care At a Distance (WCAD) protocol.

As always, our research projects are relevant at several levels, most importantly because of their ability to understand and overcome the difficulties faced by the rural population. The information and the knowledge these studies generate allows CERMUSA to design paradigms that could be incorporated in the standard protocols followed to deliver care. For example, the Telehealth Test Bed-Quality of Life study helps older and compromised populations to remain independent and self-reliant. The Telehealth Test Bed-Autism Studies project has helped occupational therapists to connect with patients with Autism to find ways of improving attention and positive behavior. Similarly, Telehealth Test Bed-Wellness study brought about behavioral changes and educated patients in adapting to a healthier lifestyle. Our distance learning projects have helped individuals, such as healthcare providers, to maintain their competency (certification) and remain current with the advances in the medical knowledge without leaving their work environment. All of our studies help the military population as well. These results are equally applicable to the veteran population and their families, many of whom are filling the roles of caregivers to the wounded warriors while residing far away from modern conveniences such as quality education and expert healthcare.

In conclusion, CERMUSA uses all of its facilities to identify ways to deliver healthcare without compromising quality. It collaborates with the subject matter experts in telehealth and distance learning urban education centers to bring their expertise to the rural population. In short, CERMUSA is a rural entity which consistently demonstrates that technologies can improve the quality of life, and thus offer hope that rural populations will lead a normal and independent life.

## CERMUSA FY08 STAFFING LIST

| STAFF MEMBER | ROLE |
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| Kristine M. Anderson | Distributed Learning Course Management Specialist |
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| Robert E. Griffin | Assistant Director for Distance Learning |
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| Jennifer Irvin | Programmer/Systems Analyst |
| Jean A. Kline | Administrative Assistant (DL) |
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| Dana M. Friedman (Termination date 1/16/2010) | Technology Coordinator |
| Jenny LeMoine (Termination date 6/30/2010) | Part time – Telehealth Subject Matter Expert |

# Saint Francis University
## CERMUSA FY08 Publications and Presentations
## May 2009 to June 2010
(listed most recent first)

**Rural Health Publications (7)**

Center of Excellence for Remote and Medically Under-Served Areas. (June 2010). *CERMUSA Newsletter*. Loretto, PA: CERMUSA

Center of Excellence for Remote and Medically Under-Served Areas. (March 2010). *CERMUSA Newsletter*. Loretto, PA: CERMUSA

Anderson, K. (2010) Teaching and Assessment In Multi-User Virtual Environments. *Critically Engaging the Digital Learner in Visual Worlds and Virtual Environments (Selected Readings of the International Visual Literacy Association.* pp 51-54.

Griffin, R. (2010) The Healthcare Presentation: PowerPoint And Word Visuals Combine For A Deadly Combination. *Critically Engaging the Digital Learner in Visual Worlds and Virtual Environments (Selected Readings of the International Visual Literacy Association.* pp 115-122.

*The following publications (5/2009 to 12/2009) are cross-listed with the CERMUSA FY07 Annual Report, due to the FY07 no-cost extension, submitted 12/31/2009:

Center of Excellence for Remote and Medically Under-Served Areas. (December 2009). *CERMUSA Newsletter*. Loretto, PA: CERMUSA

Center of Excellence for Remote and Medically Under-Served Areas. (September 2009). *CERMUSA Newsletter*. Loretto, PA: CERMUSA

Center of Excellence for Remote and Medically Under-Served Areas. (June 2009). *CERMUSA Newsletter*. Loretto, PA: CERMUSA

**Rural Health Presentations (43)**

Shanafelt, M. (June 2010). *Web-Based Case Study Development for Mobile Platforms.* ASCUE 2010 Conference, Myrtle Beach, SC: CERMUSA.

Cassisi, A. (June 2010). *Robotics Camp (Advanced).* Summer 2010 Kids' College, Loretto, PA: CERMUSA.

Cassisi, A. (June 2010). *Robotics Camp (Basic).* Summer 2010 Kids' College, Loretto, PA:

Gerraughty, J. (June 2010). *Digital Media Production.* Summer 2010 Kids' College, Loretto, PA: CERMUSA.

McIlhenny, C., & Muncert, E., (June 2010). *Assistive Technology.* SFU Occupational Therapy Students, Loretto, PA: CERMUSA.

Roberts, J. (June 2010). *CERMUSA: Past, Present, and Future.* Showcase for Commerce, Johnstown, PA: CERMUSA.

Muncert, E. (May 2010). *Training Percussion Therapy Technology to Occupational Therapists via Technology Gateways.* Academy for Multidisciplinary Neurotraumatology 8th International Congress, Stowe, VT: CERMUSA.

Guzic, B. (May 2010). *Medical Simulation at a Distance for Advanced Pre-Hospital Airway Management Training.* ATA 2010: 15th Annual International Meeting & Exposition, San Antonio, TX: CERMUSA.

Shanafelt, M. (April 2010). *Web-Based Case Study Development for Mobile Platforms.* Association of Information Technology Professionals, Loretto, PA: CERMUSA.

Guzic, B., Cronin, G. & Knee, D. (April 2010). *Medical Simulation at a Distance.* Bishop Carroll High School's Husky Day, Loretto, PA: CERMUSA.

Grosik, L. (February 2010) *Dissecting At a Distance,* Pennsylvania Educational Technology Expo and Conference, Hershey, PA: CERMUSA

*The following presentations (5/2009 to 12/2009) are cross-listed with the CERMUSA FY07 Annual Report, due to the FY07 no-cost extension, submitted 12/31/2009:

McIlhenny, C. (November 2009). *Assistive Technology for OT Students.* SFU Occupational Therapy Students, Loretto, PA: CERMUSA.

Guzic, B. & Tonkin, K. (November 2009). *Autism and Drumming Research.* SFU Science Day, Loretto, PA: CERMUSA.

Mainhart, R. & Bender. T. (November 2009). *Assisting Coal Mine Rescue from the Skies Above.* SFU Science Day, Loretto, PA: CERMUSA.

Miller, J. & Wolfe, D. (November 2009). *Robotics: Using Electromechanical Engineering to Solve Big Problems.* SFU Science Day, Loretto, PA: CERMUSA.

Mainhart, R. & Bender, T. (November 2009). *Mobile Communications Platform Overview.* PA CareerLink Careers in Demand Showcase, Johnstown, PA: CERMUSA.

National Telerehabilitation Service System (NTSS). (November 2009). *CERMUSA Hosting Annual Assistive Technology Exposition*. Johnstown, PA: CERMUSA/NTSS

Miller, J. (October 2009). *Digital Architectureal Modeling for Your Community.* SFU Technology Day, Loretto, PA: CERMUSA.

Guzic, B. & Tonkin, K. (October 2009). *Autism and Drumming Research.* SFU Technology Day, Loretto, PA: CERMUSA.

Mainhart, R. & Bender, T. (October 2009). *Mobile Communications Platform Overview.* 2009 Bud Shuster Run for Your Life Race, Bedford, PA: CERMUSA.

Anderson, K. (October 2009). *Teaching and Assessment in Multi-User Virtual Environments.* International Visual Literacy Association Conference, Chicago, IL: CERMUSA.

Griffin, R. (October 2009). *The Healthcare Presentation: PowerPoint and Word Visuals Combine for a Deadly Combination.* International Visual Literacy Association Conference, Chicago, IL: CERMUSA.

Tonkin, K. (October 2009). *How to Use Technology to Help Patients in Rural Areas.* SFU Day of Reflection, Loretto, PA: CERMUSA.

Mainhart, R. & Bender, T. (October 2009). *Mobile Communications Platform Overview.* Mining Technology Training Center, Prosperity, PA: CERMUSA.

Roberts, J., Tonkin, K., Bickford, S., Griffin, R., & Shanafelt, M. (September 2009). *Second Life & H1N1 Virus Case Study Demonstration.* National Center for Disaster Medicine and Public Health Conference, Washington, DC: CERMUSA.

*Rural Telehealth and Advanced Technologies Conference.* (September 2009). *CERMUSA Hosting - Chronic Care: Model, Solutions, and Technology Applications*. Loretto, PA: CERMUSA

Roberts, J. (September 2009). *CERMUSA Overview.* Rural Telehealth and Advanced Technologies Preconference Workshop, Loretto, PA: CERMUSA.

Anderson, K. (September 2009). *Continuing Distance Education for Health Sciences.* Rural Telehealth and Advanced Technologies Preconference Workshop, Loretto, PA: CERMUSA.

Guzic, B. (September 2009). *Medical Simulation at a Distance.* Rural Telehealth and Advanced Technologies Preconference Workshop, Loretto, PA: CERMUSA.

Tonkin, K. (September 2009). *Rural Health Technology Applications.* Rural Telehealth and Advanced Technologies Conference, Loretto, PA: CERMUSA.

Taylor, J. & Mainhart, R. (August 2009). *Mobile Adaptable Telecommunications RF/IT Infrastructure.* ARMTech Showcase, Kittanning, PA: CERMUSA.

Anderson, K. & Friedman, D. (August 2009). *Wimba Live Classroom.* SFU Community Development Week, Loretto, PA: CERMUSA.

Guzic, B. & Knee, D. (August 2009). *Patient Simulator Demo.* SFU Community Development Week, Loretto, PA: CERMUSA.

Knee, D. & Wendekier, C. (August 2009). *The Internet: A Viable Option for Patient Education Resources.* AADE 2009: American Association of Diabetic Educators Annual Meeting, Atlanta, GA: CERMUSA.

Guzic, B., Knee, D., Bickford., & McIlhenny, C. (July 2009). *Basics of Telehealth and Technology.* Area Health Education Center *(*AHEC), Loretto, PA: CERMUSA.

Miller, J. (June 2009). *Robotics Camp, Session I.* Summer 2009 Kids' College, Loretto, PA: CERMUSA.

Miller, J. (June 2009). *Robotic Camp, Session II.* Summer 2009 Kids' College, Loretto, PA: CERMUSA.

Tonkin, K., Wolfe, D. & Roberts, J. (June 2009). *Radio Over IP Communications/Mesh Networking and MAP Networking.* OASIS - TATRC Advanced Medical Technology Expo, Fort Detrich, MD: CERMUSA.

Roberts, J., Zitnay, G. & Demuth, B. (May 2009). *CERMUSA/DVBIC Presentation & Teleconference with Wounded Warrior.* Showcase for Commerce, Johnstown, PA: CERMUSA.

Tonkin, K., Griffin, R. (May 2009). *CERMUSA Technology Transfer-RF to IP Bridge System and Pharmcon Projects.* Showcase for Commerce, Johnstown, PA: CERMUSA.

Anderson, K., Griffin, R., & Wilson, T. (May 2009). *Wimba – Virtual Classroom Software.* Community Development Week, SFU, Loretto, PA: CERMUSA.

Demuth, B., Tonkin, K., Wendekier, C., Muncert, E., Guzic, B., Knee, D., Bickford., & Bender, T. (May 2009). *Telehealth Tools to Improve Learning: Practicum. Basics of Telehealth: Applications in Nursing Education* University of Pittsburgh School of Nursing Conference, Pittsburgh, PA: CERMUSA.

Griffin, R. (May 2009). *I Have All These Wonderul Teaching Tools…Now What Do I Do? Basics of Telehealth: Applications in Nursing Education* University of Pittsburgh School of Nursing Conference, Pittsburgh, PA: CERMUSA.

**Rural Health Poster Presentations (4)**

Guzic, B. (May 2010). Poster Presentation: *Training percussion Therapy Techniques to Occupational Therapy Practitioners via a Technology Gateway.* ATA 2010: 15th Annual International Meeting & Exposition, San Antonio, TX: CERMUSA.

Muncert, E. (May 2010). Poster Presentation: *Enhancing the Quality of life for Special Needs Populations Through integration of Assistive Technology.* ATA 2010: 15th Annual International Meeting & Exposition, San Antonio, TX: CERMUSA.

Tonkin, K. (May 2010). Poster Presentation: *The Beat Goes On: Technical Challenges of Remotely Training Therapists in Drum Interventions for Kids With Autism.* ATA 2010: 15th Annual International Meeting & Exposition, San Antonio, TX: CERMUSA.

Bapat, A., & Gerraughty, J. (March 2010) *CERMUSA Overview.* 8th World Congress on Brain Injury, Washington, DC: CERMUSA

# Saint Francis University's
# Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA)

**FY08 Annual Report**
**(May 4, 2009 to July 31, 2010)**

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**Protocol Title:** Wireless Test Bed

**Protocol No.:** 05-TATTH206-05

**Date:** July 2010

## Principal Investigator

*Kent Tonkin, MA, Assistant Director for Information Technology*

## Introduction

CERMUSA's Wireless Test Bed is an ongoing study that is instrumental for the previous and current projects. Originally conceived as the backbone for CERMUSA's First Responder Emergency Communications-Mobile (FREC-M) telemedicine ambulance, the Wireless Test Bed has since yielded innovations in mesh networking, radio frequency to Internet protocol (RF to IP) conversion, and communications robotics. Like all CERMUSA protocol work, projects within the Wireless Test Bed emphasize novel combinations of commercially-available off-the-shelf (COTS) technologies and real-world significance. Examples of this ideology can be found in the patented and patent-pending RF to IP Bridge System. Originally developed to assist in extending radio communications into "dead zones" for firefighters, the RF to Bridge System epitomizes practical engineering and relevance to both civilian and military audiences; whereas civilian first responders face communications impediments in basements and subterranean structures, warfighters operate in tunnels and areas of mass destruction, often dealing with similar technical difficulties (Cooper, 2008). Interoperability between data and voice systems also remains a wide-reaching problem for the military, ready for new approaches and ideas (Lawlor, 2008).

## Body

**During FY08, CERMUSA worked on the following projects:**

**Project 1:**

• Perform network and application testing of 900 MHz mesh network and compare results to existing 802.11 mesh architecture, based on second generation CERMUSA-constructed 900 MHz range mesh nodes. Construction of these nodes was nearly complete during the previous year's project work, but overheating issues prevented the revised devices from being deployed.

After completion and extensive use of CERMUSA's original mesh network design, technical staff compiled a list of changes and upgrades to construct a new, better, more capable system to augment and possibly replace the original. The original system used a "2 radio" architecture consisting of an 802.11a 5.8GHz backhaul and an 802.11b/g 2.4GHz client radio in each node. This type of mesh network functions reliably, but has limited capabilities for range and expansion from the single radio backhaul. With the 2-3dBi gain "stubby" omni-directional antennas, currently used by CERMUSA, range is limited to approximately 150-200 yards line-of-sight between nodes. Range increases but beam width decreases as larger, higher gain antennas are used.

The proposed system revision used a "3 radio" architecture, a reconfigurable 802.11a 5.8GHz or 900MHz backhaul and an 802.11b/g 2.4GHz client radio in each node. This type of mesh network, although more complex, was theoretically immune from bandwidth degradation due to additional hops. Operating at 900MHz and a higher transmission power was anticipated to provide better coverage and foliage penetration compared to a more line-of-sight frequency, such as 5.8GHz.

After construction of the new mesh network and configuration for use with a 900MHz backhaul, CERMUSA personnel conducted multiple pre-research tests to examine user interfaces and general performance. Observed results were compared with known qualities of the original system. The 900MHz system appeared to be less capable and less efficient than the original in our application environment, which included steep inclines, dense foliage, varying terrain, and non-line-of-sight applications. Based on disappointing initial performance, CERMUSA staff decided to perform side-by-side comparison tests of each system, maintaining identical testing procedures for each.

Three side-by-side comparison tests were performed on the Saint Francis University campus. Tests performed measured received signal strength, streaming video bandwidth, ping latency, Internet access bandwidth, and large file transfers in both directions. The types of environmental tests performed are listed as follows:

- An outdoor test with perfect line-of-sight on a flat field with no obstructions
- An outdoor test with no line-of-sight in dense foliage
- An indoor test with no line-of-sight and many obstacles in an office environment

Based on these tests, a series of pros and cons was assembled for each system. They are listed below.

<u>Original Mesh Network – 2 Radio System – 5.8GHz Single Radio Backhaul</u>

**Pros:**

- Simple design requiring two antennas per box.
- Easy to configure and monitor via the web-based network management console.
- Large 8dBi omni-directional antennas provide good backhaul distance between nodes.

**Cons:**

- Due to the nature of single radio backhaul architecture, all nodes must be on the same channel. This configuration limits the number of hops from the portal to four in any direction. Bandwidth is effectively cut in half for each additional hop.
- A 5.8GHz backhaul frequency tends to be more line-of-sight than lower frequencies.
- This system does not have a real-time graphical map of the operational mesh network.

<u>New Mesh Network – 3 Radio System – 900MHz Dual Radio Backhaul</u>

**Pros:**

- A dual-radio backhaul architecture should allow hop extension well beyond four hops in any direction. Bandwidth should not be limited due to each unit having full duplex transmit and receive capabilities on the backhaul.
- 900MHz radios have a higher transmit power output and were anticipated to penetrate foliage well with less reliance on line-of-sight communications.
- Simple configuration utility for swapping nodes from 5.8GHz to 900MHz operation.
- Mesh Dynamics (manufacturer of 900MHz units) access points provide two wired Ethernet ports per node.
- Detailed graphical user interface for monitoring real-time mesh network statistics.
- GPS receivers integrated into each node to provide exact, real-time location information while in an outdoor environment.

- New, more efficient power management system. One large, rugged switch is used to turn each node on and off. One large LED is used to monitor remaining battery life.

**Cons:**

- Smaller 3dBi omni-directional antennas, although more resistant to damage, compromise the added transmit distance between nodes from a higher transmit power output.
- Actual measured operational distance between nodes has been about ½ the distance for reliable communications with the 5.8GHz original mesh system.
- Overall bandwidth on a 900MHz backhaul is inherently several times lower than a comparable 802.11a system due to available channels and bandwidth allowed in the ISM band at 900MHz.
- The Mesh Dynamics access points seemed to reboot every time a new wired device was connected to one of the two Ethernet ports on the node.
- Nodes timed-out for approximately 30 seconds every few minutes. This had detrimental effects on large file transfers and two-way video conference applications as they usually failed and would not resume operation after the time-out session. There was no known reason for this ongoing occurrence. After numerous discussions with the manufacturer, three units were sent back for evaluation. Problems and issues experienced at CERMUSA could not be duplicated in their lab. Engineers at Mesh Dynamics concluded the problems were caused by environmental factors and CERMUSA's mobile box applications environment, which differs from how the devices are marketed and intended to be used.
- Mesh Dynamics access points generated a lot of heat. Cooling fans were added to the nodes in an attempt to prevent overheating. Modification managed to drop overall temperatures on the boards by approximately 10 degrees; however, this change in temperature was not adequate to keep the radios from overheating when used in a sunny outdoor environment in the summer months.
- The nodes took a long time to associate with each other and form meshing channels and backup routes. Proxim AP-4000M mesh access points take an average of 30 seconds to boot and form associations with neighbor units; the 900MHz Mesh Dynamics devices averaged several minutes.

After performing the above-mentioned tests, CERMUSA staff documented that the 900MHz backhaul revision was not as capable as our original 5.8GHz system for a rapidly deployable mobile mesh system. Much of the bandwidth limitations, time-outs, and errors associated with the 900MHz system, or any dual-radio architecture, could be due to having both the transmitting and receiving omni-directional antennas located approximately 12 inches from each other on the same horizontal plane. Larger antenna separation is recommended, as well as having antennas radiating on the same frequency band mounted on different planes (See Figure 1 below from Mesh Dynamics' MD4000 Series Installation Manual). Designing an antenna application to follow these rules into a small, mobile Pelican case, the standard housing for CERMUSA mesh networks, is not practical. More horizontal separation between transmitting antennas is always better; this general rule applies to any wireless system, not just WiFi or 900MHz. Using a larger Pelican case with additional real-estate for antenna separation could have helped, although this configuration would limit the system's portability. This limitation was known initially; however, CERMUSA personnel felt it necessary to attempt to try this configuration on the small node

boxes to determine if the low power transmission would overcome this challenge. The decision was based on the advanced noise immunity characteristics the Ubiquiti radio cards used in the nodes and their promised ability to operate in the harshest of RF interference environments.

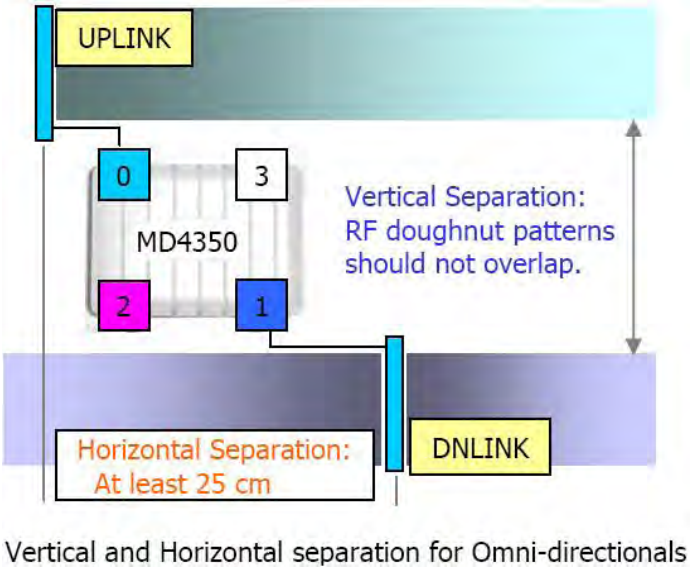


Figure 1: Excerpt from Mesh Dynamics' MD 4000 Series Installation Manual

No new reliable 900MHz mesh network devices have been found aside from Rajant's LX line of BreadCrumbs. We've always compared our in-house mesh equipment to Rajant's more expensive suite of mesh devices. Our system was always depicted as the low-cost, more features, version of Rajant's product line.

**Project 2:**
• Deploy best-of-breed RF to IP bridging technologies
• Integrate bridging technologies with both 900 MHz and 802.11 mesh networks and perform voice testing in a variety of physical settings and environments

No formal documented transmission of voice traffic over a 900 MHz or 802.11 mesh network was generated during the previous project year, as all formal research on RF to IP conversion was conducted via point-to-point links. The potential advantage of deploying a mesh system versus point-to-point in an RF to IP scenario is greater signal propagation/coverage within either subterranean areas, disaster/wreckage scenes, or other close-quarter logistics. Additionally, lessons learned from the Johnstown Fire Department deployment, which is continuing through July 2011, will be integrated into this research effort.

CERMUSA set out to complete several tests of the RF to IP Bridge System using a mesh network architecture as the backhaul communications link instead of the 900MHz point-to-point system. Several tests were conducted on the Saint Francis University campus. CERMUSA's

mesh network was distributed in a string-of-pearls manner so as to assure maximum distance between nodes and maximum available "hops". 802.11a at 5.8GHz was used as the backhaul frequency between nodes with a client PC monitoring the stats being connected via 802.11b/g at 2.4GHz. CERMUSA also used 8dBi gain omni-directional antennas in place of the stubby 3dBi rugged units normally used with the mesh system. The RF to IP Bridge System outdoor unit and indoor unit were physically connected to the endpoint nodes of the mesh via Cat-5 cables. Some notes from the tests are as follows:

- Average RSSI/SNR signal strength between mesh nodes was around 15, which is a very acceptable signal strength indication.
- Bandwidth requirements for the system are very low, the actual RF to IP conversion units only require 64kbps. Available bandwidth through the mesh network has been documented at several Mbps, even through 4 wireless "hops".
- Latency of 1-2mS per hop did not affect the system.
- Distances usually exceeded 100 yards between nodes over varying, rugged terrain throughout the campus environment.
- Audio transmission through the system worked 100% of the time. System audio delay was perceived at less than ¼ second.
- Six separate tests were performed in varying weather conditions.
- All results were documented and maps indicating unit location via GPS coordinates have been generated.

After performing the above-mentioned tests, CERMUSA staff believe a mesh network, of any practical size, is well suited as a backhaul transmission medium for two-way radio communications through devices such as the RF to IP Bridge System. CERMUSA staff performed coverage testing with the RF to IP Bridge System and mesh network, extending reach through four hops on the SFU campus. Voice quality was excellent with very little delay.

**Project 3:**

• Identify and select robotic chassis capable of carrying existing mesh repeater components and of 802.11 remote control
• Integrate mesh repeater into robotic chassis
• Repeat mesh network range testing, including robotic repeater
• Experiment with the addition of mobile-specific components, including camera and two-way audio

CERMUSA staff built, from commercially-available components, a revised Mobile Access Point (MAP) using an existing mesh network node. An underlying 4-wheel drive skid-steer chassis was constructed and mounted to the base of the access point enclosure. With this revision, the intent was to standardize the mesh network Pelican case form factor, rather than performing component integration on a developer chassis such as the P3-AT. As part of this chassis revision, evaluation of several types of 802.11 remote controllable servo systems was conducted. The first system was a plastic WiFi robot with an integrated web camera costing several hundred dollars. As this chassis was designed for recreational use, sourcing enough current to drive the larger chassis motors became an issue along with poor web cam video quality. The second system purchased was a more hobbyist-oriented, high-torque aluminum chassis that was also disassembled and integrated into the Pelican case MAP form factor (refer to Figure 2 for a comparison of form factor revisions between the first and second generation MAP units).

Operation and control was performed from a hand-held computer via 802.11b/g, wirelessly through the mesh network. A PS2-type gaming controller was integrated with the hand-held computer for easier manipulation of the robot via joysticks. A 22x optical zoom high-quality IP camera and headlights were also integrated into the MAP system for enhanced driving ability and control in any lighting conditions.

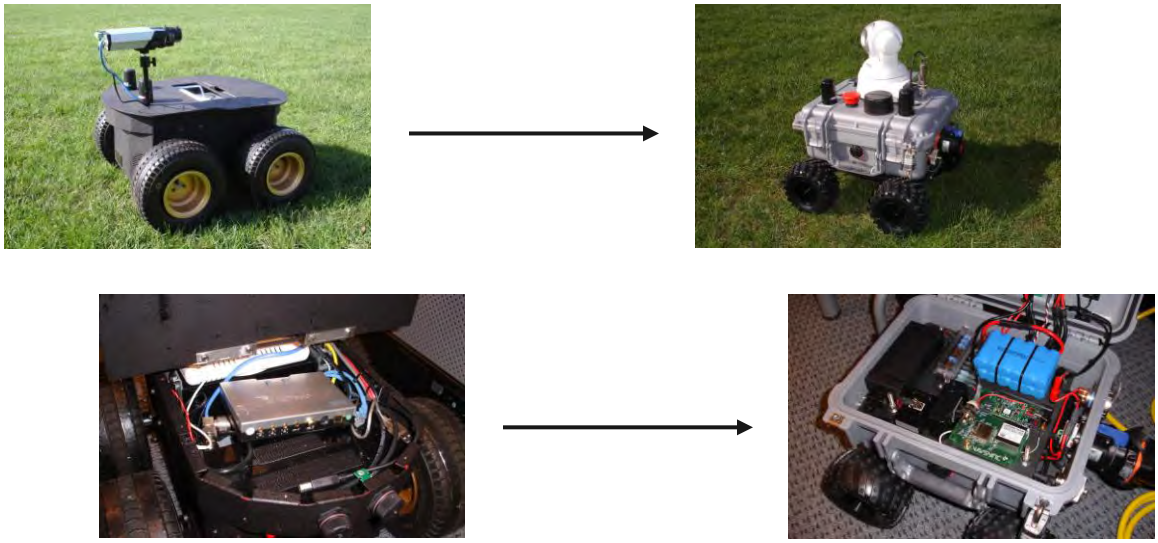

Figure 2: Comparison of first generation (left) and second generation (right) MAP form factors.

CERMUSA staff deemed it unnecessary to perform additional mesh network range testing with the robotic repeater, based on the fact that significant evaluation of these components had been performed under prior project years. As the robotic chassis integrated into the base of a traditional mesh network node, no other significant physical or logical changes were made to the system that would impact wireless performance.

As stated above, a Pan/Tilt/Zoom IP camera has been added to the MAP chassis. Installed into the lid of the mesh network node, it provides real-time, full 360 degree views with resolutions of up to 640x480. The camera was equipped with the ability to function in low-light and no-light conditions with the addition of headlights on the robotic chassis. Video streaming quality was adequate and decreased incrementally as additional mesh "hops" were added between the MAP chassis and receiving base station. Camera resolution was limited to 320x240dpi at 10 frames per second. This is less than half of what the camera is capable of producing; however, as the higher resolutions were tested, they tended to be choppy and break up due to bandwidth limitations through the mesh. Uncompressed high quality 640x480 resolution video streams can occupy upwards of 8Mbps of throughput.

A two-way audio streaming device was not included on this MAP revision. Previous versions included an on-board computer and two-way video conferencing equipment. However, these

components proved to be very unreliable. Problems with the previous architecture were tied to the logical function of a mesh network.

Typical mesh networks function as follows: When an access point is added or removed from the mesh network, the architecture reconfigures itself accordingly to provide the best data traffic routes. The system also automatically verifies link integrity and makes route changes as necessary at regular intervals, usually every 45 seconds to a minute. Each time this happens, packet data flow is briefly interrupted. If a running "ping" command is used, this results in one time-out for approximately every 20 pings that get through. Video conference systems tested and used with the original mobile access points could not handle this time-out very well due to low software tolerance for latency. This issue usually produced dropped calls and constant reconnects. Remote desktop software used to control the on-board MAP computers also suffered the same consequences and disconnected repeatedly.

By removing the two-way video conference system and remote desktop application from the new MAP chassis, frequent audio/video disconnects and remote desktop session failures were eliminated. A streaming IP camera does not suffer from time-out issues and latency on a network as a VTC system does. The camera broadcasts video regardless of network conditions. The operator may notice a few dropped video frames during mesh reconfiguration; however, the video stream will resume operation in a very short time.

As the robotic chassis does not contain a computer requiring a constant remote network session for command and control, MAP chassis movement was affected very little by latency and time-out issues associated with normal mesh network operation. The IP controlled servo system and motors proved to be very tolerant to network issues and are able to continue operation under these conditions.

## Key Research Accomplishments

- Early generation 900MHz Mesh Networks do not work as well as more mature 5.8GHz/2.4GHz 802.11 based systems.
- Successful use of CERMUSA's patented RF to IP Bridge System through a Mesh Network in place of the point-to-point 900MHz backhaul. This allows better expansion of the system and use in areas where the 900MHz radios may not function as intended.
- Construction of a 2$^{nd}$ Generation Mobile Access Point (MAP) in house from scratch using COTS equipment. This MAP functions better than original designs and costs two times less.
- Demonstrated potential in low-profile/low-cost robotic chassis produced completely from commercial off-the-shelf components.

## Reportable Outcomes

- The RF to IP Bridge System has received a **design** patent (Patent No. D590,791 S) and is patent pending (currently in discussions with U.S. Patent Office) for a **mechanical** patent.
- CERMUSA is currently in process of negotiating the commercial sale or licensing of the RF to IP Bridge System via FirstLink, a DOD-sponsored first responder technology commercialization group.

- CERMUSA Mesh Network and RF to IP development has assisted in gaining contract work with the National Institute for Occupational Safety and Health (NIOSH)/Center for Disease Control (CDC) and Monmouth University.

## Conclusion

CERMUSA's continuing research within the Wireless Test Bed has demonstrated relevance to the first responder and EMS community through their continual use of, and interest in, the RF to IP Bridge System. Recent negotiations by a commercial company to purchase or license this system indicate that CERMUSA is developing technologies with wide market interest. This past year's research has also revealed faults and limitations in technologies which showed much promise, including revised 900 MHz mesh radios, and has proven the viability of using multiple COTS technologies to create solutions which are superior to existing market approaches (i.e. MAP).

Within the coming project year, CERMUSA will continue to refine existing research efforts, such as the RF to IP Bridge System, while exploring new and emerging approaches of key interest to emergency services personnel. Examples of these approaches may include pico cells (extremely low-profile, rapidly-deployable networks), acoustic data transmission (for penetration of solid rock or aquatic barriers) (Jones), and revised/emerging wireless networking standards. Despite increasing propagation of wireless broadband technologies, land-mobile radio (LMR) will continue to be a part of our country's communications requirements for the near future (Werner), and as such, the merging of both technologies will be a continuing theme in CERMUSA's research. Hybrid technologies, such as push-to-talk satellite communications, may also serve as bridges to constant communications for first responders (Dittmar). As always, CERMUSA technical staff will seek to identify and solve the communications challenges for civilian and military first responders.

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# Saint Francis University's
# Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA)

**FY08 Annual Report**
**(May 4, 2009 to July 31, 2010)**

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**Protocol Title:** CERMUSA Technology Test Bed

**Protocol No.:** 07-TATIT301-07

**Date:** July 2010

## Principal Investigator

Kent Tonkin, MA, Assistant Director for Information Technology

## Introduction

The purpose of the CERMUSA Technology Test Bed was to provide a demonstration pilot phase prior to a structured study, and to serve as an open forum to evaluate candidate technologies. Rather than investing substantial project dollars from individual protocols in the hopes of yielding successful outcomes, CERMUSA's Technology Test Bed provided information reconnaissance and hands-on assessments of key devices and methodologies prior to deployment in specific projects. Under prior project management structures, CERMUSA principal investigators (PIs) have been required to predict specific required technologies, including software, hardware, and subscription services. By migrating to a technology test bed model, PIs had the opportunity to purchase or lease candidate technologies to determine the best possible selections for each protocol. Making use of this test bed also reduced the total amount of time spent in the initial phases of project research or assist in quickly changing project structures or reallocating funding.

## Body

In order to identify devices or equipment that would enhance current and potential future CERMUSA projects, the following studies were undertaken for FY08:

1. Development of handheld content delivery framework/further development of online case studies for smart phones
2. Wound care via cell phone
3. Netbook evaluation by CERMUSA staff for viable desktop replacements
4. Assistive technology (AT) for smart phones

**1. Development of handheld content delivery framework/further development of online case studies for smart phones:**

This project within the CERMUSA Technology Test Bed was driven by recent trends in the industry and CERMUSA/Saint Francis pushing educational content to handheld devices. As evident from Educause's 2010 "Horizon Report", today's students want to be able to access high quality online educational content regardless of their location or device they are using (Johnson et. al, 2010). Students rely heavily on portable devices including smart phones, netbooks, and tablets to consume educational material, and they expect that content to be available from anywhere.

Despite providing the user with Internet access and a variety of forms of media content, smart phones are not well equipped to deal with many online learning tools, such as Course Management Systems (CMS), some forms of streaming video (Adobe Flash, Silverlight), and other synchronous/asynchronous applications. As a result, online education is often not a universal fit for all methods of access.

This difficulty was a key concern for CERMUSA because of our emphasis on distance learning. Previous non-TATRC work, most notably preparation for the pilot Independent Duty Corpsman project, demonstrated the potential utility of accessing online course materials via handheld

devices. In evaluating this possibility of using handhelds and smart phones in this regard, the following weaknesses were identified:

1. Code/language incompatibility: Most handheld devices demonstrated little-to-no support for applications developed in either Java or Flash.
2. Multimedia/streaming video: Many streaming video formats, including Microsoft Silverlight (frequently used for automated video streaming/archive viewing), Adobe Flash and Apple QuickTime were not universal fits. Video formats that can be displayed on one mobile platform may or may not be compatible with others.
3. Proprietary emphasis: As opposed to the standards-based web browsing experience for most PC users, the majority of cell phones relied on limiting, proprietary formats for rich media distribution. For example, the Apple iPhone works well with QuickTime but will not play videos encoded in the Windows Media format.
4. Direct downloads: Many videos and other media files could not be directly streamed on handheld devices or cell phones, but required users to sync these devices with external PCs to transfer files.

Based on these issues, combined with increased student expectations of course access via handhelds, CERMUSA technical staff initiated the development of a handheld content delivery framework. A previously-developed CERMUSA case study tool developed for Physician Assistant and Physical Therapy courses was used as a foil for this work. The overall intent was to develop an automated process of producing a case study that could be viewed on either a standard PC browser or smart phone without requiring an instructor to create separate courses for each device.

The initial web-based case study tool was used by students at Saint Francis University as a reinforcement exercise. Figure 1 shows an example screen from the case study tool. Students interfaced with the tool as such:

1. Students select a case study to review.
2. Students view a fictional but accurate patient record and a video displaying a scripted doctor/patient interaction where the student is introduced to the patient and his or her symptoms.
3. The student reviews and chooses one question from a list of applicable questions that he or she would like to ask of the patient.
4. A video plays showing the doctor asking the selected question of the patient and the patient's response.

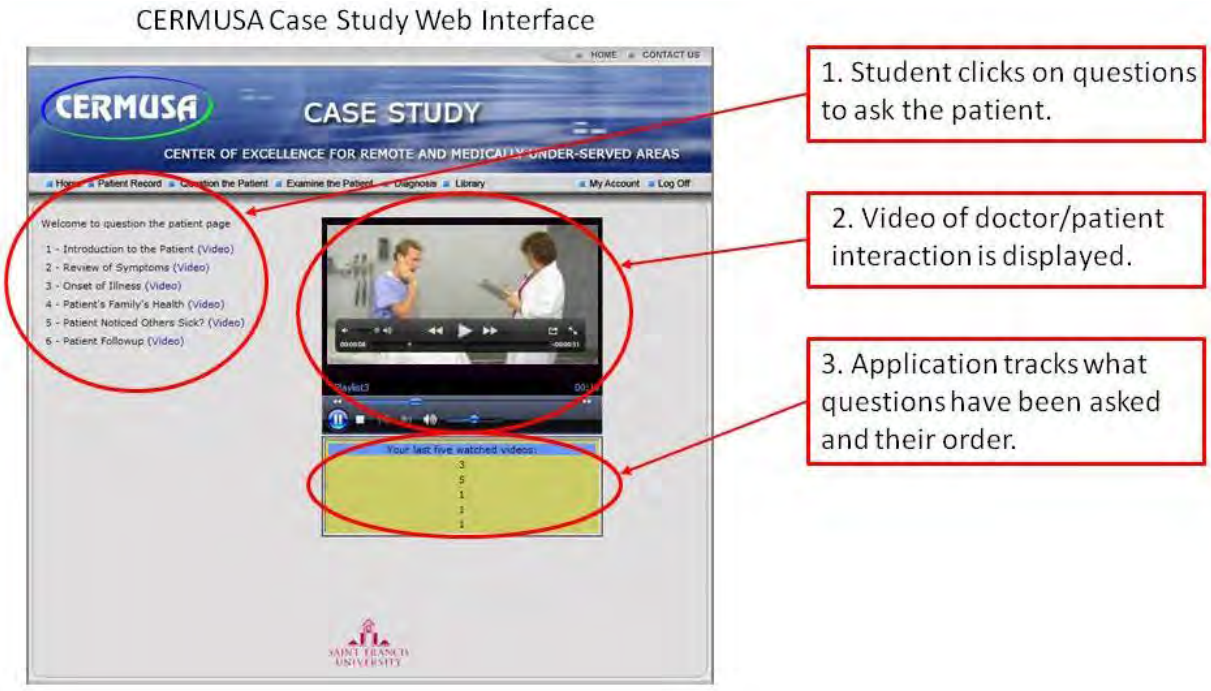


**Figure 1 - Web-based Case Study Tool**

These interactions continue until the student feels confident to make a diagnosis. At this point, the student clicks on the "Diagnosis" link and is presented with several open-ended questions that focus on creating a care plan for the patient. The student's responses are saved in a database to be reviewed and possibly graded by the instructor. Additionally, the sequence in which the students ask questions is saved in the database. This allows the instructor to view what questions were and weren't asked and the order in which the student progressed through the questions.

Building a case study involves the following steps:

1. The instructor creates a script for the actors simulating the patient and doctor to follow.
2. The patient/doctor interactions are filmed in CERMUSA's Distance Learning Prototype Laboratory using a realistic environment (props, backgrounds, etc.).
3. The produced videos are encoded in a Windows Media format and uploaded to a streaming server.
4. Finally, the instructor goes into the administrative web pages of the case study tool and builds the case study using a step-by-step wizard. It is during this step that the instructor determines what questions will be asked of the student during the diagnosis phase of the interaction. Figure 2 shows the user interface for this wizard. From here, instructors can add, update, or delete questions for a particular case study's assessment phase.

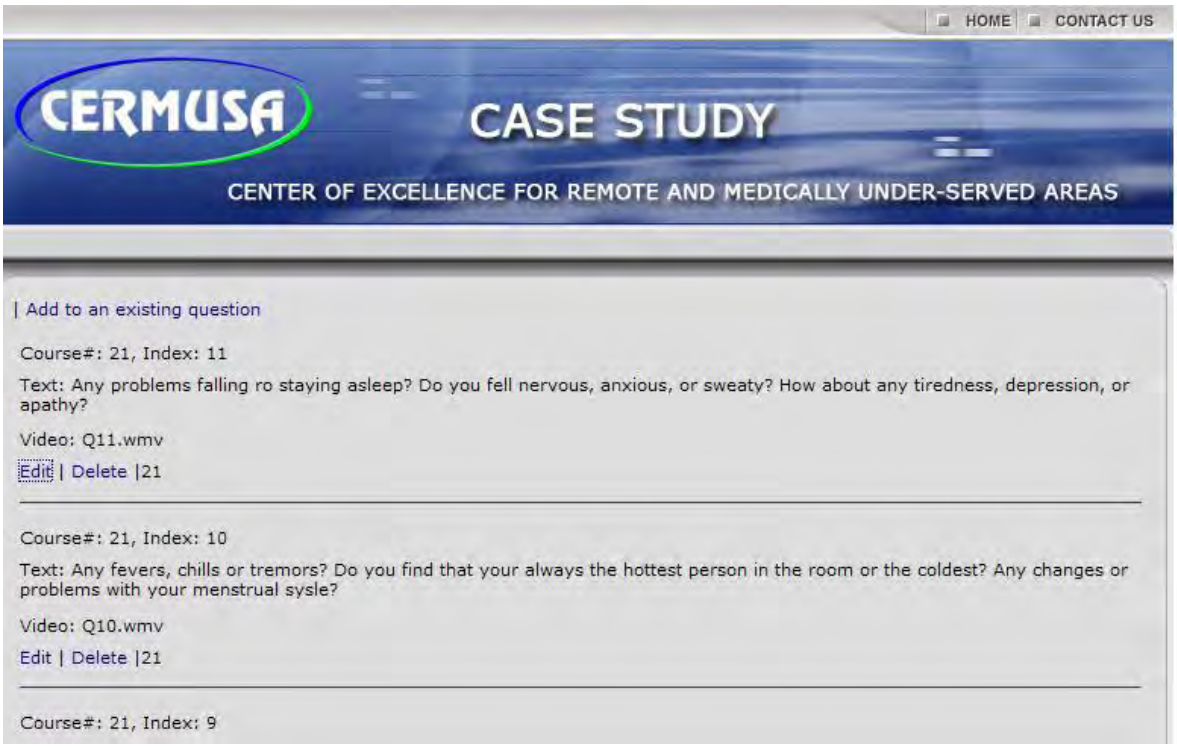


**Figure 2 - Adding/editing questions**

To make the case study tool available to individuals in a mobile setting, CERMUSA had to first determine what platform to begin development on. Research was conducted to see which mobile platform would be the most suitable to the application while reaching the largest number of users possible. The leader is this space is Apple's iPhone Operation System (OS), with over 66% of the mobile web browsing market (Musil, 2009). Additionally, devices using the iPhone OS are capable of streaming video from web servers, as long as that video is encoded in formats friendly to the device. The decision was made to focus on the iPhone OS first and subsequently look into moving the case study to additional platforms.

CERMUSA began identifying best practices in mobile web sites by investigating other sites designed for mobile use. Sites such as CNN Mobile, USA.gov Mobile, and Amazon showed successful transformations of sites to a mobile format. CERMUSA identified these requirements to be met when designing the mobile version of the case study:

1. The mobile site should make heavy use of cascading style sheets (CSS) to format the look and feel of the application.
2. The mobile site should have a familiar interface so that users do not have to be trained or retrained in its use.
3. Entering text (typing) in a mobile site is often difficult due to the size or lack of the keyboard. When possible, text controls should be replaced with controls that are friendlier in a mobile format, such as option buttons and check boxes.
4. Finally, the use of graphics should be much more limited on the mobile version of the case study. There simply is not enough screen real-estate to effectively use a large number of graphics that are not required for the case study.

The next step in the process involved identifying tools that could help build mobile websites. Several HTML, JavaScript, and CSS frameworks were evaluated including, PhoneGap (http://phonegap.com/), iWebKit (http://iwebkit.net/), jQTouch (http://www.jqtouch.com/), and Joe Hewitt's iUI (http://code.google.com/p/iui/). Of these, iUI was chosen as the framework for the pilot project due to its ease of use, quick installation, standardized look and feel of pages, and maturity of the framework.

Using the iUI framework, CERMUSA software developers were able to quickly create a website specifically designed for mobile devices for the case study tool. Figure 3 shows how the menu driven case study displays within mobile Safari, the iPhone OS's default web browser. A student first selects which case study he or she would like to take, which displays a list of actions that can be performed with the case study. Typically, a student will first view the patient record, followed by questioning and examining the patient.


**Figure 3 - View of case study designed for iPhone OS**

When asking questions or performing examinations in the case study, the iPhone OS video player, QuickTime, launches and displays the video. The video is encoded and served to the mobile device through the use of a QuickTime streaming server. The iPhone OS requires that video is encoded in the QuickTime format, as opposed to the Windows Media Video (WMV) format that is used on the web version of the case study. Figure 4 shows how the video displays within the web browser.


**Figure 4 - Video displayed on iPhone OS**

The final aspect that needed to be added to the mobile version of the case study was the assessment measurement tool. Students utilize the mobile device's on-screen keyboard to complete the series of diagnosis questions and then submit the answers to the database, where they are stored for grading and comments in the same manner as the original case study application. The only display difference between the diagnosis screen(s) on the original case study and the mobile version is that the mobile version displays the questions one at a time, while the original case study showed all of the questions on the same page. Figure 5 shows an example of the assessment screen.


**Figure 5 - Diagnosis screen**

In total, two new iPhone-friendly web pages were created. The main page handles all of the application's menus, questions, and examinations. The second page handles assessment through the use of diagnostic text boxes.

Videos for the web-based case study had been rendered in Window's Media Video (WMV) format and thus would not display properly on an iPhone, which requires Apple's QuickTime video format. Therefore, the case study videos had to be converted from WMV to QuickTime format. Fortunately, Red Kawa Inc. (http://www.redkawa.com/) has developed an application called "Videora iPod Converter" and makes it freely available to perform such conversions. This

program was used to convert approximately 20 WMV case study videos to the QuickTime format. The videos were placed on a Macintosh computer running the Snow Leopard operating system, which functioned as the media server.

*Validation*
Validation of the mobile case study was completed in a purely technical form. CERMUSA programmers ensured that the information on both the mobile and web-based case study tools was identical in content and differed only in presentation. Additionally, video load time was one area of concern for the application and was tested as well.

The iPhone can connect to the case study in one of three different manners:

- Wireless Networking (802.11g)
- AT&T Edge Network
- AT&T 3G Network

Each network connectivity type was tested by measuring the amount of time it took for three separate videos to load on each network. Table 1 summarizes these results, and Appendix A shows the data used to create the summary.

| Average Video Load Times | | |
|---|---|---|
| Network | Load time in seconds | Range in seconds |
| Wireless LAN | 6 | 6-7 |
| AT&T 3G | 13 | 12-13 |
| AT&T EDGE | 64 | 44-91 |

**Table 1 - Video load times**

The data show that the video load times for both the wireless LAN and AT&T's 3G network were acceptable (under 30 seconds). However, the slower AT&T's EDGE network leads to a significantly longer load time of over 60 seconds. Unfortunately, as of 2009, this is the AT&T network that serves the Saint Francis University geographic area, which would mean that the Saint Francis students would not receive the video files in a timely manner when not connected to the campus wireless network.

After testing with an iPhone, the website was tried on two additional platforms – the RIM Blackberry and the Motorola Droid. In both cases, the text portions of the web application performed admirably and nearly identically to the experience on the iPhone OS. However, neither of these smart phones allowed for the videos to play as needed.

*Conclusion*
Using existing software frameworks, CERMUSA migrated an existing multimedia web application to a mobile platform with little difficulty and without changing the underlying structure upon which the web application relies. Other than the additional video encoding specific to the iPhone OS, the migration occurred in a manner that was transparent to the course instructors. The model developed in this project can be utilized with other developed web-based

content delivery systems. This knowledge will aid CERMUSA in future studies that require mobile delivery of educational content.

**2. Wound care via cell phone:**

The wound care via cell phone investigation is both a revision to previous CERMUSA project work ("Improving Wound Care Management") and a potential precursor to future studies. Over the past several project years, CERMUSA evaluated the efficacy of connecting visiting nurses in the home to a centrally-located wound care specialist via analog videoconferencing (VTC). Even with relatively low-quality video (5-10 frames per second), this project showed promising results (reduced wound healing time, reduced travel for the wound care specialist). Recommendations made during CERMUSA's 2009 American Association of Biological Sciences (AIBS) review both from independent auditors and TATRC administration strongly encouraged re-investigation of the remote wound care project with mobile and cellular devices. The AIBS recommendation reflects increasing trends of using such devices for telemedicine, perhaps even on a world-wide scale (Telemedicine). In addition, this research is very timely, considering the 9.6% increase in shipments of smart phones in 2009 and anticipated sales boost of 10.8% in 2010 (iSuppli Corporation).

As a result of this conversation, CERMUSA plans on undertaking a new remote wound care project, "Wound Care at a Distance (WCAD)," during FY09. An investigation of potential cellular/handheld devices for this purpose was undertaken in the hopes of determining the best technological options for supporting transmission of wound imagery from a home to a centralized wound care specialist.

With the next generation of smart phones being introduced into the market, along with associated applications being developed for a multitude of purposes, the handheld industry has exploded. Applications for a wide range of tasks are now being sold on the market. These application categories include live video-transmission programs that will stream audio and video from a smart phone device to any Internet-ready host computer via cellular technology.

To this end, there are multiple smart phones, software developers, and cellular providers capable of being combined to provide video streaming. The purpose of this study was to determine which smart phone, streaming application, and cellular carrier would give the best picture quality and reliability in a rural area.

To determine the best possible devices, software, and network, two separate cell phones were purchased: an Apple iPhone and a Motorola Droid (Figure 6). The Apple iPhone was chosen because it has over 100,000 downloadable iPhone apps (Chen, 2009). Included in these applications was the video streaming software to be used in this study. The Motorola Droid was chosen because it uses the Google Android operating system, which enables the capability to download and install applications like the iPhone. Although there are other cell phones that utilize the Android OS, the Motorola Droid had the biggest camera pixel size and largest processor available. It was thought that these capabilities would provide higher fidelity communications than lesser phones when the study was initiated.

Not every smart phone has the ability to download and install apps, like the iPhone and Android-enabled Droid can; subsequently, other smart phones that do have this capability, such as Research in Motion (RIM) Blackberries, have limited application stores from which to shop and purchase. Blackberry smart phones were considered for this study, but comparable video streaming software was not available for these devices at the time of the study.

**Figure 6-Apple iPhone and Motorola Droid**

Both of the smart phones were capable of meeting the minimum video streaming specifications, as defined by each selected application:

- 3G capability
- Integrated camera
- Capability to install third party software

The Apple iPhone was placed onto the AT&T cellular provider, while the Motorola Droid was placed onto the Verizon cellular provider. Due to Apple and AT&T's exclusivity contract, the iPhone had to be placed on the AT&T network. This division of software and services would help to determine which smart phone and cellular carrier had the best capacity to provide quality service. In addition, an upload/download monitor application, called Speed Test, was installed to measure the data transmission rate for each of these phones at various locations. This monitor was created by Xtreme Labs and displays both the average and top upload and download speeds of the phone (Figure 7). The top two video streaming applications, called Qik and Ustream, were loaded onto each device These packages were considered the top streaming applications because of market penetration and software robustness. These live interactive broadcast platforms enable anyone with an Internet connection to view a video stream. Unlike previous webcasting technology, these applications use a one-to-many model, which means that the user can broadcast to an audience of unlimited size via the Internet. When the study was conducted, both applications were run on each phone to determine which provided the best quality and had the best features, such as text messaging and delay monitoring.


**Figure 7-Extreme Labs Software**

To ensure that a standard image was viewed for every test, a "font image" was created. This image contained font sizes that varied from 8pt font to 72pt font. During testing, this image was held at a standard distance from the smart phone, and the users on the other end would look to see what the smallest font was visible (See Figure 8 below).

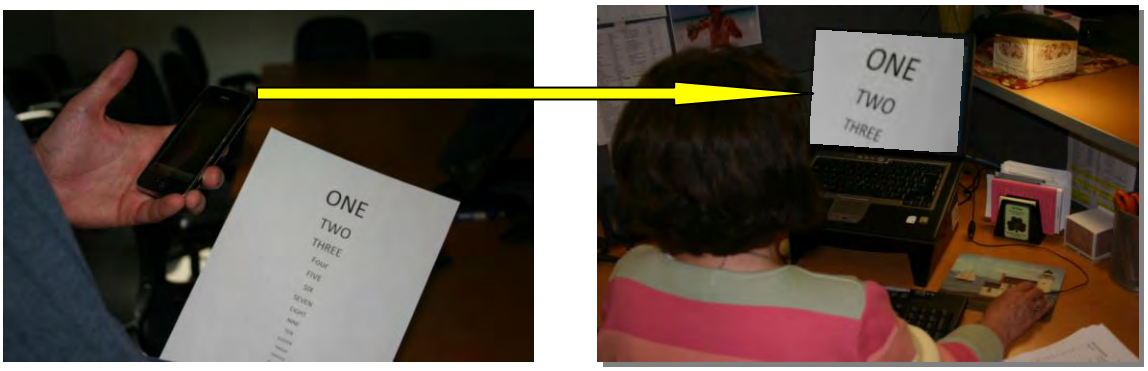


**Figure 8-Font Size Testing**

Testing was accomplished as follows:

1. The remote user traveled to designated testing locations and recorded the GPS location.
2. The remote user opened the data monitor application on the first smart phone and recorded the average and max upload and download data rate.
3. The remote user established a connection to the end user, located in Loretto, PA, with the Qik video streaming application.
4. The remote user placed the font image display a set distance from the smart phone.

5. The end user watched the video stream from the smart phone via a PC and web browser and recorded the video quality, pixilation, and motion quality on a Likert scale from 1-5.
6. The end user timed and recorded the video delay from when the image was initially recorded to when the image was actually received at the monitoring base.
7. The remote user established a connection to the end user, located in Loretto, PA, with the Ustream video streaming application.
8. The end user watched the video stream from the smart phone via a PC and web browser and recorded the video quality, pixilation, and motion quality on a Likert scale from 1-5.
9. The end user timed and recorded the video delay from when the image was initially recorded to when the image was actually received at the monitoring base.
10. Steps 2-9 were repeated with the second smart phone.

The survey yielded the following results: After taking a sampling of various locations in a 60 mile radius of Johnstown, Pennsylvania, AT&T demonstrated higher data transfer rates over Verizon. The download speed on the AT&T network was 985 kb/sec average compared to 778 kb/sec average on Verizon. The upload speed on the AT&T network was 152 kb/sec average compared to 101 kb/sec average on Verizon. This data shows that the AT&T has a higher transfer rate in this area than Verizon, and this cellular provider should be used when purchasing future smart phones for the wound care project, because this provider will provide better bandwidth, and therefore better performance. Coverage area was also an indicator of performance. In the test areas used, there were locations that AT&T could connect and Verizon could not.

When comparing the Qik software to the Ustream software, Qik scored better on both the AT&T and Verizon networks. The user scores listed in a Likert scale from 1-5 and are listed in Table 2 below.

| | AT&T | | | Verizon | |
|---|---|---|---|---|---|
| | Qik | Ustream | | Qik | Ustream |
| Video Quality | 3.22 | 3.13 | | 3.11 | 2.44 |
| Pixilation | 3.33 | 3.00 | | 3.00 | 2.44 |
| Motion Quality | 2.89 | 2.50 | | 2.89 | 2.78 |

**Table 2-QiK and Ustream Cellular Test Scores**

Another method used to determine which product was better was video delay. This measurement was taken to determine how long the video transmission took from the smart phone, through the cellular network, and finally displayed on the end user's computer screen. The measurement was taken in seconds, and the longer the delay the less effective the product was. The results are listed in Table 3 below:

| | AT&T | | | Verizon | |
|---|---|---|---|---|---|
| | Qik | Ustream | | Qik | Ustream |
| Video Delay | 25.88 | 15.33 | sec | 43.88 | 3.75 |

**Table 3-Qik and Ustream Video Transmission Latency**

Even though the Qik software had a higher user score, the delay between transmission and receipt was longer, as noted in the figure above. This delay is probably due to the fact that there is a higher encoding process being used to give the better picture quality. For the wound care project, a slightly longer delay should not affect the outcomes, so the time delay should not be a deciding factor. Of the two packages evaluated, Qik software should be used because of the better image quality and lower pixilation.

**3. Netbook evaluation by CERMUSA staff for viable desktop replacements:**
One of the most compelling trends in mobile computing is the emergence of netbooks. Netbooks are portable computers with smaller form factors than traditional laptops (See Figure 9). Sacrificing processing power and drive size for portability and light weight, netbooks are built on the idea of cloud computing, namely performing more functions and storing more information on the Internet than on a local drive.

**Figure 9-Laptop vs. Netbook Comparative Size**

As netbooks typically use traditional graphical user interfaces (GUIs) and operating systems (OSs), and are much less expensive than typical laptop computers, these devices present the potential of cost savings for businesses while offering end users a familiar system look and feel. One example of this type of device is the ASUS EEE netbook, which is available with a 2GB hard drive and Linux operating system for $189.00. However, other current netbook computers

offer more robust configurations of a 160GB hard drives and Windows XP operating systems for around $300. Some examples of this approach include the Acer Aspire One for $289, the Asus Seashell for $299, and the Compaq Mini for $314 (Prices quoted from Computer Data Warehouse-Government).

Because of their size, netbooks are widely regarded as computers that people can use on the go to surf the web and not as serious work appliances. However, most workers do the bulk of their work on desktop programs such as the Microsoft Office suite, which is the most popular desktop software with an estimated 80% of enterprise customers using it (Montalbano, 2009). These desktop programs are not resource intensive, meaning that a lower-powered computer should be able to handle a normal day's workload.

Because most of the work currently performed by CERMUSA administrative staff does not demand process-intensive computers, a test was proposed to see if the reduced performance of these devices would outweigh the lower cost of purchasing netbooks for all CERMUSA staff as basic clerical/office tools when the lifecycle of the current laptops expires. The ultimate goal of this analysis was to determine if netbooks would be accepted over the more established format of a laptop computer. CERMUSA included a comparative analysis of netbooks versus laptop PCs for typical office work. This analysis gathered qualitative information about how CERMUSA employees viewed the functionality of a netbook computer as compared to various aspects of current staff administrative computing devices. In addition, this analysis examined various manufacturers and configurations of netbook design to determine which computer was most user-friendly.

After market research, CERMUSA staff determined that the de facto standard for netbooks in the $300-$350 price range was equipped with 1GB of RAM and 160GB of storage; using these criteria, four netbooks were identified and purchased:

- Acer Aspire One
- Hewlett-Packard Mini
- Lenovo S10e
- Asus Seashell

Netbooks running disparate OS's were selected to determine if it would be more advantageous to use Linux or Windows-powered devices. After deliberation with CERMUSA's network administrator, it was concluded that the Windows OS would be used for this evaluation and for all future CERMUSA netbook purchases. Once this factor was settled, two different versions of Windows were installed on the netbooks: Windows XP and Windows 7. The installation of these two versions would help determine if there would be any issues regarding the upgrade from the older version of Windows to the newer version.

To evaluate the various netbooks, a survey was created. This survey asked questions on the form and functionality of each netbook to garner positive and negative attributes of these devices. The survey then asked the respondents to compare specific characteristics of their current laptop with those of a netbook. Finally, the survey asked open-ended questions as to what they liked and did not like about the netbooks.

The surveys yielded the following results, the averages of some of the results gathered are listed in Table 4 below.

| Ease of Use | Size & Weight | Display | Keyboard | Mouse | Speed vs. Laptop | Startup vs. Laptop | App load vs. Laptop | App location |
|---|---|---|---|---|---|---|---|---|
| 4.00 | 5.00 | 3.33 | 4.67 | 4.33 | 3.17 | 4.33 | 3.50 | 3.67 |

**Table 4-Netbook User Satisfaction Averages**

Daily Work Usage: a percentage of respondents (33%) found the netbook detrimental to daily work. These people cited the fact that "It can be very slow and this can be frustrating when trying to complete work in a timely fashion."

Form Factor: The greatest benefit of the netbook was the small form factor. It was mentioned more than once that the small size made the device beneficial for business travel. Device size did not affect traditional keyboard size, and there were no issues in typing reported. As expected, the screen size was the biggest detriment to the computer. The small size of the device limited screen size to 10.1 inches, making screen reading potentially difficult.

When comparing the netbook functionality to the current laptops in use by CERMUSA staff on the survey form, there were no major differentiating factors. Both the startup speed and application loading speed for netbooks received high marks. The only notable difference was that an external monitor and mouse had to be connected to the netbook to give the full functionality as that of the existing staff laptops. This is because the inherently small size of the netbook gives a limited view of the screen, and the touchpad has a small surface area as well. Connecting these devices give the netbook both a larger viewing area and mouse control in a more standard setting for work.

In conclusion, the low cost of the netbooks, along with the high marks received by the survey respondents, indicated that the purchase of netbooks as next generation computer devices should be considered. Except for one respondent, there was no loss of productivity in the workplace. To resolve the issue of users multiple devices slowing down specific users, a separate, more powerful computer could be purchased to fulfill their needs. Netbooks cannot fulfill every need in the workplace. Staff members that do not have a need for high end computing could use the netbooks, while personnel that do have a need for powerful computers could have separate, more powerful laptops purchased. The amount of CERMUSA employees that would require this advanced laptop is small. Even with the added cost of purchasing several high-end laptops for specific staff (i.e. graphic developers, programmers), a great cost savings can be achieved with the use of netbooks in the workplace instead of traditional computing.

**4. Assistive technology (AT) for smart phones:**

CERMUSA has long been invested in the evaluation and deployment of assistive technology (AT) devices for persons with disabilities. Based on the current Quality of Life (QOL) project work at CERMUSA's National Telerehabilitation Service System (NTSS), CERMUSA staff investigated new and emerging AT for use on handheld and cellular devices. Like the aforementioned handheld content delivery work, this study was built upon the increased

proliferation of cellular data devices and smart phones within the general population (iSuppli Corporation).

CERMUSA staff investigated a number of peripheral devices and software that could be of value for the QOL project, evaluating the functionality and ease of use of each. The end goal of these evaluations was the potential inclusion into the QOL project or other CERMUSA protocols involving AT.

CERMUSA researchers evaluated various Apple iPhone software applications in three main AT areas: Training applications, Augmentative and Alternative Communications (AAC) applications, and Health and Wellness applications. The various applications were selected to cover the population base being examined for the QOL study at the NTSS. The individuals to be included in the QOL study have a variety of disabilities, such as, traumatic brain injury (TBI), stroke, language and learning disorders, and amyotrophic lateral sclerosis (ALS), also commonly known as Lou Gehrig's disease. The following is a list of software applications that were researched, along with a brief description of each. The Apple iPhone software version being used for the following evaluations was 3.1.3.

Training Applications:

- CPR & Choking – is a software application that instructs an individual on how to perform CPR and come to the aid of a choking victim. There are a series of videos (approximately 1 minute in length) that cover procedures on how to perform the life saving actions on adults, children, and infants.

AAC Applications:

- Proloquo2Go – is an AAC text-to-speech software application designed to provide vocally-challenged end users with a communication solution. This application deploys a combination of text-to-speech voices and images/symbols and image texts to enable end-users to produce vocal communications by either typing words or selecting specific images. A versatile application, Proloquo2Go can be used with adults and children with autism, Down's syndrome, ALS, stroke, TBI, and other disabilities that disrupt normal speech communications. Individual users can download their own images and even record their own voice if they are capable. In addition, this application also allows for pre-recorded messages that can be stored and used at a later date and time.
- iPrompts – is an ACC software application designed to provide individuals who are language impaired and developmentally challenged with a means to communicate. This application is picture-based and offers no audio reinforcement for the images. Like the Proloquo2Go application, it can be used with adults and children with autism, Down syndrome, ALS, stroke, TBI, and other disabilities that disrupt the normal speech communication function. iPrompts is broken down into four key areas for visual prompting: 1) picture schedules, 2) visual countdown, 3) choice prompts, and 4) image library (the database where all images are stored for use).

Heath and Wellness Applications:

- iStethoscope Pro – this application is designed to record and transmit heartbeats, waveforms, and other cardiovascular data, including phonocardiographs and spectrograms.
- iHeart – Pulse Reader – this application measures heart rate and stores this information and related notes to be stored on the iPhone. This application allows for different configuration of the chart views as well as e-mail transmission of the data.
- Heart Monitor – this application uses a headphone with a microphone to detect a heart rate and can also track pulse count for when individuals are training.
- WaveSense Diabetes Manager – is an application that allows the tracking of glucose readings, carbohydrate intake, and insulin doses. This application also offers videos provided by dLife to help improve the quality of life for individuals living with diabetes. dLife is a website resource for diabetic patients and their caregivers that provides information on all facets of diabetes. Some of the main features of this software application include: logbook, trend charts, tagging, and emailing of results.
- BloodWise Glucose / Blood Sugar Tracking Utility – an application to record and keep track of blood glucose readings. The software offers statistics to review glucose readings and visually charts your results. This application also allows for email of data collection.

**Research Outcomes**:

Training Applications:

- CPR & Choking – CERMUSA researchers reviewed each instructional video, approximately one minute in length, and found the audio and video quality of a high quality standard (comparable to watching a DVD on an HD LCD monitor). Videos played flawlessly on the IPhone and all associated audio was easy to hear and discern, both via internal speakers and headsets. The instructions given within each video were detailed and easy to follow, and pause/rewind functions were available for viewing interruption/repetition. This application could be an excellent tool for caregivers to review life saving techniques to be applied to persons with heart-related or choking disorders. Despite the high quality of the content and application, the manufacturer recommends that formal instruction should also be obtained by the individuals using this application.

AAC Applications:

Each of the following applications was compared to the DynaVox SeriesV AAC device. The DynaVox SeriesV is one of the more advanced AAC products on the market today. The primary function of the DynaVox SeriesV, as with all Dynavox Units, is to produce spoken communications from text and and graphical controls. In other words, this device produces audible speech communications for individuals who are incapable of verbalizing. This device offers a variety of alternative control methods, including a touch screen, eye tracking/head tracking capability, and joystick adaptation. Based on a compact, fully functional Windows XP PC, this device is durable, suitable a broad range of ages (younger child to older adult), multilingual, and uses customizable graphics to fit the user's needs. Because the DynaVox SeriesV is Windows-based, it allows for any PC-compatible software to be installed, such as Microsoft Office package, MP3 files, web cameras, and other Internet-based applications. The DynaVox SeriesV can also be used

as a universal remote control for items such as DVD players, televisions sets, and even light switchers, and other home controls.

CERMUSA researchers have been evaluating this hardware device for several years within the organizational protocol-related research. Researchers felt the DynaVox SeriesV AAC device was very comparable to the two AAC software applications (Proloquo2Go and IPrompts) and decided to see how it compared to the competition. All of the devices are meant to help individuals with communication disabilities. Table 5 below compares the features of each software package (as installed on an IPhone) to those of the DynaVox SeriesV:

| | **DynaVox SeriesV** | **Proloquo2Go on iPhone** | **iPrompts on iPhone** |
|---|---|---|---|
| Internet Connection | Yes | Yes | Yes |
| Interactive Pages | Yes | Yes | Yes |
| Free Speak Text | Yes | Yes | No – no audio |
| Touch Screen | Yes | Yes | Yes |
| Cost | $7,820.00 | $189.00 | $49.99 |
| Wi-Fi | Yes | Yes | Yes |
| Switches | Yes – 2 ports | No | No |
| Select Voice | Yes | Yes | No |
| Record Voice | Yes | No | No |
| Visual Countdown Timer for activities | No | No | Yes |
| Weight | 4 lb 11 oz | 4.8 oz | 4.8 oz |
| Add Images | Yes | Yes | Yes |
| Create pages | Yes | Yes | No |
| Image Captions | Yes | Yes | Yes |
| Create Schedules | No | No | Yes |
| Visual Support | Yes | No | Yes |
| Edit Caption | Yes | Yes | Yes |
| Email Accounts | Yes | Yes | Yes |
| Full XP computer interface | Yes | No | No |
| Headphone jack | Yes | Yes | Yes |
| Microphone jack | Yes | Yes | Yes |
| Foreign Language | Yes | No | Yes – by editing the caption field |

**Table 5-Comparison of DynaVox to AAC iPhone Applications**

Although, the DynaVox SeriesV is a more advanced device for individuals with communication needs, researchers felt that the Apple iPhone was a much more portable and socially-acceptable device for the younger generation (iPromps iTouch App Review). Despite this advantage, the Apple iPhone screen is much smaller than that of the

DynaVox SeriesV, which may make it less desirable to older users, who may find it difficult to use the touch screen. As shown in Table 5 above, the combined cost of both the software applications and iPhones are less the DynaVox SeriesV. Although not required to use the programs compared in this study, the user should still keep in mind that monthly data service charges for the IPhone are not included in this comparison.

Health and Wellness Applications:
Several tests were performed to gather data on each of the following software applications. The time line on gathering of the data was December 2009 thru beginning of April 2010. The main reason for this extended timeline was to propagate the databases within the software applications to review the trending and log files stored within the software themselves.

- iStethoscope Pro – Several tests were performed with this software application, which proved to be very cumbersome and unreliable. According to the manufacturer, this software package was to be used as follows:
    - An external microphone is to be attached to the IPhone
    - The microphone is to be placed to the skin near the left nipple
    - The stethoscope software should be able to register the pulse
- CERMUSA evaluators were unable to locate a heartbeat using an external microphone. Instead, they used a traditional stethoscope to locate the heartbeat and then placed the external iPhone microphone to that area of the skin. At that point, a heartbeat could be recorded.
- Researchers followed the instructions on shaking the iPhone to hear and see the last eight seconds of the phonocardiograph waveform. Figure 10 shows an example of a waveform with a timestamp at the top of the screen.

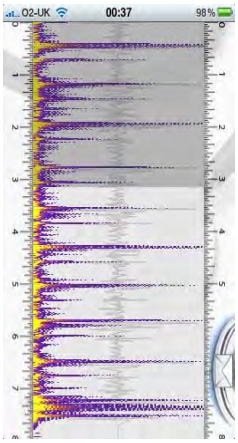


**Figure 10-Example iStethoscope Pro Waveform**

Although the video for reviewing the spectrogram and phonocardiograph was very clear and crisp, difficulties occurred when trying to hear the waveform and determining the wave components. The audio playback was very hard to hear and picked up extraneous room noise, even after making the necessary changes with the filters on the software. As advertised, the images could be emailed to another party for review, but researchers found that starting a new record was very difficult to accomplish.

This software application was compared against a more-highly developed, FDA-approved device called Biolog EKG (Figure 11), which is a handheld, mobile device produced by QRS Diagnostics. Biolog is a one lead EKG that delivers a waveform on the device's window. The concept for gathering data is relatively the same as the iStethoscope Pro: place the device on the chest of the individual and press a record button on the side of the unit, resulting in a documented wave form for store and forward. The data can be transferred to a software application called CardioView, which can be stored, printed, or emailed. Unlike the iStethoscope Pro, there is no audio required for the Biolog due to its built-in leads. Based on the relative lack of product development on the iStethoscope Pro, researchers agreed that more testing of the software application would need to be completed prior to trying this application in the field.


**Figure 11-Biolog Device**

- iHeart – Pulse Reader – CERMUSA researchers found this application to be easy to use. To apply this device, the user holds the iPhone in one hand and presses the start button with another. It was found to work best in a resting state as opposed to during periods of intense cardiovascular activity. When readings were performed in a noisy environment, the software stated "noisy signal – possible incorrect value." All menus were clearly laid out and easy to read (Figure 12), along with the trending charts and reports (Figure 13). These charts allowed for total averages vs. daily averages, along with total measurements, to be recorded. For transmission of data, the results could be emailed out in a summary report to a doctor. The researchers compared the data gathered on the iHeart software with the accuracy of the traditional method for finding the pulse on the wrist area. Simultaneous traditional and digital pulse readings produced different results, pointing to an inconsistency in the software. Due to this inconsistency, researchers did not see any benefits in using this software application as opposed to traditional pulse reading, which may ultimately prove more reliable and accurate in gathering this type of healthcare data. Further in-depth review by qualified medical staff should be considered to produce conclusive data.


Figure 12-iHeart Diagnostic Menu

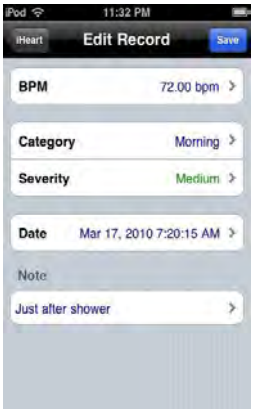


Figure 13-iHeart Report Menu

- Heart Monitor – researchers found that this application does not deliver effective results in a noisy room, since the heart monitor uses sound to identify heart rates (Figure 14). The application was tested using the built-in microphone on the bottom of the iPhone. Anatomic regions used to gather heart rate data included the wrist, upper left chest wall, and the neck area. Researchers noted different results in each of these areas. There are no trending charts, graphs, export of data, or logs offered with this software. However, there is a section that lists the results with a date and time stamp (Figure 15). Most users would be better off purchasing a traditional heart rate monitor to get accurate results. To give an example of the readings variance, four consecutive readings were taken, producing results of 66, 46, 53, and 63.


Figure 14-Heart Monitor Heart Rate Menu


Figure 15-Heart Rate Results Menu

- WaveSense Diabetes Manager – the researchers found this application to be a quick and intuitive way to track blood glucose readings, carbohydrate intake, and insulin dosage. WaveSense, a company that also markets their own blood glucose meters, developed this software application to work with all blood glucose meters on the market today. Users can enter their data without the means of propriety software applications for a specific meter, while also reducing the need for paper and pencil data recording. The iPhone can be programmed with a password, so the data gathered is safe and not compromised. The

researchers found the trend charts and log files to be easy to read and well-organized. The results can be emailed to doctor, diabetes educator, and anyone else who monitors diabetes results. One unique feature this application offers is dLife videos that patients can watch and become better informed about managing their diabetes. Researchers did not find any disadvantages to this software application, which is also a free download.

- BloodWise Glucose / Blood Sugar Tracking Utility – this application is a way for mobile users to track and record blood glucose readings. Researchers found no issues with this application in entering records. The individual takes his/her glucose reading with any glucose meter and manually enters in the data on the iPhone. The main page is simple with only one data field; once an end user completes data entry, the record button is pressed. The measurement time field is entered automatically by syncing to the iPhone's onboard clock. Researchers also found that users can go back to a previous date and time to enter in data which may have been recorded outside of the phone (i.e. pencil and paper). The statistics feature is useful in the way that it allows a user to see the bar graph of all data entered (Figure 16). This feature also shows a measurement distribution by range which could be useful for monitoring readings that are normal or hazardous. This rating is scored on a percentage scale so end users can improve their chances of hitting the normal range with their individual blood glucose readings. (Refer to the Figure 16 to see how this is broken down). The user can also enter in notes for each reading. For example: An end user could state that testing was performed after 60 minutes of exercising. There is also an e-mail feature that can to send the data to the individual's doctor. This application would be a great way to improve QOL for individuals who have Type II diabetes. The only deficiency that researchers found with the software is that it does not allow for low blood sugar recordings.


**Figure 16-BloodWise Bar Graph**

All medical devices that provide diagnostics, recommend treatment, or prevention of a medical issue must be approved and reviewed by the FDA and meet the 510(k) standards (FDA U.S. Food and Drug Administration). CERMUSA researchers have not found any written documentation that states that the Apple iPhone or any other smart phone are, or will become, FDA approved. As such, all the health and wellness software applications available on these devices should include disclaimers that the software is not intended to provide diagnostics, recommend treatment, or prevent medical complications.

The following Mobile/Handheld Apple iPhone software application evaluation matrix (Table 6) represents each software application attributes as it pertains to the Apple iPhone hardware infrastructure.

**Mobile/Handheld Apple iPhone Software Applications Evaluation**

| | Display | Software Required | Monitors: Daily, Weekly, Monthly | Monitor: EKG, Heart Rate | Monitor: Glucose Data | Transfer Data: Email File Format | Memory Size | Hardware Required | Cost | A/V |
|---|---|---|---|---|---|---|---|---|---|---|
| Training Applications | | | | | | | | | | |
| CPR &Choking | Whole iPhone display is used | OS 3.0 | NA | NA | NA | NA | 9.6 MB | NA | Free | 1 minute videos |
| AAC Applications | | | | | | | | | | |
| Proloquo2go | Whole iPhone display is used | OS 3.0 or later | NA | NA | NA | NA | 222 MB | NA | $189.00 | Yes |
| iPrompts | Whole iPhone display is used | OS 3.1 or later | NA | NA | NA | NA | 4.0 MB | NA | $49.99 | Video only |
| Health & Wellness Applications | | | | | | | | | | |
| iStethPro | Whole iPhone display is used | OS 3.0 or later | NA | Heart Rate, Wave form | NA | Email file | 0.5 MB | Headphones with microphone | $0.99 | Yes |
| iHeart | Whole iPhone display is used | OS 3.0 or later | Several weeks of data saved for reports | Heart Rate | NA | Email file: Plain table, CSV, Summary Report | 0.8 MB | Headphones with microphone | $4.99 | Yes |
| Heart Monitor | Whole iPhone display is used | OS 2.0 or later | Several weeks of data saved for reports | Heart Rate | NA | NA coming newer version | 1.8 MB | Headphones with microphone | $2.99 | Yes |
| WaveSense Diabetes Manager | Whole iPhone display is used | OS 3.0 of later | Several weeks of data saved for reports | NA | Yes Carbohydrate Readings, Insulin Readings | Email file: CSV | 5.1 MB | NA | Free | Yes – dLife videos |
| BloodWise Glucose / Blood Sugar Tracking Utility | Whole iPhone display is used | OS 2.2.1 or later | Several weeks / months of data saved for reports | NA | Yes | Email file CSV | 1.0 MB | NA | $1.99 | Video only |

**Table 6-iPhone Software Evaluation Matrix**

The following bar graph (Table 7) represents each individual software applications on the quality and ease of use for that product. A 5-point Likert scale was used to determine the measurable

outcomes, with a ‘5’ on the scale indicating strong agreement while a „1’ indicates strong disagreement.

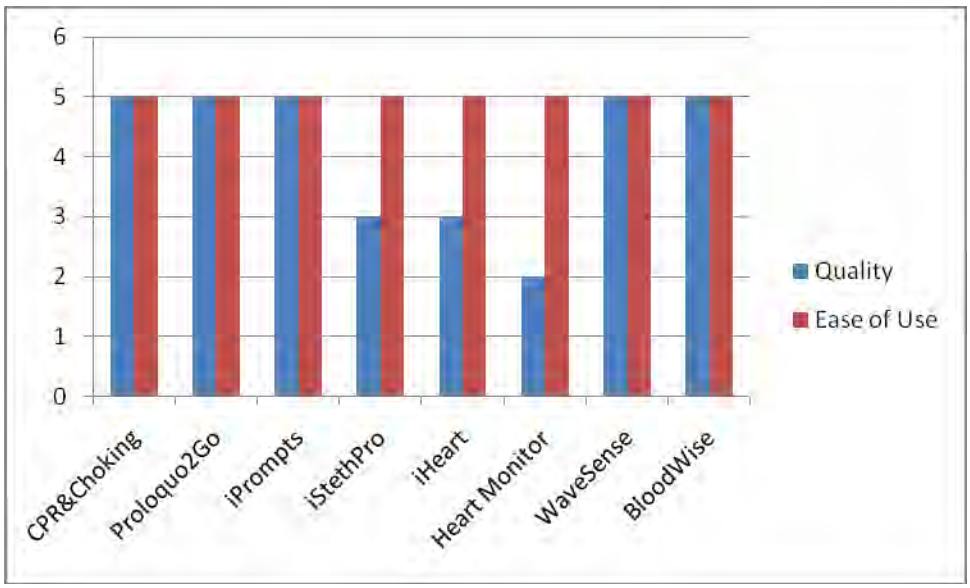


**Table 7-Overall Product East of Use**

## Key Research Accomplishments

- Proof that handheld content delivery framework can be viably constructed and deployed and construction of prototype site
- Identification of potential software applications for upcoming Wound Care At a Distance protocol
- Determination that netbooks are viable desktop replacements
- Identification and evaluation of specific AT devices for potential inclusion in future protocol work

## Reportable Outcomes

- Usable handheld content delivery framework which may support other CERMUSA research and commercial efforts, potentially including groundwork for upcoming Wound Care At a Distance protocol
- List of technologies to be included/excluded from future QOL and other AT-related protocols
- Cost-savings alternative for CERMUSA office support
- Presentations at the Association of Information Technology Professionals Meeting (AITP), May 2010 and the Association of Small Computer Users in Education Conference (ASCUE), June 2010

## Conclusion

During FY08, CERMUSA’s Technology Test Bed continued to fill a niche of providing a low-risk environment for examining new and emerging devices and services for deployment in other protocols. Operating on a very limited budget, project work within this test bed produced

content delivery frameworks for mobile devices and identified technologies that will likely be deployed during the FY09 project year. It is clear from the research and associated data that a quickly-growing number of applications for mobile and handheld devices are becoming available, but that diligence is still required in evaluating these systems. As shown through many of the AT evaluations, these products do not always function as specified.

The software evaluations carried out in advance of the WCAD will likely be used to steer the technology decision making process throughout FY09. In addition, netbooks will definitely be considered as cost savings measures for both project and administrative computing within the next project year.

Along with the Wireless Test Bed, CERMUSA's Technology Test Bed will be enveloped into the new Commercial Technology Integration Center (CTIC) during FY09. As both projects are intended to evaluate novel integration of emerging technologies, this consolidation makes sense. CERMUSA anticipates that a combination of independent information technology research and forward technological reconnaissance for other protocols will continue well into the future.

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# Appendix A

## Video Load Times

| Video #1 - 14 Seconds | |
|---|---|
| Network | Load Time |
| Wireless LAN | 0:06 |
| AT&T 3G | 0:12 |
| AT&T EDGE | 0:44 |

| Video #2 - 33 Seconds | |
|---|---|
| Network | Load Time |
| Wireless LAN | 0:06 |
| AT&T 3G | 0:12 |
| AT&T EDGE | 0:57 |

| Video #3 - 58 Seconds | |
|---|---|
| Network | Load Time |
| Wireless LAN | 0:07 |
| AT&T 3G | 0:14 |
| AT&T EDGE | 1:31 |

Note: Wireless LAN testing was done on the same LAN that hosted Case Study. AT&T testing utilized a Virtual Private Network (VPN).

# Saint Francis University's
# Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA)

**FY08 Annual Report**
**(May 4, 2009 to July 31, 2010)**

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**Protocol Title:** Telehealth Test Bed - Autism Studies

**Protocol No.:** 07-TATTH302b-07

**Date:** July 2010

## Principal Investigator

Brenda Guzic, RN, BSW, MA, Telehealth Research Specialist

## Introduction

The use of music therapy has been shown to improve the clinical outcomes for individuals with cognitive and neurological dysfunction (Kaplan and Steele, 2005); however, there is a shortage of trained facilitators to provide this form of therapy. Saint Francis University's CERMUSA collaborated with Camco Physical and Occupational Therapy, LLC, a provider of contract rehabilitation services in Western Pennsylvania, and Saint Francis University's Fine Arts and Occupational Therapy Departments to train percussion therapy techniques to rural occupational therapists. Occupational therapists, through a technology gateway, were able to simultaneously participate in live percussion exercises with the instructor, in order to become percussion-group facilitators.

## Body

The primary issue in the FY07 and FY08 phases of this study was that occupational therapists in rural areas did not have access to rhythmic therapeutic training. Occupational therapists strive to find ways in which they can assist their clients to communicate and control their environments. Prior to the implementation of this protocol, CERMUSA met with occupational therapists to evaluate their needs and outline the proposed project. Based upon these collaborative and consultative meetings, the decision was made to move forward with the study.

As in any clinical intervention, high priority and high impact must be ascertained. As part of the planning process, a formal needs assessment was conducted with the subject matter experts (SMEs) involved in the research. Also, staff from CERMUSA attended the National Autism Conference held at Pennsylvania State University and conducted informal and impromptu interviews of parents, practitioners, and educators to determine what their needs and the needs of their children were as they related to clinical interventions, in particular, the use of rhythmic interventions. In addition, an extensive literature search was conducted prior to the implementation of the study to:

- Reveal existing knowledge on the subject matter.
- Identify gaps in knowledge.
- Identify what approaches would be taken in research design and methodology.
- Identify other researchers with similar interests.
- Clarify the future directions for the research.

As a result, in FY07, Saint Francis University (SFU) established a „pilot program' to remotely train occupational therapists to facilitate percussion-oriented groups for children with autism and other disorders. The first stage of the program provided training over live interactive video teleconferencing (VTC). The program measured the feasibility of remotely extending a percussion instructor based at SFU via live interactive VTC to dispersed groups of occupational therapists, serving public school children throughout the Commonwealth of Pennsylvania. These occupational therapists, through this technology, were able to simultaneously participate in live percussion exercises with the instructor in order to become percussion-group facilitators.

This phase of the study demonstrated and evaluated the viability of using VTC as a training link between occupational therapists at one location and a percussion facilitator trainer/music instructor located at a different location. Beginning with a feasibility study, CERMUSA experimented with telecommunications technologies to overcome the difficulties of time, distance, and geography to deliver instruction in percussion-oriented techniques, utilizing a point-to-point application. The efficacy of using this method of delivery was assessed. Sustainable technologies, including IP-based (h.323) VTC and established networks were deployed to contain costs and increase the likelihood of a successful project. Audio, video, and networking components selected from a large pool of commercial off-the-shelf devices were also used.

The principal goal was to make sure that training in the use of percussion instruments, delivered via VTC, was comparable to training delivered via in-class instructions. This was measured by comparing participants' outcomes in the test group and the control group. The study design determined the efficacy of the training session and addressed technical issues that are important for this type of educational session. The research plan proved that percussion-oriented techniques learned using VTC were equivalent to those learned using a standard classroom presentation. The research studied the effectiveness of the method of delivering the training and not the training content. Unlike other educational sessions delivered over VTC, the delivery of music instruction poses unique challenges related to latency (measure of time it takes for a piece of information to travel from its source to a destination) and lag (time it takes to send information to and receive a response from a server along a network). The results from the training identified the salient features of this paradigm: hands on experience, instructor supervision, on-sight and distant testing, and video debriefing.

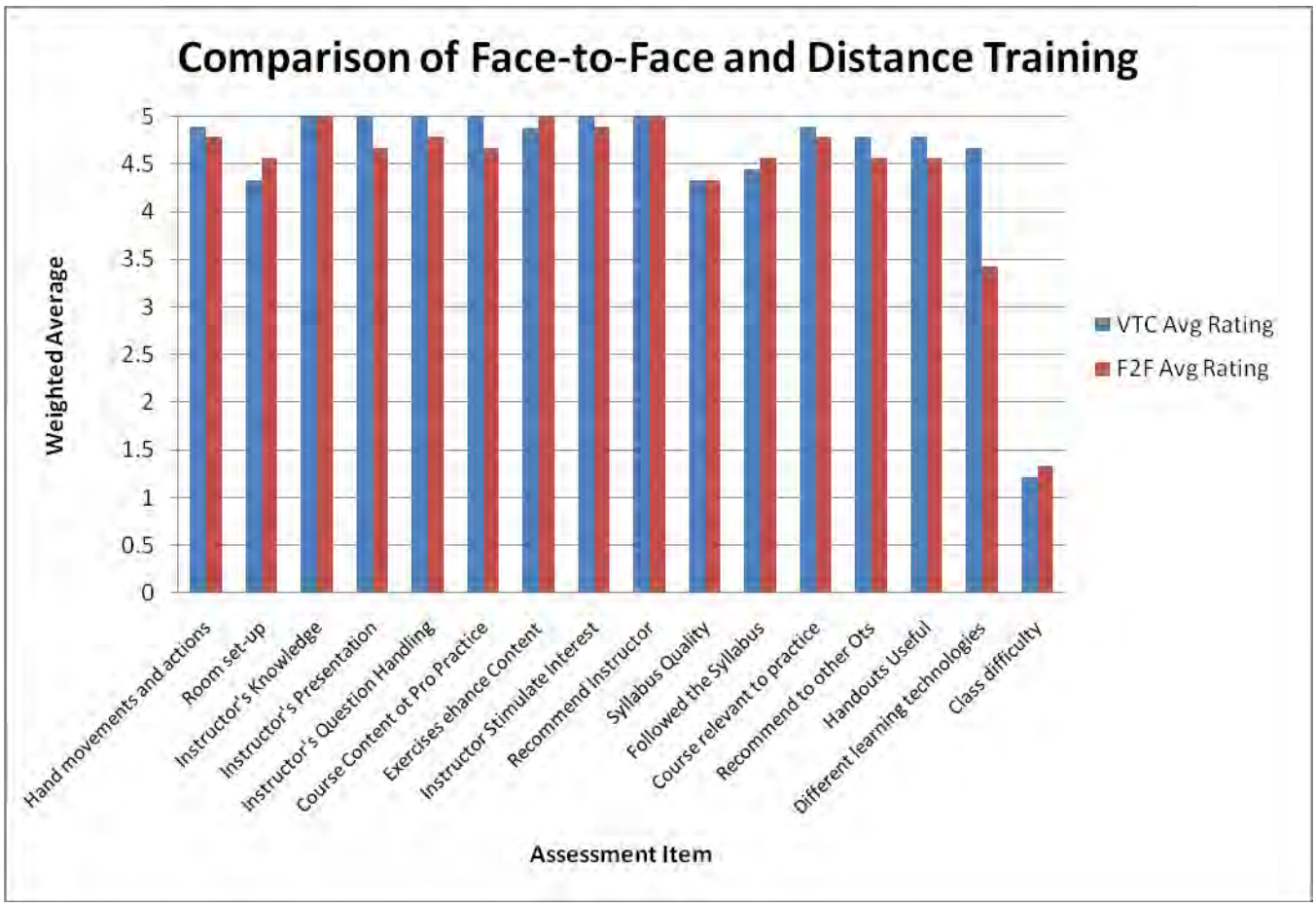
CERMUSA then expanded the study by deploying various drum-emulation software programs in conjunction with desktop sharing software, such as Virtual Network Computing (VNC), so that a drumming facilitator was able to remotely train occupational therapists, with a PC and high-speed Internet connection, in "electronic" percussion techniques. CERMUSA evaluated the tying of external electronic drum pads and augmentative devices (such as alternative computer keyboards) to computer workstations to enhance the experience of in-room percussion instruction. Prior to implementation of the instructions, CERMUSA tested and evaluated the technology that was used to deliver this education to ensure that a quality drumming education session was possible. Tests were conducted in the following areas:

- Audio quality
- Latency/lag affect on collaborative playing
- Web conference connections

Through its research efforts and expertise, CERMUSA overcame the lack of access to training and information in rural and medically underserved areas by utilizing its well-established technological infrastructure to facilitate the delivery of telehealth interventions and distance learning opportunities.

- FY07: Data Analysis results from the training done in FY07 are displayed in Figure 1.

**Figure 1**




In phase two (FY08), occupational therapists who participated in the classes utilized the techniques learned, in an attempt to increase on-task behavior and academic productivity of their students. Participants were occupational therapists whose clients are school children with learning disabilities. The study participants acted as their own control and measured baseline attention-to-task prior to initiation of the percussion intervention. The occupational therapists explained the importance of paying attention and completing work to the students. The occupational therapists systematically observed the students' behavior to determine whether they were attending-to-task more frequently, with greater consistency and for longer periods of time. Attention-to-task was measured and results were compared and contrasted against the baseline data. This was a pilot, outcome-based study involving subjects previously diagnosed with an autism spectrum disorder. The subjects acted as their own control (eight weeks of standard traditional intervention vs. eight weeks of percussion intervention). Collaborating with CERMUSA on this phase of the study was Camco Physical and Occupational Therapy, LLC, and Saint Francis University's Fine Arts and Occupational Therapy Departments.

FY08: Data Analysis results from FY08 are displayed below:

- Demographic Information (Figure 2)
  In FY08, there were 41 individuals in the study. Three of the participants were female (7.32%) and 38 (92.68%) were male. The pie chart below depicts these proportions.
    - Tally for Discrete Variables: Gender
        - Gender Count Percent
            - Female 3 7.32
            - Male 38 92.68
            - N = 41

**Figure 2**

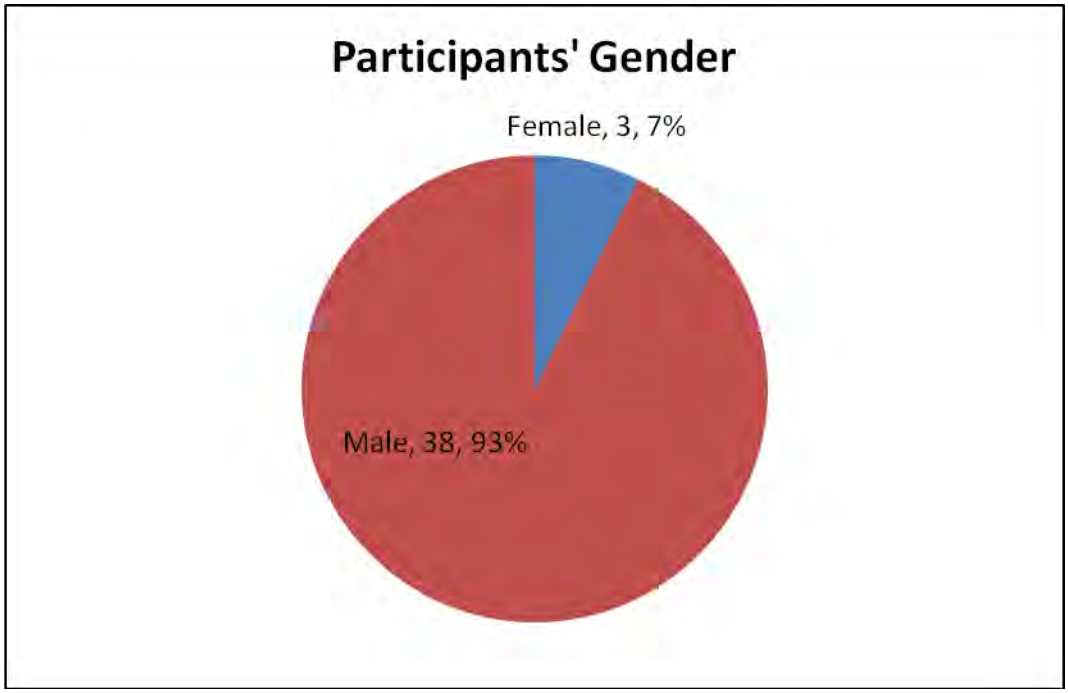


Table 1 shows the number of participants in the study ranged from age 2 to age 17. The mean age of study participants was 8.375, with a median age of 8:

**Table 1**

| Age | Frequency | Relative Frequency |
|---|---|---|
| 2 | 1 | 2.44% |
| 3 | 1 | 2.44% |
| 5 | 5 | 12.19% |
| 6 | 3 | 7.32% |
| 7 | 8 | 19.51% |
| 8 | 5 | 12.19% |
| 9 | 5 | 12.19% |
| 10 | 3 | 7.32% |
| 11 | 4 | 9.76% |
| 13 | 2 | 4.88% |
| 14 | 3 | 7.32% |
| 17 | 1 | 2.44% |
| Total | 41 | 100.0% |

- The grade level of the participants varied from pre-kindergarten to 8th grade as illustrated by Table 2 below:

**Table 2**

| Grade Level | Frequency | Relative Frequency |
|---|---|---|
| Pre-Kindergarten | 3 | 8.11% |
| Kindergarten | 8 | 21.62% |
| 1 | 7 | 18.92% |
| 2 | 1 | 2.70% |
| 3 | 4 | 10.81% |
| 4 | 5 | 13.51% |
| 5 | 4 | 10.81% |
| 6 | 1 | 2.70% |
| 7 | 1 | 2.70% |
| 8 | 3 | 8.11% |
| Total: | 37 | 100.0% |

***Note:*** *Four (4) participants did not report grade level*

- Table 3 illustrate the various diagnoses of the study participants:

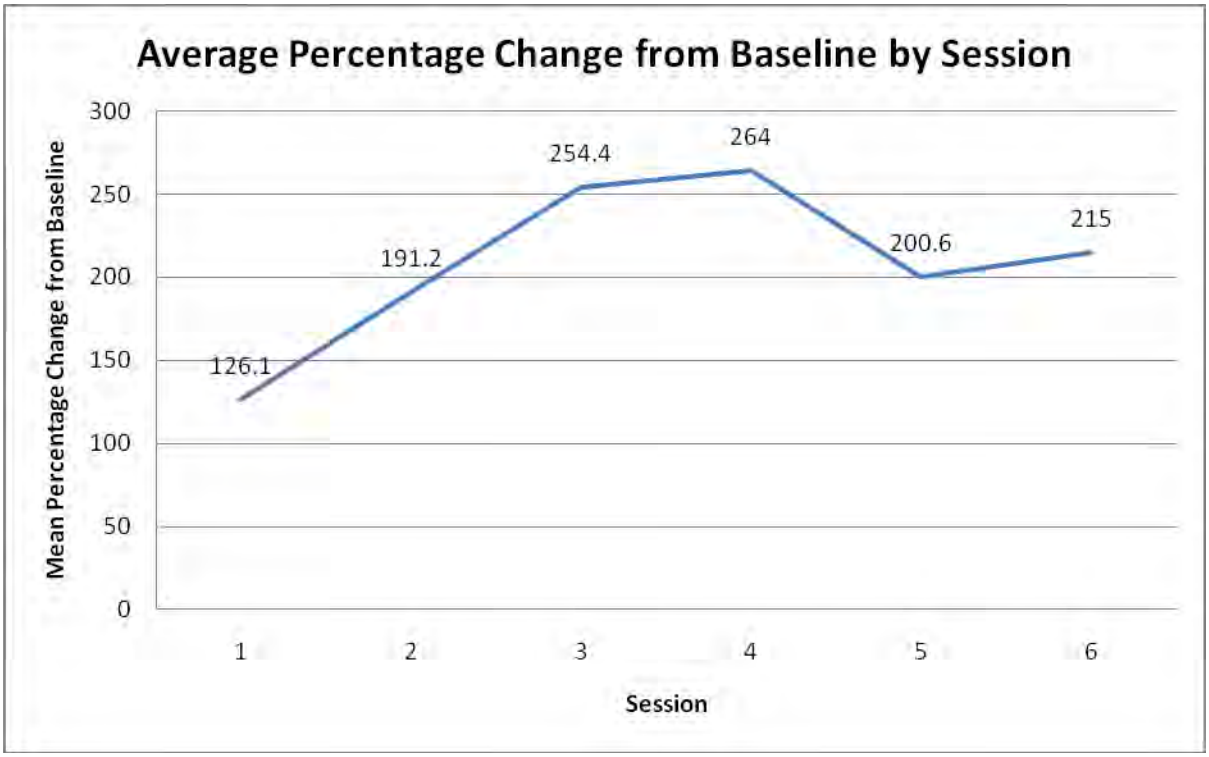
**Table 3**

| Diagnosis | Frequency | Relative Frequency |
|---|---|---|
| Aspergers | 5 | 12.82% |
| Autism Spectrum | 29 | 74.36% |
| MR with Autism | 1 | 2.56% |
| PDD | 4 | 10.26% |
| Total | 39 | 100.0% |

***Note:*** *2 participants did not report a diagnosis*

- Attention-to-task percent change - For each participant in the study, an initial measure of attention-to-task in seconds was recorded. Attention-to-task was also measured during each therapy session. The percentage change from the baseline measure was then calculated for each session. The following line chart (Figure 3) shows the average percentage change in attention-to-task from the baseline by session. For example, 40 of the 41 study participants had a session 1. Of those, the average percentage change in attention-to-task was 126.1% of the baseline percentage. Further a series of one-sample *t* tests showed these changes to be statistically significant.

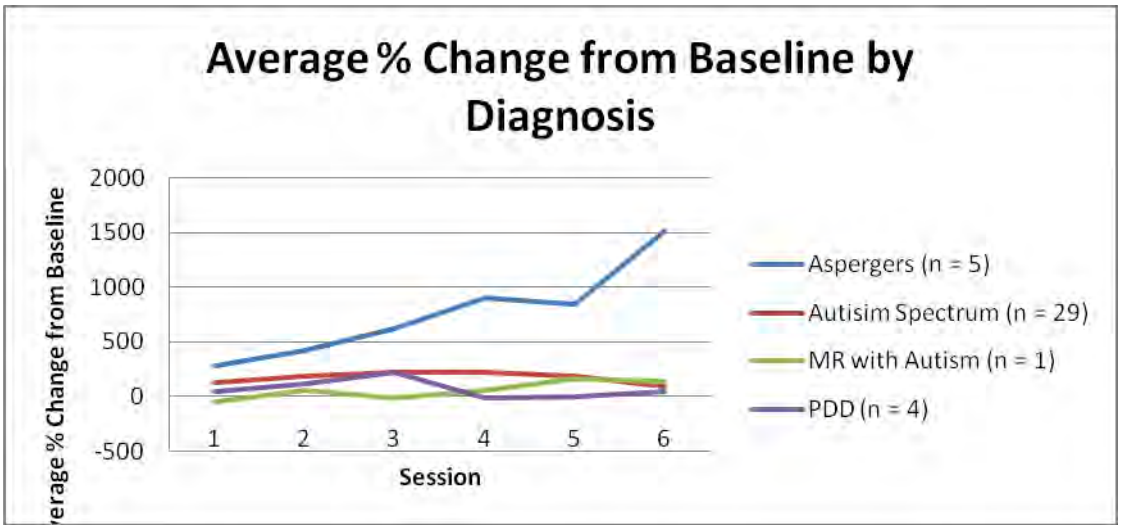
**Figure 3**




***Note:*** *Not all study participants had 6 sessions. The sample size and p value for each session is as follows: Session 1: n = 40, p =0.043; Session 2: n = 38, p = 0.017, Session 3: n = 35, p = 0.11; Session 4: n = 32, p = 0.024, Session 5: n = 27, p = 0.021; Session 6: n = 23, p =0.064.*

- There were patients in the study with 4 different diagnoses and each realized an average percentage increase in attention-to-task as compared to the baseline value. The line chart below (Figure 4) depicts the average % increase by session.

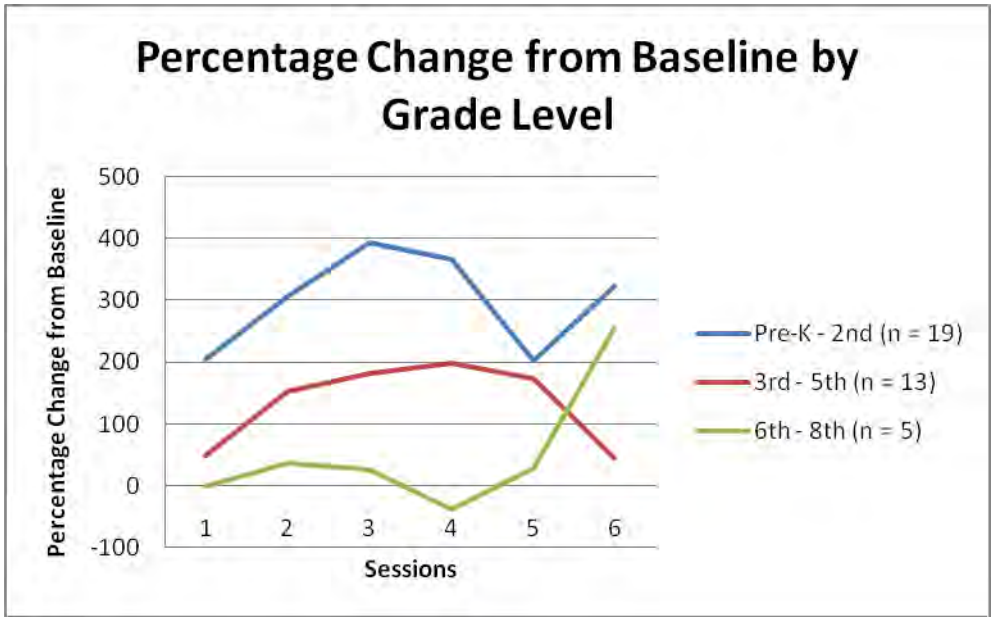
**Figure 4**




***Note:*** *Because the Asperger's percentage change is so high, it somewhat distorts the graph.*

- There were patients in the study varying in grade-level from Pre-Kindergarten to 8th grade; each realized an average percentage increase in attention-to-task as compared to the baseline value. The line chart (Figure 5) below depicts the average % increase by session.

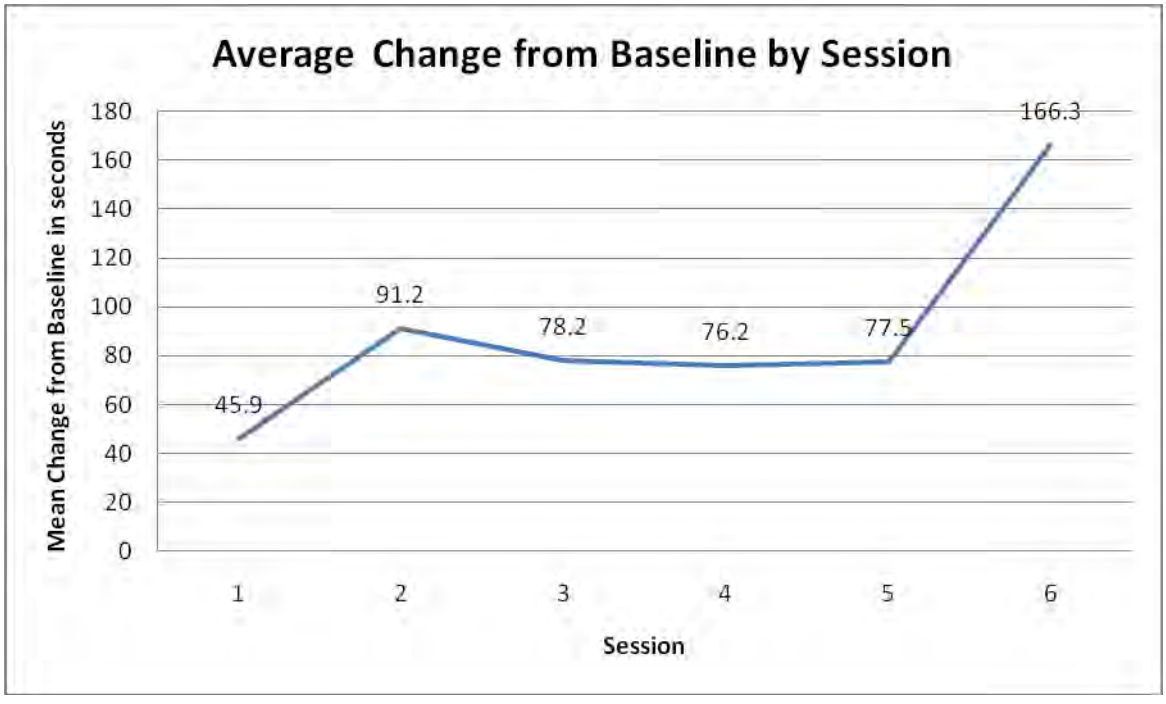
**Figure 5**



- Attention-to-task (Average Change over All Sessions) - As expected, and for various reasons, each participant's performance in the study was not always consistent. There were participants who had realized a significant increase in attention-to-task in one session and then fell below their baseline in the very next session. Therefore, given the nature of the participants and the study, each participant's attention-to-task measured by sessions was averaged to yield a mean change from baseline. The results of this analysis showed that participants in the study realized a statistically significant average increase of 90.3 ($p < 0.01$ seconds) with a median of 74.15 seconds. This is an average percentage change of 189.1%

- Attention-to-task (Raw Change from Baseline) - For each participant in the study, an initial measure of attention-to-task in seconds was recorded. Attention-to-task was also measured during each therapy session. The change from the baseline measure was then calculated for each session. The following line chart (Figure 6) shows the average change in attention-to-task from the baseline in seconds by session. For example, 40 of the 41 study participants had a session 1. Of those, the average change in attention-to-task was an increase of 45.9 seconds from their baseline value. Further, a series of one-sample t-tests showed these changes to be statistically significant.

**Figure 6**




***Note:*** *Not all study participants had 6 sessions. The sample size and p value for each session is as follows: Session 1: n = 40, p =0.126; Session 2: n = 38, p = 0.007, Session 3: n =35, p = 0.006; Session 4: n = 32, p = 0.036, Session 5: n = 27, p = 0.007; Session 6: n = 23, p =0.007.*

Music-related therapy is known to improve communication skills. The reason rhythm is such a powerful tool is that it permeates the entire brain. "Drumming synchronizes the frontal and lower areas of the brain, integrating nonverbal information from lower brain structures into the frontal cortex, producing feelings of insight, understanding, integration, certainty, conviction, and truth, which surpass ordinary understandings and tend to persist long after the experience, often providing foundational insights for religious and cultural traditions" (Winkleman, 2000). The human response to rhythm has been studied for centuries. Rhythm is documented to have a far more influential effect upon us than previously believed (Dolle, 2006). "Research findings confirm positive links between music education, scholastic achievement, and social adaptability, especially among at-risk and special needs children" (Portowitz and Klein, 2007). According to The Institute for Music and Neurologic Function, music affects our neurological, psychological, and physical functioning in areas such as learning, language processing, emotional expression, memory, and physiological and motor responses. The Rhythmic Arts Program (TRAP), employs drums and percussion to teach and enhance basic life skills such as maintaining focus, using memory, taking turns, developing leadership, using numbers, using prepositional concepts, following instructions, and modeling. Issues of spatial awareness, fine and gross motor skills, and speech are also addressed (The Rhythmic Arts Project, 2008).
"The sound of drumming generates dynamic neuronal connections in all parts of the brain even where there is significant damage or impairment such as in traumatic brain injury, stroke, Parkinson's disease, Alzheimer Disease, and Attention Deficit Disorder. The ability to access unconscious information through symbols and imagery facilitates psychological integration and a reintegration of self" (Drake, 2009). Also, a study by Barry Quinn, Ph.D. demonstrates that even a brief drumming session can double alpha brain wave activities, dramatically reducing stress (Friedman, 2000).

## Key Research Accomplishments

- Completed VTC and online training
- Development of "attention-to-task" measurement tool
- Orientation of occupational therapists to use of the tool
- Implementation of percussion techniques by occupational therapists with students on the autism spectrum
- Attention-to-task measurements completed and data analyzed

## Reportable Outcomes

- Acceptance of two posters by the American Telemedicine Association for presentation at their 2010 annual international conference
- Acceptance of an oral presentation at the 2010 International Neurotraumatology Conference
- Article in the Saint Francis University Magazine
- Television interview done with local NBC affiliate, WJAC-TV, that was featured on their "Making a Difference" segment

## Conclusion

Educating occupational therapists in percussion techniques from a distance, using a „technology gateway', is feasible and effective. It is possible to combine instruction in percussion techniques

with distance education and telecommunications technologies. The techniques learned have been tested in a clinical trial to measure attention-to-task results on school age children with autism spectrum disorders. In addition to individuals with autism, documented findings support that percussion techniques work well with people diagnosed with stroke, traumatic brain injury, mental illness, Alzheimer disease, and other dementias (The Rhythmic Arts Project: drums and therapy working hand in hand, 2008 and Gilbertson, S. 2008).

During FY09, CERMUSA will expand the protocol and include an initiative to provide mental healthcare practitioners and families of children with developmental, neurological, emotional, and/or mental health disorders the opportunity to participate in percussion training and interventions delivered via a technology gateway facilitated by Saint Francis University's CERMUSA.

Areas to be addressed, that are compatible to telehealth applications and distance learning modalities, will include counseling, education, social interaction, enjoyment, and treatment of diseases. Study participants will include patients, families/caregivers, and healthcare practitioners on the "continuum of care" and the effectiveness of the techniques will be measured through cognitive and affective assessments.

The goals are to offer percussion training that can be used to:

- Assist parents and professionals raise, treat, and teach special needs children
- Provide opportunities for enjoyment, laughter, play and fun
- Develop and expand retention, coordination, self-esteem, and physical and cognitive functioning

CERMUSA is collaborating with the Quittie Glen Center for Mental Health; a center with a practice based upon the theory of the biopsychosocial model. The biopsychosocial model centers around the belief that mind, body, spirit, and experience are interconnected and all play a role in the health and well being of individuals. The role of the biopsychosocial model, developed by George Engel (Engel, 1977) is important in the studies of how psychological stress affects the development of diseases since many facts have been identified about the interaction between the nervous, endocrine, immune, and other organic systems in stressful situations (Havelka, J. Lucanin, D. Lucanin, 2009).

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## Appendices

A. International Neurotraumatology Conference Abstract – 2010

B. Saint Francis University Magazine Article – 2010

C. American Telemedicine Association Poster Presentation – May 2010, San Antonio, TX
   a. Clinical Format

D. American Telemedicine Association Poster Presentation – May 2010, San Antonio, TX
   a. Technical Format

E. Autism Schema Document

F. Attention-to-Task Document

**Appendix A**

## TRAINING PERCUSSION THERAPY TECHNIQUES TO OCCUPATIONAL THERAPISTS VIA TECHNOLOGY GATEWAYS

B. Guzic*, K. Tonkin*, J. Roberts*, B. Demuth*, A. Bapat*, J. Donovan*

*Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA), Saint Francis University, Loretto, Pennsylvania, USA.

**SCOPE:**

Saint Francis University (SFU) established a „pilot program' to remotely train occupational therapists to facilitate percussion-oriented groups for children with Autism. The program measured the feasibility of remotely extending a percussion instructor based at SFU via live interactive video teleconferencing (VTC) to dispersed groups of occupational therapists and placed an interactive drumming program online to translate traditional rhythm and music intervention strategies to a technology driven medium.

**BACKGROUND:**

The use of music therapy has been shown to improve the clinical outcomes for individuals with cognitive and neurological dysfunction;[1] however, there is a shortage of trained facilitators to provide this form of therapy. Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA) collaborated with CAMCO, a physical and occupational therapy organization serving children with autism, and James Donovan an international performing and teaching artist, to train percussion therapy techniques to rural occupational therapists. Occupational therapists, through a technology gateway, were able to simultaneously participate in live percussion exercises with the instructor, in order to become percussion-group facilitators.

**MATERIAL & METHODS:**

A post-test only, control-group design was utilized for the study and a proficiency score and descriptive statistics were computed for each participant. Mean test scores were computed for the post-test proficiency scores for both groups and both groups were stratified on demographic variables gathered from the survey to determine if the groups were similar on possible intervening variables. The mean score difference between the two groups was tested for statistical significance using a t-test. A convenience sample, of nine occupational therapists was utilized as the test group, and the control group consisted of nine different occupational therapists.

**RESULTS:**

Comparison of face-to-face and distance training participants were made. All of the participants in both the face-to-face training and the distance education passed all aspects of the

training. Participant age, prior musical training, clinical practice setting, or years of clinical experience did not affect outcomes. All participants rated the "relevancy of the course to professional practice" as very good (11.1%) or excellent (88.9%) and indicated that they would apply course concepts to their professional practice.

**DISCUSSIONS & CONCLUSIONS:**

Educating occupational therapists in percussion techniques from a distance, using a ‚technology gateway', is feasible and effective. It is possible to combine instruction in percussion techniques with distance education and telecommunications technologies. The techniques learned are now being tested in a clinical trial, to measure attention-to-task results on school age children with autism spectrum disorders. Results from this trial are anticipated to be available in June 2010. Further collaborations are being sought to expand the project to include other neurological disorders. In addition to working with intellectually challenged individuals, applications have worked very well with people in various therapeutic and healthcare situations including stroke, traumatic brain injury, mental illness, Alzheimer disease, and other dementias.[2]

**REFERENCES:**

(1) Kaplan, R.S. and Steele, A.L. (2005). An analysis of music therapy program goals and outcomes for clients with diagnoses on the autism spectrum. Journal of Music Therapy, 42, 2-19.

(2) The Rhythmic Arts Project: drums and therapy working hand in hand. Retrieved February 7, 2008 from http://www.traponline.com/home.html.

## Appendix B

**Marching to (and talking through) the Beat of Their Own Drums: Percussion Therapy for Persons with Autism Spectrum Disorder begins at Saint Francis University**

- Imagine having a six-year old son who has never spoken to you.
- Imagine being a teacher managing a student who can't get from one classroom to another without counting every tile on the floor.
- Imagine having a sibling who breaks into tantrums if a single part of his or her daily routine is interrupted.

Such images are the face of Autism Spectrum Disorder (ASD): a range of complex neurodevelopment disorders that affects 1 in 100 children in the United States. A national report released in the journal, Pediatrics (October 2009), revealed that one percent of U.S. children ages 3-17 have an autism spectrum disorder. Given these statistics, it is imperative that new and innovative methods be investigated to help this population.

ASD is characterized by social impairments, communication difficulties, and restricted, repetitive, and stereotyped patterns of behavior with the hallmark feature being impaired social interaction. It is common for children with autism to have social isolation issues. This happens because they miss the link to communicate. Persons with ASD, particularly children, are often misunderstood, leaving them isolated from their families and teachers.

Early in 2008, researchers at Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA) began discussions with Jim Donovan, a renowned percussionist and drum workshop facilitator. Donovan, a full-time instructor of music at Saint Francis and a founding member of the popular multi-platinum selling band Rusted Root, had worked with CERMUSA previously in extending the reach of arts education via videoconference, interactively broadcasting to students around the world with music and cultural presentations. Donovan worked with CERMUSA employees Brenda Guzic and Kent Tonkin to create a concept of applying percussion interventions at a distance to help persons with ASD.

This idea of using percussion as therapy for persons with ASD was based upon research performed by CERMUSA and previous session work by Donovan with persons with disabilities. Guzic, a registered nurse and telehealth research specialist, who is also a member of the American Music Therapy Association, discovered that limited data existed on the efficacy of using percussion or general music therapy with persons with ASD, but that nearly all published studies indicated a high rate of success in engendering communications between children and parents.

**Appendix C**

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# Training Percussion Therapy Techniques to Occupational Therapists Via Technology Gateways

**Brenda Guzic, Kent Tonkin, Jay Roberts, Barbara Demuth, Eric Muncert**
Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas, Loretto, Pennsylvania

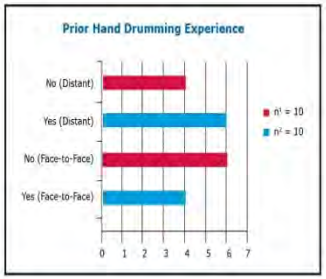
CERMUSA

## Hypothesis

Providing access to percussion education, via live interactive video teleconferencing, can result in greater numbers of healthcare professionals having access to percussion education and improved user satisfaction.

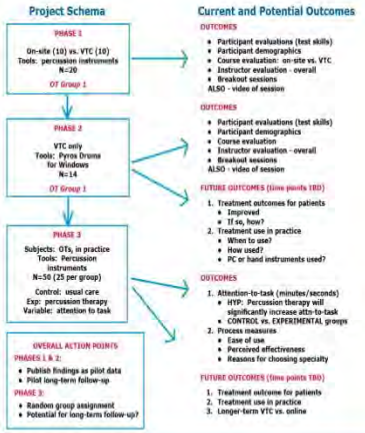
## Introduction

The use of music therapy is known to improve the clinical outcomes for individuals with cognitive and neurological dysfunction.[1] However, there is a shortage of trained facilitators to provide this unique form of therapy. Saint Francis University's (SFU) Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA) collaborated with Camco Physical and Occupational Therapy, LLC, a physical and occupational therapy provider organization in Western Pennsylvania serving children with autism, and James Donovan, an international performing and teaching artist, to teach percussion therapy techniques to rural occupational therapists. Through a technology gateway, a network point acting as an entrance to another network, occupational therapists were able to simultaneously participate in live percussion exercises with the instructor, in order to become percussion-group facilitators. An interactive drumming program was also placed online to translate traditional rhythm and music intervention strategies to a technology driven medium.




## Methodology

A post-test only, control-group design was utilized for the study and a proficiency score and descriptive statistics were computed for each participant. This design was used to measure the effectiveness of remotely extending a percussion instructor based at SFU via live interactive video teleconferencing (VTC) to dispersed groups of occupational therapists. Mean test scores were computed for the post-test proficiency scores for both groups, and both groups were stratified on demographic variables gathered from the surveys to determine if the groups were similar on possible intervening variables. A convenience sample of ten occupational therapists was utilized as the test group, and the control group consisted of ten different occupational therapists. The mean score difference between the two groups was tested for statistical significance using a t-test.




## Results

A comparison of face-to-face and distance training participants was completed. All of the participants in both the face-to-face training and the distance education passed all aspects of the training. Participant age, prior musical training, clinical practice setting, or years of clinical experience did not affect outcomes. All participants rated the "relevancy of the course to professional practice" as very good (11.1%) or excellent (88.9%), and indicated that they would apply course concepts to their professional practice.

The chart shows the weighted average of those items that were assessed by both the face-to-face and distance participants. Most of the ratings are very similar.

Cognitive Learning: All occupational therapists in both the face-to-face and the distance education classes successfully completed all aspects and levels of training.


## Discussion & Conclusions

Educating occupational therapists in percussion techniques from a distance, using a 'technology gateway', is feasible and effective. It is possible to combine instruction in percussion techniques with distance education and telecommunications technologies. The techniques learned are now being tested in a clinical trial to measure attention-to-task results of school age children with autism spectrum disorders. Results from this trial are anticipated to be available in June 2010. To improve the quality and expand the scope of the project, CERMUSA is collaborating with community mental health organizations. In addition to individuals with autism, documented findings support that percussion techniques work well with people diagnosed with stroke, traumatic brain injury, mental illness, Alzheimer's disease, and other dementias.[2]

Percussion instructor located at SFU trains occupational therapists via VTC.

Occupational therapists located at remote site receive percussion training via VTC.

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(2) *The Rhythmic Arts Project: drums and therapy working hand in hand.* Retrieved February 7, 2008 from http://www.traponline.com/home.html.

## Acknowledgement

This project is supported by Saint Francis University's CERMUSA in Loretto, Pennsylvania, and funded by the U.S. Army Medical Research and Materiel Command (USAMRMC) Telemedicine and Advanced Technology Research Center (TATRC), Fort Detrick, Maryland – Contract Number W81XWH-06-2-0018.

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**Appendix D**

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# And the Beat Goes On: Technical Challenges of Remotely Training Occupational Therapists to Perform Drumming Interventions for Children with Autism

**Kent Tonkin, Brenda Guzic, Jay Roberts, Barbara Demuth, Ashok Bapat, Eric Muncert, James Donovan**
Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas, Loretto, Pennsylvania

CERMUSA

## Hypothesis

Videoconferencing and other remote access technologies can be deployed to extend the reach of percussion therapy and training to occupational therapists (OTs) and patients at a distance.

## Introduction

Saint Francis University's (SFU) Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA) established a 'pilot program' to remotely train OTs to facilitate percussion-oriented groups for children with autism. Existing and low-cost technologies were deployed to extend the reach of this program beyond the campus of SFU. This project was a collaboration between CERMUSA and Camco Physical and Occupational Therapy, LLC, a physical and occupational therapy provider organization that offers rehabilitation services in varied healthcare and educational settings.

The technological work detailed here was performed in support of CERMUSA's Telehealth Test Bed – Autism Studies project. The study, intended to measure the efficacy of training OTs at a distance to facilitate percussion-based interventions for children with autism, required support for online transmission of percussion instruction in a real-time format. The use of music therapy has recently garnered interest as a method of facilitating communications and interaction for children with autism,[1] and has demonstrated significant efficacy in providing interpersonal support.[2] The approach taken for this project built upon previous CERMUSA work in broadcasting music education via video teleconferencing (VTC) and other research which has demonstrated the efficacy of this methodology.[3]

## Methodology

Pre-Research Phase:

1. Performed testing and evaluation of percussion instrument transmission via VTC.
2. Reviewed and tested technologies to assist in remote percussion instruction.
3. Initial approach: Experimented with remote percussion instrument collaboration to determine if standard VTC equipment would support real-time group performance.
4. Test run:
   - Percussion instructor and an associate investigator performed simple rhythms together on hand drums via VTC (H.323 Internet Protocol systems operating at 384kbps).
   - Conducted experiments at a distance with instructor addressing OTs in the use of acoustic and electronic tools as interventions for children with autism.
5. Installed license-free drumming software package on laptop computers and evaluated them as alternatives to acoustic percussion devices.
6. Demonstrated assistive technology devices to OTs that could be used to reach a wider variety of individuals on the autism spectrum (i.e., some individuals may respond to tactile devices while other individuals may respond to visual applications).

Project Schema


Conducted two education sessions with the OTs from Camco Physical and Occupational Therapy, LLC, during summer 2009:

**Phase I:**

- Percussion instructor trained two separate groups of OTs on-site (day 1) and at distance via VTC (day 2) in the use of acoustic percussion tools.

**Phase II:**

- OTs were given instruction in the same methodology via electronic percussion tools at a distance via VTC (day 2).

At the conclusion of Phase I remote session, participants were asked to score and evaluate the technologies they had used (Table 1) and to complete a competency exam.*

Table 1. Participant Assessment of Session Technical Quality

| Attribute | Rated Poor | Rated Fair | Rated Good | Rated Very Good | Rated Excellent | No Opinion |
|---|---|---|---|---|---|---|
| Video Quality | 0 | 0 | 0 | 1 | 2 | 6 |
| Audio Quality | 0 | 0 | 0 | 2 | 5 | 2 |
| Distant Participants' Assessment of VTC Connection | 0 | 0 | 0 | 1 | 2 | 6 |
| Distant Participants' Assessment of Ability to View Hand Movements and Actions | 0 | 0 | 0 | 1 | 8 | 0 |

* One of the ten participants did not complete a survey.

## Results

- Video transmission latency of current H.323 videoconferencing systems made real-time musical collaboration impossible.
- Time delay testing performed with U.S. Government Atomic clock (www.time.gov) showed transmission delays of up to two seconds (Table 2).
- "Call and Response" methodology implemented as effective alternative strategy.
- Drumming software/laptops are effective peripherals and can be "played" like drums.
- OTs' opinions regarding quality of the distance sessions were highly positive; overall ratings were nearly identical between on-site and remote learning groups, as indicated by compiled post-class surveys (see Table 1)*.

Table 2. Video Conference Percussion Latency

| Beat Number | Perceived Time at Local Site | Perceived Time at Receiving Site |
|---|---|---|
| 1 | 10:28:17 | 10:28:19 |
| 2 | 10:28:28 | 10:28:30 |
| 3 | 10:28:36 | 10:28:38 |
| 4 | 10:28:45 | 10:28:46 |
| 5 | 10:28:54 | 10:28:56 |
| 6 | 10:29:01 | 10:29:03 |
| 7 | 10:29:08 | 10:29:10 |
| 8 | 10:29:17 | 10:29:19 |
| 9 | 10:29:26 | 10:29:28 |
| 10 | 10:29:33 | 10:29:35 |

## Discussion & Conclusions

- Remote video connectivity is a practical tool for training OTs to perform percussion interventions.
- Despite the need to adapt to the technological limitations and nuances, existing standards-based equipment provides a viable toolkit for extending access to percussion trainers.
- Free and low-cost software and adaptive devices offer viable alternatives to the purchase of traditional acoustic percussion devices.
- OTs generated a series of ideas for further uses of both remote and local technologies in assisting students with autism. Examples include: the use of colored tape on electronic drum pads to associate colors, characters (i.e., the alphabet), or words (i.e., names) with specific sounds.
- The next iteration of this project may include some level of remote connection with OTs, either for refresher training or direct interaction with children with autism/their parents.

## References

(1) Scott, J. (2009). *Studying the Impact of Music on Children with Autism*. Foods Matter, 17. Retrieved March 29, 2010, from ProQuest Nursing & Allied Health Source.
(2) Walworth, D., Register, D., & Engel, J. (2009). *Using the SCERTS Model Assessment Tool to Identify Music Therapy Goals for Clients with Autism Spectrum Disorder*. Journal of Music Therapy, 46(3), 204-16. Retrieved March 29, 2010, from ProQuest Health and Medical Complete. (Document ID: 1877801701).
(3) Gibson, J., Pennington, R., Stenhoff, D., & Hopper, J. (2010). *Using Desktop Videoconferencing to Deliver Interventions to a Preschool Student With Autism*. Topics in Early Childhood Special Education, 29(4), 214-225. Retrieved March 29, 2010, from Career and Technical Education. (Document ID: 1934757381).

* For a full critique and breakdown of participant ratings, please see the poster entitled, "Training Percussion Therapy Techniques to Occupational Therapist Via Technology Gateways," also featured at the ATA 2010 Annual Meeting poster presentation.

## Acknowledgement

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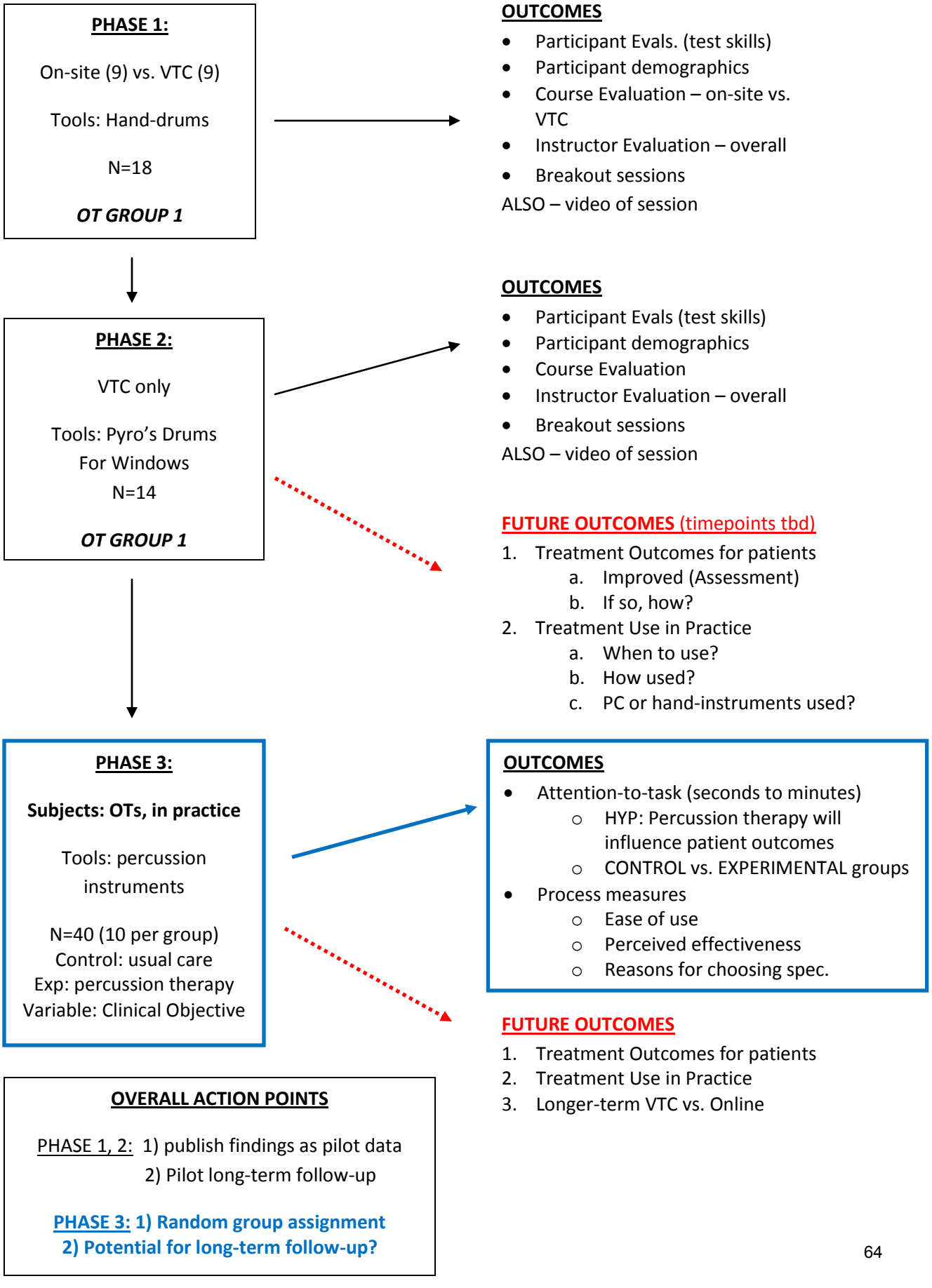
## Appendix E – Protocol Schema



**Appendix F**

**Center of Excellence for Remote and Medically Under-Served Areas**
**(Attention-to-Task)**

*Please complete basic information and record needed information for each session. Please contact Brenda Guzic, phone:* ***814-471-1204*** *or email:* ***bguzic@cermusa.francis.edu*** *with questions or concerns. Thank you for your time and efforts!*

| ***Basic Information*** | |
|---|---|
| **Therapist Information**<br>**Name:**_____<br>Professional Status: *please select*: OT OT-A<br>Year Licensed: _____<br>Years in Practice:_____<br>Date of Online Training Review: _____ | **Patient Information:**<br>**Student #:**_____<br>Age: _____<br>Grade Level: _____<br>Sex: *please select*: Male Female<br>Diagnosis: _____ |
| **Baseline** (*please record attention-to-task prior to beginning percussion therapy*)<br>Date:_____<br>Attention-to-task (minutes: seconds):_____ | |

| ***Percussion therapy sessions*** | |
|---|---|
| Session #:_____<br>Attention-to-task (minutes: seconds):_____ | Date: |
| Session #:_____<br>Attention-to-task (minutes: second):_____<br>Percussion tool(s) used:_____ | Date:_____ |
| Session #:_____<br>Attention-to-task (minutes: second):_____ | Date: |
| Session #:_____<br>Attention-to-task (minutes: second):_____ | Date: |
| Session #:_____<br>Attention-to-task (minutes: second):_____ | Date: |
| Session #:_____<br>Attention-to-task (minutes: second):_____ | Date: |

# Saint Francis University's
# Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA)

**FY08 Annual Report**
**(May 4, 2009 to July 31, 2010)**

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**Protocol Title:** Telehealth Test Bed - Wellness Studies

**Protocol No.:** 07-TATTH302a-07

**Date:** July 2010

## Principal Investigator

Carol McIlhenny, BSN, RN, Telehealth Research Specialist

## Introduction

Information technologies have been identified as a leading means of decreasing the remoteness of rural healthcare. Internet accessibility is growing in rural America, as is the amount of information available on the World Wide Web. Individuals are searching the Internet with growing frequency to find answers to their health questions or for help to manage their chronic diseases. Because not all information available on the Internet is current and/or evidence-based, CERMUSA created a web portal to link to reputable, non-commercial health and wellness sites. A nurse educator will be providing individualized patient education, along with guidance through the Internet portal, for the participants in the intervention group. Lessons learned from this ongoing study can be applied to a variety of healthcare, public, and private settings. This study will address the ongoing challenge of providing all patients (civilians, active military, warriors in transition, and aging veterans) with access to quality health and wellness education.

## Body

Health promotion has been described as an aggregation of health education and related organizational, political, and economic changes aimed at improving health (Hooyman, 1999). Increasing emphasis has been placed on interventions that consider multiple social, biological, cultural, and economic factors that influence health and health behavior. Health promotional efforts are intended to exemplify a transformation from the more traditional biomedical model that accentuates the physician's responsibility to treat disease, to a model in which individuals are increasingly responsible for optimizing their health and the quality of their life through self-care (Parker, 2001).

The delivery of quality health promotion information to rural populations can be a difficult and challenging process. The target population in Huntingdon County, Pennsylvania, lives in a rural area and is poor with 11.8% of the population living below the poverty level (Bureau of Health Statistics, Pennsylvania Department of Health, 2007c). Consequently, the health clinics these patients attend also have few resources. The clinics rely on free education material provided by pharmaceutical companies. Often, the information contained in the patient handouts is outdated by the time the resource has been depleted.

Complicating the issue is that more than 25.4% of the county's residents have not completed high school (U. S. Bureau of Census, 2000). This raises concerns regarding health literacy and its effects on health and wellness education.

Since this study's inception, CERMUSA has sought to meet the need of providing accurate, current patient education materials to residents in rural Pennsylvania. One key objective of this protocol was to build a comprehensive, sustainable model for healthcare, health and wellness education, and quality of life issues for the rural, medically underserved areas of southwest central Pennsylvania.

Telehealth is the delivery of health-related services and/or information via telecommunications technologies (U.S. Department of Health and Human Services, Health Resources and Services

Administration, n.d.). Utilizing telehealth technologies, such as the Internet, can assist rural healthcare practitioners in providing health and wellness education. Accessing health information on the Internet can assist the public in becoming more aware of their self-management needs. The information may also result in patients becoming proactive in their healthcare which may lead to improved quality of life and clinical measures. The Internet has already become a primary source of health-related information in today's society. With this technology, people can obtain the most current data available to manage their illness. But because many sites contain information that is not evidence-based, or may be biased due to advertising, CERMUSA created a web portal to link current, evidence-based health-related websites: My Health Education and Resources Online (MyHERO).

CERMUSA is currently assessing the impact of this health education model with two clinics in Huntingdon County. These clinics currently exist in an area that already reports significantly higher percentages of adults who describe their health as fair or poor compared to Pennsylvania in general (Bureau of Health Statistics, Pennsylvania State Department of Health, 2002). According to the Pennsylvania Behavioral Risk Factor Surveillance System data (Bureau of Health Statistics, Pennsylvania State Department of Health, 2007a), residents who have incomes below $15,000 or less than a high school education are at a higher risk for reporting one or more days of poor physical or mental health.

The scope of the impact will include changes in quality of life (Appendices A, B, C), knowledge (Appendices D, E) and health literacy (Appendices F, G). The protocol will monitor changes in clinical data such as fasting blood glucose levels and hemoglobin A1C, among other things. The data collection will also include questions regarding behavior change (Appendices, H, I) as a result of participation in the protocol. The nurse educator is to collect qualitative data and anecdotal information from the intervention group during the scheduled participant education sessions (Appendices J, K). The qualitative data will reveal the acceptability of and satisfaction with the Internet portal to the participants and the nurse educator (Appendices L, M). The researchers plan to conclude the data collection phase in early FY09.

## Key Research Accomplishments

- Maintained a public web portal (MyHERO) to non-commercial healthcare education sites
    - Unrestricted, public access to current, reliable health and wellness information will be available to military personnel, their families, warriors in transition, veterans and civilians of all ages
- Initiated collection of 6 month surveys and clinical data
    - Six month surveys are currently being stored in Blackboard (online course management system)
    - This data will be exported to an Excel Spreadsheet to be forwarded to CERMUSA's biostatistician
    - Three and six month clinical data are currently being stored in an Excel spreadsheet
    - Qualitative data is still in raw format requiring transcription
- Concluded data collection phase of study
    - Baseline survey data are currently being stored in Blackboard

    - This data will be exported to an Excel Spreadsheet to be forwarded to the biostatistician
    - Baseline clinical data are currently being stored in an Excel spreadsheet
- Concluded individualized patient education model which included web-based education
- Monitored web usage of MyHERO (Appendix N)
    - MyHERO usage has been less than expected
    - Anecdotal data from the nurse educator indicated that many participants lack access to a personal computer in their home, Internet access, and the desire to use and/or learn to do so

## Reportable Outcomes

- Literature review information and statistics is being utilized to apply for Centers for Disease Control and Prevention (CDC) education grant
- Plan to submit for presentation to the 2011 American Telemedicine Association International Meeting

## Conclusion

This is a continuing study. Data collection for this protocol concluded in the FY08 no-cost extension period. Data analysis and final reports will continue into FY09. Until all data is analyzed, the impact of the educational model will be unknown. To date, MyHERO access has been significantly lower than anticipated. This may be due in part to the age of the participants and the lack of Internet access in the home in rural Pennsylvania. The latest statistics in rural Pennsylvania show Internet access growing. Currently 69% of the homes in rural Pennsylvania have Internet access, compared to 78% of urban homes (The Center for Rural Pennsylvania [CRP], 2009). However, only 5% of households below the poverty level have Internet access (CRP, 2007). Internet access is increasing among senior citizen households with more than half connected (CRP, 2009).

The anecdotal data provided by the nurse educator regarding the intervention group's lack of desire to access the Internet is disappointing. Even though participants may have lacked access in their homes, many public libraries often provide this service free of charge. CERMUSA also provided laptop computers connected to the Internet and printers in each clinic for patients to use to access and print the health education materials.

After analyzing the data from this study, we anticipate to determine the relationship between the accessibility of understandable, evidence-based health and wellness information and improvement in clinical measures and quality of life. We also predict that participants will demonstrate a greater increase in knowledge regarding the management of their chronic disease as a result of individualized patient education sessions over traditional patient education. Results of this study can be used to improve the delivery of current, evidence-based patient education information. Qualitative data will be considered when designing future web-based patient health and wellness education applications.

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# Appendix A

# HEALTH-RELATED QUALITY-OF-LIFE MEASURE (HRQOL-14)

**Health Care and Aging Studies Branch**
**Division of Adult and Community Health**
**National Center for Chronic Disease Prevention and Health Promotion**
**Centers for Disease Control and Prevention**

The 4-item set of health-related quality-of-life questions (HRQOL-4) below has been in continuous use in the state-based Behavioral Risk Factor Surveillance System (BRFSS) since January, 1993 (See http://www.cdc.gov/nccdphp/brfss/). As of the end of 1999, over 800,000 adults aged 18 and older have responded to these core BRFSS questions. Beginning in 2000, the HRQOL-4 are also asked in the National Health and Examination Survey (NHANES) for persons aged 12 and older. A related 10-item Quality-of-Life (QOL) module has also been available for optional use in the BRFSS since January 1995. When used together, the HRQOL-4 and the supplemental 10-item module form the expanded HRQOL-14 set of questions that many states and communities are now using in their surveys, providing a large public-domain source of HRQOL population data.

The CDC HRQOL-14 questions have been validated in several studies, including ones that have cross-validating the questions with the widely-used Rand Corporation's Medical Outcomes Study Short-Form 36 (SF-36). Results to date indicate that the HRQOL-14 questions, in spite of their brevity, predict short-term mortality and hospital utilization and have reasonably good criterion validity with respect to the SF-36 in both healthy and disabled populations. The BRFSS QOL questions significantly extend the utility of the BRFSS, now administered and used by all 50 states and the District of Columbia.

---

The interview will only take a short time, and all the information obtained in this study will be confidential.

**Section 1: Health Status**

1. Would you say that in general your health is: (33)

| | **Please Read** | |
|---|---|---|
| | a. Excellent | 1 |
| | b. Very good | 2 |
| | c. Good | 3 |
| | d. Fair | 4 |
| | **or** | |
| | e. Poor | 5 |
| **Do not** | Don't know/Not sure | 7 |
| **read these** | Refused | 9 |
| **responses** | | |

2. Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good? (34-35)

a. Number of days _ _
b. None 88
Don't know/Not sure 77
Refused 99

3. Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good? (36-37)

a. Number of days _ _
b. None **If Q. 2 also "None," skip next question** 88
Don't know/Not sure 77
Refused 99

4. During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation? (38-39)

a. Number of days _ _
b. None 88
Don't know/Not sure 77
Refused 99

# Supplemental Quality-of-Life Module

**These next questions are about physical, mental, or emotional problems or limitations you may have in your daily life.**

1. Are you LIMITED in any way in any activities because of any impairment or health problem?
   - a. Yes 1
   - b. No **Go to Q. 6** 2
   - Don't know/Not sure **Go to Q. 6** 7
   - Refused **Go to Q. 6** 9

2. What is the MAJOR impairment or health problem that limits your activities?
   **Do Not Read. Code Only One Category.**
   - a. Arthritis/rheumatism 0 1
   - b. Back or neck problem 0 2
   - c. Fractures, bone/joint injury 0 3
   - d. Walking problem 0 4
   - e. Lung/breathing problem 0 5
   - f. Hearing problem 0 6
   - g. Eye/vision problem 0 7
   - h. Heart problem 0 8
   - i. Stroke problem 0 9
   - j. Hypertension/high blood pressure 1 0
   - k. Diabetes 1 1
   - l. Cancer 1 2
   - m. Depression/anxiety/emotional problem 1 3
   - n. Other impairment/problem 1 4
   - Don't know/Not sure 77
   - Refused 99

3. For HOW LONG have your activities been limited because of your major impairment or health problem?
   **Do Not Read. Code using respondent's unit of time.**
   - a. Days 1 _ _
   - b. Weeks 2 _ _
   - c. Months 3 _ _
   - d. Years4 _ _
   - Don't know/Not sure 7 7 7
   - Refused 9 9 9

4. Because of any impairment or health problem, do you need the help of other persons with your PERSONAL CARE needs, such as eating, bathing, dressing, or getting around the house?
   - a. Yes 1
   - b. No 2
   - Don't know/Not sure 7
   - Refused 9

5. Because of any impairment or health problem, do you need the help of other persons in handling your ROUTINE needs, such as everyday household chores, doing necessary business, shopping, or getting around for other purposes?
   - a. Yes 1
   - b. No 2
   - Don't know/Not sure 7

Refused 9

6. During the past 30 days, for about how many days did PAIN make it hard for you to do your usual activities, such as self-care, work, or recreation?
   a. Number of days _____ _
   b. None 8 8
   Don't know/Not sure 7 7
   Refused 9 9

7. During the past 30 days, for about how many days have you felt SAD, BLUE, or DEPRESSED?
   a. Number of days _____ _
   b. None 8 8
   Don't know/Not sure 7 7
   Refused 9 9

8. During the past 30 days, for about how many days have you felt WORRIED, TENSE, or ANXIOUS?
   a. Number of days _____ _
   b. None 8 8
   Don't know/Not sure 7 7
   Refused 9 9

9. During the past 30 days, for about how many days have you felt you did NOT get ENOUGH REST or SLEEP?
   a. Number of days _____ _
   b. None 8 8
   Don't know/Not sure 7 7
   Refused 9 9

10. During the past 30 days, for about how many days have you felt VERY HEALTHY AND FULL OF ENERGY?
    a. Number of days _____ _
    b. None 8 8
    Don't know/Not sure 7 7
    Refused 9 9

**END**QOLMOD.00Q

# Appendix B

## Problem Areas In Diabetes (PAID) Questionnaire

**INSTRUCTIONS:** Which of the following diabetes issues are currently a problem for you?

Circle the number that gives the best answer for you. Please provide an answer for each question.

| | Not a problem | Minor problem | Moderate problem | Somewhat serious problem | Serious problem |
|---|---|---|---|---|---|
| | τ | τ | τ | τ | τ |
| 1. Not having clear and concrete goals for your diabetes care? | 0 | 1 | 2 | 3 | 4 |
| 2. Feeling discouraged with your diabetes treatment plan? | 0 | 1 | 2 | 3 | 4 |
| 3. Feeling scared when you think about living with diabetes? | 0 | 1 | 2 | 3 | 4 |
| 4. Uncomfortable social situations related to your diabetes care (e.g., people telling you what to eat)? | 0 | 1 | 2 | 3 | 4 |
| 5. Feelings of deprivation regarding food and meals? | 0 | 1 | 2 | 3 | 4 |
| 6. Feeling depressed when you think about living with diabetes? | 0 | 1 | 2 | 3 | 4 |
| 7. Not knowing if your mood or feelings are related to your diabetes? | 0 | 1 | 2 | 3 | 4 |
| 8. Feeling overwhelmed by your diabetes? | 0 | 1 | 2 | 3 | 4 |
| 9. Worrying about low blood sugar reactions? | 0 | 1 | 2 | 3 | 4 |
| 10. Feeling angry when you think about living with diabetes? | 0 | 1 | 2 | 3 | 4 |
| 11. Feeling constantly concerned about food and eating? | 0 | 1 | 2 | 3 | 4 |
| 12. Worrying about the future and the possibility of serious complications? | 0 | 1 | 2 | 3 | 4 |
| 13. Feelings of guilt or anxiety when you get off track with your diabetes management? | 0 | 1 | 2 | 3 | 4 |
| 14. Not "accepting" your diabetes? | 0 | 1 | 2 | 3 | 4 |
| 15. Feeling unsatisfied with your diabetes physician? | 0 | 1 | 2 | 3 | 4 |
| 16. Feeling that diabetes is taking up too much of your mental and physical energy every day? | 0 | 1 | 2 | 3 | 4 |
| 17. Feeling alone with your diabetes? | 0 | 1 | 2 | 3 | 4 |
| 18. Feeling that your friends and family are not supportive of your diabetes management efforts? | 0 | 1 | 2 | 3 | 4 |
| 19. Coping with complications of diabetes? | 0 | 1 | 2 | 3 | 4 |
| 20. Feeling "burned out" by the constant effort needed to manage diabetes? | 0 | 1 | 2 | 3 | 4 |

# Appendix C

## MINNESOTA LIVING WITH HEART FAILURE® QUESTIONNAIRE

The following questions ask how much your heart failure (heart condition) affected your life during the past month (4 weeks). After each question, circle the 0, 1, 2, 3, 4 or 5 to show how much your life was affected. If a question does not apply to you, circle the 0 after that question.

| **Did your heart failure prevent you from living as you wanted during the past month (4 weeks) by -** | **No** | | | **Very Little** | | | | | **Very Much** |
|---|---|---|---|---|---|---|---|---|---|
| 1. causing swelling in your ankles or legs? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 2. making you sit or lie down to rest during the day? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 3. making your walking about or climbing stairs difficult? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 4. making your working around the house or yard difficult? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 5. making your going places away from home difficult? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 6. making your sleeping well at night difficult? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 7. making your relating to or doing things with your friends or family difficult? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 8. making your working to earn a living difficult? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 9. making your recreational pastimes, sports or hobbies difficult? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 10. making your sexual activities difficult? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 11. making you eat less of the foods you like? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 12. making you short of breath? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 13. making you tired, fatigued, or low on energy? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 14. making you stay in a hospital? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 15. costing you money for medical care? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 16. giving you side effects from treatments? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 17. making you feel you are a burden to your family or friends? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 18. making you feel a loss of self-control in your life? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 19. making you worry? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 20. making it difficult for you to concentrate or remember things? | 0 | | | 1 | 2 | 3 | 4 | 5 | |
| 21. making you feel depressed? | 0 | | | 1 | 2 | 3 | 4 | 5 | |

# Appendix D

## Type 2 Diabetes

# BASICS

## Pre/Post Knowledge Test

**Second Edition**

**INTERNATIONAL DIABETES CENTER**

Name: _____ Date: _____

Circle one: Session 1 Session 2 Session 3 Session 4

**Directions:** Read each question and decide which choice ***best*** completes the statement or answers the question. Indicate your answer by circling the appropriate letter.

1. Risk factors for type 2 diabetes include:
   a. Eating high-sugar foods and "sweets"
   b. High levels of physical activity
   c. A family history of diabetes
   d. An immune system that is working too hard
   e. I don't know

2. If at least half (50%) of your blood glucose levels are in the recommended target range (70–120 before meals, less than 160 after meals), your A1C test should be:
   a. About 6%
   b. About 7%
   c. About 8%
   d. About 9%
   e. I don't know

3. When diabetes starts, why do people with type 2 diabetes have high blood glucose levels?
   a. The pancreas has completely stopped making insulin
   b. The kidneys are not working properly
   c. The body cannot use insulin properly or the pancreas does not make enough insulin
   d. The "sweets" they ate caused diabetes
   e. I don't know

4. A common symptom of diabetes is:
   a. Weight gain
   b. Fatigue
   c. Rash
   d. Craving for sweets
   e. I don't know

5. One carbohydrate choice contains:
   a. 5 grams of carbohydrate
   b. 15 grams of carbohydrate
   c. 25 grams of carbohydrate
   d. 50 grams of carbohydrate
   e. I don't know

6. The following is true about fat in foods:
   a. Fat can cause blood glucose to go up
   b. A high-fat diet can help with weight loss
   c. Fat should be counted as a carbohydrate choice
   d. Certain kinds of fat can increase the risk for heart disease
   e. I don't know

7. Mary had a sandwich with 2 slices of wheat bread, 2 ounces of turkey, 1 teaspoon of mayonnaise for lunch. She also had a small apple and 1 cup of skim milk. How many carbohydrate choices did Mary have?
   a. 3
   b. 4
   c. 6
   d. 7
   e. I don't know

8. How does physical activity usually affect blood glucose levels?
   a. Lowers blood glucose
   b. Raises blood glucose
   c. Has little effect on blood glucose
   d. None of the above
   e. I don't know

9. Creating a Diabetes Success Plan (goal-setting) is a way to help you make positive lifestyle changes. Which plan below is an example of a practical plan?
   a. If you have never exercised: "I will jog 5 miles, 5 days a week."
   b. "I will lose 30 pounds in 2 months."
   c. If you are currently exercising: "I will increase the time I currently exercise by 5 or more minutes each session"
   d. "I will never forget to take my diabetes medication."
   e. I don't know

10. Symptoms of low blood glucose include:
    a. Feeling shaky or sweaty
    b. Dry skin
    c. Feeling energetic
    d. Dry mouth
    e. I don't know

11. A good treatment for hypoglycemia is:
    a. ½ cup orange juice
    b. 1 can regular soft drink
    c. 1 full size candy bar
    d. 1 ounce peanuts
    e. I don't know

12. Illness and emotional stress generally cause your blood glucose levels to:
    a. Increase
    b. Decrease
    c. Stay the same
    d. None of the above
    e. I don't know

13. Which of the following is not a complication of diabetes?
    a. Kidney problems
    b. Lung problems
    c. Nerve problems
    d. Heart problems
    e. I don't know

14. Good foot care for people with diabetes includes:
    a. Aggressively removing corns and calluses
    b. Soaking the feet
    c. Going barefoot in your house
    d. Checking your feet daily
    e. I don't know

15. Some diabetes pills:
    a. Resist the action of insulin
    b. Help your body use insulin better
    c. Contain insulin
    d. None of the above
    e. I don't know

# Appendix E

# Shih Heart Failure Knowledge Test

The following questions ask you to share your knowledge of the signs and symptoms of heart failure. Please circle the best answer for each question. T for True, F for False, and DK for Do Not Know.

| | True | False | Do Not Know |
|---|---|---|---|
| 1. The following may be symptoms of heart failure. | | F | DK |
| a. Difficulty breathing (shortness of breath) | T | F | DK |
| b. Increased appetite | T | F | DK |
| c. Fatigue | T | F | DK |
| d. Headache | T | | |
| 2. The following may be signs of heart failure. | | | |
| a. Skin rash | T | F | DK |
| b. Swollen ankles and legs | T | F | DK |
| c. Increased blood pressure | T | F | DK |
| d. Fever | T | F | DK |
| 3. If my body weight increased by 5 pounds over 3 days, | | | |
| a. I would eat less to control my weight | T | F | DK |
| b. I would continue to observe for 2 more days | T | F | DK |
| c. I would call my healthcare provider or nurse specialist | T | F | DK |
| d. I would limit my water intake | T | F | DK |
| 4. If I noticed a persistent cough and increased shortness of breath, I would: | | | |
| a. Rest more to save energy | T | F | DK |
| b. Drink more water and take Vitamin C | T | F | DK |
| c. Take an over-the-counter medicine to relieve the cough | T | F | DK |
| d. Call my healthcare provider | T | F | DK |
| 5. How would I weigh myself to know if I am retaining water? | T | F | DK |
| a. Weigh with different day's clothes | T | F | DK |
| b. Weigh at the same time of the day | T | F | DK |
| c. Weigh once a week | T | F | DK |
| d. Weigh every day | | | |

**Heart failure medications are used to reduce your symptoms and the limitations imposed on your heart muscle. It is the goal of these medications to maximize your remaining heart muscle function and prevent further damage. The following questions are about medications often taken for heart failure.**

| | True | False | Do Not Know |
|---|---|---|---|
| **6. take vasodilators (medications that decrease my blood pressure) because they** | | | |
| a. Dilate my trachea (the respiratory tube) and help me breath | T | F | DK |
| b. Reduce the pressure my heart muscle must pump against | T | F | DK |
| c. Improve kidney function and decrease my urine output | T | F | DK |
| d. Help prevent upper respiratory infections | T | F | DK |
| **7. If after taking one of my pills I feel dizzy or very lightheaded, I would:** | | | |
| a. Call and report this to my healthcare provider | T | F | DK |
| b. Reduce the dose and frequency of the medication | T | F | DK |
| c. Sit down and rest perhaps slightly elevateing my feet | T | F | DK |
| d. Keep taking the medication, because it is ordered by my doctor | T | F | DK |
| **8. If I forget to take my diuretics (water pills) I may experience:** | | | |
| a. Dizziness | T | F | DK |
| b. Ankle or leg swelling | T | F | DK |
| c. Shortness of breath | T | F | DK |
| d. Fever | T | F | DK |
| **9. For patients with heart failure, blood tests are often performed for the following purposes:** | | | |
| a. Check kidney function | T | F | DK |
| b. Check blood levels of medications | T | F | DK |
| c. Check blood sugar | T | F | DK |
| d. Check sodium and potassium levels | T | F | DK |

**Good nutrition is necessary for all people with heart muscle disease. There is one specific dietary change that is suggested for patients with heart failure – limit your intake of salt. The following questions ask you about this modification.**

| | True | False | Do Not Know |
|---|---|---|---|
| **10. The reason I must modify my diet in this manner is to:** | | | |
| a. Reduce retention of fluid | T | F | DK |
| b. Prevent elevation of my blood sugar | T | F | DK |
| c. Reduce my muscle mass | T | F | DK |
| d. Decrease the work of my kidneys | T | F | DK |
| **11. To meet the goal of this diet, I would:** | | | |
| a. Avoid using table salt | T | F | DK |
| b. Eat fresh instead of pre-packaged food | T | F | DK |
| c. Use soy-sauce instead of table salt | T | F | DK |
| d. Read labels to avoid high intake of sugar | T | F | DK |
| **12. Which of the following is a low salt food?** | | | |
| a. Potato chips | T | F | DK |
| b. Baked potato | T | F | DK |
| c. Canned beans | T | F | DK |
| d. Fresh meat | T | F | DK |

**While heart failure can rarely be cured, it can almost always be managed. With the appropriate medications, dietary changes, and adjustment in your daily life you may feel a lot better. The following questions are about your level of daily activity.**

| | True | False | Do Not Know |
|---|---|---|---|
| **13. I should choose my activity level according to:** | | | |
| a. Guidelines in exercise books | T | F | DK |
| b. My energy level | T | F | DK |
| c. The same as other patients with heart failure | T | F | DK |
| d. The discussions with my healthcare provider | T | F | DK |
| **14. The following may be signs and symptoms of overexertion:** | | | |
| a. Fever | T | F | DK |
| b. Fatigue | T | F | DK |
| c. Shortness of breath | T | F | DK |
| d. Increased urination | T | F | DK |
| **15. While exercising, I begin to experience chest pain and my heart begins pumping very hard. This may indicate:** | | | |
| a. I have achieved my exercise goal | T | F | DK |
| b. I am over-exerting myself | T | F | DK |
| c. I need more diuretics (water pills) | T | F | DK |
| d. I need to discuss this situation with my healthcare provider | T | F | DK |

# Appendix F

# RAPID ESTIMATE OF ADULT LITERACY IN MEDICINE (REALM)©

Terry Davis, PhD • Michael Crouch, MD • Sandy Long, PhD

Patient Name/ Subject # _____ Date of Birth _____ Reading Level _____ Grade Completed _____

Date _____ Clinic _____ Examiner _____

| List 1 | | List 2 | | List 3 | |
|---|---|---|---|---|---|
| fat | ____ | fatigue | ____ | allergic | ____ |
| flu | ____ | pelvic | ____ | menstrual | ____ |
| pill | ____ | jaundice | ____ | testicle | ____ |
| dose | ____ | infection | ____ | colitis | ____ |
| eye | ____ | exercise | ____ | emergency | ____ |
| stress | ____ | behavior | ____ | medication | ____ |
| smear | ____ | prescription | ____ | occupation | ____ |
| nerves | ____ | notify | ____ | sexually | ____ |
| germs | ____ | gallbladder | ____ | alcoholism | ____ |
| meals | ____ | calories | ____ | irritation | ____ |
| disease | ____ | depression | ____ | constipation | ____ |
| cancer | ____ | miscarriage | ____ | gonorrhea | ____ |
| caffeine | ____ | pregnancy | ____ | inflammatory | ____ |
| attack | ____ | arthritis | ____ | diabetes | ____ |
| kidney | ____ | nutrition | ____ | hepatitis | ____ |
| hormones | ____ | menopause | ____ | antibiotics | ____ |
| herpes | ____ | appendix | ____ | diagnosis | ____ |
| seizure | ____ | abnormal | ____ | potassium | ____ |
| bowel | ____ | syphilis | ____ | anemia | ____ |
| asthma | ____ | hemorrhoids | ____ | obesity | ____ |
| rectal | ____ | nausea | ____ | osteoporosis | ____ |
| incest | ____ | directed | ____ | impetigo | ____ |

SCORE

List 1 _____

List 2 _____

List 3 _____

Raw Score _____

# Appendix G

**Nutrition Facts**

| | |
|---|---|
| Serving Size | ½ cup |
| Servings per container | 4 |

Amount per serving

| | | | |
|---|---|---|---|
| Calories | 250 | Fat Cal | 120 |

| | %DV |
|---|---|
| **Total Fat** 13g | 20% |
| Sat Fat 9g | 40% |
| **Cholesterol** 28mg | 12% |
| **Sodium** 55mg | 2% |
| **Total Carbohydrate** 30g | 12% |
| Dietary Fiber 2g | |
| Sugars 23g | |
| **Protein** 4g | 8% |

*Percentage Daily Values (DV) are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

**Ingredients:** Cream, Skim Milk, Liquid Sugar, Water, Egg Yolks, Brown Sugar, Milkfat, Peanut Oil, Sugar, Butter, Salt, Carrageenan, Vanilla Extract.

# Appendix H

6-week follow-up questionnaire

**Diagnosis appropriate questions to be asked at 6 week intervals in-person or via phone:**

- How often do you follow the diet prescribed by your doctor? (both diabetes and heart failure)

  Never Sometimes Half the time Most of the time All of the time

- How often do you follow the medication regimen prescribed by your doctor? (both diabetes and heart failure)

  Never Sometimes Half the time Most of the time All of the time

- How often do you engage in physical activity? (both diabetes and heart failure)

  Never Sometimes Half the time Most of the time All of the time

- For what amount of time? (both diabetes and heart failure)

  1 – 5 minutes 6 – 15 minutes 16 – 30 minutes 31 – 60 minutes >60 minutes

- How often do you weigh yourself? (heart failure)

  Never <Once a month <Once a week <3 times a week <6 days a week Every day

- How often do you check your feet? (diabetes)

  Never <Once a month <Once a week <3 times a week <6 days a week Every day

- How often do you test your blood sugar? (diabetes)

  Never Not as often as Rx as often as Rx more than Rx

# Appendix I

Study Conclusion Follow-up questionnaire

**Diagnosis appropriate questions to be asked at the conclusion of the study in-person or via phone:**

0 = Stayed the same
1 = Slightly more compliant
2 = Somewhat more compliant
3 = Half the time compliant
4 = Much more compliant
5 = Almost always compliant
6 = Always compliant

- Overall, how have your eating habits changed as a result of this study? (both diabetes and heart failure)

  0 1 2 3 4 5 6

- Overall, how has the percentage of time you follow your prescribed medication regimen changed as a result of this study? (both diabetes and heart failure)

  0 1 2 3 4 5 6

- Overall, how have your physical activity habits changed as a result of this study? (both diabetes and heart failure)

  0 1 2 3 4 5 6

- Overall, how has the frequency of weighing yourself changed as a result of this study? (heart failure)

  0 1 2 3 4 5 6

- Overall, how has the frequency of checking your feet changed as a result of this study? (diabetes)

  0 1 2 3 4 5 6

- Overall, how has the frequency of testing your blood sugar changed as a result of this study? (diabetes)

  0 1 2 3 4 5 6

# Appendix J

## DIABETES EDUCATIONAL NEEDS ASSESSMENT

DATE OF DIAGNOSIS: _____ EDUCATIONAL NEEDS ASSESSMENT DATE: _____

FAMILY MEMBERS WITH DIABETES:

☐ Parents ☐ Brother/Sister ☐ Grandparents ☐ Grandchildren

☐ Spouse ☐ Aunts/Uncles ☐ Children

### METHOD OF TREATMENT

Do you follow a special diet? ☐ Yes ☐ No If yes, explain: _____

Is a nutritional assessment done? ☐ Yes ☐ No Date: _____

| | | | | SIDE EFFECTS |
|---|---|---|---|---|
| DIABETES MEDICATIONS: | | | | |
| OTHER MEDICATIONS: | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| EXERCISE | DATE | YES | NO | TYPE OF ACTIVITY | HOW OFTEN? | HOW LONG DO YOU EXERCISE? |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

### MONITORING

| | DATE | YES | NO |
|---|---|---|---|
| Do you check your Blood Sugar at home? | | | |
| Would you like to learn? | | | |

Type _____ Frequency _____ Review of Log _____

| Average Range of BS: | DATE | LEVEL | DATE | A1C LEVEL |
|---|---|---|---|---|
| FBS | | | | |
| RBS | | | | |

### FACTORS AFFECTING LEARNING

How do you like to learn new information:

☐ Reading ☐ Slides/Movies ☐ Doing things ☐ Have someone show you

☐ Listening ☐ Talking/asking questions ☐ With a group ☐ One on One

### PATIENT IDENTIFICATION

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| FACTORS INFLUENCING EDUCATION | | | |
|---|---|---|---|
| DATE | YES | NO | |
| | | | Do you have a family member or friend who helps you with your diabetes? |
| | | | Do you want your support person with you? Who? |
| | | | Employed? |
| | | | Do you smoke? How much? |
| | | | Do you drink Alcohol? How much? What kind? |
| | | | |
| | | | |
| | | | |
| | | | Stresses identified |
| | | | a. Emotional |
| | | | b. Financial |
| | | | c. Family |
| | | | d. Other, i.e. transportation, indoor plumbing at home |
| How many people live in your house? | | | |
| Who does most of the cooking in your home? | | | |

| FACTORS INFLUENCING EDUCATION | | | | |
|---|---|---|---|---|
| *(Check Yes or No and explain if needed.)* | | | | |
| | DATE | YES | NO | |
| VISION PROBLEMS | | | | |
| HEARING PROBLEMS | | | | |
| MOBILITY PROBLEMS | | | | |
| LOSS OF SENSATION | | | | |
| COMPLICATIONS OF DM | | | | |
| ENGLISH PRIMARY LANGUAGE SPOKEN | | | | |

| HEALTH BELIEFS | | | |
|---|---|---|---|
| DATE | YES | NO | |
| | | | Do you feel Diabetes can be prevented? |
| | | | Do you believe your religious/spiritual beliefs affect your health? |
| | | | Do you believe that no matter what you do, if you are going to get sick, you will? |

Do you feel your health is: ☐ poor ☐ good ☐ excellent

Date _____ Weight _____

Do you believe you are: ☐ too fat ☐ too thin ☐ just right

What would you like to weigh?_____

How do you feel about having diabetes?

☐ Angry ☐ Annoyed ☐ Afraid ☐ Depressed

☐ Guilty ☐ Satisfied ☐ Worried ☐ No Way

☐ Denial ☐ Always tired ☐ Sometimes Tired

How much energy do you usually have? ☐ Low ☐ Medium ☐ High

## CURRICULUM

*Check the topics you feel you need to learn more about so you can control your diabetes.*

- ☐ What is Diabetes
- ☐ Feelings about having Diabetes
- ☐ Coping with Diabetes at home
- ☐ Nutrition
- ☐ Exercise
- ☐ Medications
- ☐ Monitoring Blood Glucose
- ☐ Low blood sugar
- ☐ High blood sugar
- ☐ High blood pressure
- ☐ Smoking
- ☐ Retinopathy
- ☐ Periodontal Disease
- ☐ Neuropathy
- ☐ Nephropathy
- ☐ Illness
- ☐ Complications
- ☐ Personal Care
- ☐ Responsibilities of care
- ☐ Use of Health Care Systems
- ☐ Community Resources
- ☐ Alcohol and Diabetes
- ☐ Heart Problems
- ☐ Sexual Problems
- ☐ Foot Care
- ☐ Gestational Diabetes
- ☐ Pre-Preg Counseling
- ☐ Diabetes & Pregnancy
- ☐ Other:

| | | PLAN OF ACTION | DATE | EVALUATION/OUTCOME |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## PATIENT IDENTIFICATION

| | | DATE OF FOLLOW-UP | PROVIDER SIGNATURE | INITIALS |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

The following is a list of abbreviations that are used in the form:

BS = Blood Sugar
FBS = Fasting Blood Sugar
RBS = Random Blood Sugar
A C = Glycosylated Hemoglobin Test

| PATIENT QUESTIONS/EDUCATOR NOTES |
|---|
| |

# Appendix K

# CONGESTIVE HEART FAILURE
# EDUCATIONAL NEEDS ASSESSMENT

DATE OF DIAGNOSIS: _____ EDUCATIONAL NEEDS ASSESSMENT DATE: _____

FAMILY MEMBERS WITH CONGESTIVE HEART FAILURE:

☐ Parents ☐ Brother/Sister ☐ Grandparents ☐ Grandchildren

☐ Spouse ☐ Aunts/Uncles ☐ Children

## METHOD OF TREATMENT

Do you follow a special diet? ☐ Yes ☐ No If yes, explain: _____

Is a nutritional assessment done? ☐ Yes ☐ No Date: _____

| HEART MEDICATIONS: | | | | SIDE EFFECTS |
|---|---|---|---|---|
| | | | | |
| OTHER MEDICATIONS: | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| EXERCISE | DATE | YES | NO | TYPE OF ACTIVITY | HOW OFTEN? | HOW LONG DO YOU EXERCISE? |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

## MONITORING

| | DATE | YES | NO |
|---|---|---|---|
| Do you check your weight at home? | | | |
| Would you like to learn? | | | |

Time _____ Frequency _____ Review of Log _____

| Average range of weight | DATE | Weight | DATE | Weight |
|---|---|---|---|---|
| | | | | |
| | | | | |

## FACTORS AFFECTING LEARNING

How do you like to learn new information:

☐ Reading ☐ Slides/Movies ☐ Doing things ☐ Have someone show you

☐ Listening ☐ Talking/asking questions ☐ With a group ☐ One on One

## PATIENT IDENTIFICATION

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| FACTORS INFLUENCING EDUCATION | | | |
|---|---|---|---|
| DATE | YES | NO | |
| | | | Do you have a family member who helps you with your Congestive Heart Failure? |
| | | | Do you want your support person with you? Who? |
| | | | Employed? |
| | | | Do you smoke? How much? |
| | | | Do you drink Alcohol? How much? What kind? |
| | | | |
| | | | |
| | | | |
| | | | Stresses identified |
| | | | a. Emotional |
| | | | b. Financial |
| | | | c. Family |
| | | | d. Other, i.e. transportation, indoor plumbing at home |
| How many people live in your house? | | | |
| Who does most of the cooking in your home? | | | |

| FACTORS INFLUENCING EDUCATION | | | | |
|---|---|---|---|---|
| *(Check Yes or No and explain if needed.)* | | | | |
| | DATE | YES | NO | |
| VISION PROBLEMS | | | | |
| HEARING PROBLEMS | | | | |
| MOBILITY PROBLEMS | | | | |
| LOSS OF SENSATION | | | | |
| COMPLICATIONS OF HF | | | | |
| ENGLISH PRIMARY LANGUAGE SPOKEN | | | | |

| HEALTH BELIEFS | | | |
|---|---|---|---|
| DATE | YES | NO | |
| | | | Do you feel Congestive Heart Failure can be prevented? |
| | | | Do you believe your religious/spiritual beliefs affect your health? |
| | | | Do you believe that no matter what you do, if you are going to get sick, you will? |

Do you feel your health is: ☐ poor ☐ good ☐ excellent

Date _____ Weight _____

Do you believe you are: ☐ too fat ☐ too thin ☐ just right

What would you like to weigh?_____

How do you feel about having congestive heart failure?

| | | | |
|---|---|---|---|
| ☐ Angry | ☐ Annoyed | ☐ Afraid | ☐ Depressed |
| ☐ Guilty | ☐ Satisfied | ☐ Worried | ☐ No Way |
| ☐ Denial | ☐ Always tired | ☐ Sometimes Tired | |

How much energy do you usually have? ☐ Low ☐ Medium ☐ High

## CURRICULUM

*Check the topics you feel you need to learn more about*

- ☐ What is congestive Heart Failure
- ☐ Feelings about Heart Failure
- ☐ Coping with Heart Failure
- ☐ Nutrition
- ☐ Exercise
- ☐ Medications
- ☐ Monitoring Weight
- ☐ Cholesterol / Triglycerides
- ☐ High Blood Pressure
- ☐ Heart Rate
- ☐ Smoking and Heart Failure
- ☐ Appropriate Clothing
- ☐ Signs and Symptoms of Heart Failure
- ☐ Other
- ☐ Exercise
- ☐ Illness
- ☐ Complications
- ☐ Personal Care
- ☐ Responsibilities of care
- ☐ Use of Health Care Resources
- ☐ Community Resources
- ☐ Alcohol and Heart Failure
- ☐ Heart Problems
- ☐ Sexual Problems
- ☐ Heart Failure and Future Pregnancy
- ☐ Treatment Options
- ☐ Other
- ☐ Other
- ☐ Other

| | | PLAN OF ACTION | DATE | EVALUATION/OUTCOME |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## PATIENT IDENTIFICATION

| | | DATE OF FOLLOW-UP | PROVIDER SIGNATURE | INITIALS |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

The following is a list of abbreviations used in this form:

HF = Heart Failure

| Patient Questions/Educator Notes |
|---|
| |

# Appendix L

| ***Please check the boxes below to show how satisfied you are with this education program.*** ***SA = Strongly Agree; A = Agree; DK = Don't Know; D = Disagree; SD = Strongly Disagree.*** | | | | | |
|---|---|---|---|---|---|
| | **SA** | **A** | **DK** | **D** | **S** |
| 1. The nurse educator was courteous and professional. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2. The nurse educator was approachable and available for my needs. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3. The nurse educator listened carefully to me and spent sufficient time with me. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4. The nurse educator answered all my questions regarding my diagnosis | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5. My diagnosis was clearly explained. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6. All my questions on my diagnosis were answered in a way I could understand | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7. The education was provided in a confidential and private manner. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8. I could easily access health education materials | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9. Help was available when I could not access the education websites. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10. I like using MyHERO to find truthful information about my health. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11. I like using MyHERO to find help with social services such as health insurance or help for people with disabilities. | ☐ | ☐ | ☐ | ☐ | ☐ |

***Please check the boxes below to show how satisfied you are with this education program.***

***SA = Strongly Agree; A = Agree; DK = Don't Know; D = Disagree; SD = Strongly Disagree.***

What do you like the best about receiving health/wellness education from the Internet?

What do you like the least about receiving health/wellness education from the Internet?

List any suggestions you have to improve this program:

Additional comments:

# Appendix M

# Health Educator Satisfaction Survey

**General Instructions:** The purpose of this form is to obtain information concerning the utilization of Internet resources for patient education via MyHERO. Please mark an *x* in the appropriate space for yes/no questions and follow with an explanation for your answer. For questions with Likert scale responses, please circle the appropriate number. If necessary, continue written explanations on additional sheets of paper.

## CERMUSA

1. Did the in-service training you received at CERMUSA adequately prepare you for your tasks?
   _____ Yes _____ No

   Explain your answer:

2. Once you began protocol execution, were adequate support services available for you at your workplace?

| | | |
|---|---|---|
| a. Technical problems | _____ Yes | _____ No |
| b. Manuals | _____ Yes | _____ No |
| c. Help desk | _____ Yes | _____ No |
| d. Onsite support | _____ Yes | _____ No |
| e. Online CERMUSA support services | _____ Yes | _____ No |

3. Would you recommend our CERMUSA patient education format to other healthcare providers?
   _____ Yes _____ No

4. Explain your answer:

5. Were you satisfied with CERMUSA's technology?
   _____ Yes _____ No

   Explain your answer:

## MyHERO

5 = Excellent; 4 = Very Good; 3 = Good; 2 = Fair; 1 = Poor; NA = Not Applicable

1. How would you rate MyHERO for the following?
    a. Ease of navigation of MyHERO website 5 4 3 2 1 NA
    b. Reliability of sites 5 4 3 2 1 NA
    c. Appearance of MyHERO web page 5 4 3 2 1 NA
    d. Applicability to patient population 5 4 3 2 1 NA

2. Overall, how satisfied are you with MyHERO?

    5 4 3 2 1 NA

3. How likely are you to utilize MyHERO for patient education again?

    5 4 3 2 1 NA

4. How likely are you to recommend MyHERO to your friend/ relative?

    5 4 3 2 1 NA

5. How likely are you to recommend MyHERO to your colleague?

    5 4 3 2 1 NA

6. Please provide examples of positive feedback from patients using MyHERO:

7. Please provide examples of negative feedback from patients using MyHERO:

8. Document examples of patients using information obtained from MyHERO for improved health and wellbeing:

9. What did you like most about MyHERO?

10. What did you like least about MyHERO?

11. Please tell us how CERMUSA can improve MyHERO.

**Blackboard CE**

5 = Excellent; 4 = Very Good; 3 = Good; 2 = Fair; 1 = Poor; NA = Not Applicable

1. How would you rate Blackboard CE

a. Ease of navigation of Blackboard CE website 5 4 3 2 1 NA

b. Appearance of Blackboard CE web page 5 4 3 2 1 NA

2. Overall, how satisfied are you with Blackboard CE?

   5 4 3 2 1 NA

3. Please provide examples of positive feedback from patients using Blackboard CE:

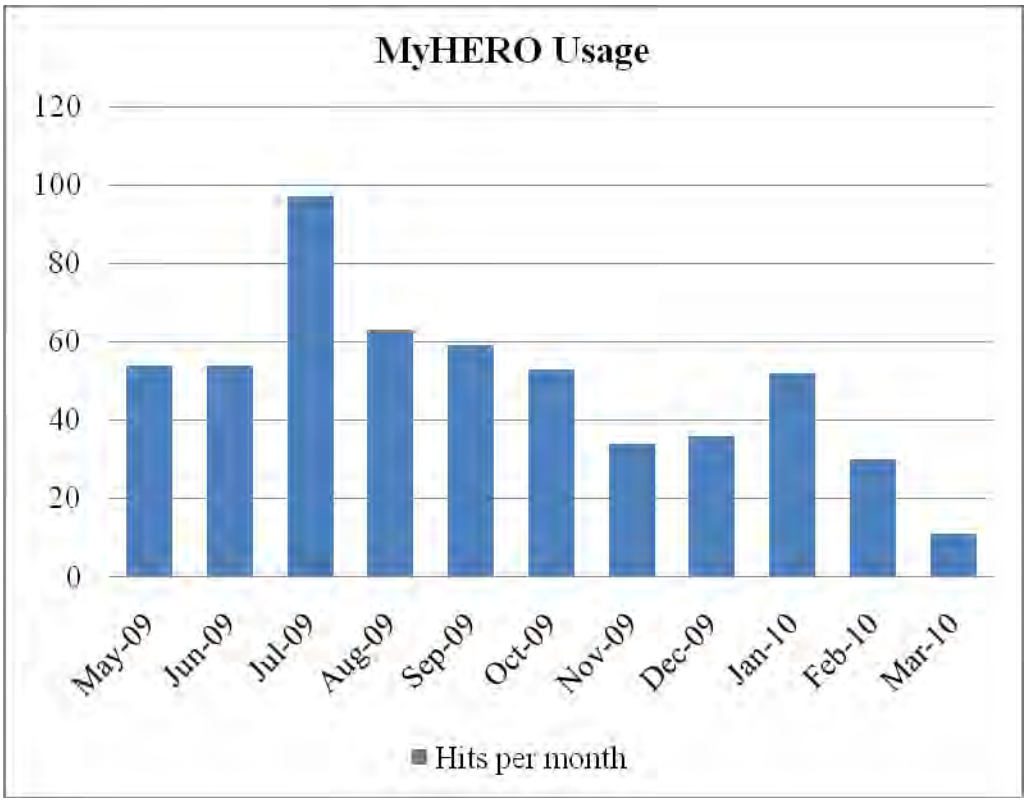
4. Please provide examples of negative feedback from patients using Blackboard CE:

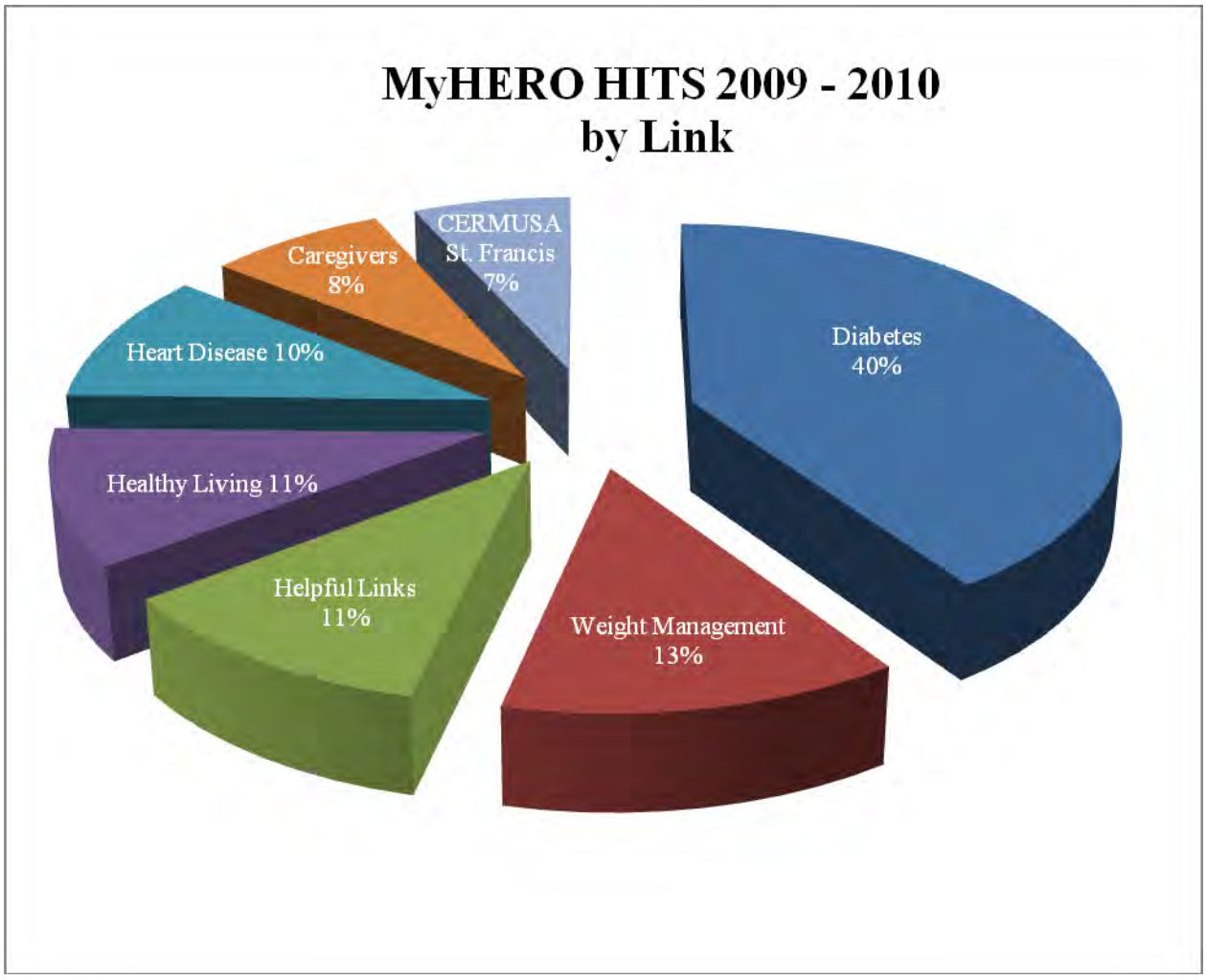
5. What did you like the most about Blackboard CE?

6. What did you like the least about Blackboard CE?

**Additional Comments:**

# Appendix N


MyHERO Usage
120
100
80
60
40
20
0
May-09
Jun-09
Jul-09
Aug-09
Sep-09
Oct-09
Nov-09
Dec-09
Jan-10
Feb-10
Mar-10
Hits per month


MyHERO HITS 2009 - 2010
by Link
CERMUSA
St. Francis
7%
Caregivers
8%
Heart Disease 10%
Healthy Living 11%
Helpful Links
11%
Weight Management
13%
Diabetes
40%

# Saint Francis University's
# Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA)

**FY08 Annual Report**
**(May 4, 2009 to July 31, 2010)**

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**Protocol Title:** Telehealth Test Bed - Quality of Life Studies

**Protocol No.:** 07-TATTH302c-07

**Date:** July 2010

## Principal Investigator

Eric Muncert, BA, Telehealth Research Specialist

## Introduction

The number of older individuals in America is expected to double over the next two decades; many of these individuals will be retired military personnel. The United States Census Bureau reports the population in March 2010 of the United States is 308,943,647. (U.S. Census Bureau, 2010) Several population demographics, including warriors in transition, veterans, individuals with physical and mental disabilities, and older adults (age 65 and older) will require assistive technology devices to aid in maintaining or improving their quality of life. Assistive technology is any item, piece of equipment, or product system that is used to maintain or improve functional capabilities of individuals with disabilities. (Kids Together, 2010) In 2010 there will be an estimated 40.65 million people 65 and older (National Institute on Aging, 2010). Soldiers who fought in Operation Iraqi Freedom and Operation Enduring Freedom have been wounded in action or have sustained injuries from non-combat accidents. Depending upon the severity of the injury, assistive technologies may be needed temporarily or long-term to help them regain and maintain normal daily functions. Saint Francis University's CERMUSA and the NTSS are exploring alternative solutions to foster independent living through the use of technology. An evaluation matrix comparing assistive technologies was developed to identify devices that could improve or maintain the quality of life for these populations. The integration of telehealth and telerehabilitation applications was examined to help improve home rehabilitation via access to healthcare specialties in medically underserved settings. CERMUSA staff researched and tested assistive technologies that could be included in an independent self contained living space module. The research requires individuals to test and evaluate the functions of these commercially-available technologies. The results will be useful in selecting the technologies that could enhance or extend the quality of life of a special needs population.

## Body

The FY08 Telehealth Test Bed - Quality of Life (QOL) study is an extension of the FY07 study that was reported on in December 2009. The research protocol examines alternative methods of providing QOL experiences for the warrior-in-transition, older adult and individuals with disability. The project deliverables for FY08 included ongoing literature searches and reviews and continued research to identify telehealth and telerehabilitation assistive technologies. An evaluation matrix for the protocol was developed in FY07 after literature searches were completed to ascertain if an instrument had been published comparing different assistive technologies and recording the result. Research completed found no matrices showing an evaluation of a device and its application for maintaining or improving the quality of life as a measurement. It was found that matrices have been developed as evaluation tools for many applications, but none have focused on assistive technology devices for the three populations studied in this protocol. Employees from Pennsylvania's Assistive Technology Lending Library were also contacted to determine if they were aware of this type of evaluation tool.

The most important basis for evaluating an assistive device is whether it satisfies the needs of the disabled consumer; however, the factors that consumers consider in determining whether a device meets their needs are not well understood (Batavia, & Hammer, 1990). It was determined that an innovative approach to evaluate the devices was to design a matrix using factors believed to be of importance to the end-user. It was also anticipated that these devices be included in an

independent living module. The focus of technology research included speech, sight, hearing, and cognitive disabilities. These initial investigations of potential technologies were intended to be integrated into the Blueroof Independence Module (BIM). The BIM, shown in Figure 1, is a 28' x 13'6" mobile independent living environment that has provided CERMUSA with a setting for demonstrating telerehabilitation and telehealth applications that have the potential to enhance or extend the quality of life for these target populations

In FY08, CERMUSA continued its collaboration with Blueroof Technologies, Inc. Located in McKeesport, Pennsylvania, Blueroof is a non-profit corporation that develops smart-living facilities that promote independent living capabilities for special needs populations such as warriors in transition, older adults, and individuals with disability. CERMUSA and Blueroof participated in August of 2009, at the Pennsylvania Disabled Veterans Rehabilitation/Vocational Retraining Project Community Response Symposium at the Hiram G. Andrews Center (HGAC) in Johnstown, Pennsylvania. CERMUSA demonstrated telerehabilitation and telehealth applications integrated into the BIM. These applications have the potential of enhancing or extending the quality of life for the special needs populations. The technologies successfully integrated into the BIM include:

- Biolog Electrocardiogram: measures the electrical activity of the heart and indicates the overall rhythm of the heart, as well as weaknesses in different parts of the heart muscle
- Pulse and Spirometry Oximetry: monitors patient's oxygenation of hemoglobin and measuring air volume and flow of the lung function
- Video Gaming for Rehabilitation: activates and motivates eye-hand coordination and increases muscle development and coordination
- Cognitive Fitness: stimulates the brain and enhances quality of life in relation to primary area of cognition involved

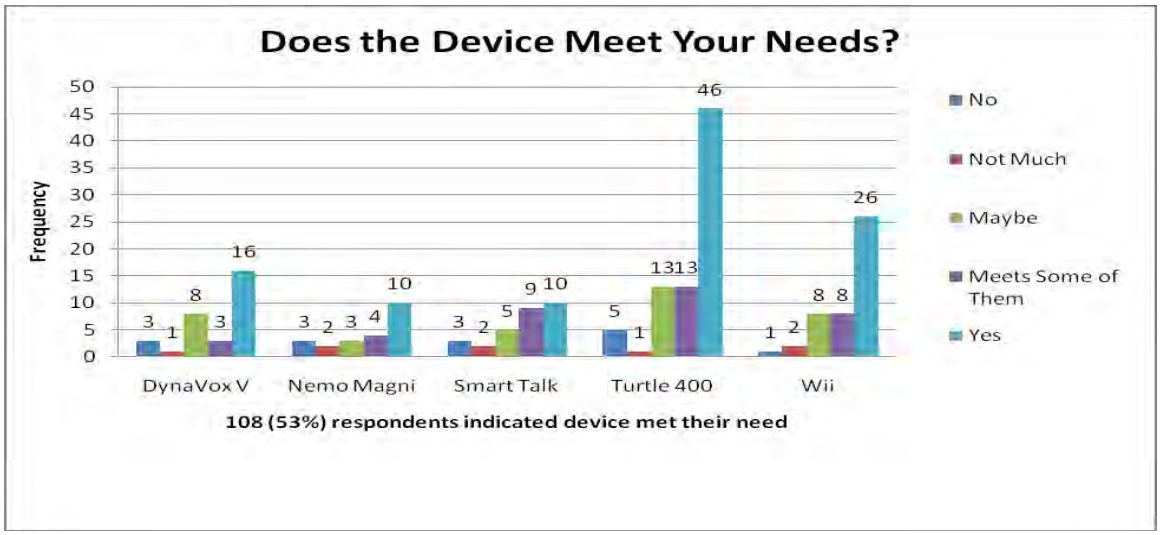
Also in 2009, Blueroof made a decision to reassign the BIM to CERMUSA. This meant the BIM would be permanently located at HGAC. This afforded CERMUSA and NTSS another facility to gather data from individuals for testing and evaluation assistive technologies by special needs populations.

**Figure 1: Blueroof Independence Module**

During FY08, staff focused on the testing and evaluation of the assistive technologies by older individuals (Figure 2), warriors-in-transition, retired military persons, veterans, individuals with disability, caregivers, and those in clinical practices or in an educational setting preparing for clinical practice.

**Figure 2: Older Adults testing and evaluating assistive technologies**

Attendees at CERMUSA's Assistive Technology Exposition in November 2009 were invited to review eight devices and completed surveys that included technology and demographic questions. (Appendix A) Using the independent living laboratory located at the NTSS as the test bed, 272 surveys were completed during the exposition. After testing and evaluating a specific device, respondents were asked to complete a survey assessing the technology on several measures. Five of the selected eight technologies were available for further evaluation. Results of the responses to a common question for all technologies "Does the technology meet your needs?" are shown in Graph 1.




**Graph 1**

In June 2010, clients of Allegheny Lutheran Social Ministries in Hollidaysburg and Johnstown, Pennsylvania and those in an educational setting preparing for clinical practice from Saint Francis University's Occupational Therapy Department, also tested and evaluated devices. The data from these surveys is currently being gathered and analyzed and will be reported in future reports.

## Key Research Accomplishments

- Continued growth of existing and new collaborations
- Obtained 272 assistive technology evaluation surveys from attendees at the Assistive Technology Exposition
- Obtaining and analyzing additional evaluation surveys from clients of Allegheny Lutheran Social Ministries and those in an educational setting preparing for clinical practice
- Established new collaborations with DynaVox Technologies and Allegheny Lutheran Social Ministries
- Developing manuscript for publication that disseminates the findings of this protocol
- Preparation of the BIM as a testing and evaluation unit that include general and specialized assistive technologies to accommodate the many unique needs of the special needs populations
- Acceptance of poster, "Enhancing the Quality of Life for Special Needs Populations Through Integration of Assistive Technology" at the American Telemedicine Association's 15th Annual International Meeting & Exposition (Appendix B)

## Reportable Outcomes

- 2009 May Basics of Telehealth: Applications in Nursing Education, University of Pittsburgh School of Nursing, Pittsburgh, PA. Telehealth Tools to Improve Learning Demonstration
- 2009 June Telemedicine & Advanced Technology Research Center (TATRC) Onsite Review
- 2009 Aug. Pennsylvania Disabled Veterans Rehabilitation/Vocational Retraining Project Community Response Symposium
- 2009 Nov. National Telerehabilitation Service System (NTSS). CERMUSA Hosting Annual Assistive Technology Exposition, Johnstown, PA
- 2010 May Poster presentation - American Telemedicine Association, San Antonio, TX "Enhancing the Quality of Life for Special Needs Populations Through Integration of Assistive Technology" (Appendix B)

In the context of health promotion, delivery of rural healthcare and the continuity of rehabilitative services at home, CERMUSA will continue to grow existing collaborations and establish new partnerships in FY08 with such organizations as, DynaVox Technologies, Pittsburgh, PA; Hiram G. Andrews Center, Johnstown, PA; Allegheny Lutheran Social Ministries, Hollidaysburg, PA, and Blueroof Technologies, Inc., McKeesport, PA. New collaborations with organizations noted below will be sought in FY09. These include, but are not limited to: Defense and Veterans Brain Injury Center, Johnstown, PA; Veteran Leadership Program of Western Pennsylvania, Johnstown, PA; Veteran Community Initiatives, Inc., Johnstown, PA; James E. Van Zandt Veterans Administration Medical Center, Altoona, PA; and the Pennsylvania Veterans Home, Hollidaysburg, PA. Each of the existing and potential collaborators provide access to education, therapies, technologies that can aid in the sustainment and/or improvement of QOL protocol.

## Conclusion

Many of the soldiers returning from Operation Enduring Freedom and Operation Iraqi Freedom have suffered injuries that have resulted in life-long care. This creates an economic and social crisis as America struggles to care for these individuals as they develop or deal with disabilities. Innovative research is needed to develop the best combination of special needs education and technologies that assist or maintain the preferred quality of life for transitioning warriors, older adults, and individuals with a disability. Continued research, evaluation, and integration of qualifying technologies into healthcare living environments for these special needs populations is needed. This loss of independence can be very frustrating for the person experiencing the loss as well as for their caregiver(s). Fortunately, there are many devices and technologies that can be utilized by special needs populations and/or to assist the caregiver. An individual's environment is extremely important and most people would prefer to have the option of staying in their own homes if possible.

The development of an independent living module capable of providing an environment that allows the individual to maintain or improve their quality of life, can offer alternative living accommodations, for warriors in transition, individuals with disability and older adults. The most important basis for evaluating an assistive technology is whether it satisfies the needs of the consumer (Batavia, & Hammer, 1990). Healthcare technologies must be cost effective, portable, unobtrusive, non-invasive, and sustainable in order to ensure that the target populations will properly adapt to them. The objective of this study was to develop an evaluation matrix that demonstrates the correlation between assistive technology and the need of an individual.

If this method of testing and evaluation of assistive technology allows the end user to better determine their needs, the necessary requirements for maintaining or improving their quality of life and independence can be satisfied. Continued literature review and research of emerging technology devices will be ongoing to further understand and develop testing and evaluation methodology that meet each individual's need.

## References


Batavia, A. I., & Hammer, G. S. "Toward the development of consumer-based criteria for the evaluation of assistive devices." Journal of Rehabilitation Research & Development, 1990 Fall; Volume: 27 Issue: 4 Pages: 425-36. Retrieved January 7, 2010, from http://www.ncbi.nlm.nih.gov/pubmed/2089152

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National Institute on Aging. Figure 4. U.S. population aging 65 years and older: 1990 to 2050 Retrieved March 3, 2010 from, http://www.nia.nih.gov/ResearchInformation/ConferencesAndMeetings/WorkshopReport/Figure4.htm

U.S. Census Bureau | Population Division "U.S. PopClock Projection" Retrieved March 26, 2010 from http://www.census.gov/population/www/popclockus.html

## Appendices

A. Protocol Survey

B. ATA 2010 Conference – Poster Presentation

# Appendix A

## Survey

Please complete the survey below by choosing one answer for each question. You are free to refuse to answer any question.

*"By completing this questionnaire, I indicate my consent to participate in the research. I understand confidentiality will be maintained. I also understand that today's activities may be filmed for procedure documentation or public relations materials concerning the study activities."*

| | |
|---|---|
| Study Title | Telehealth Test Bed – Quality of Life Studies |
| Study Number | 07-TATTH302c-07 |

**You are testing the**
(Insert name and cost of device here)

**Circle your choice for each:**

| | | | | | |
|---|---|---|---|---|---|
| Cost of device: | Costs way too much | | Costs too much | | I would pay this much |
| How easy was it to use? | Very hard | Hard | OK | Easy | Very easy |
| Does this device meet your needs? | No | Not much | Maybe | Meets some of them | Yes |
| Would you use this device at home? | No | Not much | Maybe | Sometimes | Yes, a lot |
| Would you need help to use this device at home? | Yes, a lot | Sometimes | Maybe | Not much | No |

**Demographics**

**Age**
A. 18-34
B. 35-50
C. 51-64
D. 65 and above

**Gender**
A. Male
B. Female

**Do you have a disability?**
A. Yes
B. No

**Are you a Veteran?**
A. Yes
B. No

If yes, what branch: _____

**Are you a Health Care Provider or Student?**
A. Yes – Provider
B. Yes – Student
C. No

If yes, what profession: _____

*PLEASE ANSWER THE FOLLOWING QUESTIONS ONLY ONCE DURING YOUR VISIT TODAY:*

What do you need the most help with in your home?

What do you have the most trouble with in your home?

## Appendix B

SAINT FRANCIS UNIVERSITY
FOUNDED 1847

# Enhancing the Quality of Life for Special Needs Populations Through Integration of Assistive Technology

**Eric Muncert, Jay Roberts, Barbara Demuth, Ashok Bapat, Brenda Guzic, Steven Bickford**
Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas, Loretto, Pennsylvania

CERMUSA

### Hypothesis

The quality of life for target populations, including warriors in transition, older adults, and individuals with disabilities, can be maintained or improved through the utilization of telehealth and telerehabilitation applications.

### Introduction

The number of older adults in the United States is likely to double over the next two decades, and many of those individuals will be retired military personnel. Currently, there are 9.7 million veterans over the age of 65 in the U.S.[1] Many soldiers returning from Operation Iraqi Freedom and Operation Enduring Freedom have suffered injuries resulting in permanent disabilities that potentially require life-long care. Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA) is investigating ways to enhance or maintain the health of the above-mentioned target populations using assistive technologies (AT). AT is any item, piece of equipment, or product system that is used to maintain or improve the functional capabilities of individuals with disabilities.[2] The AT in this study are tested to identify the tools that will enable an individual to maintain their independence in order to avoid or postpone institutional care.

Older adults testing and evaluating assistive technologies.

### Methodology

A total of sixty-five (65) AT technologies were selected because of their ability to assist those having sensory and cognitive disabilities. An evaluation matrix (Table 1) was developed to compare the selected technologies.

Table 1. Evaluation Matrix

| Factor: | "Tele" Aspect | Ease of Use | Meets Need of Target Population | Portability | Stability | Cost Effective | Adaptability with other Technologies | Insurance Recognized | Value Index |
|---|---|---|---|---|---|---|---|---|---|
| TECHNOLOGY: | | | | | | | | | |
| 1. DynaVox V - DynaVox | 9 | 7 | 5 | 4 | 4 | 4 | 6 | 6 | 174 |
| 2. LifeVest - Vivametrics | 7 | 4 | 4 | 4 | 4 | 4 | 4 | 1 | 126 |
| 3. mPower - Dakim | 4 | 7 | 4 | 2 | 4 | 2 | 1 | 5 | 114 |
| 4. Nano Magni - Universal Aids, Inc. | 8 | 8 | 2 | 8 | 4 | 4 | 1 | 1 | 104 |
| 5. Pen Elite - WizCom Tech | 8 | 6 | 2 | 8 | 4 | 3 | 1 | 1 | 88 |
| 6. SmartTalk - Freedom Scientific | 8 | 5 | 4 | 8 | 4 | 3 | 6 | 2 | 153 |
| 7. SmartVein - Humanware | 8 | 7 | 2 | 8 | 4 | 4 | 1 | 2 | 99 |
| 8. Turtle 400 - ViTelNet | 8 | 5 | 5 | 2 | 4 | 2 | 1 | 2 | 133 |
| 9. VivaResponder Belt - Vivametrics | 7 | 5 | 2 | 3 | 4 | 2 | 4 | 2 | 106 |
| 10. Wii - Nitendo | 8 | 7 | 5 | 4 | 4 | 5 | 3 | 4 | 186 |
| WEIGHT: | 3 | 4 | 5 | 3 | 4 | 3 | 3 | 3 | |

KEY:
Weight x Factor = Value Index

The lack of literature on matrices evaluating AT prompted CERMUSA to develop a benchmark range of numbers of >100, assigning each device a number based on its value to the consumer, which qualified the final eight technologies (Table 2) for public evaluation. Five of the selected eight technologies were available for further evaluation by the attendees of CERMUSA's Assistive Technology Exposition. The evaluation surveys were completed by the target populations, caregivers, and those in clinical practices or in an educational setting preparing to enter a clinical practice. The surveys included technologic and demographic questions.

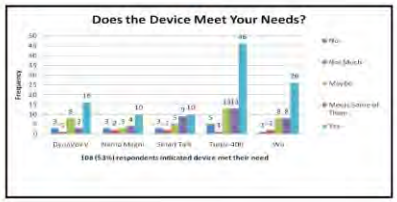
Table 2. Technologies Accepted Against the Evaluation Matrix

| Technology | Use |
|---|---|
| 1. DynaVox V - DynaVox | Augmentative and alternative communication |
| 2. LifeVest - Vivametrics | Respiratory and cardiopulmonary monitoring |
| 3. mPower - Dakim | Cognitive fitness |
| 4. Nano Magni - Universal Aids, Inc. | Pocket-sized digital magnifier |
| 5. SmartTalk - Freedom Scientific | Small personal computer for visually impaired |
| 6. Turtle 400 - ViTelNet | Vital sign monitoring unit |
| 7. VivaResponder Belt - Vivametrics | Compact, continuous life-sign monitoring system |
| 8. Wii - Nintendo | Video gaming for cognitive fitness |

### Results

The respondents assessed each technology on several measures. For example, the results of the responses to a common question for all technologies "Does the device meet your needs?" are shown in Graph 1.

Graph 1




108 (53%) respondents indicated device met their need

### Discussion & Conclusions

Healthcare technologies must be cost effective, portable, unobtrusive, non-invasive, and sustainable in order to ensure that the target populations will properly adapt to them. The objective of this study was to develop an evaluation matrix that demonstrates the correlation between assistive technology and the needs of an individual. This method allows the end user of the technology to better determine which devices meet their need and the necessary requirements for maintaining or improving their quality of life and independence.

### References

(1) Agingstats.gov. Retrieved March 20, 2009, from http://www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2008_Documents/Population .aspx
(2) Together, Inc. Retrieved March 23, 2010 from http://www.kidstogether.org/at.htm

### Acknowledgement

This project is supported by Saint Francis University's CERMUSA in Loretto, Pennsylvania, and funded by the U.S. Army Medical Research and Materiel Command (USAMRMC) Telemedicine and Advanced Technology Research Center (TATRC), Fort Detrick, Maryland – Contract Number W81XWH-06-2-0018.

Assistive Technology Exposition attendees evaluate AT devices.

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# Saint Francis University's
# Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA)

**FY08 Annual Report**
**(May 4, 2009 to July 31, 2010)**

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**Protocol Title:** Medical Simulation at a Distance (MSAD)

**Protocol No.:** 07-TATDL214-07

**Date:** July 2010

## Principal Investigator

Brenda Guzic, RN, BSW, MA, Telehealth Research Specialist

## Introduction

The focus of this project is to deliver quality education through medical simulation to rural and military healthcare providers. Numerous healthcare providers have little 'real-world' experience and many face difficulties in acquiring skills needed to provide vital patient care. What's more, there is documented evidence that 'appropriately educated' healthcare providers improve patient survival rates. Saint Francis University's CERMUSA collaborated with the University of Pittsburgh's Peter M. Winter Institute for Simulation, Education and Research (WISER) to explore the practicability, reliability, and impact of combining medical simulators with advanced distance education and telecommunications technologies. Technology was used to connect subject matter experts, simulator operators, and curriculum content developers with medical simulators, faculty, and class participants. The location of the students and the simulators, in relation to the simulator operators and instructors, made the project unique. The concept is based on access to the central simulation facility and its personnel from a remote site.

The study utilized a course designed to cover all aspects of providing high quality airway care to patients in the prehospital setting. Web-based study material covered knowledge necessary to perform skills and scenarios associated with a day in the simulation center. Real-world scenarios challenged the participants to demonstrate their mastery of skills and knowledge. Researchers studied the effectiveness of delivering this type of education at a distance, using point-to-multipoint technology, with an experimental group of 12 and compared it with a control group of 429, who participated via in-person instruction. Both groups completed online pretests and post-tests. An analysis of each question on the pretest and post-test was performed to identify areas where there may have been significant differences between the control and experimental group. Post-exercise video debriefing was also utilized to review student performance. Results demonstrated that the approach used was effective in performing medical simulation education 'from a distance'.

## Body

Medical simulation provides a platform for education, skills training, decision-making, and performance assessment in an environment in which it is safe to practice and learn from mistakes. There is evidence that simulation training can decrease medical errors and improve performance and competence by providing a system for experiential learning, repetitive practice, and appropriate feedback without putting patients at risk. Simulation can be used for both individual and team learning; however, access to simulation systems, telecommunications technologies, and expertise in remote, military, and rural areas is challenging, although equally important for learning new techniques and approaches, as well as retaining skills and knowledge. This can be particularly important for those events that may be infrequent in rural settings, are complicated, and demand critical appropriate decision-making, special skills, and effective, efficient performance.

According to Immersion Medical, an organization whose mission includes promoting the use of medical simulation in improving patient safety, delivering more effective provider training, and

reducing healthcare costs, medical competence utilizing medical simulation can be measured in the following areas:

- Patient care and safety
- Medical knowledge
- Practice-based learning
- Interpersonal and communication skills
- Professionalism
- Practice (Immersion Medical, 2008)

High fidelity medical simulation supports these components. Each component is evaluated during training using subjective observation techniques and objective evaluation measurements. The cognitive, practical, and didactic benefits of computer-controlled simulation training are that it enables individuals to learn, practice, and repeat procedures as often as necessary in order to correct mistakes, perfect techniques, and optimize clinical outcomes. This feedback is playing an increasingly important role in medical education (Shetty, 2006). Reductions in teaching time, the ability to teach individuals at multiple locations simultaneously, limited availability of patient subjects or instructors, and rapid advances in the number and complexity of diagnoses and treatment are additional reasons to consider incorporating medical simulation as an education tool.

In response, CERMUSA collaborated with WISER, and established the *Medical Simulation at a Distance* pilot program. The first phase (FY07) of the program measured the feasibility of remote operation of one medical simulator in educating one group of allied health professionals (paramedic trainees) using a single point-to-point contact between WISER and CERMUSA's National Telerehabilitation Service System (NTSS). The location of the students and the simulator, in relation to the simulator operator, rendered the first phase of the CERMUSA/WISER pilot project unique.

The second phase of the project (FY08) explored a point-to-multiple-point configurations. This was being done by using networking and telecommunication technology that we have at CERMUSA to connect WISER Subject Matter Experts (SME) and simulator operators to medical simulators, faculty, and class participants at remote sites. What made the second phase unique was the use of simultaneous 'multiple point-to-point' site connections as opposed to a single 'point-to-point' site connection. In the second phase of the study, there were four groups of students two high-fidelity medical simulators, one skills training station, and one live interactive VTC didactic station positioned concurrently at four locations while the simulator operators and instructors were positioned at a distance, away from the students, simulators, skills trainer and the VTC site. Thus, the four groups of students were able to successfully and simultaneously participate in each session from a distant location as reflected in the following data report.

- Cognitive Learning - To establish a baseline for each participant's knowledge of the subject matter before the educational intervention, a pretest was administered to all study participants. Following the educational intervention, a post-test was completed by each participant. The data analysis performed showed that participants experienced an average increase over 3% (3.33%) on the 10-item exam after the educational intervention. The average percentage correct before the education intervention was 63.33%, while after the

intervention it had risen to 66.67%. A paired t-test was conducted to determine if this difference was significant. The p-value of 0.462 indicated that there was not enough evidence to infer that there was significant difference between the group before and after the intervention.

Each exam consisted of 10 questions. Table 1 shows the number and percentage correct for each of the 10 questions.

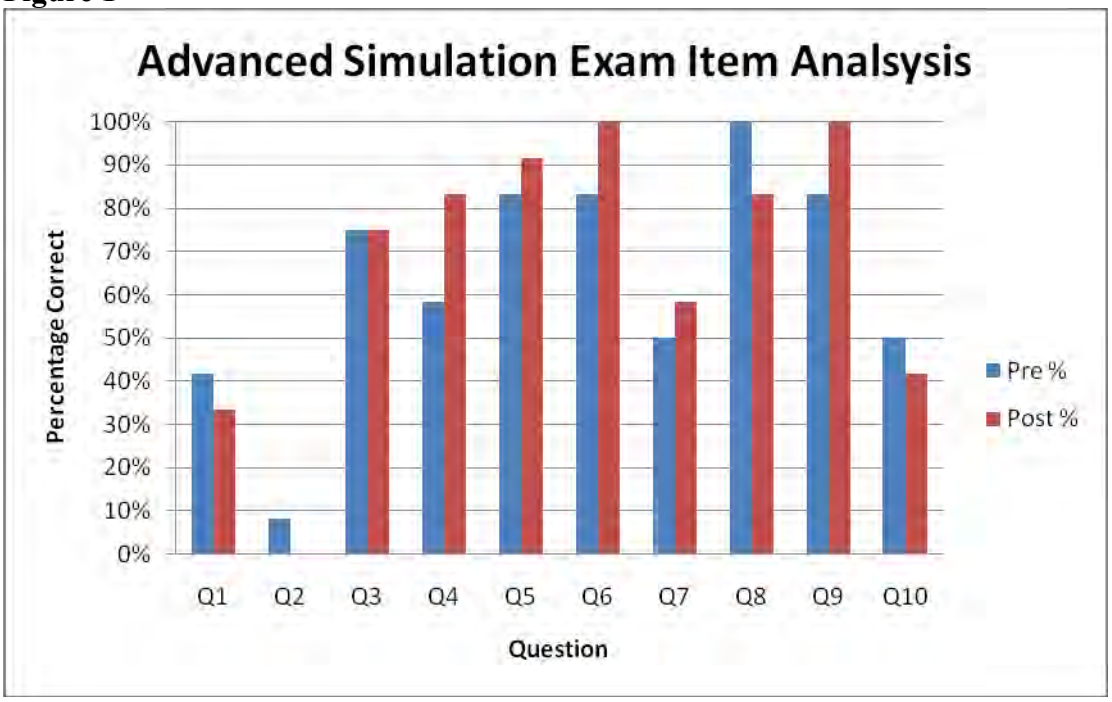
**Table 1: Advanced Airway Management Item Analysis**

| Question | Pretest | | Posttest | | Difference | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Question 1 | 5 | 42% | 4 | 33% | -1 | -8% |
| Question 2 | 1 | 8% | 0 | 0% | -1 | -8% |
| Question 3 | 9 | 75% | 9 | 75% | 0 | 0% |
| Question 4 | 7 | 58% | 10 | 83% | 3 | 25% |
| Question 5 | 10 | 83% | 11 | 92% | 1 | 8% |
| Question 6 | 10 | 83% | 12 | 100% | 2 | 17% |
| Question 7 | 6 | 50% | 7 | 58% | 1 | 8% |
| Question 8 | 12 | 100% | 10 | 83% | -2 | -17% |
| Question 9 | 10 | 83% | 12 | 100% | 2 | 17% |
| Question 10 | 6 | 50% | 5 | 42% | -1 | -8% |

***Note**: n=12. Table shows number and percentage answering each question correctly respectively.*

- The graph below (Figure 1) shows the students' performance on the individual questions of the advanced airway management exam.

**Figure 1**




- **Course Evaluation** - After its completion, students were asked to evaluate the course. Students were provided positive statements and were asked to indicate their level of agreement on a 9-point Likert scale. A 9 on the scale indicates strong agreement, while a 1 indicates strong disagreement. Averages of these results were calculated and the results are found in Table 2:

**Table 2: Course Evaluation**

| | Statement | Average Level of Agreement |
|---|---|---|
| 1. | The objectives of the course were clearly stated. | 8.00 |
| 2. | The course was appropriate for my level of learning. | 7.78 |
| 3. | I plan to apply what I learned here to my practice (i.e. knowledge & skills). | 8.00 |
| 4. | Overall course rating. | 7.67 |
| 5. | The simulation scenarios were realistic. | 7.90 |
| 6. | The simulation scenarios were challenging. | 7.80 |
| 7. | I feel the simulations have improved my technical skills. | 7.70 |

| | | |
|---|---|---|
| 8. | I feel the simulations have improved my medical knowledge. | 7.11 |
| 9. | I feel the simulations have improved my judgment skills. | 7.44 |
| 10. | The scenarios were appropriate for my level of education. | 7.78 |
| 11. | I found the simulation based training to be valuable. | 8.00 |
| 12. | The web-based pre-course curriculum was helpful. | 7.30 |
| 13. | The web-based pre-course curriculum was well organized. | 7.70 |
| 14. | The web-based pre-course curriculum was easy to use. | 6.80 |
| 15. | The web-based pre-course curriculum was helpful | 7.80 |
| 16. | The workshop web-based- curriculum was well organized. | 7.33 |
| 17. | The workshop lecture was informative. | 7.50 |
| 18. | The length of the workshop was appropriate | 6.40 |
| 19. | The discussion of my performance was helpful. | 7.90 |
| 20. | The debriefing session allowed me to see my mistakes. | 7.80 |
| 21. | The debriefing session allowed me to learn from my mistakes. | 7.40 |
| 22. | The debriefing was conducted in a professional manner. | 7.80 |
| 23. | The WISER staff was supportive. | 8.10 |
| 23. | My orientation to the simulation environment was adequate. | 7.90 |

***Note:*** *n=10.*

A *t* test was conducted to determine if there was evidence to show that the mean for these items was greater than a value of 5, which for this 9-point Likert scale would indicate sentiment neutrality. As you can see from Table 3, there was statistical evidence (p value < 0.05) to support this hypothesis for all questions with the exception of #14 and #18. Once again, with such small sample sizes it is difficult to really generalize these findings.

**Test of mu = 5 vs. not = 5.**

**Table 3**

| Variable | N | Mean | St. Dev | SE Mean | 95% CI | T | P |
|---|---|---|---|---|---|---|---|
| Q1 | 10 | 8.000 | 1.563 | 0.494 | (6.882, 9.118) | 6.07 | 0.000 |
| Q2 | 9 | 7.778 | 1.641 | 0.547 | (6.516, 9.040) | 5.08 | 0.001 |
| Q3 | 10 | 8.000 | 1.944 | 0.615 | (6.610, 9.390) | 4.88 | 0.001 |
| Q4 | 9 | 7.667 | 1.581 | 0.527 | (6.451, 8.882) | 5.06 | 0.001 |
| Q5 | 10 | 7.900 | 1.524 | 0.482 | (6.810, 8.990) | 6.02 | 0.000 |
| Q6 | 10 | 7.800 | 1.549 | 0.490 | (6.692, 8.908) | 5.72 | 0.000 |
| Q7 | 10 | 7.700 | 1.947 | 0.616 | (6.308, 9.092) | 4.39 | 0.002 |
| Q8 | 9 | 7.111 | 1.900 | 0.633 | (5.650, 8.572) | 3.33 | 0.010 |
| Q9 | 9 | 7.444 | 1.667 | 0.556 | (6.163, 8.726) | 4.40 | 0.002 |
| Q10 | 9 | 7.778 | 1.922 | 0.641 | (6.300, 9.255) | 4.34 | 0.002 |
| Q11 | 10 | 8.000 | 1.633 | 0.516 | (6.832, 9.168) | 5.81 | 0.000 |
| Q12 | 10 | 7.300 | 1.889 | 0.597 | (5.949, 8.651) | 3.85 | 0.004 |
| Q13 | 10 | 7.700 | 2.214 | 0.700 | (6.116, 9.284) | 3.86 | 0.004 |
| Q14 | 10 | 6.800 | 2.573 | 0.814 | (4.959, 8.641) | 2.21 | 0.054 |
| Q15 | 10 | 7.700 | 1.947 | 0.616 | (6.308, 9.092) | 4.39 | 0.002 |
| Q16 | 9 | 7.333 | 1.803 | 0.601 | (5.948, 8.719) | 3.88 | 0.005 |
| Q17 | 10 | 7.500 | 1.841 | 0.582 | (6.183, 8.817) | 4.29 | 0.002 |
| Q18 | 10 | 6.400 | 2.066 | 0.653 | (4.922, 7.878) | 2.14 | 0.061 |
| Q19 | 10 | 7.900 | 1.595 | 0.504 | (6.759, 9.041) | 5.75 | 0.000 |
| Q20 | 10 | 7.800 | 1.619 | 0.512 | (6.642, 8.958) | 5.47 | 0.000 |
| Q21 | 10 | 7.400 | 1.776 | 0.562 | (6.129, 8.671) | 4.27 | 0.002 |
| Q22 | 10 | 7.800 | 1.317 | 0.416 | (6.858, 8.742) | 6.73 | 0.000 |
| Q23 | 10 | 8.100 | 1.595 | 0.504 | (6.959, 9.241) | 6.15 | 0.000 |
| Q24 | 10 | 7.900 | 1.663 | 0.526 | (6.710, 9.090) | 5.51 | 0.000 |

## Key Research Accomplishments

- Incorporated real-life scenarios (outside accident scenes, indoor hospital exam rooms, and appropriate weather/noise/olfactory conditions) into the simulation experiment for added realism and measured their impact on student performance.
- Offered simulation classes to paramedics and conduct measurements of knowledge and retention associated with course content and clinical application.
- Through the use of telecommunications technology CERMUSA was able to provide access to real-time, interactive medical simulation for the purpose of training healthcare specialists remotely.
- Used profession/curriculum specific validation tools and demonstrated that new technological approaches in the delivery of healthcare education are effective.
- Utilized medical simulators for education with the simulator and the simulator operator located at different sites.

## Reportable Outcomes

- Acceptance of protocol abstract and oral presentation at the 2010 American Telemedicine Association international conference in San Antonio, TX (Appendix D).
- Successful completion of the Advanced Prehospital Airway Management class by all 12 study participants.

## Conclusion

CERMUSA is applying its knowledge of technology and expertise in distance education to connect world-renowned medical experts, high-fidelity medical simulators, skills and task trainers, and medical professionals, with expert simulator operators and instructors at WISER. Using a variety of medical simulators and skills and task trainers, healthcare providers can learn and practice clinical skills without placing patients at risk.

We plan to continue our research to include distant training on different classifications of simulators, and specialty task and skills trainers. Our goal is to develop and test, through a research initiative, different classifications of simulators that can be used for training and instruction from a distance in:

- Individual skills and team training
- Initial skills acquisition and maintenance and enhancement of skills
- Off-site training and in-situ training
- Just-in-time training

CERMUSA specifically aims to test a configuration of equipment that will meet the needs of providers with no or limited healthcare experience to highly trained healthcare providers in both the civilian and military arenas. We want to provide an alternative to the issue of limited clinical resources, utilizing traditional and non-traditional methodologies. This approach will be a more affordable way to provide high quality healthcare instruction in many locations and for many different purposes.

CERMUSA also intends to develop a mobile simulation platform that will connect rural and military healthcare providers with subject matter experts, high to low fidelity simulators, skills and task trainers, and simulator operators for the purpose of training. We have successfully

proven that distant manipulation of the high-fidelity medical simulator is possible, as is didactic education from a distance for medical professionals and para-professionals; however, many of those who provide frontline or initial care have minimal healthcare training. In addition, a mobile simulation platform needs to include more than a high-fidelity simulator if it is to offer comprehensive training to all those in need of training.

CERMUSA's contribution to the third phase of this project continues to be its extensive experience and success in the fields of telehealth, distance learning, and applied research. It is CERMUSA's intent to continue to collaborate with highly regarded and experienced partners for healthcare simulation training and the development of new educational uses for simulators and advanced instructional methods and environments for patients. In doing so, CERMUSA will continue to explore the practicability, reliability, and impact of combining medical simulators with advanced distance education telecommunications technologies. The purposes are to provide, support, monitor, and expand educational opportunities for medical providers and students in military/veteran's facilities and rural, medically underserved areas in the United States and around the world. Existing literature clearly indicates the persistent and rapidly growing need for continuous education and training of healthcare students, and civilian and military pre-hospital and hospital personnel. Therefore, there is a need to increase access to health and wellness education by providing a gateway to this education, particularly to remote populations and locations. As technology advances and today's students and professionals become increasingly more accepting of technologies, alternative learning environments that include the use of medical simulation from a distance, are fast becoming viable vehicles for instruction.

A number of research studies have been conducted worldwide on the use and effectiveness of medical simulation training, both on site and from a distance (Alverson et al, 2008; Carriere, Harvey, 2001; Matheson, Schittek, Attstrom, Lyon, 2001). The Israel Center for Medical Simulation conducts hands-on experiential courses in a wide variety of clinical domains including Anesthesia, Cardiology, Obstetrics-Gynecology, Trauma, and Chemical & Biological Warfare Management. The medical simulation center also offers communication skills courses through programs dedicated to teaching the challenging tasks of breaking bad news, obtaining informed consent, and the detection of domestic abuse (MSR Israel Center for Medical Simulation, 2007). In several of these studies, simulators, simulator operators, and students were positioned at the same location, while other studies had the simulator operator and simulator at the same location and the students located at distant sites. Also, in a study conducted using 27 third- and fourth-year medical students and 33 medical educators, over 80% of both students and educators agreed that simulation should be required for all medical students (Gordon et al., 2001). These studies have shown that this approach to education provides an ideal opportunity to deliver a just-in-time or on-demand type education and training. Medical simulation training can improve performance, increase student confidence and competence, and may result in improved patient outcomes. Potential end users of this distinctive educational application would be, but are not limited to, members of the first responder community (emergency medical technicians, paramedics, and firemen), and health science majors in academic institutions and healthcare facilities. This innovative educational modality will be of particular value to military healthcare systems and associated providers.

The delivery of quality specialty healthcare training to rural, underserved, and military healthcare providers can be a difficult and challenging process. Phase three of the MSAD study will continue to address this ongoing challenge. Evidenced-based medical education is a major component of a community's healthcare infrastructure. In phase one, CERMUSA demonstrated that a comprehensive and sustainable model for healthcare education could be established and maintained using point-to-point medical simulation education. In phase two, CERMUSA showed that a comprehensive and sustainable model for healthcare education can be accomplished using a multi-poin-to-point approach.

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## Appendices

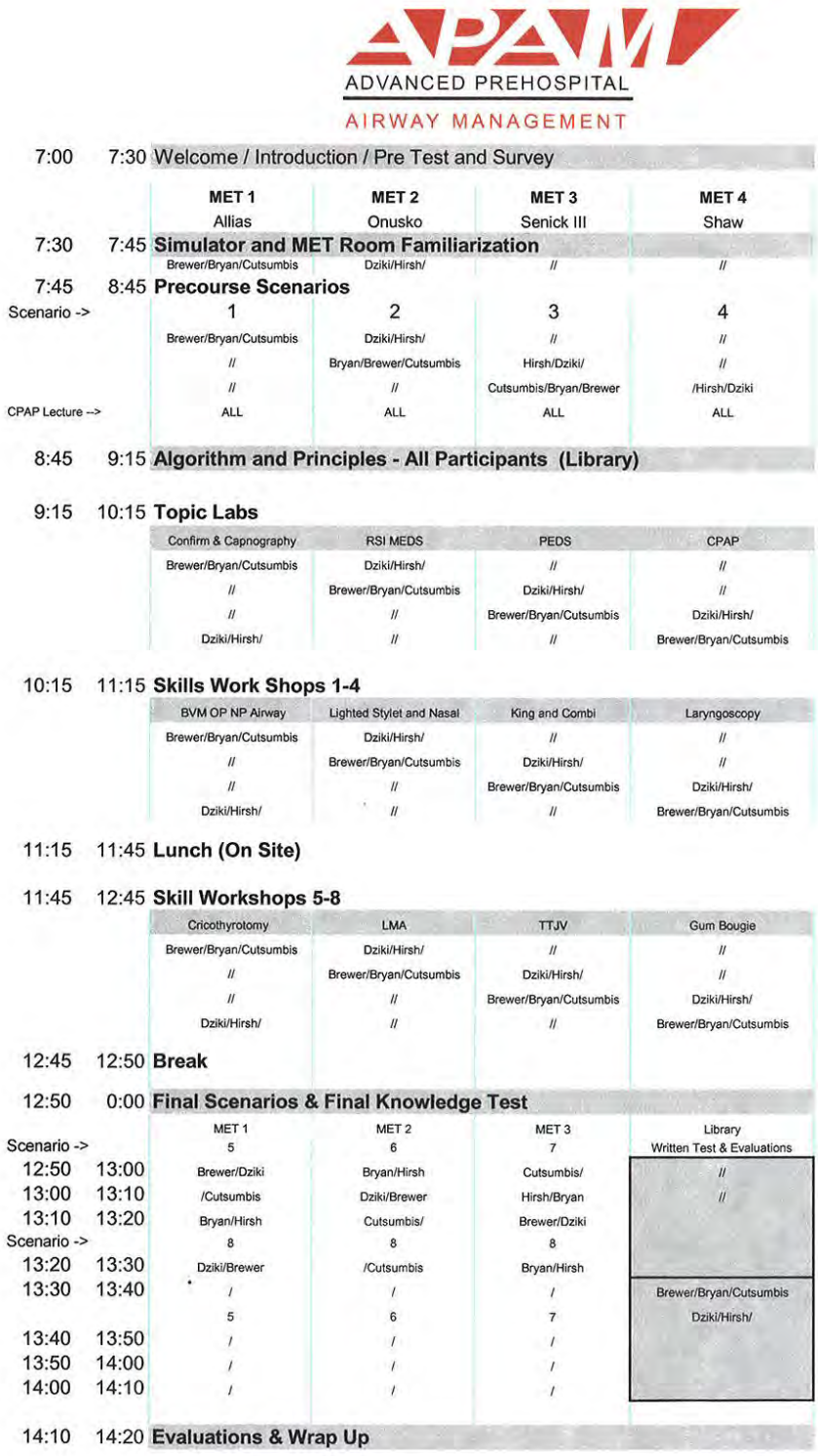
A. APAM Course Outline

B. WISER Sample Pre-quiz/Post-quiz (are the same

C. WISER Survey/Evaluation

D. ATA Presentation Abstract: *Medical Simulation at a Distance for Advanced Pre-hospital Airway Management Training*

# Appendix A



APAM
ADVANCED PREHOSPITAL
AIRWAY MANAGEMENT

| | | | MET 1 | MET 2 | MET 3 | MET 4 |
|---|---|---|---|---|---|---|
| | | | Allias | Onusko | Senick III | Shaw |
| 7:00 | 7:30 | Welcome / Introduction / Pre Test and Survey | | | | |
| 7:30 | 7:45 | **Simulator and MET Room Familiarization** | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ | // | // |
| 7:45 | 8:45 | **Precourse Scenarios** | | | | |
| Scenario -> | | | 1 | 2 | 3 | 4 |
| | | | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ | // | // |
| | | | // | Bryan/Brewer/Cutsumbis | Hirsh/Dziki/ | // |
| | | | // | // | Cutsumbis/Bryan/Brewer | /Hirsh/Dziki |
| CPAP Lecture --> | | | ALL | ALL | ALL | ALL |
| 8:45 | 9:15 | **Algorithm and Principles - All Participants (Library)** | | | | |
| 9:15 | 10:15 | **Topic Labs** | Confirm & Capnography | RSI MEDS | PEDS | CPAP |
| | | | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ | // | // |
| | | | // | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ | // |
| | | | // | // | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ |
| | | | Dziki/Hirsh/ | // | // | Brewer/Bryan/Cutsumbis |
| 10:15 | 11:15 | **Skills Work Shops 1-4** | BVM OP NP Airway | Lighted Stylet and Nasal | King and Combi | Laryngoscopy |
| | | | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ | // | // |
| | | | // | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ | // |
| | | | // | // | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ |
| | | | Dziki/Hirsh/ | // | // | Brewer/Bryan/Cutsumbis |
| 11:15 | 11:45 | **Lunch (On Site)** | | | | |
| 11:45 | 12:45 | **Skill Workshops 5-8** | Cricothyrotomy | LMA | TTJV | Gum Bougie |
| | | | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ | // | // |
| | | | // | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ | // |
| | | | // | // | Brewer/Bryan/Cutsumbis | Dziki/Hirsh/ |
| | | | Dziki/Hirsh/ | // | // | Brewer/Bryan/Cutsumbis |
| 12:45 | 12:50 | **Break** | | | | |
| 12:50 | 0:00 | **Final Scenarios & Final Knowledge Test** | MET 1 | MET 2 | MET 3 | Library |
| Scenario -> | | | 5 | 6 | 7 | Written Test & Evaluations |
| 12:50 | 13:00 | | Brewer/Dziki | Bryan/Hirsh | Cutsumbis/ | // |
| 13:00 | 13:10 | | /Cutsumbis | Dziki/Brewer | Hirsh/Bryan | // |
| 13:10 | 13:20 | | Bryan/Hirsh | Cutsumbis/ | Brewer/Dziki | |
| Scenario -> | | | 8 | 8 | 8 | |
| 13:20 | 13:30 | | Dziki/Brewer | /Cutsumbis | Bryan/Hirsh | |
| 13:30 | 13:40 | | / | / | / | Brewer/Bryan/Cutsumbis |
| | | | 5 | 6 | 7 | Dziki/Hirsh/ |
| 13:40 | 13:50 | | / | / | / | |
| 13:50 | 14:00 | | / | / | / | |
| 14:00 | 14:10 | | / | / | / | |
| 14:10 | 14:20 | **Evaluations & Wrap Up** | | | | |

Course Date

**Med Director**

**Instructors**

**Students**

## Appendix B

WISER - View Sample Quiz 





Questions highlighted in red are not active and will not be visible during testing.

Display Correct Answers

1. **A combination of End Tidal CO2 measurment and the use if the esophageal detector device may be adequate for tube confirmation during endotracheal intubation.**
   a. True
   b. False

2. **The expected depth of an endotracheal tube in an average adult male as measured at the teeth is**
   a. 17 cm
   b. 19 cm
   c. 21 cm
   d. 23 cm
   e. 25 cm

3. **When confirming the placement of an endotracheal tube the breath sounds should be assessed first**
   a. True
   b. False

4. **The sniffing positioning is when the lower part of the neck is leaning forward (flexed) and the head is tilted backward**
   a. True
   b. False

5. **In a patient in cardiac arrest there is likely to be color change on the EndTidal Color Change device if the endotracheal is in the esophagus**
   a. True
   b. False

6. **A correct dose of succinylcholine for rapid sequence intubation of a 100kg adult would be**
   a. 50 mg
   b. 75 mg
   c. 150 mg
   d. 300 mg
   e. 400 mg

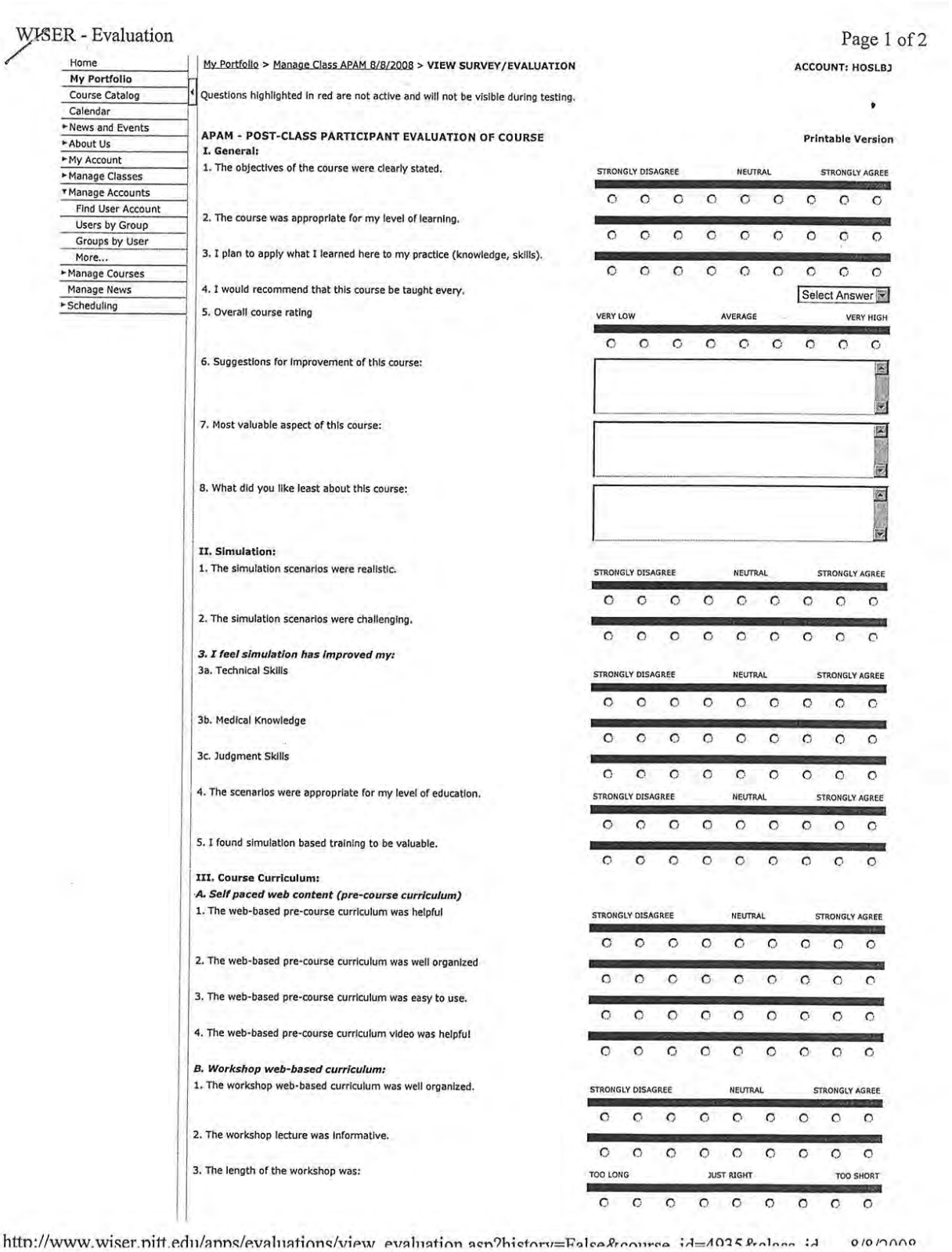
7. **The narrowest part of the airway of a young child is below the vocal cords**
   a. True
   b. False

8. **The gum elastic bougie may be useful to assist in endotracheal intubation when**
   a. No landmarks are visible because of swelling and edema after a burn injury
   b. A partial view, but not ideal view of the vocal cords is seen
   c. An obstruction of the airway is occurring because of epiglottis in a child

9. **When performing a surgical cricothyrotomy the incision should be made transversely (side to side)**
   a. True
   b. False

10. **A spinal cord injury (c6) patient is in severe respiratory arrest and requires intubation. Which medication (if any) are contraindicated?**
    a. Etomidate
    b. Lidocaine
    c. Succinylcholine
    d. Vecurronium
    e. None are contraindicated

# Appendix C



WISER - Evaluation



Home
My Portfolio
Course Catalog
Calendar
▸News and Events
▸About Us
▸My Account
▸Manage Classes
▾Manage Accounts
Find User Account
Users by Group
Groups by User
More...
▸Manage Courses
Manage News
▸Scheduling

My Portfolio > Manage Class APAM 8/8/2008 > VIEW SURVEY/EVALUATION

ACCOUNT: HOSLBJ

Questions highlighted in red are not active and will not be visible during testing.

Printable Version

**APAM - POST-CLASS PARTICIPANT EVALUATION OF COURSE**

**I. General:**

1. The objectives of the course were clearly stated. — STRONGLY DISAGREE / NEUTRAL / STRONGLY AGREE
2. The course was appropriate for my level of learning.
3. I plan to apply what I learned here to my practice (knowledge, skills).
4. I would recommend that this course be taught every. — Select Answer
5. Overall course rating — VERY LOW / AVERAGE / VERY HIGH
6. Suggestions for improvement of this course:
7. Most valuable aspect of this course:
8. What did you like least about this course:

**II. Simulation:**

1. The simulation scenarios were realistic. — STRONGLY DISAGREE / NEUTRAL / STRONGLY AGREE
2. The simulation scenarios were challenging.

***3. I feel simulation has improved my:***

3a. Technical Skills — STRONGLY DISAGREE / NEUTRAL / STRONGLY AGREE

3b. Medical Knowledge

3c. Judgment Skills

4. The scenarios were appropriate for my level of education. — STRONGLY DISAGREE / NEUTRAL / STRONGLY AGREE
5. I found simulation based training to be valuable.

**III. Course Curriculum:**

***A. Self paced web content (pre-course curriculum)***

1. The web-based pre-course curriculum was helpful — STRONGLY DISAGREE / NEUTRAL / STRONGLY AGREE
2. The web-based pre-course curriculum was well organized
3. The web-based pre-course curriculum was easy to use.
4. The web-based pre-course curriculum video was helpful

***B. Workshop web-based curriculum:***

1. The workshop web-based curriculum was well organized. — STRONGLY DISAGREE / NEUTRAL / STRONGLY AGREE
2. The workshop lecture was informative.
3. The length of the workshop was: — TOO LONG / JUST RIGHT / TOO SHORT

## Appendix D

## Title: Medical Simulation at a Distance for Advanced Pre-hospital Airway Management Training

**Objectives:**

- Assess, demonstrate, and evaluate the feasibility, quality, and quantity of encounters and documentation of educational requirements through distance education using point-to-point medical simulation technology.
- Prove that the operation of medical simulators from a distance is as clinically accurate and effective as on-site operation of the simulator; when the simulator is located at one site and the simulator operator is located at a different separate site.
- Expand access to medical simulation education to rural and medically underserved areas.
- Offer classes in Advanced Prehospital Airway Management to healthcare providers unable to travel to the central simulation center.
- Conduct measurements of knowledge and retention in pharmacology associated with airway care, airway related patient assessment, bag valve mask ventilation, endotracheal intubation, cricothyroidotomy, use of rescue airway devices, and patient monitoring equipment.

**Abstract:**

The focus of this project is to deliver quality education through medical simulation to rural and military healthcare providers. Numerous healthcare providers have little experience with intubation and many face difficulties in acquiring skills needed to provide this vital care. What's more, there is documented evidence that 'appropriately educated' healthcare providers improve patient survival rates. Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas collaborated with The Peter M. Winter Institute for Simulation, Education and Research to explore the practicability, reliability, and impact of combining medical simulators with advanced distance education and telecommunications technologies. Technology was used to connect subject matter experts, simulator operators, and curriculum content developers with medical simulators, faculty, and class participants. The location of the students and the simulator, in relation to the simulator operator, made the project unique. The concept is based on access to the central simulation facility and its personnel from a remote site.

The study utilized a course designed to cover all aspects of providing high quality airway care to patients in the prehospital setting. Web-based study material covered knowledge necessary to perform skills and scenarios associated with a day in the simulation center. Real-world scenarios challenged the participants to demonstrate their mastery of skills and knowledge. Researchers studied the effectiveness of delivering this type of education at a distance with an experimental group of (11) and compared it with a control group of (399) who participated via in-person instruction. Both groups completed online pre-test and post-test. An analysis of each question on the pretest and post-test was performed to identify areas where there may have been significant differences between the control and experimental group. Post-exercise

video debriefing was also utilized to review student performance. Results demonstrated that the approach used was effective in performing medical simulation education.

# Saint Francis University's
# Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA)

FY08 Annual Report
(May 4, 2009 to July 31, 2010)

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**Protocol Title:** Continuing Distance Education for Health Sciences

**Protocol No.:** 07-TATDL212-07

**Date:** July 2010

## Principal Investigator
Kristine Anderson, PhD, Distance Learning Course Management Specialist

## Introduction
The overlap period in the research study: FY07 (March 12, 2008 to December 31, 2009) and FY08 (May 4, 2009 to July 31, 2010) concluded the completion of the medical toolkit research (Dental Box and MRSA (Methicillin Resistant Staphylococcus Aureus) Kit). The outcomes of the medical toolkit research are reported in the FY07 Annual Report. The data collection and analysis that occurred summer and fall of 2009 are reported here in the FY08 Annual Report.

In addition, the protocol in 2010 focused the remaining area of research on substance abuse in the military. This study conducted an investigation to determine methods to promote proper medication adherence and advising of care for chronic conditions to prevent medication errors and substance abuse issues of prescription, herbal, and recreational drugs among members of the military. Members of the military are at an increased risk for abuse problems with recreational, herbal, and prescribed medications due to increased occupational stress and injury risk. The program and methods to deliver the program at a distance have been defined in this study. The implementation of the program will be investigated in the pilot study of FY09 Military Screening, Brief Intervention, and Referral to Treatment (SBIRT) Program.

*Medical Toolkits*
The study identified areas in medical care that lacked the necessary training. Specifically, these areas are acute dental emergency care and community MRSA.

A needs assessment was conducted with the medical community to determine the areas of need and the requested topics of concern within patient safety. It found that in rural Pennsylvania, there is one dentist for every 2,200 residents and the following four counties have less than five dentists each: Cameron, Forest, Fulton, and Sullivan (Center for Rural Pennsylvania, 2006). Additionally relevant to this study is that over the last couple of years, Pennsylvania has had a terrible problem with HA-MRSA (MRSA Notes, 2008). There are annually 17,000 preventable deaths in the United States. While hospital screening and control is vastly improving, home care is lacking and leading to repeat MRSA cases and spreading of the disease. This in-part has led to the development of the super-bug, CA-strand. The study developed medical toolkits and training materials to address each of these problems.

These problems are also concerns in the military. There is a chronic military dental workforce shortfall (ADA, 2009). Blast injuries, traumatic brain injury, and other incidents can cause oral trauma (Shuker, 2009; Veterans Affairs, 2008). This study's goal was to enable healthcare teams to perform emergency care and provide field medical staff and support staff to be able to administer timely care.

*Substance Abuse*
One in four soldiers admitted abusing prescribed drugs, mostly pain relievers, in the 12 months prior to a Pentagon survey in 2008, according to the results released in 2010. Fifteen percent said they had abused drugs in the 30 days before the survey. More study is needed to understand why and how troops are abusing prescription medications. Pentagon records show the abuse of

prescription drugs is higher in the military than among civilians. Five percent of civilians reported abusing prescription drugs in a 30-day period in 2007, compared to 11% of military personnel surveyed in 2008 (Zoroya, 2010).

According to the United States Department of Veterans Affairs, in 2008, there are currently 1.1 million veterans in Pennsylvania (VA, 2008). The study seeks to educate with comprehensive and accurate advising of care for chronic conditions to prevent substance abuse, promote proper medication adherence, and address issues faced by members and veterans of the military.

The care of chronic physical, emotional, and mental health conditions may lead to methods of self-medication. Self-medication is the unsupervised use of medicaments, including alcohol, prescribed medicines (with or without an authorized prescription), herbal, and recreational drugs (SAMHSA, 2009). Members of the military are at an increased risk for abuse problems with recreational, herbal, and prescribed medications due to increased occupational stress and injury risk. The Substance Abuse and Mental Health Services Administration (SAMHSA)'s National Survey on Drug Use and Health (NSDUH) found that in 2003, an estimated 3.5% of veterans used marijuana in the past month, compared with 3.0% of their non-veteran counterparts, and heavy use of alcohol in past months was more prevalent among veterans (7.5%) than comparable nonveterans (6.5%). However, of this group only an estimated 0.8% of veterans received specialty treatment for a substance use disorder (alcohol or illicit drugs) in the study (SAMHSA, 2009). (The data from NSDUH that were used to compare substance use, dependence and treatment among veterans and non veterans used veterans that were defined as persons who had formerly served in any of the U.S. Armed Forces (Army, Navy, Air Force, Marine Corps, etc.). The nonveteran comparison group reflected the age, gender, and geographic distribution of veterans as indicated in the Veterans Health Administration's benefit eligibility data.) Latest NSDUH report can be found at: http://www.oas.samhsa.gov/2k5/vets/vets.htm.

A key measure of action in this situation is prevention. Well-designed health education programs would promote effective self-management support strategies that: involve interaction between the healthcare service provider and the patient; support organizations that are ready to make permanent changes to integrate self-management support into care delivery, enable implementation of these strategies in diverse settings, and directly assist organizations and individuals with training curricula, tools, and technical assistance; and evaluate success of the implementation and success factors in different settings (Heisler, Bouknight, Hayward, Smith & Kerr, 2002).

As many treatments become more complex and depend on self-management techniques, education is increasingly more important (Parker & Schwartzberg, 2001). Effective health education programs are needed, as they have the ability to change poor health behaviors and poor treatment procedures. The improvement of health behaviors and treatments leads to better health and better quality of life for the patient. Behavior change programs that target motivation as an important factor are more successful in accomplishing at least some of the behavioral goals and remain more consistent with the principle of individual autonomy and, according to Dunsmore and Goodson (2006), this is a cornerstone value of health promotion practice, especially with medication adherence and abuse prevention.

SBIRT or "Screening, Brief Intervention and Referral to Treatment" is an early intervention approach that represents a paradigm shift in the provision of treatment for substance use and abuse. The services are different from, but designed to work in concert with, specialized or traditional treatment (SAMHSA, 2009).

According to SAMHSA (2009) the primary focus of specialized treatment has been persons with more severe substance use or those who have met the criteria for a substance use disorder. The SBIRT initiative targets those with nondependent substance use and provides effective strategies for intervention prior to the need for more extensive or specialized treatment.

The goal of this program is to utilize distance learning methodologies and technologies to provide SBIRT training at a distance. This includes initial training and refresher follow-up programming with participants.

A problem analysis and needs analysis for the SBIRT program was conducted for the program to be delivered at a distance for medical providers of active and veteran military members. This is a framework for the development, distribution, and assessment of the materials.

## Body

*Medical Toolkits*
In 2002, there was an outbreak of MRSA among trainees at a Marine Recruit Training base. Prior to the outbreak, the monthly incidence of MRSA did not exceed 2 cases per 1,000 recruits. During the outbreak periods (Aug-Dec 2002), the monthly incidence ranged from 4.9-11.0 cases per 1,000 recruits. Contributing outbreak factors were the close physical contact environment of training and the physical nature of recruit training resulting in minor cuts/abrasions that increased the risk of developing a skin infection. Control measures to improve hygiene were instituted to include frequent hand washing and the use of antibacterial hand sanitizers (United States Department of Health and Human Services, 2002).

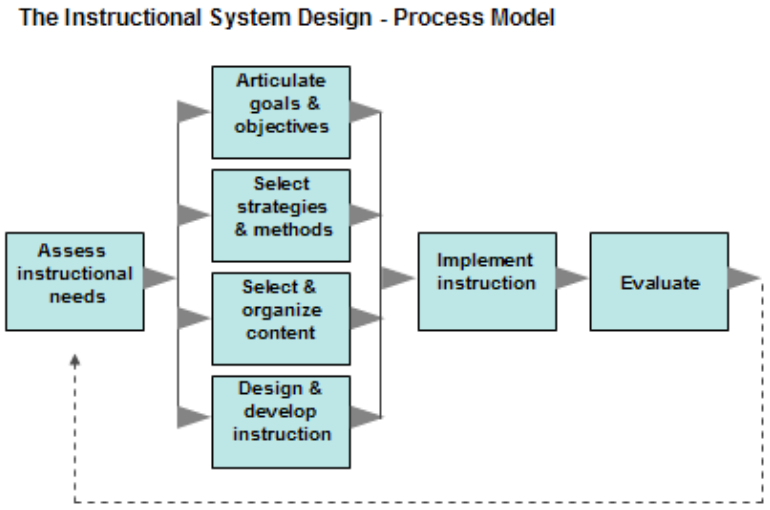
This study demonstrated that a training solution designed as a total package vehicle best addresses educational needs at a distance with a convenience kit to solve a problem. A total package vehicle is using equipment and training together, as needed, to address the issue. Both sets of materials addressed the training needs by providing an immersive, interactive learning at a distance, to improve clinical performance, increase safety adherence, and conduct an experimental inquiry with Web 2.0 applications (i.e. social networking, virtual worlds, peer-to-peer communication tools, interactive socializing).

The instructional design strategy implemented in the development of the materials in this study is illustrated in Figure 1. The instructional design model is a systematic process for developing instructional programs and materials. The diagram to follow shows some of the key stages which are often part of the instructional design process.

Some potential benefits of incorporating good instructional design into the teaching and learning process are that instructional quality often improves because the selection of content, use of specific instructional strategies, and methods of assessment are tightly integrated. The learner

success often increases with instruction that is effective and clear with measurable goals and outcomes. The research-based principles guide the selection of media and instructional methodologies which address diverse learning styles. Collaboration occurs throughout the development process by involving experts in media production, visual and graphic design, information design, and software development and learner evaluation.

**Figure 1:** Instructional System Design: Process Model




The instructional design process results in a task condition standard; it defines a training process that can reach multiple people with the same method. As in this study, the learners are all located at separate locations and each advance at their own pace in the program. The materials were developed so each learner could accomplish the objectives of the training program.

The purpose of this study was to implement new equipment training and put the training to use in a current situation to fix a problem. The dental kit and MRSA kit address problems that are occurring in military and civilian situations. Both of the kits were designed to be convenient and to solve the common problems associated with each issue.

*Dental Kit*

The dental kit (Figure 2) was designed by an emergency physician, and provides for the emergency care of acute dental emergencies until definitive care by a dentist can be arranged. The medications, medicaments, and anesthetics contained in the kit enable busy emergency professionals to quickly and easily take care of fractured teeth, subluxations, luxations, avulsions, dry sockets, deep caries, loose appliances, and bleeding mucosa.

**Figure 2:** Photo of the Dental Kit


The specific kit contents are (Figure 3): 2-Tray Non-Tip Heavy Duty Plastic Utility Box; 20% Benzocaine Topical Anesthetic Gel (2) - provides mucosal anesthesia; Calcium Hydroxide Paste, Catalyst & Base - seals fractured teeth; Zinc Oxide/Eugenol Temporary Cement; Catalyst & Base - anesthetic and antibacterial cement for deep, painful caries and for securing loose caps, crowns or fillings; Periodontal Dressing; Catalyst & Base - stabilizes subluxed or luxated teeth & excellent for covering mucosal lacerations; Bupivacaine/Epinephrine Cartridges—Canister of 50 -injectable local anesthetic for dental blocks; 27 Gauge, 1.5" Needle Disposable Syringe System with Reusable Plastic Ringed Aspirators - for use with anesthetic cartridges; Topical Mucosal Bactericidal Solution - for use as a topical antibacterial agent in the mouth; Cotton Dental Roll Gauze (50); Dry Socket Medicament - for use in the treatment of alveolar osteitis; Mixing Pads; 3" X 3" Size, Stainless Steel Cement Spatula - for use in mixing pastes, glues, dressings, etc.; Stainless Steel Plastic Filling Instrument - for application of pastes, glues, dressings, etc.; Laminated Quick-Reference Cards - to be used as a clinical reference when using contents and performing dental blocks; access to video tutorial and online assessment series; Cotton Tipped Applicators (50) - for application of topical anesthetic; Wooden Tongue Blades - for mixing periodontal paste; Tooth Preservation System - for preserving avulsed teeth until re-implantation can occur; Inventory Lid Insert; and Dental Sealant System - for use in the setting of post extraction bleeding.

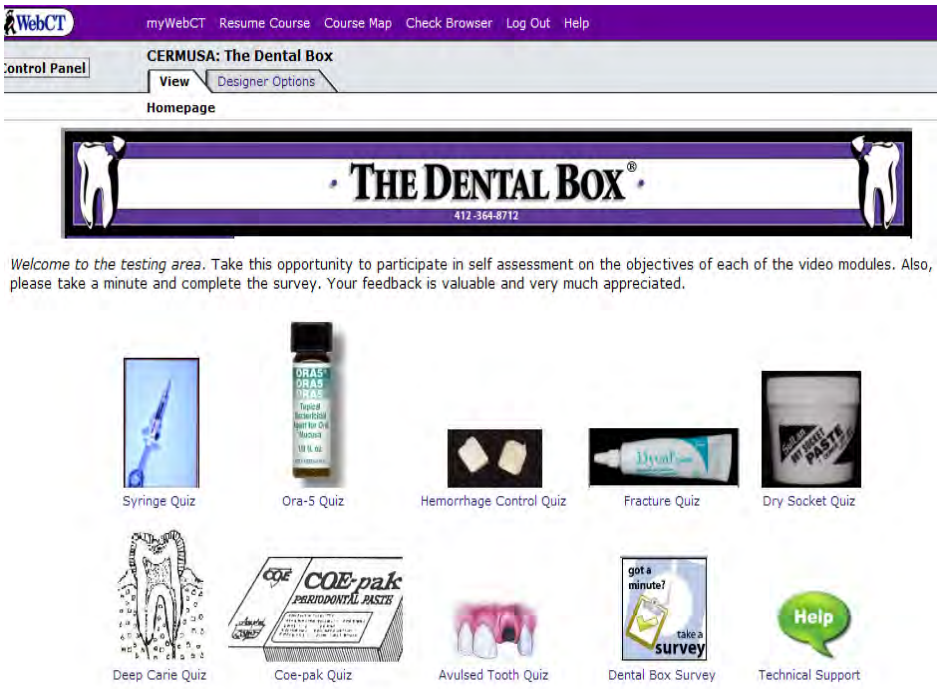
**Figure 3:** Photo of the Interior of the Dental Kit

This convenience kit, designed to provide everything required for care directly to the bedside, includes pictorial laminated "quick reference" cards (Figure 4) for use when performing dental blocks or taking care of the above-listed clinical conditions. Items selected for inclusion in the dental kit are designed to be easy to use in the emergency setting. They have an extended shelf life and provide for multiple patient treatments. All items can be restocked.

**Figure 4:** Photo of a Quick Reference Card

The educational instruments in the dental kit also include video tutorials (Figure 5) on how to use each of the materials contained in the kit. The training modules are for syringe use, Ora-5, hemorrhage control, addressing fractures, dry sockets, deep caries, Coe-Pak usage, and on avulsed tooth. Each of these are accompanied by a video tutorial that was scripted and produced by a licensed board certified physician in a production studio with tooth models and a dental kit. They are all downloadable to mobile devices for just-in-time training opportunities.

**Figure 5:** Screenshot of Dental Training Program



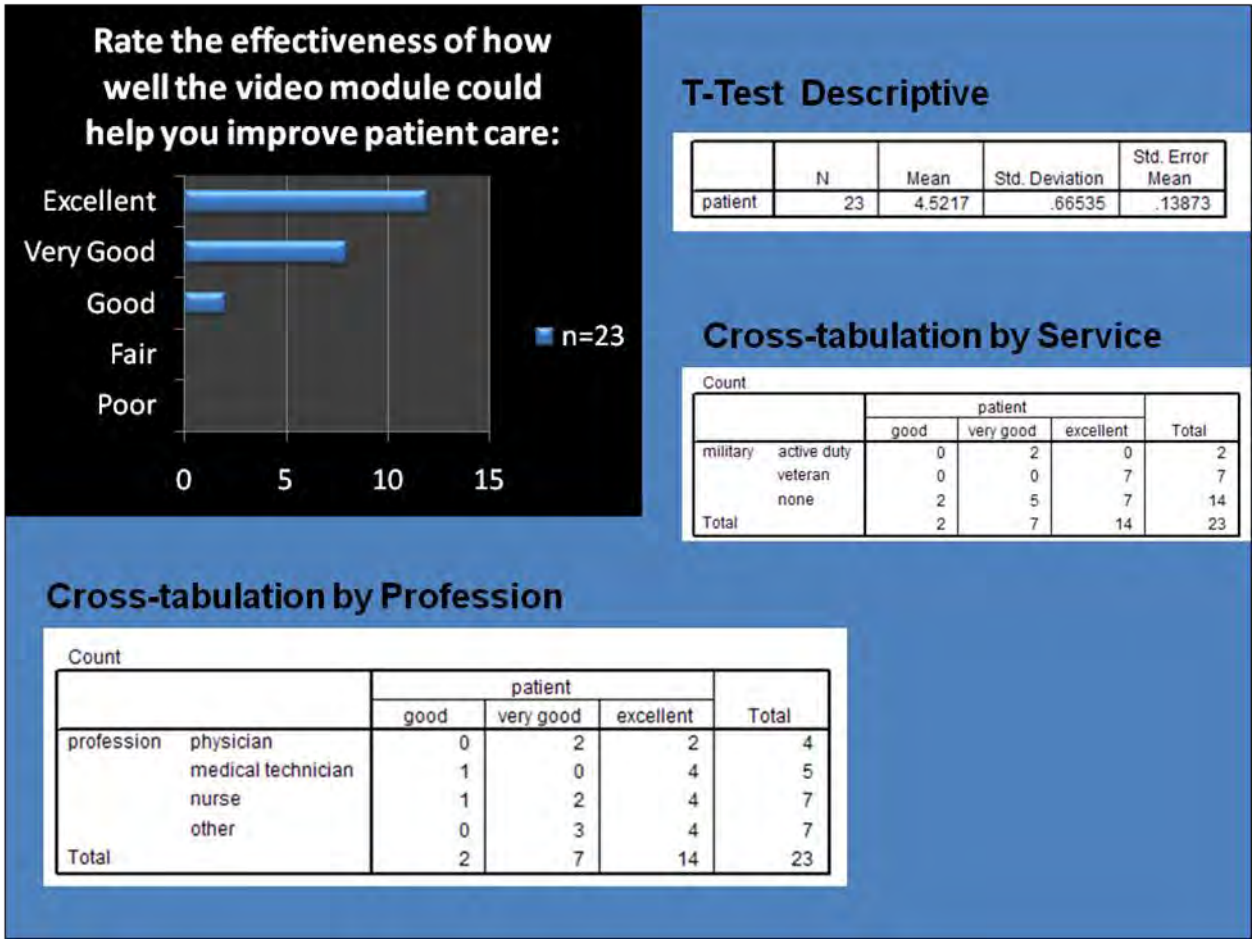

The assessments in the program (Figure 5) include pictorials of the procedures that are being evaluated. They are designed to reinforce the steps and methods to properly conduct each of the procedures. In addition, affective assessments were collected from the learners to gain their perspectives of the study.

**Figure 5:** Screenshot of Dental Training Program Assessment


The demographics of the 23 learner participants in the dental kit program in the study were: employer/profession classification, 63% Health Care Facility (Hospital/Nursing Facility), 10% Corporate/Managed Care, 10% Military, 3% Retail, and 14% Other. The participants' professions were 32% Nurse, 23% Technician, 14% Physician, and 32% Other. The participants that have military service included 27% Veteran and 10% Active.

All study participants (100%) felt that they learned something new rather than verifying information that they had already known. In Figure 6, the analysis of "Rate the effectiveness of how well the video module could help you improve patient care" is shown. The majority of the 23 participants rated it very highly. On a scale of 1 to 5, with 5 being the highest, there was a mean score of 4.5. A more in-depth analysis can be obtained in the broken out sections provided in Figure 6 by military service and profession.

**Figure 6:** Analysis of Improved Patient Care




**T-Test Descriptive**

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| patient | 23 | 4.5217 | .66535 | .13873 |

**Cross-tabulation by Service**

Count

| | | patient | | | |
|---|---|---|---|---|---|
| | | good | very good | excellent | Total |
| military | active duty | 0 | 2 | 0 | 2 |
| | veteran | 0 | 0 | 7 | 7 |
| | none | 2 | 5 | 7 | 14 |
| Total | | 2 | 7 | 14 | 23 |

**Cross-tabulation by Profession**

Count

| | | patient | | | |
|---|---|---|---|---|---|
| | | good | very good | excellent | Total |
| profession | physician | 0 | 2 | 2 | 4 |
| | medical technician | 1 | 0 | 4 | 5 |
| | nurse | 1 | 2 | 4 | 7 |
| | other | 0 | 3 | 4 | 7 |
| Total | | 2 | 7 | 14 | 23 |

Figure 7 is the analysis of "Rate the effectiveness of how well the video module related to your practice needs". The majority of the 23 participants rated it very highly. On a scale of 1 to 5, with 5 being the highest, a mean score of 4.6 was found. A more in-depth analysis can be obtained in the broken out sections provided in Figure 7 by military service and profession.

**Figure 7:** Analysis of Relation to Practice Needs

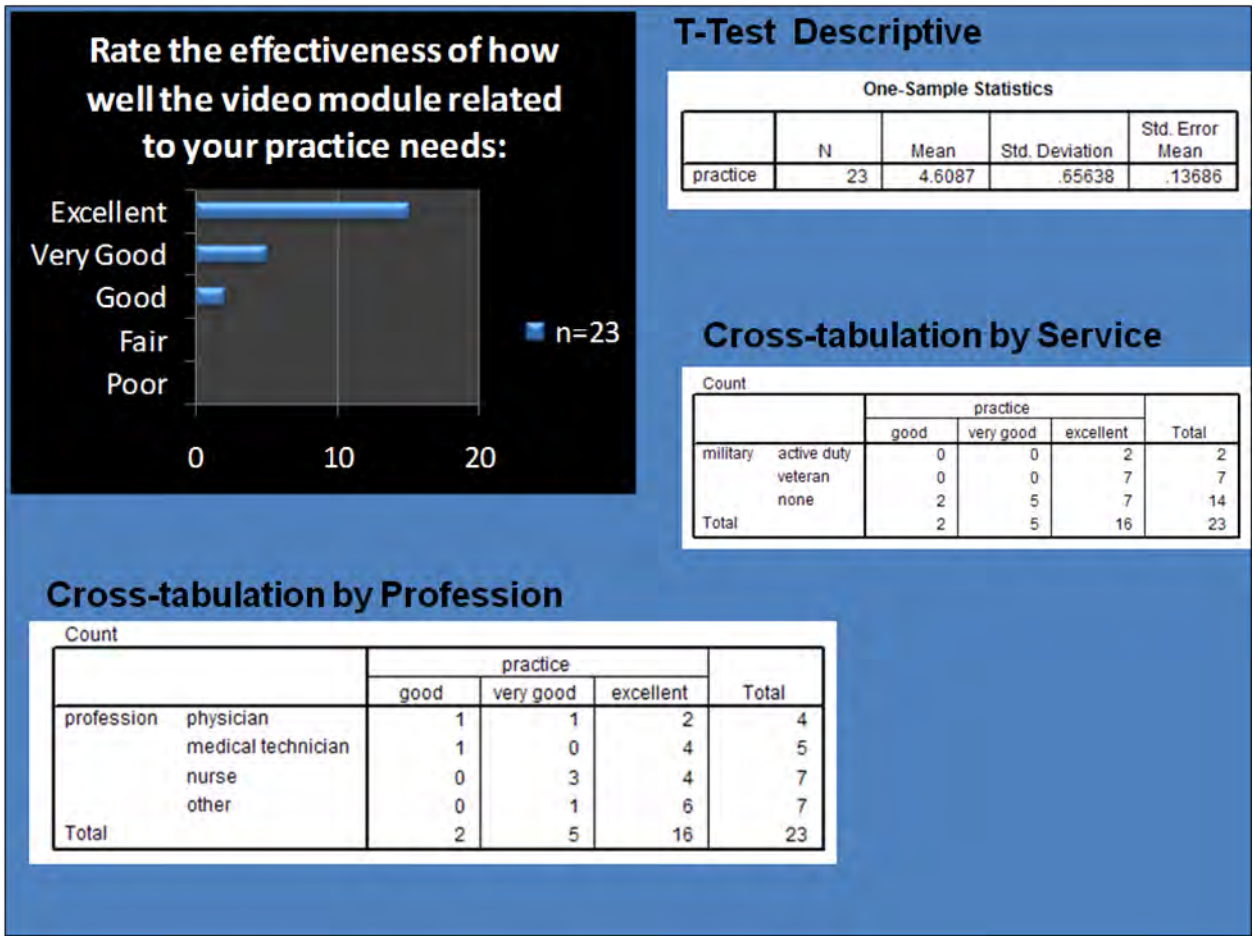
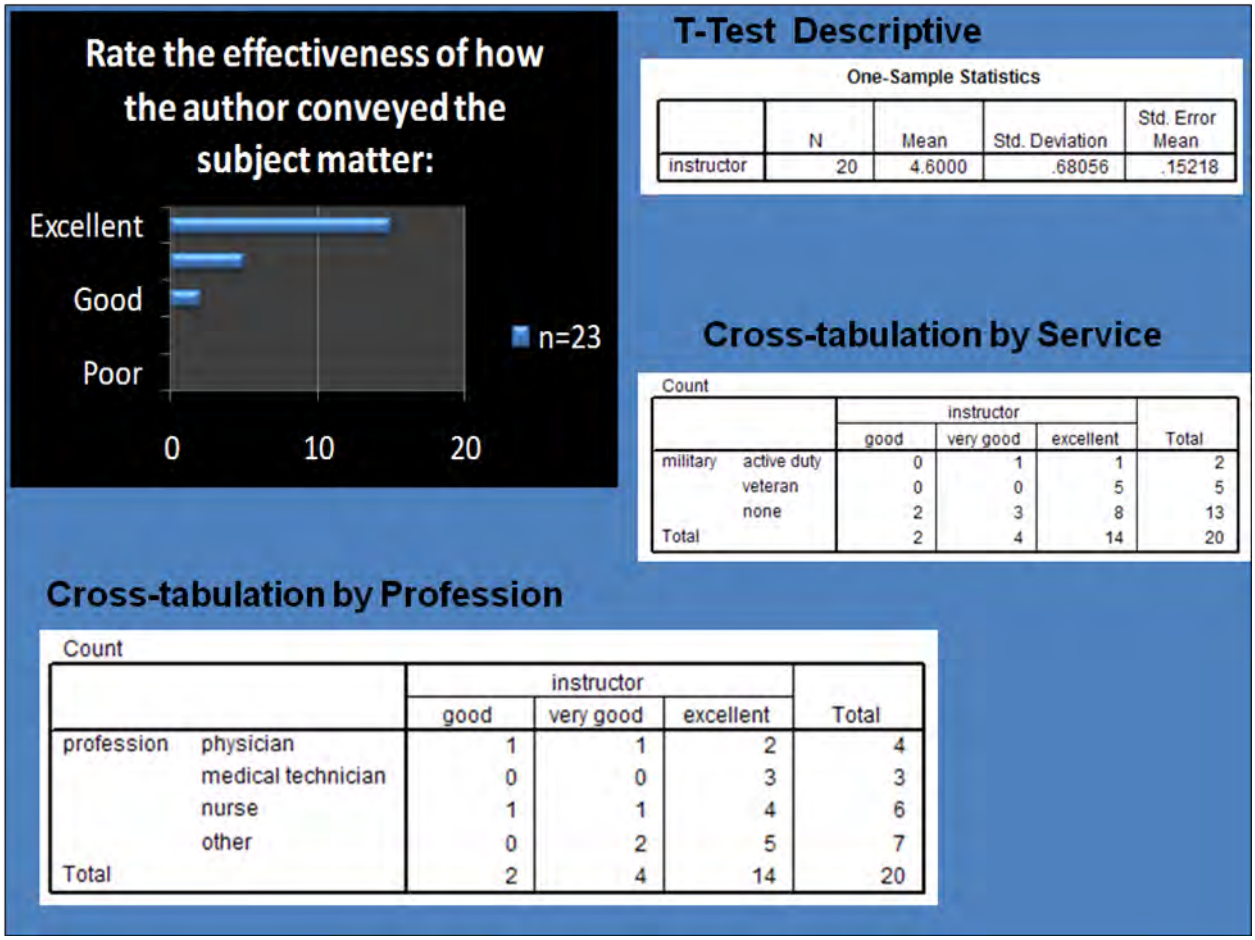



Figure 8 is the analysis of "Rate the effectiveness of how well the author conveyed the subject matter". The majority of the 23 participants rated it very highly. On a scale of 1 to 5, with 5 being the highest, a mean score of 4.6 was calculated. A more in-depth analysis can be obtained in the broken out sections provided in Figure 8 by military service and profession.

**Figure 8:** Analysis of how the Author Conveyed the Subject Matter




**T-Test Descriptive**

One-Sample Statistics

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| instructor | 20 | 4.6000 | .68056 | .15218 |

**Cross-tabulation by Service**

Count

| | | instructor | | | |
|---|---|---|---|---|---|
| | | good | very good | excellent | Total |
| military | active duty | 0 | 1 | 1 | 2 |
| | veteran | 0 | 0 | 5 | 5 |
| | none | 2 | 3 | 8 | 13 |
| Total | | 2 | 4 | 14 | 20 |

**Cross-tabulation by Profession**

Count

| | | instructor | | | |
|---|---|---|---|---|---|
| | | good | very good | excellent | Total |
| profession | physician | 1 | 1 | 2 | 4 |
| | medical technician | 0 | 0 | 3 | 3 |
| | nurse | 1 | 1 | 4 | 6 |
| | other | 0 | 2 | 5 | 7 |
| Total | | 2 | 4 | 14 | 20 |

*MRSA*

MRSA is a bacterium responsible for difficult-to-treat infections in humans (Figure 9). It may also be referred to as multidrug-resistant Staphylococcus aureus or oxacillin-resistant Staphylococcus aureus (ORSA). MRSA is, by definition, a strain of Staphylococcus aureus that is resistant to a large group of antibiotics called the beta-lactams, which include the penicillins and the cephalosporins (Raygada & Levine, 2009).

MRSA has evolved an ability to survive treatment with beta-lactam antibiotics, including methicillin, dicloxacillin, nafcillin, and oxacillin. MRSA is especially troublesome within hospital-associated (nosocomial) infections. In hospitals, patients with open wounds, invasive devices, and weakened immune systems are at greater risk for infection than the general public. Hospital staff that do not follow proper sanitary procedures may transfer bacteria from patient to patient. Visitors to patients with MRSA infections or MRSA colonization are advised to follow hospital isolation protocol by using the provided gloves, gowns, and masks if indicated. Visitors who do not follow such protocols are capable of spreading the bacteria to cafeterias, bathrooms, and elevators (Raygada & Levine, 2009).

The organism is often sub-categorized as community-acquired MRSA (CA-MRSA) or health care-associated MRSA (HA-MRSA), although this distinction is complex. Some have defined CA-MRSA by characteristics of patients who develop a MRSA infection, while other authors have defined CA-MRSA by genetic characteristics of the bacteria themselves. The first reported cases of community-acquired MRSA began to appear in the mid-1990s from Australia, New Zealand, the United States, the United Kingdom, France, Finland, Canada, and Samoa, notable because they involved people who had not been exposed to a healthcare setting. The new CA-MRSA strains have rapidly become the most common cause of cultured skin infections among individuals seeking emergency medical care in urban areas of the United States (Raygada & Levine, 2009).

**Figure 9:** Examples of MRSA

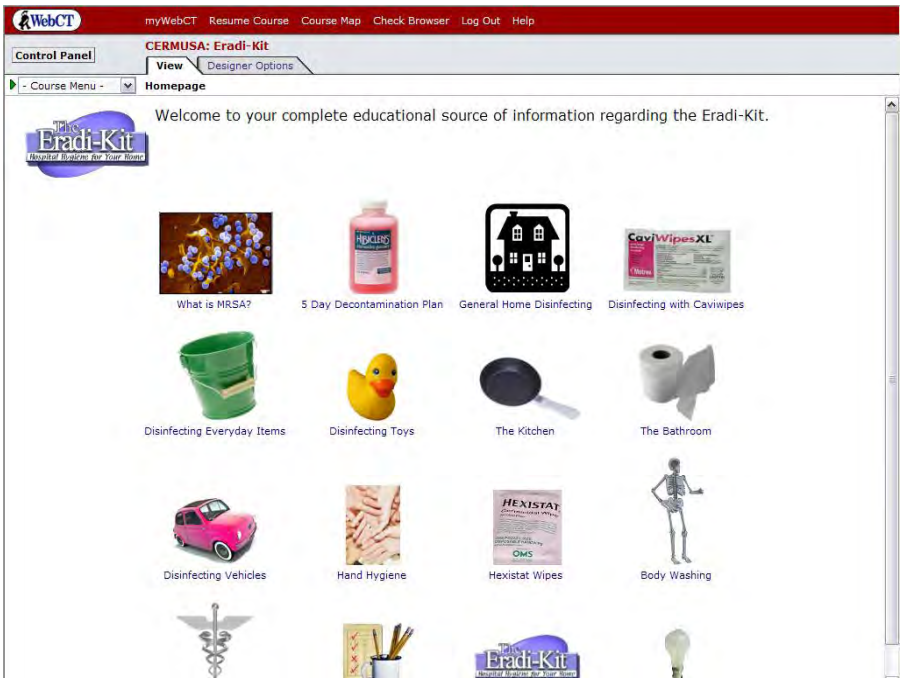
The MRSA kit (Figure 10) was developed as a comprehensive decontamination method of eradicating MRSA from the home environment. CA-MRSA, or community-associated MRSA, is a new strain of bacteria capable of infecting even healthy people of all ages. CA-MRSA produces a toxin that is able to attack the immune system much more aggressively than the hospital-associated strain (HA-MRSA). MRSA can prey upon anyone, not just the chronically sick or those with a weakened immunity.

**Figure 10:** Photos of the MRSA kit


The kit communicates that the key to stopping disease-causing germs is not better, stronger antibiotics. The best way to prevent infections in ourselves and our families is by preventing the spread of germs in our homes. Designed by two Pennsylvania doctors, they've identified the proper methods and medications for MRSA cleansing and decolonization. The kit contains sets of Hexistat cloths, Hibclens body wash, Hexistat Wipes XL, Caviwipes, nail cleaners, and a Hibclens pump for hair washing. The kit also contains a comprehensive packet of information on the proper procedures for conducting a home MRSA cleaning.

In addition, the kit also has a series of tutorial videos, additional information, and test-your-knowledge opportunities with the accompanying online program (Figure 11). Everything in the kit is a common household cleaner, such as bleach, and is used to conduct a home cleaning. The program explains the importance and benefits of cleaning the home to prevent repeat outbreaks of MRSA or passing it along to another person in the home. The program breaks the house into sections to make it more manageable for a person to conduct an invasive, in-depth cleaning. It should take 5 days to conduct this full cleaning of each person, pet, house, car, and other items around the home.

**Figure 11:** Screenshot of the Online Program




The majority of the participants in the study (85%) felt that they learned something new rather than verifying information that they had already known. Figure 12 shows the analysis of "Rate the effectiveness of how well the video module could help you improve your care". The majority of the 15 participants rated it very highly. On a scale of 1 to 5, with 5 being the highest, a mean score of 4.2 was calculated. A more in-depth analysis can be obtained in the broken out sections provided in Figure 12 by military service and sample statistics.

**Figure 12:** Analysis of Improve Your Care

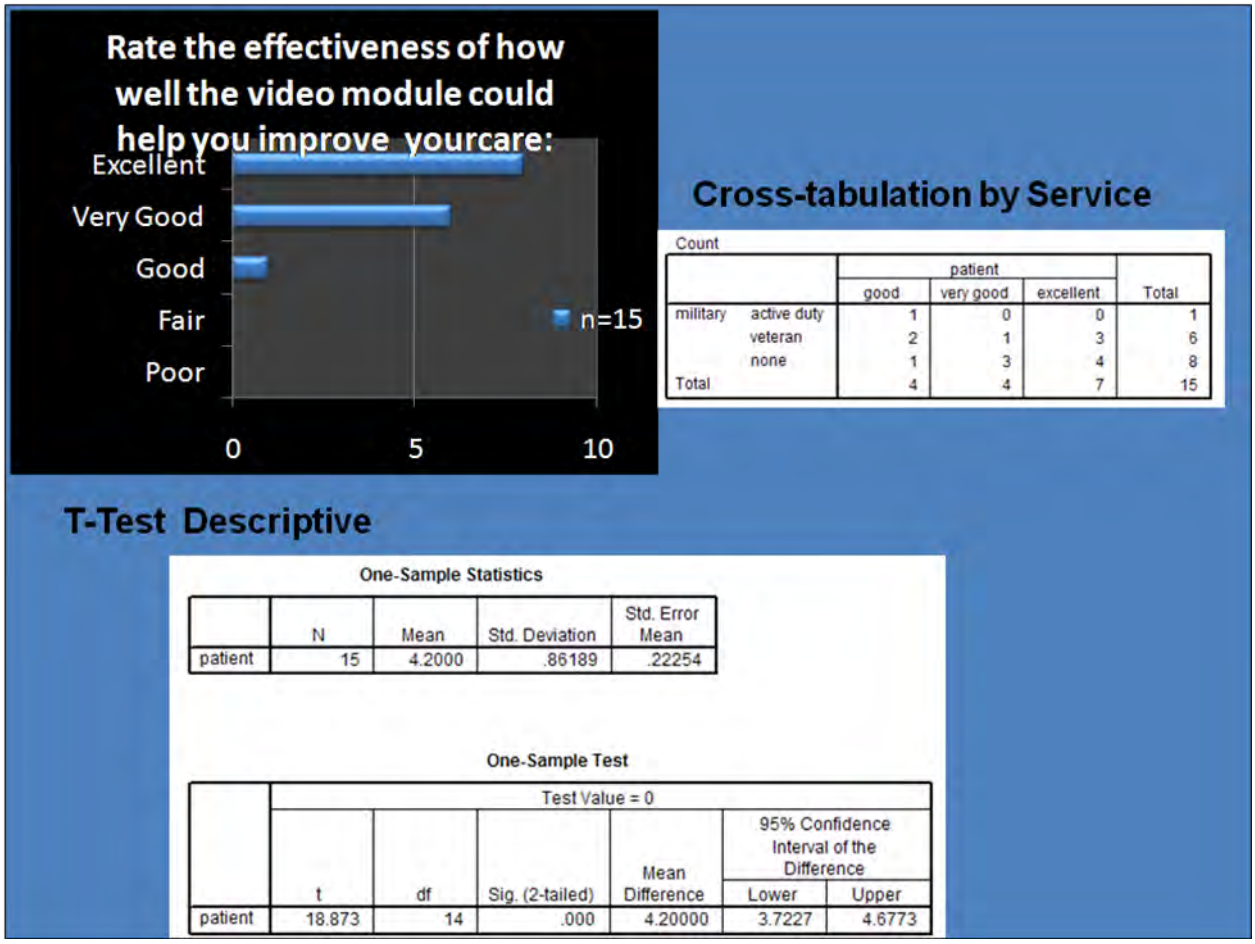



Figure 13 is the analysis of "Rate the effectiveness of how well the video module related to your needs". The majority of the 15 participants rated it very highly. On a scale of 1 to 5, with 5 being the highest, a mean score of 4.7 was found. A more in-depth analysis can be obtained in the broken out sections provided in Figure 13 by military service and sample statistics.

**Figure 13:** Analysis of Relation to Your Needs

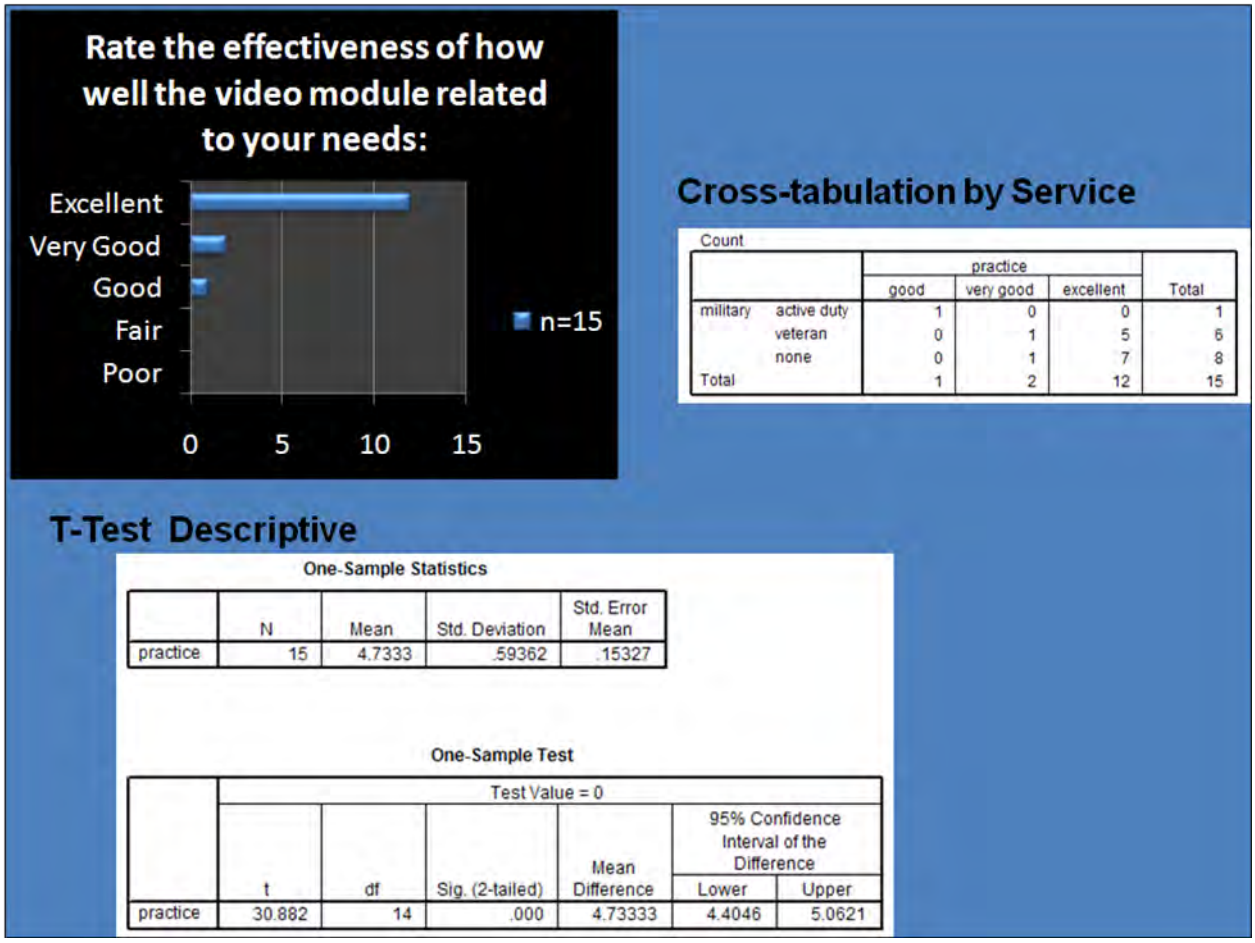
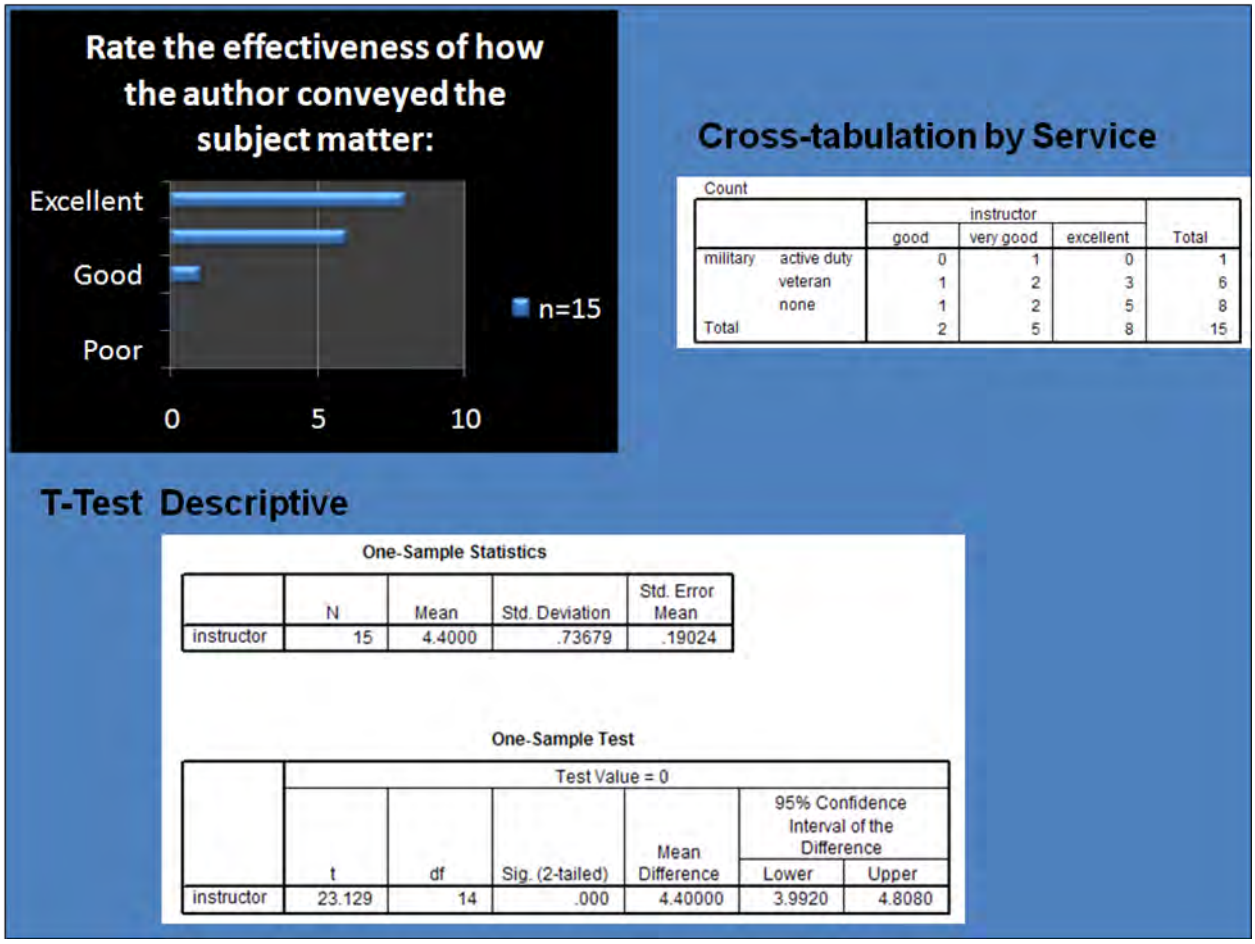



Figure 14 is the analysis of "Rate the effectiveness of how well the author conveyed the subject matter". The majority of the 15 participants rated it very highly. On a scale of 1 to 5, with 5 being the highest, a mean score of 4.4 was calculated. A more in-depth analysis can be obtained by the broken out sections provided in Figure 14 by military service and sample statistics.

**Figure 14:** Analysis of Author Convey the Subject Matter




*Substance Abuse*

Substance abuse is one of our nation's most significant public health challenges. It destroys lives, undermines families, and costs hundreds of billions of dollars annually in healthcare, legal, workplace, and other expenses. (Office of National Drug Control Policy, 2010).

Substance use disorders are an immediate concern in all branches of the military. Almost two million veterans, or 6% of veterans in the United States, reported using illicit drugs in the past year according to the NHSDA report (2002). An annual average of 7% of veterans experienced serious psychological distress (SAMHSA, 2009) and approximately, 21% of service members admit drinking heavily, a statistic that has remained steady for the past twenty years (Rhem, 2000).

The SBIRT program can directly assist military personnel to improve their health behavior and identify persons in need of care before the behavior evolves into a serious problem that is detrimental to themselves, their families, and their job. According to the DASIS report (2001), the most common source of referral for veterans was the criminal justice system. This project

proposal seeks to extend the services of SBIRT to military personnel before unlawful conduct occurs.

A strong and direct method of intervention with military and family that are located globally is to implement methods of distance education. This method of interaction is cost effective and overcomes barriers often encountered with rural and under-served areas (large rural areas, lack of heath access, and inadequate services) that military may be located (Dunsmore & Goodson, 2006). The distance education methods such as learning management systems, virtual classrooms, and online centers of information can perform a critical role in screening, intervention, and treatment with this audience.

*SBIRT Program Description*

The majority of Americans see a healthcare provider at least once a year. By encouraging healthcare professionals to identify at-risk populations and intervene early, we can significantly reduce the abuse of alcohol and addiction to drugs among Americans. After screening for drug-using behavior, medical professionals can provide brief substance abuse intervention, if necessary. These research-based intervention dialogs help explain to patients the consequences of drug use and provides them with a solid strategy to reduce or eliminate substance use (Office of National Drug Control Policy, 2010).

SBIRT is an established evidence-based tool developed by the United States Department of Health and Human Services for the care of individuals with substance use disorders (Center for Substance Abuse Treatment, 2009). This treatment program trains medical professionals and members of the community on how to provide opportunities for early intervention with at-risk substance users before more severe consequences occur.

The effectiveness of SBIRT is due to its three-step process of screening, brief intervention, and referral to treatment. The first step of screening involves the use of substance abuse screening instruments, such as biomarkers and patient reports, to determine the patient's awareness of the problem, feelings about their substance use, and motivation for changing the poor health behavior. This routine screening, that only takes minutes to conduct, has proven to be effective in early identification (National Institute on Alcohol Abuse and Alcoholism, 2005).

The second step is a brief intervention. This can be conducted in a single session or multiple sessions of motivational discussion focused on increasing insight and awareness regarding substance use and motivation toward behavioral change (Center for Substance Abuse Treatment, 2009). These brief interventions have proven effective in the treatment of substance abuse disorders (Barry, 1999).

The referral to specialized treatment is the final step of the SBIRT program. Those individuals recognized as needing more extensive treatment are directed to the care of the appropriate medical staff. The effectiveness of the referral process to specialty treatment is a strong measure of SBIRT success and involves a proactive and collaborative effort between SBIRT providers and those providing specialty treatments to ensure access to the appropriate level of care (Center for Substance Abuse Treatment, 2009). The referral resources of the program are quite extensive and address several conditions of substance abuse (National Institute on Drug Abuse, 2000).

*Summary of Program Model*

1. *Screening:* Conduct screening for substance use using a validated screening tool
2. *Brief Intervention:* Provide a brief motivational intervention for patients with moderate or high screening assessment scores
3. *Brief Treatment:* Patients with moderate screening assessment scores may be referred for brief treatment which consists of 3-20 sessions
4. *Referrals:* Patients with high screening assessment scores will be referred for a more intensive assessment to determine the type and level of treatment they require

*Instructional Systems Design Description*

Instructional systems design (ISD) is based on the premise that learning should not occur in a haphazard manner, but should be developed in accordance with orderly processes and have outcomes that can be measured. Basically, ISD requires defining what is to be learned, planning an intervention that will allow learning to occur, measuring learning to determine if objectives were met, and refining the intervention until objectives are met.

The professional development plan was based on the principles of instructional system design. The model expects that the four phases are done in order with a final assessment:

1. Performance Analysis
2. Needs Assessment
3. Development and Implementation (professional development plan)
4. Assessment (impact of the professional development plan)

*Seels and Glasgow Model*

As can be seen in Figure 15, the Seels and Glasgow (1990) model is made up of three phases: needs analysis, instructional design, and implementation and evaluation. This division allows a project to be planned, resourced, and managed as three phases.

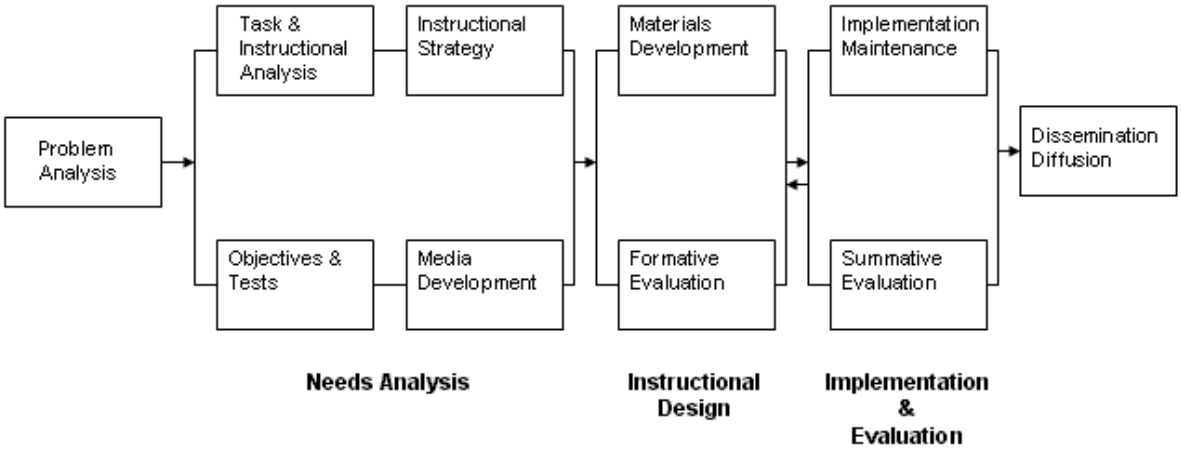
Presetera (2002) explains that the, "Seels and Glasgow model leads to efficiency in project planning, resource allocation, and the control of the product development cycle while recognizing that instructional designers are often asked to either manage a project or work within an established project management framework" (p.7).

The first phase, needs analysis, includes the establishment of the instructional goals, requirements, and context. The second phase, instructional design, begins after phase one is complete and is made up of six steps: task analysis, instructional analysis, objectives and tests, formative evaluation, materials development, and instructional strategy and delivery systems, all of which are joined by feedback and interaction. The third phase, implementation and evaluation, includes the development and production of materials, delivery of the training, and summative evaluation. The steps and phases in this model can be applied in a linear fashion but they are often applied iteratively. In particular, the steps in the instructional design phase are interdependent and concurrent and may involve iterative cycling (Gustafson & Branch, 2001).

Product-oriented models are normally used to produce an instructional package. Product production requires a team and a significant resource commitment and so calls for strong project management to stay within time and budget. A team would include an experienced instructional

designer to perform some front-end analysis, develop the materials (rather than select them), and perform a significant amount of formative evaluation. The end product is likely to be widely distributed using a moderately to highly technical delivery media (Gustafson and Branch, 2001).

**Figure 15:** Seels and Glasgow Model




*Instructional Strategy*
Self-directed learning is learning initiated and directed by the learner and can include self-paced, independent, and individualized learning as well as self-instruction. Whatever terminology is used, self-directed learning places the responsibility for learning directly on the learner. Learners who take the initiative and are proactive learners learn more and better than passive (reactive) learners. Proactive learners enter into learning more purposefully and with greater motivation. They also tend to retain and make use of what they learn better and longer than reactive learners. The independent learner is one who is more involved and active within the learning process.

Online learning supports the self-directed learner in pursuing individualized, self-paced learning activities. The learner, working at a computer at a convenient time and pace, is able to search and utilize the vast resources of the Internet research for nearly any topic imaginable. Students can visit libraries, museums and various institutes world-wide, talk to professionals, access recent research, and read newspapers and peer reviewed scholarly journals online. Students can write collaboratively with peers and even publish written and multimedia products on web pages.

*SBIRT Program Design*
The instructional design research concluded that the components of the online SBIRT program should contain the following to be able to effectively deliver the program at a distance:

- The curriculum effectively parses knowledge and skill targets
- Web application supports all levels of knowledge acquisition, including knowledge regarding how skills can be acquired via guided case studies.
- Face-to-face application is used for skill acquisition
- Post-tests (knowledge only) are embedded within web-based curriculum
- Proficiency checklists (skill only) are used with face-to-face skill development activities

*Needs Assessment*
The needs assessment determines the parameters for conducting an analysis with the target subjects to test the design of the program. This will be investigated in the pilot study of FY09 Military SBIRT program.

A representative group of the target audience will be formed so researchers can interview them. The feedback will provide relevant information for the design of the project in the FY09 Military SBIRT study. The feedback will also be discussed with SAMHSA's Erich Kleinschmidt, MSW, LICSW, Public Health Advisor DHHS/SAMHSA/CSAT, as he reflects on his experience of providing counseling services to returning military members from active combat theatres.

*Target Audience*
The target audience is men and women currently serving in the military. These individuals should not have diagnosed substance abuse issues. Instead, they should be borderline abusers or occasional users.

The primary focus of specialized treatment has been persons with more severe substance use or those who have met the criteria for a substance use disorder. The SBIRT initiative targets those with nondependent substance use and provides effective strategies for intervention prior to the need for more extensive or specialized treatment.

The study will implement the SBIRT program with intermediate leaders of the military. Defined as squad leaders, section leaders, and team leaders, these individuals have direct relationships with subordinate personnel and are responsible for their wellbeing. In the Army's own words: "It is the duty of the squad/section/team leader to account for his soldiers and ensure that they receive necessary instructions and are properly trained to perform their jobs. Noncommissioned officers (NCO) duties are numerous and must be taken seriously. An NCO's duty includes taking care of soldiers, which is a priority. Corporals and sergeants do this by developing a genuine concern for their soldiers' well-being. Leaders must know and understand their soldiers well enough to train them as individuals and teams to operate proficiently. This will give them confidence in their ability to perform well under the difficult and demanding conditions of battle" (Department of the Army, 2002).

*Needs Assessment Questions*
The following is a draft of the needs assessment questions to be conducted within the group in the pilot study of FY09 Military SBIRT program:

Introduction

1. Do you currently serve in the United States Military?
    a. If Yes, continue to next question.
    b. If No: Thank you for your interest, but you are not eligible to participate in this study.
2. Please indicate your branch of service:
    a. A. Army, B. Air Force, C. Navy, D. Marine Corps, E. Coast Guard, F. National Guard

Substance Use

1. How often do you drink anything containing alcohol?
2. How many 6oz. drinks do you have on a typical day when you are drinking?
3. How often do you have two or more drinks on one occasion?
4. In the last year, have you used drugs other than those required for medical reasons?
5. In the last year, have you used prescription or other drugs more than you meant to?
6. Which drug do you use most frequently?
7. Do you use prescribed medications for pain? (reason)

Identification of Abuse

1. What do you think are the signs of a person with a substance abuse problem?
2. Could you identify a fellow person with a substance abuse problem?
3. What are the symptoms you look for when you are making this identification?
4. Would you help that person? (What would you do?)
5. Do you have any substance abuse experiences to share? (post a reminder that all answers are anonymous and confidential)
6. What are common substance abuse issues you have witnessed with your peers in the military?

Screening, Brief Intervention, and Referral to Treatment (SBIRT) Program

1. To your knowledge, what resources or programs are available for substance abuse problems? (availability, price, qualifications to participate)
2. In your own opinion, do you think this proposed SBIRT program would be effective?
3. If you designed a program to help those with substance abuse problems, what would you be sure to include?
4. Do you think that an intervention program could help a person with a substance abuse problem?

Distance Education

1. In your own words, define what distance education is.
2. Do you have regular access to the internet? (Define.)
3. In the classroom, by which method do you learn the best (Being told how to do it, reading a book on how to do it, or attempting to do it yourself)?
4. Have you ever participated in an online class?

Other

1. What are your future goals?
2. Any other comments?

## Key Research Accomplishments

*Medical Toolkits*

- Applicable in crisis situations
- Effectively educated the emergency medicine providers
- Developed online training that will provide continuing education and be available anywhere and anytime with an Internet connection
- Improved the educational knowledge concerning emergency dental care and MRSA decontamination
- Provided several methods of distribution
- Addressed specific rural needs as to increase access and availability of the training materials

*Substance Abuse*

- Partnership with University of Pittsburgh School of Pharmacy
- Established the parameters and questions to conducting a needs assessment with a group of military members
- Collaborative meeting with SAMHSA's Erich Kleinschmidt
- Developed a detailed project protocol, management plan, and budget requirements obtain final approval for plan and implementation in FY09 protocol Military SBIRT program

## Reportable Outcomes

- Publication: Zaragoza Anderson, K. (2010). Teaching and assessment in multi-user virtual environments, International Visual Literacy Association Selected Readings
- Presentations: TATRC 2009 Rural Telehealth and Advanced Technologies Conference, and the 2009 International Visual Literacy Association Conference
- Abstract Submission: 2010 American Telehealth Association
- Abstract Submission: 2009 EDUCAUSE

## Conclusion

The materials and technology necessary to produce a SBIRT program with the military have been identified and allocated. The program will move forward in the FY09 Military SBIRT at a Distance protocol. The Continuing Distance Education for Health Sciences protocol comes to an end after making several achievements in medical and educational research. The study developed and tested two medical emergency kits, the dental box and the MRSA kit. The outcomes proved that they are applicable in crisis situations and effectively educate the emergency medicine providers. The study also researched how to implement a SBIRT program that would work in the military and have an impact to reduce the number of soldiers dealing with substance abuse.

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**Appendix A**

# SBIRT Tool Kit (PDF)

Please complete the survey by selecting a response to each question. You may refuse to answer any item without repercussion. By completing this questionnaire, I indicate my consent to participate in the study. I understand confidentiality will be maintained.

1. Rate the effectiveness of how well the video modules met the learning objectives:
    a. Excellent
    b. Very Good
    c. Good
    d. Fair
    e. Poor

2. Rate the effectiveness of how well the video module related to your practice needs:
    a. Excellent
    b. Very Good
    c. Good
    d. Fair
    e. Poor

3. Rate the effectiveness of how well the video module could help you improve patient care:
    a. Excellent
    b. Very Good
    c. Good
    d. Fair
    e. Poor

4. Rate the production quality of the modules:
    a. Excellent
    b. Very Good
    c. Good
    d. Fair
    e. Poor

5. Rate the effectiveness of how the author conveyed the subject matter:
    a. Excellent
    b. Very Good
    c. Good
    d. Fair
    e. Poor

6. Rate the overall quality of the video modules:
    a. Excellent
    b. Very Good

c. Good
d. Fair
e. Poor

7. As a result of the activity, did you learn something new or verify information you already knew?
a. Learned something new
b. Verified prior knowledge

8. Please indicate your classification:
a. Retail
b. Corporate (Managed Care)
c. Health Care Facilities (Hospital, Skilled Nursing Facility, etc.)
d. Research
e. Marketing
f. Military
g. Other

9. Please indicate your profession:
a. Dentist
b. Physician
c. Medical Technician
d. Nurse
e. Other

10. Were you (or are you) a member of the military?
a. Active Military
b. Veteran
c. None

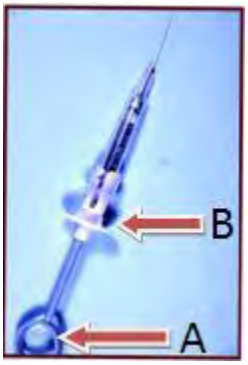
11. Did you have any technical problems? If so, please describe.

12. Suggestions/Comments:

*Please complete the quiz by selecting a response to each question. You may refuse to answer any item without repercussion. By completing this questionnaire, I indicate my consent to participate in the study. I understand confidentiality will be maintained.*

**Syringe Quiz**

1. The carpulses of anesthetic contain:
    *a. 1.8 cc
    b. 2.5 cc
    c. 3.4 cc
    d. 0.5 cc




2. Identify the sections of the syringe system:
    [b] 1. Thumb Aspirator
    [a] 2. Syringe

    a. B
    b. A

3. Which methods were suggested to lock the barb of the thumb ring aspirator into the rubber end of the carpule?
    *a. Use a quick, forceful push with your thumb
    b. Roll the syringe in your hand
    c. Pull the thumb ring towards yourself
    *d. Tap on the palm or table

4. True or False: 20% Benzocaine is an Esther anesthetic.
    *a. True
    b. False

5. True or False: 20% Benzocaine works faster than topical 4% Lidocaine.
    *a. True
    b. False

**Ora-5 Quiz**

1. True or False: Ora-5 is a topical anti-bacterial ointment for abraded, lacerated and sutured mucosa.

    *a. True
    b. False


2. (Select all that apply) Ora-5 is an ideal ointment because:
    *a. It is fairly soothing to the tissue
    b. It will irrigate blood clots from the socket
    *c. It is effective for areas that are high risk for infections
    d. It is a calcium hydroxide paste

3. True or False: Ora-5 can be used with Coe-Pak.
    *a. True
    b. False

4. Ora-5 is applied with a:
    *a. soaked clean cotton swab
    b. dry clean cotton swab
    c. poured into area

5. True or False: Sores will turn white when Ora-5 is applied.
    *a. True
    b. False

**Hemorrhage Control Quiz**

1. Hemcon is not recommended for patients with what kind of allergies?

Correct Answer(s):
a. Shell fish
b. Shellfish
c. Shrimp
d. Shell

2. The Hemcon dressing is most effective if:
a. Equal parts of Hemcon have been prepared
b. Applied the topical spray thrombin first
c. The enamel is dry
*d. Enough blood is present to wet the contact surface area

3. (Select all that apply) Other methods of stopping bleeding (but perhaps not as effective as the Hemcon) include:
*a. Pressure
*b. Surgicell
*c. Gelfoam
d. Coe-Pak

4. True or False: Hemcon is a chitosan derived hemostatic gauze.
*a. True
b. False

5. When placing the Hemcon dressing into the extraction socket, remember to:
a. Force the dressing the whole way into the apex of the socket
*b. Keep the dressing flush with the crestal gingival
c. Set the dressing above the crestal gingival

**Fracture Quiz**

1. A calcium hydoxide paste (Dycal) is used for tooth fractures because: (select all that apply)

a. It has a low Ph
b. It is difficult to work with
*c. It is watertight
*d. It hardens on contact with saliva
e. It can only be used with enamel/chip fractures

2. True or False: Eating hard foods or excessive chewing will cause the calcium hydroxide paste to wear off more quickly.
*a. True
b. False


3. Identify how calcium hydroxide paste (Dycal) is prepared:
a. Take one part catalyst with two-parts base
*b. Mix the catalyst and base in equal parts
c. Combine the base with two-parts catalyst

4. True or False: A tooth block should be conducted prior to covering the tooth with the calcium hydroxide (Dycal) paste.
*a. True
b. False

5. Typically, how long should the calcium hydroxide (Dycal) paste last?
a. Several hours
b. Several months
c. 15 minutes
*d. Several days

**Dry Socket Quiz**


1. Arrange the steps in order of using the Dry Socket Paste:
    [c] 1. Irrigate or suction debris from the socket
    [a] 2. Apply Dry Socket Paste into the socket
    [d] 3. Perform a dental block
    [b] 4. Patient has their dentist replace the paste

    a. Step Three
    b. Step Four
    c. Step Two
    d. Step One

2. True or False: Dry Socket Paste contains eugenol in a very sticky base onitment.
    *a. True
    b. False

3. The Dry Socket Paste will eventually dissolve after how long?
    a. Four hours
    *b. Several days
    c. Several months
    d. Four to six weeks

4. (Select all that apply) A few of the signs and symptoms of alveolar osteitis (dry socket) include:
    *a. Visible bone in the socket
    *b. Swollen lymph nodes around the jaw or neck
    c. Fracture thru the enamel
    *d. Bad breath or a foul odor coming from the mouth
    *e. Pain that radiates from the socket to the ear or eye on the same side of the face

5. What is the first thing that should be conducted when treating an alveolar osteitis (dry socket)?
    a. Apply the Dry Socket Paste
    *b. A tooth block
    c. Suction the socket
    d. Apply gelfoam to the socket

**Deep Carie Quiz**

1. True or False: Temrex can be used to glue loosened caps, crowns, or fillings back into place.


*a. True
b. False

2. A deep carie can be defined as:
a. The abnormal enlargement of the gingiva surrounding the teeth caused by poor oral hygiene

*b. Multifactorial disease of the hard substance of the tooth, which when untreated increasingly destroys the structure and function of the teeth and leads to tooth loss
c. The longitudinal vertical plane that divides the mouth into two halves (left and right)

3. If a patient complains of tooth pain and has deep caries with isolated percussion tenderness, the patient most likely has:
a. Impacted tooth
b. Plaque
*c. Pulpitis or an abscess
d. Gingivitis

4. Pulp necrosis can be defined as:
a. A viral infection in the gums
*b. Death of the pulp tissue
c. An opening on a tooth or other oral structure
d. An anti-microbial agent

5. True or False: Temrex glue is a bacteriacidal and an anesthetic.
*a. True
b. False

**Coe-pak Quiz**

1. Match the descriptions below:
    [b] 1. Subluxed teeth
    [a] 2. Luxated teeth

    a. Displaced teeth
    b. Loosened teeth

2. True or False: If the tooth is minimally loose and remains fairly firm in the socket, nothing acutely needs to be done.
    *a. True
    b. False

3. (Select all that apply) When using periodontal paste (Coe-Pak) it is important that:


    *a. The enamel is dry
    *b. Your hands are wet
    c. The periodontal paste (Coe-Pak) is dry
    *d. The gingival tissue is dry

4. Place in order the steps to using the periodontal paste (Coe-Pak):

[b] 1. Apply the paste with wet hands
[a] 2. Wipe off saliva on the enamel
[c] 3. Dip the paste into water
[d] 4. Mix equal parts of base and catalyst till thick like silly putty

a. Step Two
b. Step Four
c. Step Three
d. Step One

5. True or False: Periodontal paste (Coe-Pak) does not adhere to the enamel.
a. True
*b. False

**Avulsed Tooth Quiz**

1. An avulsed tooth is:
a. A tooth with a dentin fracture
b. A tooth with deep caries
*c. A tooth that is completely removed from the socket
d. A subluxed tooth

2. An avulsed tooth has approximately how long until the periodontal ligament cells begin to desiccate?
a. 3 to 4 hours
*b. 35-45 minutes
c. 5 to 10 minutes
d. 1 to 2 days

3. EMT toothsaver and Save-a-Tooth will preserve the periodontal ligament cells for up to how much time?


a. 2 to 4 days
b. 45 to 50 minutes
c. 4 to 8 hours
*d. 12 to 24 hours

4. True or False: Milk will preserve the periodontal ligament cells for approximately 4 to 8 hours.

*a. True
b. False

5. True or False: The avulsed tooth does not need to be immediately placed into milk, EMT Toothsaver, or some other form of Hanks solution.

a. True
*b. False

# Saint Francis University's Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA)

**FY08 Annual Report**
**(May 4, 2009 to July 31, 2010)**

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**Protocol Title:** Telehealth Test Bed - Neurocognitive and Neurophysical Studies

**Protocol No.:** 08-TATTH302d-08

**Date:** July 2010

## Principal Investigators

- Carol McIlhenny, BSN, RN, CERMUSA Telehealth Research Specialist
- Ivan Mulligan, PT, DSc, SCS, ATC, CSCS, Saint Francis University Faculty Coordinator, Athletic and Orthopedic Health and Wellness
- Mark Boland, PT, MPT, OCS, Director, Physical Therapy, DiSepio Institute for Health and Wellness

## Introduction

A multitude of concussion assessments exists today. Some record facts surrounding the event that caused the injury. Others assess neurocognitive or neurophysical changes. These assessments all vary with regard to their sensitivity, validity and reliability. No one test measures all of the parameters. Currently, researchers agree that a full spectrum test battery be performed for athletes who sustain a concussion, regardless of the severity. Baseline testing provides a benchmark measure which can determine whether an athlete has sufficiently recovered from his/her injury. However, few neurophysical concussion assessment studies have examined the phenomenon of learned response. Two test groups of college-aged adults will perform repeated testing for either the NeuroCom Sensory Organization Test (SOT) or Balance Error Scoring System (BESS) at scheduled intervals to determine the minimum period of time from which the learned response of baseline testing is extinguished. This study also seeks to determine a correlation between BESS and SOT for rapid concussion evaluation in the field. Although many tools exist to assess the extent of injury, a gold standard has yet to be determined. Having a simple, portable, reliable on-site assessment tool to determine the extent of injury and to accurately triage individuals may diminish the likelihood of more serious injury in the future. This will not only benefit athletes but will also benefit the warrior assigned to active duty by equipping medics with the gold standards for concussion assessment. Timely assessment and evaluation of mild traumatic brain injuries (MTBI) in the field could potentially circumvent more serious morbidity and disability for the individual in the future.

## Body

Currently, in the literature, there is a lack of documented sensitivity of the SOT (Appendix A) to concussion in collegiate athletes (Broglio, Macciocchi & Ferrara, 2007). The NeuroCom SOT procedure does not typically compare between baseline and post-injury data and does not have the capacity to randomize its testing program. A study by Welti-Santos (2004) indicates that participants can learn to improve their performance on balance equipment with repeated trials. In another study utilizing repeated trials of the Balance Error Scoring System (BESS; Appendix B), the researchers concluded that scores returned to baseline 21 days after the last assessment in high school athletes (Valovich, Perrin, & Gansneder, 2003). There is no available research suggesting a similar return to baseline period in a college-aged adult population.

The researchers began data collection for this study in February 2010. The data collection phase of this study will continue through FY08 into FY09. A total of 21 participants have been recruited for BESS testing. Twenty have completed the full four-week follow up which includes completion of the demographics questionnaire (Appendix C) at baseline and with each follow-up testing date. Recruitment and data collection will continue until 170 participants have been recruited. Data collection and final reports will follow. The researchers plan to prepare a manuscript for publication from results of this study.

## Key Research Accomplishments

- Ongoing literature search and review
- Completed athletic trainer training
- Initiated participant recruitment
- Began data collection
- Consulted with biostatistician to discuss statistical and power analyses

## Reportable Outcomes

- Exploring federal grants related to neurocognitive and neurophysical assessment
- Seeking to establish a partnership with an area business to apply for federal grant as an extension of this study

## Conclusion

Traumatic Brain Injury (TBI) has been identified as the "signature injury" of the war on terrorism. Nearly one third of veterans between 2003 and 2007 have been diagnosed with TBI (Department of Defense, 2008). Griffin (2006) reported that 62% of the returning war-wounded suffers from TBI. Based on statistics from the Veterans Administration, approximately 150,000 veterans have been diagnosed with TBI (Donnelly, 2009). Among civilians, up to 3.8 million cases of MTBI occur every year, many of which go undiagnosed or untreated (Mihalik, et. al., 2009). The study of MTBI or concussion is still in its infancy. Although many tools exist to assess the extent of injury, a gold standard has yet to be named. Timely evaluation of MTBI in the field utilizing a simple, portable, reliable on-site assessment tool could potentially circumvent more serious morbidity and disability for the individual in the future.

We predict that the learned effect of repeated balance testing in college-aged individuals will be equivalent to that of high-school aged individuals. We also predict there will be a high correlation between BESS and NeuroCom testing. Based on the results of this study and future phases of this study, our goal is to integrate a reliable neurophysical and a reliable neurocognitive measure on a portable, hand-held ruggedized device that will be valuable assessment and triage tool for civilians and armed forces personnel.

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## Appendices

Appendix A - NeuroCom Sensory Organization Test

Appendix B - Balance Error Scoring System

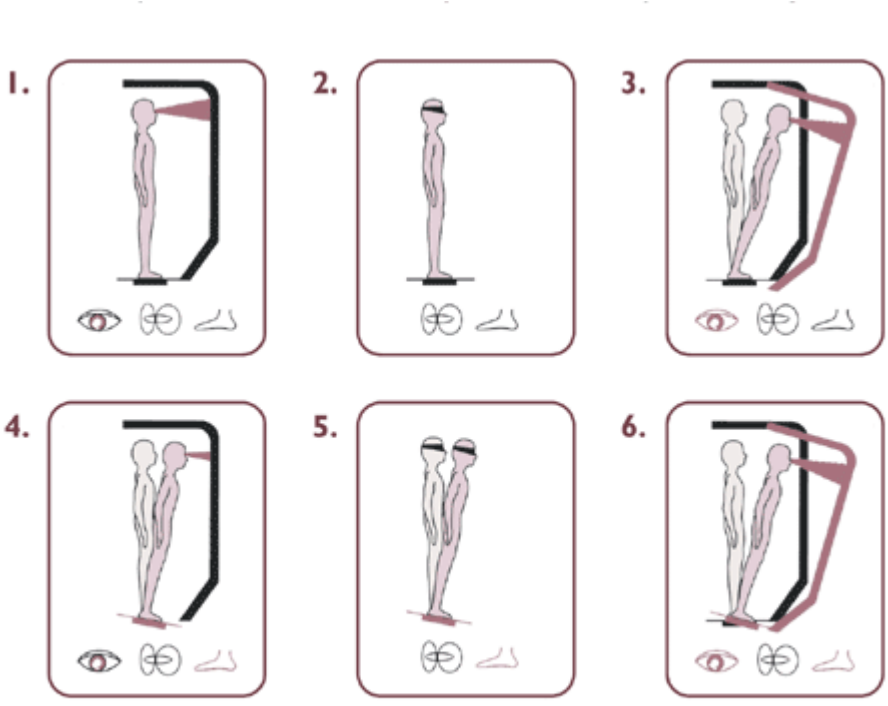
Appendix C - Demographics Questionnaire

**Appendix A**

# NeuroCom Sensory Organization Test (SOT) Description

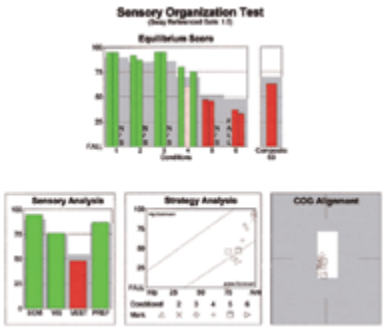
The SOT protocol objectively identifies abnormalities in the patient's use of the three sensory systems that contribute to postural control: somatosensory, visual and vestibular. During the SOT, useful information delivered to the patient's eyes, feet and joints is effectively eliminated through calibrated "sway referencing" of the support surface and/or visual surround, which tilt to directly follow the patient's anteroposterior body sway. By controlling the usefulness of the sensory (visual and proprioceptive) information through sway referencing and/or eyes open/closed conditions, the SOT protocol systematically eliminates useful visual and/or support surface information and creates sensory conflict situations. These conditions isolate vestibular balance control, as well as stress the adaptive responses of the central nervous system. In short, patients may display either an inability to make effective use of individual sensory systems, or inappropriate adaptive responses, resulting in the use of inaccurate sense(s).

The SOT protocol is comprised of six sensory conditions:




Sensory Organization Test

# SOT Comprehensive Report




1. **Equilibrium Score** quantifies the Center of Gravity (COG) sway or postural stability under each of the three trials of the six sensory conditions. Effective use of individual sensory inputs is determined from the overall pattern of scores on the six conditions. The composite equilibrium score, the weighted average of the scores of all sensory conditions, characterizes the overall level of performance.
2. **Sensory Analysis** ratios are used in conjunction with the individual equilibrium scores to identify impairments of individual sensory systems.

| Ratio | Comparison | Functional Relevance |
|---|---|---|
| Somatosensory (SOM) | Condition 2 / Condition 1 | Patient's ability to use input from the *somatosensory system* to maintain balance |
| Visual (VIS) | Condition 4 / Condition 1 | Patient's ability to use input from the *visual system* to maintain balance |
| Vestibular (VEST) | Condition 5 / Condition 1 | Patient's ability to use input from the *vestibular system* to maintain balance |
| Preference (PREF) | Condition 3 + 6 / Condition 2 + 5 | The degree to which a patient relies on visual information to maintain balance, even when the information is incorrect. |

3. **Strategy Analysis** quantifies the relative amount of movement about the ankles (ankle strategy) and about the hips (hip strategy) the patient used to maintain balance during each trial. Normal, stable individuals move primarily about the ankle joints when the surface is stable and shift to hip movements as they become less stable.
4. **Cog Alignment** reflects the patient's COG position relative to the center of the base of support at the start of each trial of the SOT. Normal individuals maintain their COG near the center of the support base.
5. The shaded area on each graphic represents performance outside of the normative data range. Green bars indicate performance within the normal range; red bars indicate performance outside the normal range.

## Functional Implications

Accurate organization of sensory information is critical to maintaining balance within the variety of environments encountered in daily life. An inability to organize sensory information appropriately can result in instability in environments where visual cues are diminished (darkness, lack of contrast/depth cues), the surface is unstable or compliant (sandy beach, gravel driveway, boat deck, etc.), or conflicting visual stimuli are present (busy shopping mall, large moving objects such as a nearby bus, etc.). Inability to appropriately organize sensory information can lead to or be exacerbated by impairments in COG alignment and/or selection of movement strategies.

## Reference

NeuroCom International (2009). Sensory organization test (SOT). Retrieved on October 14, 2009 from http://resourcesonbalance.com/neurocom/protocols/sensoryImpairment/SOT.aspx

# Appendix B

# The Balance Error Scoring System (BESS)

*Obtain Preseason Baseline Score; Compare with Post-Concussion Score*[33-34]

The Balance Error Scoring System[33-34] provides a portable, cost-effective and objective method of assessing static postural stability. The BESS can be used to assess the effects of mild head injury on static postural stability. Information obtained from this clinical balance tool can be used to assist clinicians in making return to play decisions following mild head injury. The BESS can be performed in nearly any environment and takes approximately 10 minutes to conduct.

The balance-testing regime consists three stances on two different surfaces. The three stances are double leg stance, single leg stance and tandem stance. The two different surfaces include both a firm (ground) and foam surface. Athletes' stance should consist of the hands on the iliac crests, eyes closed and a consistent foot position depending on the stance. Shoes should not be worn.

In the double leg stance, the feet are flat on the testing surface approximately pelvic width apart.
In the single leg stance position, the athlete is to stand on the non-dominant leg with the contralateral limb held in approximately 20° of hip flexion, 45° of knee flexion and neutral position in the frontal plane.
In the tandem stance testing position, one foot is placed in front of the other with heel of the anterior foot touching the toe of the posterior foot. The athlete's non-dominant leg is in the posterior position. Leg dominance should be determined by the athlete's kicking preference.

Administering the BESS: Establish baseline score prior to the start of the athletic season. After a concussive injury, re-assess the athlete and compare to baseline score. Only consider return to activity if scores are comparable to baseline score. Use with Standardized Symptom Scale Checklist.

Scoring the BESS: Each of the trials is 20 seconds. Count the number of errors (deviations) from the proper stance. The examiner should begin counting errors only after the individual has assumed the proper testing position.


Double Leg Stance
Firm Surface


Single Leg Stance
Firm Surface


Tandem Stance
Firm Surface


Double Leg Stance
Foam Surface


Single Leg Stance
Foam Surface


Tandem Stance
Foam Surface

**Errors**:
- **Moving the hands off the hips**
- **Opening the eyes**
- **Step, stumble or fall**
- **Abduction or flexion of the hip beyond 30°**
- **Lifting the forefoot or heel off of the testing surface**
- **Remaining out of the proper testing position for greater than 5 seconds**

*The maximum total number of errors for any single condition is 10.*

*If a subject commits multiple errors simultaneously, only one error is recorded.*

| B.E.S.S. SCORECARD | | |
|---|---|---|
| Count Number of Errors max of 10 each stance/surface | FIRM Surface | FOAM Surface |
| Double Leg Stance (feet together) | | |
| Single Leg Stance (non-dominant foot) | | |
| Tandem Stance (non-dominant foot in back) | | |
| TOTAL SCORES: total each column | | |
| B.E.S.S. TOTAL: (Firm+Foam total) | | |

Appendix C

SAINT FRANCIS UNIVERSITY
FOUNDED 1847

## DEMOGRAPHICS QUESTIONNAIRE

Your participation in this research is **confidential.** Only the study investigator and his/her assistants named on this study will have access to your identity and to information that can be associated with your identity. In the event of publication of this research, no personal identifying information will be disclosed.

1. Gender (circle one): Male Female
    a. If Female, are you pregnant? Yes No
2. Height: _____ inches
3. Weight: _____ pounds
4. Marital Status (circle one): Single Married Separated Divorced
5. Age (circle one):

    18 19 20 21 22 23 24 25 26
6. Involved in SFU athletics programs? Yes No
    a. If yes to #6, please indicate to which athletics team(s) you currently belong:

    _____
7. Have you had a blow to the head within the last six months? Yes No
    a. If yes, circle any of the symptoms you have had as a result:

    loss of memory loss of consciousness dizziness

    fogginess nausea confusion
8. Do you have a history of any brain injury or disease, such as concussion, traumatic brain injury, brain surgery, or brain tumor? Yes No
9. Do you have a history of inner ear or balance problems? Yes No

(Questionnaire continued on back)

(continued)

10. Have you experienced any cold and/or flu or flu-like symptoms within the past month?

    Yes  No

11. Have you consumed any alcoholic beverages within the last seven days?  Yes  No

    a. Have you consumed any alcoholic beverages within the last 24 hours?

       Yes  No

12. Have you used any recreational drugs within the last seven days?  Yes  No

    a. Have you used any recreational drugs within the last 24 hours?  Yes  No

13. Please list all the prescription and over-the-counter medications you are currently taking or have taken within the last month:

    _____

    _____

14. How many hours of sleep did you get last night? _____

15. On the average, how many hours of sleep do you get every night? _____

16. Do you suffer from motion sickness?  Yes  No

17. Are you restricted from using heavy machinery or restricted to certain driving conditions?

    Yes  No

*When completed, please give this form directly to the researcher working with you on this study.*

# Saint Francis University's
# Center of Excellence for Remote and Medically Under-Served Areas (CERMUSA)

FY08 Annual Report
(May 4, 2009 to July 31, 2010)

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**Protocol Title:** Telehealth Test Bed - Physical Activity for Rural Cancer Survivors

**Protocol No.:** 08-TATTH303-08

**Date:** July 2010

## Principal Investigator

Jenny LeMoine, PhD, CERMUSA Telehealth Subject Matter Expert /
Saint Francis University Associate Professor, Exercise Physiology

## Introduction

There are almost 10 million cancer survivors in the United States alone (Longley, 2009), with one of every two men and three women at risk to develop cancer in their lifetime (Denmark-Wahnefried et al., 2008). Decreased fitness and physical function, lost quality-of-life and increased fatigue are common for cancer survivors and can last for years after treatment (Bower et al., 2006; Dimeo, 2001; Lucia et al., 2003; Schneider et al., 2003). Physical activity is associated with healthier cancer survivorship, and has been shown to improve fitness, function, and quality-of-life across different ages and cancer sites (Courneya et al., 2003; Courneya et al., 2004; Demark-Wahnefried et al., 2004, 2006; Dimeo et al., 2004; Johnson et al., 2009, Kelm et al., 2003; Windsor et al., 2004). In rural areas, cancer and cancer survivorship are even more pressing issues than in the general population. Factors related to these cancer-related health disparities affecting rural residents – who number over 50,000,000 – include increased risk factors and decreased healthcare access (Eberhardt & Parmuk, 2004). Cancer survivorship is also a key concern for individuals in the military and for military families. Available data indicate higher incidences of breast and prostate cancer affecting U.S. military versus the general population (Zhu et al., 2009). The telehealth aspect of the proposed research plan – developing and testing a physical activity intervention which we can monitor remotely to track and improve exercise adherence – is undeniably important for those in the military. By working to deliver and promote adherence to physical activity regimen for cancer survivors in remote settings, we will further the cause of improving cancer survivorship for the military and their families. Our overarching research goals are to determine the benefits of increased physical activity for rural cancer survivors and the best means for delivering and promoting adherence to physical activity programming for these individuals. Our goal in FY08 was to conduct Phase 1 of this investigation by identifying collaborators, fully developing the physical activity study protocol, obtaining IRB approvals and addressing other key logistical issues. In FY09, the goal is to conduct Phase 2 of this investigation, continuing our work to bring cancer survivorship research to rural Pennsylvania. Phase 2 will include 1) preliminary identification of body monitoring technologies to measure key variables related to physical activity and sedentary behavior and a pilot intervention to determine the feasibility of physical activity programming and monitoring in rural cancer survivors. 2) A market survey will be performed to identify optimal available technologies for physical activity monitoring. The purpose of this proof-of-concept study is to lay the groundwork for future randomized controlled trial investigations of the benefits of physical activity for rural cancer survivors.

## Body

The rural residents appear to be physically less active than other individuals (Eberhardt & Parmuk, 2004; Weidinger et al., 2008). Only 19% of rural cancer survivors meet the recommended 150 minutes/week of moderate-to-vigorous physical activity recommended for improved survivorship health and cancer prevention (Rogers et al., 2009). These data clearly indicate the need for physical activity for these individuals. There is a striking lack of information regarding physical activity in rural cancer survivors and to our knowledge, no intervention studies have been conducted in this underserved and highly vulnerable population.

The optimal means of delivering and monitoring exercise programming and physical activity prescription is not known. A home-based physical activity program, monitored at a distance via telehealth applications, could provide an ideal intervention given the remote location of the target population. Rural cancer survivors cite home-based, moderate-intensity exercise as their preference (Rogers et al., 2009), and rural residents are 54% more likely to follow their doctor's recommendations to exercise when presented with a specific exercise program, and consequently, being contacted for follow-up (Weidinger et al., 2008).

Progress on the approved technical and research objectives of this protocol are delineated below.

Per Technical Objective 2, body monitoring technologies to measure key variables related to physical activity and sedentary behavior have been identified and will be evaluated via the established matrix (Appendix A). Key data points will include: minutes/day and minutes/week of physical activity (exercise + increased activity), minutes/day and minutes/week of physical inactivity/sedentary behavior, MET-hours/day (MET: metabolic equivalent task), and energy expenditure. This matrix will also be used to evaluate other key variables of these technologies, such as:

- Type of display
- Software
- Monitoring
    - Daily
    - Weekly
    - Monthly
- Monitors
    - EKG
    - Heart rate
    - METS
    - Physical activity
    - Oxygen levels
    - Posture
    - Respiration
    - Body temperature
- Data storage media
- Other medical peripherals
- Cost
- Ease of use

Evaluation of these technologies will allow us to determine optimal means for measuring quality-of-life and self-reported physical activity (Technical Objective 3). To date, we have not conducted in-house testing of physical activity monitors to be used in the Phase 2 pilot trial (Technical Objective 1).

Per Research Objective 1, the search continues to identify healthcare collaborator(s) for this project. Due to time constraints, we have not identified recruitment sites or established necessary memorandums of understanding and related agreements. Similarly, we have not fully developed the physical activity study protocol and related documents to be used in Phase 2

(Research Objective 2). Similarly, we have not submitted nor gained approval from the institutional review boards (IRBs) from all institutions involved with Phase 2 study (Research Objective 3).

## Key Research Accomplishments

- Continued literature search and review
- Development of an evaluation matrix for market survey
- Preliminary identification of body monitoring technologies to measure key variables related to physical activity and sedentary behavior, to be evaluated in Phase 2 market survey
    - Civilian significance: will allow at-a-distance monitoring of physical activity and related variables
    - Military significance: will allow at-a-distance monitoring of physical activity and related variables
- Preliminary of evaluation matrix for wearable body monitoring technologies above
    - Civilian significance: will allow evaluation of various physical activity monitors, and identification of optimal technologies for monitoring at-a-distance
    - Military significance: will allow evaluation of various physical activity monitors, and identification of optimal technologies for monitoring at-a-distance

## Reportable Outcomes

- Exploring federal grants related to cancer survivorship in rural areas
- Developed matrix to assess key factors

## Conclusion

Cancer survivors must face many challenges brought about by the effects of their disease and its treatment. Decreased fitness and physical function, lost quality-of-life and increased fatigue are common for cancer survivors and can last for years after treatment (Bower et al., 2006; Dimeo, 2001; Lucia et al., 2003; Schneider et al., 2003). Unfortunately, only 19% of rural cancer survivors meet 150 minutes/week of moderate-to-vigorous physical activity recommended for improved survivorship health and cancer prevention (Rogers et al., 2009). This data clearly indicates the need for physical activity interventions for rural cancer survivors. There is a striking lack of information regarding physical activity in rural cancer survivors and, to our knowledge, no intervention studies have been conducted in this underserved and highly vulnerable population. The use of a home-based physical activity program, monitored at-a-distance using telehealth applications, could provide an ideal intervention given the remote location of those in our target population.

We predict that rural cancer survivors, when provided with a program to increase their physical activity using a wearable body monitoring device and the use of telehealth applications, will demonstrate healthier cancer survivorship, improved fitness, function, and quality of life.

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**Appendix A**

## PA Rural Cancer Survivors Monitor Matrix

| | Display | Software | Monitoring: Daily, Weekly, Monthly | Monitors: EKG, Heart Rate | Monitors: METS | Monitors: Physical Activity | Monitors: Oxygen, Posture, Breathing | Monitors: Body Temp | Data Storage Media | External Medical Perphials | Cost | AV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FitBit | | | | | | | | | | | | |
| Sense Wear Arm Band | | | | | | | | | | | | |
| Nutribase EZ Software | | | | | | | | | | | | |
| KAM Coach Activity Monitor | | | | | | | | | | | | |
| BioTrainer Weight Loss System | | | | | | | | | | | | |
| Dynamed Solutions | | | | | | | | | | | | |
| VivoMetrics | | | | | | | | | | | | |
| HoneyWell HomMed | | | | | | | | | | | | |
| HealthHUB | | | | | | | | | | | | |
| Vitel Net | | | | | | | | | | | | |
| Polar FT40F | | | | | | | | | | | | |
| Wrist Mounted Oximetry System | | | | | | | | | | | | |
| Vital Jacket | Tshirt | Yes | Yes | Yes<br>Yes | NA | Yes | Yes<br>Yes<br>Yes | Yes | SD | Yes | NA | No |
| AMON | | | | | | | | | | | | |
| | | | | | | | | | | | | |