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Introducing Wireless Grids Technology to the Field of Telemedicine

Dale W. Meyerrose
Syracuse University

ABSTRACT

While telemedicine and technology-enabled education are not new concepts and have significant bodies of research, in depth application to management and treatment of veteran Post-Traumatic Stress Disorder (PTSD) and Traumatic Brain Injury (TBI) is relatively new. The conflicts in the Southwest Asia over the last two decades have significantly increased the need for healthcare and support services for these returning warriors. Creative thinking and innovative technologies are needed to meet the growing and changing demand of these patients in the face of many competing demands within the U.S. healthcare sector.

This doctoral research study investigated the potential for a platform-agnostic (ad hoc) networking technology to serve as a trusted social networking and training platform for healthcare providers who are striving to provide quality healthcare that meets the needs of veterans suffering from PTSD and TBI. This research study analyzed the effectiveness of a digitally networked environment to deliver desired training and certification outcomes in a military healthcare environment. The level of acceptance of an ad hoc network technology (GridstreamRx) by healthcare professionals using it as an enabler of collaboration during the training process was evaluated. The results also assessed the readiness of healthcare professionals to use this Information Communications Technology (ICT), or analogous new applications and services, to help them perform their healthcare responsibilities.

This thesis study, accomplished with the support of the U.S. Army and National Science Foundation, took place at two large military medical centers over a twelve-month period of time. Data was gathered from 568 healthcare professionals using quantitative survey instruments. Ninety-six respondents provided additional quantitative and qualitative inputs at various times during a proscribed training regimen. DeLone and McLean's 2003 Information System Success Model, modified by findings of more recent research, provided the theoretical lens for analyzing the data from 32 of the training participants in determining the perceived net benefit of the GridstreamRx technology.

The data gathered for the study showed, at the 95% level of confidence, that a majority of the professionals of these two medical centers would perceive a positive net benefit from using GridstreamRx in a healthcare training environment. The conclusion from this analysis was that not only are the healthcare providers in this study ready to use ICT and social networking in this professional setting, but also that GridstreamRx is an acceptable platform for performing these functions.

The study participants provided input with respect to their priorities regarding information sharing techniques, functionality, and suggestions for improving the platform. The outcomes confirmed that GridstreamRx can be a successful introduction of ad hoc networking to telemedicine. This thesis concluded with recommendations for scholars and practitioners to pursue in the future; and should be followed up with further research and actions in order to build toward a Fully Integrated Virtual Healthcare Environment (FivHe).

INTRODUCING WIRELESS GRIDS TECHNOLOGY TO THE FIELD OF TELEMEDICINE

By

Dale W. Meyerrose

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M.B.A., University of Utah, 1978

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No one travels far in life—or starts a worthwhile enterprise—by walking alone.
One of Life's Lessons

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I am a blessed man. The rest of my special “thanks” is personal—no last names needed—you all know who you are—and that’s all that matters.

Linda, you are the best of everything in life about which I care—for the past forty years—and the forty on the horizon.

To the women of my life: Madonna, Julia, Laura, Alexandra, Kylie, Danielle, Beth, Dee Ann, Dawn, Esther, Opal, Josephine, Patty, Winnona, and Margaret.

To the men: Allen, Geoff, Tim, Mike, Rick, Greg, Elmer, Glenn, Tom, Jerry, Tom, Sammy, Edwin, Don, Buddy, John T, Gerry, Robert T, Jim B, and Dale Too.

To the: Generals, Admirals, Colonels, Majors, Captains, Lieutenants, Chiefs, Shirts, NCOs, Airmen, U.S. Government civilians, ’75 Best Alive, USAFAPT, and ROTS.

Finally, I humbly salute those comrades in arms—who selflessly stood the watch for America—willingly paid the price for freedom—and now need our best efforts to help them deal with the both the visible and invisible scars of their sacrifice.

That which is hard-earned is treasured; that which is free or easily gained is less valued.
Unknown

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CHAPTER I. INTRODUCTION

Overview

This doctoral research study investigated the potential for a platform agnostic (ad hoc) networking technology to serve as a trusted social networking and training platform for healthcare providers who are striving to provide quality healthcare that meets the needs of veterans suffering from Post-Traumatic Stress Disorder (PTSD)[1] and Traumatic Brain Injury (TBI)[2]. This research study analyzes the effectiveness of a networked environment to deliver desired training outcomes in a military healthcare environment. The doctoral thesis also assesses the performance of participants that used an ad hoc network technology model (GridstreamRx[3]) to enable collaboration

[1] PTSD first appeared in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (*DSM-III*). PTSD is designated as condition 309.81 and defined as "the development of characteristic symptoms following a psychologically traumatic event that is generally outside the range of human experience" (American Psychiatric, 1980).

[2] TBI is classified in the ICD-10 as S06, or an "intracranial injury." TBI is a group of morbidities (including concussion, cerebral edema, hemorrhage, *et cetera*) caused by external force that traumatically injures the brain (World Health, 2008).

[3] GridstreamRx™ is a trademarked ad hoc networking application of the Wireless Grids Corporation designed to provide "Workplace as a Service" for the medical sector. The Syracuse University Wireless Grid Innovation Testbed (WiGiT) provided GridstreamRx and administered the system dedicated for the purposes of this study (McKnight, 2013a).

during the training process. Research results evaluate the ability of an ad hoc network to support a trusted social network environment as well as the readiness of healthcare professionals to use this technology, or analogous new applications and services to help them perform their healthcare responsibilities.

The goal of this doctoral study, the first of its kind, is to provide analytic evidence of the potential or non-potential for using ad hoc networking to enable healthcare providers to improve the health outcomes for their patients with PTSD and TBI. The public health and public policy issues are currently being addressed in various ways throughout the U.S. Department of Defense (DoD), Veterans Administration (VA) and civilian healthcare systems (Force, 2010). But no study of this kind has been attempted to date. The potential significance of this research then is therefore self-evident; while the case for its merit and originality may also be made on this basis.

Steptoe (2012) found that the need to equip healthcare team members with the skills necessary for the standard and consistent integration of culturally competent methodologies when treating military service members, veterans and their families is critical to achieving the desired healthcare outcomes. Generalizing from the Steptoe findings, the primary focus of this doctoral study is to validate the effectiveness of desired healthcare training outcomes with ad hoc and social networking technology-enhanced methods that can enable distributed and mobile interaction with healthcare providers and community members, if security, quality, reliability and effectiveness can be demonstrated.

General Context and Issues

The impetus for this study came through direct interaction with many veterans and their healthcare providers with regard to PTSD and TBI issues that arose from combat events during the past four decades. The linkage between these mental conditions and suicide is a proven fact (Huso, 2013). As a point of emphasis, it is alarming that the number of suicides among veterans exceeded the number of combat-related deaths in 2012 (Smith, 2013).

Coping with the carnage of warfare has posed a number of societal issues since the beginning of civilization. Modern battlefield medicine and protective technologies have been turning many who would have been fatalities in past wars into living casualties with chronic conditions. By far, the most wide-ranging of these conditions have been PTSD and TBI, affecting up to 20% of the total number of U.S. combatants in Southwest Asia (Hoge, 2008).

There are major hurdles to introducing new technology into most fields of human endeavor (Venkatesh 2003; Rogers 1995). This study will show once again that the virtualized world of telemedicine is no different and serves as a reminder that taking account of the human element is essential for technology adoption to occur and innovations to be validated by consumers and the market place. Relevant issues that are particularly applicable to the field of telemedicine include access to medical data, lack of security standards, and liability associated with experimentation in delivering healthcare services (Schafer, 2013).

Gaining access to United States (U.S.) federal agency medical data can be challenging. In general, the U.S. Government's control of all personally identifiable

information (PII), which includes medical information, is subject to the Privacy Act of 1974. By the Department of Justice's (DOJ's) own admission, the ambiguity of this law and its uneven application over the years adds major difficulty to anyone seeking access to PII data (Justice, 2013). In accessing medical information, there is also the additional burden of the legal mandates of the 1996 Health Insurance Portability and Accountability Act (HIPAA, 1996).

According to a report by the Association of Academic Health Centers (Steinberg, 2009), HIPAA gave researchers unnecessary difficulty in recruiting participants, and the privacy rules limited their ability to add diversity to their studies. HIPAA has "fundamentally changed the conduct of research" and "scientific credibility is at risk for the future" (Steinberg, 2009, p. 10). While reforms to HIPAA have been proposed (Steinberg, 2009; Wang, 2013; Chesanow, 2013), new challenges arise as privacy of information raises in significance as a policy concern for politicians and some of their constituents (Arthur, 2012).

In addition to the difficulties in accessing PII, there are widespread concerns regarding the lack of IT security standards in telemedicine. David Luxton at the National Center for Telehealth and Technology demonstrated this lack of standardized data security in telemedicine to ensure privacy while utilizing the full capacity of mobile devices (Luxton et al., 2012). The authors concluded that a standardized framework is needed to assure that these HIPAA compliance standards are met and enforced in a manner that does not place the burden on developers or users.

According to Nguyen (2011), there are liability and trust issues of mixing experimentation and the actual delivery of healthcare services, particularly from the

providers' perspective. There remains widespread reluctance by many doctors and nurses to deliver care virtually. Not only are many of these professionals of an age to be "digital immigrants," but they fear the culpability and liability of possible mistakes associated with not actually seeing and examining the patient in person. Additionally, there are legal difficulties with delivering care across state lines and other jurisdictions that have differing care standards and insurance requirements.

One of the primary challenges in completing this doctoral thesis was finding the point of introduction for a new technology that was not overwhelmed by the inherent obstacles previously cited (Eysenbach, 2000) in addressing the dilemma of delivering healthcare in the information age—and even considered the nuances brought about by the emerging cyber world. The framework and illustration [Figure 1] was developed to depict the scope of this study and the relationship of related influencing factors. The "training/orientation" segment of the provider environment is the focus of this study.

The opportunity to access the healthcare provider environment for this study came from the military's need to enhance the training of physicians and allied healthcare providers in ways that provide more effective delivery of the needed healthcare services to U.S. military active duty members and veterans who suffer from PTSD and TBI, as well as related care issues for their families. Specifically, the Army's Telemedicine and Technology Research Center (TATRC) recently created an initiative to train healthcare providers that did not originally include an Information Communications Technology (ICT) platform for networking the participants as they went

through the training.[4] This opportunity established the focus for this research study of the provider training environment.

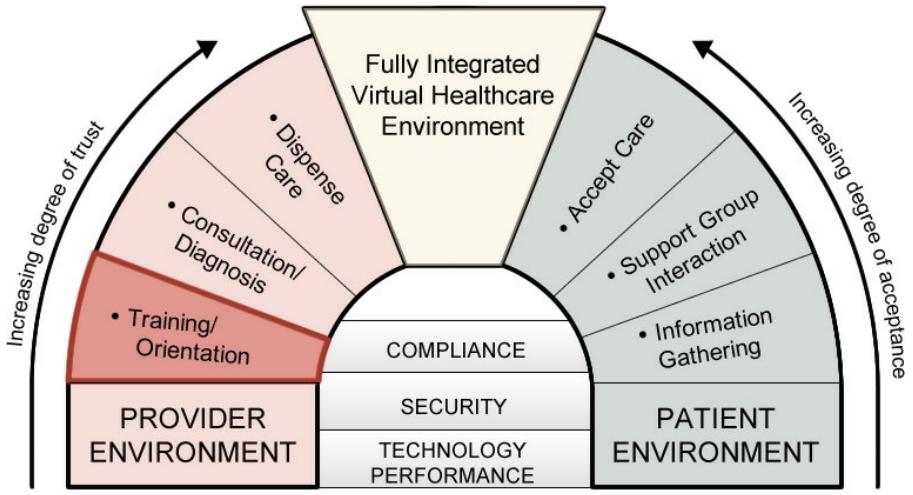

Figure 1 Framing the Thesis: Fully Integrated Virtual Healthcare Environment (FivHe)

Figure 1 represents the macro-functions to be accomplished within the provider and patient environments that make up the Fully Integrated Virtual Healthcare Environment (FivHe). This does not constitute an enterprise architecture but rather a relational structure of those functional capabilities from the respective environments that are needed in order to create a FivHe. The common functions (compliance, security, and technology performance) are broad terms that account for all related enabling functions within both environments. Technology performance covers all technical aspects of this eco-system, including the ICT infrastructure irrespective of its location.

[4] In May 2012, the Army awarded the contract to the Steptoe Group's Warrior-Centric Healthcare Training (WCHT) ® system (Steptoe, 2012d).

Warrior-Centric Healthcare Training

The Warrior-Centric Healthcare Training (WCHT) program was designed to enable the healthcare team to recognize, affirm, and value the cultural similarities and differences that provide the framework for meeting the total health and healthcare needs of active duty service members, veterans, their families, and communities (Tarr, 2011). WCHT is designed to assist in identifying and overcoming pre-existing biases that may exist on the part of healthcare and administrative personnel thereby enabling them to deliver high-quality services that are patient-centered, evidence-based, formalized, standardized, and addresses the mental and behavioral health needs of vulnerable populations (Steptoe, 2010a).

WCHT has two phases (Steptoe, 2012d; Tarr, 2011). Phase I involves:

- Conducting Environmental Scan survey of a representative sample of healthcare providers at each demonstration site to determine baseline levels of general cultural awareness and competence.
- Intensive on-site training to a select group of healthcare providers at each site representing a range of disciplines during which they are trained in the Warrior-Centric Healthcare approach.
- Survey of participants before and after training to measure changes in treatment knowledge, beliefs, and cultural competency.

Phase II involves:

- Online training conducted at 3, 6, and 9-month points after the initial training in which trainees interact with Avatars to demonstrate how they would

provide treatment and support to individuals living with PTSD, TBI, and other mental and behavioral health conditions.

- During the online training, participants answer a series of questions designed to measure the extent to which they have retained and are applying the knowledge gained in the initial training.

Research Sites

The U.S. Army selected the two healthcare sites to test the WCHT system and agreed that the testing could be a part of this research study [Appendix A]. For the purposes of this research, these sites were given pseudonyms as a part of the Syracuse University Institutional Review Board (IRB)-approved protocol for data collection that will protect the anonymity of the study's participants.

Both locations are large military medical centers with staffs and contractors that number between 900 and 1800 professionals for providing healthcare, mental health treatment, and ancillary services to service members and veterans. The site with the larger number of healthcare providers will be referred to as "Site A" during this study. The other location will be labeled "Site B."

The Wireless Grids Innovation Testbed (WiGiT)[5] facility, a virtual distributed experimental testbed at Syracuse University, provided access to the ad hoc technology platform (GridstreamRx) and administered the system dedicated to support this study.

[5] The National Science Foundation Division of Engineering, Industrial Innovation and Partnerships, for Partnership for Innovation program supports WiGiT as a collaborative effort of Syracuse University, Virginia Tech, Massachusetts Institute of Technology, Tufts University, and other academic institutions, private organizations, and corporate partners. (http://wigit.ischool.syr.edu/) The researcher had an existing relationship with the Wireless Grids Corporation prior to the initiation of this study. However, at no time did the researcher receive compensation or added consideration before, during or after the conduct of this thesis research for such involvement.

GridstreamRx

This study examined the potential for an ad hoc network (as represented by GridstreamRx) to provide a trusted social network environment to train healthcare professionals who care for people suffering from PTSD and TBI. GridstreamRx was selected as the example of a "cloud-to-the-edge" ad hoc technology based on work of the WiGiT, which has been exploring wireless grids technology as an infrastructure delivery method supporting critical functions with the promise of (Treglia, 2011):

- Lower cost and investment.
- Better trust fabric.
- Greater agility in a rapidly changing environment.
- More comprehensive participant collaboration.
- Fewer demands for increasingly hard-to-find, expensive talent.

The Wireless Grids Corporation provided access to its ad hoc network technology through Syracuse University to WiGiT for use in this study. The technology, known as GridstreamRx, seeks to provide a "Healthcare Workplace as a Service" capability for the medical sector (McKnight, 2013a).

Research Approach

Key factors that will influence this study include those related to the healthcare profession, the culture of the military, new technologies, and training outcomes.

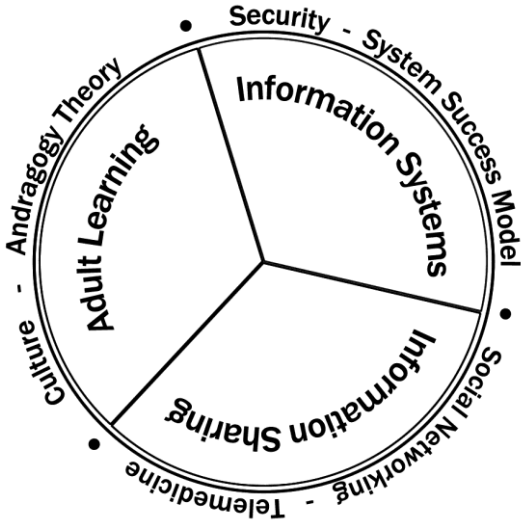

Figure 2 Research Areas

Three broad fields of inquiry inform this study, as is depicted in Figure 2. Around the edge of the diagram are core areas that are the associated concepts, models, and theories against which the means, results, and motivation within this study will be grounded and analyzed. Chapter II will examine each of these in detail.

Prior Research

In 2006, Chaudhry et al. conducted a systematic literature review of over 250 studies to clarify technology's impact on healthcare quality and emerging issues. The researchers concluded that providers' use of technology resulted in increased use of evidence-based care, decreased medication errors, and enhanced monitoring of patient health. In the process, they identified issues associated with best practices in training providers, use of social media, and ethical considerations—all of which are relevant to this research study (Chaudhry et al., 2006).

Two recent studies specifically addressed using wireless grids technology in social networking and educational environments with favorable results. McKenna used WeJay social radio, an application also embedded in the WiGiT to investigate how wireless grids can help foster creativity and innovation in an educational setting. She found the tool to be both desirable and beneficial and that the technology contributed positively to context awareness and ambient learning (McKenna, 2012).

Similarly, Chauncey cited WeJay's utility in promoting behavior self-regulation and positive self-efficacy in troubled youth in a fragile population. This study supported the claim that informal learning can occur in a formal learning environment using wireless grids technology (Chauncey, 2012).

There is no question to the significance of the GridstreamRx ad hoc and social networking platform assessed in this study, i.e. in that it merits this degree of study, as it is a variant of the Gridstream and GridstreamX “Workplace as a Service” applications. The GridstreamX capabilities have already been incorporated into a number of studies, demonstrations, white papers, and draft open specifications (McKnight, 2003; McKnight, 2013b; Brooks, 2013b; McKnight, 2013c; McKnight, 2004; McKnight, 2013d; McKnight, 2013e; Treglia, 2009; McKnight, 2013f; McKnight, 2013g), some of which were developed in cooperation with the Enterprise Cloud Leadership Council of TM Forum, a leading information technology industry standards organization. Therefore, while GridstreamRx may or may not ultimately succeed in the marketplace, it is at the least an example of a new class of solutions which are experiencing evaluation, and in some cases appear to be poised for rapid market adoption. So the question arises, will the healthcare training environment prove more or less conducive a place for these innovations to be utilized?

Deficiencies in Addressing the Problem

While telemedicine and using technology-enabled education are not new and have significant bodies of research, in-depth application to management and treatment of veteran PTSD and TBI is relatively new. Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) involved the deployment of over two million U.S. troops since October 2001. The re-deployment of these forces back to the U.S. has significantly increased the need for healthcare and support services, as PTSD and TBI cases are not infrequent. It is now recognized that the psychological toll of these deployments outweighs the physical injuries resulting from combat. Another complicating facet to the

"lessons learned" regarding PTSD and TBI and other invisible wounds of war is the lack of data regarding female veteran and service members (Steptoe, 2012d).

The utility of wireless grids technology has been tested in a number of sectors to include: emergency response, energy, environmental management, entertainment, and K-12 and university education. However, it has not yet been used in conjunction with adult education and professional training in the context of the healthcare industry and telemedicine (McKnight, 2012a).

Additionally, this study can help the DoD and the VA in assessing the quality of provider training in both networked and non-networked environments and possibly adjust the requirements of future training.

Research Question

The research question being answered by this study is: *Can wireless grids technology enhance the ability of physicians and allied healthcare providers to deliver healthcare services to U.S. military veterans suffering from Post-Traumatic Stress Disorder (PTSD) or Traumatic Brain Injury (TBI)?*

The results of this study also inform elements regarding the viability of the example ad hoc technology (GridstreamRx) that was used during the course of this research. Questions such as those below can also be addressed:

a. Experience of participants using this technology?
b. Performance as a trusted networking platform in the healthcare environment?
c. Potential acceptability within the healthcare provider environment community to work toward a Fully Integrated Virtual Healthcare Environment (FivHe)?

These questions were addressed primarily using survey methods, which included an Environmental Scan at both research sites and pre- and post-training questionnaires. Additionally, a focus group from each of the study sites will provide feedback to inform portions of the study. Chapter III will provide an in-depth review of the study's methodology.

Purpose of the Study

The doctoral study investigates the potential for wireless grids technologies to serve as the education and training medium for healthcare providers to address the needs of veterans suffering from PTSD and TBI. This study assesses the effectiveness of a digitally networked environment to deliver desired outcomes and the willingness of healthcare providers in a military related environment to use Information and Communications Technology (ICT).

Significance of the Study

The inclusion of various new information and other technologies in updated healthcare regimens can be key to achieving improved outcomes. In that PTSD and TBI are two of the leading healthcare problems of service members returning from combat, this is an area of inquiry that needs more study.

By leveraging the WCHT, this study contributes to a new part of the overall training system that is incorporating and addressing the healthcare recommendations of the research findings from: the Rand Report—Invisible Wounds of War (Tanielian, 2008), the final report of the Defense Task Force on the "Prevention of Suicide by Members of the Armed Services" (Force, 2010), the DoD "Recovering Warrior Task

Force Report" (Force, 2011), the Army's "Generating Health and Discipline in the Force Ahead of the Strategic Reset" (Army, 2012), and the Joint Commission (Commission, 2012) recommendations on care management of mental and behavioral health conditions.

The findings from these five major research reports stressed the immediate and unabated need for the implementation of warrior-centric and evidence-based training specifically targeting the military and veteran communities. The WCHT system provides this warrior-centric, evidence-based training and is applicable to primary care managers, nurse case managers, psychologists, social workers, clinical nurses, medical specialists, physical therapist, occupational therapists, support center personnel, ancillary professional staff, and cadre. Most importantly WCHT directly addresses the results of these reports (Steptoe, 2010b).

Not only will this thesis address the issues surrounding training and orientation of healthcare providers, but it will also lay groundwork to inform related studies and other efforts to develop the technology and techniques necessary to use wireless grids-based technologies in the healthcare sector.

CHAPTER II. LITERATURE

Three areas of inquiry and associated literature informed this thesis study: information systems, information sharing, and adult learning (refer back to Figure 2). In pursuing this study's research question, the guiding principle for inclusion of related literature in this chapter was its relevance to the convergence of the functionality of wireless technologies (specifically GridstreamRx), adult learning outcomes, military culture, healthcare, social networking, and telemedicine. The information systems literature directly informed the research question, the adult learning literature informed the study participant experience and goals, while the information sharing literature added context with regard to the applied operating environment, not only for this study, but for those that will come later.

Most of the cited ad hoc networking and wireless grids research took place within the last decade, as this is a relatively new technology. The distinguishing factor for ad hoc networking is the use of "edge" resources that operate at the external boundary of a network, versus those found at the core information technology infrastructure. How technologists have looked at the "edge" of an information network has evolved because of the developments of recent years. Originally, the "edge" was where hardware devices resided beyond the core infrastructure that connected client devices such as computer, phones, cameras, and access points to the Internet. The evolution of ad hoc networking technology has brought along the universally accepted notion that software

that resides at the “edge” can also contribute to the access, functionality, and interoperability of the client environment (Pereira-Beardsley, 2011).

It was important to realize that the participants had different adult learning factors that played into this experience. First, there was the assimilation of knowledge presented by the WHCT systems. Second, were those elements in dealing with the military culture and chronic conditions of PTSD and TBI. Third, the participants experienced application of that subject matter expertise in the context of the collaborative training environment. Fourth, there was the aspect of dealing and learning about the technology. These defined the parameters for the inclusion of adult learning research specifically relevant to this study.

Lastly, the literature on information sharing and telemedicine (as an information sharing platform) served as the functional backdrops for both the technology and adult learning aspects of this study. In today’s environment, confusion exists with both concepts—for different reasons. In the case of the former, many cannot distinguish between social networking as a social science from the social networking enabled by contemporary, commercial technology products (Porter, 1985). Regarding the latter, a plethora of terminology (telemedicine, telehealth, iHealth, eHealth, virtual medicine, cybermedicine, etc.) sometimes clouds definitions and impact. While there are legitimate differences with some of the terminology, that does not alter the confusion that surrounds the healthcare industry (ATA, 2012).[6] In either case, both concepts constitute rapidly expanding areas of social science research.

[6] Telemedicine is a broad term for delivering medical services through a communications link (Dictionary, 2013). Telehealth is sometimes substituted for telemedicine, but can imply monitoring, treatment, and provider/patient information (American Telemedicine, 2009). For the purposes of this paper, telemedicine will be the standard term used.

Information Systems

The crux of this study's research question is the use of an ad hoc networking information and information communication technology (ICT) as a training platform for healthcare providers in a military environment. Ad hoc networking is a decentralized construct that does not rely on a preexisting infrastructure (Toh, 2002).

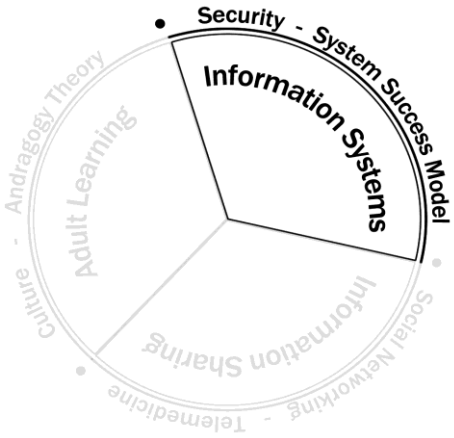

Figure 3 Information Systems

Wireless grids have been an emerging ad hoc networking concept that creates machine-to-machine communication at the "edge" in the form of an "application overlay," capable of sharing physical and virtual resources among heterogeneous devices and networks. The phrase "cloud-to-edgeware" captures the idea of software-defined ad hoc networking functions (McKnight, 2013g; McKnight, 2011). Specifically, wireless grids technology dynamically shares physical and virtual resources among heterogeneous devices. The promise of this technology is its ability to share available resources, thereby increasing wireless coverage while reducing the need for dedicated, costly infrastructure (McKnight, 2007).

GridstreamRx

The Wireless Grids Corporation, along with other partners in the WiGiT, created a structure of edgeware collaborative learning tools to demonstrate and evaluate the potential uses of ad hoc networking and wireless grids technology. The concept behind the Gridstream family of applications is to ensure the secure and private sharing of anything—Workplace as a Service (WPaaS) (McKnight, 2013g). GridstreamRx

provides a “Healthcare Workplace as a Service,” HIPAA-compliant capability for the medical sector (McKnight, 2013a).

This thesis study could theoretically have been accomplished with a variety of social networking technologies. In today’s social networking environment there is no shortage of applications and software packages designed to work with a variety of mediums and information appliances (Institute of Medicine, 2013). As one of the study’s participants articulated, the first concern with respect to the technology being tested was its usability. While the security and compliance required by law and good business practices was acknowledged and well understood, an application had to first work (Campbell, 2013b).

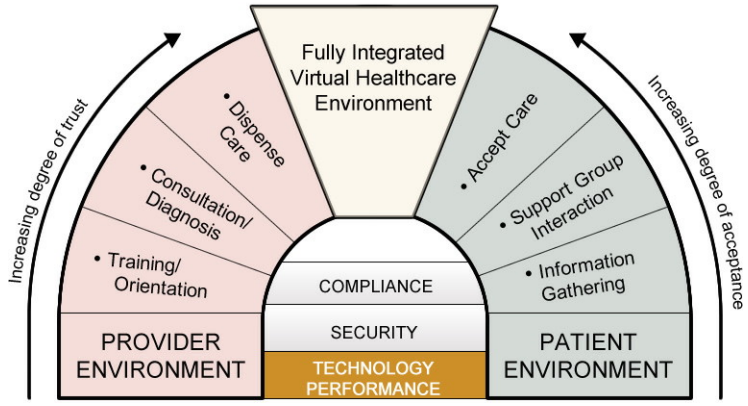

Figure 4 Assessing Technology Performance in this Thesis

To meet this challenge and foster real-time collaboration, the Gridstream family of applications outlined a compendium of information sharing features (Table 1)[7] that presented an integrated, user-defined environment in which the networking functionality required by each discipline could be embedded (McKnight, 2013g).

Table 1 Gridstream Features

Individual “followers”/”following”*
Work groups*
Secure file and document sharing*
Calendar
Colleague and content location*
Client profiles
Messaging*
Private chat/consultation
Meeting planner
Live broadcast/video conferencing*

[7] *Features available in the version of GridstreamRx used by participants in this study

Ad hoc technology, as represented by GridstreamRx, creates peer-to-peer networks at the “edge” that can have advantages to not only naturally fit the situation of this study, but also the potential telemedicine environments that are extensions of this research. Newton (2013) describes ad hoc networking: roles can be dynamically assigned, users can send and receive data without having to rely on a central infrastructure, the same task can be assigned to multiple nodes, and devices can have equal access.

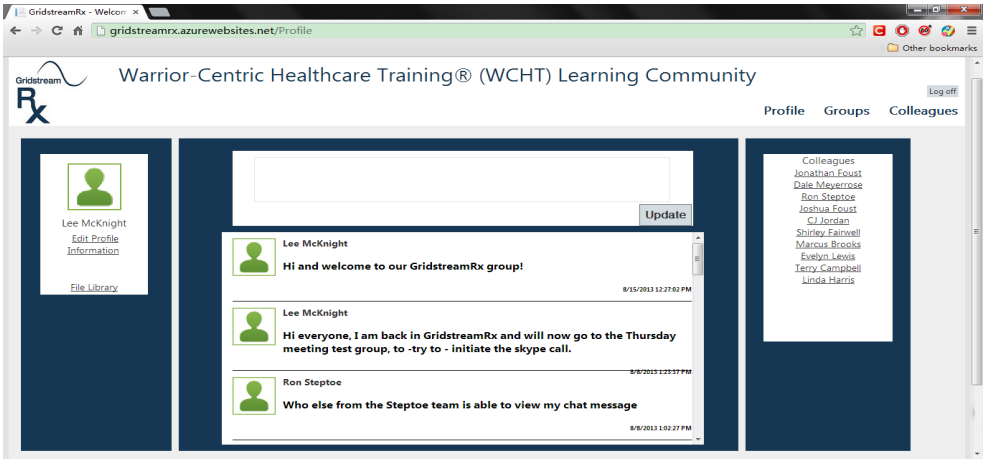

Figure 5 GridstreamRx Application

Further, wireless grids technology offers multiple potential advantages over other commercially available collaboration products (McKnight, 2004; McKnight, 2012a):

1. Protected virtual environment that ensured the privacy and security of participant interaction.
2. The potential to be specifically configured to fit participant desires while maintaining privacy and security posture.

3. Does not depend on Internet resources—creating the ability to remain up during power outages, emergency and peak usage situations.

As Foster and Kesselman (2013) posited, today's technology of on-demand services and open specifications should give impetus to more wireless grids deployment and utilization. They believe that these trends will help combat the historic obstacles inhibiting this ad hoc technology, namely deployment and operations costs, motivation to share ICT resources, and complexities associated with certain types of services.

Security[8]

For the purpose of this study, security has two relevant aspects. First, the HIPAA and Privacy Act set the requirements and policy standards associated with the healthcare industry. The second is GridstreamRx's ability to meet these requirements and standards.

Compliance

For years subject matter experts and organizations have made the compelling case for universally accepted security and compliance standards for ICT irrespective of its purpose or residing in the private or public sectors (MeriTalk, 2013). In

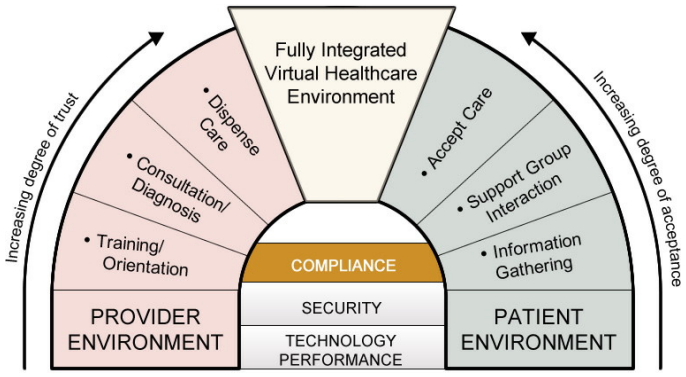

Figure 6 Compliance in the FivHe

[8] The aspect of security that gets the most scrutiny within the healthcare industry today is that associated with electronic health records (EHRs), electronic medical records (EMRs) and patient privacy rights (Chaudhry et al., 2006). Since this thesis study does not involve either patient records or data, this highly visible healthcare security issue will not be directly addressed. This issue may have great significance for related research efforts.

spite of this advocacy and existing legislative requirements, this has not effectively taken place within the healthcare environment (LunarLine, 2013). While not the objective of this study, the context of standards is critical for understanding the healthcare environment.

An important issue for practitioners implementing new wireless technologies in a healthcare setting is assurance that the technology itself will comply with HIPAA. Concentra Health Services faced this problem when they deployed an 802.11b wireless Local Area Network in 231 of its clinic locations. Their ability to conform to HIPAA regulations was complicated by the fact that existing regulations are not clearly defined for technology. Grygo (2002) contended that chief information and technology officers in healthcare organizations must be aware of potential security flaws in new wireless technology and develop strict policies and procedure to which new technologies must adhere. Luxton et al. (2012) documented that this situation has persisted for years and continues today.

HIPAA regulations continue to negatively impede academic healthcare research by limiting the scope, slowing the process, and adding to costs. According to a report by the Association of Academic Health Centers (Steinberg, 2009), HIPAA causes researchers unnecessary difficulty in recruiting participants, and that the privacy rules limit their ability to ensure diversity in their studies. HIPAA has “fundamentally changed the conduct of research” and “scientific credibility is at risk for the future” (Steinberg, 2009, p. 10). The report recommended revisions to the privacy rule, such as exemptions from its provisions for certain research, which have yet to be fully implemented (Wang, 2013).

In a study conducted at Syracuse University and the SUNY Institute of Technology, Jarrell et al. (2012) dispelled a notion that improving the quality and flow of information to providers is enough to overcome the difficulties or confusion created by HIPAA. The study rejected a hypothesis that the greater a healthcare provider's knowledge of HIPAA, the less likely they will be to report problems or changes in information quality and flow following implementation.

In order to move the discussion forward, Brooks (2013b) took a worst case scenario in order to establish a framework for analyzing GridstreamX security and compliance. Others have used the 2008 U.S. National Security Agency coordinated "top 20" series of critical security controls through the SANS Institute (2013;NCA, 2009). Additionally, other National Institute for Standards and Technology (NIST) publications such as the risk management guide have provided the guidance for organizations to prove that security standards were met that conformed with HIPAA requirements (NIST, 2012).

In the face of not having universally agreed upon standards, there is a growing consensus of security experts to use guidelines from the NIST as a framework for achieving HIPAA compliance (McGee, 2014). This includes all organizations, public or private, since the Department of Health and Human Services through Presidential Order has confirmed that it will use these as a baseline for enacting enforcement policies (EOP, 2013).

These considerations are very important as both government and industry scramble to digest the HIPAA Omnibus Final Rule (Field, 2014). In January 2013, the Department of Health and Human Services issued the HIPAA Omnibus Final Rule,

which significantly modified privacy, security, enforcement, and breach notification regulations by modifying the Health Information Technology for Economic and Clinical Health (HITECH) Act (HHS, 2013).

Technically Meeting the Security Requirements/Standards

Brooks et al. (2013b) analyzed the security architecture of GridstreamX in a peer-to-peer environment using the anatomy of a network attack. While this revealed vulnerabilities in the native code, the study was unable to put this application in a specific control or risk management framework. This is an area meriting further research and is outside the scope of this study.

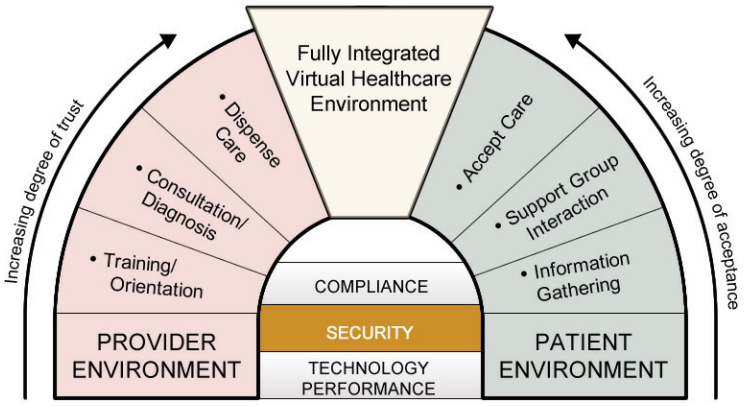

Figure 7 Security in the FivHe

However, Brooks (2013a) did create a roadmap for verifying that the Gridstream and other edgeware applications could meet the required security and compliance parameters (Table 2). While this is also outside the bounds of this study, the family of Gridstream applications will need to grow to match the security requirements in order to prove itself as a trusted information sharing platform.

Perhaps the most far-reaching of Brooks' (2013a) studies was his finding that traditional network-based security models are inadequate for protecting the dynamic wireless environment. He determined that the emerging requirement is for a net-centric

sharing and collaborating service-enabled architecture that discovers services and applications and makes real-time use of their code and data. This was added reinforcement to recently developed security practices examined by the National Security Agency designed to address advanced persistent threats that bypass traditional network perimeter defenses through change detection techniques from a known trusted condition (Starnes, 2011).

Table 2 Roadmap to Ensure GridstreamX Security Brooks et al. (2013b)

Network Hardening
Application Code Security Review
Security-Aware Error and Exception Handling
Fault Propagation Analysis
Security Fault Injection of Application Executables
Port Blocking
Intrusion Detection Deployment

Networked Multimedia Information Services (NMIS) Project

Sponsored by the Defense Advanced Projects Research Agency (DARPA) and the National Science Foundation, the Networked Multimedia Information Services (NMIS) Project encompassed a number of studies and research projects from 1993 – 1997. This was a collaborative effort among the Massachusetts Institute of Technology (MIT), Dartmouth College and Medical School, and Carnegie Mellon University with the corporate sponsorship of IBM and Turner Broadcasting (Ezekiel, 1997).

The relevance of this nationally renowned project to this research thesis is the national scope and areas of concentration. This effort can serve as verification for comprehensively addressing multiple of the factors within this study. A brief review of the three areas of concentration in this effort bears this out (p. 1):

- K-12 education, continuing education, and the healthcare community (which relates to adult learning).

- Live subscription, on-demand delivery models (which relates to information sharing).
- Research on standards and policy, including security (which relates to information systems).

One area where the findings of the NMIS project that has been overcome by recent technology developments were the “promising but not yet mature technologies” such as latency of streaming video, large file transfer, filling in the “gaps” with tailored software modules, and synchronization between audio and video (p. 28). These capabilities have not only matured in the last decade but accelerated in ways not envisioned by the researchers and experts of this project (InfoWorld, 2012).

Yet interestingly, an area that has been unchanged since the 1997 recommendations of this project are those that call for standards in middleware, specifications for information infrastructure, and other policy issues such as security and compliance (p. 30). These continue to be unresolved years later (Steinberg, 2009; Luxton et al., 2012; Schafer, 2013).

A major portion of this research work dealt with the Dartmouth Interactive Media Laboratory and their work with the Army and National Guard on a project called “Preventive Medicine in the Combat Theater” (Ezekiel, 1997, p. 17). The project identified the basics of extending healthcare to rural communities where tyranny of distance plays a central role—analogous to the isolation experienced by those suffering from PTSD and TBI—the target group to be cared for by the participants in this study.

The MIT Center for Advanced Educational Services also developed a series of multimedia information services for the continuing education of professionals—which

constitute an excellent set of criteria against which to judge GridstreamRx performance in this thesis study (Ezekiel, 1997, p. 14):

- Facilitates access to colleagues.
- Easier to locate content.
- Cost of hardware implementation small fraction of total solution costs.
- Need for open standards.
- Flexibility of technology to allow partial or incremental implementations.

Theoretical Framework

Several theoretical frameworks provide important insights into the adoption and use of GridstreamRx as a training platform—or subsequently as a consultative/diagnostic medium, or one of dispensing care—and were examined.

The Technology Acceptance Model (TAM) has been popular framework for information technology, education, and business (Davis, 1989; McKnight, 2013b; Selic, 2008; Venkatesh, 2000; Venkatesh, 2003). TAM focuses on tracing external factors to the intent and attitudes toward using a particular technology (Anshori, 2013). While useful, such an approach would raise multiple tangential issues to the purpose of this study.

Other researchers of wireless grids technologies have used a variety of theories to specifically analyze their work (Table 3). While all of these frameworks can be related in some way to this thesis topic, none of them significantly addresses the central element of this study, which is enhancing the training of healthcare professionals.

Table 3 Other Theoretical Frameworks for Analyzing Wireless Grids Technology

Title	Theory	Author(s)/Year	Study Focus
WG: Assessing a New Technology from a User Perspective	Davis' Diffusion of Innovations Theory	McKnight, Sharif, Wijngaert (2004)	User acceptance
A case study of the launch and first use experience of WeJay social radio in education	Emergence Theory	McKenna (2012)	Transformation and disruption
Investigating the effects of a wireless grid social radio station on collaboration and communication in fragile populations	Bandura and Walter's Social Cognitive Theory	Chauncey (2012)	Digital social networking
Edgeware Security Risk Management: Cloud, Virtualization and Wireless Grid Vulnerabilities	Schmit & Roth's Risk Management Theory	Brooks (2013a)	Security

A trans-disciplinary construct such as System Theory does hold promise as the basis for providing a useful framework. This theory states that a system consists of four basic elements: objects, attributes, internal relationships, and an environment. This theory purports that a closed system which does not take in information is destined to weaken and die. Conversely, an open system has an improved likelihood of growth and success. System characteristics include: wholeness, interdependence, correlations, cause-and-effect, chain-of-influence, hierarchy, suprasystems/subsystems, self-regulation, goal-orientation, and interchange with external entities, inputs/outputs, homeostasis, adaptability, and equi-finality (Littlejohn, 2001). Over the years, there have been variations and levels of complexity of this concept (Infante et al., 1997).

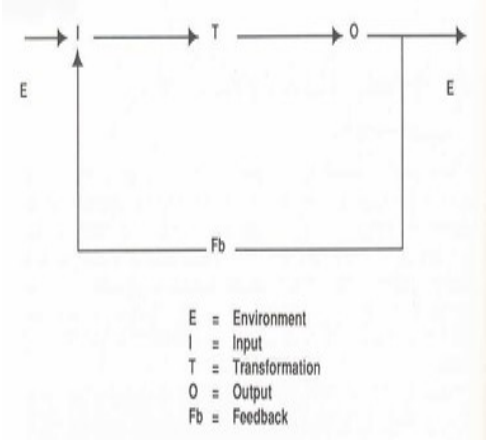

Figure 8 Simple System Model (Littlejohn, 2001)

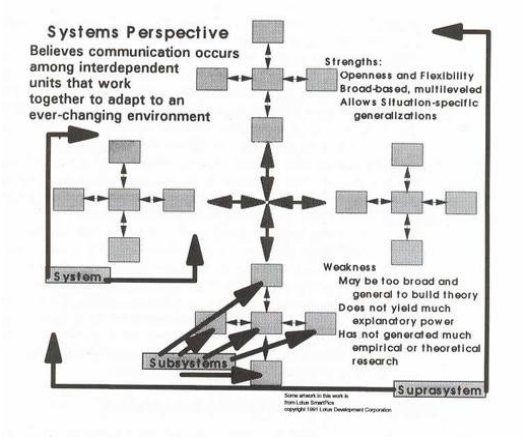

Figure 9 Elaborate System Model (Infante et al., 1997)

System Theory has been used with respect to healthcare studies. Kazley and Ozcan (2009) used System Theory to demonstrate how small hospitals that used Electronic Medical Records (EMRs) performed more efficiently than other small hospitals without EMRs. However, each of the four areas would require a significant decomposition of the four basic elements in order to adequately analyze this particular study. Such a construct might be more applicable to follow-on efforts to this study even though it is insufficient for the purposes at hand.

The DeLone and McLean Information System Success Model (ISSM) has garnered significant attention as a benchmark construct for measuring the effectiveness and success of virtual information sharing systems (Rai, 2002; Agourram, 2009; Khayun et al., 2012). The DeLone and McLean model (1992) created a taxonomy of six dimensions measured at the technical, semantic and effectiveness level, information quality, system quality, information use, user satisfaction, individual impact, and organizational impact.

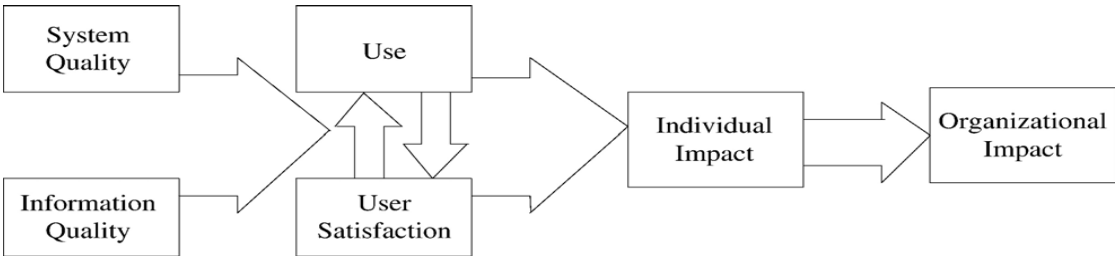

Figure 10 Information System Success Model (ISSM)
(DeLone, 1992)

As researchers began to test the ISSM, the six dimensions became the basis for six success variables. They found that the success of IS services not only depended on technology but on how users successfully used the technology (Molla, 2001; Rai, 2002).

As is shown in Figure 11, DeLone and McLean (2003) added a third major

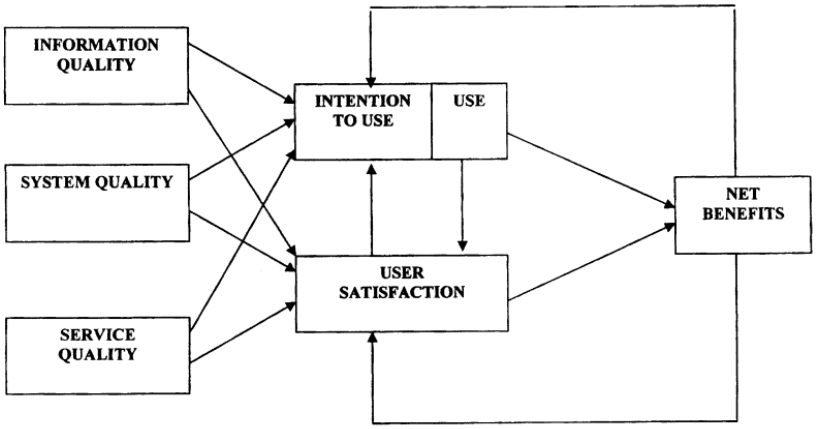

Figure 11 Updated of the ISSM
(DeLone, 2003)

dimension, service quality, in a more advanced model. Also, the success dimension, information use, was given an alternative measure in intention to use.

In the medical area, Van Der Meijden et al. (2003) used the ISSM to conduct a systematic literature review of EMR studies published between 1991 and 2001 and assigned attributes in those studies to any of the six dimensions postulated by DeLone

and McLean, including, system quality, information quality, use, user satisfaction, individual impact, and organizational impact.

The updated DeLone and McLean model started to gain traction in context by viewing information, system, and service quality as well as use and user satisfaction as success variables. Wang and Liao (2007) took the ISSM a step further in that they differentiated the difference between mandatory and voluntary use of the technology. They saw this as a key ingredient in determining user satisfaction in the DeLone and McLean ISSM.

Khayun et al. (2012) added one other extension of ISSM while validating it during their research—namely adding the influence of Individual Characteristics to the Perceived Net Benefit [see Figure 12]. Citing the work of other researchers (Mahmood, 2001; Masrek, 2008; Choi, 2004; Teo, 2009) this study made a compelling case that Individual Characteristics such as education, training, and professional levels played a significant influence upon technology acceptance.

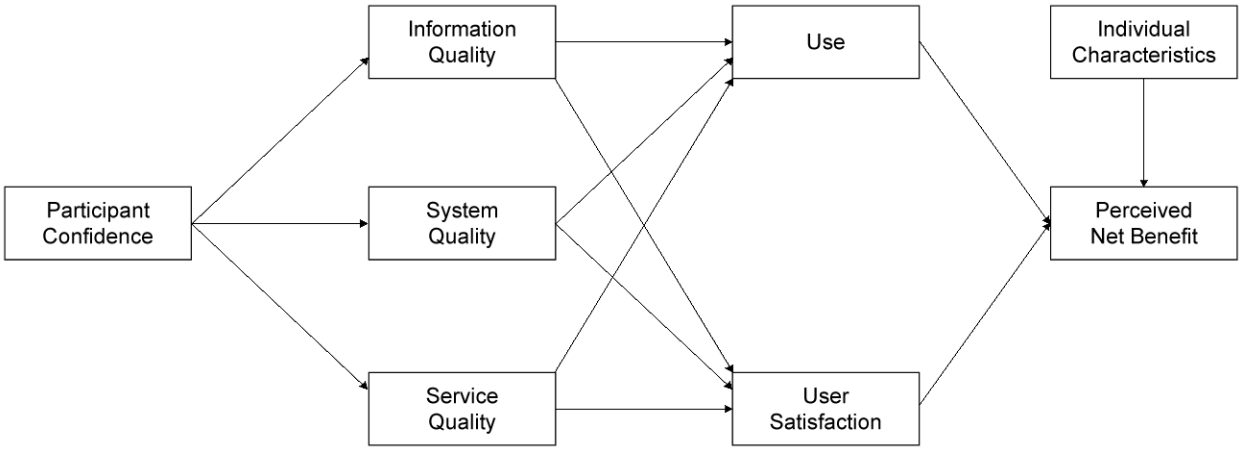

Figure 12 ISSM Modified
(Khayun et al., 2012; Wang, 2007)

Thus, the ISSM appears to be an excellent theoretical construct for this thesis study. The six dimensions of this model cover all of the elements within this thesis study. Additionally, the availability the respondents' demographics, education level, professional status, and familiarity with technology add a dimension of analysis that was not present in the theories previously discussed. In essence, the ISSM helps to quantify the user's experience in relation to technology and its utility—which is at the center of this study.

Adult Learning

This study deals with adult learning as opposed to formal, primary, secondary, or post-secondary education. In particular, there was the need to explore how learning takes place within specific contexts, environments, and within organizations or adult individuals—within time frames and for what reasons (Merriam, 2007).

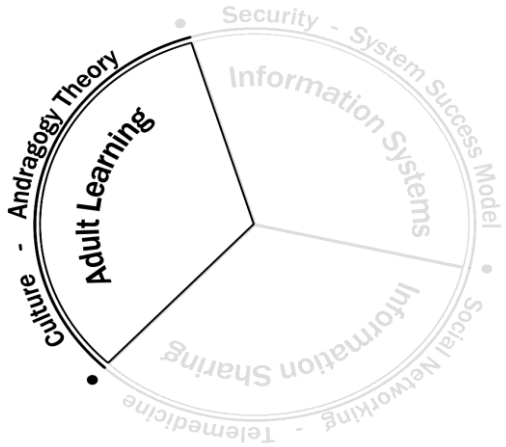

Figure 13 Adult Learning

Thompson (1976) distinguished training activities from others such as teaching and education by referring to it as the "mastery of action." According to Thompson, teaching and education focus primarily on the understanding of principles that are not necessarily for an intended purpose or to work a specific task. Training, on the other hand, is both purposeful and intentional—requiring the learner to apply what they learn on a problem at hand. However, education and training are certainly overlapping conceptually and share a variety of similarities.

It is this distinction which provided the realization that adult learning theory will affect the participants in four different ways in this research project—each with its own associated field of research. First, has to do with participant learning in the context of their individual and collective experiences. Second, will be the participant assimilation of cultural aspects of providing healthcare services. Third, will be the role of learning and social networking. And lastly, will be the adult learning foundation that forms the basis for the development of the WCHT system.

Applicable Theories, Methodologies, and Their Scholars and Practitioners

John Dewey was a professor at the University of Chicago and founder of the New School in New York City and an early pioneer in adult education. He was known for developing the classic Learning Theory and the highly influential idea of reflective inquiry with five noted elements of suggestion, problem, hypothesis, reasoning, and testing (Dewey, 1933).

Of note, Dewey approached much of his research through the epistemological lens of pragmatism. As a major figure in progressive education, he saw learning as a tool to solve problems and make social change (Violas, 2008). Since this study deals with healthcare providers adapting to elements of culture in order to gain knowledge to solve patient issues, such a viewpoint will help to inform the adult learning backdrop of this study.

Even though Dewey continued to explore adult learning for many years, there was a gap of almost four decades in significant research of adult learning and education from his initial writings. Dickinson and Rusnell (1971) documented that by the early 1970s only 22% of adult education journal articles were based on empirical research.

Further, Long and Agyekym (1974) found that 60% of articles from 1964-1973 were based on program descriptions or an argument of personal beliefs.

The “breakout” period for adult learning theory development came in the 1980s and 1990s as several researchers and practitioners rose to prominence. Several of these efforts were especially relevant to this study’s focus on experienced professionals, the military environment, and web-based technologies.

Adult Learning and Participant Experiences

All of the participants in this research study are highly educated and have significant healthcare experience. This provides the basis from which each will approach the task at hand and may heavily figure into the Individual Characteristics and associated relationship with Perceived Net Benefit within the ISSM.

David A. Kolb, founder and chairman of Experience Based Learning Systems, Inc. and Case Western Reserve University, proved to be a leader in the resurgence of studying adult learning. His four-stage cycle that combined experience, perception, cognition, and behavior was the basis for what became known as the Experiential Learning Theory (Kolb, 1984).

Kolb’s theory of experiential learning is a four-stage cycle that combines experience, perception, cognition, and behavior. Those stages are as follows:

1. DO or concrete experience.
2. OBSERVE or reflective observation.
3. THINK or abstract conceptualization.

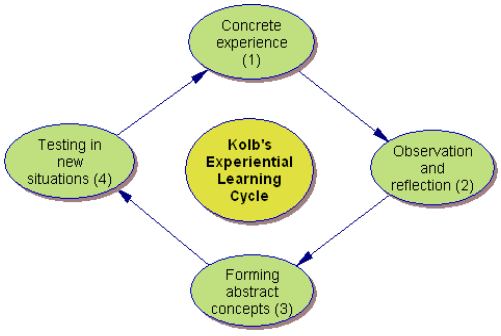

Figure 14 Experiential Learning Cycle (Kolb, 1984)

4. PLAN or active experimentation.

5. REPEAT.

A learner may start at any step, but the subsequent steps must be done in the above sequence. The cycle shows how experience is translated through reflection into learned concepts, which become guides for active experimentation and the choice of new experiences. The first stage, concrete experience, is where the learner actively experiences an activity in their environment, such as at work or in school. The second stage, reflective observation, is when the learner consciously reflects back on that experience and what it meant to them. The third stage, abstract conceptualization, is where the learner attempts to creates a hypothesis or working theory of what is observed. The fourth stage, active experimentation, is where the learner is trying to plan how to test their informal hypothesis or plan their next experience (Kolb, 1975). Kolb (1984) also identified four learning styles, which correspond to stages.

Table 4 Learning Styles (Kolb, 1984)

Learning Style	Description
Assimilators	Those who learn better when presented with sound logical theories to consider
Convergers	People who learn better when provided with practical applications, concepts, and theories
Accommodators	Individuals who learn better when provided with concrete, hands-on experiences
Divergers	Those who learn better when allowed to observe and collect a wide range of information

As participants exhibit any of these learning styles, Kolb's work may inform important aspects of this study and their acceptance of social networking as a learning function and virtual environment as a trusted training, and eventual one of delivering healthcare services.

Peter Jarvis, known for his studies on organizational development and culture, conducted research with the U.S. Army's effort to repatriate prisoners of war in Korea. His adult learning in a social context not only addressed the military culture but also built the foundation for a variation of learning theory that has become known as Learning Process Theory (Jarvis, 1987).

Jarvis suggested, "All learning begins with experience" (1987, p. 16). In Learning Process Theory, real learning begins when a response is required in relation to a particular experience. If an individual is left unchanged by a situation, Jarvis doubts whether real learning took place at all. He proposed that new experiences need experimentation, evaluation, reflection, and reasoning for effectual change and learning to occur. He argued that the highest form of learning occurs where change and increased experience have happened. Jarvis's framework offered a learning model that can help facilitators improve education and learning situations.

Both of these theories would provide an excellent analysis framework if this was a study that was able to track the performance of the participants over a longer period time. They might even provide the lens through which to examine a series of studies aimed at attaining the ultimate goal of a Fully Integrated Virtual Healthcare Environment (FivHe). Accordingly, they serve in part, to inform the analysis of the demographics data collected by this study.

Adult Learning in the Context of a "Culture of Professionals"

Lave and Wenger (1991) and Wenger, et al. (2002) suggested that learning and practice cannot be separated when professionals work in "communities of practices"

(COP). A COP is a group of people who share in practice and engage in collective learning that creates bonds between them. It is defined by three key characteristics:

1. Domain—people with a shared domain of interest.
2. Community—people who engage in joint activities.
3. Practice—people with a shared repertoire of experiences, tools, and stories.

For example, (Parboosingh, 2002) used COP to describe a program of research planned to assess physician learning. He concluded that interactive communications technology-enhanced learning COP was the wave of the future.

Communities of Practice could play an important role in better understanding the healthcare provider environment within the Fully Integrated Virtual Healthcare Environment (FivHe)—particularly with regard to the training environment—the core of this research study.

Adult Learning and Social Networking

As social networking through technology started to take hold, researchers and practitioners soon followed. Toward the end of the 1990s, a theory emerged that also took into account the impact of information technology on learning, namely the Media Richness Theory (MRT). The two main assumptions of MRT are: (1) people want to overcome uncertainty in communication; and (2) some media commonly used in organizations works better for certain tasks than others. Trevino, Daft, and Lengel created a media richness hierarchy, arranged from high to low degrees of richness, to demonstrate the capacity of media to process ambiguous communication in organizations. The criteria are as follows (Trevino, 1987):

1. Ability to provide instant feedback.
2. Capacity of the medium to transmit multiple cues such as body language, voice tone, and inflection.
3. Face-to-face communication is the richest communication medium in the hierarchy followed by telephone, electronic mail, letter, note, memo, special report, and finally, flier and bulletin.
4. From a strategic perspective, this suggests that effective managers make rational choices matching a particular communication medium to a specific objective and to the degree of richness required to meet that objective.

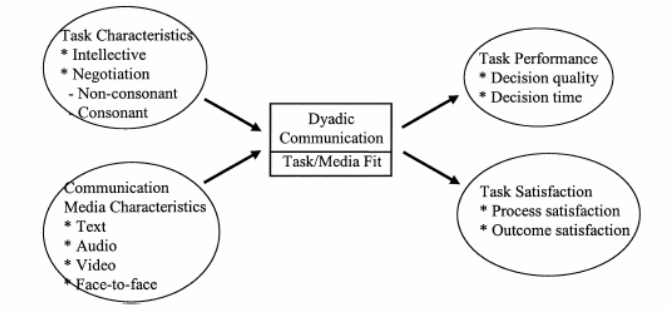

Figure 15 Media Richness Model (Suh 1999)

For example, MRT was rationalized by Gilman and Turner (2001) as appropriate for healthcare training application. They argued that healthcare organizations that think of education narrowly are less likely to meet the training objectives than ones that create custom training environments utilizing various media.

Another social networking model gaining notoriety, “Connectivism” (Siemens, 2005) posits that learning is a network creation process, rather than in artificial organizations and presentations of information, such as curriculum or coursework. The Connectivist view significantly changes how learning is designed and developed within adult learning environments. Learning is seen under the control of the learner and is a messy, nebulous, informal, chaotic process. Connectivism promotes a networking

model or learning that places less emphasis on presenting material and more emphasis on building the learner's ability to navigate the material.

The Connectivist view holds to nine principles (Pettenati, 2007):

1. Learning requires a diversity of opinions and permission to select the best approach.
2. Learning is a network development process, which connects information sources as nodes.
3. Knowledge resides in networks.
4. Knowledge resides in certain technologies, and learning is facilitated by this technology.
5. The capacity to learn more is more critical than what has been previously learned.
6. Learning and knowing are on-going processes and not end products.
7. The ability to recognize patterns in information, see connections within areas of knowledge, and make sense of ideas and concepts are the critical skills for adult learners today.
8. Currency is king in all learning.
9. Making decisions is learning. The choice of what to learn and deciphering incoming information is a moving target. If an answer is right today, it may be wrong tomorrow because new information may affect the decision.

Both of these theories and methodologies address different aspects of adult learning and social interaction via technology. However, these theories cannot only inform this thesis study but should provide a basis for analyzing the spectrum of

research to be accomplished in both the provider and patient environments. Connectivism may be useful in analyzing the patient environment while Media Richness Theory might apply equally to both the provider and patient environments.

Adult Learning and WCHT Development

The Blended Learning Methodology, supported by the leading research results of the "Next Generation of Corporate Learning" element of the Thompson Job Impact Study (2002), was a major influence in the Steptoe development of WCHT (Steptoe, 2010b). The primary research goals of the Thompson Job Impact Study were to determine if there were significant accuracy and time performance differences on real-world tasks among learners who received a blended learning solution, e-Learning alone or no training. This study was based on current instructional design, learning style, training evaluation research, and the theoretical significance of each construct (Thompson, 2002).

An approach by Rogers and Freiberg (1994) and Knowles (1968) not only added to the recent evolutionary thinking with respect to adult learning, it also played a central role in the basis and evaluation of the WCHT system (Tarr, 2011).

Humanist Learning Theory holds that learning is a self-directed activity to fulfill one's own potential. This theory promotes self-actualization and sees the teacher as a facilitator to the learning experience. It focuses on human freedom, dignity, and potential. A central assumption is that people act from their intents and values—in contrast to the behaviorist notion of operant conditioning, which argues that behavior is the result of the application of consequences or the cognitive view that the discovering knowledge and constructing meaning are central to learning (Knowles, 1968).

The humanist perspective (also known as Theory of Andragogy) purports that it is necessary to study the whole person, especially as an individual grows and develops during their life. The self-understanding, motivation, and goals are important to this philosophy. Learning is student-centered and personalized, and the educator's role is that of a facilitator.[9] Affective and cognitive needs are critical, and the goal in adult humanist learning is to develop self-actualized people in a cooperative, supportive environment (Knowles, 1968). This fits the highly trained and educated healthcare participants in this study.

Robert Gagne pioneered his ideas while training pilots in World War II with the Army Air Corps. He suggested that organizing learning tasks for intellectual skill development in a hierarchy according to complexity, thereby providing a basis for the sequencing of instruction. Below are Gagne's nine instructional events used to evaluate the WHCT system (Gagne, 1985):

1. Gain attention.
2. Inform learners of the objective.
3. Stimulate recall of prior learning.
4. Present the new information.
5. Provide learning guidance.
6. Elicit performance.
7. Provide feedback.
8. Assess performance.
9. Enhance retention and transfer.

[9] Sometimes referred to as "learner-constructed contracts." (Knowles, 1968)

WCHT Methodology

This research effort did not focus on building the WCHT system. However, understanding the logic behind its construct and implementation is fundamental to comprehending its effect on the outcome this study with respect to the ISSM Quality of Information success variable.

WCHT was designed to be an adult learning platform among highly educated and trained professionals. It was assessed by an independent evaluator predicated on two major learning theories, conditions of learning (Gagne) and adult learning theory (Knowles) (Tarr, 2011).

Malcolm Knowles was previously cited regarding his work with the humanist perspective on learning. His characteristics of adult learners were incorporated into the WCHT evaluation as follows (Knowles, 1998):

- Adults are autonomous and self-directed. They need to be free to direct themselves. Facilitators must actively involve adult participants in the learning process and serve as facilitators for them by getting participants' perspectives about what topics to cover and let them work on projects that reflect their interests.
- Adults have accumulated a foundation of life experiences and they need to connect learning to this knowledge/experience base. To help them, facilitators should draw out participants' experience and knowledge, which is relevant to the topic.
- Adults are goal-oriented; they usually know what goal they want to attain and are scrutinizing the course and content through this lens. Facilitators must

show, early in the course, participants how this class will help them attain their goals.

- Adults are relevancy-oriented. They must see a reason for learning something. Learning has to be applicable to their work or other responsibilities to be of value to them. Address this need by letting participants choose projects or activities that reflect their own interests.
- Adults are practical, focusing on the aspects of a lesson most useful to them in their work. They may not be interested in knowledge for its own sake, so facilitators must tell participants explicitly how the lesson will be useful to them on the job.
- Adults need to be shown respect; acknowledging the wealth of experiences that adult participants bring to the classroom and treating them as equals in experience and knowledge results in enjoyable and effective experience for everyone.

In essence, Gagne's work provided the analysis framework and Knowles contributed the qualitative assessment values for WCHT.

The evaluation team assessed that not all of Gagne's nine instructional events would play equally with this particular group of participants and settings (Tarr, 2011). They highlighted four that would play major roles in the motivation, reinforcement, retention, and transference of learning as they pertained to culture and healthcare provider attitudes. The four were: stimulate recall, present new information, elicit performance, and provide feedback. This process validated the WCHT learning

objectives, refined specific training events, and adjusted content, delivery techniques, and sequence.

Military Culture

There have been many studies dealing with military education, training, and learning. Schein suggested that, in general, adults and organizations fail at transformational learning more often than not. That is, they rarely change their fundamental behaviors. He promoted the idea that learning is fun, particularly for adults. He described learning with adults and in organizations in a similar way to that of the brainwashing he observed while studying prisoners of war of the Korean conflict (Schein, 1990).

Many factors can influence the response to treatment of patients afflicted with PTSD or TBI. These factors include age, gender, environment, and culture. Historically the consideration of effects of culture, an important variable, has been absent in research and training regarding the treatment and consequences of debilitating mental and behavioral health conditions. With a wide field of cultural subgroups and individual variations, culture is considered by many to shape the construct of health as much as heredity. Culture accounts for the many variations in how people experience, comprehend, and communicate their symptoms, particularly when related to mental and behavioral health illness or disease. In addition, culture helps to define what an individual constitutes as a disability, the assumptions of illness, appropriate treatment, as well as the overall value given to the healthcare system (Bonder, 2002).

Research by Jarvis (1987) found that most people have multiple cultural identities. He found that this is strongly evident among military and veteran personnel,

who may experience numerous distinct cultures: military culture (branch of service, rank, Active versus Reservist/National Guard); military sub populations (Marines, Rangers, Navy Seals, etc.); age, gender, socio-economic status, spiritual orientation, etc. (Jarvis, 1987).

Healthcare Implications and Learning

Medical schools and the medical community in general have been slow to adopt the concept of using lectures on video and other social media for educational and training value. However, at the urging of institutions like Case Western, such technology acceptance is catching on (Carr, 2013).

An early example of Internet-based healthcare provider training was the Philippine Medical Association who developed a Web-based continuing medical education (CME) program (BusinessWorld, 1998). A similar system at Newfoundland's Telemedicine Center was evaluated in scholarly literature as setting benchmarks in medical training (Curran et al., 2000).

Seibert, Guthrie, and Adamo (2004) demonstrated telemedicine training in the nursing field with the use of standardized patients. A standardized patient (also known as a sample or simulated patient or patient instructor) is an individual who is trained to act like a real patient to simulate a set of symptoms or problems. The Seibert et al. study examined the relationship of technology-based learning strategies and the improvement of learning outcomes and competencies. Results showed that the use of standardized patients and telemedicine, compared to a traditional distance learning teaching technique, significantly improved outcomes. The authors showed that there

was also a significant increase in motivation and an interesting decrease in student satisfaction that may be linked to the anxiety of performance-based learning.

Rafiq and Merrell (2005) recognized that continuing medical training is now more feasible with synchronous or asynchronous access to learning content. However, they asserted the challenge in the implementation of telemedicine training tools will be the development of a best practice that integrates appropriate standards of care and regulatory mechanisms.

Shershneva and Olson (2005) contended that a lack of quality standards in telemedicine is a major issue. They found that none of the available sets of standards available addressed all of the relevant issues to telemedicine education. Also, there are important issues of telemedicine that were not addressed at all, such as patient confidentiality. While available standards provide frameworks for quality distance education at a high level, there is no guidance for local-level implementation. They concluded that quality standards for telemedicine will require a systematic approach and continuous improvement.

Luanrattana et al. (2012) found that the culture of healthcare training was ripe for sharing lessons learned and perspectives with technology to facilitate such learning. They claimed that while the possibilities were evident, there was a lack of strategies to implement and evaluate the effectiveness of the integration of mobile devices and healthcare training.

Merriam et al. (2007) established that learning takes place within specific contexts, environments, and within organizations or individuals—within time frames and for specific reasons. For example, Media Richness Theory was rationalized by Gilman

and Turner (2001) as appropriate for healthcare training application—giving credibility to its use in related subsequent studies. They argued that healthcare organizations that think of education narrowly are less likely to meet the training objectives than ones that create custom training environments utilizing various media.

Information Sharing

Social networking and telemedicine provide both the context and applied environment for this thesis study — understanding whether ad hoc networking technology can or should be a factor in developing the fully integrated virtual environment for healthcare delivery. Social networking constitutes the functionality required; telemedicine the means to deliver that functionality.

Social networking and telemedicine are well researched areas.[10] The Institute of Medicine argued that the fully integrated virtual environment for healthcare delivery is closer by far, still not a reality today, and is badly needed (Institute, 2001; Institute of Medicine, 2013). The discussion of this final area of literature review will fill out the landscape of the major factors informing this study—and set the stage for the follow-on research efforts needed to create the desired fully functional virtual fabric for healthcare.

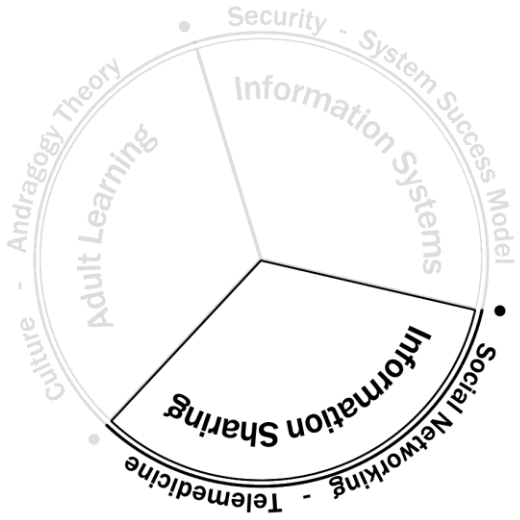

Figure 16 Information Sharing

[10] *Medline* lists over 10,000 citations of published works related to telemedicine.

Social Networking

Social networking services are information and communication technologies that focus on facilitating or building social relationships among people. These services are typically Web-centric and based on shared interests or mutual relationships (Borgatti, 2009). This describes the manner in which information sharing occurs during the learning exercises undertaken in this thesis research.

In deference to the explosion of research interest in social networking (Borgatti, 2009), there appear to be gaps in the areas that most closely relate to this thesis study. The following search combinations returned no relevant literature:[11]

- *social networking/social networks/social media/health provider training*
- *social networking/social networks/social media/veterans*
- *social networking/social networks/social media/PTSD*
- *social networking/social networks/TBI*

Fessler and Gremy (2001) maintain that technology sets relationships between human beings and their environment, both physical and human. Therefore, no technology can be seen as merely instrumental. There are two constructs that build on one another and provide a lens to help better understand this research.

Social Capital is “the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition—or in other words, to membership in a group”

[11] The Syracuse Library tool “Summons,” was used to search every database to which the library has access. An analysis of the few entries found using these search combinations revealed nothing related to the context or the specific research themes of this thesis study. Parsing the combinations more narrowly did produce different results. For example, "social networking and PTSD" returned articles related to the care delivery for PTSD patients. However, none of the more encompassing queries aligned with the full context of this study. First query performed: February 5, 2013. Subsequent query: December 17, 2013. Both searches produced the same results.

(Bourdieu, 1986). According Harvard political science professor Robert D. Putman, the essential concept of Social Capital is the strength of a community's ability to reflect and collaborate (Putnam, 2001).

Social Capital has important aspects in terms of adult learning. Kilpatrick et al. (2010) found that social capital to be a useful theoretical lens for analyzing lifelong adult learning and how communities develop. They proposed three sequential elements for how this occurs:

1. Social capital measures the way in which people are treated, encouraged, communicated with, and valued in a learning environment;
2. Social capital uncovers shared values and norms of a learning community, particularly how much they value differences and diversity; and
3. Social capital illuminates the capacity for change within the learning community.

Similarly, Social Construction of Technology (SCOT) theorizes that human action shapes technology, as opposed to the other way around. How a technology is used cannot be understood fully without first uncovering how a technology is embedded in a social context. Beyond the social context, there are two other main principles in SCOT: interpretative flexibility and a closure mechanism (Bijker et al., 1987; Pinch, 1984).

Interpretative flexibility means that each type of technology means something different to different groups of people. These groups can be users or producers of technology and can vary across socioeconomics and other demographics. Since there are many different meanings of technology across these groups, there are many ways

to construct technology. This may result in conflict over use and design. SCOT attempts to understand these relationships, meanings, and conflicts (Bijker et al., 1987).

After a technology is developed, the flexibility in its design and interpretative meaning begins to diminish. This is known as closure. Once users see their needs being met by the technology, the need for alternative solutions goes away. This lasts until a new problem arises (Bijker et al., 1987). These thoughts should inform not only the findings of this research study, but also the follow-on adaptations potentially needed by GridstreamRx or any other technology needed to ultimately create a Fully Integrated Virtual Healthcare Environment (FivHe).

There are documented best practices based on the Social Capital construct. Burgess (2009) identified several best practices for educators using social networking as an instruction tool to promote social capital among women adult learners. These included:

- Creating LinkedIn, Facebook, or Twitter profiles for student interactions.
- Defining the online community early in the course of instruction.
- Constructing a “class network.”
- Blogging by the instructor to supplement course activity.
- Leveraging the course network as a foundation for a future professional network among the learners.

Telemedicine[12]

Telemedicine was first used at the University of Nebraska in Omaha in 1959. A two-way, closed-circuit television was used to transfer data across campus of neurological examinations. In 1962, the University used telemedicine to connect the Nebraska Psychiatric Institute with the Norfolk State Hospital (Maheu, 2001). Its beginnings as a closed system, designed for the purpose transmitting diagnostic data, created a paradigm that proved limiting in the early years of its use. But over time, its functionality was examined through four lenses: cost, access, education, and improved care (Eysenbach, 2000).

Sisk and Sanders (1998) found that many institutions looked at telemedicine in purely economic terms—as a replacement for in-person healthcare. They compared the costs and consequences of delivering health services through telemedicine to traditional means. They addressed the question: are the expected health benefits of telemedicine worth the investment? However, they found, as did Rojas and Gagnon (2008) a decade later, that like much of the healthcare sector and its lack of standards, they could not determine cost centers and associated charges.

In the 1970s, telemedicine began to be used extensively to provide healthcare services in rural areas that did not have local physicians. Central clinics would staff rural satellites with non-physician medical staff. They could use telemedicine to provide ambulatory services and reduce the need for a physical referral (Dhillon, 1978). Almost

[12] Health Information Technology (HIT). Also known as Health Information Systems or Hospital Information Systems (HIS), HIT is the umbrella under which the comprehensive management of health information across computer systems takes place and encompasses telemedicine. HIT is also concerned with the secure exchange of health information among patients, providers, government entities, and insurers (Chaudhry et al., 2006).

twenty years later, Girard (2007) described the role telemedicine plays within the VA by allowing the care of patients isolated by geography, poverty, and disability. He found the limited availability of telemedicine systems to be insufficient to meet the needs of thousands of active-duty military, dependents, and veterans who experience the challenges of TBI in daily life.

The early 2000s saw concerted efforts to use telemedicine as a means for continuing health information and education. Efforts of Curran et al. (2000) and Bangert et al. (2001) started to leverage the power of the rapidly expanding World-Wide Web. Today, there are entire organizations, such as the American Telemedicine Association (ATA, 2009), with learning centers dedicated to promoting telemedicine as an education and information sharing platform, in addition to its assumed function of care delivery.

Since the turn of the 21st Century, the public acceptance of social networking and e-health has transformed healthcare delivery into a patient-centric mindset where the public is not only an active participant in their own healthcare, but also a consumer of healthcare services. Today patients take advantage of online processes, patient portals, and physician Web pages (Ball, 2001). New types of data and healthcare technologies have emerged—everything from patient DNA data to medical charts on tablets (Kulikowski, 2002).

In a recently completed study in Barcelona, physicians successfully treated 200 HIV patients using an online healthcare delivery system over a period of five years. The published results reported that virtual care, including a virtual pharmacy and community forums, is as effective as in-patient hospital healthcare (Leon, 2011). The study adds credence to the idea that an increased reliance of virtual health services may not only

result in cheaper medical costs, but perhaps in better quality of medical care in the very near future.

Experts in the field now foresee applications and techniques where telemedicine would bring just-in-time mobile education and training. The scenario is of a student on a clinical internship, or healthcare provider in a remote location faced with a specific challenge that is new to them. In a matter of a few moments, they are able to access expertise, whether coming from another professional or a stored bank of videos, in order to deal with the challenge at hand (Carr, 2013).

Reichertz and Haux (2006) took a twenty-year look at medical information systems and concluded:

> Future hospital information systems will have to concentrate more and more on the quality of medicine. Systems will increase in the area of patient management, but also of direct problem management.... The development of hospital information systems therefore should be considered to be 'social engineering' as well as the pursuit of scientific objectives in medicine for the increase of quality of medical care. This requires comprehensive research and the cooperation of clinical medicine, medical informatics, industry and administration. The development certainly is still quite at the beginning, not yet approaching its end of possibilities. However, because it is social engineering in changing systems ecology, it is a field which deserves careful attention and concern of all involved in order to create a useful future. (p. 298)

Clinician Acceptance

Landman et al. (2010) studied and found that 64% of surgical residents and 22% of faculty at a teaching hospital had Facebook pages. Their purpose was not to survey social networking usage but rather offer a set of guidelines of professionalism in regard to using social networking websites. Glickman et al. (2012) conducted a similar study for research bias reasons and found the use of social networking sites within the medical community, particularly the younger physicians to be on the rise.

InformationWeek conducts an annual survey of doctors as a part of their annual Healthcare IT priorities issue (McGee, 2012).[13]

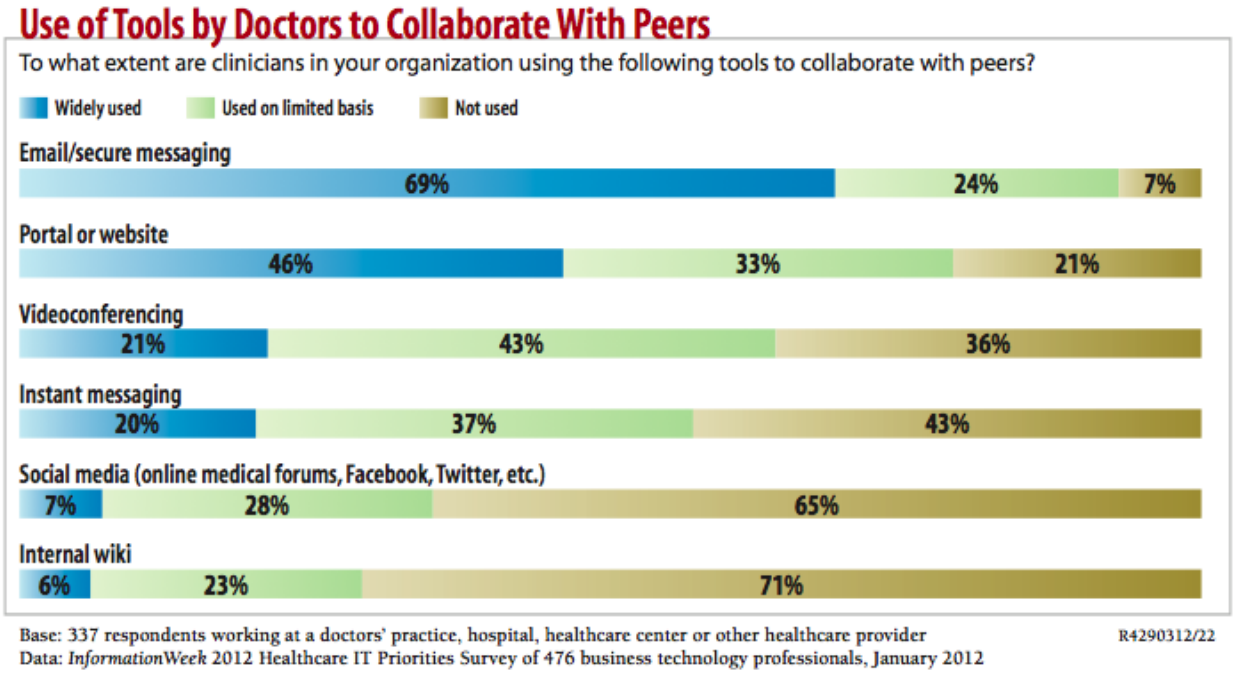

Figure 17 Doctor-to-Doctor Virtual Collaboration

Two key observations regarding this survey are noteworthy. First, it collected data from a large sample size of the population across the U.S. A shortcoming of much clinical research, particularly "pilot and beta efforts" is that they are often limited by the small number of participants in each study. For instance, 25 years ago, a review found that 71 negative studies published in respected medical journals prematurely condemned potentially valuable treatments due to the small sample size of the associated study populations. A follow-up Journal of American Medical Association

[13] The 2013 priorities list (Hoffman, 2013) largely dealt with other IT issues such as EMR/EHR security and the Affordable Care Act in lieu of doctor preferences and other IT priorities. The only collaborative tool category to reflect statistical change in the 2013 study was a 10% increase use of instant messaging.

review six years later validated this finding by reviewing all of the 383 randomized control trials in four different years (Cerrato, 2013).

Second, this reflects the willingness of doctors to use Information Communications Technology (ICT) to collaborate in today's healthcare environment. Comparing this level of acceptance to that found in this study will inform its results—at least partially. It should be noted that the survey documents doctor-to-doctor virtual collaboration, while this study focuses on a healthcare team's (composed of a cross-section professionals) willingness to use ICT to virtually collaborate.

The same national survey should also give added insight into the receptivity of doctors to use ICT in their current willingness to use in collaborating with patients (McGee, 2012). Of note, is the extent to which doctors use these tools is roughly one half of what they are willing to do with colleagues.

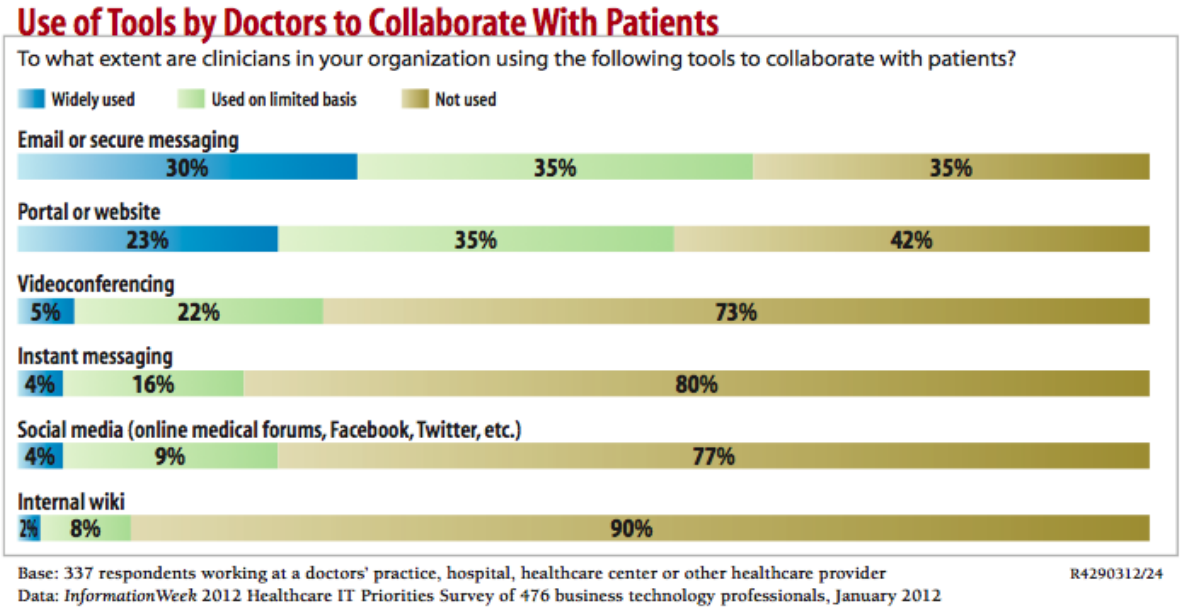

Figure 18 Doctor-to-Patient Collaboration

Military Acceptance

In 1985, the VA started using the Decentralized Hospital Computer Program (DHCP), called VistA today, which represented the U.S. Government's successful attempt to introduce an Hospital Information Systems (HIS) on a national scale and included telemedicine projects (Brown, 2003). In 1988, the Composite Health Care System's (CHCS) HIS was activated for all military healthcare facilities and is still today used by the DoD (Beyster, 2007).

Morland et al. (2004) conducted a pilot study of telemedicine and veterans suffering with PTSD to compare the telemedicine and face-to-face groups, levels of attrition, patient satisfaction, clinician satisfaction, and patient retention of information. The authors concluded that videoconferencing is just as effective as face-to-face and is feasible for use in providing coping skills groups for veteran PTSD patients who reside in remote locations. This finding indicates encouraging results in potential follow-on studies to this one dealing with the FivHe Patient Environment.

In a partnership with the U.S. Air Force, HealthCare Resolution Services, Inc. (HCRS) provided medical records coding, auditing, and training services at 17 Air Force treatment facilities. The real success in this program was the information that it provided to the healthcare providers and staff. This study used its findings as the basis of a new training program for medical providers (Brosowsky, 2006).

The U.S. Army Telemedicine and Advanced Technology Research Center (TATRC) has conducted multiple studies during the past decade (Lam, 2004; Lam, 2006a; Lam, 2007; Lam, 2005; Lam, 2006b). They reported being encouraged by the rapid development of technology that cannot only be used in the battlefield but to

connect to the battlefield to provide early and continuous care to medical staging areas that provide higher levels of care (Romano, 2006).

Sayer et al. (2009*)* conducted interviews with 40 healthcare providers from across the United States who provided specialized TBI or PTSD services to veterans returning from Iraq or Afghanistan. Their study identified the challenges providers are facing in engaging patients with co-occurring TBI and PTSD, determining presenting problems, coordinating services, and modifying standard treatment protocols when necessary. Patients with TBI and PTSD also have other conditions, such as sleeping problems and chronic pain that require specialized treatment. One of the study's more important findings was the need for provider training tailored to patients and their family's needs. Importantly, the study revealed that a systematic approach toward patient and provider education is needed.

The award-winning Defense Centers of Excellence (DCoE) for Psychological Health and Traumatic Brain Injury uses social media platforms, like Facebook, YouTube, and Twitter support service members and their families by providing information on issues related to their psychological health, particularly TBI. DCoE social media also delivers new and effective resources for healthcare providers who work closely with wounded warriors (Hasty, 2011).

Possemato et al. (2011) demonstrated the ability of the Internet to initiate combat veterans in PTSD treatment by offering an online psychological intervention. Thirty-one participants used secure, website sessions to write about their thoughts and emotions regarding one traumatic combat experience. The intervention was found to be feasible and safe. Half of the participants reported symptom reductions.

Project VALOR (Veterans' After-discharge Longitudinal Registry) is a longitudinal patient registry assessing combat-related PTSD among veterans who served in Operation Enduring Freedom or Iraqi Freedom. The registry includes 1,200 veterans with a recent diagnosis of PTSD according to VA EMRs and will also include a comparison group of 400 veterans without a medical record-based PTSD diagnosis to also allow for treatment-control analyses. VALOR includes data collected from databases, EMRs, a self-administered questionnaire, and a semi-structured telephone interview. Project VALOR is a unique and timely registry study that will progress the clinical work PTSD and the health outcomes of carefully selected returning OEF/OIF Veterans (Rosen, 2012).

More recently, Turner et al. (2012) introduced a pilot test of neuropsychological evaluation and feedback via clinical videoconferencing for veterans who lived at least 115 miles from the regional VA health center. Of the fifteen veterans evaluated, eight chose telemedicine over face-to-face. No significant clinical difficulties were encountered, and participants reported high satisfaction with “telemental care.” Interestingly in following up, all 15 veterans requested feedback via telemedicine instead of coming into the center for in-person feedback.

CHAPTER III. METHODOLOGY

The previous chapter presented a literature review that established a theoretical lens and analysis framework for information systems in order to accomplish this doctoral research study. Relevant literature from adult learning and the functionality of information sharing was included as it relates to this applied context—that of the military telemedicine environment. This chapter provides the methodology that was used in the thesis to gather and analyze data to address the research question presented in Chapter I.

Framing the Study

The primary goal of this thesis is to investigate the potential for a platform agnostic (ad hoc) networking technology to serve as a trusted social networking and training platform for healthcare providers who are learning to more fully address the needs of military personnel and veterans suffering from PTSD and TBI. The study will use proven techniques to collect data at various points in time during a nine-month training program (WCHT) at two large military medical centers. The illustrative technology that the respondents will use is GridstreamRx, a trademarked ad hoc

networking application of the Wireless Grids Corporation shared with Syracuse University and other National Science Foundation Partnerships for Innovation WiGiT partners, designed to provide “Workspace as a Service” for the medical sector during a portion of their training [Chapter I, p. 1].

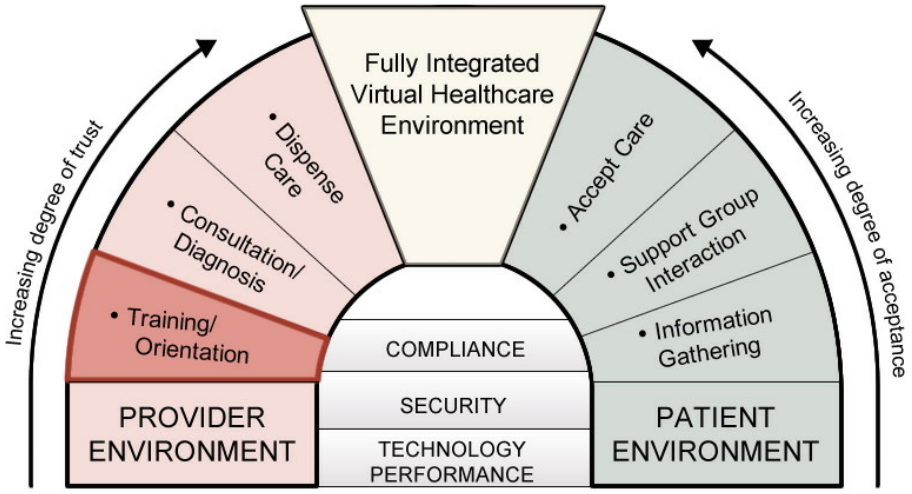

Figure 19 Framing the Study within the FivHe

This study is intended to propose, test, and validate an entry point for inserting technology as a critical element for creating a Fully Integrated Virtual Healthcare Environment (FivHe). Not only does the training experience pose the fewest obstacles to technology innovation as previously outlined, but it also forms the trust basis for healthcare providers to perhaps subsequently use the same technology, processes, and procedures for other medical requirements such as consultation and diagnosis and dispensing care [Chapter I, pp. 3-6].

The literature review presented in Chapter II made the case for using a frequently cited analytic construct, the Information System Success Model (ISSM), as the theoretical lens for this study (Agourram, 2009). The ISSM describes the relationships among six success variable categories based on a review of published research over a six-year period of time (DeLone, 1992), subsequently updated by ten years of research

and testing of the original model (DeLone, 2003), and modified by assessments of researchers using the concept (Khayun et al., 2012; Wang, 2007).

Bias

The data gathering and analysis method of this study addresses bias in five aspects: the researcher, Steptoe Group's WCHT system, survey instruments, research design, and participants.

Researcher Bias. The researcher is a retired military officer with over three decades of leading technology-based organizations in both the private and public sectors. The researcher will access anonymized study data through the Steptoe Group and will not have direct contact with any of the participants taking part in the training—nor the facilitators organizing the sessions. This will not only contribute to protecting the respondents' identity and privacy but should factor out the researcher's propensity to rely on technology to solve human needs and challenges.

Information Bias. In developing the WCHT system, the Steptoe Group hired an independent, non-profit organization that specializes in applied scientific research and development to conduct an impartial, in-depth assessment of the WCHT system.[14] This evaluation validated the Steptoe Group training methods, delivery, and their approach to certifying the effectiveness of the sessions [Chapter II, pp. 40-44].

Survey Bias. The Steptoe Group employed a specialized evaluation contractor to gather and assess the data—adding to veracity and credibility to their product of improving the knowledge of healthcare professionals.[15] The portions of the survey

[14] www.ctc.com

[15] http://www.jeassociates.com/

instruments with regard to the GridstreamRx sessions went through additional vetting that not only included the Steptoe Group contractor, but also an adult learning expert, a training subject matter expert, and the Syracuse University WiGiT personnel [p. 71].

Research Design Bias. The research design addressed bias in three ways. First, the project established a baseline at each of two different military medical centers—reducing the potential bias of only using a single site—and then judging how representative those taking the WCHT sessions were of a larger population. Second, the researcher used the focus group at each site as a secondary data source. Their reactions to the possibility of using technology to augment their training experience would not only add insight to the tally of the survey instruments, but might also serve as an objective input. Third, the participant experience with GridstreamRx came from both medical centers—again reducing the potential bias introduced by having a single research site.

Participant Bias. All of those who agreed to participate in the GridstreamRx sessions did so voluntarily. Therefore, all of the available data will be analyzed to determine if their participation in this part of the study was influenced in such a manner so as to affect the results.

Research Design

Today telemedicine largely applies to diagnostic and curative medicine in a closed system that is heavily dependent on costly Information and Communications Technology (ICT) infrastructure [Chapter II, p. 51]. Ad hoc networking technologies (such as GridstreamRx) are a way of opening up the availability and needed global exchange to create a Fully Integrated Virtual Healthcare Environment (FivHe)—

particularly for those individuals/institutions that do not have large ICT infrastructures [Chapter II, pp. 18-20].

Commercially-available social networking systems do not meet the required HIPAA security, privacy, and auditability standards for medical record sharing, dispensing care, or healthcare-specific, tailored functionality required by healthcare providers [Chapter II, pp. 18-20]. GridstreamRx could potentially provide that secure, trusted platform, specifically tailored to integrate the provider and patient environments into a Fully Integrated Virtual Healthcare Environment (FivHe).

This study examines, in part, GridstreamRx's ability to satisfy the functionality required within a portion of the healthcare provider environment. To fully address this area, the preliminary findings in this part of the study would need to subsequently be analyzed with those designed to prove GridstreamRx's performance with respect to security and compliance. Similar study linkages would also need to done to test GridstreamRx's sustainability over ad hoc network environments and deployability across various virtual platforms. Appendix K depicts the GridstreamRx technical architecture used for this study.

The starting point for the design of this research project centers on the element of introducing ad hoc networking to the telemedicine sector. Then, further focus was provided by looking at the provider training environment in order to minimize start-up obstacles and establish credibility before moving into other areas of a possible fully integrated virtual healthcare environment [Chapter I, pp. 3-6].

The research design also considered patient isolation and the culture associated with military related care are the big contributors to active duty and veteran suicides of

those who suffer from PTSD and TBI [Chapter I, p. 3]. The Steptoe Group's WCHT seeks to address the military culture and care techniques [Chapter I, pp. 7-8]; GridstreamRx is aimed at providing the networking platform to reduce patient isolation and supplement the delivery of healthcare services [Chapter I, pp. 8-9]. Together, these two efforts have the potential to progress toward next-generation telemedicine, or cybermedicine, or eHealth—or whatever name the healthcare industry decides to give this functional area.

This study is designed to gather data to assess:

- Use of a virtual environment to enhance the medical training environment—and the potential to extending that to other healthcare services and processes, and eventually extending care.
- Willingness of providers to use ICT as a training and information sharing platform.
- Specific level of acceptability of GridstreamRx to perform the required functions—and outlining possible criteria toward adjusting this platform or creating a family of functions or applications for use in telemedicine and healthcare.

In supporting this design, the Steptoe Group's delivery of the WCHT sessions to Sites A and B personnel provided the mechanism and participant interaction, which was the pacing factor for this research study. Their task was to improve the skills of the healthcare providers at two large military installations. GridstreamRx was used as an enabling ICT for a portion of the WCHT training process.

This aspect of the study's design was worked out over a series of sessions with the Steptoe Group, Syracuse University WiGiT personnel, and the Steptoe Group focal point for this project (Steptoe, 2012a; Campbell, 2012; Campbell, 2013a). The top-level view of the study's events and data collection points is depicted in Figure 20.

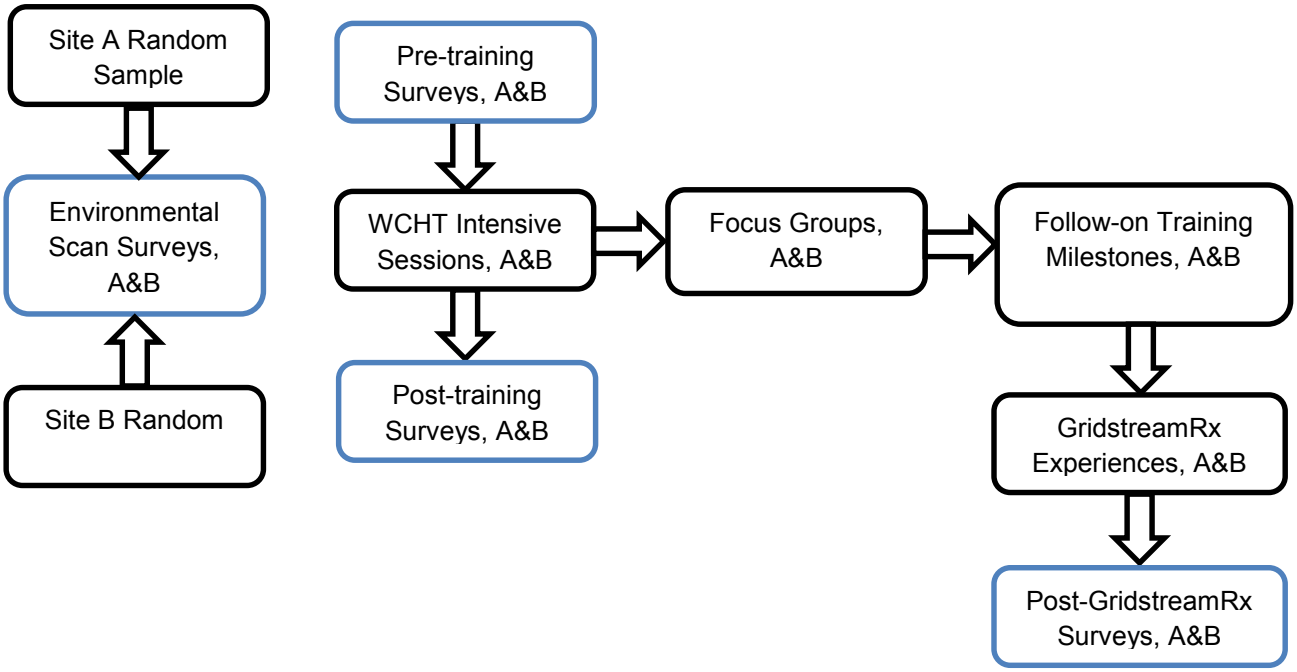

Figure 20 Research Design

Thesis Research Synchronization

Many in the Federal Government have recognized that inconsistent treatment of veterans and active duty personnel with PTSD and TBI is creating challenges for the U.S. Department of Defense (DoD), Veterans Administration (VA) and civilian healthcare systems (Commission, 2012). Further, much of the healthcare is delivered by providers that are not familiar with the military cultural aspects of the veteran patients (Tanielian, 2008).

To address this training deficiency, in May 2012 the Department of the Army's Telemedicine and Technology Research Center (TATRC)[16] awarded the Steptoe Group the 2012 AMEDD Advance Medical Technology Initiative (AAMTI) contract for training sessions at Site A and Site B. In August of 2012, the Army agreed to allow this study to take place with the researcher utilizing the contractor as the vehicle for accessing the data collected in conjunction with training the healthcare providers [Appendix A].

The original timeline for the project was from August 2012 through October 2013. However, U.S. Congressional budget sequestration actions that started in March 2013 and the Federal Government shutdown in the fall of 2013 stretched the project into January 2014 (Steptoe, 2013). The study's resultant calendar is outlined in Table 5.

Table 5 Thesis Timeline
(Campbell, 2013b)

Event	Site A	Site B
Environmental Scans	October-November 2012	March-April 2013
Intensive On-site Training	January 25, 2013	June 7, 2013
Focus Groups	March 15, 2013	July 24, 2013
3-month Training Sessions	April 2013	September 2013
6-month Training Sessions	July 2013	December 2013
9-month Training Sessions	October 2013	March 2014
GridstreamRx Sessions	December 2013	January 2014

Study Participants

"Owner" of the Need

The military's responsibility to provide healthcare to its service members, veterans, and their families make the institution accountable for creating a healthcare

[16] http://www.tatrc.org/initiatives.html

provider environment (Defense Task Force, 2010). In this instance, the Army's TATRC created the opportunity around which this research study took place.

In a broad sense, the Army is either the direct or indirect employer of all of those who gave and received the training. Thus, they set the conditions of employment, training environment, and terms of participation for all of the study's respondents.

Trainer and Facilitator

The Steptoe Group is a Service-Disabled, Veteran-Owned Business, located in Ellicott City, Maryland. Their objective is to create sustainable partnerships with government agencies and private organizations in order to improve access and delivery of quality health, science, and education services.[17]

In 2012, the Army awarded a contract to the Steptoe Group who had developed an interactive seminar designed to equip healthcare team members with the skills necessary for the standard and consistent application of culturally competent methodologies when treating military service members, veterans and their families. The methodology is known as the "Warrior Centric Healthcare Training (WCHT) ® System and Certification" with the moniker: "You Must Know Me to Treat Me™" (Steptoe, 2010b).

With concurrence of the U.S. Army, the Steptoe Group agreed to provide the data for this study without the associated identities of the participants and respondents who went through the WCHT process. The data, while not publically available, could then be used for the purposes of this study as long as the participants' anonymity is

[17] http://thesteptoegroup.com/

preserved [Appendix B]. Steptoe gave the researcher access not only to the data, but to their analysts and project manager during this study.

Technology Provider

The Wireless Grids Innovation Testbed (WiGiT)[18] launched in 2009 at the School of Information Studies at Syracuse University, sponsored in conjunction with the National Science Foundation Partnerships for Innovation WiGiT Project and with support from Virginia Tech. Over the past five years, WiGiT expanded to a virtual organization of over eighty university campuses, companies, and communities supporting research, innovation, and commercialization (McKnight, 2013c).[19]

The WiGiT has tested a number of wireless grids applications in multiple venues to include: emergency response, information technology enterprise management, the energy and entertainment industries, smart buildings, K-12 education, and government operations. However, it has not yet been fully deployed in adult training situations, medically related fields, and social networking settings (McKnight, 2012a).

In 2012, the Steptoe Group reached an agreement with WiGiT to collaborate on this research project (Steptoe, 2012c). WiGiT also agreed to cooperate with WiGiT partners and Wireless Grids Corporation (WGC) on the GridstreamRx user interface customization for the purposes of this study, while WGC provided the hardware that

[18] http://wigit.ischool.syr.edu/

[19] Including: Syracuse University, Virginia Tech, Tufts University, Museum of Science Boston, City College of New York/City University of New York, Rochester Institute of Technology, University at Albany College of Nanoscience Engineering, Illinois Institute of Technology, Wayne State University, Indiana University, University of Zululand, University of Aalborg, Syracuse City School District, Ballston Spa School District, BOCES Rockland County, Madison County Sheriff's Office, Syracuse City Police, Oneida Indian Nation, Seneca Nation of Indians, Organization for Economic Cooperation and Development, CAER, WGC, Sensyr, Summerhill Biomass Systems, MOD-Eco, SRC, Qualcomm, Critical Technologies, Govsphere, Equity Investment Services, Living Labs Foundation/TEDxHarlem, and Noviah Technologies.

hosted the study project. WiGiT's technically qualified graduate assistants helped administer the system for this effort (McKnight, 2012b).

Study Participants

There are four groups at two locations (eight total, with some degree of overlap), of healthcare providers that contributed data for this study.

The first group includes those respondents that took an "environmental scan" survey prior to any WCHT training sessions [Appendix G]. The Steptoe Group conducted these surveys at both of the sites as a part of their methodology. The purpose was to determine baseline levels of general culture awareness and competence at the two locations. While much of the data gathered during this process had little to do with the focus of this study, it did provide context and environmental factors such as demographics, educational level, etc. Respondents were selected on a random basis from the approximately 1,800 professionals at Site A and the 900 similarly classified personnel at Site B.

The second group of respondents to provide data for this study was the healthcare professionals that participated in the WCHT intensive session at each site. These were two randomly selected groups, one at each site, of healthcare providers representing a range of disciplines. Participants included a mix of physicians, nurses, psychologists, social workers, physical therapists, medical technicians, physician assistants, and others. There is no way of knowing if these contributors also participated in the environmental scans at each site, but this was not found to be a relevant factor to the analysis of the data gathered by this study.

The third group of respondents was those who participated in the WCHT sessions and subsequently volunteered to participate in a focus group at each site. The primary orientation of these two focus groups was to provide feedback on the WCHT sessions. However, both sessions, run by a trained facilitator, did provide input with respect to the use of technology and social networking, providing useful insight for the results of this study.

The fourth group of respondents was the subset of those who took the WCHT sessions and subsequently participated in sessions using GridstreamRx. These individuals volunteered to participate at the behest of the Steptoe Group [Appendix M] in training sessions using GridstreamRx as a social networking learning platform. These respondents are at the core of this study.

Protecting the Participants

Participation in the WCHT experience was accomplished through an already planned U.S. Army project as a part of their continuing healthcare training program. Participant consent was obtained through established internal Army procedures that are a condition of their employment—which eliminated the need for researcher participation or the insertion of any influence bias.

The Steptoe Group was contractually obligated to the Army to treat all participants in accordance with Federal Government statutes and Army regulations. Individuals had inspector general and chain of command recourse should anyone felt the need to complain or be excused from the WCHT regimen (Steptoe, 2012d).

Survey Instruments

The Steptoe Group developed a series of data gathering surveys as a part of their WCHT and subjected these instruments to independent subject matter experts for verification and validation [Chapter II, pp. 42-43]. To eliminate potential confusion of those going through the training and the GridstreamRx experience, the researcher de-conflicted possible duplication in the questions already being asked as a part of the WCHT methodology. This was done by including additional questions in the same pattern and format as those created by the Steptoe Group process, and incorporated the additional questions into the existing data collection mechanisms to the maximum degree possible.

The study's questions that were added to the WCHT data gathering instruments went through a vetting process that included the Steptoe Group independent validation contractor (Steptoe, 2012b), an adult learning expert (Thomas, 2012), a training subject matter expert (Montoya, 2012), and the Syracuse University WiGiT personnel (Nanno, 2012).

Most of the study's questions use a 5-level Likert scale format to provide the quantitative data needed to inform the various aspects of the DeLone and McLean Information System Success Model (ISSM) as modified by Khayun et al. [Chapter II, pp. 28-30] and adapted for the purposes of this study. Figure 21 shows the relationships among the data types that are gathered using the ISSM.

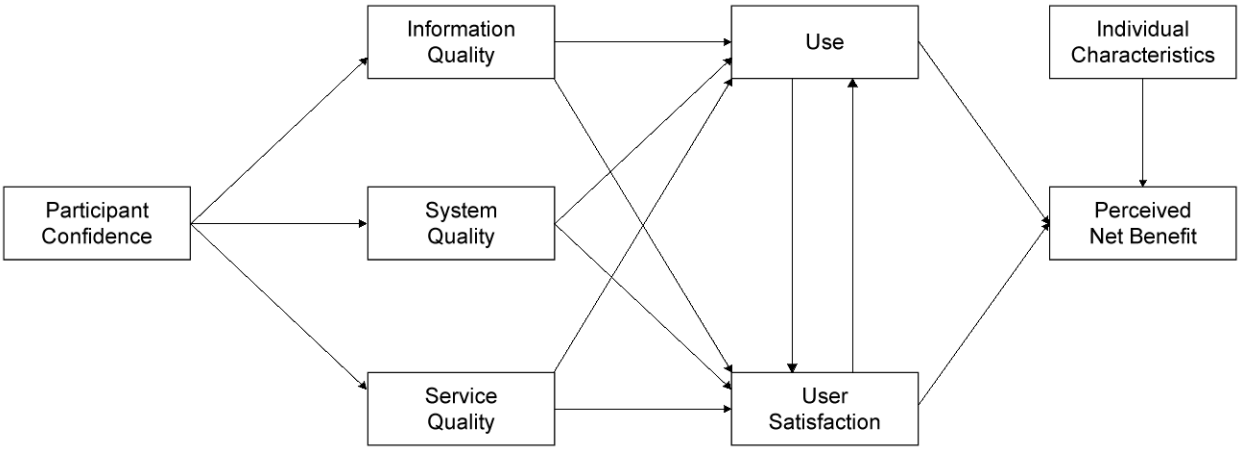

Figure 21 Modified ISSM
[Chapter II, p. 19]

Environmental Scans

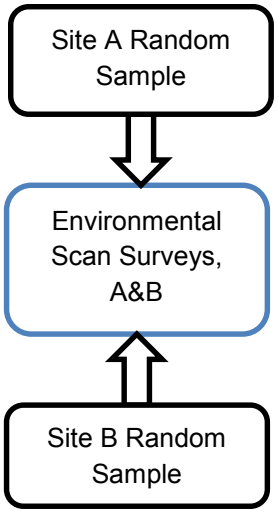

Figure 22 Environmental Scans

Prior to respondents beginning any training, the Steptoe Group's Environmental Scan survey [Appendix G] [20] of a representative sample of healthcare providers was conducted at both study sites in order to determine baseline levels of general cultural awareness and healthcare delivery competence. The data that is relevant to this study was gathered through the twelve demographic questions, which provide the quantitative context and demographics validation for the smaller sample size that goes through the WCHT sessions, and even smaller population that experiences GridstreamRx.

[20] Survey title: "Cultural Information Questionnaire." Twenty-two questions deal with each respondent's attitude toward military culture, ethnicity, and administering healthcare. Twelve questions deal with each respondent's demographics.

Pre-Training Surveys

When the participants at Site A and those from Site B gathered for their respective intensive WCHT sessions, they took a pre-training session survey [Appendix H][21]. This was largely a training level-one (participant reaction survey) exercise. Most of the survey questions posed used the Likert scale—providing quantitative data. It is this pattern that established the model for the additional questions that the researcher added throughout the WCHT data collection process.

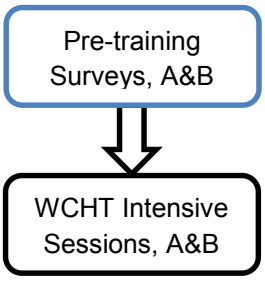

Figure 23 Pre-training Surveys

For the pre-training survey instrument, most of the questions related to the certification of the participants and their competency as a care provider. There are two relevant sets of data for this research from this questionnaire.

First, the demographic questions will provide quantitative context for the sample population for those who are a part of the GridstreamRx experience and provide the inputs for the Individual Characteristics. There were six demographics used for this analysis: age, gender, military affiliation, medical specialty, years of service, and parents in the military. Given the relatively small GridstreamRx sample size, medical specialties were consolidated into two groups: medical (doctor, nurse, etc.) and non-medical (administration, social worker, case worker, etc.).

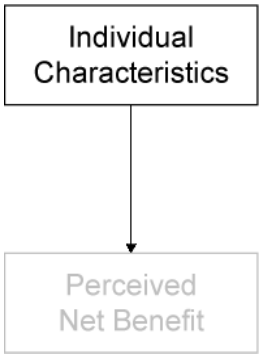

Figure 24 Individual Characteristics

[21] Survey title: "Culture and Treatment Pre-training Questionnaire." Twenty questions deal with culture and treatment issues, six deals with each respondent's demographics, and two with comfort level with routinely using ICT and social networking.

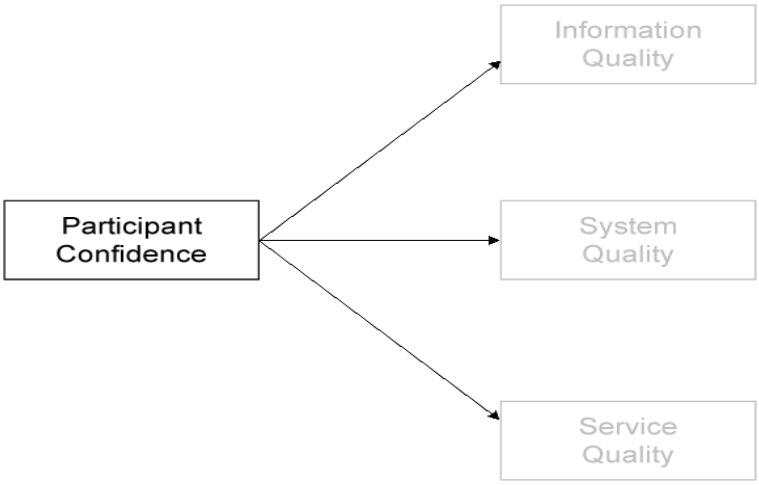

Figure 25 Participant Confidence

Second, the respondents answered 5-level Likert scale questions regarding their general level of comfort of routinely using ICT and social networking in their daily lives. This second set of data will inform the Participant Confidence portion of the ISSM.

Post-Training Surveys

At end of the intensive residency training sessions, each participant took a post-training survey instrument [Appendix I].[22] Like the pre-training questionnaire it is a training level-one (participant reaction survey) exercise. The first fifteen questions dealt with each respondent's attitude toward military culture, ethnicity, and administering healthcare—and were closely related to those administered during the pre-training questionnaire.

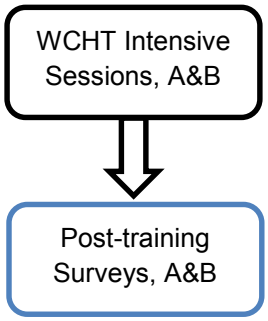

Figure 26 Post-training Surveys

[22] Survey title: "Culture and Treatment Post-training Questionnaire." Fifteen questions deal with culture and treatment issues, five deal with each respondent's perception of quality of training information, five with the training experience, and two with using ICT and social networking in the training environment.

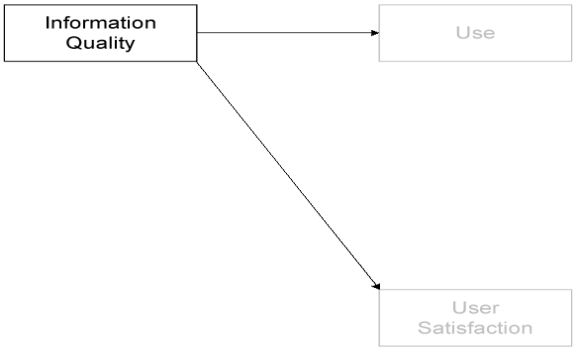

Figure 27 Information Quality Input to the ISSM

Five questions on this questionnaire will inform the Quality of Information parts in the ISSM. The five 5-level Likert scale questions measured how much the participants enjoyed the WCHT experience. The analysis will measure if there is a direct correlation between the participants' perception of the Information Quality and their willingness to use this newly gained knowledge in the future. This may in fact be one of few true indicators of the Quality of the Information—maybe even more than direct questions regarding the perceptions of information quality.

The post-training survey also included two 5-level Likert scale questions with respect to using ICT and social networking in a training environment, and will figure into the discussion with respect to next steps.

Focus Groups

About six weeks following each residency training session a focus group was held at both sites. This was intended to be exploratory in order to gain further insight into participant evaluation of the WCHT program and attitudes about the effectiveness of the training to that point in time. The facilitators gathered thematic notes to aid the interpretation of the open-ended questions on military culture and attitudes to help the team validate the training experience. Given the relatively small number of participants and the concentration during the sessions focused on WCHT feedback, this was deemed a secondary source of insight for this study.

GridstreamRx Surveys

After both sites completed their 6-month training milestones, the people that attended the WCHT sessions were offered the chance to experience GridstreamRx during a supervised training session [Appendices L and M]. Those volunteers subsequently had a GridstreamRx experience and took the thirteen-question survey [Appendix N], which will feed multiple portions of the ISSM. The first twelve questions are 5-level Likert scale queries producing quantitative answers that can be used in various parts of the ISSM. Survey questions numbered 6, 7, 8, 9, 12, and 13 pose open-ended qualitative opportunities for respondents to provide more insight into their answers, or to make suggestions about future implementations or applications.

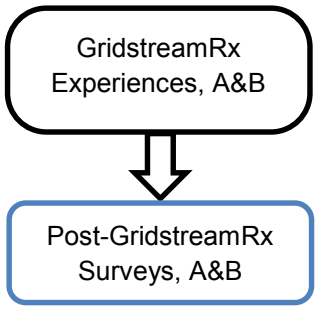

Figure 28 GridstreamRx Surveys

Question 9 will inform System Quality.

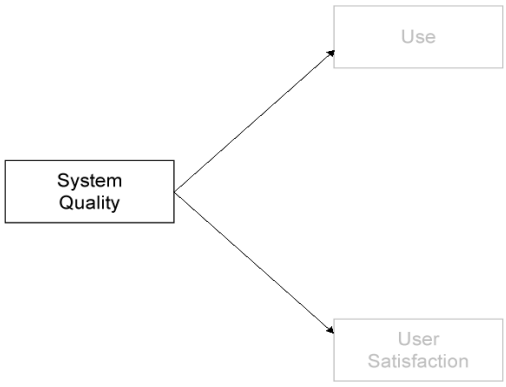

Figure 29 System Quality Input to the ISSM

Question 5 will provide the data for the Service Quality module of the ISSM.

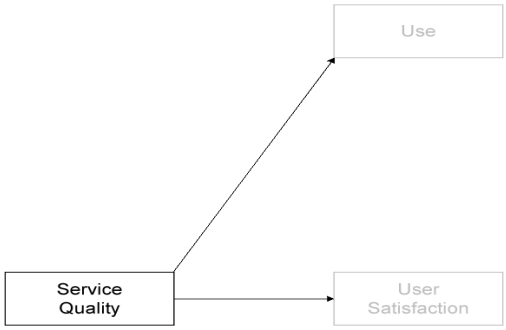

Figure 30 Service Quality Input to the ISSM

Questions 1 and 2 will address the respondents' perception of the analysis of Use and questions 3 and 4 will provide a similar input to the respondents' perception of User Satisfaction.

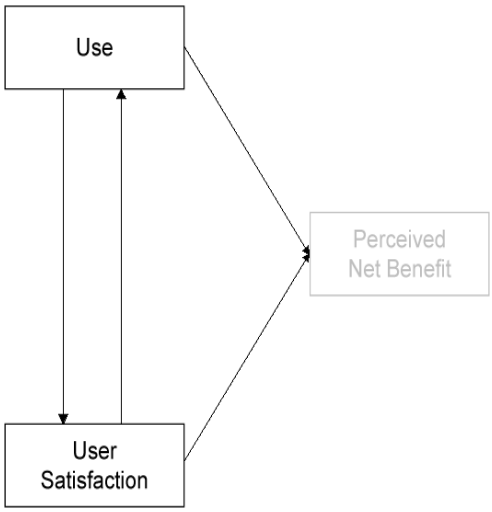

Figure 31 Use and User Satisfaction

Questions 6, 7, 8, and 10 not only potentially add clarity to the results within the IS Success Model, but were specifically designed to inform the next steps for follow-on research efforts and GridstreamRx development.

Data Collection

The basic data handling procedures were coordinated with the Steptoe Group survey subject matter expert on December 12, 2012. Specifically the process of the data collection and the removing of PII that would attribute the respondent answers to specific individuals were established. That meeting was followed with a more detailed

session on April 19, 2013 with regard to data coding of potential answers the open-ended survey questions and structure with the contractor's evaluation research consultant. This meeting also laid out the data collection plan [Table 6].

Table 6 Data Collection Plan (Campbell, 2013a)

Milestone Event	Date	Data Source	Instrument	Qualitative Element
Environmental Scan, both sites	Oct-Nov 2012 Mar-Apr 2013	Site A & B employees	Questionnaire	No
Post-training Site A	Jan 25, 2013	Participants	Questionnaire	No
Post-training Site B	Jun 7, 2013	Participants	Questionnaire	No
Focus group Site A	Mar 15, 2013	Participants	Interview	Yes
Focus group Site B	Jul 24, 2013	Participants	Interview	Yes
GridstreamRx experience Site A	Dec 20-27, 2013	Participants	Questionnaire	Yes
GridstreamRx experience Site B	Jan 13-15, 2014	Participants	Questionnaire	Yes

Protection

As explained in Chapter I [pp. 3-4], the PII associated with this study has to be protected in accordance with multiple statutes—and the Syracuse Institutional Review Board (IRB) approved the protection aspects of this study. Maintaining PII was limited to only three entities during this study: the Army, Steptoe Group and sub-contractors, and GridstreamRx system administrator. The restricted access to these data bases was controlled by contractual relationships and a strict need-to-know (Steptoe, 2012d).

- While the Army could conceivably identify the participants and respondents, they were only provided summary reports of the surveys by the Steptoe Group without any specific identification data. Therefore, none of the respondents' specific answers were made known to their employer, the Army.
- The Steptoe Group was bound by contract to protect the PII as a part of their WCHT effort, and by extension, for this project. They demonstrated this as

competency in order to win the Army contract initially and put in place access safeguards to disassociate respondent identity and data.

- The Syracuse University WiGiT facility has in-house policies and procedures for protecting Steptoe Group and GridstreamRx PII data—to include its disposal at the end of the study [Appendix J].
- At no time did the researcher come in contact with the respondents, their PII, or any data that wasn't already anonymized. Once the researcher received the anonymized data, it was kept in an off-line, password protected storage drive that was under continual control.

Sample Sizes

Environmental Scan Surveys (568 respondents)

1. Site A has approximately 1,800 professionals (in-house, or on retainer and/or contract) available to provide healthcare services to military members, veterans, and their families. In November 2012 the survey instrument was sent to a random sample of 375 staff. By January 2013 a total of 184 completed surveys were returned for a 49% response rate.
2. Site B has 900 professionals (in-house, or on retainer and/or contract) available to provide healthcare services to military members, veterans, and their families. In March 2013, using the same survey instrument as previously used at Site A was sent to a random sample of 540 staff. By April 2013 a total of 384 completed surveys were returned for a 71% response rate.

WCHT Intensive On-site Sessions (96 respondents)

1. At Site A, although 50 individuals had voluntarily registered to attend the training from across the medical center, a weather emergency in the local area on the same day of the WCHT session, reduced participation to 28. While everyone took the pre-training survey, only 21 took the post-training survey. All 28 data contributors provided valuable information to the WCHT effort. However, only the 21 who took both surveys was considered most relevant for informing the conclusions of this study.
2. Site B had 75 participants attend the WCHT session on June 7, 2013. These individuals were among the 85 invited to participate in the training session using a randomly selected list from among all medical center staff and stratified by department to ensure proportional representation. Participants included a mix of physicians, nurses, psychologists, social workers, physical therapists, medical technicians, physician assistants, and others.

Focus Groups (9 Respondents)

1. Site A. All 21 of the participants who had attended the WCHT sessions and answered the pre- and post-training surveys were asked to take part in a focus group. Ten voluntarily registered to take part in the focus group. On March 15, 2013, six of the volunteers actually participated in the discussion that was a lunch-time discussion.
2. Site B. The Steptoe Group facilitator drew a random sample of 20 of the 75 trainees who had attended the WCHT sessions and invited them to

attend a focus group in late July. Due to scheduling conflicts that apparently could not be cleared, only three invitees attended the focus group, which was run on the morning of July 24, 2013.

GridstreamRx Experience (32 Respondents)

1. Site A. All 21 of the participants who had attended the WCHT sessions and answered the pre- and post-training surveys were asked to take part in a Steptoe Group-led training session using GridstreamRx. Eleven individuals took part in that experience between December 20th and 27th, 2013. The low turnout was due to the holiday work schedule at the medical center.
2. Site B. All 75 of the participants who had attended the WCHT sessions and answered the pre- and post-training surveys were asked to take part in a Steptoe Group-led training session using GridstreamRx. Twenty-one individuals engaged in that experience between January 13th and 15th, 2014.

Quantitative

The focus of this study's methodology was centered on the data gathered from the 32 respondents who participated in one of the two WCHT sessions, and subsequently experienced a GridstreamRx-enabled training event. The two principal survey instruments for this study (post-WCHT and GridstreamRx experience surveys) provided 960 5-level Likert scale points of data to be potentially analyzed in conjunction with the DeLone and McLean ISSM.

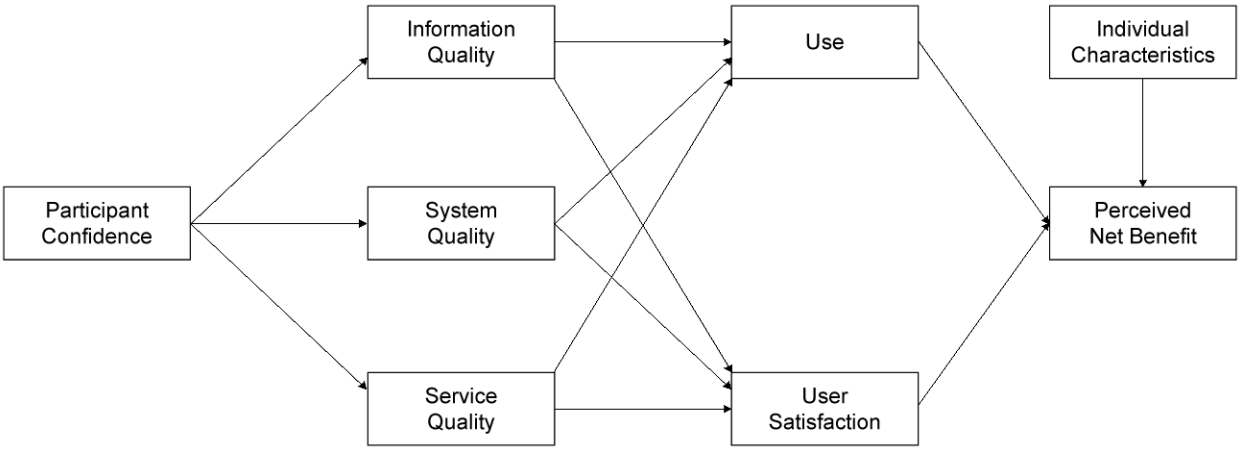

Figure 32 Modified DeLone and McLean ISSM (Khayun et al., 2012)

DeLone and McLean based their model on six interrelated dimensions of information systems success. Others added to the basic construct while validating it in subsequent research [Chapter II, pp. 28-30]. Of note for the data structure to support this study, DeLone and McLean (2002; 2003) suggested that Information Quality, System Quality, and Service Quality each should be measured separately because of how they subsequently influence Use and User Satisfaction—setting up a series of independent and dependent variable relationships. The survey instruments of this study were specifically designed to do just that—in addition to asking for the respondents' specific perceptions of Use and User Satisfaction [questions 1, 2, 3, and 4] and were addressed by the post-GridstreamRx survey [Appendix N].

Table 7 Measuring the ISSM Dimensions

Dimension	Questionnaire	Question(s)
Information Quality	Post-training survey	#'s16-20; #34
System Quality	GridstreamRx survey	# 9
Service Quality	GridstreamRx survey	# 5
Participant Confidence	Pre-training survey	#'s 21, 22
Use	GridstreamRx survey	#'s 1, 2
User Satisfaction	GridstreamRx survey	#'s 3, 4
Perceived Net Benefits	GridstreamRx survey	#11 less #12

Each multi-question dimension will receive a composite score, tested for reliability and consistency. The results of these calculations within the model will be tested for bias and possible correlations between and within each site and the associated demographics of the sample populations.

The 5-level Likert scale GridstreamRx survey instrument also collected data outside of the scope of the ISSM designed to inform its outcomes and prioritize the respondents' inputs regarding next steps and possible improvements to the training environment or GridstreamRx product development.

Qualitative

The two focus group opportunities and six GridstreamRx experience questions offer open-ended respondent answers. While these are not central to answering the research question and associated hypotheses, they do have a purpose as a secondary source of input. These add a measure of reliability and validity to detecting possible distortion, biases, and blind spots in the two principal survey instruments of this study—and will inform the recommendations of Chapter V.

The qualitative answers will be sorted in two categories—those that can be coded and converted to a best-to-worst 5-level Likert scale input similar to the other survey questions and those that present new information. In the event of new information being presented by the respondents, these will be grouped and categorized to either clarify inputs to the quantifiable information or inform the next steps for research or further development of GridstreamRx—or similar technologies.

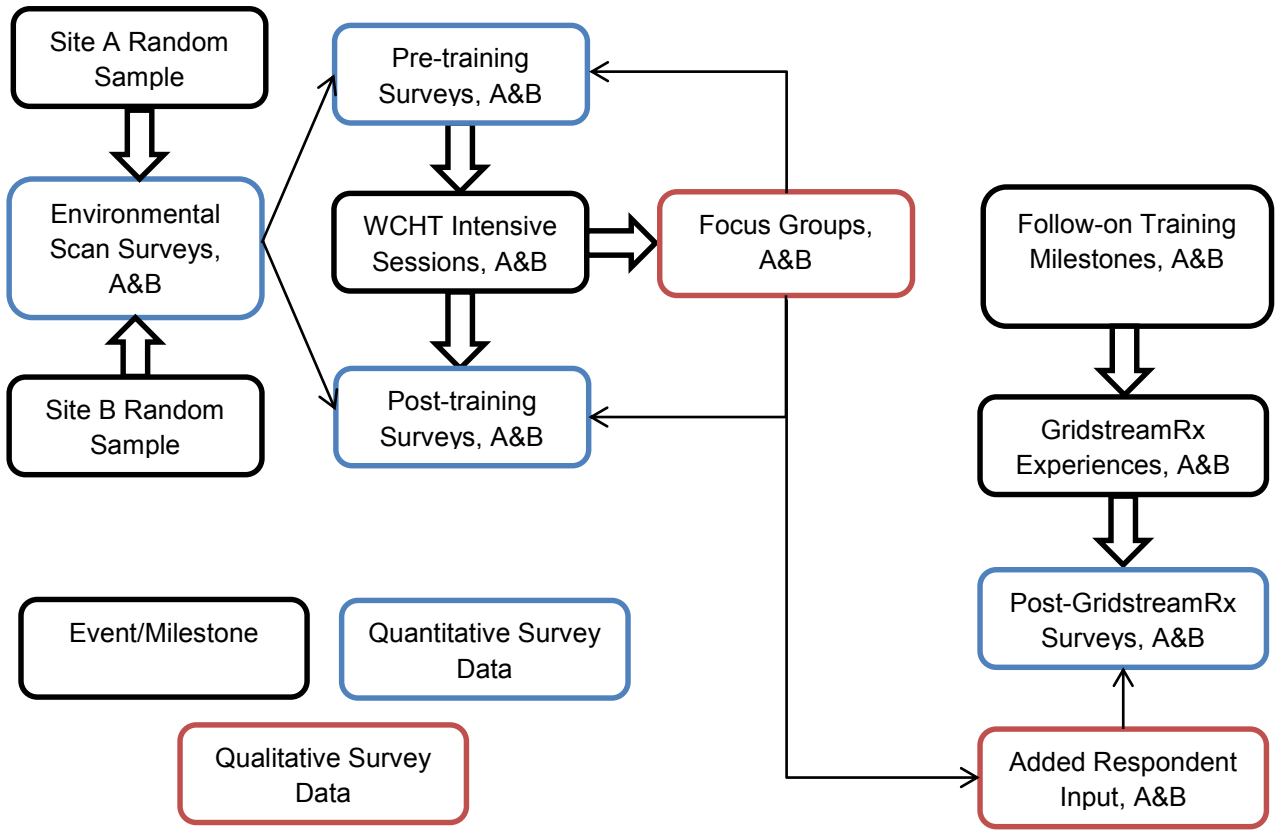

Figure 33 Mapping the Data

Research Question

The research question being answered by this study is: *Can wireless grids technology enhance the ability of physicians and allied healthcare providers to deliver healthcare services to U.S. military veterans suffering from Post-Traumatic Stress Disorder (PTSD) or Traumatic Brain Injury (TBI)?*

In order to answer this question, two underlying aspects were pursued. First, how receptive are healthcare providers to using ICT and social networking in the training environment and subsequently in healthcare delivery? Second, to what degree is GridstreamRx a viable candidate for meeting the need, if it exists?

Hypotheses

Using the Khayun et al. (2012) validation of the modified DeLone and McLean ISSM as a template, the following hypotheses were developed.

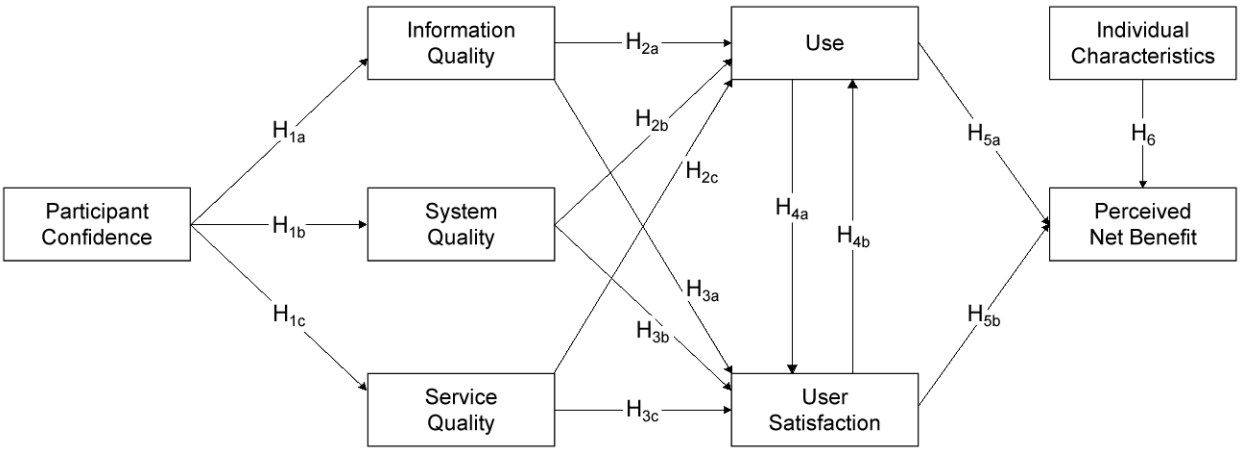

Figure 34 ISSM Hypotheses Tested in this Thesis (Khayun et al., 2012)

- H_{1a} Participant Confidence will have a positive influence on perceptions of Information Quality.
- H_{1b} Participant Confidence will have a positive influence on perceptions of Systems Quality.
- H_{1c} Participant Confidence will have a positive influence on perceptions of Services Quality.
- H_{2a} Perceptions of Information Quality will have a positive influence on Use.
- H_{2b} Perceptions of Systems Quality will have a positive influence on Use.
- H_{2c} Perceptions of Service Quality will have a positive influence on Use.
- H_{3a} Perceptions of Information Quality will have a positive influence on User Satisfaction.

- H_{3b} Perceptions of System Quality will have a positive influence on User Satisfaction.
- H_{3c} Perceptions of Service Quality will have a positive influence on User Satisfaction.
- H_{4a} Perceptions of Use will have a positive influence on User Satisfaction.
- H_{4b} Perceptions of User Satisfaction will have a positive influence on Use.
- H_{5a} Use will have a positive influence on Perceived Net Benefit.
- H_{5b} User Satisfaction will have a positive influence on Perceived Net Benefit.
- H_6 Individual Characteristics will have a positive influence on Perceived Net Benefit.

Analysis Approach

Similar to the Khayun et al. approach (2012), linear regression analysis will be used to test the hypotheses and the relationships among the predictors and outcomes. There are six tiers of data analysis sequenced within this study:

- Demographics among sample sizes and reliability of the data.
- Participant Perceptions regarding the general acceptability of the respondents to using ICT and social networking and that impact on Information Quality, System Quality, and Service Quality.
- Participant perceptions with regard to each of the Information Quality, System Quality, and Service Quality and their effect on Use and User Satisfaction.
- Participant perceptions with regard to Use and User Satisfaction and their effect on Expected Net Benefit.

- Individual Characteristics and their impact on Expected Net Benefit.
- Qualitative inputs providing clarification, validation, emphasis, or next steps information.

First Round of Calculations

The access to a large number of respondents through the environmental scans (586) and those that took the WCHT sessions (96) could help to examine the smaller number of those who had the GridstreamRx experience (32). If there is a positive correlation among these three groups, it might help mitigate potential shortcomings of small sample sizes as noted in other medical studies by Cerrato [Chapter II, pp. 53-54].

The data associated with each of the success variables in the ISSM will be evaluated for internal consistency using Cronbach's Alpha. As Khayun et al. demonstrated (2012) an Alpha value of 0.7 reflects an acceptable level of reliability.

Second Round of Calculations

Participant Perceptions analysis is based on two 5-level Likert scale questions during the pre-training survey. These measure the participants' perceptions of acceptance for using ICT and social networking in general. These will correlated as a composite score with each of the three success factors of Information Quality, System Quality, and Service Quality.

Third Round of Calculations

The respondent input for Information Quality will come from a correlation of five Likert scale questions from the post-training survey. The input for System Quality and Service Quality will each come from one, but different queries from the post-

GridstreamRx experience. These three success variables will individually feed into the respondents' perceptions of Use and User Satisfaction.

Fourth Round of Calculations

Inputs into the Use success parameter will come from a composite of two questions from the GridstreamRx survey. The same will occur for the User Satisfaction calculation. Both will then feed the Perceived Net Benefit.

Fifth Round of Calculations

The six demographics of age, gender, military service, specialty, years of service, and parents in the military will be measured individually as Individual Characteristics to be potentially factored into Perceived Net Benefit.

Sixth Round of Calculations

The potential qualitative inputs come from the Focus Group and open-ended portions of six questions from the post-GridstreamRx survey. These will be used to clarify or validate the Likert scale outcomes or inform next steps, concerns, and suggestions for future research.

Informing the Analysis

Throughout the analysis process, the literature cited in Chapter II helps inform and bring clarity to the various parts of this evaluation.

The DeLone and McLean ISSM [Chapter II, pp. 28-30] provides the analysis framework for determining the readiness of healthcare providers to accept an enabling technology and that of GridstreamRx to fulfill that role. However, to understand the six

success variables of this model and the implications of the analysis requires the application of related research.

The Steptoe WCHT system and the participants' learning experience provide the main inputs to the Information Quality variable and the Participants' Perception. The WCHT material was influenced by a blended learning methodology, advocated by Thompson, and Humanist Learning Theory, also known as Theory of Andragogy or learner-constructed contracts [Chapter II, pp. 40-42]. These along with application of Kolb's four-stage Experiential Learning concepts [Chapter II, pp. 33-34] should help explain variances in this part of the data.

The System Quality inputs come from the participants after their GridstreamRx experience. These are the technical elements of the analysis and System Theory [Chapter II, pp. 27-28] will be helpful to explain the analysis of the data in this area.

The Service Quality inputs are aligned with the participants' experience in social networking. Chapter II discussions on Communities of Practice [p. 36], Media Richness Theory [pp. 36-37], and Connectivism [pp. 38-39] should provide insight, not only for quantitative data but also any qualitative submissions by the participants.

The data should highlight whether this group of healthcare providers in this military culture mirrors the recent studies with respect to clinician acceptance [Chapter II, pp. 52-54].

The 1997 NMIS project [Chapter II, pp. 24-26] should provide a good, practical analytical lens through which to view the performance of GridstreamRx with respect to being a viable candidate as a social networking platform. In particular, the MIT portion of that study dealt with the education of professionals and what they valued, namely:

access to colleagues, locate content, cost of implementation, open standards, and flexibility.

There will also be respondent inputs regarding security, compliance, health records, patient access, and service delivery. These will not be addressed in this study's analysis, but rather in the recommendations and next steps discussed in Chapter V.

CHAPTER IV. RESULTS

This chapter provides a response to the study's research question and tests the 14 hypotheses posed in Chapter III based upon the analysis of the data collected.

Sample Populations

There are four groups at the two study locations of healthcare providers that contributed data for this study.

Sites A and B

Several weeks prior to any WCHT training sessions, the Steptoe Group conducted environmental scan surveys to determine baseline levels of general culture awareness and healthcare competence at the two locations. It is from these two relatively large sample sizes that we can characterize the baseline populations from which the WCHT participants came and examine similarities and differences as a way of detecting bias in the data.

1. Site A. Of the 375 staff who received the environmental scan survey, 184 respondents returned the questionnaire for a 49% response rate. Their specialties can be seen in Table 8. While 34% of respondents were active duty military personnel, the majority were civilians – either government employees (38%) or contractors (26%). Forty-four percent of respondents

Table 8 Roles at Site A

Primary Roles	Percent
Nurse/Physician Assistant	25%
Physician	18%
Technician	15%
Administrative Staff	11%
Allied Health Professional	5%
Psychiatrist/Psychologist	5%
Administrator	4%
Chaplin	3%
Physical Therapist	3%
Research/Training/Education	3%
Social Worker	3%
Medic/Corpsman	2%
Receptionist/ Scheduler	2%
Other	2%

said they worked for the DoD; the others worked for or reported to the Navy (29%), Army (25%), or Air Force (2%). They reported a wide range of experience in their current capacity: 38% less than 5 years, 27% 5-9 years, 15% 10-14 years, and 20% more than 15 years. Most respondents were highly educated: 35% had doctoral or professional degrees, 16% master's degrees, and 18% bachelor's degrees. Most respondents were women (61%) and the average age was 44 years (range: 19-74).

2. Site B. Of the 540 staff who received the environmental scan survey, 184 respondents returned the questionnaire for a 71% response rate. Their specialties can be seen in Table 9. While 18% of respondents were active duty military personnel, the majority were civilians – either government employees (71%) or contractors (9%). Eighty-two percent of respondents said they worked for or reported to the Army; the others worked for the DoD (17%) or the Air Force (1%). About half (49%) had worked in their current capacity for less than 5 years. The others had longer periods of experience: 23% for 5-9 years, 10% for 10-14 years, and

18% had more than 15 years. Most respondents were women (64%) and the average age was 45 years (range: 20-72). Most respondents were highly educated: 18% had doctoral or professional degrees, 25% master's degrees, and 18% bachelor's degrees. Another 17% had associate's degree and 18% had some college credits.

Table 9 Roles at Site B

Primary Roles	Percent
Nurse/Physician Assistant	29%
Social Worker	15%
Physician	12%
Allied Health Professional	9%
Technician	9%
Administrative Staff	8%
Administrator	4%
Receptionist/ Scheduler	4%
Medic/Corpsman	3%
Psychiatrist/Psychologist	3%
Physical Therapist	2%
Chaplin	0%
Research/Training/Education	0%
Other	1%

The professional populations of these two large medical centers are quite homogeneous. The slight differences (more women at Site B—64% versus 61%, and a higher percentage of personnel working for the Army at Site B) did not have an impact on any part of the analysis since this sample size only provided context for the others.

WCHT

The Steptoe Group held intensive on-site seminars at both locations. It is likely, but not verifiable that individuals in this sample also answered the Environmental Scan Surveys. However, given the limited use of these instruments, it was determined not to matter for the purposes of analysis that this was unknown. Further, the demographic differences between those who experienced WCHT at either site was ultimately determined not to be a factor in the ISSM analysis, as none of the Individual Characteristic hypotheses were supported by the data collected in this study.

1. Site A had 28 participants attend the WCHT session held on campus but only 21 filled out the post-training surveys. The demographic data was collected on the pre-training survey. For the purposes of comparing the WCHT sample population demographics to those for the medical center, n=28. For the purposes of the size of the Site A WCHT sample population for all other calculations, n=21.

Their specialty areas can be seen in Table 10. Three of the participants (11%) were active duty service members; half (50%) were civilian government employees; 35% were civilian contractors; one was a graduate student intern. Most participants (58%) worked for the DoD, 23% for the Navy, and 19% for the Army. Thirty-two percent had worked in their current capacity for less than 5 years; 36% for 5-9 years; 21% for 10-14 years; and 11% for 15 or more years. Women comprised 75% of the training participants. Participants' mean age was 48 years (range 25-68).

Table 10 Site A: WCHT Participants

Department	Percent
Internal Medicine	36%
Department of Surgery	32%
Pediatric/Adolescent Medicine	15%
Neurology	7%
Psychology & Psychiatry	7%
Chaplin/Pastoral Services	4%

2. Site B had 75 participants attend the WCHT session held on. Their specialty areas can be seen in Table 11. Most participants (69%) were civilian government employees and another 5% were civilian contractors. Twenty-one percent were active duty service members and 3% were in the

Table 11 Site B: WCHT Participants

Department	Percent
Warrior Transition Brigade	27%
Behavioral Health	23%
Medicine	20%
Family and Community Medicine	18%
Others	13%

Reserve component. Most participants (78%) worked for the Army, 18% for the DoD, and 3% for the Air Force. Most (56%) had worked in their current capacity for less than 5 years; 16% for 5-9 years; 5% for 10-14 years; and 23% for 15 or more years. Women comprised 68% of the training participants. The participants' mean age was 47 years (range 27-68).

GridstreamRx

There were 32 respondents who went through the WCHT intensive residency and also participated in the GridstreamRx experience. Thirty-four percent of these participants were from Site A, which was an over representation by 23%. This group was more heavily represented by females than either of the WCHT sessions. Those who experienced GridstreamRx had slightly more time on the job than the WCHT sample and were a year older with an average age of almost 50. Interestingly, and contrary to the general stereotype of technology early adopters being typically male and younger in age.

This sample size does constitute 33% of the possible number of participants who had the opportunity to experience GridstreamRx [Table 12], which is significant. Further, as the application of the ISSM demonstrates, this sample is of sufficient size to establish meaningful correlations with respect to the research questions and hypotheses.

Table 12 Sample Population Participation Rates

	Site A	Site B	Total	%
Total personnel at sites	~1,800	~900	~2,700	
Environmental scans sent	375	540	915	
Environmental scan respondents	184	384	568	62%
Respondents who participated in WCHT sessions	21	75	96	17%
Sample of participants who responded to post-training GridstreamRx questionnaire	11	21	32	33%

As will be demonstrated by the Perceived Net Benefit calculations used to answer this study's research question, this sample size is sufficient to predict a positive correlation regarding GridstreamRx with a 95% confidence rate, for over half of each medical center.

Focus Groups

Both sites produced observations regarding the prospect of using GridstreamRx. Due to the small size of this sample population (9% of the GridstreamRx sample population), these qualitative inputs were used as a secondary source of data to inform the critical path of analysis.

1. Site A responses suggested that there may be age differences in attitudes about technology, with younger staff (those under 40) being more open to the use of social networking. Their objections to social networking included: concerns about Internet security, being spammed, and not having the time for it. However, they expressed a willingness to try the new application during the training (J&E, 2013a).

2. Site B respondents had concerns about having enough time as government sequestration was limiting their available time to work each week. If the challenges of scheduling could be overcome, there was an eagerness to try GridstreamRx (J&E, 2013b). Twenty-one of the 75 WCHT participants were able to attend GridstreamRx sessions.

There were different nuances in the tone of each Focus Group. Site A's response to using GridstreamRx, while positive, showed less enthusiasm with phraseology of "willingness" versus Site B's characterization of "eagerness." Site A's concerns were directed at the GridstreamRx application, while Site B was worried about having the time.

The Site A focus group "age input" was taken into account during the Individual Characteristic portion of the ISSM. As will be seen in that discussion [Chapter IV, p. 103], none of the demographics had a correlation with the Perceived Net Benefit calculation. Therefore, this input was discarded. The comments about security show up again, but in a contradictory fashion.

Security was cited as a "Most Liked About GridstreamRx" feature by 11% of the respondents. However, the negative implication of security was so great in one respondent's answers on the post-GridstreamRx survey that it drove this input to be the only negative Perceived Net Benefit evaluation of GridstreamRx out of the 32 folks in the sample. While security was not a specifically evaluated in this ISSM analysis, it will be addressed in Chapter V.

The Site B higher level of enthusiasm and concerns with respect to scheduling weren't born out by the data gathered by the post-GridstreamRx survey. Therefore,

these focus group inputs were disregarded since 21 people from Site B participated in the GridstreamRx experience.

Reliability of the Data

Data provided in response to the 5-level Likert scale questions posed by the researcher are at the center of analysis ISSM analysis and needed to be analyzed for consistency. These questions were asked on three different survey instruments—two questions each administered at the pre- and post-training milestones—and twelve questions posed post-GridstreamRx experience. Since the first two were taken within hours of each other, and the latter taken months later, they were evaluated separately.

The pre- and post-training questions dealt with the respondents' general and training scenario level of comfort with ICT and social networking. A *t*-score was run individually and together in order to detect any significant differences between the answers given prior to the WCHT sessions and at the end of each residency class. As can be seen in Table 13, the results showed a consistency of answers between the two survey instruments.

Table 13 Data Reliability Pre- and Post-Training

Perception/ Anticipated Use Of	Before Training Mean	After Training Mean	Before Training Std Dev	After Training Std Dev	p-level	Result
Information Technology	4.194	4.29	0.828	0.746	0.346	No Difference
Social Networking	3.484	3.742	1.058	1.065	0.127	No Difference
Both	3.839	4.016	0.69	0.725	0.205	No Difference

The 5-level Likert scale questions on the post-GridstreamRx survey provided enough data to evaluate the internal consistency for each individual and among all of the respondents using Cronbach's alpha. This helps identify random responses or unreliable data gathered during the process. The goal of a reliable survey instrument is for the scores to reflect consistency of answers, but also for each question to contribute uniquely to the analysis. A Cronbach alpha of >0.7 is considered good. The Cronbach's alpha for entire GridstreamRx questionnaire was 0.89—borderline between good and excellent [Appendix O].

Analysis

Linear regression analysis[23] was used for hypothesis testing and evaluating the relationships among the various predictors and outcomes [the calculations of which can be seen in Appendix P]. As can be seen in Figure 35, this study's data show a positive relationship in all six of DeLone and McLean's success variable categories (Information Quality, System Quality, Service Quality, Use, User Satisfaction, and Perceived Net Benefit). This did not hold true for the two variable categories, Participant Confidence and Individual Characteristics, which were added onto the model through the subsequent research of Khayun et al., Wang, and Liao, among others. That will be examined more closely later in this Chapter.

[23] Combination of StatPlus and R Studio used to compute calculations.

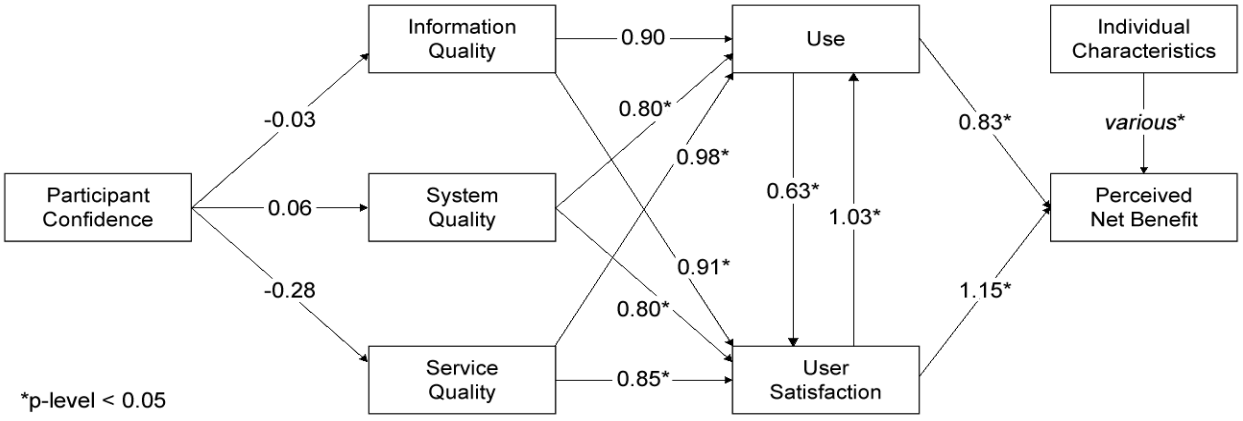

Figure 35 ISSM Regression Analysis Results

Hypothesis Testing

As can be seen in Table 14, nine of the fourteen hypotheses were supported. Of the five not supported, one was borderline acceptable but fell "below the line,"—namely, Information Quality's correlation with Use (β=0.896, R^2=0.112, p=0.081). Changing accepted level of confidence criteria to 90% would have made this a "supported hypothesis," which suggests that there is a likely correlation between these two success factors. Doing so would have aligned, at least in the tally of the result category, this relationship with the other H_2 hypotheses. But in the final analysis of this study, the focus on the Perceived Net Benefit of GridstreamRx technology in this environment, is unaffected by accepting a lower level of confidence merely to regard this as a "supported hypothesis."

Table 14 Summary of ISSM Hypothesis Testing

Hypothesis	Independent Variable	Dependent Variable	Coefficient	R^2	p-level	Result (p-level<0.05)
H_{1a}	Participant Confidence	Information Quality	-0.03	0.003	0.774	Unsupported
H_{1b}	Participant Confidence	System Quality	0.061	0.011	0.636	Unsupported
H_{1c}	Participant Confidence	Service Quality	-0.281	0.067	0.159	Unsupported
H_{2a}	Information Quality	Use	0.896	0.112	0.081	Unsupported
H_{2b}	System Quality	Use	0.802	0.257	0.016	Supported
H_{2c}	Service Quality	Use	0.979	0.55	0	Supported
H_{3a}	Information Quality	User Satisfaction	0.913	0.207	0.015	Supported
H_{3b}	System Quality	User Satisfaction	0.795	0.305	0.008	Supported
H_{3c}	Service Quality	User Satisfaction	0.854	0.679	0	Supported
H_{4a}	Use	User Satisfaction	0.632	0.649	0	Supported
H_{4b}	User Satisfaction	Use	1.027	0.649	0	Supported
H_{5a}	Use	Perceived Net Benefit	0.833	0.398	0	Supported
H_{5b}	User Satisfaction	Perceived Net Benefit	1.147	0.465	0	Supported
H_6	Individual Characteristics	Perceived Net Benefit	various	various	all > 0.05	Unsupported

Participant Confidence

The understanding of Participant Confidence may need to be reconsidered from its presentation in this study. In the model, the pre-test Questions 21 and 22 were used as a measure of Participant Confidence based on principles laid out by Jarvis' Learning Process Theory [Chapter II, p. 35]; and then applied to Khayun et al. research work with the ISSM [Chapter III, p. 81]. It is possible that the data collected by these questions, perceived comfort with ICT and social networking, does not factor in at all. Moreover, if they do, there is a missing element that was not considered in the construction of the survey instrument.

Table 15 ISSM Participant Confidence

Hypothesis	Independent Variable	Dependent Variable	Coefficient	R^2	p-level	Result (p-level<0.05)
H_{1a}	Participant Confidence	Information Quality	-0.03	0.003	0.774	Unsupported
H_{1b}	Participant Confidence	System Quality	0.061	0.011	0.636	Unsupported
H_{1c}	Participant Confidence	Service Quality	-0.281	0.067	0.159	Unsupported

It is also possible that this part of the ISSM does not hold for certain cultural dimensions. Of the studies cited in Chapter II [pp. 28-30] as examples of validating the ISSM, which included a confidence factor, none was a sample population from strictly the U.S. Notably, the Khayun and Wang studies took place in Thailand. The other studies took place in South Korea, Singapore, and Malaysia—and none involved people serving in the healthcare career field. As Hofstede (1984) documented, some cultural dimensions of models that worked fine for the U.S. and European countries, started to fall apart in studies in Asian countries. The reverse could be true as well.

Individual Characteristics

Khayun et al. (2012) validated a major extension of ISSM during their research—namely adding the influence of Individual Characteristics to IT System Acceptance, Use, and Perceived Net Benefits. Specific characteristics studied included level of education, training, professional level, length of service, etc. Wang and Liao (2007) used age and gender, and it was also one of the inputs from the Focus Groups.

Therefore, it was prudent to test as many independent variables as the data would support to determine if any of the Individual Characteristics would result in a $p<0.05$. Of note, the initial regression was performed without considering the ICT and

networking inputs. The second time through the process they were included and the result was a better fitting regression equation—but still with unsupported results [Appendix P]. This added a degree of credibility to the analysis process and associated outcomes.

Table 16 ISSM Individual Characteristic Correlation to Perceived Net Benefit

Hypothesis	Independent Variable	Dependent Variable	Coefficient	p-level	Result (p-level<0.05)
H_{6a}	Civilian? (Y/N)	Perceived Net Benefit	-0.451	0.659	Unsupported
H_{6b}	Years of Service	Perceived Net Benefit	-0.03	0.518	Unsupported
H_{6c}	Age	Perceived Net Benefit	-0.041	0.352	Unsupported
H_{6d}	Female? (Y/N)	Perceived Net Benefit	-0.672	0.335	Unsupported
H_{6e}	Parents in Military? (Y/N)	Perceived Net Benefit	-0.077	0.912	Unsupported
H_{6f}	Medical? (Y/N)	Perceived Net Benefit	-0.664	0.377	Unsupported
H_{6g}	IT Use	Perceived Net Benefit	0.85	0.088	Borderline
H_{6h}	Social Networking	Perceived Net Benefit	-0.312	0.465	Unsupported

As can be seen in Table 16, none of the demographics, specialty, years of service, military affiliation, or level of expectation of using ICT and social networking was supported. There could be multiple, plausible reasons based on the literature review contained in Chapter II.

- The studies quoted in the Khayun et al. work took place in 2001, 2004, 2008, and 2009. Clearly much as changed with respect societal and individual attitudes and expectations with respect to ICT and social networking as born out in recent, national surveys of doctors' attitudes towards these tools and concepts (Safavi, 2014) [Chapter II, pp. 53-55].

- Khayun et al. (2012) used a Delphi Technique in order to collect the data which provided an opportunity to refine survey instruments from a sample size of 77 respondents from 26 companies.
- More recent studies (Landman, 2010; Glickman, 2012) show a universal acceptance of medical professionals with respect to using ICT and social networking, potentially reducing the measurable variances needed for predictability [Chapter II, pp. 53-55].
- There may be characteristics peculiar to the military or healthcare cultures. However, the gaps in the research previously outlined [Chapter II, pp. 55-57], may make some of these determinations problematic.
- The demographic that showed the closest positive correlation was age ($p=0.285$). There is research to suggest that the use of technology by healthcare providers is driven by the generational demographics (MacCracken, 2009), but the data gathered in this study did not support this; even though the ages in this study ranged from 25 to 68.
- The questions posed in this study may have needed different wording in order to produce better information.

There is no discernible reason within the purview of this study to definitively determine the reason this hypothesis is not supported. This is an area that merits more research in order to determine if there remains a correlation with causation between Individual Characteristics and Perceived Net Benefits in the ISSM for U.S. populations.

Respondents: Additional Inputs

Q6 on the post-GridstreamRx survey asked: "What portion of this training experience was most helped by GridstreamRx technology?" The vast majority of respondents cited information delivery/dissemination and networking with colleagues. Two individuals each added one feature not on the pre-set list, namely file sharing and streaming video. This data will inform Chapter V.

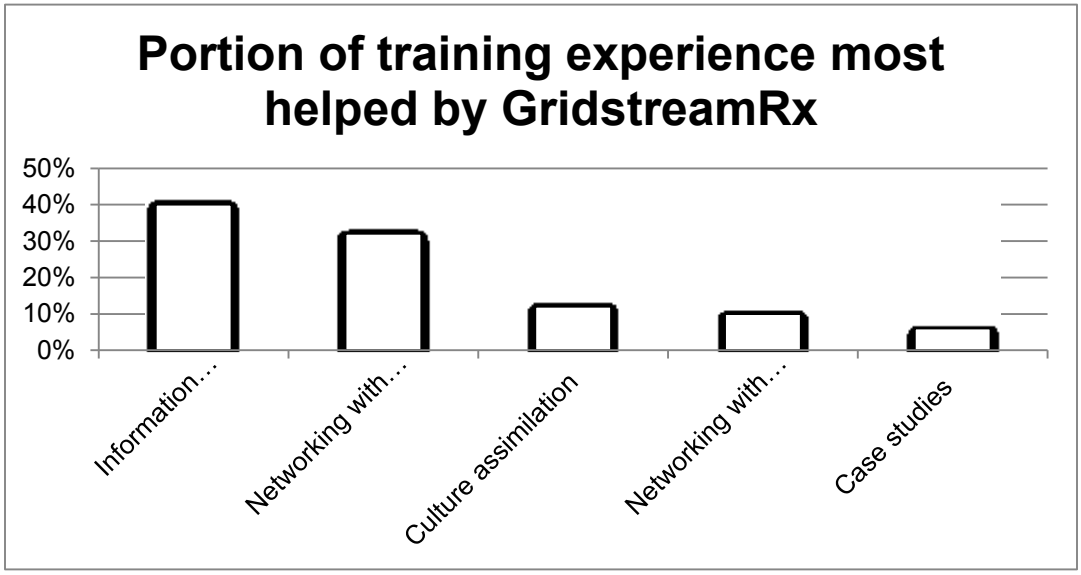

Figure 36 GridstreamRx's Most Helpful Feature

Q7 on the post-GridstreamRx survey asked: "What did you like most about GridstreamRx technology as you experienced it during this training?" The majority stated that the ease of use and applications were the most positive. However, 29% checked "No Comment"—reflecting neutral feedback. This data will inform the Building towards HCWaaS section of Chapter V.

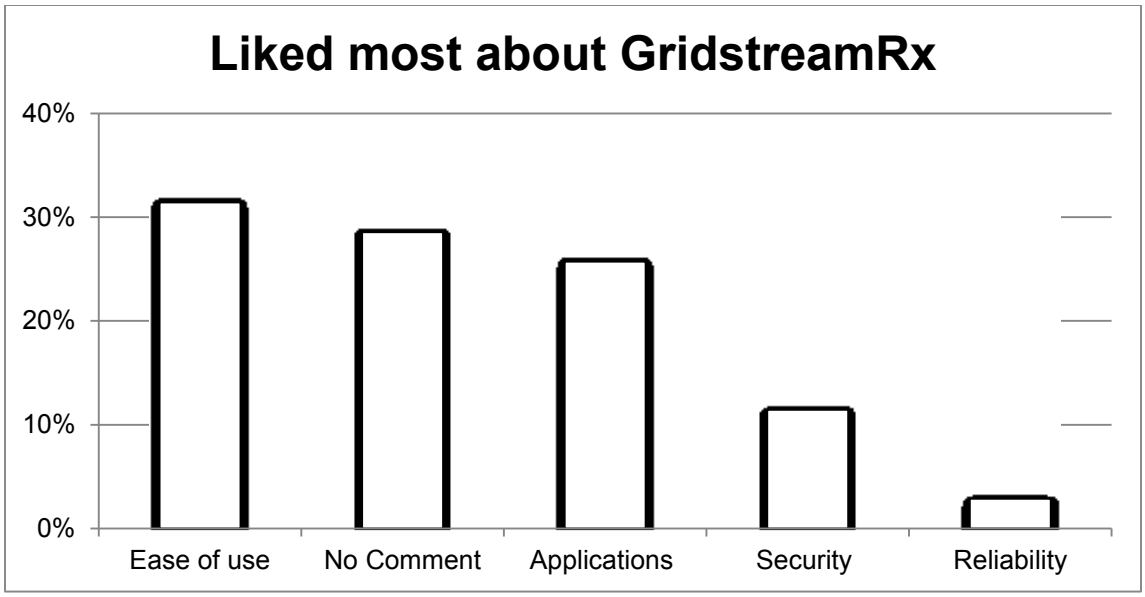

Figure 37 GridstreamRx Positive Performance Factor

Q8 on the post-GridstreamRx survey asked: "What about GridstreamRx technology needed the most improvement?" Significantly, most respondents checked the "No Comment" answer. Assessment of this input is uncertain. It could signify multiple intentions that include anything from apathy to complete satisfaction. A different answer—such as "None Comes to Mind"—in conjunction with other answer choices might have resulted in more information. This data will inform the Building towards HCWaaS section of Chapter V.

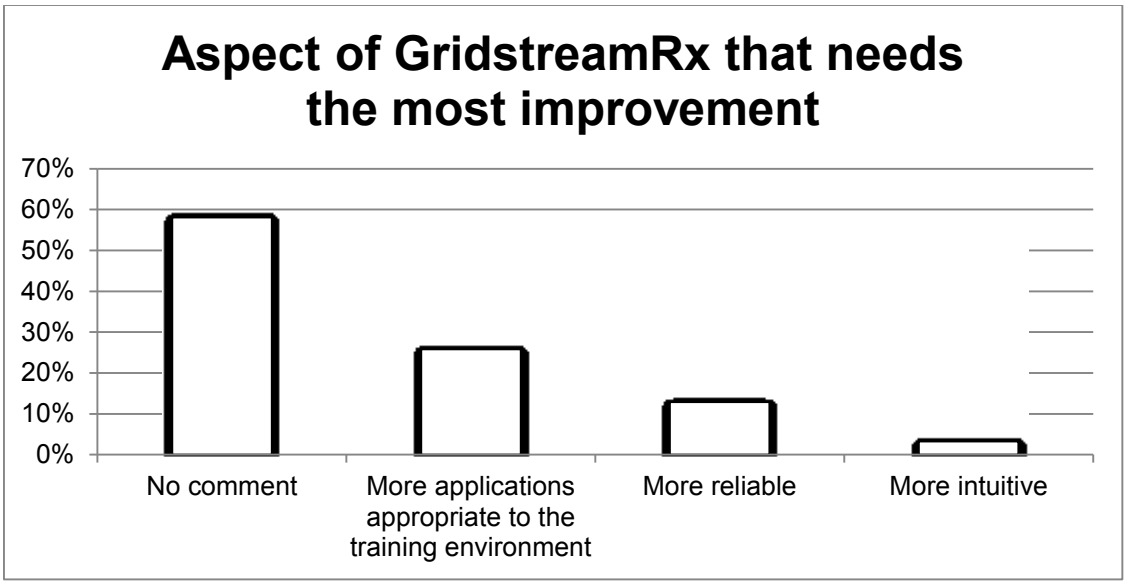

Figure 38 GridstreamRx Improvement Areas

Q10 on the post-GridstreamRx survey asked each respondent to: "Select the word or phrase that best describes your experience with GridstreamRx in this training environment." Having 50% of the respondents rating the applications features as "Adequate" does provide insight to the GridstreamRx discussion above in that these two answers together paint a picture of general satisfaction among the respondents with using, not only this tool, but with ICT and social networking in their professional work environments [Figure 38]. This is also borne out by the favorable Perceived Net Benefit analysis within the ISSM. This data will inform the Building towards HCWaaS section of Chapter V.

Q13 on the post-GridstreamRx survey gave the respondents the opportunity add any other comments that they had with respect to this training experience and its potential use of technology as part of the learning process or administering to patients and their families.

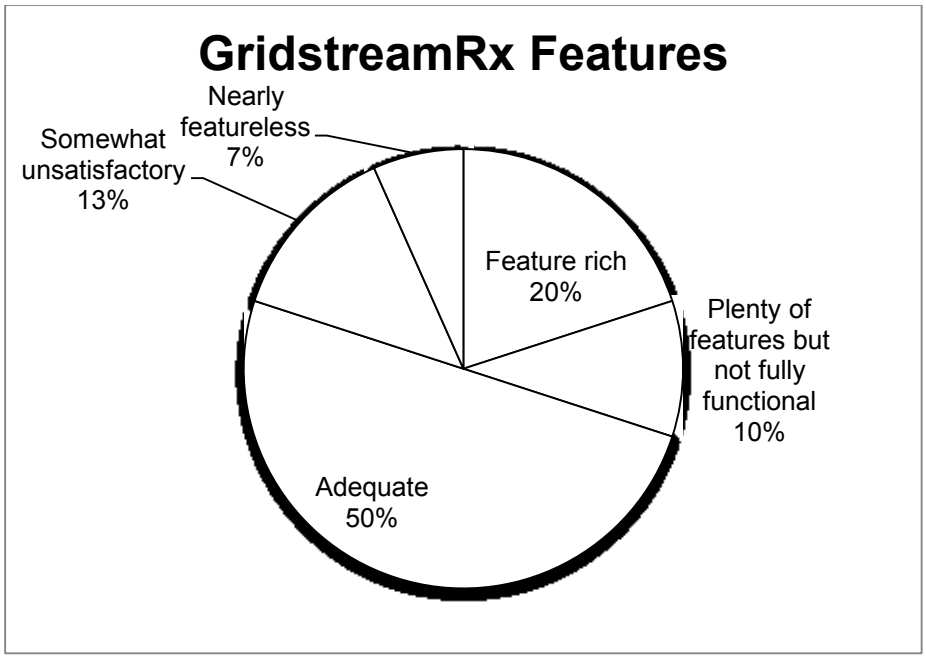

Figure 39 GridstreamRx Features

There were three inputs, which verbatim were:

1. Great technology but needs to be tweaked against the possibility of information being intercepted by others without the need to know, military environment, etc.
2. Great idea.
3. This training improved my ability to care for other active duty veterans and their families. However, policies must be in line with the culturally competent methodologies, learned to enhance our experience, and make the implementation enjoyable and rewarding for us.

None of these provided new insight into the ISSM results or for the discussions in Chapter V.

Answering the Research Question

In the model, the post-GridstreamRx experience survey values of Q12 (the opportunity to assign an overall negative GridstreamRx evaluation) were subtracted and those of Q11 (the opportunity to assign an overall positive GridstreamRx evaluation) as the measure of Perceived Net Benefit. After considering the other data gathered throughout this study (seven 5-level Likert scale questions, the six questions that offered opportunity for open-ended responses, and the focus group inputs), the consistency of the answers to the survey instruments supports using this relationship to determine Perceived Net Benefit; and by inference the GridstreamRx performance in this environment.

There are four basic scenarios that fit by the results of this analysis:

1. Most favorable input for GridstreamRx: perception of High value, Low risk.
2. Least favorable input for GridstreamRx: perception of Low value, High risk.

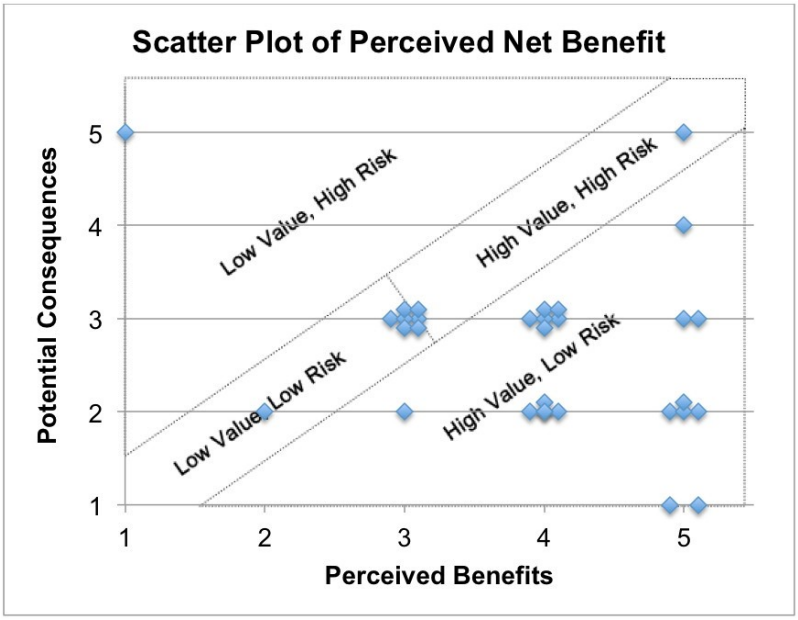

Figure 40 GridstreamRx Value versus Risk

3. Completely neutral inputs regarding GridstreamRx.
4. Net-zero: perception High value, High risk; Low value, Low risk.

Figure 40 is a graphical representation of the study data in each scenario. If a data point falls down and to the right, it is a

high value-low risk data point. One up and to the left is low value, high risk. The band diagonal from bottom-left to upper-right are the Perceived Net Benefit net-zero folks, and most of them fall right in the dead center as truly neutral since they actually answered both Q11 and Q12 as "Neutral."

This data can be evaluated by Table 17:

Table 17 Summary of GridstreamRx Level of Acceptance[24]

Perceived Net Benefit	Measurement	Percentage of Sample	Margin of Error (95% confidence)	Population Estimate
Positive Benefits	Perceived Benefits – Potential Consequences > 0	68%	±13%	55%-81%
Zero Net Benefit	Perceived Benefits – Potential Consequences = 0	29%	±12%	17%-41%
Negative Consequences	Perceived Benefits – Potential Consequences < 0	3%	±3%	0%-6%

The data gathered for the study showed, at the 95% level of confidence, that a majority of the professionals (>55%) of these two medical centers would have a positive Perceive Net Benefit from using GridstreamRx in a healthcare training environment. The conclusion from this analysis is that not only are the healthcare providers in this study ready to use ICT and social networking in this professional setting, but also that GridstreamRx is an acceptable platform for performing these functions.

The voluntary participants cannot be taken as a general representative sample, but only for what they are, a sample of healthcare professionals at two, large military healthcare facilities. Given that the study relates to a potential introduction of new technology into highly controlled settings, the fact that this sample of potential early adopters is favorably inclined is a significant outcome (Rogers, 1995).

[24] Sample Size calculator, Creative Research Systems. http://www.surveysystem.com/sscalc.htm

CHAPTER V. CONCLUSIONS

Findings

The context of this study was providers learning to deliver improved healthcare services in a military environment to patients suffering from Post-Traumatic Stress Disorder (PTSD) and Traumatic Brain Injury (TBI). Based on analysis of the data gathered over a year for this study, there are three principle findings:

1. There is a high potential for ad hoc networking technology (such as GridstreamRx) to serve as the ICT medium providing the trusted social networking platform in this environment.
2. The Information System Success Model is appropriate for evaluation of the variables determining success in the study.
3. Most significantly, a Fully Integrated Virtual Healthcare Environment (FivHe) is shown to be an achievable goal, utilizing future ICT that integrates ad hoc and social networking capabilities in trusted environments.

GridstreamRx

Two success variables needed to be understood to determine GridstreamRx's potential as an ICT medium capable of providing the social networking platform for this environment—namely, the willingness of the healthcare providers to use technology for collaboration and their level of acceptance of GridstreamRx to perform that function. The data gathered for the study showed, at the 95% level of confidence, that a majority of the professionals of these two medical centers (>55%) would have a positive

Perceived Net Benefit from using GridstreamRx in a healthcare training environment. In fact, only one participant in the study saw a negative Perceived Net Benefit for using ICT and social networking. The conclusion from this analysis is that not only are the healthcare providers in this study ready to use ICT and social networking in this professional setting, but also that GridstreamRx is an acceptable platform for performing this function. Of course, GridstreamRx as used in this study, serves as an example of a prospective new class of HIPAA-compliant, ad hoc and social networking platforms.

Information System Success Model (ISSM)

As shown in the literature review, the DeLone and MacLean ISSM has been a proven and often cited ICT model [Chapter II, pp. 28-29] for analyzing trans-disciplinary and multi-dimensional success variables. The data gathered in this study supported nine of the ten hypotheses core to the 2003 model that premised having a positive influence on participant perceptions with regard to the model's success variables. And the one unsupported hypothesis (between Information Quality and Use) did suggest that there was a likely correlation at the >90% level of confidence.

The data did not support a positive correlation with two success factors (Participant Confidence and Individual Characteristics). These factors were validated as refinements to the core ISSM by research subsequent to the 2003 model that took place in various countries and cultures [Chapter II, pp. 30-31]. The three unsupported hypotheses with respect to Participant Confidence and the unsupported one of Individual Characteristics conceivably did not hold due to the factors not included in the survey instruments. This is an area meriting more research with respect to these success variables, the ISSM, and sample populations in the military, U.S., or both.

The basic ISSM framework shows universally strong correlations with respect to the willingness of the healthcare providers to use technology for collaboration and their level of acceptance of GridstreamRx to perform that function. Therefore, the compelling evidence from the data gathered by this study is that the core ISSM not only validates that healthcare providers in this environment are ready to use ICT and social networking, but also that GridstreamRx is an acceptable platform for performing this function.

Healthcare Workplace as a Service (HCWaaS)

From the data gathered during this study, there are three strong indications that GridstreamRx performed satisfactorily:

1. Eighty percent of the respondents described GridstreamRx features as adequate or better.
2. Fifty-eight percent of the respondents gave a “no comment” input to the question regarding needed GridstreamRx improvements.
3. The very favorable Perceived Net Benefit analysis within the ISSM.

The vast majority of respondents (72%) in this study, like those in highlighted by the nation-wide effort in the 1997 NMIS project [Chapter II, pp. 24-25], cited information delivery and dissemination, and networking with colleagues, as the most treasured performance factors. These are an obvious priority to keep in mind as the GridstreamRx application potentially evolves into a productized “Healthcare Workplace as a Service (HCWaaS).”

The data gathered in this study revealed the most positive GridstreamRx features to be the ease of use and functionality of the applications. It also suggested

improvement areas such as adding even more functionality to the application, and making it even more reliable and intuitive.

In the context of introducing ad hoc networking technology (GridstreamRx) to telemedicine, the literature in Chapter II that set the context of this study, in essence created findings beyond just the analysis of the data gathered. The compelling evidence in the relevant literature is that in order to truly advocate using ad hoc networking technology as a trusted platform in the healthcare sector, the multiple "back-end infrastructure" factors must be considered concurrently with the user confidence and interface analysis addressed by this study [Chapter II, pp. 21-24].

Creating a plan that matures GridstreamRx on-demand services in conjunction with the needed technical parameters—or a technology equivalent—must account for:

- Risk management plan [Brooks' discussion, Chapter II, pp. 23-24].
- Open specification and deployment plans [Foster's work, Chapter II, p. 20].
- HIPAA Omnibus Final Rule [Institute of Medicine dialog, Chapter II, p. 23].
- Evolving user functionality [outlined in the NMIS project and by recent healthcare sector trends, Chapter II, pp. 25-26, 53-54].

Strengths

Support by the Army, the customer of the study's results, and its authorized agent, the Steptoe Group proved to be an asset. When issues arose outside the control of everyone involved with the study, e.g. U.S. Government Sequestration and shutdown, the project endured. Steptoe Group's Warrior-Centric Healthcare Training (WCHT) was a strong, well-vetted regimen that withstood these execution challenges. Most importantly, WCHT delivered a quality product—highly valued by the participants

as evidenced by data gathered during the study. When augmented with GridstreamRx ad hoc and social networking features to support the WCHT 'Learning Community,' as this thesis has shown, user reaction was also very positive.

The study drew sample populations from two large, geographically-separated military medical centers, which helped to reduce potential bias in the data. The participants that went through the WCHT experience were diverse by specialty, and eager to participate. Those WCHT participants who volunteered to use GridstreamRx showed an additional degree of motivation to benefit from the program by attending additional training sessions.

Importantly, the data doesn't support that idea that the eagerness of the target group was fueled by an undue affinity for technology, but rather influenced more by their favorable WCHT exposure. Those who participated in the GridstreamRx sessions more favorably rated their WCHT experience than did those who went through WCHT but didn't participate in the GridstreamRx ones. There was no such correlation between the two groups with respect to use of ICT and acceptance of social networking [see Table 18].

Table 18 Motivation for Participant Involvement

Sample Population	WCHT Index	ICT Acceptance	Social Networking Use
WCHT experience only	4.29	4.13	3.75
GridstreamRx experience	4.81	4.28	3.72

The ISSM construct provided an excellent analytical lens for categorizing trans-disciplinary and multi-faceted success measures. The multiple expert reviews of the survey instruments for both the WCHT and GridstreamRx experiences produced data that was consistent, comprehensive and was a good fit for the ISSM. The further

validation of the ISSM methodology demonstrating its utility for evaluating future information systems should encourage future researchers to continue to add to the ISSM literature.

The FivHe model fills a void in the current literature and adds to concept development with respect to virtual healthcare thinking. This model creates a coherent construct that provides the top-level view of the functionality needed to create an integrated healthcare environment. The importance of such an approach is that it accounts for building in security and compliance in a technology framework that is congruent with provider and consumer viewpoints—seeking to meet the needs of both.

Limitations

Due to the contractual relationship set up by the Army, flexibility to make adjustments or perform follow-up activities did not exist. There was no latitude to pursue elements that added costs to the Army or its authorized agent, the Steptoe Group. Thus, a GridstreamRx orientation could not be added to the WCHT residency seminars. This resulted in multiple familiarization GridstreamRx sessions, which may have introduced degrees of variability in participant understanding and reduced potential participation.

The impact of U.S. Government Sequestration and shutdown delayed the schedule of the WCHT deployment and initial study plan. These unforeseen interruptions led to multiple GridstreamRx sessions and increased the intervals between study milestones. This limited the number of people per session. Not only did this not stress the capacity of GridstreamRx, possibly allowed for the possibility of inconsistent participant experiences.

Implications

Military Healthcare

The relevancy of this study for military healthcare is three-fold:

- Future Army programs.
- Training healthcare professionals.
- Viability of ad hoc networking technology.

The Telemedicine & Advanced Technology Research Center (TATRC, 2014) is an office of the headquarters of the U.S. Army Medical Research and Materiel Command (USAMRMC), whose mission is to address critical gaps in the DoD medical programs. This organization fosters research on topics central to this thesis study, namely health informatics, telemedicine, m-Health (mobile-Health), and medical training systems [Chapter II, pp. 55-57].

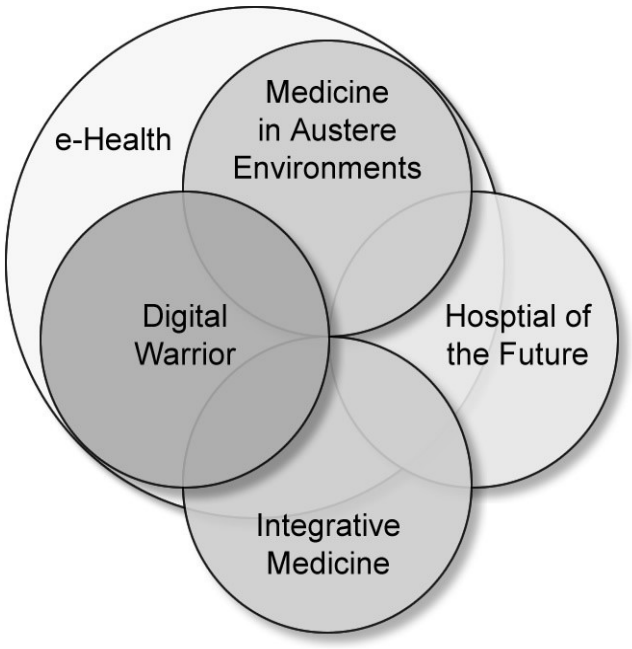

Figure 41 TATRC Initiatives (TATRC, 2014)

Their major initiatives are depicted in Figure 41. Based on their mission statement above, the research discussed in Chapter II, and the construct of their plans, leveraging multiple aspects of ICT is clearly central to the success of their future programs.

First, healthcare providers at two of the Army's large military medical centers are very accepting of using ICT and social networking. Second, the

data gathered for the study showed, at the 95% level of confidence, that a majority of the professionals of these two medical centers would have a positive Perceived Net Benefit from using a trusted platform in a healthcare training environment. Third, the vast majority of respondents (72%) see information delivery and dissemination, and networking with colleagues as being very important with regards to the most helpful features in a digitally networked environment.

Lastly, ad hoc networking technology would appear to hold promise for multiple Army initiatives, particularly those related to the Digital Warrior and Medicine in Austere Environments. The advantages of open specifications, dynamic tasking, limited infrastructure, and stringent security that ad hoc networking demonstrated in other stressed environments, appear to be analogous to the requirements in these similarly challenged conditions [Chapter II, pp. 50-52].

Healthcare Providers

Chapter II documented that the medical community, in general, has been slow to adopt the concept of using ICT and other social media for education and training. This study reinforces other recent research that found the culture of healthcare training to be ripe for sharing lessons learned and perspectives with technology to facilitate such learning [Chapter II, pp. 44-47]. This was very much the WCHT approach, which was central to providing the environment and mechanism for gathering respondent data.

The data gathered in this study is supported by significant peer-reviewed research, which is finding eHealth care, including a virtual pharmacy and community forums, to be as effective as in-patient hospital care [Chapter II, pp. 51-52]. This

includes making diagnoses, developing treatment plans, and finding just-in-time access to highly specialized, medical information and expertise.

Experts in the field now foresee applications and techniques using telemedicine as an element of cost control, mobility, and a willingness on the part of healthcare providers to use ICT in the execution of their professional duties [Chapter II, p. 52].

"Train like you fight" is a colloquial expression in the military meant to imply that using the tools, tactics, and procedures in a training situation as nearly the same as actual combat as possible increases the probability of success when it counts. Incorporating ICT and social networking into provider training should have the same effect when it comes time to deliver healthcare services (Schafer, 2013).

Ad Hoc Networking Technology

This study was configured to analyze the healthcare provider reaction to GridstreamRx, a secure, cloud-to-edge ad hoc networking technology application. The data gathered for the study showed, at the 95% level of confidence, that a majority of the professionals surveyed at two medical centers (>55%) would perceive a positive net benefit from using GridstreamRx in a healthcare training environment. This finding supports GridstreamRx's general approach to application development and deployment for HIPAA-compliant, social media-like user interfaces to healthcare workplace information.

However, to be clear, security, HIPAA compliance, and technical performance over a multiple-node ad hoc network configuration, with dynamically-assigned access and functions, and overall system reliability of the evaluated application are beyond the scope of this study. In order for the introduction of a wireless grids technology as a

trusted telemedicine platform to be complete, this “back-end” infrastructure, which is not apparent to normal users, would have to be examined in a series of follow-on studies, or in one or more heterogeneous edge-to-hybrid cloud ones [Appendix K].

Recommendations to Apply Findings

To get to the Fully Integrated Virtual Healthcare Environment (FivHe) envisioned by this thesis, there are three parallel, equally important bodies of work—each likely to proceed at a different pace (see Figure 42):

- Healthcare Workplace as a Service (HCWaaS)—healthcare provider point of view.
- Healthcare as a Service (HCaaS)—patients’ perspective.
- Ad Hoc Networking Technical Performance, security, and compliance factors—all capable of simultaneously supporting both the provider and patient environments.

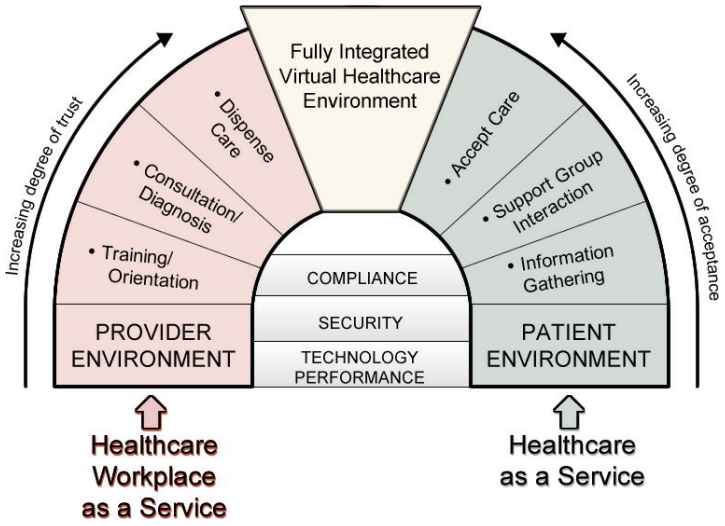

Figure 42 Fully Integrated Virtual Healthcare Environment (FivHe)

This study successfully found a point of introduction for GridstreamRx within the healthcare provider environment (HCWaaS) that returned definite, positive results. The next level of challenge would be to evaluate and address the more stringent requirements of healthcare consultation and diagnosis functions in an "Internet of Things" context. As discussed in Chapter I, this would entail: access to medical data, privacy and security standards, and level of comfort with the ICT and social networking associated with these responsibilities [Chapter I, pp. 3-5]; and is also beyond the scope of this thesis.

Not only will the level of complexity go up in these next steps, but so will the functions, outcomes, and nature of the healthcare provider experience with respect to the technology. The adult learning philosophies that helped to explain the participant experience of this study will likely shift to being informed by Communities of Practice and Experiential Learning discussions in Chapter II [pp. 33-37].

Similarly, there is a need to work the same developments of ICT and social networking from the point of view of the Patient Environment. First, there would be a need to find a point of introduction for the technology, prove capable of meeting the need, and then progressing to the more rigorous requirements requiring increased levels of acceptance. While there may be a correlation to the technical requirements of the provider environment, the patient orientation will fundamentally be that as a "consumer of healthcare" [Chapter II, p. 57] vice a "provider of healthcare." Correspondingly, the analytical lens of this environment will likely shift away from those of the healthcare provider to that of the patient. Therefore, other concepts discussed in Chapter II like Media Richness, Connectivism, Social Capital, and Social Construction

of Technology may each play a more prominent role of informing these future results [pp. 36-39, 47-49].

The development of the ad hoc networking technology evaluated in this thesis needs to track with both the provider and patient environments. The technical performance standards associated with the "back-end" infrastructure need to be proven, as previously noted. These are likely to be very similar as both environments have to deal with the same regulatory requirements. The difference between the two will be the application functions needed by the providers vice those by the patients.

Recommendations for Further Research

Using Figure 42 and the results of this thesis study as a starting point, there are multiple, obvious subsequent research areas to be undertaken that would prove exciting and groundbreaking. As highlighted in Chapter II there has been extensive research on social networking, media, telemedicine, military health, healthcare provider training, PTSD, and TBI, but the combination of these subjects in peer-reviewed research is lacking [Chapter II, p. 47]. Failing to take into account all of the related aspects of the Fully Integrated Virtual Healthcare Environment (FivHe) potentially could lead to the same type of incomplete research landscape for this concept.

The need to introduce the technology into the FivHe patient environment is self-evident—as is the need for a series of successive studies of both the provider and patient environments to match the need for increasing degree of trust and acceptance for top-tier functionalities. What might not be as obvious is the need for potential research with regard to the dissection of the FivHe enabling functions and the

integration of other telemedicine activities, all of which are just as important as the series of user-facing applications [Table 19].

Table 19 Future FivHe Research Opportunities

Technical Functionality	Security	Compliance	Integrating Related Research
Stress test and supportability	Application integrity	Repeatability	Monitoring patient conditions
Patient and provider needs analysis	Domain trustworthiness	Policy implementation	Alerting and notification
Deployability and resource sharing	Medical/health records	Regulatory requirements	Interactive and eMedicine
Cost comparisons	Data management	Standards implementation	Social networking development
Operational configuration	Transactional processes	Auditability	"Hospital of the Future"

Much of this research does not need to be sequential. However, the important foundational approach to this research is linking and synchronizing the various efforts. Should any of these related areas become disassociated with from the FivHe body of work, added risk becomes an immediate concern. For instance, continued evolution of an ad hoc networking technology (such as GridstreamRx) that works from the standpoint of the provider and patient environment perspectives, but fails to be secure, is just as untenable as a secure one that doesn't work from the user viewpoint.

Lastly, in the context of this thesis, additional research areas were raised, which deserve explorations.

- It was not apparent whether the military provider and patient environments would be similar or would differ substantially from their civilian equivalents.
- There did not appear to be significant research to determines if patients would use healthcare services differently for chronic conditions (such as PTSD and TBI) and acute (such as injury).

- The DeLone and MacLean Information System Success Model (ISSM) proved to be an excellent analytical lens through which to analyze this technology. The two added dimensions of Participant Confidence and Individual Characteristics were not supported. Understanding the reasons behind these results would be enlightening for future research [Chapter IV, pp. 100-103].
- Creating methodologies that ease the burden of current U.S. laws (such as HIPAA and the Privacy Act), which put research and scientific credibility at risk [Chapter I, pp. 3-5].

The promising findings of this thesis, further research on these subjects is both warranted and can be undertaken following rigorous methodologies to protect patients and provider information, while still enabling researchers to obtain significant results for informing the further evolution of the FivHe.

APPENDICES

APPENDIX A. **ARMY LETTER OF COOPERATION**

<Research site locations redacted per Syracuse IRB.>

Walter Reed
National Military
Medical Center

August 9, 2012

Office of Research Integrity and Protections

Syracuse University

121 Bowne Hall

Syracuse, NY 13244

To Whom It May Concern:

Dale Meyerrose has requested permission to collect research data from primary care providers, case managers, and professional staff and cadre through a project entitled: *Can Wireless Technology Enhance the Training of Health Providers to Deliver Health Services to U.S. Military Veterans with Chronic Conditions such as Post-Traumatic Stress Disorder and Traumatic Brain Injury?* I have been informed of the purposes of the study and that he is doing this research for the expressed purpose for his dissertation in pursuit of a Doctorate of Professional Studies through the School of Information Studies, Syracuse University.

In May 2012, Department of the Army's - Telemedicine and Technology Research Center (TATRC) awarded the Steptoe Group's Warrior-Centric Healthcare Training (WCHT) ® the 2012 AMEDD Advance Medical Technology Initiative (AAMTI) contract for trainings at [redacted] and [redacted]. Mr. Meyerrose will access the data through the Steptoe Group and will not have direct contact with the participants taking part in the training—neither those taking the training nor those administering the program.

As a representative of Walter Reed National Military Medical Center and as the co-principal investigator I am authorized to grant permission to have the access to the data referenced above through the contract awarded to the Steptoe Group. The researcher has agreed to the following restrictions: will not be accessing any military or treatment facility databases. Also, as noted above the researcher will have no direct contact with any participants or any of the personnel administering the program. Lastly, no personal identifiable data or personal health information will be accessed in completion of this project.

If you have any questions, please contact me at 301-404-3495.

Sincerely,

Travis B. Richardson, MD, FACP
LTC, MC
Co-Principal Investigator
WCHT AAMTI Project

APPENDIX B. **CONTRACTOR LETTER OF COOPERATION**

<Research site locations redacted per Syracuse IRB.>

August 7, 2012

Office of Research Integrity and Protections
Syracuse University
121 Bowne Hall
Syracuse, NY 13244

To Whom It May Concern:

Dale Meyerrose has requested permission to collect research data from primary care providers, case managers, and professional staff and cadre through a project entitled: *Can Wireless Technology Enhance the Training of Health Providers to Deliver Health Services to U.S. Military Veterans with Chronic Conditions such as Post-Traumatic Stress Disorder and Traumatic Brain Injury?* I have been informed of the purposes of the study and that he is doing this research for the expressed purpose for his dissertation in pursuit of a Doctorate of Professional Studies through the School of Information Studies, Syracuse University.

In May 2012, Department of the Army's - Telemedicine and Technology Research Center (TATRC) awarded our organization's Warrior-Centric Healthcare Training (WCHT) ® the 2012 AMEDD Advance Medical Technology Initiative (AAMTI) contract for trainings at [redacted] and [redacted]. Mr. Meyerrose will access the data through this company and will not have direct contact with the participants taking part in the training—neither those taking the training nor those administering the program.

As a representative of Steptoe Group, LLC, I am authorized to grant permission to have the access to the data referenced above through the contract awarded to the Steptoe Group. The researcher has agreed to the following restrictions: *[/no second contact facility access/will only meet clients outside of waiting room/provide a copy of published conclusions or results.)]*

If you have any questions, please contact me at (443) 324-1030. We are a Service Disabled Veteran Owned Small Business committed to working in partnership with government agencies and private organizations to ensure access by all citizens to evidence-based quality healthcare, health education, and support services. In this case we accomplish this goal by working as an extension of the client, providing quality services to support them in their mission.

Sincerely,

Ronald J. Steptoe

Ronald J. Steptoe, CMR
CEO
Steptoe Group, LLC
443-324-1030
ron@thesteptoegroup.com
www.thesteptoegroup.com

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APPENDIX C. **IRB DETERMINATION**

SYRACUSE UNIVERSITY
Institutional Review Board
MEMORANDUM

TO: Lee McKnight
DATE: August 14, 2012
SUBJECT: **Determination of Exemption from Regulations**
IRB #: 12-209
TITLE: *Can Wireless Technology Enhance the Training of Health Providers to Deliver Health Services to U.S. Military Active Duty and Veterans with Chronic Conditions such as Post-Traumatic Stress Disorder and Traumatic Brain Injury, and Their Families?*

The above referenced application, submitted for consideration as exempt from federal regulations as defined in 45 C.F.R. 46, has been evaluated by the Institutional Review Board (IRB) for the following:

1. determination that it falls within the one or more of the five exempt categories allowed by the organization;
2. determination that the research meets the organization's ethical standards.

It has been determined by the IRB this protocol qualifies for exemption and is assigned to category **1**. This authorization will remain active for a period of five years from **August 13, 2012** until **August 12, 2017**.

CHANGES TO PROTOCOL: Proposed changes to this protocol during the period for which IRB authorization has already been given, cannot be initiated without additional IRB review. If there is a change in your research, you should notify the IRB immediately to determine whether your research protocol continues to qualify for exemption or if submission of an expedited or full board IRB protocol is required. Information about the University's human participants protection program can be found at: http://orip.syr.edu/human-research/human-research-irb.html Protocol changes are requested on an amendment application available on the IRB web site; please reference your IRB number and attach any documents that are being amended.

STUDY COMPLETION: The completion of a study must be reported to the IRB within 14 days.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Tracy Cromp, M.S.W.
Director

Note to Faculty Advisor: This notice is only mailed to faculty. If a student is conducting this study, please forward this information to the student researcher.
DEPT: Information Studies, 343 Hinds Hall **STUDENT:** Dale Meyerrose

Office of Research Integrity and Protections
121 Bowne Hall Syracuse, New York 13244-1200
(Phone) 315.443.3013 ♦ (Fax) 315.443.9889
orip@syr.edu ♦ www.orip.syr.edu

APPENDIX D. **IRB MODIFICATION #1**

SYRACUSE UNIVERSITY
Institutional Review Board
MEMORANDUM

TO: Lee McKnight
DATE: November 21, 2012
SUBJECT: **Amendment for Exempt Protocol - Modifications Required**
IRB #: 12-209
AMENDMENT#: 1-Change in Questionnaire
TITLE: ***Can Wireless Technology Enhance the Training of Health Providers to Deliver Health Services to U.S. Military Active Duty and Veterans with Chronic Conditions such as Post-Traumatic Stress Disorder and Traumatic Brain Injury, and Their Families?***

The above referenced application, submitted for consideration as exempt from federal regulations as defined in 45 C.F.R. 46, has been evaluated by the Institutional Review Board (IRB) for the following:

1. determination that it falls within the one or more of the five exempt categories allowed by the organization;
2. determination that the research meets the organization's ethical standards.

It has been determined by the IRB that authorization of your protocol is deferred until you respond to the modifications required or issues raised below:

1. **Please submit a signed copy of the amendment request form. This can be sent electronically, via fax (315.443.9889), or through campus mail.**

These required modifications should be addressed in a memorandum outlining changes; including highlighted changes to the application. Make sure to reference your IRB # on all communications. All correspondence should be sent to the address below within **ONE MONTH** of the date of this letter.

As a reminder, you may not initiate this human participants research project until the protocol receives IRB authorization.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Tracy J. Cromp

Tracy Cromp, M.S.W.
Director

Note to Faculty Advisor: This notice is only mailed to faculty. If a student is conducting this study, please forward this information to the student researcher.
DEPT: Information Studies, 343 Hinds Hall **STUDENT: Dale Meyerrose**

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APPENDIX E. **IRB MODIFICATION # 2**

SYRACUSE UNIVERSITY
Institutional Review Board
MEMORANDUM

TO: Lee McKnight
DATE: May 29, 2013
SUBJECT: **Amendment for Exempt Protocol**
AMENDMENT#: 2 - A) Change in Protocol Title; B) Addition of Research Staff (Dr. Teresa Campbell) C) Change in Questionnaire; D) Other - Eliminate Attachment #9; E) Change in Timeline of the study
IRB #: 12-209
TITLE: *Introducing Wireless Grids to the Field of Telemedicine*

Your current exempt protocol has been re-evaluated by the Institutional Review Board (IRB) with the inclusion of the above referenced amendment. Based on the information you have provided, this amendment is authorized and continues to be assigned to category **1**. This protocol remains in effect from **August 13, 2012** to **August 12, 2017**.

CHANGES TO PROTOCOL: Proposed changes to this protocol during the period for which IRB authorization has already been given, cannot be initiated without additional IRB review. If there is a change in your research, you should notify the IRB immediately to determine whether your research protocol continues to qualify for exemption or if submission of an expedited or full board IRB protocol is required. Information about the University's human participants protection program can be found at: http://orip.syr.edu/human-research/human-research-irb.html Protocol changes are requested on an amendment application available on the IRB web site; please reference your IRB number and attach any documents that are being amended.

STUDY COMPLETION: The completion of a study must be reported to the IRB within 14 days.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Tracy J. Cromp

Tracy Cromp, M.S.W.
Director

Note to Faculty Advisor: This notice is only mailed to faculty. If a student is conducting this study, please forward this information to the student researcher.
DEPT: Information Studies, 343 Hinds Hall **CC:** Dale Meyerrose

Office of Research Integrity and Protections
121 Bowne Hall Syracuse, New York 13244-1200
(Phone) 315.443.3013 ♦ (Fax) 315.443.9889
orip@syr.edu ♦ www.orip.syr.edu

APPENDIX F. **IRB MODIFICATION # 3**

SYRACUSE UNIVERSITY
Institutional Review Board
MEMORANDUM

TO: Lee McKnight
DATE: September 18, 2013
SUBJECT: **Amendment for Exempt Protocol**
AMENDMENT#: 3 - A) Addition of Research Staff; B) Change in Total Number of Subjects; C) Other - Attachment 4 Data
IRB #: 12-209
TITLE: *Introducing Wireless Grids to the Field of Telemedicine*

Your current exempt protocol has been re-evaluated by the Institutional Review Board (IRB) with the inclusion of the above referenced amendment. Based on the information you have provided, this amendment is authorized and continues to be assigned to category **1**. This protocol remains in effect from **August 13, 2012** to **August 12, 2017**.

CHANGES TO PROTOCOL: Proposed changes to this protocol during the period for which IRB authorization has already been given, cannot be initiated without additional IRB review. If there is a change in your research, you should notify the IRB immediately to determine whether your research protocol continues to qualify for exemption or if submission of an expedited or full board IRB protocol is required. Information about the University's human participants protection program can be found at: http://orip.syr.edu/human-research/human-research-irb.html Protocol changes are requested on an amendment application available on the IRB web site; please reference your IRB number and attach any documents that are being amended.

STUDY COMPLETION: The completion of a study must be reported to the IRB within 14 days.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Tracy J Cromp

Tracy Cromp, M.S.W.
Director

Note to Faculty Advisor: This notice is only mailed to faculty. If a student is conducting this study, please forward this information to the student researcher.
DEPT: Information Studies, 343 Hinds Hall **CC:** Dale Meyerrose

Office of Research Integrity and Protections
121 Bowne Hall Syracuse, New York 13244-1200
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APPENDIX G. **ENVIRONMENTAL SCAN**

Survey title: "Cultural Information Questionnaire."

This survey instrument is the confidential and proprietary property of the Steptoe Group, LLC. The first twenty-two questions deal with each respondent's attitude toward military culture, ethnicity, and administering healthcare. Since this data had no impact to the research question of this study, they are not included in deference to the Steptoe Group's request. The last twelve questions deal with each respondent's demographics, don't reveal Steptoe Group's copyrighted material, and factor into the analysis of this study. Therefore, these questions are listed below.

Demographics

D.1. What is your age? ☐

D.2. What is your gender?

- ❑ Female
- ❑ Male

D.3. What is your current marital status?

- ❑ Never been married
- ❑ Currently married
- ❑ Widowed or divorced
- ❑ In a committed relationship

D.4. What is the highest level of school you have completed?

- ❑ Grade school and/or some high school
- ❑ High school graduate or equivalent
- ❑ Some college, but no degree
- ❑ Associates degree
- ❑ Bachelor's degree
- ❑ Master's degree
- ❑ Professional/doctoral

D.5. Which best describes your racial/ethnic affiliation?

- ❑ African American/black, not Hispanic
- ❑ African American/Black, Hispanic
- ❑ White, not Hispanic
- ❑ White, Hispanic
- ❑ Asian or Pacific Islander
- ❑ Native American or Alaska Native
- ❑ Mixed race
- ❑ Other (Specify _____)

D.6. Where did you spend most of the time growing up?

- ❑ Large city
- ❑ Small or medium city
- ❑ Suburbia
- ❑ Rural area
- ❑ Moved around often, so did not spend most of my time anywhere
- ❑ Other (Specify: _____)

D.7. What is your role in the healthcare team?

- ❑ Physician
- ❑ Nurse
- ❑ Allied health professional
- ❑ Social worker
- ❑ Case manager
- ❑ Receptionist/appointment scheduler
- ❑ Other (Specify:_____)

D.8. Is religion important in your daily life?

- ❑ No
- ❑ Yes

D.9. Was one of your parents (or step parents) in the military?

- ❑ No
- ❑ Yes

D.10. Which branch of the service are you with?

- ❑ Air Force
- ❑ Army
- ❑ Coast Guard
- ❑ Marines
- ❑ Navy
- ❑ National Guard
- ❑ None, Civilian Contractor (skip the next two questions)

D.11. Are you active duty or reserve?

- ❑ Active duty
- ❑ Reserve

D.12 How long have you served?

- ❑ Less than 5 years
- ❑ 5-9 years
- ❑ 10-14 years
- ❑ 15-19 years
- ❑ 20 or more years

Thank you for taking the time to respond to this questionnaire.

APPENDIX H. **PRE-TRAINING QUESTIONNAIRE**

Survey title: "Cultural and Treatment Pre-Training Questionnaire."

This survey instrument is the confidential and proprietary property of the Steptoe Group, LLC. The first twenty questions deal with each respondent's attitude toward military culture, ethnicity, and administering healthcare. Since this data had no impact to the research question of this study, they are not included in deference to the Steptoe Group's request to protect their intellectual property.

The questions listed below are relevant to this study. Two questions specifically address each respondent's comfort level with routinely using information technology and social networking. The last six questions deal with each respondent's demographics.

21. How comfortable are you using information technology as part of your daily routine? (Check one)

- ❑ Very uncomfortable
- ❑ Uncomfortable
- ❑ Neutral
- ❑ Comfortable
- ❑ Very comfortable

22. How comfortable are you using social networking to interface with others? (Check one)

- ❑ Very uncomfortable
- ❑ Uncomfortable
- ❑ Neutral
- ❑ Comfortable
- ❑ Very comfortable

Demographics

D.1. Which branch of the service do you work for or report to?

- ❑ Air Force
- ❑ Army
- ❑ Coast Guard
- ❑ Marines
- ❑ Navy
- ❑ Reserve Component

(National Guard or Reserve)
- ❑ Department of Defense

D.2. What is your current status?

- ❑ Active duty
- ❑ Reserve Component (National Guard or Reserve)
- ❑ Civilian government employee
- ❑ Civilian contractor
- ❑ Other (Specify: _____)

D.3 How long have you served in this capacity?

- ❑ Less than 5 years
- ❑ 5-9 years
- ❑ 10-14 years
- ❑ 15-19 years
- ❑ 20 or more years

D.4. What is your age? _____years

D.5. What is your gender?

- ❑ Female
- ❑ Male

D.6. Was one of your parents (or step parents) in the military?

- ❑ No
- ❑ Yes

Thank you for completing this questionnaire. We would appreciate your providing us with your name and work email address; though this is optional. If you are providing this information, please print clearly.

_____ _____

Name Work e-mail address

APPENDIX I. **POST-TRAINING QUESTIONNAIRE**

Survey title: "Cultural and Treatment Post-Training Questionnaire."

This survey instrument is the confidential and proprietary property of the Steptoe Group, LLC. The first fifteen questions deal with each respondent's attitude toward military culture, ethnicity, and administering healthcare—and query the respondent with regard to healthcare proficiency. Since this data had no impact to the research question of this study, they are not included in deference to the Steptoe Group's request to protect their intellectual property.

The questions listed below are relevant to this study. Five questions address the respondent's perceptions as to the quality of the information presented during the WCHT sessions. Two questions specifically address each respondent's comfort level with using information technology and social networking in a training environment. Five questions deal with the confidence level respondents had with the WCHT experience.

For each question, circle a number to indicate how likely you will be to engage in a particular practice.

As a result of this training, how likely are you to:	**Very Unlikely 1**	**Unlikely 2**	**Unsure 3**	**Likely 4**	**Very Likely 5**
16. Record more detailed information about the client's background (military and culture) in their record.	1	2	3	4	5
17. Develop a treatment plan that accounts for the patient's branch of service, assignment, or era of service.	1	2	3	4	5
18. Involve family members, significant others, or clergy, in diagnosis or treatment planning.	1	2	3	4	5
19. Include cultural and racial factors in formulating a treatment plan.	1	2	3	4	5
20. Seek treatment interventions that are appropriate for diverse populations	1	2	3	4	5

25. Do you anticipate that using information technology for this training will enhance your experience? (Check one)

- ❑ Definitely not
- ❑ Probably not
- ❑ Neutral
- ❑ Probably
- ❑ Definitely

26. Do you anticipate that using social networking during this training will enhance your experience? (Check one)

- ❑ Definitely not
- ❑ Probably not
- ❑ Neutral
- ❑ Probably
- ❑ Definitely

Feedback on Training

For each question, circle a number to indicate your rating of the training received today.

How would you rate the following?	**Poor 1**	**2**	**3**	**4**	**Excellent 5**
30. Quality of presentations	1	2	3	4	5
31. Small group discussions	1	2	3	4	5
32. Written materials provided	1	2	3	4	5
33. Usefulness of the information	1	2	3	4	5
34. The training overall	1	2	3	4	5

APPENDIX J. **WIGIT PROTECTION OF PII**

Author: Tim Kelly, CEO, Wireless Grids Corporation

Re: How WGC conforms to OMB, HIPAA, and NSF PFI #091973 WiGiT Data Management Plan Requirements and WiGiT Open Specifications with GridstreamRx

Date: February 9, 2014

Introduction

This note elaborates on how WGC's GridstreamRx data is managed, safeguarded, and shared, for the purposes of your doctoral thesis study within the framework of the NSF PFI #091973 WiGiT (Wireless Grid Innovation Testbed) Data Management Plan per National Science Foundation policies and federal guidelines including both the Executive Order of May 9, 2013 'Making Open and Machine Readable the New Default for Government Information,' and The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy, Security and Breach Notification Rules.

WiGiT Data Management Plan

The federal government has been promoting open data sharing policies for some time. WGC understands that the WiGiT Project (Wireless Grid Innovation Testbed) established a framework in 2009 to enable data-sharing across institutions participating in its distributed experimental testbed while safeguarding Personally Identifiable Information, including Personal Health Information, as well as intellectual property and other rights. These core principles are summarized below, before we elaborate upon specific aspects of the WGC data management plan followed in the case if the GridstreamRx evaluation as part of the aforementioned doctoral study of Dale Meyerrose.

WiGiT Data Management Principles

1. WiGiT research complies with all partner institutions' data management policies.
2. WiGiT distributed experimental testbed participants may be both researchers; and subjects of study for others. Whether it is through third parties or university researchers use of wireless grid and related tools, or data gathered from Non Person Entities such as devices and applications, it is accepted that non-personally identifiable information may be aggregated and evaluated for research purposes.
3. WiGiT partners sharing access to information with other WiGiT partners does not change ownership of that information.

By following these few rules, the WiGiT testbed permits unlimited data re-use within the Virtual Organization, limited only by federal law and partner institutions' policies as well as individual privacy preferences of study participants. As data ownership is not transferred, each institution within the distributed testbed retains responsibility for their own data sets and data sharing policies. Wireless Grids Corporation, by agreeing to use of its Gridstream application for research purposes in several signed memoranda with Syracuse University's CIO Chris Sedore within the WiGiT project context, accepted that it too would safeguard data to meet Syracuse University and federal requirements. More specifics on GridstreamRx data management are elaborated upon, below, following summaries of WiGiT data sharing, data management, data integrity, and data standards policies.

Data Sharing

The WiGiT project team has experience collaborating and the project is resulting in many publications, several doctoral theses and numerous presentations. Access to some items across the web permits distributed experimentation by non-project participants as well; for example in Virginia Tech's CORNET cognitive radio test facility supported by other grants.

Data Management

Because WiGiT research may include data on human subjects as well as Non-Person Entities, WiGiT data management must adhere to all Federal Human Subjects Institutional Review Board policies and standards. Data is stored in locked and secured facilities (that is, as appropriate, hard copies are stored in locked cabinets and secured servers for electronic data). WiGiT's written data management policies are reviewed annually. Data is classified as appropriate by researchers in terms of level of personal health information. A log of personnel and their access rights to each level of data is managed by the responsible researcher. Typically, only the directly engaged doctoral student, and identified students or third party data analysts participating in the study, have access to the raw data sets. All staff takes an online course on protecting personal health information. There is a data manager assigned to each data set prior to data collection – as noted, typically the doctoral student researcher - and that manager is responsible for monitoring data collection, data entry, and data access according to written policies.

Data Integrity

As part of the data management policy, staff is trained to the data collection instrument. Data entry is monitored with error checks to identify and correct data entry errors. A similar process is followed for all data analysis. If there are

discrepancies, first the process of data conversion to the analytic tool being used is reviewed and if necessary corrective actions are taken.

Data Standards

All electronic data is stored in formats suitable for that information. Each data set includes a data dictionary developed by the appropriate researcher including information as a description of data elements, formats, types of data element, and their intended use. In the WiGiT project context, as a critical objective of the project and its broader impact is the refinement of open specifications for wireless grids, some specific elements of those open specifications which are relevant in this context are described here as well.

GridstreamRx Data Management

GridstreamRx data within the WiGiT virtual distributed experimental testbed is handled per Syracuse University Institutional Review Board (IRB) policies and procedures as outlined above, conforming to relevant federal laws including the Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy, Security and Breach Notification Rules, given that the data sets were collected with the cooperation of Walter Reed and Fort Hood Hospitals, and the U.S. Army contractor Steptoe Group. Subjective test data and in particular personally identifiable health information has been managed to the strictest standards. Further specifics on those data handling procedures are elaborated upon, it is understood, in Dale Meyerrose's doctoral thesis, and in numerous documents provided to, and approved by, the Syracuse University Institutional Review Board.

The GridstreamRx software (edgeware) application used for the study is accessible through assigned credentials to study participants, with that assignment being handled by Steptoe Group per its responsibilities to the Army, with the WiGiT researcher (Dale Meyerrose) having on direct interaction with any study subject. Wireless Grids Corporation technical staff created individual accounts as per guidance from Steptoe Group, but again had no interaction with the survey instruments or other data collected. Meaning, no person or institution has access to data that is not pre-approved by the IRB, Steptoe Group and/or the US Army. Data that is appropriately formatted for sharing and re-use may be made available following the March 2014 defense of Dale Meyerrose's thesis; but specifics there await first a successful defense, and consent of all concerned parties before data sharing occurs. GridstreamRx is composed of a variety of components in a range of formats, which are summarized below. Data at the GridstreamRx software component level is all stored in WGC's Microsoft Azure cloud account. GridstreamRx includes components written in:

- .Net 4.5
- LINQ
- Javascript
- C**
- SQL
- CSS HTML5
- XML

Microsoft Azure offers compliance certification as its website notes: "Windows Azure is committed to annual certification against the ISO/IEC 27001:2005, a broad international information security standard. The ISO/IEC 27001:2005 certificate validates that Microsoft has implemented the internationally recognized information security controls defined in this standard, including guidelines and general principles for initiating, implementing, maintaining, and improving information security management within an organization. The following Windows Azure features are in scope for the current ISO audit: Cloud Services (including Fabric and RDFE), Storage (Tables, Blobs, Queues), Virtual Machines (including with SQL Server), Virtual Network, Traffic Manager, Web Sites, BizTalk Services, Media Services, Mobile Services, Service Bus, Workflow, Multi-Factor Authentication, Active Directory, Right Management Service, SQL Database, (version 11.0.9164.000 and higher), and HDInsight. This includes the Information Security Management System (ISMS) for Windows Azure, encompassing infrastructure, development, operations, and support for these features. Also included are Power BI for Office 365 and Power Query Service. The certificate issued by the British Standards Institution (BSI) is publically available."

APPENDIX K. **GRIDSTREAMRX**

Architecture

The figure below depicts a typical “cloud-to-the-edge” architecture and Gridstream’s role in providing the Workplace as a Service (WPaaS) customer application (McKnight, 2013f). Conceptually, GridstreamRx and Healthcare Workplace as a Service (HCWaaS) is no different [see pp. 15-18 for “edge” and pp.111-112 for HCWaaS].

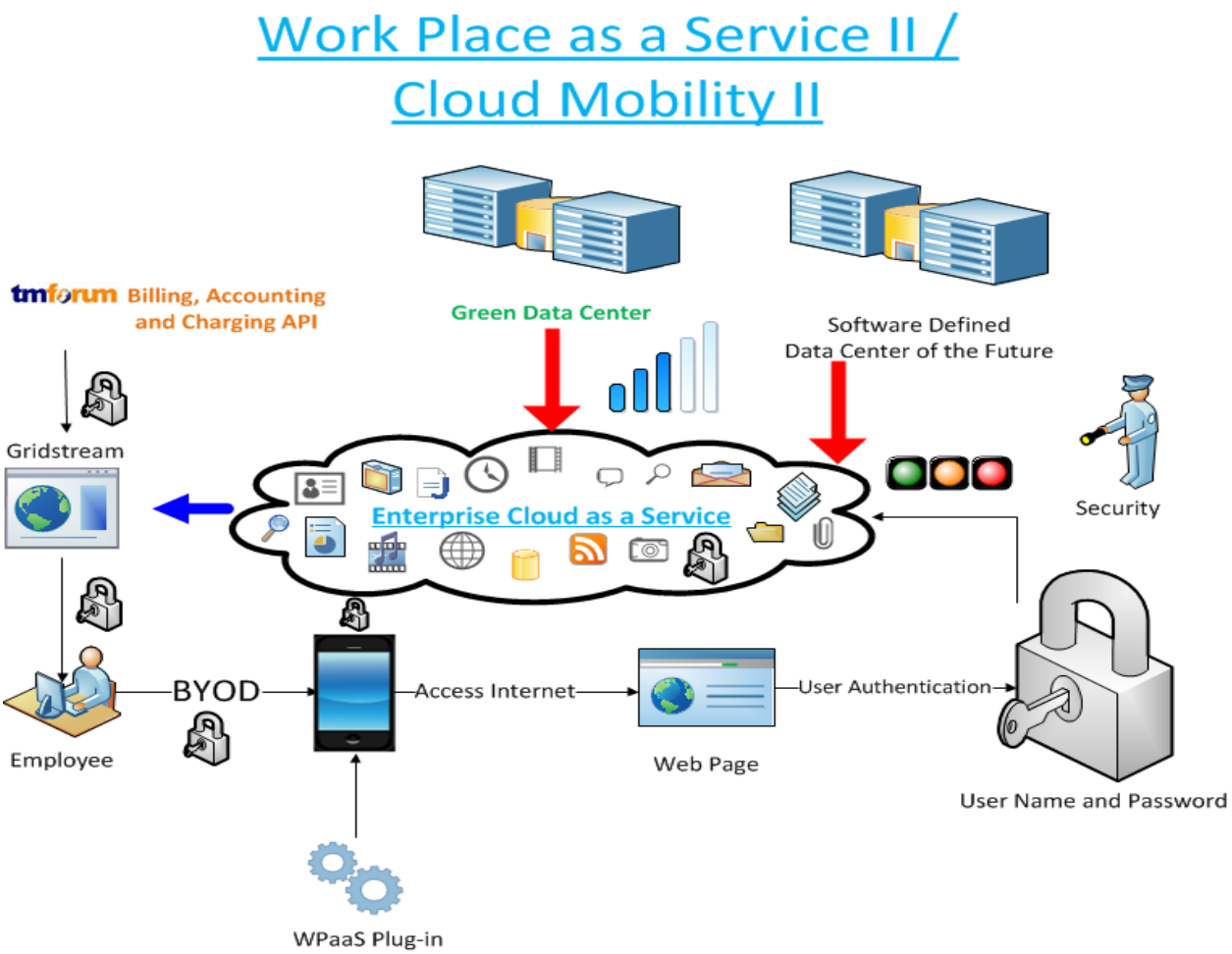


Figure 43 GridstreamRx in a Workplace as a Service Cloud-to-the-Edge

"Back-end" Ad Hoc Network Support

For ad hoc networking technology to deliver a trusted telemedicine platform to support the Fully Integrated Virtual Healthcare Environment (FivHe) (HCWaaS + HCaaS), a "back-end" support architecture is required. While not analyzed within the framework of this study, the integration of this support structure is every bit as critical as the acceptance of the user-facing interface—in this case GridstreamRx [p. 120]. Figure 45 is the Syracuse University WiGiT v0.2 open specification-based architecture of such a support construct that would have to be examined in a series of follow-on studies, or in one or more heterogeneous edge-to-hybrid cloud ones. GridstreamRx would be classified as a "Gridlet" on the right side of the figure (McKnight, 2013d).

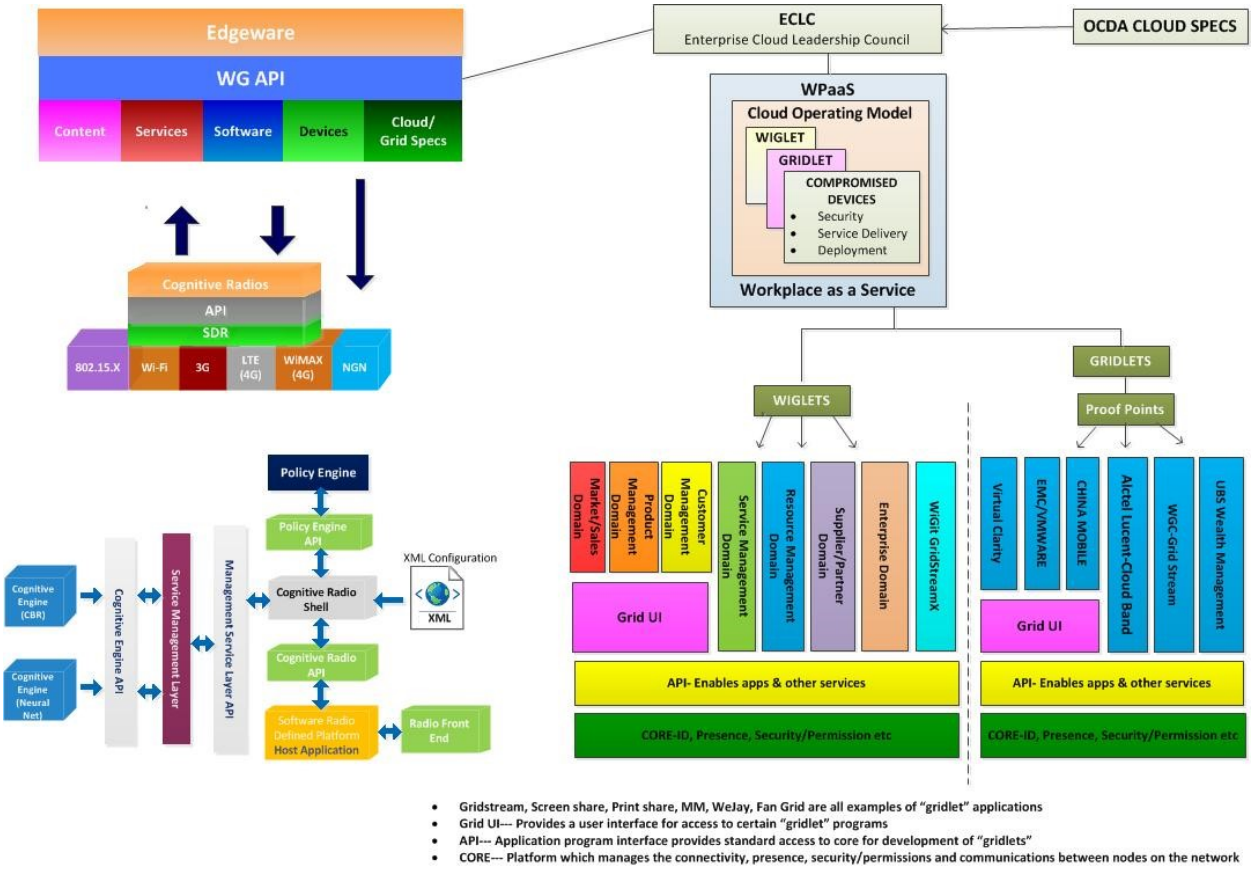


Figure 44 Ad Hoc Network Support Cloud-to-the-Edge Domain

APPENDIX L. **'HOW TO' GridstreamRx**

Supporting Steptoe Group LLC's Warrior-Centric Healthcare Training® (WCHT)

Learning Community since 2013

'How To'

GridstreamRx

Introduction to GridstreamRx

GridstreamRx is a new type of cloud to edge or wireless grid application designed to feel familiar and comfortable to social media users.

This 'How To' is your illustrated guide and reference for setting up, or updating, your GridstreamRx user account for participation in your Warrior-Centric Healthcare Training® (WCHT) Learning Community.

- GridstreamRx offers familiar social media tools for enabling wireless healthcare training on your own device, while meeting HIPAA requirements. After you have logged in, you will find your Warrior-Centric Healthcare Training® (WCHT) Learning Community Colleagues, Facilitators, and WCHT training content as well as a variety of tools.
- As a WCHT Learning Community member, you are a Colleague in a Group. You may listen to or view content, text/chat, or participate in audio/video casts with colleagues.
    - WCHT Learning Community Colleagues and Facilitators may interact with you in your private and secure Groups, in real-time.
    - You may also access content, and share your own comments with Colleagues asynchronously.
- GridstreamRx intuitive user features will help you comfortably share and learn within a virtual or wireless grid, with privacy assured. The GridstreamRx application (gridlet) offers a cloud to edge real time collaboration service and social network with advanced secure wireless grid resource sharing features.
    - Your suggestions on how we may improve the GridstreamRx learning community management system beta product, and especially how we may improve your user experience, are always welcome! Please email info@gridstreamrx.com and cc lee@wgrids.com to share your comments and any questions or concerns.

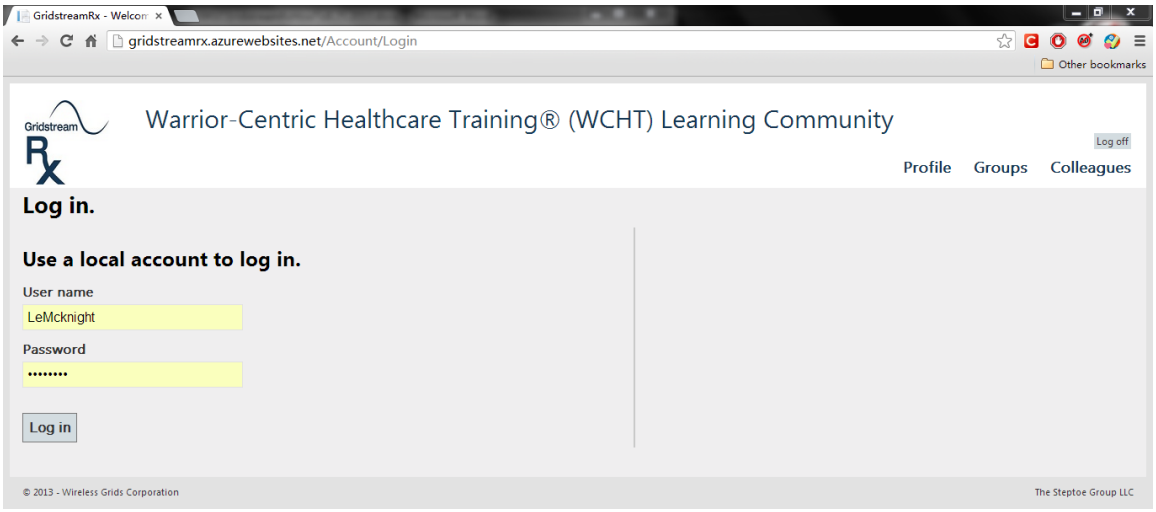
GridstreamRx Features and Set-Up

Steptoe Group's Warrior-Centric Healthcare Training® is supported by GridstreamRx, which is made by Wireless Grids Corporation under license from Syracuse University. GridstreamRx features are designed to meet the training needs of professional learning communities.

GridstreamRx features are designed to be simple and easy to use in Mac or PC environments, and on most mobile devices.

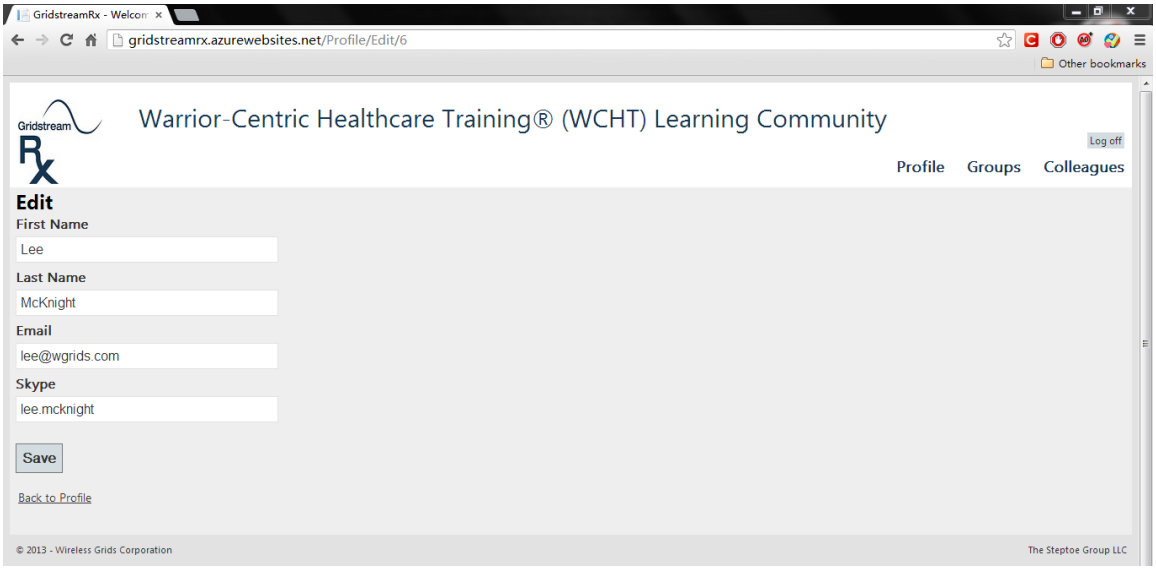
1. Please go to http://gridstreamrx.azurewebsites.net and sign-in to your Warrior-Centric Healthcare Training® (WCHT) Learning Community.

2. When you see the screen below, enter your user name and password that was provided to you by your Steptoe Group Facilitator.



3. When signed in you will see your Profile and any chats which are ongoing within the WCHT Learning Community.

4. To edit your Profile, please click 'edit profile information.' You then will see your first and last name, email and Skype name information. You can edit and save them.



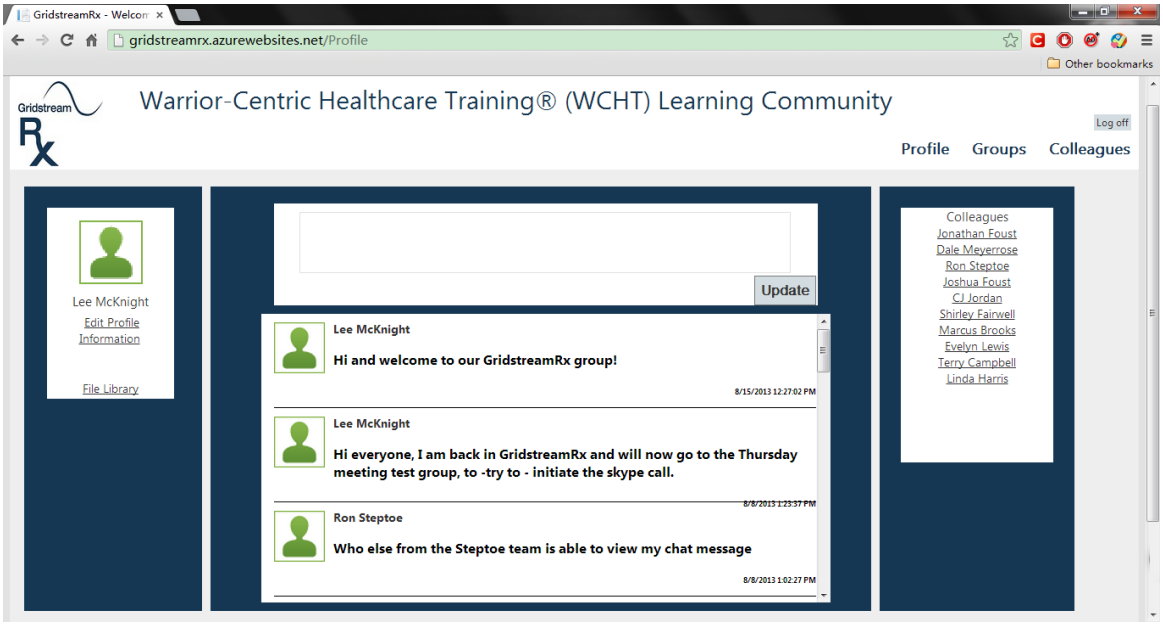
5. If you have a Skype account, please enter your user name in the appropriate box after clicking on 'edit Profile.' Please then review the 'How to Skype in GridstreamRx' Appendix to this document. Note however, that for the purposes of Warrior-Centric Healthcare Training®, you will not need to make a call; you just need to have your account and device set up so you are ready and able to receive calls from your WCHT Group Facilitator, at the times scheduled in advance by your Facilitator.

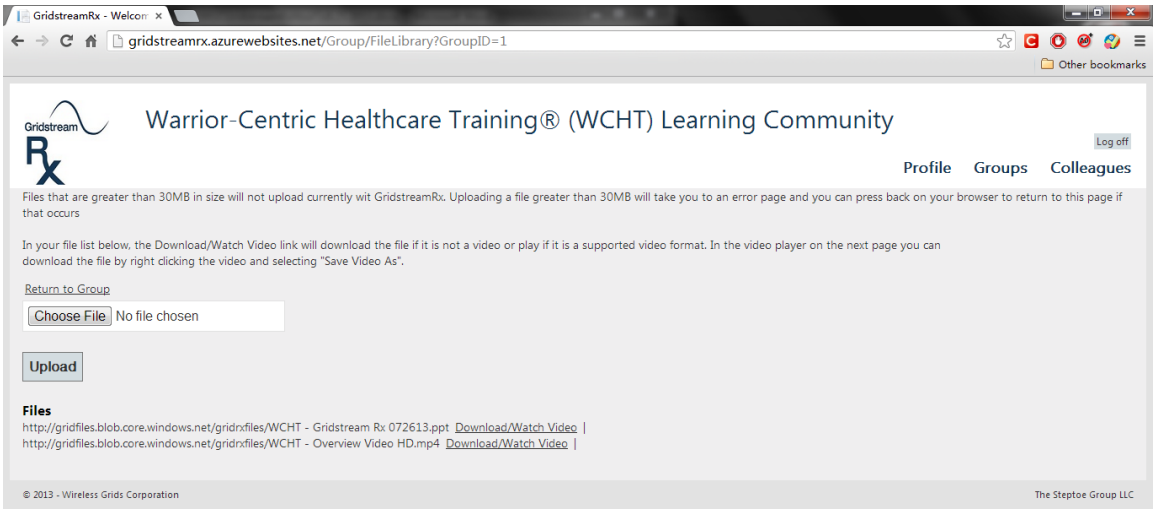
6. If you do not have a Skype account already, please go to: www.skype.com and create a (free) account. No purchase is necessary for full membership rights in the WCHT Learning Community. Once you have created a Skype account if that was needed, and have become familiar with use of Skype by using their online tools to assure you that your microphone and speakers, or headset, and webcam are properly configured, please follow step 5 above. Please also review the 'How to Skype in GridstreamRx' Appendix to this document for more guidance on audio and videoconferencing in GridstreamRx.

7. After you have your Skype account set up, please email jafoust@syr.edu to assist or confirm that your headset, microphone, and camera are properly configured. Josh Foust or another Syracuse University student will help pre-test your audio and video. If you have any questions or concerns on this or any other aspect of GridstreamRx, please call Josh Foust at 315 395 0001.

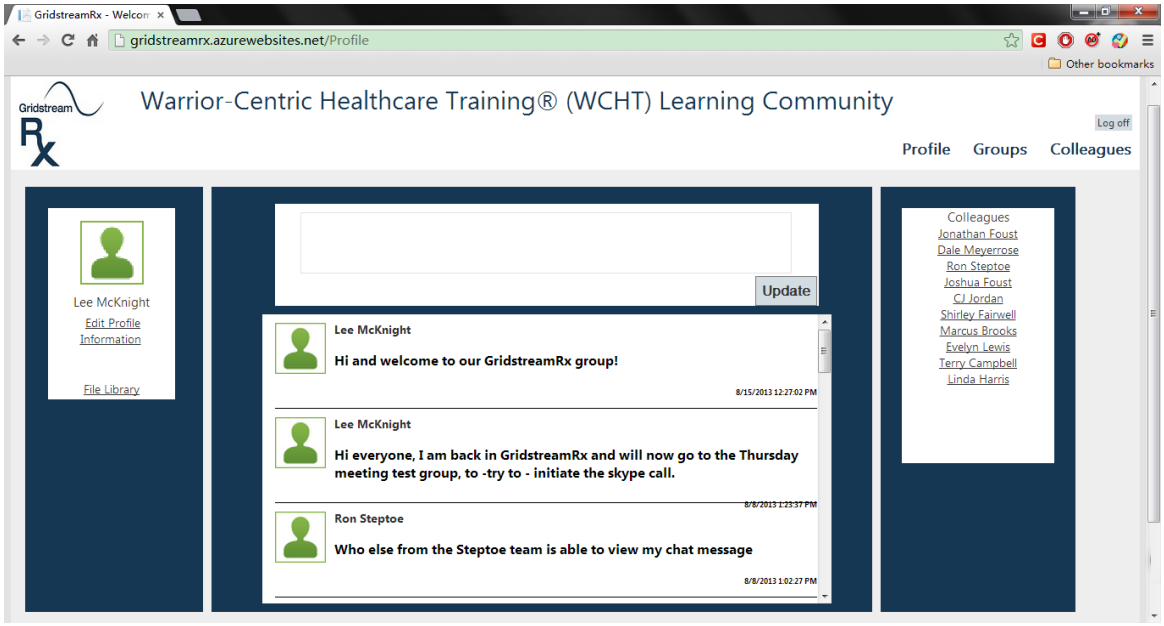
8. *For quality assurance, all Warrior-Centric Healthcare Training Learning Community members MUST do a pre-test of their equipment with Josh or another WiGiT student, prior to the date specified for a Steptoe Group activity and meeting in GridstreamRx.*

9. The File Library can be accessed below your Profile Information. Click on 'File Library' to find WCHT content. Files may be a text (word or pdf) document, PowerPoint presentation and/or recorded audio and video presentation. (The files may also be reached by clicking on the 'Files' tab which is viewable to the right of your screen, after you have entered your Group.)

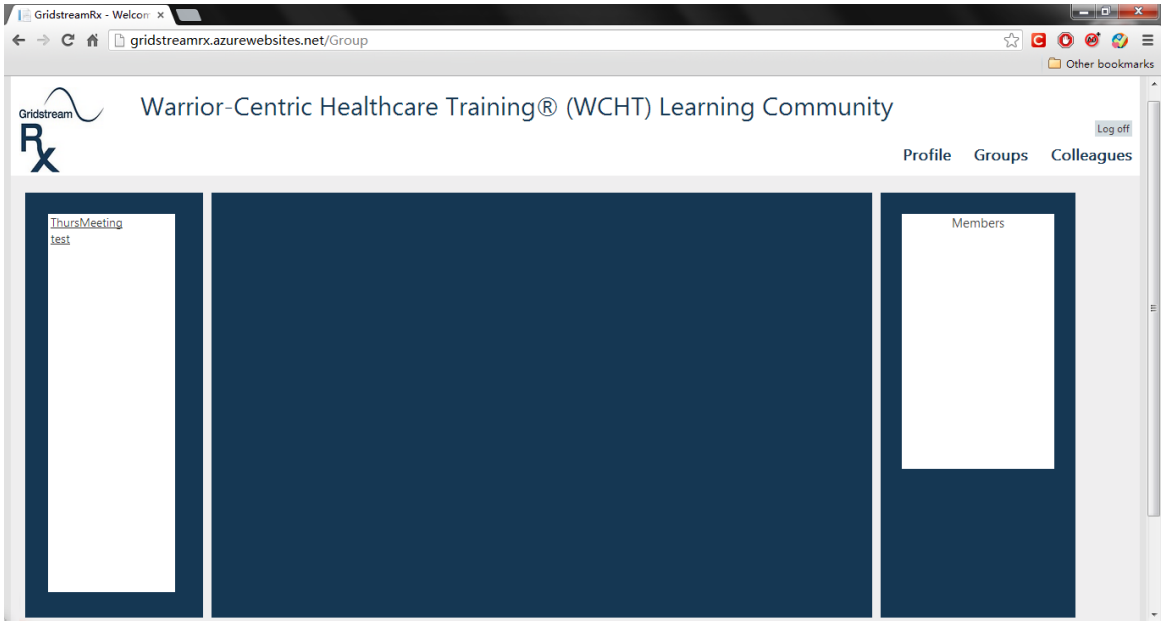




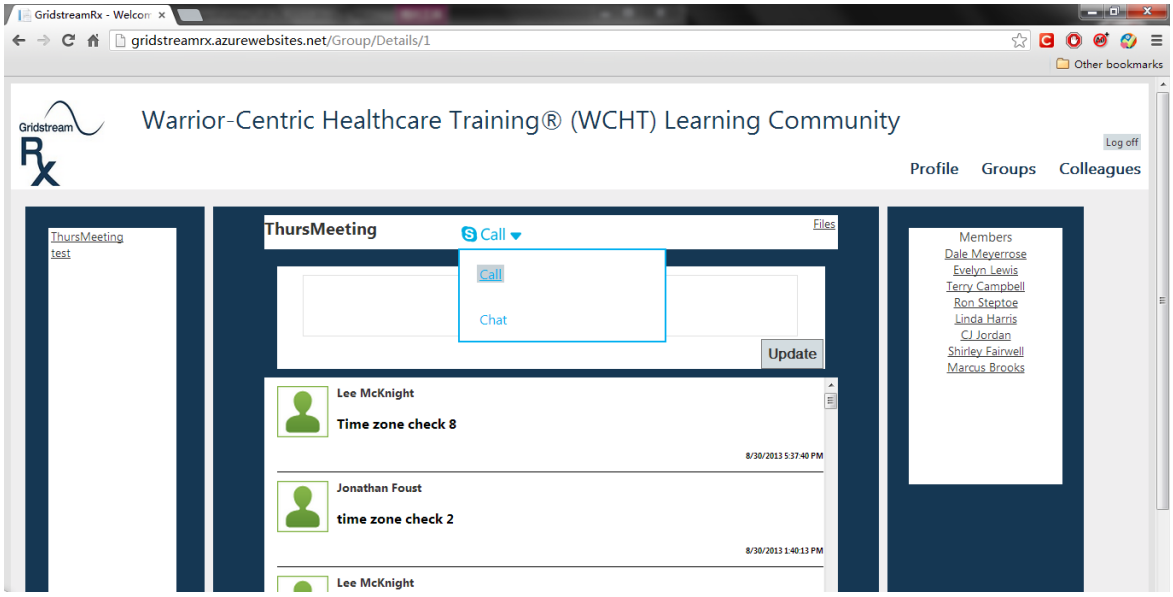
10. The chat or text box in the middle of your screen can be used by moving your cursor to the text box. Then, type a message to chat and share with your Learning Community Group, such as the 'Hi and welcome!' message below. After your type your message, click on 'Update' so that your colleagues are informed. Real-time or asynchronous chats or informal messages among WCHT colleagues and facilitators may be found here.



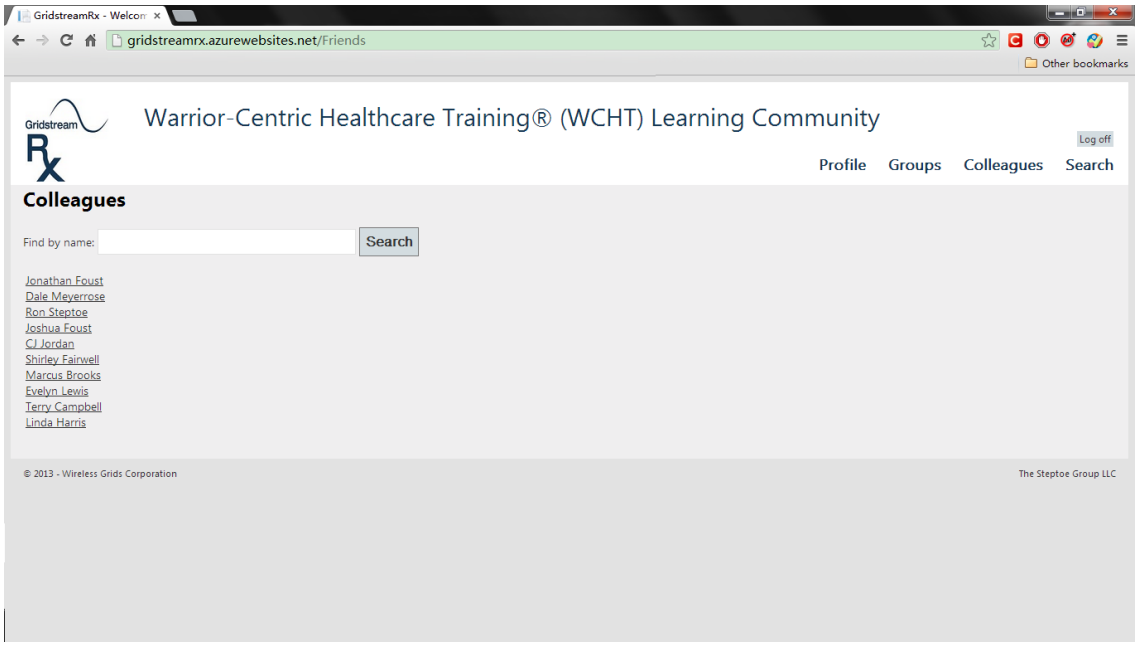
11. When you click Groups, you can see your groups listed to the left of the screen (‘Thurs Meeting’ is your Group). Group members are shown to the right.



12. For example, in the screenshot above, if you choose to click on ‘Thurs Meeting’ to the left of the example screenshot above, AND are a member of that Group, you can see the chat records, and begin a chat with everyone in the ‘Thurs Meeting’ Group (assuming they are online and available). Or you can make a Skype audio or video call with Group Colleagues by clicking on the Skype icon. See below Screenshot also from inside the ‘Thurs Meeting’ group.



13. Next, click on the 'Colleagues' button, to see all the colleagues in the learning community.



14. After reviewing this document, please email any questions or concerns about the GridstreamRx Learning Community Management System application to info@gridstreamrx.com and cc lee@wgrids.com.

15. For WCHT content or assignment-related questions, please contact your Facilitator.

About GridstreamRx

WGC, developer of GridstreamRx, is honored and pleased its learning community management system is supporting Steptoe Group's Warrior-Centric Healthcare Training® (WCHT). GridstreamRx is an edgeware 'gridlet' product developed by WGC CEO and Syracuse University School of Information Studies (iSchool) Professor Lee W. McKnight, initially for research purposes and use within the iSchool's Wireless Grids Innovation Testbed (WiGiT). Dale Meyerrose is facilitating this effort for Syracuse University research purposes.

The "GridstreamRx" beta product developed by WGC is a cloud to edge application, one of several new software applications, cloud services, and wireless devices emerging from the research undertaken over the past decade in the Wireless Grids Innovation Testbed (WiGiT) Lab at the iSchool. WiGiT partner firm WGC spun out of the Lab in 2004, and licensed intellectual property from the SU iSchool WiGiT Lab in 2005. WGC has rights to patents awarded to Syracuse University in 2012 and 2013.

WGC is sharing its 'Gridstream' product suite and other applications with WiGiT partners, in conformance with a Letter of Agreement with Syracuse University permitting experimental use for research purposes. The Letter of Agreement was most recently revised and updated in 2012 in concordance with Syracuse University Assistant Chancellor and CIO Chris Sedore. Please note Syracuse University Professor McKnight has served as CEO of WGC on four occasions since the founding of the firm. McKnight seeks to manage his conflict of interest in both WiGiT research and WGC products in consultation with all Syracuse University policy and legal obligations. (This has fortunately or unfortunately been facilitated by user reaction to WGC products and services as being (pre-GridstreamRx?) not ready for mass market use.) More information on WGC is at: http://wgrids.com.

WiGiT is a National Science Foundation Partnerships for Innovation project supported under grants #0917973 & #0227879. More information, including how to join (at no cost or obligation) WiGiT's Virtual Organization of campuses, companies, and communities distributed experimental test bed is at: http://wigit.ischool.syr.edu.

The views and opinions expressed in this document are those of the authors and may or may not be shared by Steptoe Group LLC, the National Science Foundation, Syracuse University or other institutions with which Lee McKnight is affiliated.

Appendix

‘How To’

Introduction to Skype in GridstreamRx

GridstreamRx will facilitate interaction with WCHT materials, group facilitators and colleagues.

When you are signed into GridstreamRx, Skype services are readily accessible. Skype has 300 million registered users of its freemium consumer and small business-oriented Microsoft Azure voice-over-IP service and instant messaging client.

Facetime is Apple’s Skype-comparable service, which may be more familiar to some.

If you do not have a Skype account, this ‘How To’ will assist you. Even if you do have an account already, this ‘How To’ is hopefully still helpful. It will remind you of Skype features and guide you through testing your own device, to confirm you will have a successful experience in the WCHT learning community.

Skype services allow users to communicate with peers by voice using a microphone and speakers, video by using a webcam, and instant messaging over the Internet. Phone calls may be placed to recipients on traditional telephone networks. Calls to other users with the Skype service on computers are free of charge. Calls to landline telephones and mobile phones are charged via a debit-based user account system. Skype has additional popular features, including file transfer and videoconferencing, both one to one and to small groups. Videoconferencing is a premium service; which at least one participant must have a linked debit account.

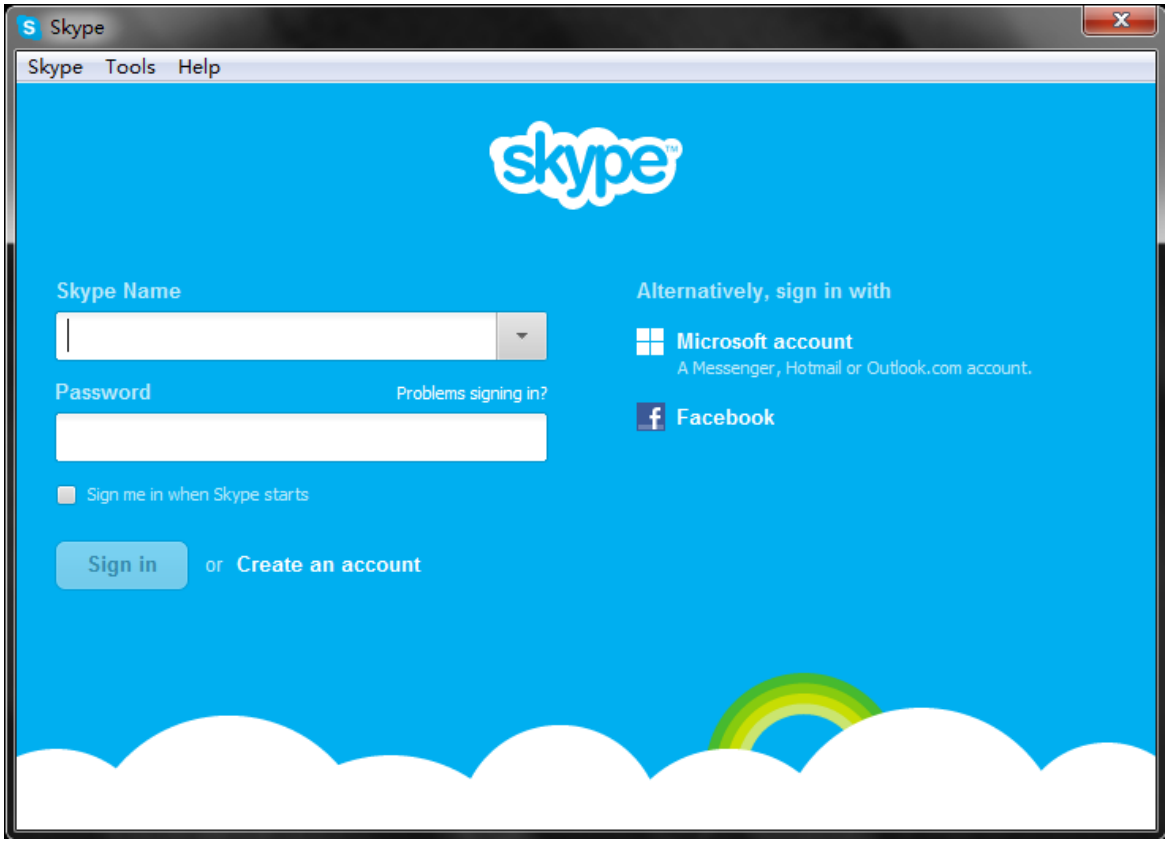
For WCHT colleagues, WGC is providing users access to all GridstreamRx features. Unlike most other VoIP services, Skype is a hybrid peer-to-peer and client–server system. It makes use of background processing on computers running Skype software, which is reflected in Skype's original proposed name of Sky Peer-to-Peer, as well as Microsoft Azure cloud services.

Skype in GridstreamRx Features

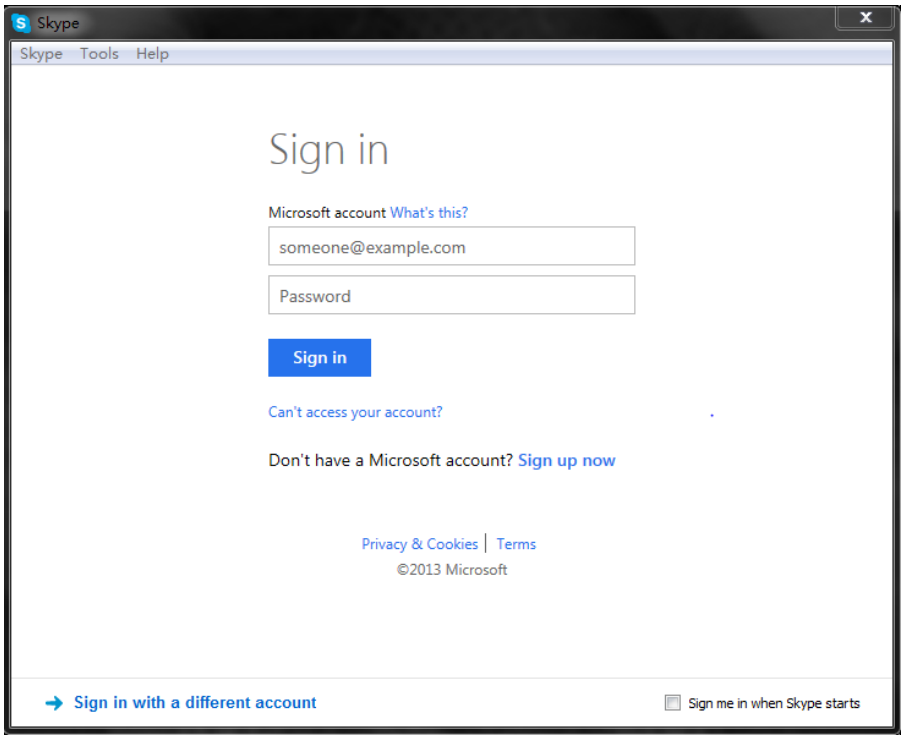
1. Skype in GridstreamRx supports voice and video services in the Warrior-Centric Healthcare Training® Learning Community.

2. If you don't have Skype on your computer, go to http://www.skype.com/ and download the software as guided for your particular device or system.

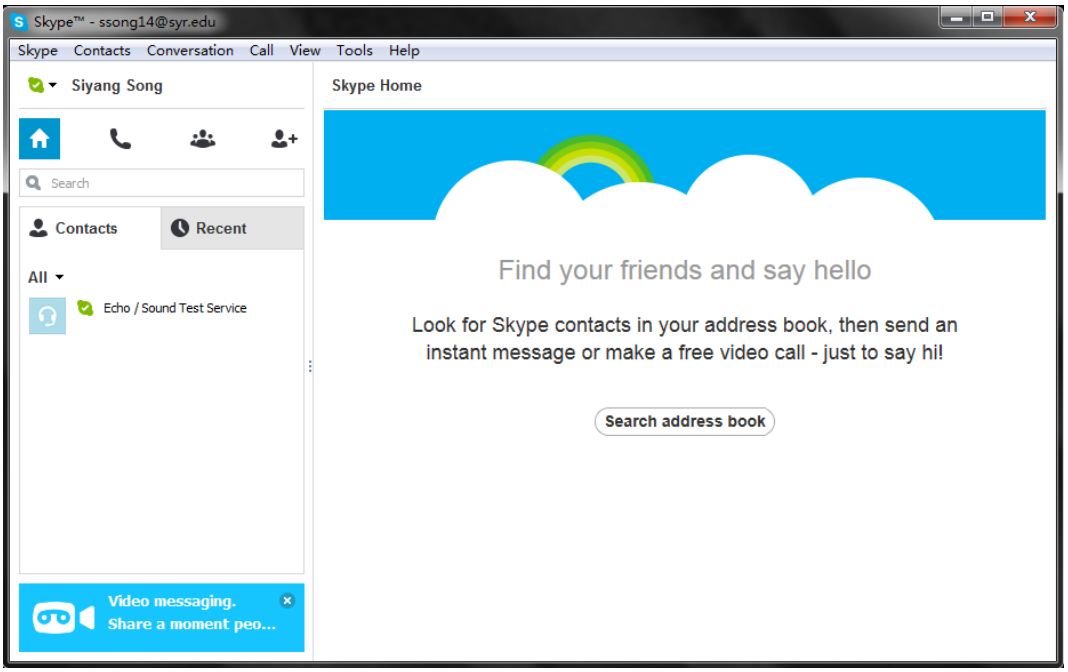
3. After you install Skype, you will see this screen. If you have a Skype account you can log into Skype at this screen.



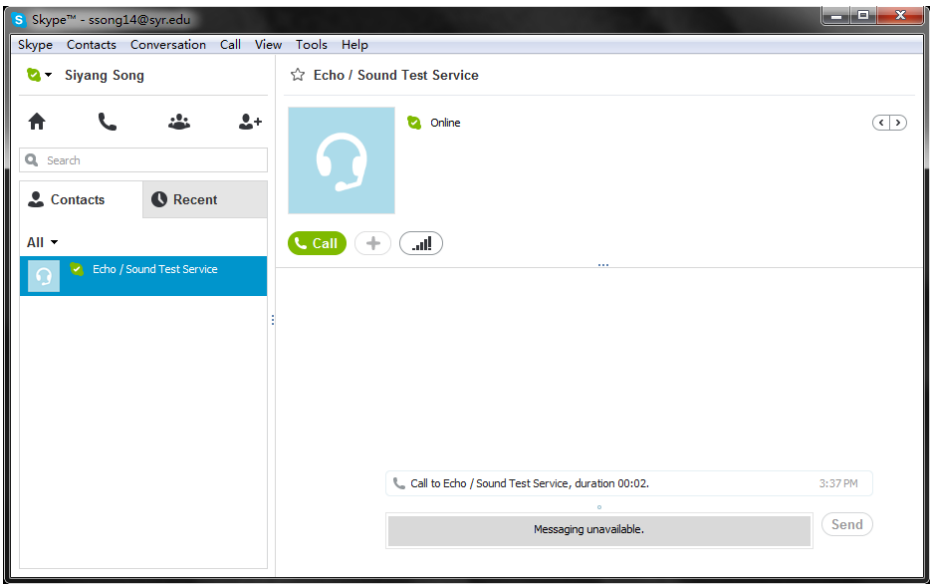
4. If you don't have a Skype account to link into GridstreamRx already, you can create an account, or sign in with your Microsoft or Facebook accounts, which can be readily linked to also permit access to Skype in GridstreamRx.



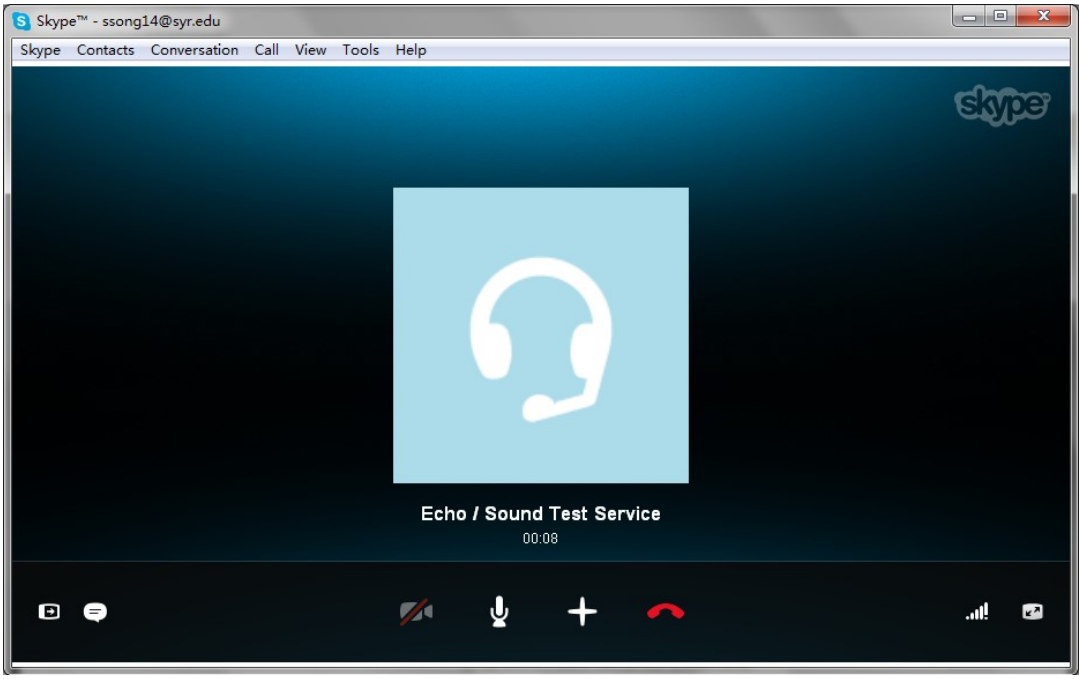
5. When you log into your account, you can find your friends and search your address book.



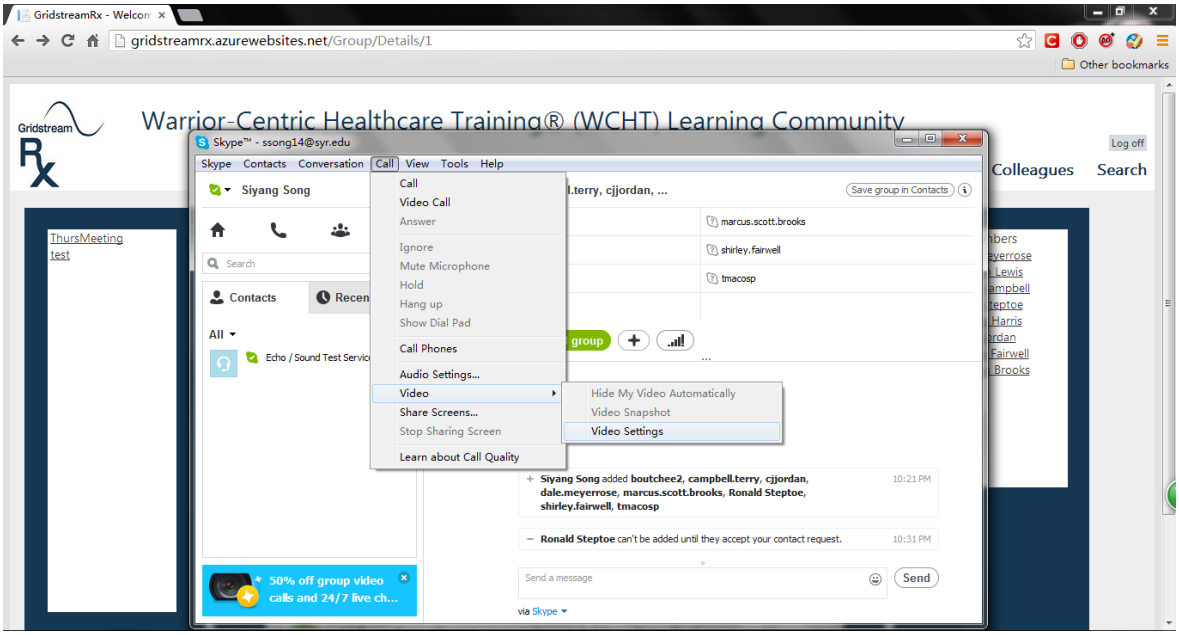
6. On the left side of the interface, there is an Echo/Sound Test Service which you can test your voice and microphone in the software. Skype assumes you have a headset with microphone; on some devices built-in speakers and microphones provide sufficient quality. Use the Echo/Sound Test Service to confirm your personal devices are in working order for videoconferencing. We strongly encourage you to use the test service again, to reconfirm your system is working properly, prior to any scheduled GridstreamRx WCHT learning community use, as shown below.



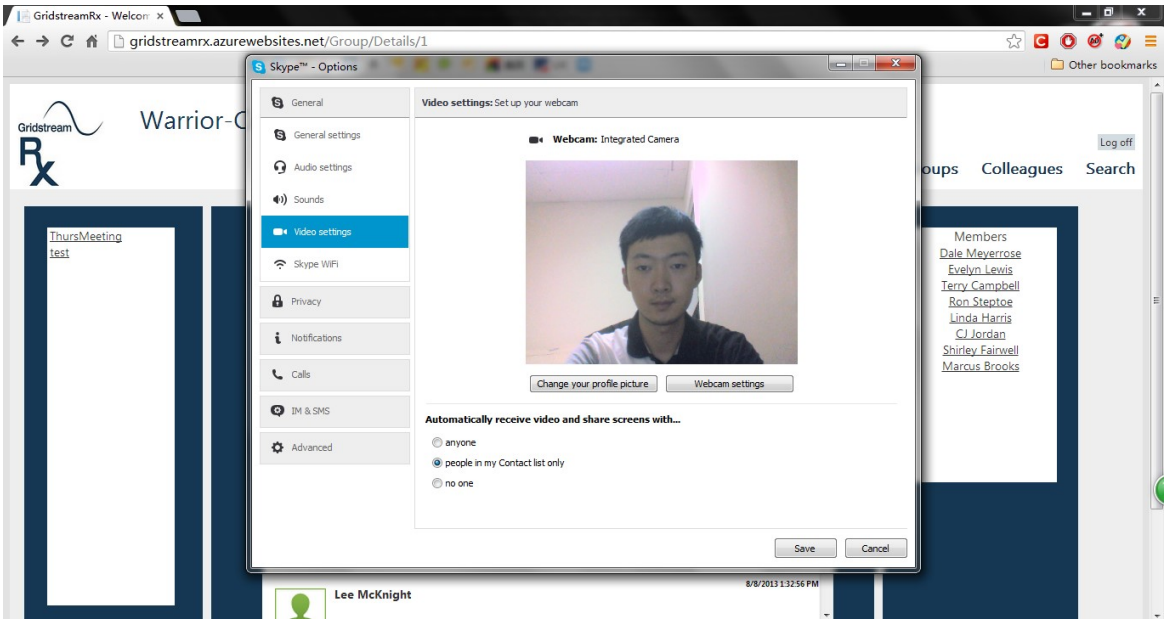
7. After you click the Call button, you will link to Skype service and there is a test that will give back your sound recording and test whether your device is working well.



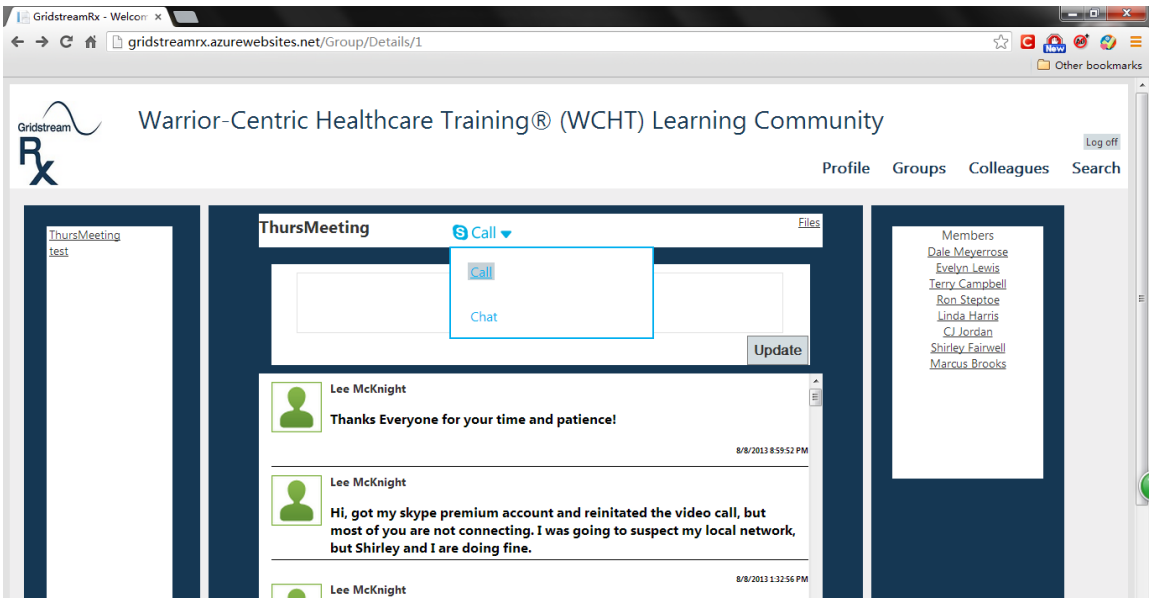
8. If you want to test whether your webcam works well, you can click Call button from the top, and choose Video, then Video Settings.



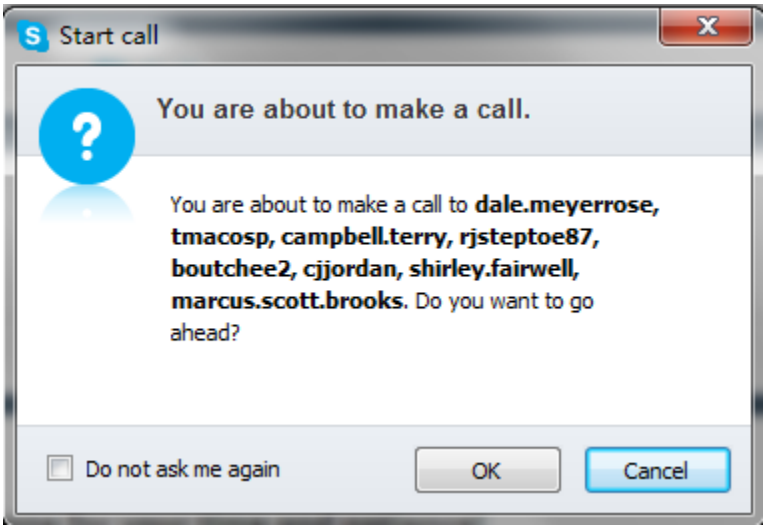
9. Then you can see whether your webcam support Skype and you can adjust your video capture filter and the webcam authority control. If you can see yourself that means your webcam works well.



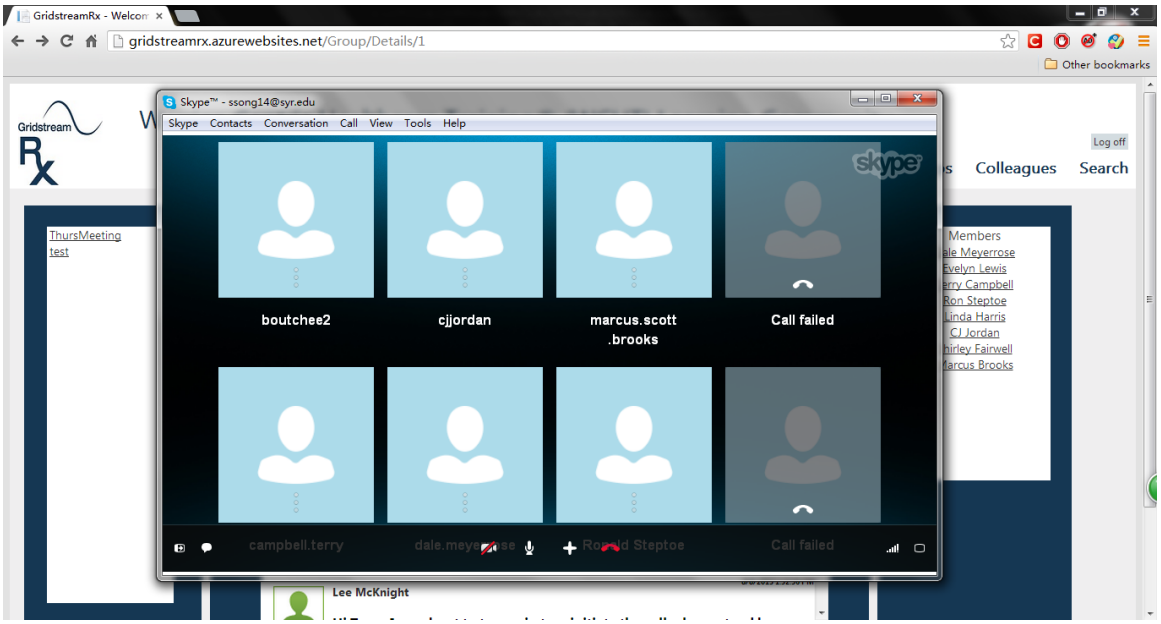
10. Then we go back to GridstreamRx website, http://gridstreamrx.azurewebsites.net/ , log in, and choose Groups option. After you choose your group in the left side, you can see the dialog box and the Skype sign.



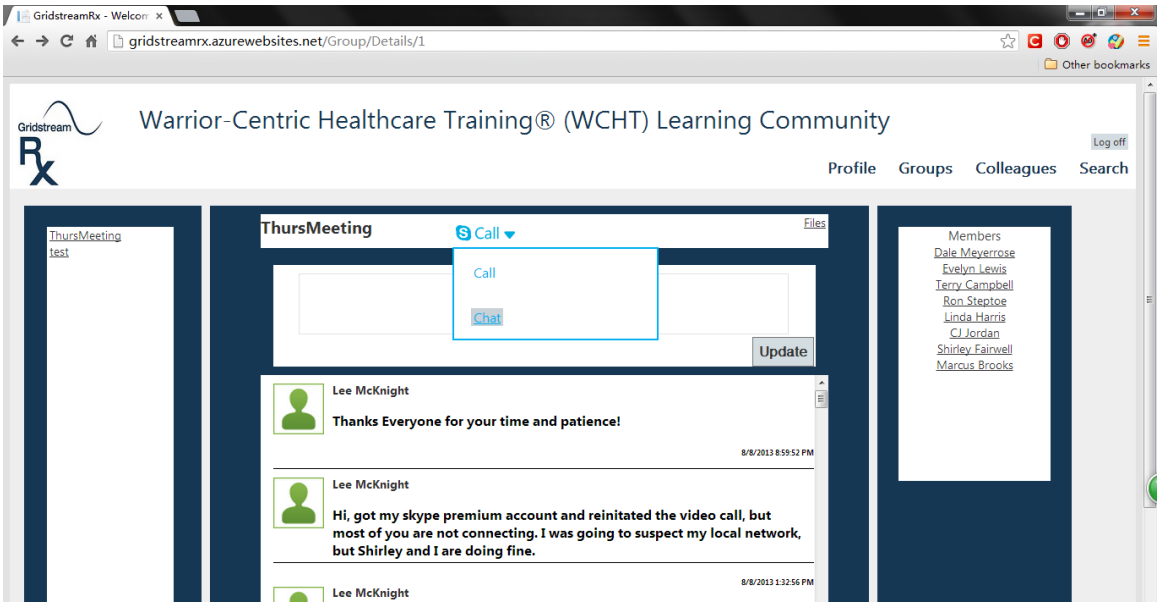
11. If you choose Call option, there will pop-up a start call warning box, it helps you make sure you want to make a video call to these members.



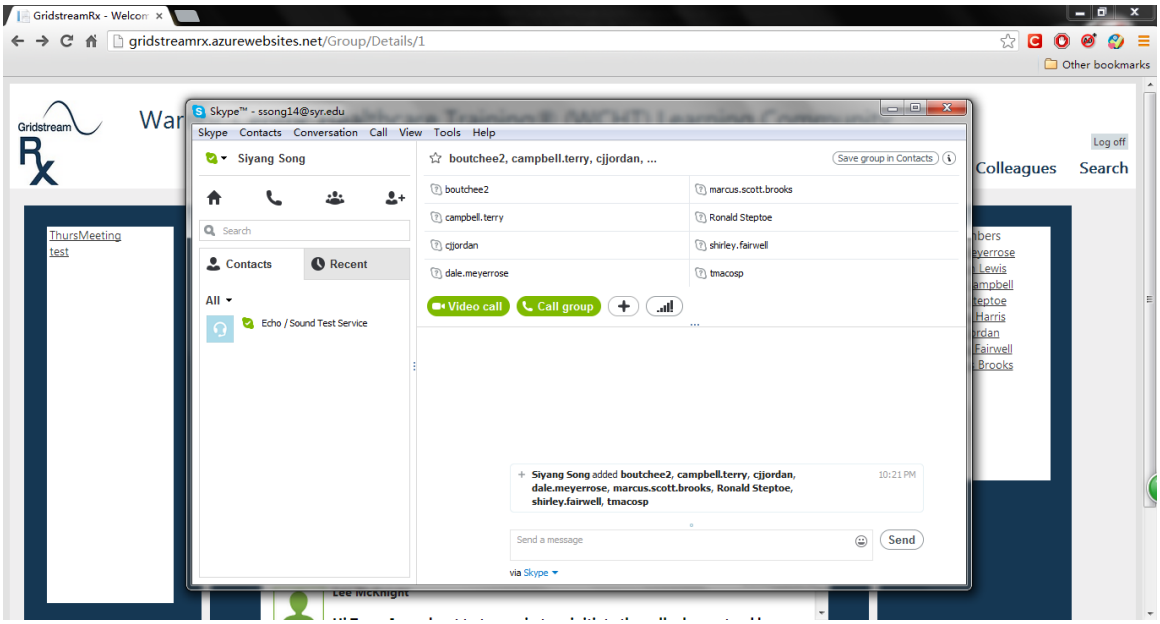
12. After you click OK, the call will be started and you can connect to everyone in the group. In this interface you can ban on video or mute and there's a button like in your phone which you can hang up the call.



13. You can also choose Chat mode from the previous page.



14. There will be a group chat dialog which you can type in what you want to say and you can also start a video call from this page.



APPENDIX M. **GridstreamRx PARTICIPATION REQUEST**

Dear WCHT Participants,

In our quest for continuous improvement, the Steptoe Group would like to solicit your voluntary participation in a one-hour networked training session to be held in conjunction with your ongoing Warrior-Centric Healthcare Training program.

There is a significant body of research with respect to social networking and the adult learning and telemedicine environments. As you can tell through the Steptoe Group's use of avatars, we believe that technology can provide important tools to enhance the training experience. We intend to remain on the leading edge of best practices—even pioneering methodologies to give the best possible care to our Active Duty members and veterans suffering from Post-Traumatic Stress Disorder and Traumatic Brain Injuries, and their families.

The Steptoe Group recently teamed with Syracuse University and the Wireless Grids Corporation to create a prototype information-sharing platform called GridstreamRx. We are evaluating the applicability of this secure application for future use and working with the developers to advance the technology behind it. Additionally, we are teaming with an independent researcher to validate and publish the findings regarding the viability of this approach and technology.

We are asking for your help in participating in a training session using GridstreamRx. If you agree, we will send you log-on credentials and directions on how to go to the web site in order to participate in the session which will be run during the training event.

We sincerely hope that if your schedule allows, you will sign up for and participate in one of the scheduled sessions. Please reply to this email with your willingness to participate and the time slot that best fits your schedule by November 15th. Thank you in advance for your careful consideration.

Sincerely

Ronald J. Steptoe, CMR
CEO
Steptoe Group, LLC

APPENDIX N. **GridstreamRx QUESTIONNAIRE**

These questions will be asked upon completion of the GridstreamRx training session.

1. How comfortable were you using GridstreamRx as a part of this training session?
   - ○ Very comfortable
   - ○ Comfortable
   - ○ Neutral
   - ○ Uncomfortable
   - ○ Very uncomfortable

2. How comfortable were you using social networking as a part of this training session?
   - ○ Very comfortable
   - ○ Comfortable
   - ○ Neutral
   - ○ Uncomfortable
   - ○ Very uncomfortable

3. Did using GridstreamRx enhance this training experience?
   - ○ Definitely
   - ○ Probably
   - ○ Neutral
   - ○ Probably not
   - ○ Definitely not

4. Did using social networking enhance this training experience?
   - ○ Definitely
   - ○ Probably
   - ○ Neutral
   - ○ Probably not
   - ○ Definitely not

5. To what degree did GridstreamRx technology improve the quality of your learning during this experience?

○ Great degree
○ Some degree
○ Neutral
○ Did not improve the learning experience
○ Detracted from the learning experience

6. What portion of this training experience was most helped by GridstreamRx technology?

○ Networking with colleagues
○ Networking with facilitators/trainers
○ Information delivery/dissemination
○ Culture assimilation
○ Case studies
○ Other:_____

7. What did you like most about GridstreamRx technology as you experienced it during this training?

○ Reliability
○ Ease of use
○ Applications
○ Security
○ No comment
○ Other _____

8. What about GridstreamRx technology needed the most improvement?

○ Needs to be more reliable
○ Needs more applications appropriate to this medical providing training environment
○ Needs to be more intuitive
○ No comment
○ Other _____

9. What is your assessment of GridstreamRx technology as a social networking technology?

○ Not sufficiently developed/reliable at this time but could grow into a good social networking medium
○ Works well as a social networking technology
○ Inappropriate as a social networking technology
○ No comment
○ Other _____

10. Select the word or phrase that best describes your experience with GridstreamRx in this training environment.

○ Feature rich
○ Plenty of features but not fully functional
○ Adequate
○ Somewhat unsatisfactory
○ Nearly featureless

11. Would GridstreamRx technology improve your ability to deliver care to your future active duty and veteran patients, and their families?

○ Definitely
○ Probably
○ Neutral
○ Probably not
○ Definitely not

12. Are there potential negative impacts in using GridstreamRx in getting to know your future active duty and veteran patients, and their families, or with your ability to administer to them?

○ Definitely
○ Probably
○ Neutral
○ Probably not
○ Definitely not

12a. If your answer is “Definitely” or “Probably,” describe why you think so?

13. Please add any other comments that you may have with respect to this training experience and its potential use of technology as part of the learning process or administering to your patients and their families.

APPENDIX O. **CRONBACH'S ALPHA**

Cronbach's Alpha	0.889780664
Split-Half (odd-even) Correlation	0.632030388
Spearman-Brown Prophecy	0.774532623
Mean for Test	22.8516129
Standard Deviation for Test	5.230115706
KR21	3.373738523
KR20	3.992790678

Reliability Calculator
created by Del Siegle (dsiegle@uconn.edu)

There are rows or columns which are not complete.

Questions	Subjects
7	31

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7
Subject1	3	5	3	4	4	4.5	0
Subject2	4	5	3	5	5	5	0
Subject3	1.5	4.6	2	5	5	5	1
Subject4	3.5	5	3	5	4.5	4	1
Subject5	5	4.8	3	5	4.5	5	3
Subject6	4		3	5	4	5	3
Subject7	4	4		3	1	3	0
Subject8	3.5	4.8	3	5	5	5	4
Subject9	4.5	4.4		3	1	3	0
Subject10	5	5	3	4	4.5	5	2
Subject11	5	5	3	4	5	5	1
Subject12	5	3.8	3	4	5	4	2
Subject13	2.5	5	2	5	5	5	4
Subject14	4	4.8	3	4	5	5	1
Subject15	3.5	4.8	3	4	4	4	2
Subject16	4			4	4	3	2
Subject17	3.5		3	4	3.5	3.5	1
Subject18	3.5	4.6		3	2.5	3.5	0
Subject19	3.5	4.2		3	3	3	0
Subject20	3	4.4		3	3	3.5	1
Subject21	3.5	4		3	3.5	3.5	1
Subject22	4.5	4.4	3	4	4	4.5	3
Subject23	3	3.8	3	3	4.5	4.5	2
Subject24	4	3.6		2	2.5	2	0
Subject25	3	4.4	3	5	5	5	3
Subject26	4	4.6	3	4	5	5	2
Subject27	3.5	4.8	3	4	3	4	1
Subject28	4.5	5	1	2	2	2	-4
Subject29	5	3.6		3	3	3	0
Subject30	5	5	2	3	3	3.5	0
Subject31	3.5	5	3	4	5	4	2
Subject32							
Subject33							
Subject34							
Subject35							

APPENDIX P. **REGRESSION ANALYSIS CALCULATIONS**

PARTICIPANT CONFIDENCE TO INFORMATION QUALITY

Linear Regression

Regression Statistics

R	0.057
R Square	0.003
Adjusted R Square	-0.035
S	0.475
Total number of observations	28

IQ = 4.6669 - 0.0304 * PC

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	0.019	0.019	0.084	0.774
Residual	26.	5.871	0.226		
Total	27.	5.89			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	4.667	0.413	3.819	5.515	11.312	1.534E-11	*Yes*
PC	-0.03	0.105	-0.246	0.185	-0.29	0.774	*No*
T (5%)	2.056						

LCL - Lower value of a reliable interval (LCL)
UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	4.576	0.424	0.91
2	4.545	0.455	0.976
3	4.621	-0.021	-0.046
4	4.56	0.44	0.943
5	4.515	0.285	0.612
6	4.545	-0.545	-1.169
7	4.56	0.24	0.514
8	4.53	-0.13	-0.279
9	4.515	0.485	1.041
10	4.515	0.485	1.041
11	4.515	-0.715	-1.533
12	4.591	0.409	0.878
13	4.545	0.255	0.547
14	4.56	0.24	0.514
15	4.56	0.04	0.085
16	4.56	-0.36	-0.773
17	4.576	-0.176	-0.376
18	4.56	-0.56	-1.202
19	4.53	-0.13	-0.279
20	4.576	-0.776	-1.663
21	4.545	-0.945	-2.027
22	4.576	-0.176	-0.376
23	4.545	0.055	0.118
24	4.56	0.24	0.514
25	4.53	0.47	1.008
26	4.515	-0.915	-1.961
27	4.515	0.485	1.041
28	4.56	0.44	0.943

PARTICIPANT CONFIDENCE TO SYSTEMS QUALITY

Comparing Means [Paired two-sample t-test]

Descriptive Statistics

VAR	Sample size	Mean	Variance
PRE21+22	31	3.839	0.69
POST25+26	31	4.016	0.725

Summary

Degrees Of Freedom	30	Hypothesized Mean Difference	0.E+0
Test Statistics	0.837	Pooled Variance	0.707

Two-tailed distribution

p-level	0.409	t Critical Value (5%)	2.042

One-tailed distribution

p-level	0.205	t Critical Value (5%)	1.697
Pearson Correlation Coefficient	0.016		

G-criterion

Test Statistics	0.055	p-level	0.126
Critical Value (5%)	0.143		

Pagurova criterion

Test Statistics	0.831	p-level	0.59
Ratio of variances parameter	0.488	Critical Value (5%)	0.063

PARTICIPANT CONFIDENCE TO SERVICE QUALITY

Linear Regression

Regression Statistics

R	0.26
R Square	0.067
Adjusted R Square	0.035
S	0.882
Total number of observations	31

SERQ = 4.9158 - 0.2806 * PC

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	1.629	1.629	2.094	0.159
Residual	29.	22.564	0.778		
Total	30.	24.194			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	4.916	0.761	3.359	6.472	6.459	0.	*Yes*
PC	-0.281	0.194	-0.677	0.116	-1.447	0.159	*No*

T (5%) 2.045

LCL - Lower value of a reliable interval (LCL)

UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	4.074	-0.074	-0.085
2	3.793	1.207	1.391
3	4.495	0.505	0.582
4	3.934	1.066	1.229
5	3.513	1.487	1.715
6	3.793	1.207	1.391
7	3.793	-0.793	-0.915
8	3.934	1.066	1.229
9	3.653	-0.653	-0.753
10	3.513	0.487	0.562
11	3.513	0.487	0.562
12	3.513	0.487	0.562
13	4.214	0.786	0.906
14	3.793	0.207	0.238
15	3.934	0.066	0.076
16	3.793	0.207	0.238
17	3.934	0.066	0.076
18	3.934	-0.934	-1.077
19	3.934	-0.934	-1.077
20	4.074	-1.074	-1.238
21	3.934	-0.934	-1.077
22	3.653	0.347	0.4
23	4.074	-1.074	-1.238
24	3.793	-1.793	-2.068
25	4.074	0.926	1.068
26	3.793	0.207	0.238
27	3.934	0.066	0.076
28	3.653	-1.653	-1.906
29	3.513	-0.513	-0.591
30	3.513	-0.513	-0.591
31	3.934	0.066	0.076

INFORMATION QUALITY TO USE

Linear Regression

Regression Statistics

R	0.335
R Square	0.112
Adjusted R Square	0.078
S	1.198
Total number of observations	28

USE =- 0.2356 + 0.8956 * IQ

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	4.724	4.724	3.293	0.081
Residual	26.	37.303	1.435		
Total	27.	42.027			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	-0.236	2.257	-4.875	4.404	-0.104	0.918	*No*
IQ	0.896	0.494	-0.119	1.91	1.815	0.081	*No*
T (5%)	2.056						

LCL - Lower value of a reliable interval (LCL)
UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	4.242	-0.242	-0.206
2	4.242	0.758	0.645
3	3.884	1.116	0.949
4	4.242	0.258	0.219
5	4.063	0.437	0.372
6	3.347	-2.347	-1.997
7	4.063	0.937	0.797
8	3.705	-2.705	-2.301
9	4.242	0.258	0.219
10	4.242	0.758	0.645
11	3.168	1.832	1.559
12	4.242	0.758	0.645
13	4.063	0.937	0.797
14	4.063	-0.063	-0.054
15	3.884	-1.384	-1.178
16	3.526	-0.526	-0.447
17	3.705	-0.705	-0.6
18	3.347	0.153	0.13
19	3.705	0.295	0.251
20	3.168	1.332	1.134
21	2.988	-0.488	-0.416
22	3.705	1.295	1.102
23	3.884	1.116	0.949
24	4.063	-1.063	-0.905
25	4.242	-2.242	-1.908
26	2.988	0.012	0.01
27	4.242	-1.242	-1.057
28	4.242	0.758	0.645

INFORMATION QUALITY TO USER SATISFACTION

Linear Regression

Regression Statistics

R	0.455
R Square	0.207
Adjusted R Square	0.177
S	0.85
Total number of observations	28

USAT =- 0.0986 + 0.9126 * IQ

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	4.905	4.905	6.796	0.015
Residual	26.	18.765	0.722		
Total	27.	23.67			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	-0.099	1.601	-3.389	3.192	-0.062	0.951	*No*
IQ	0.913	0.35	0.193	1.632	2.607	0.015	*Yes*
T (5%)	2.056						

LCL - Lower value of a reliable interval (LCL)
UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	4.464	0.036	0.043
2	4.464	0.536	0.643
3	4.099	0.901	1.081
4	4.464	-0.464	-0.557
5	4.282	0.718	0.862
6	3.552	-0.552	-0.662
7	4.282	0.718	0.862
8	3.917	-0.917	-1.1
9	4.464	0.536	0.643
10	4.464	0.536	0.643
11	3.369	0.631	0.757
12	4.464	0.536	0.643
13	4.282	0.718	0.862
14	4.282	-0.282	-0.338
15	4.099	-0.599	-0.719
16	3.734	-0.734	-0.881
17	3.917	-0.417	-0.5
18	3.552	-0.052	-0.062
19	3.917	0.583	0.7
20	3.369	1.131	1.356
21	3.187	-1.187	-1.423
22	3.917	1.083	1.299
23	4.099	0.901	1.081
24	4.282	-0.282	-0.338
25	4.464	-2.464	-2.956
26	3.187	-0.187	-0.224
27	4.464	-0.964	-1.157
28	4.464	-0.464	-0.557

SYSTEM QUALITY TO USE

Linear Regression

Regression Statistics

R	0.507
R Square	0.257
Adjusted R Square	0.22
S	0.739
Total number of observations	22

USE = 2.1163 + 0.8023 * SYSQ

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	3.775	3.775	6.914	0.016
Residual	20.	10.919	0.546		
Total	21.	14.693			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	2.116	0.861	0.321	3.911	2.459	0.023	*Yes*
SYSQ	0.802	0.305	0.166	1.439	2.629	0.016	*Yes*
T (5%)	2.086						

LCL - Lower value of a reliable interval (LCL)
UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	4.523	-0.523	-0.726
2	4.523	0.477	0.661
3	3.721	1.279	1.774
4	4.523	-0.023	-0.032
5	4.523	-0.023	-0.032
6	4.523	-0.523	-0.726
7	4.523	0.477	0.661
8	4.523	-0.023	-0.032
9	4.523	0.477	0.661
10	4.523	0.477	0.661
11	3.721	1.279	1.774
12	4.523	0.477	0.661
13	4.523	-0.523	-0.726
14	4.523	-1.023	-1.419
15	4.523	-0.523	-0.726
16	4.523	-0.023	-0.032
17	4.523	0.477	0.661
18	4.523	0.477	0.661
19	4.523	-1.523	-2.113
20	2.919	-0.919	-1.274
21	3.721	-0.721	-1.
22	4.523	0.477	0.661

SYSTEM QUALITY TO USER SATISFACTION

Linear Regression

Regression Statistics

R	0.552
R Square	0.305
Adjusted R Square	0.27
S	0.65
Total number of observations	22

USAT = 2.2287 + 0.7946 * SYSQ

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	3.702	3.702	8.767	0.008
Residual	20.	8.446	0.422		
Total	21.	12.148			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	2.229	0.757	0.65	3.808	2.945	0.008	*Yes*
SYSQ	0.795	0.268	0.235	1.354	2.961	0.008	*Yes*

T (5%) 2.086

LCL - Lower value of a reliable interval (LCL)

UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	4.612	-0.112	-0.177
2	4.612	0.388	0.611
3	3.818	1.182	1.864
4	4.612	-0.612	-0.966
5	4.612	0.388	0.611
6	4.612	0.388	0.611
7	4.612	0.388	0.611
8	4.612	0.388	0.611
9	4.612	0.388	0.611
10	4.612	-0.612	-0.966
11	3.818	1.182	1.864
12	4.612	0.388	0.611
13	4.612	-0.612	-0.966
14	4.612	-1.112	-1.754
15	4.612	-0.112	-0.177
16	4.612	-0.112	-0.177
17	4.612	0.388	0.611
18	4.612	0.388	0.611
19	4.612	-0.612	-0.966
20	3.023	-1.023	-1.614
21	3.818	-0.318	-0.501
22	4.612	-0.612	-0.966

SERVICE QUALITY TO USE

Linear Regression

Regression Statistics

R	0.742
R Square	0.55
Adjusted R Square	0.534
S	0.809
Total number of observations	31

USE = 0.0793 + 0.9793 * SERQ

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	23.204	23.204	35.436	0.
Residual	29.	18.99	0.655		
Total	30.	42.194			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	0.079	0.648	-1.246	1.405	0.122	0.903	*No*
SERQ	0.979	0.165	0.643	1.316	5.953	0.	*Yes*

T (5%) 2.045
LCL - Lower value of a reliable interval (LCL)
UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	3.997	0.003	0.004
2	4.976	0.024	0.03
3	4.976	0.024	0.03
4	4.976	-0.476	-0.598
5	4.976	-0.476	-0.598
6	4.976	-0.976	-1.227
7	3.017	-2.017	-2.536
8	4.976	0.024	0.03
9	3.017	-2.017	-2.536
10	3.997	0.503	0.633
11	3.997	1.003	1.261
12	3.997	1.003	1.261
13	4.976	0.024	0.03
14	3.997	1.003	1.261
15	3.997	0.003	0.004
16	3.997	0.003	0.004
17	3.997	-0.497	-0.624
18	3.017	-0.517	-0.65
19	3.017	-0.017	-0.022
20	3.017	-0.017	-0.022
21	3.017	0.483	0.607
22	3.997	0.003	0.004
23	3.017	1.483	1.864
24	2.038	0.462	0.581
25	4.976	0.024	0.03
26	3.997	1.003	1.261
27	3.997	-0.997	-1.253
28	2.038	-0.038	-0.048
29	3.017	-0.017	-0.022
30	3.017	-0.017	-0.022
31	3.997	1.003	1.261

SERVICE QUALITY TO USER SATISFACTION

Linear Regression

Regression Statistics

R	0.824
R Square	0.679
Adjusted R Square	0.668
S	0.536
Total number of observations	31

USAT = 0.7540 + 0.8540 * SERQ

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	17.645	17.645	61.48	0.
Residual	29.	8.323	0.287		
Total	30.	25.968			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	0.754	0.429	-0.123	1.631	1.757	0.089	*No*
SERQ	0.854	0.109	0.631	1.077	7.841	0.	*Yes*
T (5%)	2.045						

LCL - Lower value of a reliable interval (LCL)
UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	4.17	0.33	0.627
2	5.024	-0.024	-0.046
3	5.024	-0.024	-0.046
4	5.024	-1.024	-1.944
5	5.024	-0.024	-0.046
6	5.024	-0.024	-0.046
7	3.316	-0.316	-0.6
8	5.024	-0.024	-0.046
9	3.316	-0.316	-0.6
10	4.17	0.83	1.576
11	4.17	0.83	1.576
12	4.17	-0.17	-0.323
13	5.024	-0.024	-0.046
14	4.17	0.83	1.576
15	4.17	-0.17	-0.323
16	4.17	-1.17	-2.221
17	4.17	-0.67	-1.272
18	3.316	0.184	0.349
19	3.316	-0.316	-0.6
20	3.316	0.184	0.349
21	3.316	0.184	0.349
22	4.17	0.33	0.627
23	3.316	1.184	2.248
24	2.462	-0.462	-0.877
25	5.024	-0.024	-0.046
26	4.17	0.83	1.576
27	4.17	-0.17	-0.323
28	2.462	-0.462	-0.877
29	3.316	-0.316	-0.6
30	3.316	0.184	0.349
31	4.17	-0.17	-0.323

USE TO USER SATISFACTION

Linear Regression

Regression Statistics

R	0.805
R Square	0.649
Adjusted R Square	0.637
S	0.561
Total number of observations	31

USAT = 1.6067 + 0.6319 * USE

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	16.847	16.847	53.564	0.
Residual	29.	9.121	0.315		
Total	30.	25.968			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	1.607	0.346	0.898	2.315	4.638	0.	*Yes*
USE	0.632	0.086	0.455	0.808	7.319	0.	*Yes*

T (5%) 2.045

LCL - Lower value of a reliable interval (LCL)

UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	4.134	0.366	0.663
2	4.766	0.234	0.424
3	4.766	0.234	0.424
4	4.45	-0.45	-0.816
5	4.45	0.55	0.997
6	4.134	0.866	1.57
7	2.239	0.761	1.381
8	4.766	0.234	0.424
9	2.239	0.761	1.381
10	4.45	0.55	0.997
11	4.766	0.234	0.424
12	4.766	-0.766	-1.389
13	4.766	0.234	0.424
14	4.766	0.234	0.424
15	4.134	-0.134	-0.243
16	4.134	-1.134	-2.057
17	3.818	-0.318	-0.577
18	3.186	0.314	0.569
19	3.502	-0.502	-0.911
20	3.502	-0.002	-0.004
21	3.818	-0.318	-0.577
22	4.134	0.366	0.663
23	4.45	0.05	0.09
24	3.186	-1.186	-2.152
25	4.766	0.234	0.424
26	4.766	0.234	0.424
27	3.502	0.498	0.903
28	2.87	-0.87	-1.579
29	3.502	-0.502	-0.911
30	3.502	-0.002	-0.004
31	4.766	-0.766	-1.389

USER SATISFACTION TO USE

Linear Regression

Regression Statistics

R	0.805
R Square	0.649
Adjusted R Square	0.637
S	0.715
Total number of observations	31

USE =- 0.3012 + 1.0267 * USAT

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	27.373	27.373	53.564	0.
Residual	29.	14.82	0.511		
Total	30.	42.194			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	-0.301	0.58	-1.488	0.885	-0.519	0.607	*No*
USAT	1.027	0.14	0.74	1.314	7.319	0.	*Yes*

T (5%) 2.045

LCL - Lower value of a reliable interval (LCL)

UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	4.319	-0.319	-0.454
2	4.832	0.168	0.239
3	4.832	0.168	0.239
4	3.806	0.694	0.988
5	4.832	-0.332	-0.473
6	4.832	-0.832	-1.184
7	2.779	-1.779	-2.531
8	4.832	0.168	0.239
9	2.779	-1.779	-2.531
10	4.832	-0.332	-0.473
11	4.832	0.168	0.239
12	3.806	1.194	1.699
13	4.832	0.168	0.239
14	4.832	0.168	0.239
15	3.806	0.194	0.277
16	2.779	1.221	1.737
17	3.292	0.208	0.296
18	3.292	-0.792	-1.127
19	2.779	0.221	0.315
20	3.292	-0.292	-0.416
21	3.292	0.208	0.296
22	4.319	-0.319	-0.454
23	4.319	0.181	0.258
24	1.752	0.748	1.064
25	4.832	0.168	0.239
26	4.832	0.168	0.239
27	3.806	-0.806	-1.146
28	1.752	0.248	0.353
29	2.779	0.221	0.315
30	3.292	-0.292	-0.416
31	3.806	1.194	1.699

USE TO PERCEIVED NET BENEFIT

Linear Regression

Regression Statistics

R	0.631
R Square	0.398
Adjusted R Square	0.378
S	1.234
Total number of observations	31

PNB =- 1.9702 + 0.8326 * USE

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	29.247	29.247	19.202	0.
Residual	29.	44.172	1.523		
Total	30.	73.419			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	-1.97	0.762	-3.529	-0.411	-2.585	0.015	*Yes*
USE	0.833	0.19	0.444	1.221	4.382	0.	*Yes*

T (5%) 2.045

LCL - Lower value of a reliable interval (LCL)

UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	1.36	-1.36	-1.121
2	2.193	-2.193	-1.807
3	2.193	-1.193	-0.983
4	1.776	-0.776	-0.64
5	1.776	1.224	1.008
6	1.36	1.64	1.351
7	-1.138	1.138	0.938
8	2.193	1.807	1.489
9	-1.138	1.138	0.938
10	1.776	0.224	0.184
11	2.193	-1.193	-0.983
12	2.193	-0.193	-0.159
13	2.193	1.807	1.489
14	2.193	-1.193	-0.983
15	1.36	0.64	0.527
16	1.36	0.64	0.527
17	0.944	0.056	0.046
18	0.111	-0.111	-0.092
19	0.528	-0.528	-0.435
20	0.528	0.472	0.389
21	0.944	0.056	0.046
22	1.36	1.64	1.351
23	1.776	0.224	0.184
24	0.111	-0.111	-0.092
25	2.193	0.807	0.665
26	2.193	-0.193	-0.159
27	0.528	0.472	0.389
28	-0.305	-3.695	-3.045
29	0.528	-0.528	-0.435
30	0.528	-0.528	-0.435
31	2.193	-0.193	-0.159

USER SATISFACTION TO PERCEIVED NET BENEFIT

Linear Regression

Regression Statistics

R	0.682
R Square	0.465
Adjusted R Square	0.447
S	1.164
Total number of observations	31

PNB =- 3.3975 + 1.1466 * USAT

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	1.	34.139	34.139	25.204	0.
Residual	29.	39.281	1.355		
Total	30.	73.419			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	-3.398	0.944	-5.329	-1.466	-3.598	0.001	*Yes*
USAT	1.147	0.228	0.679	1.614	5.02	0.	*Yes*

T (5%) 2.045

LCL - Lower value of a reliable interval (LCL)

UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	1.762	-1.762	-1.54
2	2.335	-2.335	-2.041
3	2.335	-1.335	-1.167
4	1.189	-0.189	-0.165
5	2.335	0.665	0.581
6	2.335	0.665	0.581
7	0.042	-0.042	-0.037
8	2.335	1.665	1.455
9	0.042	-0.042	-0.037
10	2.335	-0.335	-0.293
11	2.335	-1.335	-1.167
12	1.189	0.811	0.709
13	2.335	1.665	1.455
14	2.335	-1.335	-1.167
15	1.189	0.811	0.709
16	0.042	1.958	1.711
17	0.616	0.384	0.336
18	0.616	-0.616	-0.538
19	0.042	-0.042	-0.037
20	0.616	0.384	0.336
21	0.616	0.384	0.336
22	1.762	1.238	1.082
23	1.762	0.238	0.208
24	-1.104	1.104	0.965
25	2.335	0.665	0.581
26	2.335	-0.335	-0.293
27	1.189	-0.189	-0.165
28	-1.104	-2.896	-2.531
29	0.042	-0.042	-0.037
30	0.616	-0.616	-0.538
31	1.189	0.811	0.709

INDIVIDUAL CHARACTERISTICS TO PERCEIVED NET BENEFIT

Linear Regression

Regression Statistics

R	0.322
R Square	0.104
Adjusted R Square	-0.13
S	1.653
Total number of observations	30

PNB = 4.6249 - 0.1674 * CIV - 0.0178 * YRS - 0.0479 * AGE - 0.5839 * FEM - 0.1624 * PM - 0.3145 * MED

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	6.	7.298	1.216	0.445	0.841
Residual	23.	62.869	2.733		
Total	29.	70.167			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	4.625	2.361	-0.259	9.508	1.959	0.062	*No*
CIV	-0.167	1.007	-2.252	1.917	-0.166	0.869	*No*
YRS	-0.018	0.047	-0.115	0.079	-0.38	0.708	*No*
AGE	-0.048	0.044	-0.139	0.043	-1.094	0.285	*No*
FEM	-0.584	0.701	-2.034	0.866	-0.833	0.413	*No*
PM	-0.162	0.65	-1.507	1.182	-0.25	0.805	*No*
MED	-0.315	0.729	-1.822	1.193	-0.432	0.67	*No*
T (5%)	2.069						

LCL - Lower value of a reliable interval (LCL)
UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	1.498	-1.498	-1.017
2	0.738	-0.738	-0.501
3	0.888	0.112	0.076
4	0.93	0.07	0.048
5	1.226	1.774	1.205
6	0.363	-0.363	-0.246
7	2.385	1.615	1.097
8	0.815	-0.815	-0.554
9	0.534	1.466	0.995
10	0.796	0.204	0.138
11	1.342	0.658	0.447
12	0.26	3.74	2.54
13	0.774	0.226	0.153
14	1.68	0.32	0.217
15	1.301	0.699	0.475
16	0.74	0.26	0.177
17	0.713	-0.713	-0.484
18	1.219	-1.219	-0.828
19	1.258	-0.258	-0.176
20	1.027	-0.027	-0.018
21	1.836	1.164	0.79
22	2.	0.	0.
23	1.869	-1.869	-1.27
24	1.555	1.445	0.982
25	1.594	0.406	0.276
26	0.784	0.216	0.147
27	0.796	-4.796	-3.257
28	1.379	-1.379	-0.937
29	1.306	-1.306	-0.887
30	1.392	0.608	0.413

INDIVIDUAL CHARACTERISTICS (2) TO PERCEIVED NET BENEFIT

Linear Regression

Regression Statistics

R	0.48
R Square	0.231
Adjusted R Square	-0.063
S	1.603
Total number of observations	30

2.2889 - 0.4507 * CIV - 0.0303 * YRS - 0.0408 * AGE - 0.6717 * FEM + 0.0771 * PM - 0.6636 * MED + 0.8501 * PO25 - 0.3123

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-level*
Regression	8.	16.175	2.022	0.786	0.62
Residual	21.	53.992	2.571		
Total	29.	70.167			

	Coefficients	*Standard Error*	*LCL*	*UCL*	*t Stat*	*p-level*	*H0 (5%) rejected?*
Intercept	2.289	2.636	-3.194	7.772	0.868	0.395	*No*
CIV	-0.451	1.008	-2.547	1.645	-0.447	0.659	*No*
YRS	-0.03	0.046	-0.126	0.066	-0.658	0.518	*No*
AGE	-0.041	0.043	-0.13	0.048	-0.951	0.352	*No*
FEM	-0.672	0.681	-2.089	0.745	-0.986	0.335	*No*
PM	0.077	0.693	-1.364	1.518	0.111	0.912	*No*
MED	-0.664	0.735	-2.193	0.865	-0.903	0.377	*No*
PO25	0.85	0.476	-0.14	1.84	1.786	0.088	*No*
PO26	-0.312	0.42	-1.185	0.561	-0.744	0.465	*No*
T (5%)	2.08						

LCL - Lower value of a reliable interval (LCL)
UCL - Upper value of a reliable interval (UCL)

Residuals

Observation	*Predicted Y*	*Residual*	*Standard Residuals*
1	-0.15	-3.85	-2.821
2	2.373	-2.373	-1.739
3	1.025	-1.025	-0.751
4	0.467	-0.467	-0.342
5	0.456	-0.456	-0.335
6	0.983	-0.983	-0.72
7	0.734	-0.734	-0.538
8	1.247	-1.247	-0.914
9	0.556	-0.556	-0.407
10	1.273	-1.273	-0.933
11	1.078	-0.078	-0.057
12	0.113	0.887	0.65
13	0.925	0.075	0.055
14	0.658	0.342	0.251
15	0.703	0.297	0.218
16	0.694	0.306	0.224
17	0.796	0.204	0.149
18	1.664	-0.664	-0.487
19	0.679	1.321	0.968
20	1.218	0.782	0.573
21	1.755	0.245	0.179
22	2.075	-0.075	-0.055
23	2.965	-0.965	-0.707
24	1.83	0.17	0.124
25	1.736	0.264	0.194
26	0.765	2.235	1.638
27	0.815	2.185	1.601
28	1.746	1.254	0.919
29	2.901	1.099	0.805
30	0.919	3.081	2.258

PRE-TRAINING Q21 & POST-TRAINING Q25 T-TEST

Comparing Means [Paired two-sample t-test]

Descriptive Statistics

VAR	*Sample size*	*Mean*	*Variance*
PRE Q21	31	4.194	0.828
POST Q25	31	4.29	0.746

Summary

Degrees Of Freedom	30	*Hypothesized Mean Difference*	0.E+0
Test Statistics	0.399	*Pooled Variance*	0.787
Two-tailed distribution			
p-level	0.693	*t Critical Value (5%)*	2.042
One-tailed distribution			
p-level	0.346	*t Critical Value (5%)*	1.697
Pearson Correlation Coefficient	-0.159		
G-criterion			
Test Statistics	0.028	*p-level*	0.149
Critical Value (5%)	0.143		
Pagurova criterion			
Test Statistics	0.429	*p-level*	0.331
Ratio of variances parameter	0.526	*Critical Value (5%)*	0.063

PRE-TRAINING Q22 & POST-TRAINING Q26 T-TEST

Comparing Means [Paired two-sample t-test]

Descriptive Statistics

VAR	Sample size	Mean	Variance
PRE Q22	31	3.484	1.058
POST Q26	31	3.742	1.065

Summary

Degrees Of Freedom	30	Hypothesized Mean Difference	0.E+0
Test Statistics	1.161	Pooled Variance	1.061

Two-tailed distribution

p-level	0.255	t Critical Value (5%)	2.042

One-tailed distribution

p-level	0.127	t Critical Value (5%)	1.697
Pearson Correlation Coefficient	0.279		

G-criterion

Test Statistics	0.086	p-level	0.099
Critical Value (5%)	0.143		

Pagurova criterion

Test Statistics	0.986	p-level	0.672
Ratio of variances parameter	0.498	Critical Value (5%)	0.063

COMBINED QUESTIONS 21, 22, 25, 26 T-TEST

Comparing Means [Paired two-sample t-test]

Descriptive Statistics

VAR	Sample size	Mean	Variance
PRE21+22	31	3.839	0.69
POST25+26	31	4.016	0.725

Summary

Degrees Of Freedom	30	Hypothesized Mean Difference	0.E+0
Test Statistics	0.837	Pooled Variance	0.707

Two-tailed distribution

p-level	0.409	t Critical Value (5%)	2.042

One-tailed distribution

p-level	0.205	t Critical Value (5%)	1.697
Pearson Correlation Coefficient	0.016		

G-criterion

Test Statistics	0.055	p-level	0.126
Critical Value (5%)	0.143		

Pagurova criterion

Test Statistics	0.831	p-level	0.59
Ratio of variances parameter	0.488	Critical Value (5%)	0.063

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CURRICULUM VITAE

NAME OF THE AUTHOR: Dale W. Meyerrose, Major General, U.S. Air Force, Retired

RESIDENCE: Colorado Springs, Colorado

EDUCATION:

- Bachelor of Science in Economics
  U.S. Air Force Academy, Colorado
- Master of Business Administration
  University of Utah, Salt Lake City, Utah

EXECUTIVE EDUCATION:

- National War College
  National Defense University, Washington, D.C.
- Program for National and International Security
  JFK School of Government, Harvard University, Cambridge, Massachusetts
- Senior Executive Business Course
  Haas School of Business University of California—Berkley, Monterey, California
- Leadership for Cross-Boundary Transformation
  JFK School of Government, Harvard University, Cambridge, Massachusetts
- Leadership Directions Program
  Darden School of Business, University of Virginia, Charlottesville, Virginia

ACADEMIC AFFILIATIONS:

- Visiting Associate Professor (2008 – present)
  School of Information Studies, Syracuse University, Syracuse, New York
- Lecturer and Cybersecurity Leadership Program Director (2012 – present)
  Institute for Software Research, Carnegie Mellon University, Pittsburgh, Penn.
- Guest Lecturer, National Security Program (2000, 2003, 2010)
  JFK School of Government, Harvard University, Cambridge, Massachusetts
- Guest Lecturer, School of Applied Aerospace Sciences (1990 – 2005)
  Keesler Technical Training Center, Keesler Air Force Base, Mississippi
- Special Advisor to the Chancellor (2002 – 2005)
  University of Colorado at Colorado Springs, Colorado
- Advisor for Graduate Cybersecurity Studies (2011 – 2012)
  Jones International University, Centennial, Colorado
- Guest Lecturer, Department of Computer Science (1994 – 2005)
  U.S. Air Force Academy, Colorado
- Guest Lecturer, National Defense University (2002 – 2006)
  Fort McNair, Washington, D.C.

PROFESSIONAL EXPERIENCE:

- President (2012 – present)
  MeyerRose Group, Colorado Springs, Colorado
- Vice President and General Manager (2009 – 2012)
  Harris Corporation, Melbourne, Florida
- Interim Chief Executive Officer (2008 – 2009)
  American Registry of Internet Numbers, Herndon, Virginia
- Chief Information Officer (2005 – 2008)
  United States Intelligence Community, Washington, D.C.
- Military Commissioned Officer (1975 – 2005)
  United States Air Force

PROFESSIONAL RECOGNITION:

- U.S. Air Force Cyberspace Operations and Support Hall of Fame
- Air Force and Air Traffic Control Association Hall of Honor
- EMC^2 Industry Thought Leadership Award
- Air Force C^4 Association Lifetime Achievement Award
- *Executive CIO* Top 10 Leaders and Innovators Public Service Award for Excellence in Public Leadership
- *Government Computer News* Outstanding Information Technology Achievement in Government Award
- Association of Federal Information Resource Managers Lifetime Public Service Award
- International Armed Forces Communications Electronics Association (AFCEA) Rockwell Award as the International AFCEAN of the Year
- Rocky Mountain AFCEA Chapter, North American Technology Leadership Award
- *Federal Computer Weekly,* Federal Top Ten Power Players in Washington, D.C.
- *Computerworld* "Premier 100" honoree
- *Federal Computer Weekly* "Top 100" Information Technology Professionals
- Twenty-seven military and Intelligence Community awards, decorations, and campaign medals for periods of meritorious performance during various military and U.S. Government assignments—to include Southwest Asia service