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13. ABSTRACT (Maximum 200 Words)

The purpose of the University of Hawaii Telemedicine Curriculum Research Project is to develop an effective web-based curriculum for training military healthcare personnel in the use of contemporary communication, automation, and informatics technology in the delivery of healthcare. The overall curriculum is generic in nature, while specific modules can be tailored to the needs of the military healthcare provider (HCP). The goal of the telemedicine curriculum is to impart both the necessary knowledge and practice skills to the HCP. The HCP will learn the various clinical uses of telemedicine and will also understand the clinical and organizational barriers of the successful utilization of telemedicine. The telemedicine curriculum has been designed to address the communication and automation tools available to the military healthcare system. This advanced toolkit of telemedicine curriculum modules will support the efforts of the DoD to efficiently and effectively apply the latest technological advances in communication and data transfer to improving healthcare delivery.

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INTRODUCTION

The purpose of the University of Hawaii Telemedicine Curriculum Research Project is to develop an effective web-based curriculum for training military healthcare personnel in the use of contemporary communication, automation, and informatics technology in the delivery of healthcare. The overall curriculum is broad in nature, whereby specific modules can be tailored to the needs of the military healthcare provider (HPC). The goal of the telemedicine curriculum is to impart both the necessary knowledge and practice skills to the HPC. The HPC will learn the various clinical uses of telemedicine and will also understand the clinical and organizational barriers to the successful utilization of telemedicine. The telemedicine curriculum has been designed to address the communication and automation tools available to the military healthcare system. This advanced toolkit of telemedicine curriculum modules will support the efforts of the DoD to efficiently and effectively apply the latest technological advances in communication and data transfer for improving healthcare delivery. To accomplish this task, projects using telemedicine applications have been supported, so that lessons learned from these experiences can be used in the development of educational curriculum modules designed to teach military and other healthcare providers how to utilize and implement telemedicine technologies. A clinical telemedicine service has been maintained in which a hub of physician specialists in Honolulu are available to primary care providers and patients in rural and/or remote clinics. Additionally, demonstration projects using telemedicine applications at high altitudes and with geriatric populations have been supported.

BODY

I. Development of ten core competency modules

Ten core competency areas for the training of health care providers in the use of telemedicine were completed: Telemedicine Fundamentals, Telemedicine Technology and Environment, Conducting a Telemedicine Patient Visit, Organization and Management, Clinical Telemedicine Consult Simulations, and Case Study: Audiology and Balance, Live and Asynchronous Modalities, First Responder, Simulation and Virtual Reality, and Patient Education. The first 6 modules were previously developed prior to 1 January 2003, with the topics for the last 4 modules previously selected by the UH PIs in collaboration with the project's National Advisory Council in CY2002. The content for the 4 modules were developed in CY2002 and into the period for the current final review. A brief synopsis of the information covered in each of these modules follows.

Module 1: Telemedicine Fundamentals

Gives an overview of telemedicine including history and applications. Includes a discussion of barriers to its success and listing of resources. Learning objectives:

1. Define telemedicine
2. Explain three advantages of telemedicine
3. List three common applications of telemedicine
4. Discuss three potential barriers to telemedicine
5. Describe the patient's experience with telemedicine

6. Cite two on-line telemedicine resources

Module 2: Telemedicine Technology and Environment

Outlines technology involved in implementing telemedicine. Includes telemedicine modalities, diagnostic peripherals, connections and environment. Learning Objectives:

1. Identify and understand three telemedicine modalities.
2. Name at least one common application using Store/Forward and one using realtime VTC.
3. Identify the two primary communication protocols for videoconference equipment and understand the difference between them.
4. Identify three common diagnostic peripherals.
5. Name one benefit and one drawback of using digital still cameras for telemedicine applications.
6. Understand the relationship between connection bandwidth and frame rate in a realtime VTC system.
7. Understand ISDN and TCP/IP as used for telemedicine connections.
8. Be familiar with actions to take to prepare for a telemedicine consultation and to troubleshoot problems with telemedicine equipment.
9. Identify three significant design issues for a telemedicine environment.

Module 3: Conducting a Telemedicine Patient Visit

Outlines steps required for the telemedicine visit. Includes checklists for equipment, patient and clinical preparation and descriptions of diagnostic devices used. Learning objectives:

1. Conduct physical examinations over distance
2. Conduct a 'virtual' medical visit through store/forward technology
3. List the eleven steps in a telemedicine visit
4. Discuss the single most powerful predictor of success in a telemedicine service
5. Describe three telemedicine devices
6. Contrast Real Time with Store/Forward

Module 4: Organization and Management

Discusses common causes of telemedicine failure and strategies for successful implementation. Includes advice from experts and examples of military telemedicine applications. Learning objectives:

1. Cite examples that demonstrate that telemedicine implementation has a long history of notable success and a good deal of failure in both civilian and military medical organizations.

2. Identify the significant costs of telemedicine failure associated with:

   a) poorly used human resources

b) decreased morale

c) loss of confidence in leadership

3. Cite the five main barriers to telemedicine success and explain the dimensions of each barrier.

4. Cite examples that illustrate that the majority of telemedicine failures are not solely a consequence of technical difficulties, but rather also a consequence of the lack of "social engineering" designed to accompany and enhance telemedicine utilization.

5. Cite three "investments" in the organization and business management practice that may be undertaken in a military medical organization which enhance telemedicine utilization.

6. Explain the importance of continuous evaluation of telemedicine systems and design a simple evaluation protocol for a small telemedicine system.

7. Explain the role organizational culture may play in "pulling" telemedicine systems toward successful implementation.

Module 5: Clinical Telemedicine Consult Simulations

Presents several attributes for the telemedicine encounters and view the results. Learning objectives:

1. Discuss the advantages and disadvantages of using different telemedicine modalities and/or equipment for different types of consultations.

2. Discuss the effects of different lighting techniques and background choices on the visual quality of a telemedicine consultation.

3. Discuss the impact of different connection speeds on the qualitative experience of a teleconsultation.

4. Make effective decisions about telemedicine equipment controls in order to get a high quality remote consultation.

5. Structure a sending-side environment to maximize the transmission of relevant information and minimize environmental "noise."

6. Discuss techniques for facilitating personal interactions among patients and physicians in a telemedicine environment.

Module 6: Case Study: Audiology and Balance

Includes a tutorial on Video Nystagmographic (VNG) examination. Includes in-depth information about VNG and a demonstration of each test as well as how to interpret the results. Learning objectives:

1. The participant will have the information necessary to diagnose, evaluate and treat the patient with balance disorders

2. The participant will understand the role of the case history in balance assessment

3. The participant will be able to understand the rationale behind balance assessment

4. The participant will be able to discuss the contribution of each subtest of the ENG

5. The participant will be able to determine probable site of lesion based on the results of the ENG

6. The participant will understand and apply rules of interpretation of the ENG

7. The practitioner will be able to perform vestibular screening procedures over a Telemedicine link.

8. The participant will be able to provide consultation and oversight of hearing identification over a Telemedicine link.

Module 7: Live and Asynchronous Modalities

Clinicians employing telemedicine tools must decide whether their needs are served better by asynchronous, store-and-forward (S/F) methodology or by live, real-time, interactive video-conferencing (VTC). Store/forward in its simplest form, consists of digital photographs attached to e-mail messages. In its most complex form, mostly used in radiology, store/forward may consist of high-resolution, digitized images managed by fail-safe computer systems that catalogue,

archive, fulfill requests for storage and retrieval, and track access, as is the case for the Picture Archive and Communication Systems or PACS system in radiology. In both cases, telemedicine tools allow experts to expand their geographic scope and provide patients with access to expert advice that may not be locally available. Live and asynchronous tools also enable geographically dispersed participants to interact in group discussions to improve patient care.

A comparison of content, clinical bias, logistics, cost and technical equipment for both store-and-forward and live VTC is outlined in the following table:

PARAMETER	STORE-AND-FORWARD	LIVE VTC
Content	Primarily image evaluation	Direct interaction with people
Clinical bias	Greater emphasis on the written history	Emphasis on interviewing and behavioral nuance
Logistics	Easier to accomplish; can be done with few people involved	Harder to accomplish; many people must coordinate and network connections must be made
Cost	Inexpensive equipment; transmission charges usually nominal (PACs excepted)	Special equipment more expensive; transmission charges may be substantial
Technical Equipment	Widely available, relatively simple to use	Limited manufacturers, relatively simple to use, but complex in technical details.

Module 8: First Responder

With the advent of portable physiologic sensors combined with broadband wireless networks, injured patients may now be monitored remotely. Emergency physicians or other

specialists may relay data collected remotely back to control centers for review. This capability extends the reach of the medical facility out to the patient.

Increased monitoring capabilities opens the door for more advanced therapies to be conducted by first responders. Advanced therapies may initially be supervised, telementoring or teleproctoring. As treatment paradigms become more defined, however, this could be accomplished without supervision, but based on local review of physiologic data or automated therapy similar to defibrillation. First responder therapy based on data from physiologic sensors will require a progressive research and development program to verify that it is safe and effective, and to modify provider training and licensing requirements.

This module will be divided into four sections: 1) communications networks, 2) physiologic sensors, 3) first responders – roles and responsibilities, and 4) regional control centers – roles and responsibilities.

Module 9: Simulation and Virtual Reality

The uses of simulation and virtual reality in medical education, research and clinical care are expanding. Decreasing costs and increasing computing power and bandwidth are leading to affordable and widespread implementations. This module includes basic concepts of simulation and virtual reality in medicine, to include: definitions, utility, components, current status, data/knowledge representation (datasets), artificial intelligence, human computer interface issues, clinical applications, display options, tracking options, use of haptics, and issues regarding degree of realism based on purpose, augmented reality, and procedural simulation.

Module 10: Patient Education

Patient education plays a significant role in health promotion and disease management programs. Improved patient knowledge through patient education helps to involve patients in health care decisions, resulting in better health outcomes. This module is divided into two major sections. The first section will serve as a resource to health care providers for patient education with respect to telemedicine. An electronic toolkit will be developed that includes educational materials and consent forms specific to telemedicine applications. The second section will discuss the application of telemedicine technologies in support of learning interventions, history taking and interviewing, online connections and support, and telemonitoring. Examples of each application will highlight their ability to support patient-centric disease management.

II. Evaluation of Web-Based Training Techniques

The Telemedicine Curriculum has an assessment/evaluation component that enables continuous refinement. Upon the completion of each module, readers complete a questionnaire that measures their satisfaction with the module with respect to course objectives, course content, application to current assignment, module organization and clarity, audiovisual effects, pace, and difficulty. Additionally, at the completion of each module readers take a quiz that measures changes in knowledge. Information gained from these questionnaires and quizzes can be used to modify and revise the modules.

This report given in Appendix H examines the evaluation instruments contained in the first four modules and assesses their effectiveness as evaluation tools. The modules examined were: Telemedicine Fundamentals (Module 1), Telemedicine Technology and Environment (Module 2), Conducting a Telemedicine Patient Visit (Module 3), and Organization and Management (Module 4).

III. Clinical Consultation Network

In order to gain an understanding of the training needs of telemedicine providers, as well as maintain a "test-bed" to evaluate the utility of the developed curriculum modules, the UH Telemedicine Project has established a clinical consultation network. This network encompasses a central core of clinical consultants operating from the Queen Emma Clinic, Queen's Medical Center, connected to a group of satellite clinics providing medical care to underserved areas throughout Hawaii. Hardware, connectivity, and technical support have been provided to the Telemedicine Clinic within the Queen Emma Clinic. Equipment and connectivity have been provided to remote clinics located at: Hana Community Health Center, Maui, Molakai General Hospital, Molakai, Hilo Bay Clinic and Paholoa Family Health Center, Hawaii, and the Waianae Comprehensive Health Care Clinic and Kalihi-Palama, Oahu.

Dr. Joseph Humphry was able to monitor diabetic patients located at the Hana Community Health Center. Results of these Teleconsultations were presented at the national meeting of the CDC Division of Diabetes Translation in St. Louis, MO. Teleconsultations in psychiatry, dermatology, and diabetes were being initiated with patients at Molakai General Hospital. At conclusion of the cooperative agreement, Telepsychiatry initiatives play an important role as a product of this previous development.

IV. Curriculum Related Activities

In support of the First Responder Module, physiological sensors were tested in high altitude austere environments, establishing connectivity from a remote area in Hawaii to servers

in California. Results were submitted for presentation to the 13th International Hypoxia Symposium.

In support of the Patient Education and First Responder Modules, potential proposals were formulated for the use of physiological sensors and chronic disease management in geriatric populations.

Representatives from Howard University contacted us congratulating us on the UH Telemedicine Curriculum. One advocate from Howard University is utilizing this "open source" curriculum in an undergraduate course.

KEY RESEARCH ACCOMPLISHMENTS

- All ten modules completed: Telemedicine Fundamentals, Telemedicine Technology and Environment, Conducting a Telemedicine Patient Visit, Organization and Management, Clinical Telemedicine Consult Simulations, and Case Study: Audiology and Balance, Live and Asynchronous Modalities, First Responder, Simulation and Virtual Reality, and Patient Education.
- All ten modules have been tested. Discrepancies have been fixed and usability has been improved. The curriculum has been technically tested on various operating systems and browsers and been found to work to its best, and is available through the Internet.
- Volunteer participants have evaluated the initial modules validating the content and the validation process. The collected data has been analyzed and the curriculum has been found satisfactory. Data analysis shows the Telemedicine Curriculum to be beneficial for learning.
- The Curriculum is being used at Howard University.
- Weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific has been implemented.
- A biweekly telemedicine consultation service has been setup for Diabetes case management.
- Telepsychiatry visits have been established to rural areas of Maui County.

REPORTABLE OUTCOMES

A Telemedicine Curriculum web site was created to train military healthcare personnel in the use of contemporary communication, automation, and informatics technology in the delivery of healthcare. The Telemedicine Curriculum web site is available at: http://uhtelemed.hawaii.edu/uhtp/curriculum.htm .

Two CD-ROMs are available (upon request) containing the Telemedicine Curriculum. The disks contain a server and standalone version. The CDs are forwarded electronically as Appendices M-1 and M-2.

The UH Telemedicine Project has established a clinical consultation network. This network encompasses a central core of clinical consultants operating from the Queen Emma Clinic, Queen's Medical Center, connected to a group of satellite clinics providing medical care to underserved areas throughout Hawaii. Telemedicine has been promoted in Hawaii and the Pacific.

Various abstracts, presentations, as well as publications have been published. Please refer to the References section for a list of documents. Certain abstracts and presentations were unintentionally omitted from the last annual review and are included here.

CONCLUSIONS

The University of Hawaii Telemedicine Curriculum project has been completed. The Curriculum has been tested by a selected group of people on different operating systems and browsers. Problems have been remedied and the platform and curriculum modified.

Evaluators that tested the web site have found the Telemedicine Curriculum to be satisfactory. Data analysis shows the Curriculum to be helpful for learning. The Telemedicine Curriculum project is available through a web site and on CD-ROM. The Curriculum has successfully been used in classrooms to teach students the basic knowledge in the field of Telemedicine.

A Clinical Consultation Network has been established by the UH Telemedicine Curriculum project. Telemedicine has been promoted throughout Hawaii and the Pacific.

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[1] See Appendix J

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[2] See Appendix K

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[3] See Appendix L

Digital Media

UH Telemedicine Curriculum Standalone Version 2.0, CD-ROM

UH Telemedicine Curriculum Server Version 2.0, CD-ROM

Appendix A

Third Quarter (FY03) Activities

(January 1, 2003 to March 31, 2003)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: May 2, 2003

3. Reporting period from: January 2003 to March 2003

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

LINE ITEM	CURRENT	CUMULATIVE
Personnel	$141,305.24	$1,748,010.64
Fringe Benefits	$29,680.20	$282,261.82
Supplies	$2,059.65	$197,339.89
Travel	$11,905.03	$94,683.42
Equipment	$ 0	$265,263.40
Other	$18,171.70	$485,765.92
Direct Cost	$203,121.22	$3,073,325.09
Indirect Cost	$39,355.92	$560,326.86

10. Comments on administrative and logistical matters.
University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in terms of the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. See Attached

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	70%	07/01/03
Research Manager	Deborah Birkmire-Peters, Ph.D.	25%	01/14/03
Project Coordinator	Victoria Garshnek, Ph.D.	50%	1/14/03
Administrative Secretary	Dolly Puchert	100%	08/01/01
Graphics & Systems Programmer	Andrei Sherstyuk, Ph.D.	25%	01/14/03
Systems Programmer	Mike von Platen	100%	08/02/99
Graduate Research Assistant	Kathleen Kihmm	50%	08/01/02
Clinician	Joseph Humphry, M.D.	20%	07/01/01
Clinical Associate	Daniel Saltman, M.D.	20%	04/01/01
Clinical Associate	Daniel Alicata, M.D.	20%	01/01/03
Clinical Associate	Joshua Jacobs, M.D.	25%	08/01/02
Clinical Associate	Brett Flynn, M.D.	20%	08/01/02

Item #11: Description of Progress

Personnel Related Activates:

Deborah Birkmire-Peters, Ph.D., Project Manager, decreased time to .25 FTE as of 14 Jan 2003.

Andrei Sherstyuk, Ph.D., Graphics and Systems Programmer, decreased time to .25 FTE as of 14 Jan 2003

Victoria Garshnek, Ph.D., Project Coordinator, hired .50 FTE as of 14 Jan 2003

Daniel Alicata, MD, hired .20 FTE as of 01 Jan 2003

Joshua Jacobs, M.D., hired .25 FTE as of 01 Aug 2002 (inadvertently excluded on precious reports)

Brett Flynn, M.D., 20 FTE as of 01 Aug 2002 (inadvertently excluded on precious reports)

Curriculum Related Activities:

A poster was presented at the 13th International Hypoxia Symposium held on 19-22 February 2003 in Banff, Alberta, Canada. The abstract discussed the use of Mauna Kea as an accessible laboratory for high altitude research where it was published in a peer reviewed journal. Dr. Burgess' attended the meeting along with Dr. Janet Onopa, a consultant on the project, and a part-time graduate assistant who prepared the poster also attended.

Dr. Burgess, Dr. Birkmire-Peters, Dr. Andrei Sherstyuk, Dr. Victoria Garshnek, Michael von Platen and Kathleen Kihmm continued meetings to review the development and implementation of the four new modules of the UH Telemedicine Curriculum: Live and Asynchronous Modalities, First Responder, Simulation and Virtual Reality, and Patient Education. Graphics development and author responsibilities were defined.

Drs. Burgess and Saltman gave presentations on Telemedicine to a Telemedicine and Technology Forum, East-West Center, 30 January 2003.

Weekly meetings were held for the Aging in Place (AIP) telehealth project that was designed to demonstrate the feasibility of using telehealth/telemedicine technology to enable elderly to maintain a quality of life and health in their preferred living environment. The project will demonstrate the use of remote monitoring and communication links among seniors and their care management team, including geriatric physicians, nursing specialists, psychiatrists, social workers, case managers and lay caregivers. Participants included: Dr. Daniel Davis, Dr. Brett Flynn, Dr. Patricia Blancette, Dr. Lawrence Burgess, and Kathleen Kihmm.

In anticipation of concluding the clinical portion of the project in July, clinical sites were given 90 days notice to internally fund ISDN Line coverage, which had previously been funded by UHTP. The service will be internally funded by the Clinics as of 1 April 2003.

Due to initial changeover in the PI and Research Director, a 7-month no-cost extension was filed with TATRC on 27 March 2003 to the end of Project on 31 Jan 2004 (vs. 31 July 2003). Initial consultation with TATRC indicated that this would be approved, and the cooperative agreement modified.

Clinical Directors have facilitated memorandums of agreement between agencies in developing a telepsychiatry initiative for Maui County. This would be for conventional psychiatric services as well as Felix Decree at-risk children.

UHTP was approved to evaluate the applicability of store-forward telemedicine platforms for Native Hawaiian Clinics in the State of Hawaii. This was due to the respect gained from the curriculum project and from other activities within the State.

A modified Evaluation Plan for the curriculum was finalized and forwarded to the University of Hawaii IRB for review. The UH IRB found that the exempt status did not change from the original submission. The modified Evaluation Plan and the UH IRB review report were forwarded to the Office of Regulatory Compliance and Quality, U.S. Army Medical Research and Materiel Command (USAMRMC) for final review and approval.

A comprehensive report covering the period of July 1, 2001 to December 31, 2002 was drafted. Once reviewed internally, it will be forwarded to TATRC.

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealths Health Center of Saipan (including approximately 40 physicians) has been connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Publications

Abstract:

Onopa J, Le Pape M, Thonier G, Saiki S. Montgomery K, Burgess L: High Altitude Research Hawaii. High Altitude Medicine and Biology 2003; 3:451.

Presentations

Oral:
Lawrence Burgess, M.D., January 2003, East-West Center: Telemedicine Pitfalls

Daniel Saltman, M.D.: Clinical Telemedicine Programs, Telehealth Seminar, United States Telecommunications Training Institute, East-West Center, University of Hawaii, 27-30 January 2003.

Poster:
Onopa J, Le Pape M, Thonier G, Saiki S, Montgomery K, Burgess L: High Altitude Research Hawaii. 13th International Hypoxia Symposium, February 19-22, 2003.

Appendix B

Fourth Quarter (FY03) Activities

(April 1, 2003 to June 30, 2003)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: 30 June, 2003

3. Reporting period from: April 2003 to June 2003

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

LINE ITEM	CURRENT	CUMULATIVE
Personnel	$106,033.08	$1,854,043.72
Fringe Benefits	$22,143.65	$304,405.47
Supplies	$729.40	$198,069.29
Travel	$5,861.34	$97,095.65
Equipment	$0	$265,263.40
Other	$17,625.11	$503,688.55
Direct Cost	$156,075.56	$3,229,400.65
Indirect Cost	$30,278.81	$590,605.67

10. Comments on administrative and logistical matters.
University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in terms of the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. See Attached

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	70%	07/01/03
Research Manager	Deborah Birkmire-Peters, Ph.D.	25%	01/14/03
Project Coordinator	Victoria Garshnek, Ph.D.	50%	1/14/03
Administrative Secretary	Dolly Puchert	100%	08/01/01
Graphics & Systems Programmer	Andrei Sherstyuk, Ph.D.	25%	01/14/03
Systems Programmer	Mike von Platen	75%	08/02/99
Graduate Research Assistant	Kathleen Kihmm	50%	08/01/02
Clinical Associate	Daniel Saltman, M.D.	20%	04/01/01
Clinical Associate	Daniel Alicata, M.D.	20%	01/01/03
Clinical Associate	Joshua Jacobs, M.D.	25%	08/01/02

Item #11: Description of Progress

Personnel Related Activities:

Dr. Saltman (Clinical Director) and Dr. Alicata (Telepsychiatry) terminated as of 30 June 03. Drs. Flynn and Humphry finished their program as of 1 April 03. Clinical programs and initiatives are being concluded so that the remaining months are focused on completing and validating the curriculum.

Mike von Platen has been reduced to 75% as he is working on another project.

Curriculum Related Activities

1. Drs. Burgess, Birkmire-Peters, Andrei Sherstyuk, and Victoria Garshnek, and Michael von Platen and Kathleen Kihmm met to review the development and implementation of the four new modules of the UH Telemedicine Curriculum: Live and Asynchronous Modalities, First Responder, Simulation and Virtual Reality, and Patient Education. It was determined that a start letter for the curriculum evaluation would be needed by September 1, 2003 in order to complete the project by January 31, 2004. (May 19, 2003)
2. Kathleem Khimm programmed the four satisfaction surveys, knowledge assessment pre-test, and four knowledge assessment questionnaires for presentation during the curriculum evaluation. All questionnaires are web-based and will be accessible to evaluation participants.

The program includes scoring and storage of responses in a database. Ms. Khimm and Dr. Birkmire-Peters met with Dr. Burgess to review the programming. (June 5, 2003). New modules will also have questions and surveys available on-line for those who access it.

3. Dr. Birkmire-Peters forwarded the modification to the UH Telemedicine Curriculum Evaluation Plan, revised consent form, and the UH IRB approval to Melanie Oringer, Office of Regulatory Compliance and Quality, U.S. Army Medical Research and Materiel Command (USAMRMC) for review on April 9, 2003. The UH Committee on Human Studies found the evaluation plan to be exempt from full IRB review. Approval from MRMC is pending.
4. Dr. Birkmire-Peters attended the American Telemedicine Association (ATA) Human Factors SIG meeting during the annual conference. The formation of an ATA Human Factors Evaluation Committee was discussed at the meeting. Following the meeting, Dr. Birkmire-Peters was asked by Dr. Yan Xiao, acting chair of the Human Factors SIG, to chair the Evaluation Committee, if approved by ATA. She drafted a mission statement for the committee.
5. Dr. Lawrence Burgess, Dr. Victoria Garshnek and Ms. Kathleen Khimm attended the ATA meeting, April 27-30 2003, Orlando Florida.
6. A comprehensive report covering the period of July 1, 2001 to December 31, 2002 was prepared and forwarded to TATRC.
7. Dr. Birkmire-Peters prepared and presented a report on the status of the UH Telemedicine Curriculum to the Distance Learning Product Line Review. (June 10, 2003)

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealths Health Center of Saipan (including approximately 40 physicians) has been connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Publications: None

Presentations:

Oral: None

Poster:

Title: Tele-health Applications in the VA Health Care System in Hawaii
Authors: Jon M. Sakuda, OD, Spark M. Matsunaga VAMROC Ambulatory Care Clinic, Honolulu, HI; Geneva Swain, LPN., Maui Community Based Outpatient Clinic, Kahului, HI; Trina Yanellas, LPN., Hilo Community Based Outpatient Clinic, Hilo, HI; Stanley M. Saiki, Jr., MD, Pacific Telehealth and Technology Hui, Honolulu, HI; Deborah P. Birkmire-Peters, PhD, John A. Burns School of Medicine, University of Hawaii, Honolulu, HI; Glenn Kim, BS, Pacific Telehealth and Technology Hui, Honolulu, HI

Appendix C

First Quarter (FY04) Activities

(July 1, 2003 to September 30, 2003)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: 30 September, 2003

3. Reporting period from: July 2003 to September 2003

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

LINE ITEM	CURRENT	CUMULATIVE
Personnel	$82,991.65	$1,937,035.37
Fringe Benefits	$17,823.33	$322,228.80
Supplies	$652.34	$198,721.63
Travel	$3,150.01	$107,080.23
Equipment	$0	$265,263.40
Other	$3,670.54	$507,309.09
Direct Cost	$1,08,237.87	$3,337,638.52
Indirect Cost	$22,080.52	$612,686.19

10. Comments on administrative and logistical matters.

University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in terms of the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. See Attached

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	50%	07/01/03
Research Manager	Deborah Birkmire-Peters, Ph.D.	25%	01/14/03
Project Coordinator	Victoria Garshnek, Ph.D.	50%	1/14/03
Administrative Secretary	Dolly Puchert	50%	08/01/01
Graphics & Systems Programmer	Andrei Sherstyuk, Ph.D.	25%	01/14/03
Systems Programmer	Mike von Platen	75%	08/02/99
Graduate Research Assistant	Kathleen Kihmm	0%	09/01/03
Admin/Fiscal Assistant	Janet Chang	30%	7/01/03
Clinical Associate	Joshua Jacobs, M.D.	25%	08/01/02
Graduate Research Assistant	Christopher Aschwanden	50%	08/01/03

Item #11: Description of Progress

Personnel Related Activities:

None

Curriculum Related Activities

1. Drs. Burgess, Deborah Birkmire-Peters, Andrei Sherstyuk, Victoria Garshnek, and Michael Von Platen, Chris Aschwanden, and Kathleen Kihmm met to review the development and implementation of the new modules of the UH Telemedicine Curriculum.
2. Dr. Birkmire-Peters had previously submitted the UH-approved evaluation plan to the OTSG Human Subjects Review Board. It was assigned to Melanie Oringer, Office of Regulatory Compliance and Quality, for review. Dr. Birkmire-Peters responded to two reviews from Ms. Oringer clarifying details of the evaluation plan. Ms. Oringer's final determination was that a letter from the Command at Tripler Army Medical Center was required supporting participation of Tripler personnel in the evaluation. Dr. Birkmire-Peters met with COL Schempp, Chief, Department of Clinical Investigations, TAMC, to discuss the best approach to obtain the letter of support. COL Schempp recommended the submission of a protocol covering the evaluation with a TAMC employee designated as principal investigator. Dr. Birkmire-Peters wrote a DoD-formatted protocol and submitted it for review.

3. Dr. Birkmire-Peters reviewed the post-test questions for Module 7: Live and Asynchronous Modalities.
4. Kathleen Kihmm developed the interface for displaying the pre-test, reaction, and post-test questionnaires for all the modules. She designed and developed the database for retrieving and recording responses and displaying the results. She and Dr. Birkmire-Peters designed the workflow pattern and instruction sets.
5. Kathleen Kihmm updated Modules 7 and 10 with editing changes by authors Daniel Saltman, Lotus Kam and Josh Jacobs. She also updated quiz questions for Modules 7 and 10 with editing changes by authors Daniel Saltman and Lotus Kam.
6. Kathleen Kihmm created a log page that records all users that log onto the website, with restricted access.
7. Ms. Kihmm edited "pop-up" links to be consistent in how windows are displayed throughout the application and fixed the discrepancies (bugs) in the web application.
8. Chris Aschwanden increased the font size (authors) and improved the spelling in the modules, changed the JavaScript to preload images on the main page, corrected the broken links and the links within modules that pointed to wrong pages, added a link to the main page for information, and improved the quizzes (spelling/questions).
9. Mr. Aschwanden performed testing of Module 1 through 7.
10. Mr. Von Platen proofread all modules, corrected spelling errors, searched for and removed 'dead' links, obsolete references, etc., removed Chat Rooms (Module 4), and created studio photographs for image content. He also made the following revisions: Revised page templates (reduced borders and remove unused icons); revised credits, online help page and home page.
11. Mr. Von Platen tested all modules on several platforms: Mac (IE 5.2, Netscape 7), PC (IE 6, Netscape 7)
12. Michael Von Platen created a Beta version CDROM.
13. Dr. Burgess reviewed all new modules after these updates and additional content will be provided by Dr. Jacobs for Module 7.

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealths Health Center of Saipan (including approximately 40 physicians) has been connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Publications: None

Presentations:

"Voice Recognition Software" Instruction Course presented to the Annual Meeting of the American Academy of Otolaryngology – Head and Neck Surgery, Orlando, Florida, September 2003, by Dr. Burgess.

Appendix D

Second Quarter (FY04) Activities

(October 1, 2003 to December 31, 2003)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: 31 December, 2003

3. Reporting period from: October 2003 to December 2003

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

LINE ITEM	CURRENT	CUMULATIVE
Personnel	$49,146.62	$1,986,181.99
Fringe Benefits	$11,548.83	$333,777.63
Supplies	$6,812.48	$205,534.11
Travel	$1,898.26	$108,978.49
Equipment	($2,599.00)	$262,664.40
Other	$9,804.55	$517,113.64
Direct Cost	$76,611.74	$3,414,250.26
Indirect Cost	$15,638.80	$628,324.99

10. Comments on administrative and logistical matters.

University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in terms of the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. See Attached

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	40%	11/15/03
Research Manager	Deborah Birkmire-Peters, Ph.D.	25%	01/14/03
Project Coordinator	Victoria Garshnek, Ph.D.	10%	10/1/03
Administrative Secretary	Dolly Puchert	50%	08/01/01
Graphics & Systems Programmer	Andrei Sherstyuk, Ph.D.	0%	10/01/03
Systems Programmer	Mike von Platen	10%	10/01/03
Admin/Fiscal Assistant	Janet Chang	30%	7/01/03
Clinical Associate	Joshua Jacobs, M.D.	25%	08/01/02
Graduate Research Assistant	Christopher Aschwanden	0%	11/15/03

Item #11: Description of Progress

Personnel Related Activities:

Dr. Burgess reduced to 40% FTE, Dr. Garshnek reduced to 10% FTE, Dr. Sherstyuk reduced to 0%, Mr. von Planten reduced to 10%, Mr. Aschwanden reduced to 0%.

Curriculum Related Activities

1. Drs. Burgess, Deborah Birkmire-Peters, Andrei Sherstyuk, Victoria Garshnek, and Michael Von Platen, Christopher Aschwanden, and Kathleen Kihmm met to review the development, implementation, and status of the new modules of the UH Telemedicine Curriculum.
2. Dr. Birkmire-Peters met with MAJ Schuler, Office of the Center Judge Advocate, Tripler Army Medical Center, to discuss the participation of TAMC personnel in the proposed UH Telemedicine Curriculum Evaluation. MAJ Schuler agreed to speak with COL Schempp, Chief, Department of Clinical Investigations, TAMC. It was decided that they would support the participation of TAMC personnel in the evaluation. Dr. Birkmire-Peters drafted a letter of support from the Commanding General, Tripler Army Medical Center. The letter was staffed through the command at Tripler and was signed by MG Webb.
3. Dr. Birkmire-Peters submitted the letter of support from the CG, TAMC, to the OTSG Human Subjects Research Review Board. Approval for the UH Telemedicine Curriculum Evaluation was subsequently issued.
4. Janet Chang solicited bids from three local resorts for the retreat during which exit interviews will be held. Only two facilities responded and the Marriott Ihilani Resort was chosen. Dr. Birkmire-

Peters requested draft sales contracts from Lisa Nakamasu, Sales Manager, Marriott Hotels, and the sales contracts were reviewed by Lori DeBarnadis. Dr. Birkmire-Peters discussed specifics of the contracts with Ms. Nakamasu and the final sales contracts were signed for the weekends of April 3-4 and 17-18, 2004.

5. "Module 7: Live and Asynchronous Modalities" was revised by Dr. Josh Jacobs. Additional content was included in the revised version. Kathleen Kihmm input the revised module into the UH Telemedicine Curriculum. All other modules were reviewed and placed in near-final form.
6. Mr. Christopher Aschwanden completed testing and correcting of various errors/bugs for the Curriculum Website.
7. Mr. Michael Von Platen reviewed Curriculum modules and revised HTML and JavaScript files as required.
8. Mr. Von Platen also assembled, configured and tested VTC equipment for Kuikini Medical Center and provided technical support for the Grand Rounds broadcast.
9. Michael Von Platen coordinated acoustical upgrades to the telemedicine rooms at Molokai General Hospital (outpatient building) and Community Healthcare Buildings.

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealths Health Center of Saipan (including approximately 40 physicians) has been connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Publications: None

Presentations:

Birkmire-Peters, D. (2003, November). UH Telemedicine Curriculum. Presented to the 8th Center for Asian Pacific Exchange Workshop for Clinical Nurse Specialists, Honolulu, HI.

Appendix E

Third Quarter (FY04) Activities

(January 1, 2004 to March 31, 2004)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: 31 March, 2004

3. Reporting period from: 1 January to 31 March 2004

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

LINE ITEM	CURRENT	CUMULATIVE
Personnel	$27,731.94	$2,013913.93
Fringe Benefits	$7,204.11	$340,981.74
Supplies	$8.00	$205,542.11
Travel	$2216.62	$111,195.11
Equipment	0	$262,664.40
Other	$2,164.52	$517,278.16
Direct Cost	$39,325.19	$3,453,575.45
Indirect Cost	$8,022.34	$636,347.33

10. Comments on administrative and logistical matters.

University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in terms of the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. See Attached

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	40%	11/15/03
Research Manager	Deborah Birkmire-Peters, Ph.D.	25%	01/14/03
Project Coordinator	Victoria Garshnek, Ph.D.	10%	10/1/03
Programmer	Kathleen Kihmm	0% consultant	01/01/04
Administrative Secretary	Dolly Puchert	50%	08/01/01
Graphics & Systems Programmer	Andrei Sherstyuk, Ph.D.	0% consultant	01/01/04
Systems Programmer	Mike von Platen	10%	10/01/03
Admin/Fiscal Assistant	Janet Chang	30%	7/01/03
Graduate Research Assistant	Christopher Aschwanden	0%	11/15/03

Item #11: Description of Progress

Personnel Related Activities:

Kathleen Kihmm, Andrei Sherstyuk, and Christopher Aschwanden, due to earlier cost sharing, are still providing input into the proposal. Joshua Jacobs is not participating as of 01/01/04, as he completed his module.

Curriculum Related Activities

1. Drs. Burgess, Deborah Birkmire-Peters, Andrei Sherstyuk, Victoria Garshnek, and Michael Von Platen, Christopher Aschwanden, and Kathleen Kihmm met to review the development, implementation, and status of UH Telemedicine Curriculum.
2. Dr. Victoria Garshnek reviewed the modules from the Curriculum Website and noted various discrepancies in need of correction.
3. Kathleen Kihmm implemented Dr. Garshnek's corrections/suggestions including typos, broken links, quizbank bugs, and outdated information.
4. Kathleen Kihmm reviewed and edited instructions to be sent to evaluators.
5. Ms. Kihmm also updated the database and removed old information. The database was also backed up every few days for the evaluation by Ms. Kihmm.
6. Ms. Kihmm informed and discussed with Mike Von Platen some issues that occurred when he tried to make the system more secure--via a tech support inquiry
7. Michael Von Platen completed CDROM version of the Curriculum.

8. Mr. Von Platen provided additional VTC endpoint equipment and technical support for Waianae Coast Comprehensive Health Center and also provided technical consulting for new VTC endpoint at Queen's Hospital, Queen Emma Clinics.
9. Michael Von Platen provided new Adtran Atlas PRI switch for State Telehealth Access Network at UH.
10. Mr. Von Platen also provided ongoing support for telepsychiatry at Molokai General Hospital & Community Health Center.
11. Participants were recruited for the planned evaluation of the first four modules of the UH Telemedicine Curriculum. Dr. Birkmire-Peters wrote the evaluation instructions and sent the instructions, along with details of the evaluation, to all the volunteers. She obtained consent forms from all the participants. She monitored the progress of each participant and issued interim progress reports to each participant. Any problems reported by the participants with the curriculum or its website were reported to the technical team and corrections were made. Dr. Birkmire-Peters recruited replacement participants for those who decided not to participate.
12. Dr. Birkmire-Peters planned the Evaluation Retreat held at the Ihilani at Ko'Olina during which exit interviews will be conducted. Details of the evaluation participants' compensation package were discussed with the event management staff at the Ihilani. Contracts were negotiated and let for the two evaluation weekend retreats.

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealths Health Center of Saipan (including approximately 40 physicians) has been connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Publications: None

Presentations:

A paper entitled "Spatial Simulation Model for Infectious Viral Diseases with Focus on SARS and the Common Flu" by Christopher Aschwanden was presented at the HICSS conference 37, January 5-8, 2004, on the Big Island, Hawaii, with subsequent publication expected through IEEE.

Appendix F

Fourth Quarter (FY04) Activities

(April 1, 2004 to June 30, 2004)

Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: 30 June, 2004

3. Reporting period from: 1 April to 30 June 2004

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

LINE ITEM	CURRENT	CUMULATIVE
Personnel	$35,284.08	$2,049,198.01
Fringe Benefits	$9,638.33	$350,620.07
Supplies	$0	$205,542.11
Travel	$6573.86	$198,968.25
Equipment	0	$269,422.31
Other	$20,511.07	$539,789.23
Direct Cost	$70,625.44	$3,524,200.89
Indirect Cost	$1,288.78	$637,636.11

10. Comments on administrative and logistical matters.

University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in terms of the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. See Attached

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	40%	11/15/03
Research Manager	Deborah Birkmire-Peters, Ph.D.	25%	01/14/03
Project Coordinator	Victoria Garshnek, Ph.D.	10%	10/1/03
Programmer	Kathleen Kihmm	0% consultant	01/01/04
Administrative Secretary	Dolly Puchert	50%	08/01/01
Graphics & Systems Programmer	Andrei Sherstyuk, Ph.D.	0% consultant	01/01/04
Systems Programmer	Mike von Platen	10%	10/01/03
Admin/Fiscal Assistant	Janet Chang	30%	7/01/03
Graduate Research Assistant	Christopher Aschwanden	0%	11/15/03

Item #11: Description of Progress

Personnel Related Activities:

Kathleen Kihmm, Andrei Sherstyuk, and Christopher Aschwanden, due to earlier cost sharing, are still providing input into the proposal. Joshua Jacobs is not participating as of 01/01/04, as he completed his module.

Curriculum Related Activities

1. Drs. Burgess, Deborah Birkmire-Peters, Andrei Sherstyuk, Victoria Garshnek, and Michael Von Platen, Christopher Aschwanden, and Kathleen Kihmm met to review the development, implementation, and status of UH Telemedicine Curriculum.
2. Drs. Burgess, Deborah Birkmire-Peters, Victoria Garshnek, Kathleen Kihmm and Christopher Aschwanden met to coordinate the Curriculum Final Report activities to undertake.
3. Michael Von Platen packaged the Curriculum into two CD-ROM versions:
    a. Standalone Version
    b. Server Version

    The CD-ROMs have a printed cover and are packaged into a Jewel-Case. The pretests are not available on the CD-ROMs.
4. Bug fixing, corrections/suggestions have been implemented and completed by Kathleen Kihmm. This includes typos, broken links, quizbank bugs and outdated information.
5. Instructions to be sent out to evaluators have been completed by Kathleen Kihmm.

6. Mr. Von Platen provided ongoing support for telepsychiatry at Molokai General Hospital & Community Health Center.
7. The evaluation of the UH Telemedicine Curriculum has been completed. Consent forms and evaluation results have been obtained from all participants. Problems reported by the participants with the curriculum or its website were reported to the technical team and corrections were made. Dr. Birkmire-Peters finished the data analysis of the curriculum evaluation.
8. The Evaluation Retreat planned by Dr. Birkmire-Peters has been held at the Ihilani at Ko'Olina.

Administrative and Other Activities:

Coordinated weekly Grand Rounds broadcast from Queen's Medical Center to multiple sites throughout Hawaii and the Pacific. The Commonwealths Health Center of Saipan (including approximately 40 physicians) has been connecting by PEACESAT to these weekly VTC presentations.

Continuing clinical consultation service: diabetes case management. Dr. Joseph Humphry conducts biweekly telemedicine consults with the Hana Community Health Center on Maui, from the UH Telemedicine Project facilities and Queen Emma Clinic.

Publications: None

Presentations: None

Digital Media:

Created two CD-ROMs containing the UH Telemedicine Curriculum:

- Standalone Version 2.0
- Server Version 2.0

Appendix G

Final Quarterly Report

(July 1, 2004 to September 30, 2004)

Final Quarterly Report

1. Agreement No. DAMD17-99-2-9003 2. Report Date: 08 November, 2004

3. Reporting period from: 1 July to 30 September 2004

4. PI: Lawrence Burgess, M.D. 5. Telephone No.: (808) 528-2938

6. Institution: University of Hawaii, Office of Research Services, RCUH
2530 Dole Street, Sakamaki D-200, Honolulu, Hawaii 96822

7. Project Title: University of Hawaii Telemedicine Project (UHTP)

8. Current staff, with percent effort of each on project. **See Attached**

9. Agreement expenditures to date (as applicable):

LINE ITEM	CURRENT	CUMULATIVE
Personnel	$3957.18	$2,053,155.19
Fringe Benefits	$992.08	$351,612.15
Supplies	$726.06	$199,694.31
Travel	$2,552.36	$116,203.02
Equipment	0	$269,422.31
Other	$1,079.86	$540,869.09
Direct Cost	$9,307.54	$3,533,508.43
Indirect Cost	$1,898.75	$639,534.86

10. Comments on administrative and logistical matters.

University of Hawaii serves as fiduciary agency for this Cooperative Agreement. Consequently, all expenditures and activities are governed by University of Hawaii policies and procedures as per the Office of Research Services and School of Medicine Administrative Services Fiscal Office.

11. Use additional page(s), as necessary, to describe scientific progress for the quarter in terms of the tasks or objectives listed in the statement of work for this agreement. Explain deviations where this isn't possible. Include date where possible. **See Attached**

12. Use additional page(s) to present a brief statement of plans or milestones for the next quarter. See Attached

I certify to the best of my knowledge and belief that this report is true in all respects and that all disbursements have been made for the purpose and conditions of the grant or agreement.

Item #8: Current Staff

Position	Name	FTE	Effective
Principal Investigator	Lawrence Burgess, M.D.	40%	11/15/03
Research Manager	Deborah Birkmire-Peters, Ph.D.	25%	01/14/03
Project Coordinator	Victoria Garshnek, Ph.D.	10%	10/1/03
Programmer	Kathleen Kihmm	0% consultant	01/01/04
Administrative Secretary	Dolly Puchert	50%	08/01/01
Graphics & Systems Programmer	Andrei Sherstyuk, Ph.D.	0% consultant	01/01/04
Systems Programmer	Mike von Platen	10%	10/01/03
Admin/Fiscal Assistant	Janet Chang	30%	7/01/03
Graduate Research Assistant	Christopher Aschwanden	0%	11/15/03

Item #11: Description of Progress

Personnel Related Activities:

Kathleen Kihmm, Andrei Sherstyuk, and Christopher Aschwanden, due to earlier cost sharing, are still providing input into the proposal.

Curriculum Related Activities

Preparation of the Final Addendum Report for Award Number DAMD17-99-2-9003.

Administrative and Other Activities:

Remaining funds will be expensed on personnel to close the account.

Appendix H

Evaluation of Web-Based Training Techniques

Evaluation of the University of Hawaii Telemedicine Curriculum

Deborah P. Birkmire-Peters, PhD, Lawrence P.A. Burgess, MD, Kathleen Kihmm, MS, and Christoph Aschwanden, MS,
University of Hawaii Telehealth Research Institute

Introduction: The purpose of the University of Hawaii Telemedicine Curriculum Research Project was to develop an effective web-based curriculum for training military healthcare personnel in the use of contemporary communication, automation, and informatics technology in the delivery of healthcare. The overall curriculum is generic in nature, while specific modules can be tailored to the needs of the military healthcare provider. The goal of the telemedicine curriculum is to impart both the necessary knowledge and practice skills to the healthcare provider. The curriculum was designed to instruct healthcare providers in the various clinical uses of telemedicine and the clinical and organizational barriers to the successful utilization of telemedicine. The telemedicine curriculum was designed to address the communication and automation tools available to the military healthcare system. This advanced toolkit of telemedicine curriculum modules can support the efforts of the DoD to efficiently and effectively apply the latest technological advances in communication and data transfer to improve healthcare delivery.

The curriculum also has an assessment/evaluation component that enables continuous refinement. Upon the completion of each module, readers complete a questionnaire that measures their satisfaction with the module with respect to course objectives, course content, application to current assignment, module organization and clarity, audiovisual effects, pace, and difficulty. Additionally, at the completion of each module readers take a quiz that measures changes in knowledge. Information gained from these questionnaires and quizzes can be used to modify and revise the modules.

This report examines the evaluation instruments contained in the first four modules and assesses their effectiveness as evaluation tools. The modules examined were: Telemedicine Fundamentals (Module 1), Telemedicine Technology and Environment (Module 2), Conducting a Telemedicine Patient Visit (Module 3), and Organization and Management (Module 4).

Method:

Participants: Twenty-five volunteers were recruited from Tripler Army Medical Center from healthcare providers and administrators. Of the 25 healthcare providers, 23 were in the military and 2 were civilians. Figure 1 displays the distribution of participants by occupation. The distribution of specialties among the 17 physician participants was: nine in internal medicine, two each in general surgery and otolaryngology, and one each in pulmonary and critical care, cardiothoracic surgery, neurology/family medicine/geriatrics, and anesthesia. Seven physicians identified themselves as residents and one as an intern. Of the three nurses, two identified specialties and one was an LPN. Figure 2 displays the distribution of participants by years in practice:

Figure 1: Distribution of participants by occupation (N=25)

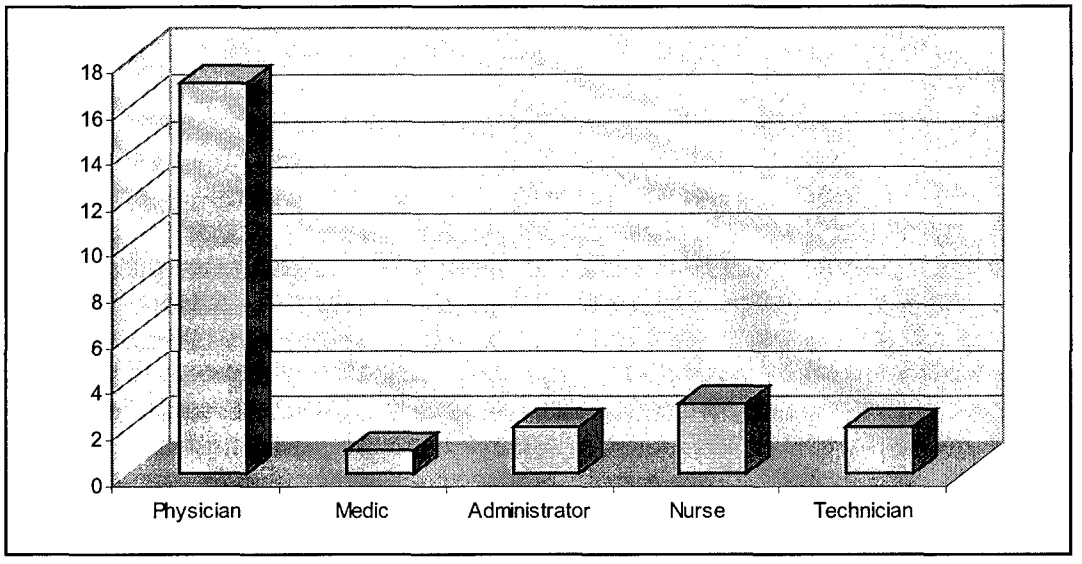
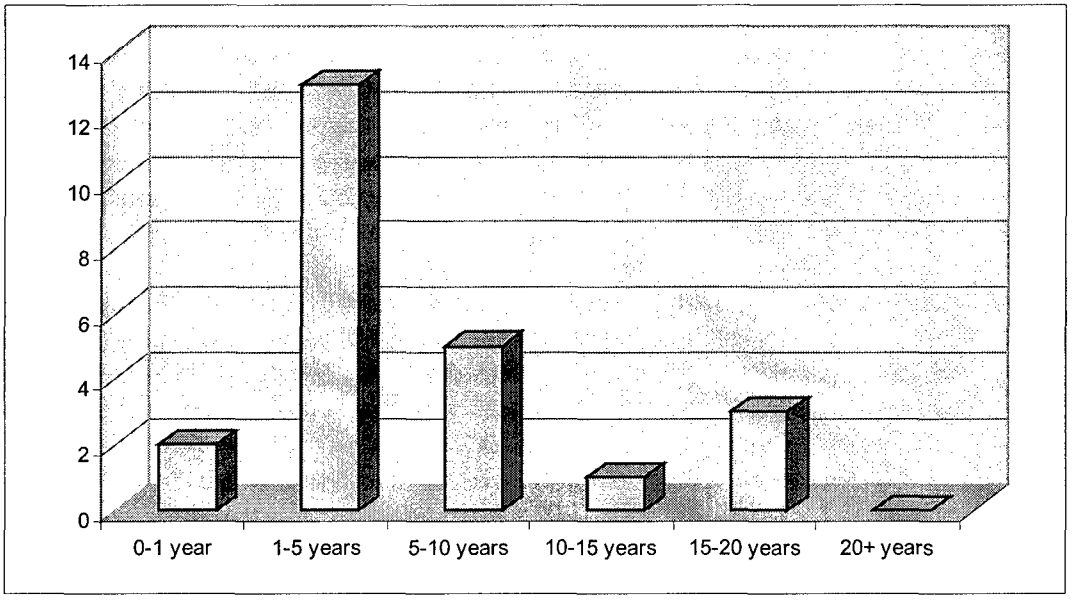


Figure 2: Distribution of participants by years in practice (N=24)



To compensate them for their time, participants were provided with one night's lodging at a local hotel. The participants' hotel accounts were also credited with one day's per diem and one night's parking. We provided Internet access at the hotel for those who needed to complete the modules. The majority of exit interviews were also conducted there.

Procedures: Individuals who were interested in volunteering to participate in the curriculum evaluation were contacted by email. An explanation of the evaluation, what their participation involved, and a consent form were sent to these individuals. If, after reading the explanation, they wanted to participate in the evaluation, they were instructed to sign the consent form and mail it to the principal investigator who enrolled the individuals in the study. The participants were then sent the URL for the University of Hawaii Telemedicine Curriculum and general instructions for registering on the curriculum website. Once participants were registered, they were asked if they were participating in the evaluation and had not taken the pre-test. Once they gave a "yes" response, they were automatically directed to a pre-test to assess their knowledge of telemedicine prior to reading the four modules. Following completion of the pre-test, each participant was told that they should read each module at their own pace and that the modules did not need to be completed in one sitting nor did the modules need to be read sequentially. Following these instructions, there was a link that directed the participants to the UH Telemedicine Curriculum home page.

Once a participant reviewed a module and felt comfortable with the information, he or she was instructed to complete the two questionnaires associated with that module. A link was provided on the contents page and on the conclusions page that directed the participant to the questionnaires. The first is a "reaction" questionnaire to measure a participant's level of satisfaction with that module with respect to course objectives, course content, application to current assignment, module organization and clarity, audiovisual effects, pace, and difficulty. Following completion of the reaction questionnaire, each participant answered 15 multiple-choice and true-false questions on the content of the module they just reviewed. Following the completion of each quiz, participants were allowed to review the questions and correct answers. Each participant repeated a quiz until a passing score of 11 (70%) was obtained. It was estimated that 2-to-2 ½ hours were required to review each module and complete the associated questionnaires. This same process was repeated with each of the four modules.

Following completion of all four modules and the associated questionnaires, each participant participated in an exit interview. This occurred approximately 1 to 2 months following completion of all four modules and the associated questionnaires and quizzes. The interview questions attempted to elicit from the participants their assessment of the strengths and weaknesses of the curriculum and the extent to which they were able to or thought that they would be able to use knowledge gained from the curriculum in performance of their duties. Participants were interviewed individually. The interviews took approximately one-half hour and were done either at the local hotel or at Tripler Army Medical Center.

Study Design: The study design is a one-way repeated measures model with four levels, i.e., modules. Outcome measures include: number of quiz attempts, pre- and post-test knowledge scores, customer satisfaction ratings, and exit interview comments.

Passing Score: The UH Telemedicine Curriculum Website was designed to measure each participant's change in knowledge about the module content following exposure to the content. A multiple choice test format was chosen for the quiz format to assure the participants acquisition of curricular content. Participants passed the quiz for each module if a programmatically-determined level of performance was achieved. This minimum passing score

is called the Angoff score. A participant repeated a quiz until they achieved the Angoff score. The Angoff score was set at 70% (11 correct responses out of 15 questions).

The optimal distribution of passing scores is one in which most participants pass the quiz for a module on the first or second attempt. Theoretically, this means that the participant learned not only while reading the module, but also while taking the quiz. In practice, however, participants will quickly adopt non-learning strategies to pass the quizzes. This is especially true if repeated administrations are required to pass and in populations of participants that are intelligent, creative, and competitive.

Success Rate: Success rate reports the percentage of participants who pass a module quiz on the first attempt. This measure can be used as a broad indicator of difficult, flawed, or boring modules. Very high or very low success rates may indicate problems with the quizzes. If a large number of participants pass the quiz on the first attempt, the quiz may be too easy. Conversely, if a small number of participants pass the quiz on the first attempt, then the quiz may be too difficult, there may be a mistake in item construction or scoring, or the content of the module may be ineffectively communicated.

Number of Standard Deviations in the Range of Scores: One of the simplest measures of the quality of a quiz compares the range of scores to the standard deviation. In general, as this ratio increases, the test becomes better at discriminating between students of differing levels of ability. The higher the number of standard deviations in the range, the tighter the distribution of grades for that quiz. That is, a high value indicates that all the participants had essentially the same score, and the quiz did not discriminate between participants. Conversely, a low number of standard deviations indicates a broad distribution of scores. This indicates a quiz which may suffer from any of the following problems: the quiz items are poorly written, the quiz items are difficult to comprehend, there are mistakes in scoring, or the content of the module may be ineffectively communicated.

The optimal ratio of the range to the standard deviation is dependent upon the number of students who take the quiz. If the number of participants completing a quiz is 25, the optimum number of standard deviations in the range is 3.9. Ratios that are significantly smaller would suggest that the quiz does not discriminate between students to the extent desired.

First attempts to pass the quiz only will be used in the analyses. As mentioned previously, data for attempts beyond the first are likely confounded by the adoption of non-learning strategies by the participants.

Pre-Quiz vs. Post-Quiz: A pre-quiz was constructed to assess the participants' knowledge of telemedicine prior to reading the four modules. The pre-quiz consisted of 20 multiple-choice and true-false items covering information contained in the first four curriculum modules. Five questions from each module's post-quiz were randomly selected for inclusion in the pre-quiz. The participant's responses to the questions on the pre-quiz were compared to their responses to the same questions after reading the modules.

Item Analyses: Two methods to identify specific test items that do not perform well are an examination of the response distribution and the incorrect response count. Skewed and asymmetric distributions and incorrect response counts can be examined in detail to determine poorly formulated questions. Again, only responses to the first attempt to take the quiz should be analyzed because the participants may have adopted non-learning strategies in taking the quizzes subsequent times. Examination of both the response distributions and the incorrect response counts for individual items can identify quiz items that need to be modified. As a general rule of thumb, items for which 80% or more and 20% or less of the responses are correct on the first attempt should be examined in detail to determine the cause for their lack of discriminability. Possible reasons for poor discriminability of quiz items are: poorly constructed questions, scoring errors, typographical errors in the item resulting in more than one correct answer, and didactic content in the module that is poorly conveyed.

Reaction Surveys and Exit Interviews: The reaction surveys measured the participants' satisfaction with the module with respect to course objectives, course content, application to current assignment, module organization and clarity, audiovisual effects, pace, and difficulty. The exit interview questions attempted to elicit more detailed information from the participants about their assessment of the strengths and weaknesses of the curriculum and the extent to which they were able to or thought that they would be able to use knowledge gained from the curriculum in performance of their duties. The participants' comments during the interviews were reviewed and common responses were noted.

Results:

Success Rate: Table 1 displays the number of participants who repeated the quiz for each module, the success rate, i.e., the cumulative percentage of participants who passed the examination, the minimum score achieved, the maximum score achieved, and the mean and standard deviation for each quiz attempt are also displayed in Table 1. The success rate for the first quiz attempt ranged from 48% to 68%.

Only first attempts were analyzed. The design of the evaluation allowed the participants to view the correct answers to the quizzes following the first quiz attempt. It was felt that the quizzes should be used as a learning tool, to direct the participants to section(s) of the module(s) that should be reviewed. In reviewing the web usage logs, it appeared from the amount of time recorded that some participants simply took a quiz, reviewed the correct answers, and re-took the quiz again without reviewing the material in the module.

Table 1. Number of quiz attempts and minimum, maximum, mean score and standard deviation.

	N	Success Rate	Minimum	Maximum	Mean	Std. Deviation
Module 1 First Attempt	25	56 %	47	100	74.72	12.857
Module 1 Second Attempt	11	96%	47	100	84.91	14.856
Module 1 Third Attempt	1	100%	80	80	80.00	.
Module 2 First Attempt	25	64%	40	93	74.68	15.999
Module 2 Second Attempt	9	100%	73	100	87.44	7.780
Module 3 First Attempt	25	48%	40	100	69.36	17.195
Module 3 Second Attempt	13	100%	73	100	87.15	10.065
Module 4 First Attempt	25	68%	27	100	75.04	17.639
Module 4 Second Attempt	8	88%	67	100	85.00	14.909
Module 4 Third Attempt	2	96%	67	80	73.50	9.192
Module 4 Fourth Attempt	1	100%	73	73	73.00	.

Number of Standard Deviations in the Range of Scores: The range, the standard deviation, and the number of standard deviations in the range of scores for each quiz for each of the four modules is displayed in Table 2. This calculation was done only for the data set of scores from the first attempt to take a quiz for each module.

Table 2. Range, the standard deviation, and the number of standard deviations in the range of scores

	N	Range	Standard Deviation (SD)	Number of SDs in Range
Module 1 First Attempt	25	53	12.857	4.12
Module 2 First Attempt	25	53	15.999	3.31
Module 3 First Attempt	25	60	17.195	3.49
Module 4 First Attempt	25	73	17.639	4.14

As noted previously, the optimum number of standard deviations in the range is 3.9 for 25 participants completing a quiz. The ratio of the range to the number of standard deviations for each of these four modules was close to the optimum number. Module 1: Telemedicine Fundamentals and Module 4: Organization and Management had a number of standard deviations in the range only slightly greater than the optimum, indicating that the distribution of scores was acceptable. Module 2: Telemedicine Technology and Environment and Module 3: Conducting a Telemedicine Patient Visit, however, have smaller ratios, indicating a somewhat broader distribution of scores.

Pre-Quiz vs. Post-Quiz: The number of correct responses to the pre-quiz items was matched to the number of correct responses to the same post-quiz items for the first attempt to take the quiz. The mean and standard deviation for the correct response rate for the pre-quiz and the post-quiz for each module and the overall quiz scores are displayed in Table 3.

A paired t-test comparison of the overall pre-quiz score and the overall post-quiz score was done ($t = -4.650$, $df/19$, $p < 0.000$). The overall post-quiz scores were significantly higher than the overall pre-quiz scores Table 3. The mean and standard deviation for the correct response rate for the pre-quiz and the post-quiz for each module and the overall quiz.

	Pre-Quiz Mean	Pre-Quiz Standard Deviation	Post-Quiz Mean	Post-Quiz Standard Deviation
Telemedicine Fundamentals	10.60	6.066	20.20	2.588
Telemedicine Technology & Environment	14.00	7.416	18.20	3.701
Conducting a Telemedicine Patient Visit	11.00	11.068	16.80	5.630
Organization & Management	11.80	6.261	21.20	1.789
Overall	11.85	7.429	19.10	3.837

Item Analyses: The distributions of responses to the individual quiz items and the number and incorrect response count and percentages are displayed in the tables in Appendix H-1.These data are from the first quiz attempt. Please note that the correct response to each item and the number of correct responses are in bold characters.

Table 4 displays the individual quiz items by module where the number of incorrect responses was less than 20% or greater than or equal to 80%. There were a relatively large number of items where over 80% of the responses were correct and there were no items for which fewer than 20% of the responses were correct. There may be a number of reasons for this pattern of results. The population of participants was generally highly educated, motivated, and competitive. As such, their distribution of quiz scores would be expected to be skewed positively. Additionally, the quizzes were designed to evaluate acquisition of knowledge, as opposed to, discriminate between high and low performers. These items, however, should be reviewed to determine if they are poorly constructed or if there are other problems.

Table 4. Individual quiz items where incorrect response rate was less than 20% or greater than 80%.

Module	**Incorrect Responses < 20%**	**Incorrect Responses > 80%**
Telemedicine Fundamentals	**6 (15)** Items 2, 3, 4, 6, 7, 11	
Telemedicine Technology & Environment	**8 (16)** Items 2, 6, 7, 8, 11, 13, 14, 16	
Conducting a Telemedicine Patient Visit	**6 (15)** 2, 4, 5, 8, 10, 13,	
Organization & Management	**7(15)** 1, 2, 4, 5, 7, 11, 15	

Reaction Surveys and Exit Interviews: The responses to the online reaction surveys are shown in the tables in Appendix H-2. In general, most participants "agreed" or "strongly agreed" that the curriculum was a good learning experience. The overall % scores are slightly lower due to a middle ranking of "3" for usability of telemedicine in the work place.

The responses from the participants during the exit interview were generally positive. A majority of the participants indicated that they felt that the modules were well written and the content was interesting. A small number of participants indicated that they did not like the technical content, but most felt that that was their personal preference.

To clarify further the issue of usability in the workplace, this issue was specifically discussed in the exit interviews. The participants indicated almost unanimously (96%) that they had not tried to implement telemedicine solutions in their current work situation. Participants were asked why they were not doing some of the things described in Modules 1 through 4. Four possible responses were suggested: (a) It isn't practical for my situation, (b) My supervisor discourages me from changing, (c) I haven't found the time, and (d) I tried it and it didn't work. Participants were asked if each of these reasons was a very significant reason (1), a somewhat significant (2), or not at all significant (3) as to why they had not implemented some of the telemedicine procedures in Modules 1 through 4. Responses to the questions are displayed in Table 5. A large majority of participants (92.6%) indicated that they did not have the time to implement telemedicine applications. The lack of time was emphasized throughout many interviews. The participants also did not largely feel that their supervisors discouraged them from changing. The participants also felt that telemedicine was not applicable to their current situation.

Table 5. Number of responses, the mean and standard deviation for significance of reason for not implementing telemedicine applications.

	N	Mean	Standard Deviation
It wasn't practical for my situation	25	1.76	.831
My supervisor discourages me from changing	25	2.72	.614
I haven't found the time	25	1.76	.926
I tried it and it didn't work	25	2.96	.200

Another theme that emerged in the interviews had to do with length and detail in the first four modules. Ten participants made comments to the effect that the first four modules were too long, too detailed, and could best be used as a resource.

Conclusions:

This report examined the first four modules and the evaluation instruments contained in the University of Hawaii Telemedicine Curriculum. The evaluation instruments in the modules were assessed for their effectiveness as evaluation tools. The modules and their associated quizzes examined were: Telemedicine Fundamentals (Module 1), Telemedicine Technology and Environment (Module 2), Conducting a Telemedicine Patient Visit (Module 3), and Organization and Management (Module 4). The Angoff score (passing score) for the individual module quizzes was set at 70%. The Telemedicine Curriculum and the on-line educational methodology was validated with post-test scores on the first attempt being higher than the pre-test scores in all modules with consistency between modules. Likewise, reaction surveys and exit interviews verified a positive learning experience.

The success rate for the first attempt for each of the quizzes was somewhat lower than what was expected given the participant population, however they were relatively consistent between modules. This may be due to multifactorial reasons that will require further delineation in subsequent studies. Specifically, quiz items will require continued evaluation and modification. Additionally, it is possible that the on-line format alone may result in lower scores than a classroom or on-line format plus classroom setting. Also, the role of non-learning strategies in self-directed learning activities needs to be examined.

The pre- and post-quizzes, however, demonstrated that the participants were learning the concepts presented in the modules. Test questions were generally easier than harder, which would indicate that lower test scores on the first round may be due to the self-directed, honor system type format, with less desire to learn without penalties for poor performance.

Given that there appeared to be the adoption of non-learning strategies by a number of participants, alternative methods should be developed. One possible alternative is to develop additional forms of the quizzes, which will reduce the possibility of non-sanctioned group learning. Modifying and validating a bank of test questions, however, generally takes years of test and development with multiple participants to validate questions with the appropriate spread between correct and incorrect answers in multiple choice formats.

Regardless, this stresses an important point of on-line learning. A certain percentage of participants will always employ non-learning strategies for various reasons. Therefore, the curriculum can be provided on-line if appropriate, but on-line testing can only be accomplished for general knowledge gathering and for educational content based on the honor system such as used in continuing medical education. Any curriculum granting certification, however, should provide testing in a monitored situation.

Appendix H-1: Tables of Item Analyses

MODULE 1 TEST QUESTIONS

TELEMEDICINE FUNDAMENTALS

1. Telemedicine can include:

	Number of Responses
a) Delivery of medical services over distance	**20**
b) Medical education using interactive CD technology	1
c) Patient information in electronic files	0
d) Administration of Physical Therapy in a hospital	4
e) Health Care Administration in a network of multiple hospitals	0

Total number of incorrect responses: 5 (20%)

2. Telemedicine networks can be:

	Number of Responses
a) End-to-end	**21**
b) Hub-and-Spoke	4
c) Circular	0
d) Branching	0
e) Nested	0

Total number of incorrect responses: 4 (16%)

3. Telemedicine can be described as a (n) _____ to use in the practice of medicine.

	Number of Responses
a) New tool	0
b) Evolving tool	**24**
c) Widely accepted tool	0
d) Cost effective tool	0
e) Essential	1

Total number of incorrect responses: 1 (4%)

4. **Which of the following is a well-documented barrier to the use of telemedicine?**

	Number of Responses
a) Monetary issues	**24**
b) Patient acceptance	1
c) Network capability	0
d) Software development	0
e) Equipment compatibility	0

Total number of incorrect responses: 1 (4%)

5. **In general, the vast majority of issues surrounding telemedicine are not very different from the issues that exist with more traditional health care deliver.**

	Number of Responses
a) True	**20**
b) False	5

Total number of incorrect responses: 5 (20%)

6. **The most frequently cited barrier to long-term sustainability of civilian telemedicine programs is related to _____:**

	Number of Responses
a) Concerns about insurance reimbursements	**22**
b) Equipment costs	2
c) Physician acceptance	1
d) Patient acceptance	0
e) Compatibility with existing information systems	0

Total number of incorrect responses: 3 (12%)

7. **Telemedicine has been recognized as a tool well suited for prison patient populations on the basis of _____:**

	Number of Responses
a) Legal considerations	0
b) Cost-benefit analyses	**25**
c) Liability considerations	0
d) Patient acceptance	0
e) Insurance reimbursement issues	0

Total number of incorrect responses: 0

8. **Which of the following are not communication methods for tele-homecare?**

	Number of Responses
a) Cable TV	7
b) Stand-alone video-telephone units	1
c) Video-telephone systems incorporated into television sets	2
d) Automated pre-recorded reminder messages sent by telephone	2
e) Fax	**13**

Total number of incorrect responses: 12 (48%)

9. **If "Televisits" by health care workers are essentially a return to house calls, albeit over distance. Why hasn't this service become more common?**

	Number of Responses
a) Patients have generally reported a low level of satisfaction with tele-homecare	0
b) Physicians are reluctant to try new technologies	3
c) Saving travel time for patients is not a high priority	0
d) Equipment costs for patients and physicians are limiting	3
e) Insurance reimbursement issues	**19**

Total number of incorrect responses: 6 (24%)

10. Malpractice claims regarding telemedicine are a major concern since they are becoming increasingly common.

	Number of Responses
a) True	8
b) False	**17**

Total number of incorrect responses: 8 (32%)

11. Patients who are good candidates for telemedicine include.

	Number of Responses
a) Those with a language barrier	0
b) Those with hearing or vision problems	0
c) Deployed military personnel	**25**
d) Those with psychosis	0
e) Very old or very young patients	0

Total number of incorrect responses: 0

12. The telemedicine orientation exercise does not include which of the following?

	Number of Responses
a) Hands-on demonstration of practice with use of telemedicine workstations and peripheral devices	1
b) Simulated distance examination	0
c) Face-to-face examination	8
d) Feedback from the patient	2
e) Review of appropriate check lists	**14**

Total number of incorrect responses: 11 (44%)

13. A Telemedicine Site Coordinator is responsible for the following functions.

	Number of Responses
a) Scheduling issues	2
b) Training of physicians, nurses, schedulers, and office assistants, billing personnel, therapists and other allied health care personnel	0
c) Champion for the telemedicine service	6
d) Insures equipment and communications operating correctly	0
e) Billing for services	**17**

Total number of incorrect responses: 8 (32%)

14. Which of the following factors are prominent benefits of telemedicine for physicians?

	Number of Responses
a) Interacting with colleagues worldwide	4
b) Simultaneous care with both the specialist and primary care physicians	**18**
c) Longer time intervals between referral and specialist consult appointments	1
d) Ease of scheduling simultaneous appointments with two physicians or caregivers	1
e) Reduced cost for physician's office	1

Total number of incorrect responses: 7 (28%)

15. Which of the following factors are benefits of telemedicine for patients?

	Number of Responses
a) Rapport building through tactile contact	0
b) Sense of isolation	0
c) Improvement in compliance	9
d) Instant access to a healthcare provider	4
e) Reduced cost for patient	**12**

Total number of incorrect responses: 13 (52%)

MODULE 2 TEST QUESTIONS

TELEMEDICINE TECHNOLOGY AND ENVIRONMNET

1. **Telemedicine communication across distance can occur in either real-time, store/forward, or both real-time and store/forward. Which of the following form of telemedicine communication is most frequently associated with both real-time and store/forward applications?**

	Number of Responses
a) Telephone, voice mail, and fax	**14**
b) Electronic-mail	0
c) Video Teleconferencing (VTC)	8
d) Internet/Web-base applications	2
e) None of the above	0

Total number of incorrect responses: 10 (42%)

2. **Advantages of store/forward telemedicine applications include:**

	Number of Responses
a) Requires less bandwidth and can be used with analog modems connected to regular telephone lines	1
b) Timing and scheduling are more flexible as both sender and receiver do not need to be present at the same time	1
c) Usually provides immediate feedback	0
d) a and b above	**22**
e) All of the above	1

Total number of incorrect responses: 3 (12%)

3. **DICOM**

	Number of Responses
a) Is an acronym meaning Digital Imaging and Communication in Medicine	3
b) Is a set of standards governing capture, storage, transfer and retrieval of radiological images	2
c) Compliancy insures that images can be transmitted and viewed on any DICOM-compliant workstation, regardless of manufacturer.	0
d) Both b and c	5
e) All of the above	**15**

Total number of incorrect responses: 10 (40%)

4. **Which of the following digital image formats would not be suitable for store/forward applications?**

	Number of Responses
a) TIFF	9
b) JPEG	2
c) Bitmap	3
d) Both a and c	**7**
e) All of the above	2

Total number of incorrect responses: 16 (70%)

5. **Real time telemedicine VTC connections are usually not used for:**

	Number of Responses
a) Psychiatry	3
b) General medicine	0
c) Situations where motion contributes to the diagnosis	5
d) Situations where effective patient-provider communication is important	0
e) Radiology	**16**

Total number of incorrect responses: 8 (33%)

6. **_____ is measured in bits-per-second (bps).**

	Number of Responses
a) Bandwidth	**15**
b) Frame rate	6
c) Resolution	0
d) Both a and b	3
e) All of the above	1

Total number of incorrect responses: 10 (40%)

7. _____ is measured in pixels in computer-based applications.

	Number of Responses
a) Bandwidth	0
b) Frame rate	0
c) Resolution	**22**
d) Both a and b	0
e) All of the above	1

Total number of incorrect responses: 1 (4%)

8. _____ describes how sharp the individual frames are.

	Number of Responses
a) Bandwidth	1
b) Frame rate	0
c) Resolution	**20**
d) Both a and b	1
e) All of the above	1

Total number of incorrect responses: 3 (13%)

9. _____ provides digital connection with a bandwidth of 128K per line that can be bonded together for higher bandwidths.

	Number of Responses
a) CODEC	0
b) POTS	1
c) ISDN	**20**
d) IP	1
e) All of the above	2

Total number of incorrect responses: 4 (17%)

10. The CODEC:

	Number of Responses
a) Converts analog to digital signals and vice versa	1
b) Compresses the two-way audio and video streams	5
c) Provides the means to connect all VTC devices (including cameras and microphones)	1
d) Both b and c	**12**
e) All of the above	5

Total number of incorrect responses: 12 (50%)

11. Web-based applications of telemedicine are best for:

	Number of Responses
a) Lower bandwidth asynchronous communications where the information is sent to the recipient and stored in a convenient location until accessed	**16**
b) High bandwidth applications such as real-time VTC	1
c) Multi-station VTCs between distant locations	2
d) Monitors the content of the information transmitted	0
e) All of the above	5

Total number of incorrect responses: 8 (33%)

12. Video cameras:

	Number of Responses
a) Are not sensitive to the color temperature of the light source illuminating the patient	0
b) Must be calibrated to the color temperature of the light source to provide accurate color in the picture.	0
c) Need to be "White Balanced"	1
d) Both b and c	**22**
e) None of the above	0

Total number of incorrect responses: 1 (4%)

13. Major sources of frame rate reduction include (choose as many as appropriate):

	Number of Responses
a) Motion	2
b) Complexity of the image	1
c) Bandwidth	0
d) Both a and c	6
e) All of the above	**15**

Total number of incorrect responses: 9 (38%)

14. Compression algorithms are used to reduce the volume of information sent over the link. These algorithms are sensitive to how much of the video picture changes from one frame to the next since it does not transmit the portions of the frame which do not change, and only updates those that do.

	Number of Responses
a) True	**21**
b) False	3

Total number of incorrect responses: 3 (13%)

15. 256K is achieved by bonding two ISDN lines together and can maintain close to 30 fps for subjects with little motion. Moderate or greater motion will reduce the frame rates to between 15 fps and 25 fps.

	Number of Responses
a) True	**24**
b) False	1

Total number of incorrect responses: 1 (4%)

16. The environment in which the telemedicine activities take place can have a large impact on the outcome. Which of the following factors need to be considered to insure a successful video teleconference?

	Number of Responses
a) Power requirements	0
b) Noise level	0
c) Room layout and equipment configuration	0
d) Lighting	0
e) All of the above	**24**

Total number of incorrect responses: 0

MODULE 3 TEST QUESTIONS

CONDUCTING A TELEMEDICINE PATIENT VISIT

1. **Which of the following represent challenges to the implementation and sustainment of a telemedicine program?**

	Number of Responses
a) Scheduling the increased number of individuals involved	1
b) Varying procedures and/or protocols	1
c) Provider resistance to new technologies	1
d) a and c	5
e) a, b and c	**17**

Total number of incorrect responses: 8 (32%)

2. **The key actions necessary for a successful telemedicine visit include all except the following:**

	Number of Responses
a) Scheduling (patient, referring site, and consulting site)	0
b) Patient preparation	0
c) Provider preparation at send/referring and receive/consultant sites	0
d) Real-time examination or store/forward consultation	3
e) Determine how billing will be handled between referring site, consulting site, and the patient	**22**

Total number of incorrect responses: 3 (12%)

3. **Orientation and initial training on telemedicine applications should be:**

	Number of Responses
a) Given during normal clinic hours so as to provide the most realistic environment	0
b) Given outside of normal clinic hours to minimize interruptions	**12**
c) Given within the clinic environment to maximize transfer of training	2
d) a and c	11
e) a, b and c	0

Total number of incorrect responses: 13 (52%)

4. **The referring provider is responsible for:**

	Number of Responses
a) Assessing the suitability of the patient for tele-consultation (psychosis, language barriers, hearing/vision difficulties)	2
b) Scheduling patient at send/referring and receive/consulting sites	0
c) Forwarding medical records of patient to receive site	0
d) Completing patient orientation	0
e) All of the above	**23**

Total number of incorrect responses: 2 (8%)

5. **It is crucial to begin each real-time telemedicine visit with complete introductions and all individuals involved on camera should be introduced. However, at times there may be personnel present who are not seen by the patient on the monitor and these individuals should not be identified, to prevent the patient from being confused by their presence.**

	Number of Responses
a) True	3
b) False	**22**

Total number of incorrect responses: 3 (12%)

6. **The most critical factor in a virtual or store/forward consultation include:**

	Number of Responses
a) The accurate gathering and timely transmission of the information needed by the consulting physician	**15**
b) The ability to give the patient immediate feedback	1
c) The ability to annotate the patient information electronically	0
d) The timely transmission of information from the consulting physician to the referring physician	0
e) All of the above	9

Total number of incorrect responses: 10 (40%)

7. **The results of a patient's audiometric screening show a significant threshold shift in hearing. The patient's history indicates that he is employed as a floor supervisor in a factory manufacturing industrial equipment. Which of the following courses of action would be the most appropriate and efficient?**

	Number of Responses
a) Record a video image of the middle ear and send the electronic image to an otologist for evaluation for pathology	**9**
b) Schedule a video-teleconference with the patient and an otologist	9
c) Repeat the audiometric testing in 30 days and if the hearing loss persists, schedule an appointment with an otologist	5
d) Repeat the audiometric testing, because the hearing loss is likely due to noise and will correct itself	1
e) No action is necessary	1

Total number of incorrect responses: 16 (64%)

8. **At the conclusion of the telemedicine visit, the patient should be invited to ask any further questions of the consultant, the local provider, and any other participant. The patient's comfort level and satisfaction with use of the telecommunications equipment should also be briefly assessed.**

	Number of Responses
a) True	**25**
b) False	0

Total number of incorrect responses: 0

9. **The light platform/control unit:**

	Number of Responses
a) Contains a high-intensity light source, such as, a xenon or halogen bulb, and the electronics to support a video camera	1
b) Can be balanced to accommodate a variety of light conditions	0
c) Connects to a cable that contains a "chip" camera	0
d) a and c	**8**
e) a, b and c	16

Total number of incorrect responses: 17 (68%)

10. To white balance the camera, point the camera or endoscope at a white surface and then hold the color reset button for 3-4 seconds.

	Number of Responses
a) True	**23**
b) False	2

Total number of incorrect responses: 2 (8%)

11. Most of the various telemedicine diagnostic devices are very similar to their non-telemedicine counterparts so very little, if any, practice is needed once the physician is familiar with using the standard instrument.

	Number of Responses
a) True	5
b) False	**20**

Total number of incorrect responses: 5 (20%)

12. When arranging the patient relative to the video monitor the patient must always be able to see the monitor clearly. The recommended arrangement is for the monitor to be facing the patient since the physician may move around and will not always be in the direct line of sight.

	Number of Responses
a) True	17
b) False	**8**

Total number of incorrect responses: 17 (68%)

13. The Exam Camera can also be used as a "document camera" when used with a tripod and for x-rays when used with a light-box. Additionally, when cost is a factor, the exam camera can replace the top-mounted camera on many video units.

	Number of Responses
a) True	**23**
b) False	2

Total number of incorrect responses: 2 (8%)

14. When using a digital stethoscope for real time transmission, it is best to use the audio channel of an existing videoconference system, since VTC is likely to already be in use for the telemedicine visit.

	Number of Responses
a) True	9
b) False	**16**

Total number of incorrect responses: 9 (36%)

15. The intent of a telemedicine visit is identical to that of a traditional face-to-face visit. However, it is imperative to also take into account the unique aspects associated with telemedicine for the examination to be a successful experience. Which of the following will be the most powerful predictor of success in a telemedicine service?

	Number of Responses
a) Available bandwidth	0
b) Equipment acquisition	0
c) Scheduling	**16**
d) a and b	0
e) a, b and c	9

Total number of incorrect responses: 9 (36%)

MODULE 4 TEST QUESTIONS

ORGANIZATION AND MANAGEMENT

1. Which of the following is a main barrier to telemedicine:

	Number of Responses
a) Spatial Issues	0
b) Time Issues	3
c) Organizational Issues	**21**
d) Societal Issues	0
e) Professional Issues	1

Total number of incorrect responses: 4 (16%)

2. How can empowered health care providers overcome barriers to telemedicine?

	Number of Responses
a) Reduce telemedicine cost by using only when necessary	0
b) Study the workflow and propose ways to modify and facilitate telemedicine	**24**
c) Insure quality by using telemedicine for less challenging cases	1
d) Use only when distances between patient and HCP are greater than 10 miles	0
e) Ask legal consultants to facilitate use	0

Total number of incorrect responses: 1 (4%)

3. Clinical quality concerns become a barrier to telemedicine because:

	Number of Responses
a) Clinical evaluation studies have not conclusively demonstrated telemedicine delivers care equivalent to the "gold standard."	**20**
b) The distance that separates a health care provider and a patient during telemedicine serves to reduce the quality of the clinical assessment that may be made.	1
c) The high-touch part of medicine is lost to this technology.	1
d) HCP prefer to have face to face interaction with patients and colleagues in order to gain important insights from non-verbal cues.	2
e) Technology glitches can occur at inopportune times.	1

Total number of incorrect responses: 5 (20%)

4. **Telemedicine programs that contain a rigorous evaluation effort have a better chance to achieve high utilization rates.**

	Number of Responses
a) True	**22**
b) False	3

Total number of incorrect responses: 2 (8%)

5. **For telemedicine to succeed, the organization implementing telemedicine needs to embrace a positive organizational learning culture.**

	Number of Responses
a) True	**25**
b) False	0

Total number of incorrect responses: 0

6. **In a telemedicine effort, one must emphasize the appropriate technology and the medicine will follow.**

	Number of Responses
a) True	5
b) False	**20**

Total number of incorrect responses: 5 (20%)

7. **It is important to have a "techie" in charge of the telemedicine effort.**

	Number of Responses
a) True	4
b) False	**21**

Total number of incorrect responses: 4 (16%)

8. What is an important reimbursement requirement for telemedicine success:

	Number of Responses
a) Primary care and specialists physicians need to split reimbursement credit	0
b) Rural under-served counties need Medicaid reimbursement of telemedicine more than urban areas.	0
c) In the military, workload credit must be fairly accounted for all parties in telemedicine encounters.	**18**
d) Reimbursements must be sufficient to allow all HCP's to receive their usual and customary fee.	7
e) Reimbursement must be the same for store and forward telemedicine as it is for two way interactive video telemedicine.	0

Total number of incorrect responses: 7 (28%)

9. An Important factor to consider when matching the telemedicine technology to medical needs is that one needs to use equipment all from one manufacturer to insure greater medical accuracy and ease workload on health care provider.

	Number of Responses
a) True	3
b) False	**22**

Total number of incorrect responses: 3 (12%)

10. To effectively market telemedicine one must determine the cost and "price" of the telemedicine solution.

	Number of Responses
a) True	18
b) False	**7**

Total number of incorrect responses: 18 (72%)

11. Most telemedicine implementations require Business Process Re-engineering.

	Number of Responses
a) True	**24**
b) False	1

Total number of incorrect responses: 1 (4%)

12. The key to cost effective implementation of telemedicine lies in high rates of utilization.

	Number of Responses
a) True	**20**
b) False	5

Total number of incorrect responses: 5 (20%)

13. An organization which has a committed and strong strategic intent to implement telemedicine will be eventually successful with telemedicine.

	Number of Responses
a) True	20
b) False	**5**

Total number of incorrect responses: 20 (80%)

14. A cost of poorly implemented and failed telemedicine efforts is diminished communication between generalists and specialists.

	Number of Responses
a) True	15
b) False	**10**

Total number of incorrect responses: 15 (60%)

15. Breakdowns in the technical system remain the single most significant cause of telemedicine failure.

	Number of Responses
a) True	3
b) False	**22**

Total number of incorrect responses: 3 (12%)

Appendix H-2: Post-Test Reaction Survey Analysis

Module 1: Telemedicine Fundamentals	Strongly Disagree	Disagree	-	Agree	Strongly Agree
The material covered was relevant to my duties.	2	3	8	6	6
The course objectives were adequately explained	0	0	2	9	14
The module was well organized	0	0	2	11	12
The material was presented in an interesting way	0	4	7	7	7
The module communicated the material effectively	0	2	4	11	8
The audiovisual effects were effective	1	2	9	8	5
I will be able to apply much of the material to my current assignment	2	3	9	9	2
As the module progressed, my questions were answered	0	0	8	11	6
Total	**5**	**14**	**49**	**72**	**60**
Percent	**2.5%**	**7.0%**	**24.5%**	**36.0%**	**30.0%**

Module 2: Telemedicine Technology and Environment	Strongly Disagree	Disagree	-	Agree	Strongly Agree
The material covered was relevant to my duties.	2	3	11	7	2
The course objectives were adequately explained	0	0	7	7	11
The module was well organized	0	0	5	10	10
The material was presented in an interesting way	1	1	11	7	5
The module communicated the material effectively	1	1	4	12	7
The audiovisual effects were effective	1	1	5	6	12
I will be able to apply much of the material to my current assignment	2	7	10	3	3
As the module progressed, my questions were answered	0	1	12	9	3
Total	**7**	**14**	**65**	**61**	**53**
Percent	**3.5%**	**7.0%**	**32.5%**	**30.5%**	**26.5%**

Module 3: Conducting a Telemedicine Patient Visit	Strongly Disagree	Disagree	-	Agree	Strongly Agree
The material covered was relevant to my duties.	2	5	8	9	1
The course objectives were adequately explained	0	0	4	12	9
The module was well organized	0	0	5	12	8
The material was presented in an interesting way	1	1	9	7	7
The module communicated the material effectively	0	1	5	11	8
The audiovisual effects were effective	0	2	3	6	14
I will be able to apply much of the material to my current assignment	3	7	12	2	1
As the module progressed, my questions were answered	1	2	10	7	5
Total	**7**	**18**	**56**	**66**	**53**
Percent	**3.5%**	**9.0%**	**28.0%**	**33.0%**	**26.5%**

Module 4: Organization and Management	Strongly Disagree	Disagree	-	Agree	Strongly Agree
The material covered was relevant to my duties.	1	2	10	9	3
The course objectives were adequately explained	0	0	7	10	8
The module was well organized	1	0	6	14	4
The material was presented in an interesting way	2	4	7	8	4
The module communicated the material effectively	0	2	7	12	4
The audiovisual effects were effective	0	1	9	9	6
I will be able to apply much of the material to my current assignment	1	5	10	7	2
As the module progressed, my questions were answered	0	1	9	11	4
Total	**5**	**15**	**65**	**80**	**35**
Percent	**2.5%**	**7.5%**	**32.5%**	**40.0%**	**17.5%**

Appendix I

Personnel Involved

The following denotes the personnel involved in this research (in alphabetic order):

Alicata, Daniel, M.D.

Aschwanden, Christoph

Birkmire-Peters, Deborah, Ph.D.

Burgess, Lawrence, M.D.

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Kihmm, Kathleen

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Sherstyuk, Andrei, Ph.D.

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Von Platen, Mike

Editorial

Norman Goldstein MD, FACP
Editor, Hawaii Medical Journal

Telemedicine

Thirty-five years ago, when I was the Dermatologist at "The Medical Group," now the Honolulu Medical Group, I received an urgent phone call from a physician at the Honolulu Airport. He had a suspect case of smallpox and I had to come right over to diagnose the patient. The plane was on hold and they were going to quarantine the entire airport.

From his description, I explained that it probably was not smallpox but rather chicken pox, but I still had to come over to examine the patient. I left my busy office, drove post haste to the airport, and confirmed that it was indeed chicken pox. No need for quarantine, and the planes resumed their schedules, although a bit late.

I thought it would be so nice if the airport medical facility had a TV camera that could broadcast images directly to my office. But that was 35 years ago, and the modern telecommunication equipment was just not available.

This Special Issue is devoted to some of the many exciting applications of modern telemedicine we have available today. Thanks to Benjamin Berg, M.D., F.A.C.P., Director of Health Education & Training, and Associate Professor of Medicine, Medicine Department, John A. Burns School of Medicine, University of Hawaii, for serving as a Guest Editor for this issue.

Guest Editor

Until there's a cure, there's the American Diabetes Association.

Until there's a cure, there's the American Diabetes Association.

How Hawaii/Pacific Basin Area Health Education Center (AHEC) Is Using Technology To Make The Pacific Smaller

Kelly Withy MD, Shaun Berry MD, Nicole K. Moore, and Deedri P. Veehala

Abstract

Introduction: In order to improve health literacy in rural areas, the Hawaii/Pacific Basin AHEC and Ke 'Anuenue AHEC are working to connect rural communities via video teleconferencing. Methods: Video teleconferencing connectivity has been established to 15 rural and underserved locations across Hawaii and to the Republic of the Marshall Islands. Results: An average of 15 individuals participate in weekly facilitated health education sessions. Discussion: Participants have reported lifestyle change as a result of sessions and attendance is significantly increasing. In some areas, mid level health care professionals attend in order to obtain information for their patients.

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Introduction

Rural areas of the US have increased infant mortality rates, decreased life expectancy, and increased mortality from chronic disease[1]. Part of the cause for this is lack of adequate healthcare resources, such as hospitals, physicians and specialists. A secondary cause, however, may be lack of access to health information and educational resources. The Institute of Medicine recently studied health literacy in the US and found that half of all Americans had sub-optimal health literacy.[2] Therefore, the Hawaii/Pacific Basin Area Health Education Center (AHEC) and Ke 'Anuenue Area Health Education Center (AHEC), Inc. have established a regular health education seminar series for rural community members to provide information requested by the participants in a real-time discussion group format using video teleconferencing.

The Hawaii/Pacific Basin Area Health Education Center is a federally funded program within the UH John A. Burns School of Medicine with the goal of "improving health for the underserved through education". Ke 'Anuenue AHEC, Inc. was created in 1995 to help meet the health education and health professions training needs of Hawaii and Maui Counties. Activities conducted by both offices include recruitment to health careers for students of all ages, training of health professional students in rural areas and interdisciplinary teams, health workforce assessment and recruitment, continuing education and community health education. Because of the nature of the educational activities, distance learning capabilities have long been an interest of both AHECs.

Prior to 2000, there were few functioning VTC units in rural areas available for public use, and many of the VTC units provided to rural clinics and hospitals were left unutilized due to lack of training and discomfort with the technology. Additionally, the digital networks that provide connectivity to rural areas utilize different VTC protocols making connectivity between units impossible. Three years ago, the Hawaii/Pacific Basin Area Health Education Center (AHEC) was awarded a grant by the U.S. Department of Commerce's National Telecommunications and Information Administration's Technology Opportunities Program to establish video teleconferencing for health information acquisition in rural areas. Funding was received for the AHEC Hawaii Unified Telehealth (HUT) project that aims to improve the health of underserved populations in Hawaii by facilitating health education through distance learning and intergenerational peer education. With distance learning technologies and rural/minority health disparities being foci of the Hawaii/Pacific Basin AHEC mission, the AHEC HUT project is a perfect fit to attempt to bridge the wide channels, which can limit the exchange of ideas and information across the Hawaiian Islands and the Pacific Rim to expand health literacy and knowledge in some of the most remote areas of the world.

Methods

The AHEC HUT project is different from many more traditional uses of video teleconferencing (VTC) within health care. While AHEC supports remote consultation, and store and forward technology, the AHEC HUT project is designed to provide peer health education in a community based location, often not associated with a healthcare facility. This is to provide easy access, and not risk any potential reluctance to participate on the part of community members.

In order to develop community based sites, partnerships were formed with various community organizations that have established local community run meeting facilities and with community health centers,

education centers and Native Hawaiian Health System sites where access to public for VTC connectivity was available. Interested communities identified where they would like units placed, and in some cases, in partnership with Ke 'Anuenue AHEC, even developed learning centers to allow for public access. Each of the 15 partner locations received installation of a Polycom video teleconferencing machine and connectivity as needed. AHEC personnel worked closely with the communities to train at least two individuals at each site to facilitate the sessions, and provided telephone or in-person technical support when necessary. Different methods of connectivity had to be utilized to connect the different centers, principally ISDN in rural areas and T1 in areas where University of Hawaii Information Technology System provided connectivity. In order to connect the different locations, the State of Hawaii Telehealth Access Network was contracted to bridge the different digital networks.

After the VTC system was established, it was anticipated that community members would request topics that would then drive the schedule of sessions. However, initially there seemed to be a lack of interest in utilizing the equipment and little to no requests for talks from communities. Ke 'Anuenue Area Health Education Center conducted an informal survey to determine the cause of this reluctance. Quite simply, community members had no clear idea of how the technology could be used to their benefit. An initial plan to hold one session per month on chronic disease management (diabetes, heart disease, etc.) starting in October 2003 changed to twice monthly sessions by January 2004. By April 2004, with additional funding obtained by Ke 'Anuenue from Young Brother's Tug and Barge, Aloha Care, HMSA, and The Ouida and Doc Hill Foundations the series became a weekly program. Topics that originally were developed based on the CDC list of health topics are now community driven Participants attending sessions were asked to request topics for future sessions keeping in mind that two sessions per month would focus on Diabetes. Speakers are recruited from health care professionals in the communities served, or at the academic institutions in Hawaii and include specialists such as pharmacists and nutritionists, as well as physicians and nurse practitioners.

The weekly real-time series of health education sessions were initially called "Ask-A-Doc", but has been renamed by the participants to a more culturally sensitive name: the E Ninau Aku I Ke Kauka (Ask-A-Healer) series. Speakers and participants attend from any site with VTC accessibility and up to 10 sites can participate at once due to the contracted use of the State of Hawaii Telehealth Access Network (STAN) bridge. Health topics covered have included: teen pregnancy; cervical cancer; diabetic foot care; nutrition – how to read and understand food labels, food demos of healthy meals for people on the go; organ donation; injury prevention – drinking and driving under the influence; the "Social Host Liability Law – Underage Drinking"; and, the Modernization of the Medicare Drug Bill.

Human subjects exemption was received from the University of Hawaii Committee on Human Subjects to collect feedback information from participants. The format included feedback of the sessions and a request for additional topics. However, only 1 of the 15 sites regularly submits the feedback forms, therefore, at the end of each session questions are asked verbally evaluating the quality of the connection, the benefit of the program to health, if the participants would use the information at work or at home, if they would be back the next week, and what other topics should be covered.

Results

Since April 2004, when the E Ninau Aku I Ke Kauka program was fully established, there has been increasing participation. Although completion of the evaluation forms has been spotty, one site has submitted their evaluations consistently. At this site, all 8 regular participants reported taking home valuable information and 5 of the 8 reported making lifestyle changes as a result of the sessions. At a separate site, 3 of the 11 participants committed to make lifestyle changes after the topic of renal failure was covered.

Verbal feedback from participants indicates that they find this method of information delivery to be safe, non-threatening, and unique--reasons they have been so active in this program. A majority of participants report utilizing the information at home, but note that family members are not as likely to be interested in the information when they tell them about it. A high percentage of the participants are repeat participants. Diabetes education has been the number one requested subject, however in recent months the focus has begun to shift to prevention (better nutrition, adoption of a regular exercise program). Topics such as vitamin therapy, food exchange, how native foods fit into the food pyramid, native healing methods, drug prevention (specifically ice/crystal methamphetamine) and medication interactions have been requested. Interestingly, in the Republic of the Marshall Islands, the most committed participants are the nursing staff of Majuro Hospital, who is seeking to learn from other rural island communities how to improve the health of the native population who sometimes are reluctant to seek professional help, but might be open to an informal educational activity.

Discussion

While not the traditional version of telemedicine, the AHEC HUT project is working to increase health literacy and health education in the rural areas of the Pacific. The direct beneficiaries of this program are the rural community members who obtain current health information from health care professionals not normally accessible to them. Initially, interest was limited in utilizing the technology offered. However, the technology is now a reason that some of the participants enjoy taking part in the sessions. The key to this program is the willingness of rural communities to learn and utilize the new technology and the successful collaborations and partnerships including community, academic, nonprofit and healthcare organizations. An unanticipated but welcome outcome of the project is that public service agencies such as the Alzheimer's Association and the Hawaii Department of Health have learned of the ongoing program and have offered speakers and additional needs assessment information regarding health education requests by communities.

Future directions for the program include expanding farther into the Pacific, working with other agencies to provide training for Community Health Workers to obtain their certification, and also to develop a cross-cultural health education program that will focus on native healing practices. In the near future, incentives, such as t-shirts, will be offered for completing and submitting the evaluation forms. The authors hope that the video teleconferencing medium for health information exchange will facilitate improved health literacy across the Pacific.

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Distance Learning on the Internet: Web-Based Archived Curriculum

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Abstract

Web-based education through archived educational modules offers a significant opportunity to provide didactic education. By archiving lectures and teaching materials, it reduces the educators' time of preparation, especially when many students will need to take the same curriculum over a long period of time. The site can package educational material in multiple formats including audio, video, and readable text, allowing the student to tailor the educational experience to his/her learning preferences. This can be a stand-alone program, or integrated into a program combining distance and in-person education. Assessment through on-line tests can also be conducted, but these must be considered open-book assessments where collaboration cannot be prevented. As such, this vehicle can be utilized effectively for continuing education programs in health care, where open book is permitted and credits are generally awarded on the honor system. However, tests for certificate courses should only be given with a proctor in attendance. In this instance, on-line tests can be used as pre-tests for the student, while being structured to enhance further learning.

Introduction

The United States Distance Learning Association (USDLA) defines distance learning as the delivery of education or training through electronically mediated instruction including satellite, video, audio graphic, computer, multimedia technology and other forms of learning at a distance.[1] The USDLA notes that distance education refers to teaching and learning situations in which the instructor and the learner are geographically separated and therefore rely on electronic devices and print materials of instructional delivery. Distance Education includes distance teaching – the instructor's role in the process; and distance learning – the student's role in the process. Most theorists of distance education agree on a basic definition of the field that includes four basic characteristics: (a) the teacher and learner must be separated for most of the learning process; (b) the course of program must be influenced or controlled by an organized educational institution; (c) some form of media must be used, both to overcome the physical separation of teacher and learner and to carry course content; (d) two-way communication in some form must be provided between teacher and learner.[2,3]

Modern distance learning is an extension of the early forms of distance learning with the difference that it is interactive and uses a mix of media. Earlier models such as correspondence still exist at various universities but these technologies are giving way to more modern communication tools. The most common strategies for distance learning are the use of synchronous communications such as videoteleconferencing and web-based forums such as chat rooms, or asynchronous vehicles such as a web site with archived material.

After review of these general methodologies, we will focus on web-based learning through archived material. The Telehealth Research Institute at the University of Hawaii, John A. Burns School of Medicine has experience in this arena, after helping to develop two archived, distance-learning web sites programs.

Videoteleconference (VTC) and the Internet allow a geographically distant learner to participate in a synchronous learning experience with a teacher or other students. This increases access to education for isolated patients due to geography and circumstances, and can play a role for students with physical disabilities that can limit access to the classroom. Most commonly, VTC programs are usually driven by large organizations with education as a major component of their mission. The organization places hardware at sending and receiving sites to conduct the interaction in classrooms. Connectivity is provided through closed circuit networks, or through commercial carriers. A common example is a large university campus that is linked to other campuses such as the community colleges to deliver lectures and seminars. Due to infrastructure and broadband connectivity utilized for this enterprise-wide solution, the hallmark of this model is excellent interactivity between sites, and therefore between teacher and student. It mirrors the classroom model but over a distributed campus network. The model is also cost efficient if there is enough volume of attendees at receiving sites, as it reduces the need for the number of qualified lecturers per classroom hour. As in any classroom situation, interactivity will

The opinions and assertions within are the private views of the authors and are not meant to be construed as being official policy of the Department of the Army, The Pacific Telehealth and Technology Hui, and the University of Hawaii.

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decrease with an increasing number of students, but this will not be due to the quality of the interaction that is available through VTC.

VTC can also be accomplished over the Internet. The limiting step here is available bandwidth for the receiving end user, which will affect resolution and the quality of the interaction. In this instance, the receiving site usually has little infrastructure and bandwidth, so interactivity is decreased. This model is commonly used to broadcast lectures or seminars using streaming video from a large organization to students in different geographic areas. This model balances the need for interactivity from students at the receiving end in exchange for wider access to any individual having access to the Internet. As the video images are generally small when viewed on the receiving monitor, it may only be a small improvement over audio transmission.

Web-Based Learning. For individuals who are unable to attend conventional classes, Internet courses have clearly emerged as the technology of choice,[4] with the natural evolution of the World Wide Web taking center stage. Web based learning is often called online learning or e-learning because it includes online course content. This may take two forms: live events such as discussion forums via email, VTC, and live lectures through videostreaming; archived courses that may be accomplished when desired by the end user with static pages such as downloadable course materials, and archived audio and/or video lectures. One of the values of using the web to access course materials is that web pages may contain hyperlinks to other parts of the web, thus enabling access to a vast amount of web-based information.[5]

Of these methodologies, archived web sites are emerging as a viable tool in distance learning. If properly designed, such a site can permit the student to tailor the educational experience. Visual learners may choose to scan through the slides of a presentation, and then read a transcribed document of the speakers talk. Auditory learners may prefer to listen to audio files while scrolling through the slides. Kinesthetic learners may prefer to watch the actual videotape of the person giving the talk, to better engage with the speaker. As such, if the educational content is packaged properly in multiple formats, the site could actually enhance individual learning for certain students as they can tailor the experience to their own learning preferences. This would also assist persons with auditory or visual disabilities, who could experience programs in their preferred format.

The ability to disseminate a curriculum through an archived web site is attractive for several reasons. A large organization can disseminate a core curriculum enterprise-wide, reducing the need for educators at each individual site to develop and teach the curriculum. This initial savings in time and expense can be substantial, with larger organizations having greater savings as the initial investment is leveraged for a larger audience of students. Web-based electronic media is also more readily updated and disseminated than any other type of educational media. This permits timely and rapid notification of users for important additions or changes. Common web technologies could alert providers to visit the site through an e-mail or telephone alert system.

A significant benefit of this platform is that user interactions with the site can be readily tracked and studied through standard tools and an associated database. Educators would know who is being trained, how they are training on the site, the assessment of training through test scores, and student assessments of the educational experience. These records would not exist in such a complete format through other communication media. As the grading of test scores is done automatically, this also saves time for educators. It is necessary to recapture this and initial time savings to review this data and update the site for improve the educational experience.

In assessing students through on-line tests, due to the nature of the interaction, the test must be considered open book with students able to interact with others to obtain answers. Students may not study at all and just take the test. If the test is set up to retake until passing, then this can be done via trial and error. The site and test can be programmed to avoid some of this. Standard web-based tools can track individual's actions on the site to determine when and how long someone spent on the site prior to taking the test, as well as how many times the test was taken. This can help to ascertain if an individual is actually studying the material as desired.

Multiple tests can also be utilized for the same group or students and this could be accomplished for two reasons. The first would be to discourage cheating, if a formal type of examination program was desired beyond the open-book format currently utilized. The second would be to study whether different testing methodologies assisted with the on-line learning experience. It is postulated that by using questions where all answers are correct except for one incorrect answer, the questions will help the student review correct concepts when he/she reads the question.

Web-based learning can be the part of a total training module that includes live training. In this format, the on-line training can be conducted first, with the live training soon to follow. This maximizes the time of the trainers to give live training exercises, as opposed to giving didactic lectures. Lectures can be archived on the site, with students completing assignments before live training exercises. This combination of archived and live instruction is especially valuable for procedurally based tasks. If certification is required, then a pretest test can be given at the start of the live exercise and the final test at the end. If given at the start, those that fail are excused as they have not studied or assimilated the material yet. If students know the consequences ahead of time, they will more likely study the archived material as required.

Web-Based Programs for Health Care Providers. A growing number of professional institutions and associations have started offering modules on-line, such as continuing medical education (CME) or continuing education units (CEUs), complete with examinations that can be e-mailed or otherwise returned electronically immediately after completion. One requirement for CME is interaction with the student and the tests are utilized for this reason. CME is generally based on the honor system that the activity was completed, but the examination is considered open book.

Though many of the on-line CME modules are also available as mail-away packets, the on-line versions have an overall faster turn around time and can be instantly scored. One such organization that offers CME credits is the National Institutes of Health (NIH), who base their modules on their expert consensus statements developed for various subject areas. The NIH develops its consensus statements through conferences attended by recognized panels of experts to improve clinical consistency in controversial practice areas.[6]

Methods: Telehealth Research Institute, University of Hawaii, John A. Burns School of Medicine (UHTRI)

UH Telemedicine Project. UHTRI is a federally funded program of the John A. Burns School of Medicine. One of the main areas of focus has been the telemedicine project. Through experiences in deploying telemedicine infrastructure and programs in the State of Hawaii, an on-line curriculum was produced (http://www.uhtelemed.hawaii.edu/curriculum/).[7] This curriculum was designed to help providers incorporate telemedicine techniques into daily clinical practice and is appropriate for physicians and allied health care clinicians. The curriculum consists of 10 modules including "Conducting a Telemedicine Patient Visit," "Patient Education," as well as case studies and simulations. The curriculum also has an assessment/evaluation component that enables continuous refinement. The progress of each participant can be monitored and any problems participants find with the curriculum or its website are reported to the technical and/or educational team and corrections made.

During validation of the modules with on-line tests, it was felt that 2 of 23 students may have taken the test without reviewing the material, despite repeated direct instructions that review of the material was important to the validation process. All students were warned on two occasions that their activity could be tracked on the site. The problem was identified after looking at site data for individual participants. The modules under review take approximately 6-8 hours to complete, and in both cases, all tests were completed within 2 hours of the initial log on.

Military Medical Unique Curriculum. UHTRI also supported development of the Military Medical Unique Curriculum Web Site with funding through the Pacific Telehealth and Technology Hui (HUI). The HUI is a joint DoD/VA venture that develops and provides telehealth research, services, education and training. One of us (L.B.) was the PI for the project while in the military, and remained on the project after joining UHTRI. Another UH faculty worked (S.S.) on the project from its inception.

The Military Medical Unique Curriculum Web Site was launched with 24 complete educational modules. This was originally hosted on Hui servers, and then transferred to the Army's Medical Department after the first year. The curriculum is currently being utilized in 35 military facilities in the United States, Germany and Korea and is a mandatory training vehicle for U.S. Army interns in 10 teaching hospitals across the nation. It is available through the Army Knowledge Network, which restricts access to Army personnel only. The requirement to train interns was an Army Medical Department Initiative that was defined at the same time that funding for this proposal was identified. The curriculum was developed from subject matter experts identified by the PI and the Army Medical Department at large.

Module development included standardized assessment following the completion of the module and provided certification of continuing education for both physicians and nurses. Each module consisted of the following: abstract, digital photo of the presenter, presentation slides, audio of the presentation synced with the slides, a transcribed text document of the presentation, a test to evaluate the student, and a survey for the student to complete. The Military Medical Unique Curriculum Web Site has achieved significant success over the past few years. In the first year, more than 5700 modules were completed by users during the first year of the site. The project had a one year return on investment of 168% and with continued operation, will conservatively save $2.5 Million dollars in 5-years for the Department of Defense.

Discussion

Distance learning through archived material available on the Web is in its infancy. The vehicle permits wide dissemination, with excellent central control by educators and administrators. The challenge with such a site is to maintain adequate funding to continuously review and update the site. This task is not time consuming, but administrative oversight must direct the updating on a regular basis and educators must be paid for their efforts.

The ability to package the site with multiple learning methodologies is a significant advantage to this format. A full study of how people learn on such sites must be conducted to better understand the utility of these sites and how they should be constructed. Should the site utilize full video presentations, or is audio synced to a slide presentation adequate? Does the transcribed text of the talk actually detract from the other modes of instruction as audio and video, or does it enhance it? Is the selection of learning method offered to the student of benefit, or do all students only utilize one or two tools?

Assessment of students through the Internet is generally open book as discussed. This is not problematic for continuing education of health care providers as opposed to certificate granting programs. If true certification is required, then the examinations must generally be accomplished in a setting with a proctor. In this instance, the curriculum can still be provided through the Internet, but the assessment needs to be accomplished in person. Although there are multiple on-line tracking methods to verify that a certain educational module is being studied in the desired fashion, there is nothing to prevent students from collaborating with one another on a web-based examination.

The lessons learned from our validation process of the telemedicine curriculum substantiates this claim. In this case, the main issue for students was the time it took to complete the curriculum, and we desired participants to review the curriculum closely for their suggestions and input. Despite several warnings, some individuals still risked losing their stipend to save time. In a certificate granting program, one cannot underestimate the means that some might go to fraudulently receive certification, even though that the majority will follow the honor system.

One possibility is to change the model to a live setting for the assessment, where the test is made available for a short time period and everyone must access and complete the test at the same time. However, a wireless network and students sitting together with lap-top computers would easily overcome this suggestion. Multiple versions of the test can be released at the same time, which makes collaboration more difficult. Even then, however, the student might have other students or professionals take the test for them. Clearly, there are methods to make collaboration more difficult, but they can all be overcome.

Site utilization is an issue. The telemedicine curriculum is a valuable resource and gets some utilization from select individuals and groups, but not to the degree necessary to maintain it as a continuing medical education enterprise. It largely serves as an on-line textbook, with no specific target audience. The Military Unique Curriculum

site has been well utilized, as it was designed for a specific need and requirement. The technology transfer of the site to the Army Medical Department went smoothly, as again, the site fulfilled an important need for a continuous flow of new students requiring the same curriculum. Funding for site maintenance was readily accomplished as it was added to an extensive array of on-line activities sponsored by the Medical Department. In constructing similar sites, it is important to identify needs of partnering organizations so that the curriculum is utilized. Constructing a curriculum without specific needs will not engender the long-term success of the site.

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The Virtual Hospital: Treating Acute Infections in the Home by Telemedicine

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Abstract

The growth and aging of the population of Hawaii mandates a need for more effective utilization of hospital beds. One approach is early hospital discharge and outpatient treatment. However, as the acuity of illness increases, satisfactory outcomes of outpatient treatment may be difficult to achieve. We have utilized telemedicine to closely monitor acutely ill patients with infections, such as community-acquired pneumonia, skin and soft tissue infections, and urinary tract infection, in the home setting. Our treatment paradigm achieved satisfactory outcomes, cost savings, and at the same time resulted in more rapid convalescence than hospitalization.

Introduction

Nationwide there were 35 million people age 65 and older in the year 2000. By 2030, this is expected to double[1]. In Hawaii, there were 160,000 residents age 65 or older in the year 2000. This number is projected to grow to 309,000 by 2025.[2] With the growth and aging of the population, there will be an increasing need for acute care hospital beds. Alternative strategies to hospitalization must be developed to care for patients with, among other things, common infections such as community-acquired pneumonia (CAP), skin and soft tissue infections (SSTI), and urinary tract infections (UTI).

Treating patients at home is one alternative that can reduce the need for hospital beds,. In order to care for more seriously ill patients in home settings as opposed to hospitals, we need to be able to monitor patients' vital signs and "look in on them" as we would if they were hospitalized. Telemedicine makes this possible by providing real-time transmission of vital signs and audio-video contact between patients in their homes and clinicians in the hospital. This "virtual umbilical cord" simulates the normal physician-nurse-patient interaction in the hospital and provides closer home monitoring of patients who might normally be hospitalized.

The majority of telemedicine use in the home has been directed at chronically ill patients with congestive heart failure, emphysema, and diabetes. This approach has proven to be cost effective, reducing the need for hospitalization and emergency room visits.[3,4] Using telemedicine in the home, the average number of daily home-nursing visits can be increased from five actual visits to fifteen televisits.[3] Telemedicine can also be used to care for acutely ill patients in remote locations.[5] We have utilized this same technology in a pilot trial, which monitored acutely ill patients with infections in the home setting.[6] To the best of our knowledge, no one else has attempted this to date. We report here further results from this study.

Methods

Equipment was purchased from American Telecare, Inc (Minneapolis, MN) and consisted of one Aviva Tower central station and four Aviva 1010 XR patient stations. We kept one patient station in reserve and therefore could treat a maximum of three patients at one time. The telemedicine connection between the patient station in the home and the central station in the hospital was through POTS (plain old telephone service) lines. The telemedicine team consisted of a physician (LE), two nurse practitioners (PK and MM), an IT consultant (EB), and a project coordinator (CY).

Patients were referred for telemedicine in the home, either from the emergency room or, if admitted, from the hospital, and were screened by the physician for inclusion in the telemedicine program. Before considering discharging a patient from the hospital on telemedicine in the home, we evaluated their Karnofsky performance score[7] and Charlson Comorbidity Index.[8] For example, if a patient had a relatively severe case of CAP with a high pneumonia severity index (PSI),[9] but had a high performance score and few comorbidities, he might be considered a candidate for treatment by telemedicine in the home. However, if he had a relatively less severe case of CAP, but had a low performance score and multiple comorbidities, he might be excluded from treatment by telemedicine. If the patient met the inclusion criteria (Table 1), the nurse practitioner discussed the trial with the patient and family members. It was extremely helpful to have a least one face-to-face interaction with the patient and their families prior to their discharge from the hospital on telemedicine in the home. This assisted us in gaining their trust and provided a comfort level in their acceptance of telemedicine in place of hospi-

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Table 1.— Criteria for Treatment of Patients with Telemedicine in the Home
Patients must have a domicile with a second person to assist the patient (usually family or a friend).
Patients must be ill enough to ordinarily require hospitalization, but have a low predicted 30-day mortality rate.
Patients must not have sepsis syndrome or the need for intensive care monitoring.
Patients with CAP are excluded if they have a mild (Fine Class I) or life-threatening (Class V) CAP.[9]
Patients with SSTI are excluded if they have mild SSTI (Eron Class I), or if they have sepsis syndrome or life-threatening (Class IV) infection.[15]
Patients with UTI are excluded if they have uncomplicated pyelonephritis or if they have an obstructed ureter or sepsis syndrome.
Patients with bacterial endocarditis (BE) are excluded if they are hemodynamically unstable, or if they have embolic episodes.

Table 2.— Types of Patients Treated by Telemedicine in the Home
A 78 year old male with leukemia and an absolute neutrophil count of 400/mm3 developed bibasilar infiltrates, a temperature of 102o C, and an oxygen saturation of 90%.
A 48 year old female with metastatic carcinoma of the breast and a white blood cell count of 2,500/mm3 developed cellulitis extending from her left hip to her axilla.
A morbidly obese 53 year old male with a mechanical aortic valve prosthesis developed high grade enterococcal urosepsis (5 of 5 sets of blood cultures and a urine culture positive).
A 66 year old male with severe aortic insufficiency and a previous right nephrectomy for a renal cell carcinoma, developed *Gemella* endocarditis with a vegetation on his aortic valve.

talization. The patient and family members were typically anxious over this new technology and needed reassurance that they would be monitored closely in their home environment. It also allowed us to obtain a face-to-face baseline history and physical exam.

After screening, they were asked to provide written informed consent, if they were found to be acceptable for treatment by telemedicine in their home. Reasons for exclusion included an unsuitable home environment, such as homelessness or living alone, an inability to learn self-administration of intravenous antibiotics, and a lack of suitable phone lines in their house. In four cases patients refused to be treated by telemedicine because of a lack of familiarity with, or fear of, computer technology.

Once they agreed to treatment by telemedicine in the home, a member of the telemedicine team met them in their home to set up and instruct them or a family member, friend, or neighbor, in the use of the equipment. The first televisit was then conducted between the patient in the home (in the presence of the telemedicine team member) and a clinician at the central station in the hospital (either a physician or a nurse practitioner trained in the management of these types of infections). After demonstrating a televisit, the telemedicine team member in the home observed the patient's technique. Once patients mastered the application of the blood pressure cuff to their arm, the stethoscope to their chest, and the pulse oximeter to their finger, they managed subsequent visits faultlessly. Problems encountered involved suboptimal lighting or excessive movement of the patient, which resulted in fragmentation of images due to excessive pixelation. The best lighting was indirect without any back-lighting.

The initial televisit usually lasted for one hour, subsequent followup visits 15 minutes, during which time patients in their home and the clinician at the central station were able to see each other and converse. The clinician at the central station was able to determine the patients' clinical status by auscultating their lungs, and monitoring their blood pressure, heart rate, respiratory rate, temperature, and oxygen saturation. With the loss of face-to-face encounters, strategies for meeting other family members and pets and for commenting on the patient's home surroundings while conducting televisits, assisted in gaining the patients' and the families' confidence and trust. Most patients televisit once daily, but for patients with more severe illnesses, televisits can be conducted several times daily. When patients improved to the point where they would normally be discharged from the hospital, patient stations were removed from homes. Should a patient's clinical status have deteriorated at anytime, he was instructed to either call a member of the telemedicine team or return to the hospital.

Results of a pilot trial:

We have reported the outcomes of a trial of telemedicine in the home in which we treated 25 patients[6]. The types of patients that were treated are illustrated by the four examples in Table 2. We compared patients treated by telemedicine in the home in a case control fashion to a comparable control group of hospitalized patients. While the large majority of patients in each group were cured, those treated with telemedicine in the home recovered at a more rapid rate, as judged by their earlier return to their normal activities of daily living.

Through the use of telemedicine, we were able to accomplish five things.

- The patient could be monitored several times a day, as if he were in the hospital.
- The patient was reassured by maintaining audiovisual contact with his health care providers.
- More efficient bed utilization was accomplished by discharging hospitalized patients earlier than would otherwise have been possible, and in some cases avoiding hospitalization altogether.
- The patient felt more comfortable at home than in the hospital.
- Based on our prior experience [6,10] and that of others,[11] patients who were managed as outpatients returned to their nor mal activities of daily living more rapidly than comparable patients who were hospitalized.

Technical problems:
We experienced several problems that must be overcome before telemedicine in the home can be widely deployed. First and foremost is that of technical problems, such as poor video images and freeze-ups. This problem is caused by low bandwidth (a measure of the amount of information that can be transmitted over a telecommunications line) of POTS. Equipment offered by the major home telemedicine vendors is, for the most part, POTS-based. The low-bandwidth of POTS connections did not consistently support the minimum telemedicine requirements of two-way video and audio connections plus one-way data transmission of patients' vital signs. With the broadband connections via cable, DSL, and Wi-Fi, that are becoming commonplace, there is now sufficient, available bandwidth to allow for higher-quality video and audio connections that could vastly improve televisits. Moreover, once the telemedicine vendors adopt the Internet protocol, then there will be even better flexibility in terms of mixing and matching devices, using different types of connections, and more easily moving the clinician's station between sites, such as the clinician's home and office.

The established telemedicine vendors have been slow to embrace the rapid technical advances in telecommunications of the past five years, and computer equipment vendors, whose products use the latest broadband and Internet protocol technologies, have generally been reluctant to enter the telemedicine marketplace. At the end of the day, it will be up to us, the telemedicine equipment buyers and users, to pressure vendors to move beyond POTS-based equipment, and to partner with them to develop and test new equipment.

Patient acceptance:
Patient reactions to telemedicine in the home may differ depending on age, gender, educational level, family support, and cultural factors. This may be especially true in Hawaii where there is such a diverse cultural representation. Telemedicine may not be appropriate in certain cases based on these considerations. Two examples of this are as follows: elderly patients who feel safer in a hospital environment than in the home;[12] individuals of Philippine or Hawaiian descent who are more accepting of hospitalization and reluctant to receive treatment by telemedicine in the home.

Care-providers may in certain cases be dissatisfied with telemedicine in the home compared to hospital care for their wards.[13] They may be unwilling to bear the entire burden of caring for a patient. It may be necessary to provide respite workers in selected cases to shop, cook, clean, bathe, and otherwise provide companionship for certain patients. This relieves a care-provider from shouldering the entire burden of a patient's care. However, it also increases the cost of telemedicine in the home.

Telemedicine is a relatively new technology that both intimidates and fascinates our patients. Once when we set up a patient station in a home, family members gathered around the camera to watch the video visit. One elderly patient remarked, "It's just like when the first television set arrived in my neighborhood." We need to take advantage of this type of attitude toward telemedicine while diminishing negative reactions to it. Acceptance of telemedicine in the home will not happen overnight and will take a concerted educational program to promote it.

Clinician acceptance:
Clinician acceptance of novel treatment strategies is traditionally slow, especially if it impacts negatively on remuneration and is accompanied by extensive government regulation with attendant loss of autonomy. Most third-party insurers, especially Medicare, do not reimburse clinicians or hospitals for home televisits except to rural areas, such as the outer Hawaiian Islands. Because of this, the development of telemedicine has been retarded largely for economic reasons. Nonetheless, there are many reports of successful cost-savings and increased productivity from telemedicine trials.[3,4]

There is still considerable skepticism amongst clinicians about changing the current practice of watching patients in the hospital until they are completely stable.[14] This reaction may be based on traditional teachings, as well as clinicians' fear of an unsuccessful outcome and the potential threat of litigation. Medical-legal challenges for bad outcomes from telemedicine in the home will undoubtedly occur. However, with additional outcomes data confirming our preliminary results, telemedicine in the home will be advanced to the level of a standard of care.

Conclusion
Telemedicine in the home has several advantages over hospitalization. It promotes more efficient utilization of hospital beds resulting in cost savings. Our results would indicate that it promotes more rapid convalescence than hospitalization. How it does this is not known, although it may relate to several factors, one of which is the removal of patients from a passive, dependent posture in the hospital to being a more active participant in their own medical care at home. This may promote in patients a sense of empowerment over their illness. Whatever the reason, outcomes such as this will hasten the acceptance of telemedicine by patients, care-providers, clinicians, and insurers.

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An International Landmine Telehealth Symposium between Hawaii and Thailand using an Internet2 and Multi-protocol Videoconferencing Bridge

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Abstract

An international telehealth symposium was conducted between healthcare institutions in Hawaii and Thailand using a combination of Asynchronous Transfer Mode, and Internet2 connectivity. Military and civilian experts exchanged information on the acute and rehabilitative care of landmine victims in Southeast Asia. Videoconferencing can promote civil-military cooperation in healthcare fields that have multiple international stakeholders.

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Introduction

Landmines are a major public health problem in Thailand. The 2001 Landmine Impact Survey found that landmines along the Cambodia, Laos, Burma, and Malaysia borders affected 531 Thai communities in 27 provinces. According to the Survey, 346 new landmine casualties were recorded between June 1998 and May 2001.[1]

This telehealth symposium enabled landmine experts from Thai Non-Governmental Organizations (NGOs), the Royal Thai Army (RTA), a Hawaii charitable service organization (Shriners Hospital for Children), and the U.S. military to exchange information on the acute and rehabilitative care of landmine victims in Thailand.

We have previously reported successful, regularly conducted videoconferences on healthcare topics using either digital telephone (ISDN) or Internet2 connectivity between two tertiary care hospitals in Hawaii and Thailand.[2,3] Expanding on this model, we conducted the landmine symposium between three sites, two institutions in Hawaii and one in Thailand, using a combination of ISDN, Asynchronous Transfer Mode (ATM), and Internet2 connectivity over an electronic bridge.

Methods

A three-hour seminar was conducted 27 July 2004 at 1600 (Honolulu) and 0900 28 July 2004 (Bangkok). There were three participating sites. The Thailand videoconferencing site was Phramongkutklao Medical Center (PMK), a 1000-bed tertiary care hospital in Bangkok operated by the Royal Thai Army that treats civilians and military personnel. There were two participating sites in Honolulu: Tripler Army Medical Center (TAMC), a 242-bed tertiary care center for U.S. military personnel and their families; and Shriner's Hospital for Children (SHC), a free 40-bed surgical and rehabilitative orthopedic hospital.

The three participating sites utilized two differing forms of connectivity and a multi-protocol videoconference bridge to enable the sites to interconnect. Two sites (TAMC and PMK) utilized International Telecommunications Union standard H323 videoconferencing using Internet protocol (IP) over the Internet2 network to connect to the bridge. These two sites utilized Tandberg videoconference equipment. The third site (SHC) utilized a private ATM circuit carrying H323 IP to connect to the bridge, and also used Tandberg equipment.

The device enabling these disparate systems to communicate is called a multi-protocol videoconference bridge, and is operated by the State of Hawaii Telehealth Access Network and housed on the UH campus. The bridge maintains H320 (ISDN) ports to the public switched telephone system, H323 (IP) ports to the public Internet and Internet2, as well as ATM ports to private circuits. The bridge translates an incoming H320 protocol into an outgoing H323, and vice-versa, enabling the differing systems to communicate. The bridge can be configured for "Continuous Presence" where all sites hear all participants and see all participants on a split-screen (Hollywood Squares); for "Voice Activated" where all sites hear all participants and see only the actively speaking site; and for "Central Control" where the bridge operator makes determinations of who-hears-and-sees-what for the duration of a videoconference.

All lectures were presented in English, with supporting PowerPoint slides. Thai NGO experts discussed the landmine problem; mine risk education; mobile prosthetic clinics; manufacture of prosthetics using local materials; research on social issues; and victim assistance. A Royal Thai Army physician discussed acute resuscitation and victim transport in Thailand, and three U.S. military healthcare providers discussed Blast Resuscitation and Victim Assistance (BRAVA) programs in Sri Lanka and Vietnam. At the conclusion of the program, participants anonymously used a wireless Audience Response System to rate the technical and educational quality of the videoconference on a 9-point Likert scale (1=awful, 9=excellent).

Results

Seventy-one people participated in the seminar, 16 in Thailand and 55 in Honolulu. There were attendees from ten countries, including Thailand and the U.S. A total of 14 different NGOs were represented at the conference. In Hawaii, nine (18%) of the attendees represented NGOs, 32 (65%) were members of the Royal Thai Army or the U.S. military, and 14 (16%) were non-NGO civilians. In Thailand, ten (63%) of the attendees represented NGOs and six (37%) attendees were either in the Royal Thai Army or the U.S. military. Nearly half of the attendees were physicians, with a higher percentage (62%) in Hawaii than in Thailand (31%). Attendees agreed that there was significant training value in the conference (mean 6.97, SD 1.29, n=33). The quality of sound (mean 6.35, SD 1.57, n=34) and video (mean 6.16 , SD 1.32, n=33) was good at all sites. No sites lost sound or video.

Discussion

The United States has a long history of participating in demining activities in Thailand. In 2002-3, U.S. humanitarian demining assistance totaled over $800,000, including $650,000 from the State Department for Thai Mine Action Center activities, and the remainder allocated for U.S. military personnel to conduct two on-site train-the-trainer mine awareness sessions.[4] This was the first landmine symposium conducted simultaneously in Thailand and the U.S. using videoconferencing.

Most international distance learning initiatives have occurred in academic settings. A two-way interactive video and internet course for nurses between the University of North Carolina and the Mie Prefecture College of Nursing in Japan has been described.[5] Ekblad et al recently reported a pilot study with Swedish medical students, in which teachers from the U.S., Australia, and Sweden used videoconferencing to train the medical students in refugee mental health.[6]

In our experience, NGO workers are uncommonly used as teachers in undergraduate or graduate medical education training programs. Trehan et al reported that medical students from Northwestern University routinely travel to Central America to work in rural health clinics staffed mainly by NGOs, with the goal of exposing the students to a different set of medical and public health issues than they would typically encounter in the U.S.[7]

Our previous Internet2 videoconferences have been conducted point-to-point between PMK and TAMC. In the current model, the use of the bridge at the University of Hawaii allowed an audience from a non-Internet2 site to participate. One disadvantage of using the bridge was the loss of the capability to show speaker and PowerPoint content simultaneously, a suboptimal situation when many participants speak English as a second language. Though it was possible to switch video input from "talking head" camera to direct input of PowerPoint slides, the resolution and scan conversion resulted in reduced legibility of images and small typeface on the PowerPoint material.

The bridge allowed the collaboration between Internet2, ATM, and ISDN-enabled sites, but a newer open-source software ensemble called the Access Grid™ permits more robust group-to-group interaction to take place over a distributed network such as Internet2. The simultaneous multipoint-to-multipoint capability of the Access Grid™ has the potential to overcome many limitations of traditional videoconferencing.

Conclusion

The landmine symposium demonstrated that videoconferencing technology can be used to promote civil-military dialog for a health-care problem that is typically encountered only in the developing world, but that has relevance to stakeholders in developed countries as well. Videoconferencing is an effective method for members of the international medical community to link geographically remote teachers and learners with common educational goals. The high bandwidth capability of the Internet2 permits high quality point-to-point videoconferencing, and new Access Grid™ software offers the possibility of expanding the international telehealth conversation to multiple sites that are all interacting at the same time.

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Shriners Hospitals for Children, Honolulu's Experience with Telemedicine: Program Implementation, Maintenance, Growth, and Lessons Learned

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Abstract

Shriners Hospitals for Children, Honolulu Telemedicine Program conducts real-time video consultations with remotes sites in Hawaii, Guam, Saipan, American Samoa, the Federated States of Micronesia, and the Republic of the Marshall Islands. The program began in 1999 and has provided over 240 consultations. This report is a summary of the Shriners Hospitals experience and lessons learned regarding program implementation and maintenance.

Introduction

Shriners Hospitals for Children - Honolulu is one of 22 hospitals within the Shriners Hospital system. The hospital provides free care to children with primarily pediatric orthopaedic conditions. The hospital's mission also includes evaluation and treatment of chronic burn scar conditions and other conditions requiring plastic surgery. Since its establishment in 1923, the Honolulu hospital has treated over 22,000 children. The majority of the children are from Hawaii, but the hospital also draws patients from the Commonwealth of the Northern Marianas (Islands), The Federated States of Micronesia, Guam, American Samoa, Samoa, Fiji, the Republic of the Marshall Islands, and the Republic of Palau. Outreach trips for outpatient clinic evaluations are scheduled on a regular basis to each of these areas. All patients requiring operative procedures or further evaluation are seen at the Honolulu hospital.

Since the large geographic area of responsibility poses significant time and distance barriers, establishment of an effective telemedicine program became a priority beginning in 1998. A generous grant from the Harry and Jeanette Weinberg Foundation provided the initial funds needed for equipment purchase. The stated goals of the program included: increasing pediatric orthopaedic surgery care access at geographically remote sites; decreasing the need for travel with its associated costs for patients and providers; providing education in the area of pediatric orthopaedic surgery for these remote and medically underserved areas; improving the coordination of care between the hospital and remote site care providers; providing further distance education opportunities for the staff of the Honolulu hospital; and gaining access to other telemedicine sites on the mainland United States such as the Shriners Hospital in Sacramento. This article reviews our experience and outlines how our telemedicine service functions along with lessons learned from implementation and maintenance of our program.

Program Implementation and Development

The telemedicine program began in 1998 with a grant from the Harry and Jeanette Weinberg foundation providing funds to purchase a video-teleconferencing system. This system complemented the State of Hawaii's initiative to develop a comprehensive statewide telemedicine network through the Hawaii Health Systems Corporation (HHSC).[1,2] Once funding was obtained, a full-time temporary telemedicine coordinator was appointed, and a medical director for the telemedicine program was appointed.

The first demonstration of the program occurred in September of 1999 when one patient was seen at Kohala Hospital on the island of Hawaii. Because the patient and family were unable to travel, the telemedicine coordinator traveled to the remote site, using the equipment at the HHSC facility and televising to the physician at the Shriners Hospital site. The videoconference successfully demonstrated ability to evaluate and manage a patient through this communication format.

During our initial start-up period, a variety of information technology programs were being developed around the Pacific to include the State of Hawaii Telehealth Access Network (STAN) and distance education initiatives such as the Pacific Resources in Education and Learning (PREL). The Harry and Jeanette Weinberg Foundation funded videoconferencing equipment for 30 key healthcare organizations in the State of Hawaii. Various granting agencies such as the National Telecommunications Information

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Agency (NTIA) and the Rural Utilities Services (RUS) assisted with the purchasing of videoconferencing equipment for areas such as Guam, Saipan, American Samoa. The PREL Star program helped the Federated States of Micronesia, the Republic of Palau, and the Republic of the Marshall Islands. Healthcare providers at remote sites found that they were able to connect up with Shriners Hospital for consultations, and providers at Shriners Hospital found they could successfully connect with remote sites for new patient evaluations and follow-ups. Subsequent telemedicine visits were then arranged on an as- needed basis with these remote sites.

The telemedicine coordinator was a vital key in developing effective relationships with remote sites, providers and funding resources. These relationships were fundamental to setting the stage and gaining access to necessary networks. The coordinator had to understand the technical capabilities and roles of all the participants in the process, how to troubleshoot problems and obstacles that arose, understand and comply with ever changing regulations governing the industry, and play promoter/marketer for an innovative service.

Shriners Hospitals for Children - Honolulu, showed its continued commitment to the program by making the telemedicine coordinator position a permanent one and continuing to support a medical director. The central headquarters for Shriners Hospitals for Children demonstrated support and responsibility by developing and advancing telemedicine throughout the Shriners Hospitals system. As a result, more than 15 of the 22 Shriners Hospitals have telemedicine capabilities.

Program Growth and Maintenance

The Shriners Hospitals Telemedicine program has had its share of growing pains. Initial equipment purchase in 1998 included the PictureTel Concord 4500 ZX video teleconferencing system with two monitors for remote and local viewing. Three Integrated Service Digital Network (ISDN) lines were installed. Additional peripheral devices purchased included a document camera, a general handheld camera, an electronic otoscope, an electronic ophthalmoscope, an electronic stethoscope, a digital camera/camcorder, and a video recorder.

Since our initial efforts, we have installed a direct T1 line to the State of Hawaii Telehealth Access Network located at the University of Hawaii. The STAN bridge has the ability to connect Shriners Hospital to the Federated States of Micronesia and American Samoa without per minute usage charges. The STAN bridge is the only conduit to these remote areas.

The PictureTel equipment failed in 2002 and was replaced by the Tandberg 2500 system. This system has the capability to do encryption, dual video, and can connect through Integrated Service Digital Network (ISDN), Asynchronous Transfer Mode (ATM), or Internet Protocol (IP). We continue to use the document camera, general handheld camera, and the digital camcorder, but have found little use for the otoscope, ophthalmoscope and stethoscope in our orthopaedic practice.

Telemedicine consultations have been successful with Guam, Saipan, the Federated States of Micronesia, the Republic of the Marshall Islands, and American Samoa. (Table 1). Efforts to serve Guam have been slowed by legal and financial issues. Consultations with Saipan have been influenced by the departure of key Saipan personnel who were responsible for scheduling and coordinating the clinic at their remote sites. Access to Shriners Hospital pediatric orthopaedic care did not significantly drop, as we continued to conduct outreach clinics at those locations twice a year.

Telemedicine consultations with American Samoa and the Marshall Islands benefited by American Samoa's direct T1 line to Hawaii with a high quality transmission connection of 384kbps, and only a one-hour time difference between the two centers. There is also a dedicated off-island referral liaison that is active in coordinating and scheduling American Samoa patients. Most importantly, there is an orthopaedic surgeon in American Samoa who found value in the process and developed a physician-to-physician relationship with providers in Honolulu.

Telemedicine consultations with the Republic of the Marshall Islands have increased because of similar factors. The Majuro Hospital has assigned a dedicated liaison to coordinate the clinics. The physician in Majuro is active in the referral and telemedicine process. Since Shriners Hospital staff travel to the Republic of the Marshall Islands and American Samoa only once a year, telemedicine at these two locations has improved access to specialized pediatric orthopaedic care throughout the year.

Telemedicine referrals have not been as successful on the neighboring islands of Hawaii because of multiple factors. Most children have insurance that pays for travel to Honolulu. Shriners Clinics are held on the neighbor islands every 4 to 6 months. General orthopaedic surgeons perform the initial evaluation on most of these children and refer directly to Shriners Hospital if there is an acute problem requiring immediate referral. In those situations, the child is brought to Honolulu for evaluation.

Table 1.— Shriners Hospitals for Children, Honolulu's Telemedicine Consults 1998– 2004

Remote Site	Number of Consults
State of Hawaii	18
Guam	51
Federated States of Micronesia	5
American Samoa	123
Common Northern Mariana Islands	32
Republic of the Marshall Islands	11

Discussion: Lessons Learned

Over the course of the past 7 years we have learned some valuable lessons. Shriners Hospital for Children - Honolulu has relied on the telemedicine program to improve access to pediatric orthopaedic care for children in the areas we serve, and it is committed to further development and expansion of the program, despite the challenges encountered at every turn.

Seeing a child through the telemedicine format is not straightforward. Videoconferencing format for a medical encounter seeks to replicate what happens in the health care provider's office. This process includes: gathering the medical history; conducting the physical examination; developing a diagnostic and therapeutic plan; counseling the patient and/or family as to the treatment plan; arranging follow-up. Challenges and barriers to accomplishing each and every one of these tasks through the videoconferencing format abound.

Since the videoconferencing format is a different encounter for both care providers, a written consent from the patient and/or family is necessary. The encounter does not occur in the usual, relative privacy of a clinic examination room. There are concerns regarding the extent of privacy when the patient visit includes a video signal moving from a remote site, through several networks and bridges to another site that typically has technical personnel and clinic coordinators present. Concerns regarding the efficacy of the encounter and whether or not adequate clinical information can be formulated by this venue are considered. If the encounter is unsatisfactory, then arranges are made for the child to be seen in person.

Patient history is obtained by interview with the remote site provider as facilitator. Barriers to an effective interview include language, cultural mores, age, level of comfort or discomfort talking to a television screen, seeing oneself projected on a television screen, lag time and technical glitches. As an interviewer, one needs to be attuned to body language in order to gain an understanding of whether or not the medical history interview is effective.

A good orthopaedic physical exam is a definite challenge as it is part observational and part hands-on. The observational part of the examination includes assessment of active range of motion, gait, posture, and, signs of inflammation such as swelling and redness. The hands-on examination assesses areas of local tenderness, quality of any swollen or indurated areas, passive range of motion, joint crepitus, stiffness, muscle tone and provocative examinations for joint stability. The quality of the hands-on part of the examination is directly dependent on the skill of the examiner at the remote site. (Figure 1).

A videoconference camera focused on a standard x-ray view box is usually used to transmit radiographs. Radiographic and transmission quality varies. The radiographs are usually relayed well enough using this technique to see gross anatomic changes such as displaced fractures. But subtle bone dysplasias, early infections, and permeative bone lesions cannot be easily identified using this modality. When this occurs, alternate means of transmitting data is required -- such as digitization of the image and e-mail transmission or mailing the radiograph to the facility.

At the conclusion of the teleconference, a diagnostic or therapeutic plan is formulated and communicated to the provider, patient and family at the remote site. Language and cultural barriers are critical at this juncture. Follow-up is then arranged around the availability of the providers at both the local and remote sites.

Figure 1.— Physician in American Samoa assisting with a telemedicine consult for the Shriners orthopaedic surgeon in Honolulu.

Using dedicated providers at the local and remote sites has helped lower some of these barriers. The providers have to be familiar and comfortable with the process. During outreach trips to these remote areas, we meet with the local providers in order to provide education and to review the orthopaedic physical examinations. Follow-up and assistance in management of our shared patients is provided. The success of the system relies on having qualified, dedicated, consistent personnel on both ends of the connection.

Regularly scheduled clinics, regardless of the number of patients to be seen, allows providers to exercise the videoconference equipment and hook-ups. Technical personnel gain experience and follow-up appointments can be more routinely scheduled for healthcare providers and patients alike.

The organization needs to support the telemedicine effort. Telemedicine clinic volume accounts for just over 1% of the total outpatient volume of Shriners Hospital - Honolulu. Despite the small percentage, the hospital continues to support a full time coordinator plus a clinician who commits 1 day-a-week to the program -- actively seeing patients via the telemedicine venue. The program budget continues to be supported by Shriners Hospitals for Children.

Finally, telemedicine has not replaced our need to travel to remote areas and conduct outreach clinics. However the quality of our clinic visits to these remote areas has improved. It is extremely beneficial to see and discuss a new child with the provider at the remote site before we see the child in person. As a result, treatment and diagnostic plans can be instituted earlier. Occasionally parents just need to be counseled and reassured. This can easily be done through the videoconferencing format. Patients with acute issues that require immediate referral and travel to Honolulu can be identified earlier and their care can be expedited. While telephones are the standard way of communicating this information, usually it is provider-to-provider only and rarely family/patient-to-provider.

The videoconferencing format allows both. As such we consider telemedicine to be an adjunct to our outreach program and not a replacement.

Conclusion

Through the use of the telemedicine technology, geographic and time barrier are no longer a hindrance to receiving and providing healthcare to rural areas. The experiences from the Telemedicine Program at Shriners Hospitals for Children - Honolulu has proven to be an additional clinical and education tool that has value and potential to improve healthcare.

The human factor has a critical impact on success of a telemedicine program. It doesn't matter how good the technology is if two sites do not want to communicate with each other. The value of telemedicine and its frequency will increase as healthcare providers begin to accept and become comfortable in its applications. Collaboration and partnerships in sharing of resources such as network capabilities and video conferencing equipment is a demonstration of the synergistic effect to the development and maintenance of telemedicine programs. Sustainability will depend on organizations' commitment to supporting healthcare providers' initiatives. As in any clinical application, without the healthcare providers' participation, there would be no clinical value whether it is through telemedicine or the traditional hands-on assessment.

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Augmentation of Special-needs Services and Information to Students and Teachers "ASSIST" — A Telehealth Innovation Providing School-based Medical Interventions

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Abstract

An innovative school-based telehealth technology was introduced in Hawaii with the purposes of: (1) evaluating students for medical/developmental conditions with educational implications, (2) providing a professionally-monitored Internet-based system of learning/development, and (3) delivering medically-based physical and occupational therapy at the student's school. Electronically recorded satisfaction surveys from parents, teachers, and providers revealed significant improvement in all three areas.

Introduction

Many school-aged children have medical/developmental conditions that affect their ability to learn and to succeed in school. Included are: Attention-Deficit/Hyperactivity Disorder, autism/pervasive developmental disorders, and specific learning disorders. These conditions impact both the medical and educational domains, as the evaluation for the conditions generally rests with the medical/psychological professionals, while intervention affects, and is the primary responsibility of, the educational system. Physician evaluation of these children is often inefficient, inadequate, and/or unavailable for a number of reasons, including: (1) Physicians vary in their level of training, experience, and comfort in dealing with these conditions; (2) Even for an experienced and motivated physician, the time constraints imposed by a busy office practice may limit the ability to provide a thorough evaluation; (3) Office-based evaluations and follow-up visits require repeated absences from school, further impeding the child's educational progress; and (4) There is a lack of consistency and quality control in the evaluation process.

This is particularly relevant to military dependent children in Hawaii. The Department of Defense (DoD) considers Hawaii to be an Outside the Continental United States (OCONUS) location, and therefore tours of duty in Hawaii are considered overseas tours. But Hawaii is unique among OCONUS duty areas because of the relatively high level of available medical resources. Furthermore, the military's Exceptional Family Member Program (EFMP) requires that the availability of services for dependents with special needs must be considered in determining a service member's duty assignment. Therefore, a service member who has a child with special medical or educational needs may be more likely to be assigned to Hawaii for an overseas tour than to other overseas locations with fewer medical resources. Additionally, there are no Federally-run schools for military dependents in Hawaii; all military dependent children who attend public school in Hawaii are enrolled in the State Department of Education (DOE) schools. The educational system in Hawaii has been criticized[1, 2] in the past for a lack of responsiveness to parents' concerns regarding the availability and quality of intervention services for children with disabilities. In addition, because the military represents a significant portion of the population in Hawaii, and particularly on Oahu, factors that affect military dependent children can have an appreciable effect on the school system statewide.

In March of 1999, a request was made of the Commander, Tripler Army Medical Center (TAMC) to help in the provision of services to special needs students who were dependents of active duty personnel in the State of Hawaii. Congressional funding provided the basis of a research / demonstration project entitled "Augmentation of Special-needs Services and Information to Students and Teachers (ASSIST)". Prior to any intervention, a thorough Needs Assessment, was carried out with careful collaboration between the Departments of Education, Health, and Defense, and the University of Hawaii. This collaborative effort identified three areas of greatest need for military dependent special-needs students in Hawaii. The Needs Assessment also provided a baseline for the project's outcome measures.

The three identified areas of need became the three major components of ASSIST:

1. Evaluation of children suspected of having one of the four most common medical diagnoses that affect a student's ability to learn in school and require specific educational planning. These diagnoses are: Attention-Deficit/Hyperactivity Disorder (ADHD), Auditory Processing Disorder (APD), Autistic Spectrum Disorder (ASD), and dyslexia. The survey also found a need to decrease the amount of time that these children spend out of school for evaluation, treatment, and monitoring of their medical condition.
2. The development of an educational web site with professionally-monitored website linkages to various educational/developmental sources of information for providers, parents and teachers of children with special needs.
3. The delivery of school-based, medically-indicated physical and occupational therapy intervention at the school, so as to limit educational/classroom interruptions.

Each of the three components of the project had specific objectives and anticipated benefits. **Component 1**, the evaluation of medical conditions with educational implications, had three objectives:

1. To demonstrate that children with these conditions could be evaluated using telemedicine, thus minimizing time away from school,
2. To improve parental satisfaction with the child's educational experience, and with the diagnosis and management of the medical condition,
3. To decrease the number of classroom problems and interrup tions attributable to the medical condition affecting the child's education by providing early detection and intervention.

The anticipated major benefits of this aspect of the project included:

- Less time spent by the families visiting physicians or other professionals in order to make the diagnosis,
- An expedited evaluation process compared with standard methods,
- Creation of a remotely-accessible store-and-forward video of the child in the classroom setting as a valuable diagnostic tool ,
- Development of educational presentations for students and teachers (initially focusing on learning disabilities), with an emphasis on understanding and acceptance of children with special needs.

The major objective of **Component 2**, development of a web site, was to provide parents, teachers, and health care professionals with a reliable, thorough, single source of information on educationally-relevant medical and developmental conditions. The primary goal for the website was to create a professionally-monitored Internet-based system of learning/development, including a central source of links to websites that would be rated and monitored by the professional staff of the project (psychologists, social workers, developmental pediatricians, occupational and physical therapists). The links needed to be accessible via the same portal that the parents and professionals use to access the ASSIST evaluation and feedback system. The development of this learning center resulted in over 100 links to internet websites, in the following categories: Advocacy, Autism, Behavior Problems/ADHD, CAPD, Disaster-Related Anxiety, Federal/Military, General Information, Genetics, Learning Disabilities / Early Intervention, Motor Development, Physical Disabilities, and Unique Military-Related Information.

Component 3, the delivery of medically-based physical and occupational therapy, had two major objectives:

1. To improve the children's quality of life, and
2. To increase patient, family and provider satisfaction.

The benefits included the ability to:

- Provide medically-indicated occupational and physical therapy services in the classroom setting,
- Allow occupational and physical therapy assistants to provide services in the schools, using electronic, web-based supervision by fully-trained pediatric occupational and physical therapists,
- Reduce absenteeism, and augment the student's educationally-based occupational and/or physical therapy services.

Methods

The research was approved by the TAMC Institutional Review Board and Human Use Committee, and consents were obtained from parents and assents from the students participating in the study. Schools on federal property were chosen due to their high percentage of military students (most over 90%). All students were referred for evaluation through the Student Services Coordinator (SSC) at their respective school, and were entered onto the secure Project ASSIST website. Students at all 9 of the Hawaii Department of Education schools located on federal property were eligible for services from Project ASSIST; however, certain conditions needed to be met in order for children to participate in the research study. For **Component 1**, only children never previously evaluated / diagnosed with one of the four medical conditions were enrolled in the research, secondary to difficulties discontinuing medication or other services. In **Component 3**, only children who had educationally mandated OT and/or PT on their Individualized Educational Plan (IEP) were enrolled in order to determine if the addition of medically indicated OT and/or PT services would improve their quality of life and parent/provider satisfaction.

Component 1: Medical Conditions with Educational Implications. The four educationally relevant diagnoses were approached in the following manner.

For children suspected of having ADHD, we identified a set of questionnaires that were already being used in our institution's ADHD evaluation clinic, and adapted them for use in an interactive electronic format. The questionnaires included the Comprehensive Behavior Rating Scale for Children (CBRSC)[1], School Situations questionnaire, ADHD Rating Scale, ADHD Comprehensive Teachers/Parents Rating Scales (ACTeRS)[2], Home Situations Questionnaire, and marital and depression scales for the parents. Some of these questionnaires had been developed in our facility, some were "freeware", while the CBRSC and ACTeRS were commercially available. These questionnaires are included as appendices. For copyrighted questionnaires, we obtained permission from the pub-

lishers to allow us to develop an electronic version.

We then set up a secure website with password-protected access. When a teacher or parent identified a student as having difficulties at home and/or in the classroom that could be an indication of ADHD, ASSIST or school personnel informed the parent about the project and assigned them an identification code and password to enable access to the site. The parent and teacher then completed the questionnaires on-line. Once each questionnaire was submitted, it could not be recalled or modified. At no time were the responses of parents or teachers available to each other. Response data was electronically tabulated, with standard scores and/or T-scores recorded on a data summary sheet. The specific questionnaire answers and data summaries were then accessible to ASSIST personnel, including psychologists and developmental pediatricians.

An additional benefit of the online questionnaires for our military dependent population was that parents who were deployed from Hawaii, or otherwise inaccessible, could still provide information on their child by using the website.

In order to provide a form of direct observation of the child, we used a small video camera in the child's classroom to compare the child's in-classroom behavior to that of an adjacent control student (student assent and parental consent were obtained from the control student and parent respectively without identifying the identity of the subject student). The camera was connected to the school's Local Area Network (LAN), and was controlled from a remote location via the LAN. A 15-minute store-and-forward video-clip of the child's (and control's) behavior during individual deskwork was recorded to allow for observation of distractibility and impulsiveness in the classroom setting. This was used in lieu of the method used by our existing ADHD evaluation clinic, in which a child is asked to perform a standardized "pseudoacademic" task for 15 minutes, while being monitored by a trained observer.

Control satisfaction surveys were obtained from the parents of students being evaluated through the ADHD clinic at TAMC. Most, but not all, parents were willing to serve as controls.

If the teacher felt the student had difficulties primarily in the areas of speech / language and socialization, an assessment for an Autistic Spectrum Disorder was initiated, using the DoD Clinical Pathway; an assessment tool adapted from the recommendations of a multidisciplinary task force[3].

Students were screened for Auditory Processing Disorders using specific on-line questionnaires. If results were suggestive of the diagnosis, screening intellectual/academic testing was done. If those results were also compatible with APD, the child was referred to an audiological specialist for further assessment.

If a student was experiencing reading difficulty but was not identified as having a Specific Learning Disability (SLD) on standardized testing by the DOE, or if the student was still having difficulties and suspected of having dyslexia despite special education intervention, specific online questionnaires were completed by parents and teachers, and a child psychologist carried out a full evaluation for dyslexia.

Research for Aspect 1 centered on two distinct areas: (1) Parents' satisfaction with the evaluation process, including accessibility, ease, and timeliness, and (2) comparison of behavior problems in the classroom before and after the evaluation. To accomplish this, 5-point Likert scale parent satisfaction questionnaires (Appendix 1) were contrasted using T-tests comparing the means between students being evaluated for any of these diagnoses at the target schools versus the currently functioning Developmental Pediatrics ADHD clinic at TAMC.

To assess whether the evaluation process made a difference in the student's functioning in the classroom, parents and teachers were asked to complete two commonly used surveillance questionnaires for treatment efficacy: the ADHD Comprehensive Teacher Rating Scale (ACTeRS) and the ADHD IV Rating scale (a 4-point scale of severity composed of the 9 inattentive and 9 hyperactive/impulsive criteria listed in the Diagnostic and Statistical Manual of Mental Disorders - DSM-IV) (Appendices 2 and 3). Each child served as his/her own control (pre- vs. post-evaluation classroom behaviors).

Component 2: Website Development for a CSPD. Visitors to the site were queried as to whether they were a parent, teacher, or provider of services, to then asked to complete a simple four question pop-up survey as they exited the site. The four questions were:

- Did this website provide you with more credible/useful information than other sites you have visited?
- Was the information on this site up-to-date in comparison to other sites you have visited?
- Was this website easier to use than other sites?
- Would you recommend this site to others?

Component 3: Provision of medically-based occupational and/or physical therapy. Objectives and outcomes were established prior to the provision of services. Parent and teacher questionnaires were developed (Appendix 4) using a 5-point Likert scale, and were administered before and three months after the initiation of services. Each child served as his/her own control. Parents were given the entire questionnaire, while teachers were asked only the first eight questions. Results of pre-and post-intervention questionnaires were analyzed using the Student T test.

Results

Component 1: Evaluation of Medical Conditions with Educational Implications:

As of the end of April 2004, 599 students have been referred and 508 evaluations have been completed for students suspected of having medical conditions with educational implications. Of these, 172 were referred for an evaluation of an ADHD and met the criteria for participation in the research. Of these 84 completed satisfaction questionnaires. Table 1 compares the parent satisfaction survey results between students evaluated through ASSIST and students evaluated through the Tripler ADHD Clinic. The survey results were overwhelmingly positive. On 10 of the 20 questions, the increase in parent satisfaction was highly significant ($p<0.01$). The most significant findings included satisfaction with timeliness, referral process, forms, location of the evaluation, and the evaluation itself. The parents also felt they were better able to enjoy and advocate for their child. There was only one question in which ASSIST parents reported lesser satisfaction than the parents who had gone through the standard ADHD clinic evaluation; that being the understanding and use of medication for an ADHD.

We also compared the teacher's perception of the child's behavior in the classroom before and 3 months after the evaluation, using the ACTeRS and ADHD-IV questionnaires. These results are summarized in Tables 2 and 3. Note that the ACTeRS is designed in such a way that post-treatment minus pre-treatment improvement in a child's behavior is reflected by positive scores in Attention and Social Skills, but negative scores in Hyperactivity and Oppositional Behavior. Also, treatment of a child who is diagnosed as having ADHD is individualized, and determined by the child's physician and the family, so these results do not reflect whether or how the child was treated for the condition.

Component 2: Website Development for a CSPD. As of the first of June 2004, there have been 566 pop-up surveys completed. The four questions asked and the percentages of respondents answering "yes" to the questions are included in Table 4. Overall, greater than 84% of the respondents answered "yes" to each of the four questions.

Component 3: Provision of Medically-Based Occupational and/or Physical Therapy. The results of the pre- and post-intervention questionnaires completed by teachers and parents are summarized in Tables 5 and 6. For the parent questionnaires, every question showed a significant positive change ($p<0.05$), and for 5 of the 8 questions the change was highly significant ($p<0.01$). For the teacher questionnaires, all of the changes were positive, but only three were statistically significant.

Discussion

It is important to realize that significant stressors for military personnel have been present since September 11, 2001, with a significant number of military personnel deployed in the Global War on Terrorism to Iraq and Afghanistan. Because of this, it was anticipated there would be an overall decrement in satisfaction questionnaires, particularly those dealing with quality of life issues. Surprisingly, this was not the case.

Component 1: Medical Conditions with Educational Implications. The parent and teacher satisfaction questionnaires indicate a significant improvement in the satisfaction of the evaluation process at Target Schools compared to a long-standing ADHD clinic at Tripler AMC, despite a similar evaluation process in place at both locations. The major improvements were in timeliness, accessibility, availability of school-based evaluations, and ease in accessing the evaluation process.

Since one goal of the project was to make the diagnosis of ADHD more efficient and streamlined for families by doing the evaluations in the school and on line, we would have predicated that the ASSIST parents would report increased satisfaction on questions dealing with timeliness and location of the evaluation. This was in fact the case. In addition, an unexpected benefit was that the parents also showed significantly improved satisfaction (compared with those going through the standard ADHD clinic) on questions concerning the benefit of the recommendations, their ability to advocate for their child, and their enjoyment of the child after the completion of the process. This could be due to a "halo effect" from the increased parental satisfaction with the process, or it could represent a benefit of the improved efficiency of the evaluation. Since the treatment of ADHD was left to the family and physician of each individual child, the questionnaire results did not reflect whether or not the child had received medical treatment for ADHD. The only area in which improvement was not noted was in a thorough understanding of medication. The TAMC ADHD program has a very detail-oriented, educational system in place to ensure understanding of the types of medication, effects, side effects, timing and duration of action of medications used for ADHD, which was not necessarily present when children were referred to their primary care physician/care manager for medical intervention.

The classroom behaviors as rated on the ACTeRS and ADHD-IV Rating Scale indicate that there was improvement in all behaviors rated on the ACTeRS. The improvement in attention on the ACTeRS scale was significant at a p value of <0.05. This is especially encouraging because impairment of attention is the most important obstacle to learning in the classroom. Social skills and oppositional behaviors also improved, though not at a statistically significant level. Improvement in these traits may take longer than in attention or hyperactivity. It might be interesting to repeat the ACTeRS questionnaires at six months to one year following the evaluation; however, the mobility and transience of military families make this impractical in this population.

The least amount of improvement on the ACTeRS was in the area of hyperactivity. This is somewhat surprising, since reduction of hyperactivity is often one of the most rapid and reliable effects when children with ADHD are treated with stimulant medication. One possible explanation is that some of the children may not have started medication at the time of the follow-up study, either because they had not yet had an appointment with their physician, or because their families had decided not to initiate medical treatment. A lack of medical intervention would not explain the improvement in attention, however that measure could have been due to other factors, for example classroom placement, and a better understanding by the teacher of the student's medical condition.

The ADHD-IV rating scale revealed an improvement in all aspects, both attention and impulsivity/hyperactivity. None of the improvements achieved a p value of <0.05. Like the ACTeRS, there was less significant change in the hyperactive/impulsive criteria, although improvement was documented in all criteria.

Component 2: Website Development for a CSPD. With so much information available on the Internet, and so few ways to determine its bias, accuracy, or scientific validity, we felt it would be helpful to provide a website that filters and professionally monitors other websites that deal with children's disabilities and educationally-related disorders. Teachers, parents, and therapists all reported that they found our site beneficial. Each of the three groups made positive comments regarding the utility and benefit of the site. Occupational and physical therapists had a somewhat lower rate of positive responses concerning their personal use of the site, perhaps because they have already determined their own list of discipline-specific "favorite" sites. Still, 85% of therapists said they would recommend the site to others. The question identifying the respondent as a parent, teacher or provider was not asked when the site was first developed,. As it was impossible to correctly identify those 210 early respondents, they were placed in the category "other". Although it is still possible to respond as "other", there have been only 19 who have chosen that category, suggesting the majority of visitors to the site are parents and teachers, the population identified as benefiting from such a website filter/monitor.

Component 3: Provision of medically-based occupational and/or physical therapy. The responses of parents and teachers to the questions regarding their satisfaction with the services provided by ASSIST were uniformly positive. The pre- vs. post-intervention parent questions relating to services were all (100%) statistically significant at a *p-value* = <0.05. Teachers responded positively to three out of eight of the questions at a statistically significant level. Both of the questions dealing with delivery of services to students (amount of service and availability of therapist) were statistically significant. The questions dealing with the teachers' knowledge of how to access services for their students were not statistically significant; suggesting that teachers know how to access services, but are unable to obtain the degree of service they felt their student needed.

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Appendix 1.— Parent Questionnaire of Satisfaction with the Evaluation

A collaborative effort of the Department of Defense, Department of Education, Department of Health, Pacific Telehealth & Technology Hui, and the University of Hawaii.

Project ASSIST / Pacific Telehealth & Technology Hui wants your honest opinions on the ease or difficulties you have experienced in getting your child/student evaluated. There are no right or wrong answers.

Parent(s) to Complete

For each question, check the box that best describes the situation.

Q1) How long did it take from the initial referral to starting an evaluation for a medical condition with educational implications?
- ❑ 1 Less than one week
- ❑ 2 One to two weeks
- ❑ 3 Two weeks to one month
- ❑ 4 One to two months
- ❑ 5 Greater than 2 months

Q2) How long did it take from the initial referral to completing the evaluation for such a medical condition?
- ❑ 1 Less than one month
- ❑ 2 One to two months
- ❑ 3 Two to three months
- ❑ 4 Three to four months
- ❑ 5 Greater than 4 months

Q3) Overall, how satisfied are you with the timeliness of your child's evaluation?
- ❑ 1 I am very dissatisfied with the timeliness.
- ❑ 2 I am dissatisfied with the timeliness.
- ❑ 3 I am neither satisfied nor dissatisfied.
- ❑ 4 I am satisfied with the timeliness.
- ❑ 5 I am very satisfied with the timeliness.

Q4) How satisfied are you with the referral process?
- ❑ 1 I am very dissatisfied.
- ❑ 2
- ❑ 3 I am neither satisfied nor dissatisfied.
- ❑ 4
- ❑ 5 I am very satisfied.

Q5) How satisfied are you with the forms you were asked to complete for the evaluation?
- ❑ 1 I am very dissatisfied.
- ❑ 2
- ❑ 3 I am neither satisfied nor dissatisfied.
- ❑ 4
- ❑ 5 I am very satisfied.

Q6) How satisfied are you with the location of the evaluation?
- ❑ 1 I am very dissatisfied with the location (distance too great or location not convenient).
- ❑ 2
- ❑ 3 I am neither satisfied nor dissatisfied.
- ❑ 4
- ❑ 5 I am very satisfied.

Q7) How satisfied are you with the evaluation done for your child's condition?
- ❑ 1 I am very dissatisfied with the length, ease, and type of questions asked.
- ❑ 2
- ❑ 3 I am neither satisfied nor dissatisfied.
- ❑ 4
- ❑ 5 I am very satisfied.

Q8) How beneficial were the recommendations for your home?
- ❑ 1 The recommendations are irrelevant, impractical and not able to be implemented.
- ❑ 2
- ❑ 3 The recommendations are somewhat helpful, and some should be incorporated.
- ❑ 4
- ❑ 5 The recommendations are both practical and are able to be implemented.

Q9) If your child is currently on medication for attention or hyperactivity, do you understand the medication(s)?
- ❑ 1 I don't understand the medication(s).
- ❑ 2
- ❑ 3 I partially understand the medication(s).
- ❑ 4
- ❑ 5 I have an excellent understanding.

Q10) Did your child start receiving services as soon as he/she needed to?
- ❑ 1 The diagnosis was made too late and he/she missed needed services.
- ❑ 2
- ❑ 3 It took longer than I wanted, but my child / student didn't miss any important services.
- ❑ 4
- ❑ 5 From start to services was very short.

(Questions 11-21)
For each question, check the box that best describes how you feel. Use boxes 2 or 4 if your answer falls between 1, 3 or 5. There are no correct answers and everyone experiences the care giving challenges differently.

Q11) Are you able to be an advocate?
- ❑ 1 I haven't figured out how to be an effective advocate for my own child or for other children.
- ❑ 2
- ❑ 3 I can advocate for my child, but I haven't yet found ways to make a difference for others.
- ❑ 4
- ❑ 5 I have found ways to make life better for my child and others.

Q12) Do you need help coordinating your child's care?
- ❑ 1 I have to do all the care coordination myself and the hassle and complexity is overwhelming.
- ❑ 2
- ❑ 3 Most of the time I can handle the coordination and paperwork, but I would like

some help.
❑ 4
❑ 5 I don't need any help with care coordination.

Q13) How much of a problem is worry for you?
❑ 1 I constantly worry about my child. There is never a time I do not think about it.
❑ 2
❑ 3 I worry a fair amount but not all the time.
❑ 4
❑ 5 I don't worry.

Q14) Is grief and sadness a problem for you?
❑ 1 I feel constant grief and sadness over my child's condition.
❑ 2
❑ 3 I usually feel grief and sadness.
❑ 4
❑ 5 I usually do not feel grief and sadness.

Q15) Do you have any physical symptoms of stress?
❑ 1 Because of my child, I have many physical symptoms of stress: headaches, bowel problems, insomnia, and/or fatigue.
❑ 2
❑ 3 I have a few mild physical symptoms of stress.
❑ 4
❑ 5 I have no effects on my own physical health.

Q16) Do you have any time to do something just for yourself?
❑ 1 I devote all my time to my child due to his needs with no spare time for myself.
❑ 2
❑ 3 I can get some housework and shopping done, and some time to do little things I like.
❑ 4
❑ 5 I spend some time taking care of my child, but I have time to do things just for myself.

Q17) Are you able to be hopeful?
❑ 1 I find no purpose or hope in this unfortunate situation for my child.
❑ 2
❑ 3 Sometimes I can make sense out of what has happened and see some hope.
❑ 4
❑ 5 I have been able to find inner peace about my child's condition.

Q18) Are you able to enjoy your child?
❑ 1 I can't find anything that my child and I enjoy doing together and I don't know where to start.
❑ 2
❑ 3 I sometimes find enjoyable things to do with my child.
❑ 4
❑ 5 I am usually able to find or create fun experiences for me and my child.

Q19) Do you get a break from care giving (respite care)?
❑ 1 We never get away from the constant demands of care giving.
❑ 2
❑ 3 We sometimes get away, but not enough.
❑ 4
❑ 5 We have frequent enough breaks from care giving.

Q20) Overall, how satisfied are you with your quality of life?
❑ 1 Most of the time, I am very dissatisfied with the quality of my life.
❑ 2
❑ 3 Sometimes I'm satisfied with the quality of my life and sometimes I am dissatisfied with the quality of my life.
❑ 4
❑ 5 Most of the time, I am very satisfied with the quality of my life.

FINAL COMMENTS
If you could make one change to the special needs services here in Hawaii, what would you change? Please be specific.

Appendix 2.— ADHD Comprehensive Teacher Rating Scale (ACTeRS)

ATTENTION	Almost Never 1	2	3	4	Almost Always 5
1) Works well independently					
2) Persists with task for reasonable amount of time					
3) Completes assigned task satisfactorily with little additional assistance					
4) Follows simple directions accurately					
5) Follows a sequence of instructions					
6) Functions well in the classroom					
HYPERACTIVITY	Almost Never 1	2	3	4	Almost Always 5
7) Extremely overactive (out of seat, 'on the go')					
8) Overreacts					
9) Fidgety (hands always busy)					
10) Impulsive (acts or talks without thinking)					
11) Restless (squirms in seat)					
SOCIAL SKILLS	Almost Never 1	2	3	4	Almost Always 5
12) Behaves positively with peers / classmates					
13) Verbal communication clear and 'connected'					
14) Nonverbal communication accurate					
15) Follows group norms and social rules					
16) Cites general rule when criticizing ('We aren't supposed to do that')					
17) Skillful at making new friends					
18) Approaches situations confidently					
OPPOSITIONAL	Almost Never 1	2	3	4	Almost Always 5
19) Tries to get others into trouble					
20) Starts fights over nothing					
21) Makes malicious fun of people					
22) Defies authority					
23) Picks on others					
24) Mean and cruel to other children					

Appendix 3.— ADHD IV Rating Scale

Attention	Not at All 1	Just a Little 2	Pretty Much 3	Very Much 4
1) Often fails to give close attention to details or makes careless mistakes in schoolwork, or other activites				
2) Often has difficulty sustaining attention in tasks or play activities				
3) Often does not seem to listen when spoken to directly				
4) Often does not follow through on instructions and fails to finish schoolwork or chores				
5) Often has difficulty organizing tasks and activities				
6) Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)				
7) Often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, or books)				
8) Is often easily distracted by extraneous stimuli				
9) Is often forgetful in daily activities				

Hyperactivity/Impulsivity	Not at All 1	Just a Little 2	Pretty Much 3	Very Much 4
10) Often fidgets with hands or feet or squirms in seat				
11) Often leaves seat in classroom or other situations in which remaining seated is expected				
12) Often runs about or climbs excessively in situations in which it is inappropriate				
13) Often has difficulty playing or engaging in leisure activities quietly				
14) Is often 'on the go' or often acts as if 'driven by a motor'				
15) Often talks excessively				
16) Often blurts out answers before questions have been completed				
17) Often has difficulty awaiting turn				
18) Often interrupts or intrudes on others (e.g., butts into conversations or games)				

Appendix 4.— Parent Satisfaction with Provision of Occupational / Physical Therapy at the School

A collaborative effort of the Department of Defense, Department of Education, Department of Health, Pacific Telehealth & Technology Hui, and the University of Hawaii.

Project ASSIST / Pacific Telehealth & Technology Hui invites you to participate in this important survey. There are no right or wrong answers. The survey must be completed by the primary care giving parent.. A repeat survey will be required one to three months from now.

Parent To Complete

For each question, check the box that best describes how you feel. Use boxes 2 or 4 if your answer falls between 1, 3 or 5. There are no correct answers, and everyone experiences the care giving challenges differently.

Q1) Does your child have all the therapy he/she needs?
- ❑ 1 I can not get the appropriate amount of therapy for my child.
- ❑ 2
- ❑ 3 My child receives some therapy that he needs, but definitely needs more.
- ❑ 4
- ❑ 5 My child receives all the therapies necessary to enhance his/her medical care and education.

Q2) Do you understand how to get the services your child needs?
- ❑ 1 I don't know how to get services for my child and I usually give up or get upset.
- ❑ 2
- ❑ 3 I know how to get services but it involves lying, getting hysterical, or nasty.
- ❑ 4
- ❑ 5 I know how to get services and I usually do it in a positive way.

Q3) Do you need help coordinating your child's care?
- ❑ 1 All the care coordination is mine, the hassle/complexity is overwhelming.
- ❑ 2
- ❑ 3 in general I can handle the coordination, but I would like some help.
- ❑ 4
- ❑ 5 I don't need care coordination help.

Q4) Can you reach the provider of your child's occupational and/or physical therapy when you need to?
- ❑ 1 I can never get the provider on the phone in a reasonable period of time.
- ❑ 2
- ❑ 3 Sometimes I can reach him in reasonable time.
- ❑ 4
- ❑ 5 I can always talk to him in a reasonable time.

Q5) Does your child's therapist listen to you?
- ❑ 1 The therapists don't care about my feelings.
- ❑ 2
- ❑ 3 Sometimes they listen but they are too busy.
- ❑ 4
- ❑ 5 They always listen and believe me.

Q6) Does your child's therapist respond to the developmental and emotional needs of your child?
- ❑ 1 My child's therapist is insensitive to his developmental/emotional needs.
- ❑ 2
- ❑ 3 His therapist sometimes responds.
- ❑ 4
- ❑ 5 His therapist always responds.

Q7) Is your child's therapist sensitive to ethnic and cultural diversity?
- ❑ 1 I don't think my child's therapist ever heard of cultural diversity or sensitivity training.
- ❑ 2
- ❑ 3 My child's therapist tries to understand different cultural practices.
- ❑ 4
- ❑ 5 My child's therapist understands my culture and beliefs and works with me.

Q8) Do you trust your child's therapist?
- ❑ 1 I don't trust them.
- ❑ 2
- ❑ 3 I have a fair amount of confidence.

❑ 4
❑ 5 I trust him completely.

Q9) How are your immediate family members coping?
❑ 1 We are having a very difficult time coping with my child's condition.
❑ 2
❑ 3 My family members usually cope.
❑ 4
❑ 5 My family members cope very well.

Q10) What kind of support do you have?
❑ 1 I feel isolated and alone. I have no support. I don't know who to ask for help.
❑ 2
❑ 3 I worry a fair amount of time.
❑ 4
❑ 5 I don't worry.

Q11) Have you begun to plan for your child's future?
❑ 1 The issues of my child's future are so difficult for me I can't begin to think about them.
❑ 2
❑ 3 I have a good idea for future plans.
❑ 4
❑ 5 I've made all the plans that need to be made.

Q12) How much of a problem is worry for you?
❑ 1 I constantly worry about my child.
❑ 2
❑ 3 I worry a fair amount but not all the time.
❑ 4
❑ 5 I don't worry.

Q13) Is grief and sadness a problem for you?
❑ 1 These are constant over my child's condition.
❑ 2
❑ 3 I usually feel grief and sadness.
❑ 4
❑ 5 I usually do not feel grief and sadness.

Q14) Do you have any physical symptoms of stress?
❑ 1 I have many physical symptoms of stress like headaches, bowel problems, and insomnia.
❑ 2
❑ 3 I have a few mild physical symptoms.
❑ 4
❑ 5 I have no effects on my own physical health.

Q15) Are you getting the sleep you need?
❑ 1 Because of my child, I never get enough sleep and am perpetually fatigued.
❑ 2
❑ 3 Sleep is only an occasional problem.
❑ 4
❑ 5 Sleep is never a problem.

Q16) How do you spend your time?
❑ 1 The needs of my child are so great I don't get any thing else done.
❑ 2
❑ 3 Most of the time, I can get some housework and shopping done.
❑ 4
❑ 5 I spend time taking care of my child but I also get many other things done.

Q17) Do you have any time to do something just for yourself?
❑ 1 I devote all my time to my child and have no spare time for myself.
❑ 2
❑ 3 I have some time for myself to do little things I like.
❑ 4
❑ 5 I have plenty of time to do things just for myself.

Q18) Are you able to be hopeful?
❑ 1 I find no purpose or hope in this unfortunate situation for my child.
❑ 2
❑ 3 Sometimes I can make sense out of what has happened and see some hope.
❑ 4
❑ 5 I have been able to find inner peace about my child's condition.

Q19) Are you able to enjoy your child?
❑ 1 I can't find anything that my child and I enjoy doing together and I don't know where to start.
❑ 2
❑ 3 I can sometimes find enjoyable things to do with my child.
❑ 4
❑ 5 I am usually able to find or create fun experiences for me and my child.

Q20) Overall, how satisfied are you with your quality of life?
❑ 1 Most of the time, I am very dissatisfied with the quality of my life.
❑ 2
❑ 3 Sometimes I'm satisfied with the quality of my life and sometimes I am dissatisfied with the quality of my life.
❑ 4
❑ 5 Most of the time, I am very satisfied with the quality of my life.

FINAL COMMENTS
If you could make one change to the special needs services here in Hawaii, what would you change?

Table 1.— Parental Satisfaction with the Evaluation Process at Target Schools Compared to the TAMC ADHD Clinic (control)) Using 5-point Likert Scale

Question	Target (n=84) Mean	Control (n=67) Mean	—	*p* value
Time - referral to starting evaluation	2.47	4.75	2.27	<0.01
Time - referral to completion of evaluation	2.21	4.49	2.28	<0.01
Satisfaction with timeliness	4.30	2.40	-1. 90	<0.01
Satisfaction with referral process	4.50	3.12	-1.38	<0.01
Satisfaction with forms	4.29	3.78	-0.51	<0.01
Satisfaction with location of evaluation	4.69	3.84	-0.85	<0.01
Satisfaction with evaluation	4.69	4.04	-0.65	<0.01
Benefit of recommendations	4.58	3.84	-0.74	<0.01
Medication understanding	1.29	1.48	0.19	0.05
Timeliness of services	2.99	2.40	-0.59	0.04
Ability to advocate	3.82	3.15	-0.67	<0.01
Worry	3.44	3.01	-0.43	0.01
Hopeful	4.39	4.12	-0.27	0.05
Enjoy child	4.80	4.31	-0.49	<0.01

Table 2.— *ADHD Comprehensive Teacher Rating Scale (ACTeRS) n=61*				
Scale	Pre-Evaluation Score	Post-Evaluation Score	–	*p-value*
Attention	15.28	18.02	2.74	0.01
Hyperactivity	12.69	12.43	-0.26	0.83
Social Skills	22.98	24.90	1.92	0.08
Oppositional	10.51	9.87	-0.64	0.54

Table 3.— *ADHD-IV Rating Scale n=64*				
Scale	Pre-Evaluation Score	Post-Evaluation Score	–	*p-value*
Attention (total)	5.55	4.53	-1.02	0.07
• 1	3.06	2.76	-0.30	0.06
• 2	2.97	2.72	-0.25	0.14
• 3	2.52	2.16	-0.36	0.05
• 4	2.91	2.61	-0.30	0.07
• 5	2.81	2.58	-0.23	-0.23
• 6	2.94	2.62	-0.32	0.08
• 7	2.56	2.19	-0.37	0.06
• 8	3.17	2.94	-0.23	0.17
• 9	2.64	2.33	-0.31	0.07
Hyperactivity (total)	2.89	2.39	-0.50	0.34
• 10	2.55	2.42	-0.13	0.55
• 11	2.13	1.89	-0.24	0.19
• 12	1.61	1.48	-0.13	0.41
• 13	1.97	1.78	-0.19	0.29
• 14	1.88	1.75	-0.13	0.48
• 15	2.20	2.09	-0.11	0.56
• 16	1.97	1.78	-0.19	0.25
• 17	2.05	1.86	-0.19	0.28
• 18	2.06	1.95	-0.11	0.55

Table 4.— Website Satisfaction	Respondents answering "YES"				
Question	Parent (n=192)	Teacher (n=132)	Provider (n=13)	Other (n=229)	Average (n=566)
1. Did this website provide you with more credible/useful information than other sites you visited?	86.5%	77.3%	76.9%	83.4%	87.6%
2. Was the information on this site up-to-date in comparison to other sites you visited?	94.8%	84.1%	76.9%	90.4%	90.1%
3. Was this website easier to use than other sites?	85.9%	81.8%	69.2%	85.6%	84.5%
4. Would you recommend this site to others?	94.3%	84.1%	84.6%	91.3%	90.5%

Table 5.— *Parent Questionnaire (5-point Likert Scale) n=34*	–	*P*
1. Does your child have all the therapy he/she needs?	-1.07	<.01
2. Do you understand how to get the services your child needs?	-0.47	0.02
3. Do you need help coordinating your child's care?	-0.43	0.03
4. Can you reach the provider of your child's occupational and/or physical therapy when you need to?	-0.83	<0.01
5. Do your child's providers of OT and/or PT listen to you?	-0.53	<0.01
6. Does your child's therapist respond to the developmental and emotional needs of your child?	-0.80	<.01
7. Is your child's therapist sensitive to ethnic and cultural diversity?	-0.37	0.02
8. Do you trust your child's therapist?	-0.77	<.01

Table 6.— *Teacher Questionnaire (5-point Likert Scale) n=35*	–	*P*
1. Does your student have all the therapy he/she needs?	-1.03	<.01
2. Do you understand how to get the services your student needs?	-0.10	0.45
3. Do you need help coordinating your student's care?	-0.27	0.10
4. Can you reach the provider of your student's occupational and/or physical therapy when you need to?	-0.40	0.03
5. Do your student's providers of occupational and/or physical therapy listen to you?	-0.10	0.45
6. Does your student's therapist respond to the developmental and emotional needs of your student?	-0.63	<0.01
7. Is your student's therapist sensitive to ethnic and cultural diversity?	-0.27	0.13
8. Do you trust your student's therapist?	-0.17	0.23

A Novel Approach to Tele-Echocardiography Across the Pacific

Jamalah A. Munir MD, Eugene K. Soh MD, Thomas N. Hoffman MD, and Jeffery P. Stewart MD

Abstract

Telecardiology provides remote delayed interpretation of echocardiographic images through a store and forward program between the interpreting center, Tripler Army Medical Center, Honolulu Hawaii, and the image acquisition center, Guam Naval Hospital, Guam USA. This routine store and forward system has inherent delay, limiting application for management of acute medical conditions. In this case report we describe a novel real-time echocardiograpic interpretation methodology integrated methodology with the eICU® system (VISICU Inc., Baltimore MD). This case report demonstrates the feasibility of a clinically relevant remote real-time echocardiographic interpretation strategy, utilizing commonly available equipment.

The views expressed in this abstract are those of the authors and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the U.S. Government.

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The growth of technology and its increasing ability for high volume data transmission is leading to an expansion of medical services via telemedicine. Many centers in remote locations have access to experts through video conferencing. Telecardiology in its simplest form involves telephonic consultation with an on-site physician relaying pertinent history, physical examination, and laboratory data, along with facsimile transmission of an electrocardiogram. In recent years the technology has advanced to include transmission of digital echocardiograms to assist in diagnostic evaluation. Tripler Army Medical Center (TAMC), a 250-bed tertiary care medical center located in Honolulu, Hawaii, has established a telehealth consultation service with the U.S. Navy Hospital (USNH) in Guam. This USNH is a forward deployed 30-bed hospital with six intensive care unit beds. Daily consultation rounds are held by physicians from the two facilities over a distance of over 3,300 miles using the eICU® solution (VISICU, Inc, Baltimore, MD). Typically these consultation rounds are held between general internal medicine or family medicine specialists at USNH Guam and critical care specialists at TAMC.

The eICU® system transmits and receives high volumes of video, audio, and primary physiologic monitoring data over Terrestrial-1 (T1) lines at a rates of up to 1544 kbits/second (Figure 1). This allows for high-resolution videoconferencing with video patient assessment. Additionally, real-time physiologic data, digital radiographic images, and electronic patient records are accessed via this system. The system is FDA 510(k) approved for marketing and is Health Insurance Portability and Accountability Act (HIPAA) compliant. The connection between these two facilities in Guam and Hawaii spans over 3800 miles, the greatest distance that has been reported using this technology.

Sine 2001 TAMC has utilized a "store and forward" telecardiology system with the USNH Guam. Echocardiograms performed on a routine basis in Guam are batched and transmitted to TAMC. Echocardiogram MEPG video images are forwarded over T1 lines, with transfer rates up to 1.54 Mbits/sec, and the NIPRNet (the "uNclassified but sensitive Internet Protocol Router Network" of Internet protocol routers used by the Department of Defense) for interpretation by TAMC cardiologists (Figure 2). Due to large file size (each echocardiogram is approximately 90-120 MBytes), file transfers only occur during off-duty hours, when there is reduced network traffic, to increase the efficiency of the synchronous transmission and decrease the loss of potentially vital information. Optimum transfer times occur from 00:00 to 06:00 Hawaii Standard Time and take between 10.8-14.4 minutes for complete file transfer. Given these constraints, there is an approximately 24-hour lag time for interpretation.

We report a unique application of the eICU® system, our initial attempt at a novel mode of tele-echocardiography. This telehealth consultative service link was employed in the care of a 55-year-old man with a history of prior myocardial infarction, prior percutaneous coronary intervention with unknown results, depressed left ventricular (LV) ejection fraction 25-30% in Feb 2004, hypertension, and cerebrovascular accident, who presented with chest pain. His symptoms were intermittent for 2 days, consisting of chest discomfort with a burning or tightness quality with radiation to the throat and left chest and arm, associated dyspnea, nausea, and diaphoresis. Symptoms were relieved with sublingual nitroglycerin. Upon evaluation in the emergency department, he was

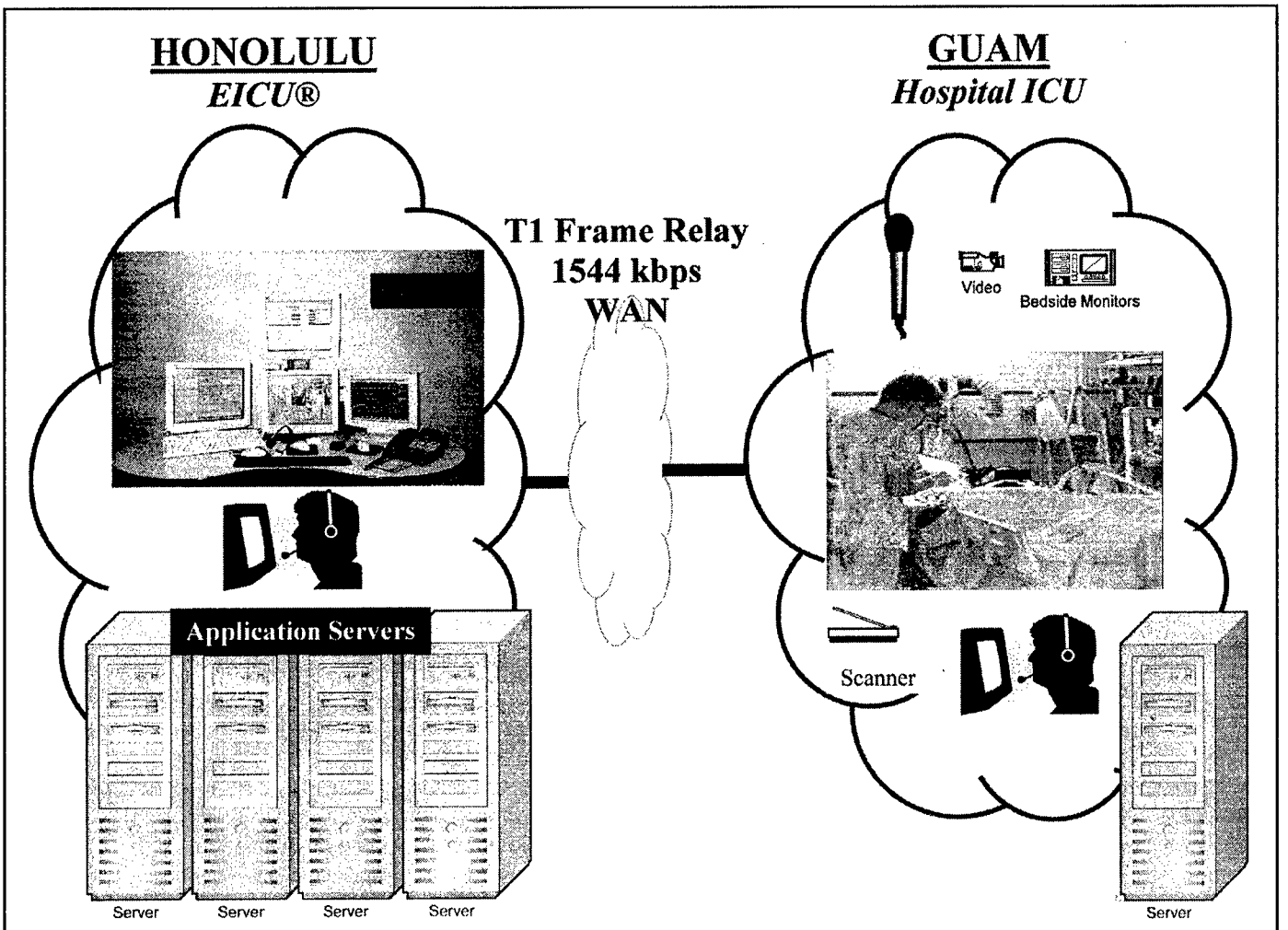

Figure 1.— System Diagram - eICU®

hypertensive to the 180s-190s/100s-110s, ECG without ischemic changes, showing normal sinus rhythm with 1st degree AV Block, and left ventricular hypertrophy. There was mild troponin I elevation to 0.68 ng/ml. During his hospital admission he had recurrent chest pain and was treated with intravenous nitroglycerin and morphine. Blood pressure and heart rte were controlled. The clinical presentation was consistent with demand related ischemia and due to his prior diagnosis of depressed LV function urgent cardiology consultation with echocardiogram was requested to evaluate current LV function and potential wall motion abnormalities to diagnose active myocardial ischemia.

At the USNH Guam in an eICU® monitored critical care bed , an echocardiogram was performed by an experienced technician, with the video camera (resolution 768 x 492 pixels) focused on the echocardiogram screen. There was real-time interpretation by a cardiologist in the TAMC e-ICU®, demonstrating preserved left ventricular systolic function with an ejection fraction of 50%, mild left ventricular hypertrophy, and an inferior and inferoseptal wall motion abnormality. Prior to the real-time bedside echo, physicians were hesitant to use negative inotropic agents due to the prior diagnosis of depressed LV function with EF of 25-30%. The echocardiographic interpretation facilitated with tailored medical management of hypertension. His symptoms improved with better blood pressure control and he was later risk stratified with a myocardial perfusion study, which showed a moderate-sized fixed transmural inferior wall defect compatible with infarction and consistent with the wall motion abnormality identified by our real-time echo. The same echocardiogram was then stored in the usual fashion and forwarded to TAMC for official interpretation. The final report of the echo was consistent with that of the initial live interpretation.

The e-ICU® has not been used for "real-time" echocardiogram interpretation previously. Although there was "real-time" interpretation of this echocardiogram, the equipment used has not been validated for use with tele-echocardiography. We acknowledge there are potential limitations with our current system. The capture rate of the camera, 32 frames/second (fps), is less than our current frames rates used to store and forward. Second, the gain required to make the image interpretable for live interpretation was significantly higher than our usual settings. In this case there was no appreciable difference in the interpretation of the live vs. store and forward echocardiogram; however, a subtle wall motion abnormality may have been missed at this frame rate. While stationary structures such as

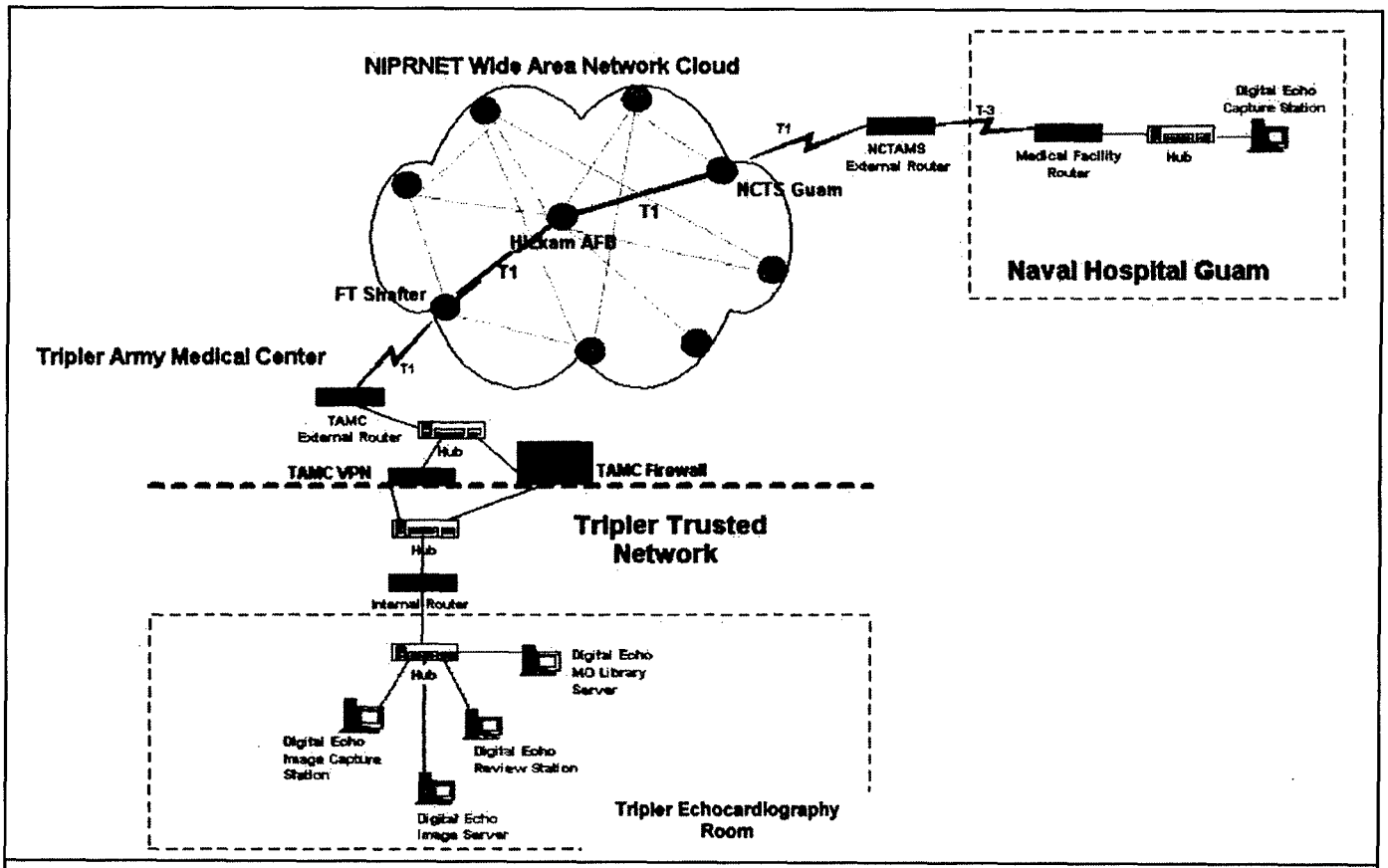

Figure 2.— Digital Echo-Cardiography-Tripler to Guam

pericardial effusions could be identified with our current real-time settings; the evaluation of mobile structures such as vegetations or contrast studies using agitated saline would require high resolution images with at least 60 fps for the most accurate evaluation.

Digital streaming video at the highest resolution and frame rate is not feasible at this time. Our current store and forward system uses MPEG-2 (Motion Pictures Expert Group) compression technology for a ratio of up to 50:1. Higher compression rates would decrease the file size and allow faster transfers, but may lead to further degradation in image quality that we have not explored. While the data lost may not be critical, this nonetheless remains an identified limitation. Another possibility is a directed echocardiogram, with short segments batched and then forwarded for interpretation. With these limitations stated we still remain optimistic about offering real-time echo for critically ill patients and hope to expand our services.

The potential applications for telecardiolgy is expansive. Adults and children with suspected or known heart disease are frequently cared for in remote intensive care units, emergency rooms and newborn nurseries, without immediate availability of cardiologists or other specialty trained providers. Essential information can be obtained via echocardiography including determination of congenital heart disease in neonates, pericardial effusions, severe valvular disease, wall motion abnormalities, and overall cardiac function[1]. In 1996, Trippi et al[2] investigated the clinical utility of interpreting after-hours urgent adult echocardiograms by an experienced technician through a telemedicine connection to on-call cardiologists. This study used standard telephone lines (14.4 Kbps) transmitting images to home laptop computers, and found 96-99% correlation in interpretation. There also was a decreased time for interpretation from the average 11.7 hours with the traditional method, to 2.1 hours with telemedicine. A Norwegian study evaluated remote echocardiography performed by an inexperienced technician or physician under the tele-guidance of specialist and found similar results between the remote exam and any repeat exam under normal circumstances[3]. This reliability will allow smaller hospitals to have access to specialist diagnostic capability.

In remote regions with widely dispersed populations networks of telemedicine have become essential to providing access to specialist care. These practices have been evaluated and found to be cost effective due to decreased hospital time and avoided transport costs. To a large health care system, these practices save money and time as well as extend care. The military and NASA are interested in using telemedicine to provide better care to their members and are in a unique position to do so because they already have many remote facilities that have excellent communications equipment but are limited in medical personnel. These techniques will allow specialist guidance and interpretation from the Space Station, the Antarctic base, or from forward deployed military units. As technology continues to improve and costs fall, expansion of these services and methodologies to additional applications of medical care seems inevitable. The specific technology is only important as far as questions of image and transmission quality, compatibility, and reliability are concerned. These telemedicine services are provided

using internet lines, ISDN lines, dedicated cables, and even with satellite phones[4]. Obstacles remain, however, with different formats, different standards, and many questions about legal and regulatory issues. These issues include questions such as patient privacy, questions of liability, licensure, quality assurance and oversight.

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Medical School Hotline

The University of Hawaii Telemedicine Project: A Web-based telemedicine curriculum for health care providers

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There are vast distances and geographic barriers to health care in the region of the world that is served by clinicians affiliated with the John A. Burns School of Medicine. This region, which includes over 30 million people[1] spread over an area larger than the continental United States, contains many rural and medically underserved communities with diverse medical problems.

Health care providers in rural areas are often trained in primary care, but in many areas lack immediate access to subspecialty and tertiary care that is necessary to treat the vast spectrum of pathology encountered. Factors that contribute to the shortage of health care providers in rural areas include geographic isolation and sparse populations, low reimbursement for medical services, high cost of living, limited educational opportunities for providers and their children, absence of interaction with the medical community and lack of access to current medical information. With modern technological capabilities and network infrastructure, telemedicine has emerged as a key tool in the primary care provider's black bag. With telemedicine, primary care providers and patients have access to expertise around the world. This medical tool requires training and specialized knowledge to operate successfully.

In keeping with its tradition of innovation, the John A. Burns School of Medicine is creating an on-line self-paced teaching curriculum for medical providers to learn the practice and principles of telemedicine. This curriculum is available to practitioners via the Internet, obviating the need to disrupt continuity of care to travel to a central site for training. The US federal government funds this effort, under the direction of the University of Hawaii Telemedicine Project[2] (UHTP). The UHTP, in developing content for the curriculum, is also engaged in facilitating telemedicine initiatives in the State of Hawaii and Pacific Rim. UHTP activities combined with other related funding activities have included the following: aging related research, hypoxia and high altitude research, telepsychiatry, teledermatology, teleradiology, bioterrorism surveillance, and international videoteleconferencing, Internet 2 applications, and simulation and virtual reality.

The primary deliverable of the UHTP, under the cooperative agreement with the Telemedicine and Advanced Technologies Research Center (TATRC), is the web-based curriculum. Currently, there are over 30 users, a mix of civilian and military physicians, graduate students, technologists, speech pathologists, and other allied health care clinicians. Many of these users are co-developers of the curriculum which highlights the cooperative effort of this concise, timely, and relevant curriculum.

There are six completed modules with four more under development. Each module is carefully reviewed for pertinence and accuracy of content, clarity of presentation, and ease of navigation. Modules are logically organized with focused learning objectives, quizzes, discussion boards, and extensive use of multimedia to simplify and demonstrate technical concepts.

Module one covers the fundamentals of telemedicine. This includes basic definitions, clinical applications, and implementation issues. Module two discusses the underlying technology and physical environment issues that are at play within telemedicine, and how to maximize them to best advantage. Module three provides step-by-step guidance on how to perform a telemedicine visit. Module four reviews organizational and management issues as they relate to the implementation of a telemedicine service. Module five provides three different clinical scenarios to get learners to think about different environments, technologies, and uses of telemedicine. module six uses audiology and balance assessment as a case study in telemedicine, to demonstrate many underlying principles brought up in previous modules.

Modules seven through ten are under development. These modules will extend the foundation of understanding principles of telemedicine, as put forth in modules one through six. Module seven will discuss in depth the different modalities available for telemedicine. Module eight will focus on use of telemedicine in emergency situations encountered by first responders. Module nine will describe the uses of simulation and virtual reality, and how these are being used in medical training. Module ten is for patient education aimed at providing a tool kit for providers to educate patients undergoing telemedicine encounters. The role of outpatient monitoring and its role in patient education and disease management will also be discussed.

With the curriculum nearing completion, providers in military and civilian sectors will have access to an educational experience that will open up their access to medical expertise around the world through telemedicine. This curriculum has the potential to facilitate better care for specific clinical problems in both urban and rural settings, as well as deliver care to rural-remote areas with real shortages in health care. The curriculum will be available for use for just-in-time training, integration into a larger program on technology in medicine, or as a stand-alone resource.

To learn more about the UH Telemedicine Project and review the curriculum, visit the website at www.uhtelemed.hawaii.edu.

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Research

Telehealth: Voice Therapy Using Telecommunications Technology

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Telehealth offers the potential to meet the needs of underserved populations in remote regions. The purpose of this study was a proof-of-concept to determine whether voice therapy can be delivered effectively remotely. Treatment outcomes were evaluated for a vocal rehabilitation protocol delivered under 2 conditions: with the patient and clinician interacting within the same room (conventional group) and with the patient and clinician in separate rooms, interacting in real time via a hard-wired video camera and monitor (video teleconference group). Seventy-two patients with voice disorders served as participants. Based on evaluation by otolaryngologists, 31 participants were diagnosed with vocal nodules, 29 were diagnosed with edema, 9 were diagnosed with unilateral vocal fold paralysis, and 3 presented with vocal hyperfunction with no laryngeal pathology. Fifty-one participants (71%) completed the vocal rehabilitation protocol. Outcome measures included perceptual judgments of voice quality, acoustic analyses of voice, patient satisfaction ratings, and fiber-optic laryngoscopy. There were no differences in outcome measures between the conventional group and the remote video teleconference group. Participants in both groups showed positive changes on all outcome measures after completing the vocal rehabilitation protocol. Reasons for participants discontinuing therapy prematurely provided support for the telehealth model of service delivery.

Key Words: telehealth, voice therapy, telepractice

Approximately 14 million individuals in the United States have a speech, voice, or language disorder (National Institute on Deafness and Other Communication Disorders, 1995). Without proper diagnosis and treatment, an affected individual's learning abilities, employment opportunities—and ultimately, standard of living—could be severely impaired. Therefore, the provision of quality speech-language pathology services is critical. However, availability of and accessibility to care are problematic for individuals who live in remote areas (American Speech-Language-Hearing Association [ASHA], 1991).

The problem of accessibility to speech-language pathology services is particularly acute in the Pacific Rim. Diagnostic and rehabilitative services are provided in the Speech Pathology Clinic at Tripler Army Medical Center (TAMC) in Honolulu, Hawaii, for a patient population that comes from a widely dispersed geographic area. TAMC is a tertiary referral center for military medical treatment facilities located in remote areas of the Pacific Rim, including Japan and Korea. In addition, civilian patients from Pacific island nations, such as Majuro and Chuuk, are referred to TAMC under a federally funded program (Burgess et al., 1999). This patient population is presently transported to TAMC for voice therapy.

Otolaryngologists at remote site clinics refer patients with voice disorders for consultations with speech-language pathologists at TAMC. However, services have not been optimal. In addition to transportation costs

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incurred for all medical evacuations, these patients have generally been seen for a period of less than 2 weeks. Follow-up has been inconsistent because options have been limited to periodic telephone calls, e-mail, or a return flight to Honolulu. Outcomes of treatment have been compromised because of the patients' geographic distance from TAMC. There is a need to provide effective follow-up care, particularly for active duty patients who are required to use their voice to accomplish their mission and whose vocal well-being affects public safety.

Many of these problems can be resolved by implementing telemedicine treatment protocols. Telemedicine is defined as the use of telecommunications technologies to provide medical information and services (Perednia & Allen, 1995). Telemedicine evolved into telehealth with the passing of the 1997 Comprehensive Telehealth Act, which expanded the focus from physician-only services to services provided by other health professionals including speech-language pathologists (ASHA, 1998). Telepractice refers to the application of technology to deliver health services at a distance by linking clinician and patient or clinician and clinician to provide training, counseling, education, assessment, intervention, or remote support and training of practitioners (ASHA, 2001).

The application of telemedicine technology has been explored in numerous medical specialties including but not limited to radiology, dermatology, oncology, cardiology, surgery, psychiatry, psychology, otolaryngology, ophthalmology, pulmonology, rehabilitation, and home health care. At this time, teleradiology is probably the most common and successful application of telemedicine. Digital radiology allows access despite geographical distance and significantly increases efficiency. Web-based software allows access to films through personal computers from any location, with sufficient quality for most consultative needs (Burgess et al., 1999).

Burgess et al. (1999) described a stepwise process used to develop a comprehensive otolaryngology–head and neck surgery service, including audiology and speech-language pathology that embraces technological advancements for both enhanced patient care and resident education. The approach includes (a) needs assessment or problem definition to examine what part of the practice would lend itself to telemedicine deployment, (b) usability studies to select the best equipment for the problem, (c) proof-of-concept in-house investigation to study the problem in a highly controlled environment and normalize technology to the current standard of care, and (d) deployment of remote units to validate in-house data if the advance being studied involves transmission of data.

ASHA has identified the use of Web-based and advanced technology as a focused initiative for 2001 to 2003. In December, 2001, the ASHA National Office Telepractice Team published a report on "Telepractices and ASHA" that includes (a) an overview of telepractices; (b) a synopsis of previous ASHA activities in the telepractices arena; (c) issues that need to be addressed, including licensure, reimbursement, ethics, liability, and education; (d) a view of current telepractice applications; (e) a vision of possible future applications; and (e) recommendations for positioning ASHA, its members, and those whom we serve to be able to fully benefit from telepractice services.

To fulfill the potential that technology offers in delivering speech-language pathology services remotely, clinical protocols must be developed and matched with technical requirements to ensure accurate diagnoses and effective treatment. Telehealth services need to be empirically validated, and evidence-based telehealth practice guidelines need to be established. Issues related to ethics, credentialing, and reimbursement must be addressed. If these challenges are met, personnel and geographic barriers inherent in providing care to underserved populations in remote areas can be overcome, work efficiency can be increased, and costs for accessing and providing care can be reduced.

Although there have been several successful studies of remote speech-language evaluation and diagnosis (Duffy, Werven, & Aronson, 1997; Werven & Duffy, 1994), there have been few investigations of remote delivery of therapy. Most attempts have been demonstration projects rather than empirical studies designed to compare outcomes of remote therapy with that of conventional practice. Our goal was to perform voice therapy in-house through a real-time video monitoring system and to compare outcomes to conventionally treated patients. If outcomes are equal, the telehealth model of providing voice therapy could be investigated from remote sites.

Method

Participants

Seventy-two patients with voice disorders referred to the TAMC Speech Pathology Clinic served as participants. Based on evaluation by otolaryngologists, 31 participants were diagnosed with vocal nodules, 29 were diagnosed with edema, 9 were diagnosed with unilateral vocal fold paralysis, and 3 presented with vocal hyperfunction with no laryngeal pathology. A total of 34 males and 38 females with a mean age of 45 years enrolled in the study. Participants were matched according to diagnostic category and were randomly assigned to either the conventional group or the remote video teleconference (VTC) group as they enrolled in the study. Although it would have been ideal to match the groups for participant age, gender, and etiology, this was not possible. Voluntary discontinuation of therapy also contributed to an imbalance between the groups.

Evaluation and Therapy

The study protocol was approved by the TAMC Human Use Committee and investigators adhered to the policies for protection of human subjects. After agreeing to participate in the study, each volunteer participant signed an informed consent form. All participants were seen for a voice evaluation. Pretreatment baseline data were collected at the time of the evaluation and included case history, voice self-rating scale on severity and functional consequences of the voice disorder, acoustic analysis of voice samples on the Visi-Pitch II (Kay Elemetrics, 1996b), and audio recording of voice samples. Voice evaluation and therapy sessions were conducted by the first author.

Participants were seen by an otolaryngologist for laryngoscopic exams before enrollment in therapy. All participants were scheduled for individual voice therapy. Participants in the conventional group received therapy conducted with the clinician in the same room. Participants in the remote VTC group received therapy conducted with the clinician in an adjacent room interacting via a real-time audio–video monitoring system. This system consisted of Sony Hi-8 video cameras with remote lapel microphones, a 27 in. ProScan color monitor in the clinician's suite, and a 21 in. JVC color monitor in the therapy room. A Kay Elemetrics (1996a) MultiSpeech Signal Analysis Workstation (Model 3700, Version 1.20) was used to provide acoustic and perceptual feedback. In the remote VTC group, the MultiSpeech application was shared via Microsoft's (1999) Windows NetMeeting (Version 3.01) software on a Compaq Presario laptop computer in the clinician's suite and an IBM Aptiva in the therapy room, consisting of a Pentium 233MMX processor and 48 MB of RAM. A Creative Labs Soundblaster AWE64 soundcard was used. The IBM monitor had built-in speakers, and a Cambridge Works 4 in. powered speaker was used as the woofer. There were numerous utility programs running in the background, including Norton Antivirus v5.0 and scheduler, 3Com's NIC Diagnostic Utility Version 1.0, Voyetra Audiostation Mixer, Microsoft Find Fast, and System Agent. With these utilities running, about 80% of the memory was available for other programs.

Treatment methods and facilitating techniques were the same for both the conventional and remote VTC groups. The only accommodation in treatment protocols for both groups was that written handouts including diagrams and vocal exercises were used to supplement oral instructions, and laryngeal manipulation techniques were excluded. The vocal rehabilitation protocol incorporated facilitating voice therapy techniques (Boone, 1982; Boone & McFarlane, 2000) including focus, establishing a new pitch, yawn–sigh, glottal attack changes, open-mouth approach, pitch inflections, and chant talk. "Confidential voice" (Colton & Casper, 1996) was used in addition with participants diagnosed with vocal nodules. Vocal function exercises (Stemple, Glaze, & Gerdeman, 1995) were used with participants who presented with vocal fold paralysis. All vocal rehabilitation programs included an explanation of the problem and vocal hygiene counseling. All participants with posterior laryngeal edema were instructed on behavioral, lifestyle, and diet management strategies for laryngopharyngeal reflux and monitored for compliance with omeprazole therapy as prescribed by the otolaryngologist. None of the participants with vocal fold paralysis or vocal nodules received surgical intervention during the course of therapy. According to Boone's (1974) criteria, participants were discharged from therapy if (a) their self-reported voice quality improved in most settings, (b) they reported less discomfort associated with prolonged voice use, (c) laryngeal lesion (if any) was reduced in size or was no longer present, (d) laryngeal edema was reduced or resolved, or (e) there was no noticeable improvement. None of the participants was involuntarily terminated from the study. Posttreatment data were collected in the clinic from participants upon discharge from therapy. All therapy sessions for the remote VTC participants were delivered in adjacent rooms and face-to-face contact was minimized as much as possible during the course of the treatment protocol. Nevertheless, because this in-house proof-of-concept study was conducted within the medical center, it was difficult to avoid informal interactions with the participants in the remote VTC group.

Data Analysis

Perceptual Judgments of Voice Quality. Voice samples in conversational speech were recorded with a Sony TCM-5000EV audiocassette recorder and Sony F-V610 microphone during the voice evaluation (pretreatment) and after completing the rehabilitation protocol (posttreatment). The pre- and posttreatment samples for each participant were randomly presented in the first or second position of the pair. Two ASHA-certified, licensed speech-language pathologists, each with over 20 years of experience in diagnosing and treating voice disorders, listened to each pair of recordings twice to determine which of the two reflected better voice quality. Neither of the speech-language pathologists conducted evaluation or therapy with the participant population. The samples were presented free field with a Sony CFD-110 CD Radio Cassette-Corder. After all of the samples were rated, 10 pairs were randomly selected and presented to assess intrarater reliability.

Acoustic Analysis. Live voice samples of sustained /a/ at comfortable pitch and loudness levels were captured and analyzed on the Visi-Pitch II, Model 3300 according to procedures described in the Visi-Pitch II Instruction Manual (Kay Elemetrics, 1996b). Pre- and posttreatment jitter (relative average perturbation) and shimmer (dB) were compared.

Patient Satisfaction Ratings. Participants rated their perception of how much their voice improved over the course of treatment on a 6-point Likert scale (1 = *not at all* to 6 = *maximally*). Participants also rated 10 statements on the process and outcome of voice therapy on a 5-point Likert scale (1 = *positive response* to 5 = *negative response*) from a questionnaire based on functional measures developed by ASHA (1989, 1997). In addition to rating their contentment with services and treatment outcomes, the participants were invited to provide written feedback on the mode of interacting with the clinician.

Fiber-Optic Laryngoscopy. To assess physiological effects of voice therapy, pre- and posttreatment laryngoscopic examinations were compared. A board-certified otolaryngologist performed pre- and posttreatment fiber-optic nasendoscopy with an Olympus NEF Type P3 flexible nasendoscope connected to an Olympus CLV-U20 light source and Olympus OTV-S4 digital signal processing system and recorded on a Sony SVHS SVO-9500MD videocassette recorder. The exams were copied onto compact disks on the Clark TUT Image Capture and Processing System (Clark Research and Development, Inc., Folsom, LA). Pairs of recordings were presented simultaneously, side by side, in random order on the Clark TUT system for two board-certified otolaryngologists to rate

TABLE 1. Distribution of participants' diagnostic category, age range, and gender by group.

	Conventional		Remote VTC	
	Enrolled	Completed	Enrolled	Completed
Diagnostic category				
Nodules	13	9	18	9
Edema	15	11	14	10
Paralysis	5	5	4	4
Hyperfunction without pathology	3	3	0	0
Age range				
18–30	3	3	11	8
31–41	8	5	14	7
42–52	8	5	6	3
53–63	5	5	2	2
64–74	9	8	2	2
75–85	3	2	1	1
Gender				
Female	21	17	17	11
Male	15	11	19	12

Note. VTC = video teleconference.

which of the two represented better physical findings. Neither of these raters performed any of the fiber-optic nasendoscopy examinations. During the course of the study, the videocassette recorder malfunctioned and the clinic upgraded its imaging and recording equipment to the Kay Elemetrics Digital Video Stroboscopy system. To ensure objective comparisons, rating was limited to pre- and posttreatment exams recorded with the same equipment.

Results

Distribution of participant characteristics according to diagnostic category, age, and, gender is displayed in Table 1. Of the 72 participants enrolled in the study, 51 (71%) completed the vocal rehabilitation protocol, 28 in the conventional group and 23 in the remote VTC group. The average number of sessions to complete the protocol was 5.7, the mean duration of each session was 30 min, and the median length of time from enrollment to discharge was 9 weeks. Although every attempt was made to obtain all four posttreatment measures on all participants, it was not always possible because of equipment changes and relocation of participants before their posttreatment reevaluation. Data for all four outcome measures were obtained from 25 participants and data for three out of four outcome measures were obtained from 20 participants. Data for two outcome measures were obtained from 3 participants, and data for one outcome measure were obtained from 3 participants.

Perceptual Judgments of Voice Quality

Two speech-language pathologists independently identified the voice sample exhibiting better voice quality from the randomly paired pre- and posttreatment voice samples of 47 participants. Agreement between the two raters on which voice sample was better was 92% within the conventional group, 86% within the remote VTC group, and 89% across both groups. There was no statistical difference between the distributions of ratings between the two raters, $\chi^2(1, N = 94) = 0.123$, $p < .726$. For the subset of 10 voice samples that were rated by each speech-language pathologist a second time, there was an 90% agreement between the first rating and the second rating for each rater.

TABLE 2. Distribution of voice samples rated by two speech-language pathologists as exhibiting better voice quality by pretreatment, posttreatment, and group.

	Voice Quality Outcome		
Group	Pretreatment	Posttreatment	Total
Conventional	6	44	50
Remote VTC	3	41	44
Total	9	85	94

The distribution of pre- and posttreatment voice samples that were determined to be better by both raters is displayed in Table 2. Posttreatment voice samples were rated as better than pretreatment samples for 90% of participants. This was statistically significant, $\chi^2(1, N = 94) = 61.447$, $p < .000$. There were no differences in the perceptual ratings between the two groups (i.e., conventional vs. remote VTC therapy), $\chi^2(1, N = 94) = 0.726$, $p < .394$. There were also no differences in perceptual ratings between the etiologies (i.e., edema, nodules, paralysis, and hyperfunction with no pathology), $\chi^2(3, N = 94) = 6.006$, $p < .111$.

Acoustic Analysis

Pre- and posttreatment acoustic measures were obtained from 47 of the 51 participants who completed voice therapy. Pretreatment jitter measures were above 1.0% for 77% of participants in the conventional group and for 52% of participants in the remote VTC group. Ninety-six percent of participants in the conventional group and 90% of participants in the remote VTC group obtained posttreatment jitter measures that were below 1.0%. One hundred percent of participants in the conventional group and 90% of participants in the remote VTC group had lower posttreatment jitter measures than pretreatment jitter measures. The mean jitter score, standard deviations, and sample size for each group are displayed in Table 3.

TABLE 3. Means, standard deviations, and sample size for jitter scores (%) by group by pre- and posttreatment.

	Pretreatment			Posttreatment		
Group	*M*	*SD*	*n*	*M*	*SD*	*n*
Conventional	2.493	1.563	26	0.547	0.380	26
Remote VTC	1.896	1.680	21	0.694	1.016	21

TABLE 4. Means, standard deviations, and sample size for shimmer scores (dB) by group by pre- and posttreatment.

	Pretreatment			Posttreatment		
Group	*M*	*SD*	*n*	*M*	*SD*	*n*
Conventional	0.800	0.418	26	0.519	0.304	26
Remote VTC	0.934	0.661	21	0.590	0.279	21

A two-way analysis of variance between groups (conventional vs. remote VTC therapy) and test (pre- and posttreatment) on the jitter scores showed no differences between the groups $F(1, 90) = 0.747, p < .390$. There was a significant difference, however, between the pre- and posttreatment scores, $F(1, 90) = 36.547, p < .000$. The estimated effect size for the pre- and posttreatment jitter scores (0.29) was small (Cohen, 1988). The interaction between group and test was nonsignificant.

Pretreatment shimmer measures were above 0.5 dB for 73% of participants in the conventional group and 76% of participants in the remote VTC group. Sixty-two percent of participants in the conventional group and 43% of participants in the remote VTC group obtained posttreatment shimmer measures that were below 0.5 dB. One participant showed no change in pre- and posttreatment shimmer measures. Eighty-one percent of participants in the conventional group and 71% of participants in the remote VTC group had lower posttreatment shimmer measures than pretreatment shimmer measures. The mean shimmer score, standard deviations, and sample size for each group (conventional vs. remote VTC therapy) and test (pre- and posttreatment) are displayed in Table 4.

A two-way analysis of variance between groups (conventional vs. remote VTC therapy) and test (pre- and posttreatment) on the shimmer scores showed no differences between the groups, $F(1, 90) = 1.283, p < .260$. There was a significant difference, however, between the pre- and posttreatment scores, $F(1, 90) = 12.032, p < .001$. The estimated effect size for the pre- and posttreatment shimmer scores (0.12) was small (Cohen, 1988). The interaction between group and test was nonsignificant.

Patient Satisfaction Ratings

Forty-nine participants completed ratings of perceived voice improvement and 47 participants completed ratings of the process and outcome of voice therapy. An analysis of voice improvement ratings showed no difference between the groups (i.e., conventional vs. remote VTC), $\chi^2(5, N = 49) = 5.532, p < .354$. The overall mean for both groups was 5.24 on a scale from 1 = *not at all* to 6 = *maximally*, indicating that on average, participants in both groups felt that their voices improved considerably with therapy.

Patient satisfaction ratings on the process and outcome of voice therapy were rated on a 5-point scale (1 = *positive response* to 5 = *negative response*). The mean process and outcome of voice therapy ratings, standard deviations, and sample size for each group (conventional vs. remote VTC) are displayed in Table 5. None of the 10 statements on the process and outcome of voice therapy were rated significantly different between the groups (i.e., conventional and remote VTC). The overall mean ratings on the 10 statements ranged from 1.00 to 1.68, indicating a generally positive response to services provided and outcome of therapy. Participants in both groups were equally satisfied with therapy. All 16 of the 16 comments on the telehealth mode of interaction were positive.

Fiber-Optic Laryngoscopy

Two board certified otolaryngologists independently identified the laryngeal recording that exhibited better physical findings from the randomly paired pre- and posttreatment recordings of 25 participants. Neither otolaryngologist performed any of the initial fiber-optic nasendoscopy examinations. Agreement between the two raters on which laryngeal recording exhibited better physical findings was 72%. There was no statistical difference between the distribution of ratings between the two otolaryngologists, $\chi^2(1, N = 50) = 0.136, p < .713$.

The distribution of pre- and posttreatment fiber-optic laryngeal recordings that were rated as better is displayed in Table 6. Posttreatment fiber-optic laryngeal recordings

TABLE 5. Means, standard deviations, and sample size for patient satisfaction ratings (1 = *positive response* and 5 = *negative response*) on the process and outcome of voice therapy by group.

	Conventional			Remote VTC		
	M	*SD*	*n*	*M*	*SD*	*n*
The services addressed my needs.	1.04	0.20	25	1.09	0.29	22
The services were explained to me in a way that I could understand.	1.00	0.00	25	1.00	0.00	22
The clinician was experienced and knowledgeable.	1.00	0.00	25	1.00	0.00	22
The clinician was sympathetic to my problem.	1.00	0.00	25	1.00	0.00	22
I feel I have benefited from speech-language pathology services.	1.04	0.20	25	1.00	0.00	22
I would recommend TAMC's Speech Pathology services to others.	1.04	0.20	25	1.00	0.00	22
The quality of my voice has improved as a result of therapy.	1.20	0.41	25	1.14	0.35	22
My voice sounds better now in most speech situations than before therapy.	1.20	0.41	25	1.09	0.29	22
My voice does not give out after I talk for more than 30 minutes.	1.68	0.95	25	1.45	0.67	22
I feel I have less fatigue, dryness, tightness, or discomfort in my throat as a result of using voice therapy techniques.	1.21	0.55	25	1.50	0.96	22

TABLE 6. Distribution of fiber-optic laryngeal recordings rated by two otolaryngologists as exhibiting better physical findings by pre- and posttreatment and group.

Group	Laryngeal Recordings Outcome		
	Pretreatment	Posttreatment	Total
Conventional	3	21	24
Remote VTC	6	20	26
Total	9	41	50

were rated as better for 82% of the participants. This was a statistically significant difference, $\chi^2(1, N = 50) = 20.480$, $p < .000$. There were no differences in the pre- and posttreatment laryngeal ratings between the two groups (i.e., conventional vs. remote VTC), $\chi^2(1, N = 50) = 0.946$, $p < .331$. There were also no differences in pre- and posttreatment laryngeal ratings between the etiologies (i.e., edema, nodules, paralysis, and hyperfunction with no pathology), $\chi^2(3, N = 50) = 7.129$, $p < .068$. The forced-choice paradigm may possibly have skewed these results; however, the overwhelming preponderance of posttreatment samples rated as improved, and no difference between conventional and remote VTC ratings mitigates against this interpretation.

A review of medical records was conducted for 10 participants who were not included in the blind comparisons of laryngoscopic exams. Based on the otolaryngologists' interpretation on written encounter forms of pre- and posttreatment laryngeal exams, 9 out of 10 records documented positive changes, and 1 showed no change. Of the 9 participants whose posttreatment exams showed improvement, 3 were in the remote VTC group and 6 were in the conventional group.

Discussion

This study investigated the telehealth model of delivering voice therapy. It was a proof-of-concept in-house investigation to study the problem in a highly controlled environment. Participants in the remote VTC group received therapy conducted with the clinician in an adjacent room, interacting via a real-time video monitoring system using PC-based telecommunications and speech analysis software, whereas participants in the conventional group received therapy conducted with the clinician in the same room. The results indicated that voice therapy delivered remotely was as effective as therapy delivered conventionally.

Completion of the voice rehabilitation protocol required a commitment from participants to attend therapy sessions on a regular basis. The majority of reasons for discontinuing therapy before completion of the protocol provide support for the telehealth model. Of the 21 participants who did not complete the vocal rehabilitation protocol, 12 (57%) were active duty military personnel who had difficulty keeping regular appointments because of deployments, work schedules, and relocations to new duty stations. Of the remaining 9 participants, 4 discontinued therapy because of their work schedules, 2 were military dependents who relocated to new duty stations with their active duty spouses, 2 had medical problems that took priority, and 1 discontinued therapy for unknown reasons. The use of telecommunications technology would have been helpful in overcoming the barrier of geographic distance during deployments and following relocations and in eliminating the commute time to our institution, which interfered with work schedules. Of the 12 participants who were retired persons, 11 completed the protocol, but 1 was unable to keep appointments after an injury from a fall. Telehealth would have enabled continuation of treatment for this participant, who was active in community service and motivated to improve her voice for a speech she was scheduled to present at a national convention. The physical and structural barriers of needing the patient and healthcare provider to be in the same location would have been overcome.

In addition to improving access to services for patients who are homebound because of physical disabilities, telehealth allows clinicians to provide care in the patient's natural, or least restrictive, environment and to increase participation of family members. What better place to communicate than in the home with family members and significant others instead of a clinic or a large medical center? Assessment and treatment can be conducted in a more ecologically valid context. For clinicians, this can be accomplished without the need to travel great distances to see patients in home-care settings (Mashima, Birkmire-Peters, Holtel, & Syms, 1999).

When treatment is provided over an extended period of time as in voice therapy, relocation presents a problem not only for the military population but for the general population as well. Telehealth would enable clinicians to follow their patients remotely. If procedures need to be performed in the traditional mode, the referring clinician can consult and collaborate with a clinician at the remote site to maximize outcomes. Furthermore, telehealth provides opportunities to enhance patient care. Master clinicians can be consulted remotely on difficult cases.

As in-home Internet connectivity with high speed communication becomes commonplace and cost requirements are reduced significantly by technological advances, the benefits of telehealth or eHealth will extend beyond resolving problems of distance from a medical facility. Although the impetus for this telehealth research was to increase the availability of and accessibility to speech-language pathology services for patients in remote sites, many participants stated that they would welcome the opportunity to receive therapy remotely if it were possible, regardless of their distance from our institution, because of the convenience and time savings. The return on investment is significant in terms of quantitative and qualitative benefits to patients and healthcare providers.

When considering barriers to overcome, the psychological barrier of resisting change and breaking out of tradition cannot be ignored. This barrier included concern for how receptive participants would be to not having the clinician in the same room and apprehension about how user-friendly the computer would be perceived by participants. The results of this study indicated that rapport with patients

was not impaired in the distance mode. Although several participants reported that they preferred to interact with the clinician face to face, they did not feel the distance mode reduced the effectiveness of therapy. Three participants had cameras interfaced with their personal computers and said they would have requested to participate in the study from their home if it had been possible. Two participants in the VTC group between the ages of 65 and 80 years routinely used e-mail to communicate with family and friends. These elderly participants were not intimidated by computers and frequently discussed their interest in the application of technology to the delivery of healthcare services.

In addition to rating contentment with services and treatment outcomes, participants were invited to provide feedback on the mode of interacting with the clinician. Subjective comments specific to the telehealth model of service delivery were positive in 16 out of 16 responses, as evidenced by the following:

> "It's the best effort of having a one-on-one relationship with the clinician that would otherwise not be available to those of us who serve at sea or away from a medical facility. The program was very helpful and user friendly."

> "Talking face-to-face for me is preferred, but my progress wasn't hindered by the use of video at all. I'd say it's an effective and good alternative if face-to-face therapy isn't feasible."

> "I feel the research project would be very valuable in treating patients in remote areas who might otherwise have to go without treatment or be brought from areas that would be very costly. This program is also a way for doctors to follow their patients even after they've PCS'd [relocated] to another location."

> "The video sessions were just as good. It made it more interesting to see technology playing a part in medical sessions."

Clinical Applications

The potential impact of telehealth on speech-language pathology is tremendous. The challenge for clinician–researchers is to determine which diagnostic and therapeutic procedures are adaptable to distance interaction and which are not, and to identify which clinical populations are appropriate to evaluate and treat remotely and which are not. For example, manual circumlaryngeal techniques would not be an option in treating muscle tension dysphonia remotely because it requires the clinician to palpate and manipulate the patient's larynx. On the other hand, vocal rehabilitation counseling to eliminate phonotraumatic behaviors has good potential to be accomplished successfully remotely. Patients with severe cognitive impairments or attention deficits may have difficulty with the distance interaction mode. Furthermore, the telehealth model may be more appropriate at different phases of therapy. If therapy techniques must be established in the traditional model of clinical interaction, perhaps generalization and maintenance could be facilitated and monitored remotely.

A second phase of this study is planned to provide voice therapy remotely using the existing infrastructure at TAMC and outlying clinics to evaluate technical acceptability, operational effectiveness, and clinical appropriateness. Deployment of services to remote workstations will enable investigators to determine acceptable technical specifications within which voice therapy can be successfully accomplished over telecommunications links. In the foreseeable future, it will be possible to conduct therapy sessions in patients' homes. The potential of in-home applications includes using cable network capabilities and personal computers with software programs that enable the sending and receiving of video, audio, and text over the Internet. For patients who do not have the necessary hardware available in their homes, clinics can maintain a supply of equipment to loan for the duration of treatment.

Conclusion

This study compared the telehealth model with the conventional model of delivering voice therapy. In this investigation no significant differences were found between remotely and conventionally delivered voice therapy for the following outcomes: perception of voice quality, acoustic changes, patient satisfaction, and laryngeal changes. As expected, however, there were significant differences between pretherapy and posttherapy measures of these same outcomes for both groups.

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DRAFT – NOT FOR CITATION

The successful integration of telemedicine into the Chronic Disease Model in a rural setting

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The health care system is relatively slow in adopting new technology. In an age where we can access almost unlimited information, interact with friends and strangers, and manage most of financial transaction, medical services provision is almost non-existence. Efforts to improve care, increase access and exploit new technology has met with substantial resistance and often failed. Telemedicine initially promised to improve communication and access to care. Even though there have been notable success and acceptance of certain technologies such as digital imagine, projects focused on video conferencing have often not proving to be viable beyond the funding. There are a number of barriers to the sustainability of telemedicine through video conferencing. The lack of system changes to maximize efficiency and compensation are major factors. Providers and patients acceptance appears to be a second barrier leading to the demise of a number of projects.

The care for patients with chronic disease is relatively ineffective and inefficient. The science provides evidence as to best practices, but population based studies repeatedly show a majority of the patients receive less than quality care. Even the best centers for diabetes care fail to achieve desirable intermediate outcomes for many patients. The NHANES data found that only 27% of patients with hypertension have acceptable blood pressure control. (JNC VI) The system of health care is recognized as a major barrier in the delivery of effective chronic disease care. The chronic disease model addresses the major weaknesses in the existing system and provides a structure that promotes system changes and improved care. (Ed Wagner)

Chronic disease management in rural American faces major barriers beyond those inherent in the health care delivery system. The rural areas lack resources and experts to effectively management patients with chronic illness. Contact with specialists is often infrequent and lacks coordination. The chronic disease model requires an integrated team approach to care with a focus on patient self management. Patients often find themselves learning aspects self-management independent of the health care system due to the relative lack of secondary and tertiary care.

Using the chronic disease model and concept of the rapid change model developed by the Institute of Healthcare Improvement, we implemented a program for diabetes care in a rural health system that used telemedicine an integral part of the evolving delivery system. Through both the use of video-conferencing and a web-based application, the program supports team development, improves patient access and monitors care and outcomes.

Site: Hana is a rural community on the island of Maui that is approximately 2 ½ hours from the urban center and hospital. The population is over 2000 people with 62% Hawaiian or part Hawaiian. The principle and only major industry is tourism. Health care is provided by a single community health center that is staffed by physicians providing 24 hours a day coverage and 7 days a week. The community lost their primary care provider 2 and ½ years ago and is currently staffed by locums. The health center has single part time nurse with the rest of the clinical staff hired from the community with limited medical experience.
Methodology: The diabetes program was developed around the chronic disease model. The staff of the clinical was oriented to the rapid change model in the first two months of the program, but had not formal training from the Institute of Healthcare Improvement or other trainers. The staff had explicit understanding up the diabetes team. The diabetes expert had face to face patient visits every other week for one day with alternative tele-video visits with the distant site on Oahu.

The initial plans were to establish a doctor-patient relationship with the patients, set up self-management and care plans, and manage unstable patients with the face to face visits using the telemedicine for stable planned visits. All patients have the option to use the video conferencing or the telemedicine. The health center was hiring a permanent primary care physician and the original plan was to develop the team around the permanent physician with co-management of difficult patients or those who were unstable.

Initially, delivery design would use a diabetes flow sheet, but the patient tracking would be transferred to a web based application when it became available. In the meantime, pertinent medical records were faxed for the telemedicine video conferences. The web based application would eliminate or substantially reduce the need to fax.

The physician expert was paid by the health center for hours of patient contact either at the center or over telemedicine. Travel expenses and the cost of the phone lines were also paid for by the health center. Technical support for the project was provided from the University of Hawaii Telemedicine Program. There are no external funds for the program.

Results: The telemedicine component of the program was rapidly implemented starting a week after the first visit. The telemedicine visits have continued as scheduled since that time. The number of patients seen has varied from zero on days when patients have cancelled to 6 with the usual number between 2 and 3.

The initial acceptance of the video conferencing has waned. Initially, most patients were enthusiastic or accepting, but as the program evolved the novelty of the "television" has worn off. The majority of the patients have expressed a preference for face to face encounters. The concept of using the telemedicine for follow up visits for stable patients did not become feasible do to the patient's preference. Older patients with hearing, visual or memory problems do not do well with the video conferencing.

The telemedicine has been very effective in two distinct situations. When patient are unstable or require a change in treatment plans, telemedicine allows for one week follow-up. There have been several occasions where patients have had progressive heart failure, exacerbation of asthma or poorly controlled diabetes where one week follow-up has been critical for follow-up and management. When the patient has an unstable condition they have all been very willing and cooperative with telemedicine follow-up and prefer maintaining contact with specialty care rather than the health center physician.

The second situation where the video conferencing has been effective is when patients need increased time for evaluation or education. The videoconferencing allows scheduling for up to an hour of time. There are selected patients that preferentially schedule for telemedicine visits when they want additional time. The provider also has used the additional flexibility to extend a face to face visit. Again, it is important that the telemedicine visit is discussed with the patient prior to the visit. There has been a significant no show rate when the patient has been scheduled without the provider getting the patients willingness to participate.

Telemedicine visits have been used for initial visits on several occasions. This approach has been necessary when the onsite schedule has been fully booked. The initial plans called for initial face to face visits, but the telemedicine visit has worked well as long as the visit is followed up in a timely manner with a face to face visit. The novelty of the videoconferencing may partly account for the receptiveness of patients to see a new physician over video conferencing.

The Chronic disease model and clinical outcome: In conjunction with the introduction of the video conferencing, there has been significant changes and education at the health center. The system design changes have allowed for a greater focus on patient self management and adherence to practice standards. Specific changes are beyond the discussion in this article with a focus on telemedicine. The telemedicine has been introduced as a part of the system designs.

The following table shows the process and outcome measures for patients seen in the last 3 months after 15 months of the program. The measures are the clinical indicators for the ADA provider recognition program.

Demographics

	M	F
Sex	42%	58%

Age Distribution

	N	Percent
45-54	5	21%
55-64	6	25%
65-74	9	38%
75-84	4	17%

Results

	Frequecy	Hana N=24	ADA Rec	HI Hedis 2001
HbA1c	1 time/yr	**100%**	**93%**	**79%**
Proportion w/HbA1c < 8%	(most recent test)	**83%**	**55%**	
Proportion w/HbA1c > 9.5%	(most recent test)	**0**	**≤ 21%**	**51%***
Eye exam	1 time/yr*	**54%**	**61%**	**56%**
Foot exam	1 time/yr	**71%**	**80%**	
Blood pressure frequency	1 time/yr	**100%**	**97%**	
Proportion < 140/90 mm Hg	(most recent test)	**75%**	**65%**	
Nephropathy assessment	1 time/yr	**100%**	**73%**	**53%**
Lipid profile	1 time/yr	**96%**	**85%**	**82%**
Proportion w/LDL < 130 mg/dl	(most recent test)	**75%**	**63%**	**49%**

Additional Results

Measures	Hana N=24
2 A1c in year	83%
ACE	83%
Statin	67%
ASA	88%
Flu	58%
Pneu	83%

Discussion: People in rural communities face significant problems in accessing quality health care. As exemplified by the Hana community there are problems in recruiting and retaining professional staff. In addition, they lack the knowledge and administrative support to make system changes to improve chronic disease care. Telemedicine has attempted to address these problems through setting up consultation services to increase access to secondary and tertiary care. Many of these programs have focused on using video conferencing to replace referrals to specialty care in urban centers. The technology has clearly improved access, but for a number of reasons, the programs have not had wide spread acceptance and sustainability.

The diabetes program at the Hana Community Health Center focused on changing the structure of care at the health center based on the chronic disease model. The telemedicine was introduced as an integral part of the program and a method to increase specialty contact. Using the chronic disease model, the system of care at the Hana Community Health Center was restructured to better address the needs of patients with diabetes. The introduction and application of tele-health was part of the larger system change implemented at the health center.

One of the key elements related to the sustained application of video conferencing was the relationship that the consultant developed with the patients through face to face visits. Many programs have focused on developing the doctor patient relationship over video conferencing. The doctor-patient relationship is a core component to improving care. Patients should not be expected to rapidly accept telemedicine as a way to develop a positive relationship with a provider. This concept is especially true in rural communities with cultural diversity such as Hana, but the same principle holds across most if not all setting where telemedicine might be effective.

A second component of building the diabetes program was the early and continued involvement of the staff and community. In a rural community, the employees of the

health center know most if not all the patients in the community. As the staff better comprehend the elements of good chronic disease management, so goes the community. The invested hours of staff education and involvement has lead to the total success of the program. The staff has continued to take a more active role in diabetes management. A single example is blood glucose monitoring. When the program started, patients occasionally got blood glucose checked as part of the visit and only by the RN. With a generous donation from Life Scan over 30 meters have been given to patients in the Hana community. Checking blood glucose is standard protocol for checking in patients and the staff has trained each other and the patients in the use of the home glucose monitoring.

The operation of the video conferencing has had a similar course. With the introduction of the video conferencing, selected staff has learned to use the equipment. The equipment has been used to communicate with the staff and they have been encouraged to get other staff involved. Even though there has been staff turnover, the knowledge of the use of the equipment and the comfort at video conferencing has been continued. It is again a combination of the system change and the development of an inclusive team in the program including the video conferencing.

The use of the rapid change model has avoided being fixed on the initial concepts of the use of video conferencing. The program was initially conceived to support the primary care provider at the Hana Community Health Center and follow-up stable patients. The recruitment efforts have been difficult and the staff and patient feed back has demonstrated that long term follow-up visits are not acceptable in this community at this time. Through analysis of no-shows and re-scheduled visits for telemedicine days and listening to the comments of the staff and patients, the telemedicine visits are no longer scheduled for planned stable visits. Clearly, patients who are stable with limited need for physician contact prefer live planned visits. Medical necessity has lead to the use of the video conferencing for the acute and unstable patients. Video conferencing is frequently used with the dynamic or unsteady patient who requires frequent follow-up. Weekly follow-up is either accomplished over the video conferencing or co-managed with the locums.

Conclusion:

The use of telemedicine to improve specialty care in rural communities has had limited success for a number of reasons. The Hana Diabetes Program is effectively using telemedicine to improve care by using technology to enhance changes in the health care delivery system. Rather than attempting to use telemedicine in the traditional format of a consultation, but rather as an integral part of a program that emphasizes patient centered care, team work and systems changes the telemedicine component of the program is a vital and viable component to the larger program. Telemedicine frequently adds direct cost to the health care system. In the Hana Diabetes Program, the telemedicine costs are justified by the development of measures that clearly show increased quality. The second important component in sustaining the program is having the consultant paid by the health center rather than billing directly for the telemedicine services. Part of the system

change for improved health care requires aligning incentives. This compensation package does not fractionate the telemedicine from the rest of the program.

Telemedicine as an IS implementation problem: comparison of dynamics in the USA and India

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Abstract: The research reported here involved a longitudinal study, lasting three years, of the utilisation of an IS system designed to enhance the quality and accessibility of healthcare for the US military and their dependents. This study employed elements of a positivist methodology and an intensive research method. A discussion of the difficulties and conflicts inherent in multi-methodological studies is presented.

Findings indicate that low utilisation rates arose from a cultural mind set mismatch. This is compared to findings in India concerning the implementation of GIS systems [1]. The mismatch was between the cultural variables conducive to organisational learning found in the implementing organisation. The Primary Care Clinic yielded low organisational learning cultural variables that were non-conducive to rapid adoption of the new and intrusive IS technology.

Keywords: Telemedicine implementation; organisational learning; organisational culture.

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1 Introduction

This research involved a longitudinal study lasting nearly three years from Spring 1997 to Autumn 1999. During this period the authors played varying roles as researchers starting as 'independent observers' and slowly migrating to the role of action researchers. The project under study was the Theater-Telemedicine Prototype Project (T2P2). This project was an IS system which was part of a five year, 100 million dollar Department of Defense (DoD) initiative to employ modern IS and telecommunications technology to

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enhance the accessibility and quality of healthcare for servicemen and women and their dependents worldwide.

The Theater Telemedicine Prototype Project (T2P2) was a desktop multimedia e-mail medical consultation system that enabled healthcare providers to solve 'real-life' patient care problems across the widely distributed Pacific region. T2P2 was designed with a strong focus on clinical usability and benefited from the ongoing review and consultation of clinical practitioners in the field. It used web-based technology, integrated with medical peripheral devices, to extend medical specialist expertise to isolated locations throughout Hawai'i, Alaska, Korea and other remote islands. T2P2 was a product of the Department of Defense's Pacific Regional Program Office (PRPO) located at Tripler Army Medical Center on Oahu in Hawai'i.

Historically when a healthcare provider practising in a remote area encountered a patient condition that required the input of a specialist, the patient had to be evacuated to a major metropolitan area for specialist consultation. This practice extended the time before the patient could be treated and was extremely costly. T2P2 was a way to eliminate unnecessary medical evacuations (medevacs).

T2P2's initial definition and design began in May 1997. PRPO began assessing needs for telemedicine in the Pacific by evaluating the nature and distribution of medevacs across the region. A clinical team reviewed years of medical and logistical records to determine which sub-specialisms of care (e.g., cardiology, dermatology, orthopaedics), most often necessitated a medevac. Additionally, the referral patterns within each sub-specialism were evaluated to identify the specific medical conditions most likely to be encountered.

Following this initial assessment, efforts focused on the definition of clinical 'protocols' to identify the specific medical information, lab tests, physical examinations and patient symptoms necessary to diagnose medical conditions effectively. These protocols formed the basis of the data design for T2P2.

T2P2 integrates emerging technologies with legacy medical system data to provide a comprehensive environment supporting the clinical consult. Patient information and test results were first imported from the Department of Defense's Composite Healthcare System (CHCS) and from Veteran's Affairs VistA hospital information systems. This information was then supplemented with clinical diagnostic input to pinpoint the patient's specific problem area. Finally, medical imagery components, with digital input devices and radiological images, acted as the remote 'eyes' for distant specialists. All of these components were integrated to yield a comprehensive text/appended image look at a patient.

Although each clinical intervention was unique to that particular patient, a typical T2P2 clinical scenario occurred according to the following example:

- A patient enters the clinic at a remote village in Alaska complaining of a troublesome lesion on the back.
- The local primary care giver (general practitioner) believes that there is probably no cause for concern but would like confirmation from a dermatologist. Unlike previous years, it is not necessary to evacuate the patient to Anchorage in order to consult with the dermatologist. T2P2 provides the means, directly from the doctor's desk.

- The doctor launches the T2P2 application using a web browser, enters the patient's identifying information and is immediately provided with information from the patient's medical record, including any recent laboratory studies or x-rays.
- The doctor examines the patient, following the instructions in T2P2's clinical format and provides specific medical history and physical exam information requested by the consulting specialist.
- The doctor takes several digital photographs of the lesion from a number of angles (as outlined in T2P2's help system). These pictures are integrated into the electronic consult.
- When ready, the doctor dials (possibly using an ISP) into the central, specialist site capable of supporting a dermatological consult. The consult and its associated data are encrypted to ensure patient confidentiality and transmitted to the specialist site.
- The dermatologist reviews the material submitted and is able to render an opinion, confirm the diagnosis and make critical treatment recommendations, all without moving the patient from his or her village.

T2P2 was deployed and served patients' needs at Tripler Army Medical Center and Schofield Barracks on Hawai'i by providing dermatology and orthopaedic support. Additionally, T2P2 software was used at medical readiness exercises around the Pacific Rim. Other clinical formats included: Generic Internal Medicine and Ear-Nose-and-Throat (ENT).

T2P2 began to have a profound impact both within and beyond its original target environment. It began to improve patient care and reduce unnecessary costs for DoD in Hawai'i and was set for expansion to a wide variety of locations. T2P2 was scheduled for deployment to Coast Guard facilities, Veterans Affairs (VA) clinics and Indian Health Service clinics in Alaska. The VA was also considering deploying T2P2 for teleconsults at many of its remote clinics across continental USA. Finally, T2P2 was being reviewed for inclusion into DoD's enterprise-wide health information system's modernisation program, Composite Healthcare System II (CHCS II) and Government Computerised Patient Record (GCPR) efforts.

T2P2 was providing qualitative and quantitative benefits to patients and to the healthcare enterprise. It made sophisticated medical specialist care immediately available early in the clinical process to facilitate informed referral decisions.

2 Methods

2.1 The initial research design

We began with a positivistic approach to the study, administering a survey to a selection of healthcare professionals (HCPs) involved in the initial T2P2 demonstration at Schofield Barracks and TAMC. Our aim was to measure the impact that the introduction of telemedicine had on a complex organisation such as the military. We intended to perform 'before and after' surveys book-ending the introduction of T2P2. After administering the first survey, we serendipitously encountered the study conducted by Walsham and Sahay [1] documenting the implementation of a GIS system into provincial

governments in India. Walsham and Sahay utilised the intensive research method that involves the researchers directly in the study as 'action researchers'. Walsham and Sahay discuss actor-network theory in their paper and strongly recommend organisations to make use of the theory when attempting to implement something such as an IS system. Interestingly, the developers of T2P2 had designed the system as if they were following the recommendations of actor-network theory, when actually they were not familiar with the theory. Lee [2] reminds us that scientific research intended for practical application often produces results and conclusions that are already known to the practitioners and in common use, simply without having been scientifically defined. For example:

> " ...When Kepler studied the optimum dimensions of wine casks, the proportions which would yield maximum content for the least consumption of wood, he helped to invent the calculus of variations, but existing wine casks were, he found, already built to the dimensions he derived." [2]

Likewise, T2P2 was already designed to the recommendations of the actor-network theory, before the Walsham and Sahay paper was published. This coincidence caught our attention and interest and because we too were studying the implementation of an IS system, we chose to follow suit and augment our positivistic elements of the study with the more qualitative observations of the intensive research study.

3 The adopted research design

The study was designed to measure the impact that telemedicine may have organisationally. This effort had two functions:

1 assessing the impact on the organisation which occurs as a consequence of the introduction of telemedicine technology into a complex organisation

2 identifying and assessing the organisational factors, which if effectively pre-positioned, will minimise the resistance and maximise the acceptance and utilisation of telemedicine technology.

To assess the organisational impact of the introduction of telemedicine technology, healthcare professionals were evaluated at three different levels: individual, group and organisational. For the individual level, the research teams utilised a survey that measured cognitive perceptions of the caregivers' job characteristics. This survey was to be administered before, during and three months after the introduction of telemedicine. At the group level, the research team chose to measure the medical decision-making process and adopted the qualitative research methodology of ethnography as the operative tool. Thus, through observation and interview, the research team studied medical decision making. At the organisational level, a survey was administered which assessed organisational learning and was to be administered with the same regimen as the job characteristics survey. The variables measured by the organisational learning survey helped to detect changes in the organisation's culture as a consequence of the introduction of telemedicine. Thus, the dependent variables were divided into three broad categories: Job Characteristics, Decision making Loci and Structure and Organisational Culture and Learning.

3.1 Dependent variables

1 *Job task characteristics* – implementation of a telemedicine system is an extraordinarily complex endeavour. The key is the early involvement of the users in its design because their lives will be impacted by the adoption of the technology in their daily activities. Successful implementation requires that individuals learn new ways of thinking about their job tasks. This learning process involves unscrambling old procedures and attitudes, moving to a new pattern and then cementing this new process into the procedures of the individual and groups. The survey of job task characteristics was chosen to assess variation on this variable.

Measurement tool: job characteristics survey. This survey consisted of statements that describe the healthcare professional's subjective cognitive view of the task characteristics of his/her job; i.e. the patient care aspects of the job of the healthcare professional [3].

2 *Decision making loci and structure* – telemedicine systems may change patterns of communication and decision making within the organisation. Indeed, the use of telemedicine is a new form of communicating within the organisation. As a consequence, the primary care physicians may wish to involve the expertise of specialised colleagues more often in their medical decision making. HCP may also alter their classification of cases from routine to non-routine or vice versa for other reasons to be determined.

Measurement tool: field observations with interviews. Observations were carried out on a daily basis for a five-month period. During the observation period, short, informal, semi-structured interviews were done with HCPs as appropriate. These interviews and observations were used to probe HCPs' interactions with the telemedicine technology and each other and to note their actions. Approximately 50 HCPs were in the pool of observed subjects. Interviews were initiated as a consequence of observing behaviours that appeared to shed light upon the underlying dynamics of the telemedicine implementation. Interview and observation journals were kept to record results.

3 *Organisation culture and organisational learning* – the impact of a new technical subsystem, such as a telemedicine subsystem, has ramifications not only for the micro-level of the social subsystem of the organisation, on the people and the dynamics of person to person interaction, but also may have ramifications for the macrolevel of the social subsystem of the organisation such as the organisational culture and the organisation's capacity to learn and adapt. In particular, the introduction of a change in the technical subsystem may result in changes in the organisation's culture with regard to the organisation's propensity to learn.

Many factors affect an organisation's propensity to learn: leadership style, openness in communication, direction of that communication (i.e., top-down, bottom-up), the degree to which different areas of the organisation view themselves as connected to other areas, the willingness to recognise shortcomings and the willingness to try new things.

Measurement tool: organisational culture and learning survey. This survey consisted of seven questions designed to determine the culture and disposition for organisational learning exhibited at Schofield and Tripler [4]. This survey measured the change in the HCPs' perception of their respective organisations' culture and learning propensity. These seven measures or factors are:

Factor 1: involvement by leadership

Leadership at all organisational levels articulates a vision and actively works to implement that vision. Leaders take a 'hands-on' approach to educating others about goals and implementing steps to reach those goals.

Factor 2: openness in organisations' climate

Information that will help us do our jobs better is available. We have relatively open boundaries among units. There are opportunities to observe others. Problems and errors are shared, not hidden. Debate and conflict are acceptable.

Factor 3: interdependence among organisational units

Our organisation focuses strongly on the interdependence among our units. We seek to optimise organisational goals at all organisational levels. We see problems and solutions systemically, i.e. how they affect the entire organisation.

Factor 4: support for continuing education

Our organisation has an ongoing commitment to continuing education at all levels. All employees are expected to develop and grow professionally.

Factor 5: willingness to recognise gaps between desired and actual performance

There is a willingness by all employees (from supervisors to healthcare professionals to staff) to recognise any gaps between desired performance and actual performance. We consider performance shortfalls to be opportunities for learning and organisational improvement. The organisation is continually trying to improve.

Factor 6: diversity in sources for initiatives for change and learning

Initiatives for change and learning may be top-down or bottom-up. People from various areas and of differing status within the organisation may recommend and evaluate initiatives for change and learning.

Factor 7: support for trying new things

Our organisation supports an experimental mindset. Employees are invited to 'play' with things. Failure is viewed as an opportunity to learn and improve, not simply as a negative. We are often experimenting with gradual changes in work processes, policies and structures.

It must be mentioned that our main objective was to identify the dynamics of the introduction of telemedicine and not to act as an agent that facilitates successful implementation of this telemedicine pilot program. However, this was, at times, a difficult tightrope to walk, especially with regard to organisational issues, since expertise in the area of organisational readiness was clearly needed as the project began its pilot study. Thus, as the study progressed, it became clear to us that we could obtain more

insight and understanding of the dynamics of the telemedicine implementation through an action research methodology and further, if we did not take on the role there was a significant likelihood that we would be seen as non-cooperative by the HCPs, thereby eliciting a backlash of non-cooperativity from the study's subjects.

4 Results

Healthcare professionals were evaluated at three different levels: the individual, group and organisation level. Surveys at the individual level measured how individuals are thinking about their present job tasks. Observation and interview were conducted at the group level and a survey was administered at the organisational level, which assessed organisational learning. The quantitative surveys were administered before the introduction of the telemedicine system. Qualitative data at the group level was collected shortly after its implementation and for a period of five months thereafter.

4.1 Pre-implementation survey (individual level) – quantitative

A total of 23 healthcare professionals were surveyed (Table 1); five specialist physicians, six primary care physicians, eight nurses and physician assistants combined and four medical technicians.

Table 1 Summary of the number of individual level surveys administered for both the individual and organisational level analyses

	Healthcare Professional			
Healthcare Factor 5	*Specialist Physicians*	*Primary Care Physicians*	*Nurses/Physician Assistants*	*Medical Technicians*
Schoffield	0	6	8	4
Tripler	5	0	0	0
Total	5	6	8	4

Figure 1 outlines the sequence of events for the study surrounding the implementation of the telemedicine system. Preliminary baseline surveys were administered followed by two, two-day workshops. Once T2P2 was implemented, observations and group interviews were conducted.

Figure 1 Timeline highlighting key events during the course of the study

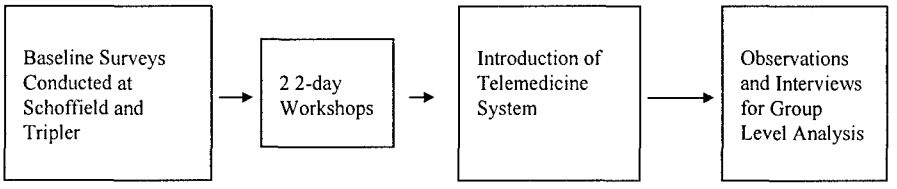

Table 2 shows the initial results of the Job Characteristics Survey used to measure cognitive perceptions of the caregivers job characteristics. This survey was conducted prior to the implementation of the telemedicine system and yields three measures of the perceived meaningfulness of the work: skill variety, task identity and task significance, one measure of the individual's perceived responsibility and autonomy and one measure of perception of job feedback. These measures are predictors of how well individuals learn new ways of thinking about their job tasks and their ability to replace old procedures and attitudes with new ones. Four groups of healthcare professionals (primary care providers, specialist care providers, nurses and medical technicians) were surveyed using a five-point scale from –2, indicating strong disagreement, +2 indicating strong agreement as the most desirable job task characteristic. Mean scores were all above neutral (0) and only a few scores were less than one. Positive scores indicate agreement with the notion that their job task offered them that particular measure. Negative numbers indicate a lack of agreement.

Table 2 Mean scores from caregivers of cognitive perceptions and desirability of job characteristics

		Specialist Physicians	*Primary Care Physicians*	*Nurses/ PAs*	*Medical Technicians*
Meaningfulness	Skill Variety	1.33	1.11	1.42	1.21
	Task Identity	1.20	1.00	1.75	0.91
	Task Significance	1.53	1.56	1.58	125
Responsibility	Autonomy	1.20	1.06	1.25	0.83
Feedback of Results	Job Feedback	0.80	1.11	1.50	0.75
	Overall	1.12	1.13	1.44	0.90

The results and insights from Table 2 are described below.

Specialist care physicians and medical technicians perceive that they do not receive enough feedback about the results of their work (0.8 and 0.75 respectively). The T2P2 system needs to incorporate automatic feedback for specialist physicians and medical technicians. Also, feedback and reinforcement should be given for the utilisation of telemedicine and for the innovation of new applications used in the telemedicine system. This may be done by simply automating an e-mail response whenever a telemedicine treated patient's computerised medical record is accessed.

Medical technicians indicate that they are unsure of their 'job title' and have trouble identifying their exact role (0.91). This gives them the impression that their work is less meaningful. Medical technicians need to be more versatile, broadening job tasks so they feel they are playing a significant role and achieve a sense of meaningfulness as part of the telemedicine system.

Medical technicians also perceive they do not have enough autonomy for scheduling tasks and determining procedures (0.83). As part of the introductory training and continuing education for telemedicine, medical technicians need to be given more responsibility and autonomy in ways that safely enhance the quality of information transferred via T2P2.

These results provide a baseline of information for later comparison to results following the implementation of the telemedicine system. However, these results provide

useful information for intervention and facilitating the implementation of T2P2. The implementation of T2P2 requires individuals to learn new concepts and new ways of thinking about their job tasks.

4.2 Administration of the organisational culture and learning survey (organisational level) – quantitative

Seven measures of the organisation's culture for the propensity to be a learning organisation were carried out on four groups of healthcare professionals. These baseline data are very useful for the development of insights concerning the planning of process reengineering and organisational interventions designed to enhance the probability of success of future DoD telemedicine interventions. A survey instrument administered concurrently with the job characteristic survey measures the organisation climate, culture and capacity to learn and adapt. A score of seven represents the highest judgement contribution to learning organisations and a greater inclination towards organisational learning. Low scores represent low perception of contribution (Table 3).

Table 3 Initial organisational culture and learning survey results

	Specialist Physicians	*Primary Care Physicians*	*Nurse/Physician Assistants*	*Medical Technicians*
Involvement by leadership	5.50	4.75	5.25	6.13
Openness	4.80	4.20	4.68	4.63
Interdependence	4.70	3.67	4.56	5.88
Support for continuing education	6.00	3.58	4.60	3.75
Acknowledge performance gaps	4.70	4.00	5.06	5.00
Diversity of initiatives	4.40	3.83	4.87	5.00
Support new things	5.10	3.50	4.90	4.50

Overall, only five instances scored below four, at less than moderate agreement and four of these were by primary care physicians. That is, primary care physicians indicated the five dimensions (interdependence (3.67), continuing education (3.58), performance gaps (4.0), diversity (3.83) and innovation (3.50)) of organisational learning to be low. Scores were significantly less than for other healthcare professionals (Fisher Test for small samples, $p \leq .05$). Specialist care physicians are more likely to define their organisational culture as a learning organisation than the primary care physicians are. And lastly, medical technicians felt a lack of support for their continuing education (3.75).

These baseline data reveal the necessity for the telemedicine system design to incorporate a continuing education program both prior to and during the implementation efforts. The programs must teach technical skills as well as enhance professionalism giving opportunity for higher levels of responsibility.

There is a strongly perceived need by the medical technicians for greater opportunity for continued education.

Table 4 reveals how only seven of the potential ten physicians used a telemedicine consult. Of these seven, only five used a telemedicine consult more than once over the two-month period.

Table 4 T2P2 utilisation rates by primary care physicians, November and December 1999

Primary Care Physicians	*Ortho. T2P2 consults: Nov - 99*	*Ortho. T2P2 consults: Dec - 99*	*Derm. T2P2 consults: Nov - 99*	*Derm. T2P2 consults: Dec - 99*
Dr. A	0	0	0	3
Dr. B	0	0	2	0
Dr. C	0	0	0	0
Dr. D	2	0	1	0
Dr. E	1	0	0	0
Dr. F	0	0	1	1
Dr. G	0	0	0	0
Dr. H	1	0	0	2
Dr. I	0	0	0	0
Dr. J	0	0	0	1
Totals	4	0	4	7

In the two specialisms implemented by T2P2 (orthopaedics and dermatology), during the two month period, only 15 patients were referred to a T2P2 consult in both specialisms when as many as 40 were anticipated.

4.3 Observations and interviews with HCPs (group level) – qualitative

Qualitative formal and informal interviews were conducted with the participating healthcare professionals to probe interactions with the telemedicine technology and each other and to note their actions. Both positive and negative themes emerged from these observations and interviews. The objectives were to understand better the attitudes of healthcare professionals during the early stages of the telemedicine implementation that may be informative for encouraging further use of the technology.

Observations and interviews highlighted certain successes and failures visible in these early stages of T2P2 implementation. These are described below and summarised in Table 5.

Table 5 Set of themes highlighted during interviews and observations with healthcare professionals

Healthcare Professional	*Theme*
Specialist physician	– Credit not received for consult since policy requires patients to be physically present with the specialist
Primary care physician	+ Enhanced quality care by using a referral that would not have normally been used + Physician learns from the specialist – Excessive workload not being credited – Need to have technical experts available at all times to ensure proper working of all hardware and software
Nurse/physician assistant	None
Medical technician	+ Medical technicians given a limited amount of autonomy can contribute significantly to the quality of healthcare
All healthcare professionals	+ A desire for continuing education with the proper education programs in place

A medical technician was observed taking photos of a paediatric patient, describing the technique to another member of staff, the patient and the patient's parents. The parents, patient and staff member were impressed by the rapid processing and quality of the photos. This limited autonomy shows how medical technicians can contribute significantly to the quality of healthcare without superceding physician instruction.

A medical technician was being trained on how to use the digital camera. During the training, a second medic began to observe and requested the scheduling of a training session for himself. This evidence demonstrates the desire for continuing education of healthcare professionals and the importance of having education programs in place prior to the implementation of telemedicine and continuously throughout.

One physician noted that he would not have sent some patients to a specialist for referral if it were not for T2P2. Therefore, there is potential for enhanced quality of care through better communication with specialists. Two benefits arise here. The patient gets better quality care and the physician learns from the specialist, improving her/his medical skills. During readiness training, potential for new learning and professional enhancement should be emphasised.

Primary care physicians expressed unrecognised, excessive workload as a major concern. During a telemedicine consult, they spent two sessions with the patient, one before and one after the digital data collection. However, DoD procedures did not allow credit for a second visit with the same patient in the same day. Therefore it appeared as if they were seeing fewer patients a day. Not crediting extra effort by physicians impacted the amount of utilisation of the system (Table 4).

The specialist physician did not receive full workload credit for T2P2 consults because DoD policy requires patients to be physically present with the specialist in order to receive full workload credit. It is critical that DoD workload policy be amended to accommodate users and consults of telemedicine. When a new system is being piloted, there needs to be some flexibility in the current protocols in order to give the system a fair chance.

Primary care physicians expressed a need to have on-the-scene technical experts available at all times to ensure proper working of all hardware and software, as well as technical assistance should it be needed. This would also enable immediate problem-solving preventing escalation of problems out of control.

Primary care physicians, during interviews, indicated that a strong T2P2 would be very significant in its ability to offer them opportunities for new learning and professional development. Primary care physicians sometimes received advice from specialists where otherwise they would not have done so.

5 Utilisations of T2P2

The primary care physicians identify their organisation as having low organisational learning cultural characteristics. Thus, the propensity for rapid adoption of new technologies, such as store and forward telemedicine, is lower than might be ideally the case. Observation of utilisation rates of the T2P2 system during its early months of implementation justified this concern. Table 4 above yields the utilisation of T2P2 during the two-month period, November and December 1999. Observation of results yielded in Table 4 shows that only seven of the potential ten physicians used a telemedicine consult

and of the seven users, only five used a telemedicine consult more than once over the two-month period.

In a primary care clinic seeing large numbers of patients each week in the two specialisms implemented by T2P2 (orthopaedics and dermatology), over the two-month period, only 15 patients were referred to a T2P2 consult in both specialisms. It had been anticipated by program managers that as many as 40 dermatology and orthopaedic consults each might be processed over the two months by telemedicine.

Correlation of Table 3 and Table 4 appears not to support the null hypothesis that organisational learning propensity within an organisation's culture is unrelated to the propensity of an organisation to utilise a new technology such as T2P2. Put in more common terms, our findings are that the lack of an organisational culture supportive of learning is associated with lower than expected utilisation rates of a newly introduced telemedicine technology, such as T2P2.

Drawing from the wisdom of Organisational Learning Theory, the shortfall between expected performance and actual performance needs to be considered an opportunity for learning and organisational improvement. At the orientation for T2P2 at the Primary Care Clinic, each physician was given a half-day training program that emphasised the technical aspects of T2P2 usage. There was no coherent effort to enhance the organisational culture to be more ready to adopt a new technology. Rather, it was assumed that all would fall in, salute and use the system appropriately.

Most organisational behaviour specialists would argue that an effective program designed to develop an organisation with stronger organisational learning cultural propensities is a significant undertaking and in most cases would require a number of full day workshops spaced over several months to allow time for the new cultural values to set in and stabilise. Many in the Primary Care Clinic and PRPO office including its leadership of both would have endorsed such a program, but the realities of the busy schedule at the Primary Care Clinic appeared to rule out the major effort to ready that organisation culturally for telemedicine implementation. There was no other continuing education or development activity of this sort undertaken at the Primary Care Clinic. Our assessment of the degree of Positive Organisational Learning capacity indicates to us that such a program was definitely called for in this case.

6 Organisation structure and policy issues

Here the workload measurement system must be highlighted. The current DoD measurement for workload does not allow the same patient to be seen by the physician twice in one day. Yet, the procedure for using the T2P2 telemedicine consult at this prototype site required such dual visits, one before and one after the necessary digital data collection. At the Primary Care Clinic, all sorts of imaginative approaches to the scheduling of patients were invented to overcome this dilemma. However, observations and interviews at the clinic indicated that many physicians opted not to use T2P2 when appropriate and the workload measurement issue may be a key reason for this lower than expected utilisation.

7 Organisational learning issues

On a more positive side, results of interviews with primary care physicians indicated a strong belief that T2P2 will be very significant in its ability to offer the primary care physician opportunities for new learning and professional development. Many times, T2P2 was used by primary care physicians to seek advice and guidance from specialists in cases where the primary care physician usually diagnosed and treated the patient without such specialist physician input. This is a very optimistic sign because not only does it demonstrate one of the key advantages of implementing store and forward telemedicine systems, but it is also a strong force in encouraging higher utilisation rates among the initiating primary care physicians.

8 Premature cancellation of the evaluation

In early 2000, the low utilisation rates in the T2P2 demonstration project were obvious to all involved. Clinical nurses involved in the project management argue that the main reason for low utilisation was the fact that the demonstration project was being evaluated. They reasoned that the evaluation requirement of randomly selecting only one half of eligible T2P2 candidates for actual T2P2 processing, required by the experimental design of the evaluation study, had the effect of cutting utilisation rates in half.

Whilst true, it is also true that the pre-study predictions of expected utilisation rates were eight times greater than those observed. Thus, the evaluation project was clearly one, but not the only nor the major cause of low utilisation.

Nevertheless, the project manager, also an army nurse, decided to halt all evaluation efforts effective from 1 February, 2000. Thus, the research project herein described was terminated, thereby preventing planned 'post-treatment' quantitative evaluations.

9 Discussion

Walsham and Sahay [1], using an intensive research study approach [5] investigated the level of success in achieving utilisation of a geographic information system (GIS) to aid decision making by district level administrators in India. District level administrators were called upon to administer numerous development activities in India; decisions in education, agriculture, wildlife management and infrastructure development. Many of these decisions were spatial in nature; for example the location of schools, or the planning of roads. The utilisation of a GIS appeared to offer significant benefits to aid these administrators in their district level decisions. Further, the GIS offered the potential to bring about some integration among the decisions across districts such that different administrators would have a common conceptual framework of map-based systems from which they might solve problems.

Despite its significant potential, the research indicates that the GIS was underutilised during the three-year study. A major impediment to utilisation was the lack of aligned interests among the key actors directly involved in the implementation program.

The successful implementation of T2P2 in the healthcare system of the US military, depends on the establishment of a network of actors who are all reasoning and acting in a

similar manner. The actors are both the people and the technology involved. If all parties are not in agreement, the network will fail to develop and the goal will not be reached. For instance, in the Walsham and Sahay study [1] the actors were the people utilising the GIS software, the organisation supervising the people utilising the GIS system, the developers of the GIS software and the software itself. All of these actors had to be thinking or acting within the same set of sociological and intellectual parameters. One of the reasons that the GIS system was not successfully implemented in India was due to objective differences among the key actors. The GIS system was developed by Western technicians; however, it was to be utilised by people from an Eastern culture who valued different goals and approached problems in an intrinsically different fashion.

Walsham and Sahay [1] noted that a key feature of the actor-network theory is that the actors can include both human actors and technological actors, such as the GIS system itself. Thus, embedded within a modern information system are values, goals, methods of inquiry and other particular viewpoints or statements considered to be 'truth' that are most often unintentionally inscribed by the system's creators. These inscriptions are, in most cases, unobtrusive and frozen into codes, electronic thresholds and other system parameters. Because these inscriptions are frozen beneath the surface of the technology, they are rarely accessed for the purpose of examination and/or modification.

Where in the Walsham and Sahay study there was a conflict between Western and Eastern cultures, there can be similar conflicts between professional and academic cultures, or even between separate professional cultures. Thus, analogous to the case in the Walsham and Sahay study [1], the mode of inquiry of a professional culture (i.e. lawyers' or healthcare professionals') is often different from that of academia. We believe that in the T2P2 case, the problem of conceptual non-alignment was avoided by involving healthcare professionals in the development phase of T2P2 so that the system would already be aligned with the interests of the doctors and technicians who were to use it. Thus, we felt our T2P2 study might serve as an interesting comparative analysis to the GIS study.

The results of our study indicate that the IS system studied was not used as frequently as expected, but was, in fact, rarely used. And this low utilisation resulted in the perception of failure by those in charge.

It is our argument that the IS system under study failed not because of different models of inquiry as was proposed by Walsham and Sahay [1] as one cause of failure of the IS system they had studied. The IS system studied here had taken steps to implement the operant models of inquiry of its potential users within its structure. Rather, we propose that the system failed primarily because the organisation selected to use it was not adequately prepared educationally, attitudinally and structurally. This does not imply that the 'models of inquiry' issue raised by Walsham and Sahay [1] is not relevant or important in IS implementation work, but only that its impact was not a significant variable in our study.

Educationally, a program of organisational cultural intervention to create a more 'learning friendly' culture was necessary. Attitudinally, the leadership of the implementing organisation needed to value the successful high utilisation of the IS system as one of its primary organisational goals. Structurally, the in-house reward structure and incentive system of workload credit needed to be modified before IS implementation such that the system utilisation would be reinforced by incentives rather than discouraged by the existing incentive system.

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Preparing Healthcare Professionals for Telemedicine: Results from Educational Needs Research

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ABSTRACT

As part of an overall research program to create a set of web-based interactive distance learning modules, an educational needs assessment was conducted. The educational needs assessment is undertaken to collect information via observation and interview as to which knowledge areas are most desirable for incorporation into the interactive distance learning modules. This research is best undertaken with a neutral stance and without any preconceptions or hypotheses as to which knowledge areas are likely to be most useful. The interactive modules were designed to enhance the utilization of telemedicine by health care providers. This paper is a report on the methodology used and the findings of the needs assessment. The educational needs assessment acts as a compass to guide the creation of curricula. In the design of interactive learning, the needs assessment may be an important tool that informs not only the selection of the content, but also the selection of technology and courseware processes. The methodology described herein may be useful as a template for other authors of interactive learning courseware. The results of this study identified four clusters of content to be offered and confirmed the selection of interactive, web-based distance learning as the most appropriate delivery approach.

INTRODUCTION

Problems with Telemedicine

The use of telecommunication technology in delivering medical care (telemedicine) has been utilized in the private sector for well over 50 years. Likewise, the US military has been actively working with the use of telemedicine for quite some time. Both sectors have incorporated some aspects of telemedicine into just about every medical specialty. While some

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programs have been successful, many more have been very difficult to implement or considered outright failures.

A major cause of telemedicine failure is low utilization by the healthcare professionals who are expected to benefit from the system. Causes of low utilization can be divided into two broad categories. The first cause is technological and the second is socio-organizational. Technology presents a number of low utilization traps for the organization to fall into:

1. Mismatched technology – when one hospital's equipment is unable to properly communicate with another hospital's, or worst, equipment within the same facility.
2. Outdated technology – where a facility ends up trying to utilize old, slow inefficient systems.
3. Over-reliance – when organizations expect technology, not people, to fill gaps in a poorly-planned project (Davenport & Prusak, 1998).

The common result of these and other technological problems is an under-utilized system that gives telemedicine and its adherents a bad reputation and leads to the second cause, socio-organizational problems, which also contributes to telemedicine's low utilization in the following ways:

1. Lack of awareness of the system – lowers utilization because the system is poorly marketed to its potential users.
2. Lack of belief in the system – causes low utilization as doctors believe that telemedicine will not aid them in their diagnosis, preferring the hands-on approach instead.
3. Technophobia – a doctor's fear of the telemedicine system or its potential complexity also leads to low utilization.

Training May Improve Utilization

The first two technological problems, mismatched and outdated technology, are the easiest to fix. With the proper technical personnel, and enough money, these two problems are easily dispatched. Conversely, the third technological problem, over-reliance, and all of the socio-organizational problems are much more difficult to overcome.

Nonetheless, once solved, the solutions offer the most promise in creating an effective telemedicine system. Training is the solution commonly offered to these problems (Blignault & Kennedy, 1999; Calcagni et al., 1996; Forkner, Reardon, & Carson, 1996; Gomez et al., 1996; Levine, Cleary, & Mun, 1998; Piscataway, 1998; Walters, 1996).

For the Department of Defense (DoD), and practically every other organization undergoing change, to successfully implement telemedicine, training may help people accept how their jobs and work environments will change.

Training provides an organization the opportunity to address the problems mentioned above. First, training offers healthcare professionals (HCPs) an introduction to the facility's telemedicine system and its proposed benefits. In essence, the training program acts as a marketing tool, increasing the project's name, recognition and communicating its abilities.

Second, training can bridge the gap between an HCP's preconceived notion of telemedicine and its actual efficacy. By showing examples of telemedicine applications in specific specialties, an HCP can become more at ease with telemedicine and understand that telemedicine is not there to replace the HCP but to augment the HCP's abilities.

Third, a combination of books, hands-on training, and mentor training may assist the HCPs to overcome their technophobia. While technology today has the stigma of being 'hard-to-learn', with the proper training techniques, an HCP's level of comfort and understanding of computer software or hardware tools may increase.

Lastly, training is an excellent response to the over-reliance upon technology. Over-reliance need not occur if the three organizational issues mentioned above are addressed. If training is properly executed, the three organizational barriers are brought down and HCPs may accept telemedicine and have meaningful inputs in further applications.

Proper Training Begins with Needs Assessment

The study that follows involves the large-scale introduction of telemedicine into the DoD medical care system. The DoD, like any private sector organization, is likely to feel a significant impact upon its processes at both the micro and macro levels. As mentioned, in order to assuage the dangers of technological as well as socio-organizational transition, a training program should be initiated. To lessen the chance of a poor training program or even a 'false start' with an unsuitable training program, an educational needs assessment is recommended (McArdle, 1998).

The educational needs assessment acts as a compass to guide the creation of the training curricula. Needs assessment attempts to address the issue of who, what, and how to teach the curricula. When done properly, needs assessment fosters a feeling of teamwork and ownership of the curricula. This is because many opinions are taken into account from all over the organization, both

Table 1. Nine Needs Assessment Techniques (Steadham, 1980).

Observation	• Used to distinguish organizational processes either formally or informally
Questionnaires	• Used to collect facts and opinions of the organization
Key consultation	• Used to gain insight from high-level or highly knowledgeable personnel
Print media	• Used to clarify normative needs in the organization's industry
Interviews	• Used to gain in-depth facts and opinions
Group discussion	• Used to support and aid ownership of final suggestions
Tests	• Used to sample outcome of final suggestions
Records & reports	• Used to objectify past successes and failures
Work samples	• Used to give researchers understanding of processes involved

horizontally and vertically. In the educational needs assessment, the effort must be to approach the initial stages with an absolutely neutral stance and no preconceived expectations or theories. This research does not follow the usual scientific positivist approach of hypothesis and then data collection. Rather, it does the opposite, data collection and then theoretical construct formulation. After the initial two stages of the educational needs assessment, the researcher does develop theoretical constructs and these guide the interview process. These constructs are found in our discussion of the survey and structural interview inventory creation.

One limitation about needs assessment is warranted. Though much information is derived from needs assessment, no assessment is able to quantify perfectly the specific requirements for a program. Rather, the needs assessment suggests the probable need and requirements for a program (Soriano, 1995). With this in mind, it is recommended to use a variety of data collection methods. Multiple data sources provide different perspectives of the same data and give more creditability to the resulting analysis. Table 1 below lists nine basic needs assessment data collection methods (Goldstein, 1986).

THE STUDY – THE DOD AND ITS COMMITMENT TO TELEMEDICINE

Telemedicine in the DoD's Mission

The primary mission of US military healthcare system is to ensure and enhance the 'readiness' of US military fighting forces. 'Readiness' is the term

used to describe US military's constant ability to engage an enemy 'anytime, anywhere'. To this end, the DoD has researched many new technologies to augment its readiness. Telemedicine is one such technology.

The DoD regards telemedicine as a discipline that is well worth exploring. Indeed, the DoD entered a research agreement with the University of Hawaii at Manoa to create a telemedicine training curriculum whereby HCPs, both new and experienced with telemedicine applications, can learn about telemedicine and thus breakdown the barriers mentioned previously.

Training and Needs Assessment

The agreement called for the University researchers to use an educational needs assessment in its telemedicine curriculum creation. There were four steps in the needs assessment: Surveillance, the identification of the current situation relative to telemedicine and its training; Investigation, the gathering of data; Analysis, the creation of a picture from the data; and Reporting, the description of the picture (McArdle, 1998).

This needs assessment has an additional benefit to those listed earlier, in that it allows for mid-course changes as needed. This educational needs assessment includes a system of research, course development, instructional delivery, and evaluation that, in-turn, provides more research data, beginning the cycle anew. The cycle continually feeds itself, producing the benefit of steady process improvement.

The organizational change that occurs within a medical care system, military or otherwise, when new technology is introduced is often difficult to anticipate. Telemedicine is a technology of the most intrusive sort. It will change the diagnosis, patient–doctor communication and medical decision-making structure within the DoD's medical care system setting. Therefore, it is imperative that care be taken to make the change occur as smoothly as possible, the first time.

THE DoD'S NEEDS ASSESSMENT OBJECTIVES AND SUBJECTS

Research Objectives

The preliminary objectives of the needs assessment are listed below. These objectives resulted from the collaboration between the University's research team and DoD personnel. This initial collaboration served to create a bond

between the two groups and begin a working relationship. Additionally, it served to create a sense of ownership between the two parties so that, as the project progressed, changes in the assumptions could be openly discussed.

The purpose of this research was to:

- Confirm if telemedicine training is needed by the DoD healthcare providers.
- Determine what are the learning needs of DoD healthcare providers.
- Determine if distance learning methods, would be appropriate for telemedicine training.
- Determine the content of the web-based, interactive learning modules.
- Identify learning modules that have the highest priority.
- Identify learning objectives appropriate for the learning modules with highest priority.

Research Subjects

Observed Programs

The subjects of the University of Hawaii's research were personnel from numerous existing DoD telemedicine projects. During the different stages of the needs assessment, personnel of varying job descriptions and ranks were interviewed and surveyed. Much of the preliminary work for the needs assessment took place at Tripler Army Medical Center (TAMC, Tripler Army Medical Hospital Website) located on the island of Oahu (same as the University of Hawaii at Manoa) in the state of Hawaii. TAMC is presently home to numerous projects that are researching, establishing, and monitoring telemedicine systems in different specialties and locations throughout the Pacific Region. One group in particular, the Pacific Regional Program Office (PRPO, Pacific Regional Program Office Website) is the host organization for seven telemedicine projects that were used at different stages of this needs assessment.

Research performed at TAMC was augmented by surveys of telemedicine personnel in Washington, DC. This subject group contributed facts and opinions related to telemedicine implementation of programs on the East Coast of the United States as well as Europe and Africa. On the East Coast, there were personnel from three major organizations (on the level of PRPO above) interviewed – Telemedicine and Advanced Technology Research Center (TATRC, Telemedicine and Advanced Technology Research Center Website), Multimedia Integrated Distributed Network (MIDN, Naval Medical Research Center Website), and Walter Reed Army Medical Center (WRAMC, Walter Reed Army Medical Center Website).

Table 2. University of Hawaii/DoD Research Subject Breakdown ($N=57$) .

Role of interviewee		Organizational level		Knowledge of telemedicine		Employer	
Doctors	29	Low	7	User	28	Military	26
Others	28	Low-mid	24	Familiar	23	Gov't/private	29
		Mid-high	19	Non-user	6		
		High	7				

Demographics

We interviewed 57 people. Of those, 33 were located in Hawaii and 24 were located in the Washington, DC area. Since doctors are typically the primary users of telemedicine, a majority of the subjects was physicians. The organizational level of the subjects was also captured. Other subjects represented a full spectrum from secretaries through project personnel to high-level personnel including program directors and high-ranking officers. The mid-level ranges were for nurses and doctors of varying ranks and roles relative to telemedicine. Moreover, the University of Hawaii research team considered the input of people with limited or even no contact with telemedicine. Table 2 below gives a breakdown of the demographics of the needs assessment.

DoD NEEDS ASSESSMENT STEP ONE – SURVEILLANCE

The Surveillance step concentrated on identifying learning needs, not developing solutions. During this stage the University of Hawaii research team performed two major activities, a presurvey and a meeting with management. The presurvey consisted of a semi-structured interview with project managers from each of the seven PRPO projects. The management meeting involved high-level PRPO managers and the University of Hawaii research team in a face-to-face meeting.

The results were used to identify the interview subjects and interview parameters for the next step, Investigation. Based on the Surveillance data, the research team created two tools; a quantitative interview instrument and a qualitative, informal-interview guide. The qualitative tool allowed subjects to express their thoughts and concerns about telemedicine in three areas: general description of their program, specific issues related to their program, and

training issues. Additionally, the tool provided the data collectors a framework within which they could accurately cull the subject's knowledge.

A quantitative instrument was created to identify potential learning objectives for a telemedicine-training program. Initially, 18 learning objectives were listed in a random order. Respondents were asked to rank the objectives with regard to importance, on a scale of 1–5. These ratings were then to be used to rank the prospective learning objectives against each other, the purpose of which was to determine those objectives that were most important to a telemedicine-training program and to see what objectives could be logically grouped into modules. An example of a question and the ranking classification is noted below.

An example of the type of question asked in the survey was:

Telemedicine Case Analysis – A presentation of how similar telemedicine programs approach the program's area of expertise. Examples from the program's clinical specialty will be explored.

1	2	3	4	5
Required	Recommended	Not sure	Not helpful	Useless

DoD NEEDS ASSESSMENT STEP TWO – INVESTIGATION

The Investigation stage involved the actual collection of data using the tools discussed above. Also, more of the programs were observed while in action, and additional literature Internet searches were conducted.

Program Observation

The research team observed several of the programs' operations. The Pacific Oncology Outreach Program's tumor board was attended on a number of occasions. The tumor board was observed in order to identify areas where training may or may not help. This opportunity was also utilized to observe the reactions and interaction of personnel while using telemedicine.

The Pacific Island Electronic Consultation and Referral Program's website was accessed along with program personnel. Mock cases were reviewed to understand the process involved better. This was coupled with the interviews of program personnel to form recommendations for telemedicine training.

The result from the observations was a better understanding of the operational issues involved in telemedicine. By observing the projects, the research

team was able to communicate with the interviewees better. The cryptic terminology and acronyms used were defined. This allowed the interview to flow smoothly and not be stopped by questions regarding terms, etc. Overall, the program observations allowed the research team to go to the next step, Analysis, and put the data collected in a proper context.

Interviews and Surveys

The interviews occurred in two stages. The first was performed during the summer of 1999. The personnel at the various PRPO projects were interviewed. Next, during the month of December, 1999, the University of Hawaii research team met with the personnel in Washington, DC.

The interviews and surveys were conducted during the same meeting with the interview being accomplished first. At the completion of the interview, the survey was conducted. This was done purposefully because the interviewee, after 30–45 min of questioning, would give well-thought out rankings on the proposed objectives, as well as a rational proposal for additional objectives.

Within the first few interviews, the interview guide was refined to get to the most salient questions first. Due to the nature of the semi-structured interviews, a very open, free flow of information occurred. Most of the people interviewed were very excited to talk about their project and their roles within, and once they started, it was initially quite difficult to direct them to the important questions on which the interviewer wanted to concentrate.

Based on the first few interviews, 2 additional learning objectives were added to the original 18 objectives on the survey instrument. After that addition, suggestions from the interviews thereafter were encompassed within other learning objectives. In general, the tool was adequate but had one limitation. While the tool collected quantitative data, the data collected here was/were on subjective items. The learning objectives used in the survey were broadly described and open to interpretation.

DoD NEEDS ASSESSMENT STEP THREE – ANALYSIS

Semi-Structured Interviews

Method and Results

During the Analysis stage, the semi-structured interview data and the survey data were consolidated. Well-established analysis techniques from

McArdle's 'Conducting a Needs Analysis' (McArdle, 1998), Phillips and Holton's 'Conducting Needs Assessment' (Phillips & Holton, 1995), and Soriano's 'Conducting Needs Assessments: A Multidisciplinary Approach' (Soriano, 1995) were employed. The data from the interviews were consolidated on a question-by-question basis. From the groups, opinions related to telemedicine, training, and support for the two were synthesized.

Surveys

Method

Using common statistical analysis software (Microsoft Excel) the data for each question were averaged on three different levels. First, on a program level, second, as a group of programs and third, on a learning-cluster basis, that is, each learning goal was grouped under a module heading and then averaged.

Results: Learning Cluster Formation

The primary factor in analyzing this data is to observe how each learning objective ranked in relation to the others. Based on the premise that the research team covered all potential, relevant learning objectives in a broad fashion, the research team grouped the objectives, forming what were called learning clusters. The basis behind the cluster formation was that each of the 20 learning objectives fell under one of four categories/titles: (1) Fundamentals of Telemedicine, (2) Clinical Applications, (3) Organization and Management, or (4) Technical Systems. These clusters formed the recommended structure for the web-based, interactive curriculum.

Results: Learning Objective Validation

All 20 objectives were found relevant to a telemedicine-training program. While some subjects listed 4's and 5's as answers (indicating the objective was 'not helpful' or 'useless'), none of the 20 proposed learning objectives had an average score higher than 2.5 (borderline of 'not sure' and 'recommended'). While the 2.5 average is not a concrete justification to instruct learners in all the learning objectives, the low average does indicate that the learning objectives were relevant to a telemedicine-training program and should be considered at some level.

Finally, the results of the comparison are given below:

Numerical rank out of 20	Average	Learning objective	Learning cluster
1	1.35	Telemedicine tools	Technical systems
2	1.48	Benefits to specialties	Clinical applications
3	1.54	Scheduling and location factors	Clinical applications
4	1.54	Standard operating procedures	Organization & management
5	1.63	Patient's perspective	Fundamentals of telemedicine
6	1.63	Distance education	Organization & management
7	1.65	How to conduct an examination	Clinical applications
8	1.69	International perspectives	Fundamentals of telemedicine
9	1.77	Telemedicine case analysis	Clinical applications
10	1.77	Organization and management	Organization & management
11	1.81	Failures of telemedicine	Fundamentals of telemedicine
12	1.81	Store and forward technology	Technical systems
13	1.83	Technology of telemedicine	Technical systems
14	1.85	Legal and regulatory aspects	Organization & management
15	1.85	Video conferencing technology	Technical systems
16	1.90	Future of telemedicine	Fundamentals of telemedicine
17	1.94	Web page interface technology	Technical systems

18	2.02	Telemedicine business aspects	Organization & management
19	2.25	Funding sources / considerations	Organization & management
20	2.31	History of telemedicine	Fundamentals of telemedicine

DoD NEEDS ASSESSMENT STEP FOUR – REPORT

The analysis was presented in a written format for delivery to the DoD leadership staff. The primary recommendation to the DoD regarding its telemedicine training curriculum centered on the aforementioned learning clusters. The University of Hawaii research team's recommendation follows.

Learning Environment

Neither observations nor interviews yielded results that were contrary to the intention of using a web-based, interactive learning environment for the content delivery. In fact, interview data indicates such to be the preferred mode. The constraints of geography, widely dispersed health care providers at stations from the Indian Ocean to North America to the European Continent, argued strongly for an Internet solution. The varied work schedules and time zone differences also indicated the need for the flexibility of a web-based, interactive learning environment.

The learning objectives were divided into types of learning which in turn drives the preferred mode of training. Three major types of learning are:

1. Effective learning which includes the fostering of attitudes, feelings, and preferences. For example, it may be desirable for participants to value a certain situation, procedure, or product. Or they may need to become more aware of their feelings and reactions to certain issues and new ideas. Effective goals are the priority when there is a lack of desire or a fear about using new knowledge or skills. This is often referred to as a 'won't do' situation.
2. Behavioral learning which includes the development of competence in the actual performance of procedures, operations, methods, and techniques. For example, participants practice skills that been have demonstrated and receive feedback on their performance. Behavioral goals are the priority when there is a lack of skill. This is often referred to as a 'can't do' situation.

3. Cognitive learning which includes the acquisition of information and concepts related to course content. Participants must not only comprehend the subject matter but also analyze it and apply it to new situations. Cognitive learning can also include the development of 'mind models' and the realization that differing cognitive scripts exist for different individuals confronted with the same initial conditions. Cognitive goals are the priority when there is a lack of knowledge. This is often referred to as a 'don't know situation'.

A study of the type of goal will lead to the type of training that is most effective. For example, behavior goals can be thought to be most effective by instructor-led training where as cognition goals are effective and cost efficient as web-based training. For effective goals, creating the 'cohort' effect is important, regardless of whether the training is instructor-led or web-based. To achieve effective learning, interaction amongst the cohort is central to the desired outcome. Most of the goals identified in this study were cognitive and effective, hence perfect for interactive web-based training (Phillips & Holton, 1995; Soriano, 1995; Steadham, 1980).

Training Time

The research team recommended that the total course allotment for time be broken down as listed in Table 3 below.

Structure

In addition to the creation of the learning modules, the University of Hawaii research team developed a structure and relationship scheme for the clusters. The diagram below is a graphical representation of the four learning clusters and their interrelationships. The dominant cluster is Clinical Applications with 40% of the course time allocated. The large center circle represents the clinical knowledge required by all healthcare providers. The smaller, peripheral circles represent the unique knowledge needed by each specialty.

Table 3. Leaning luster Time Allotment.

Learning cluster	Percentage of course time (%)
Clinical applications	40
Fundamentals of telemedicine	20
Organization and management	20
Technical systems	20

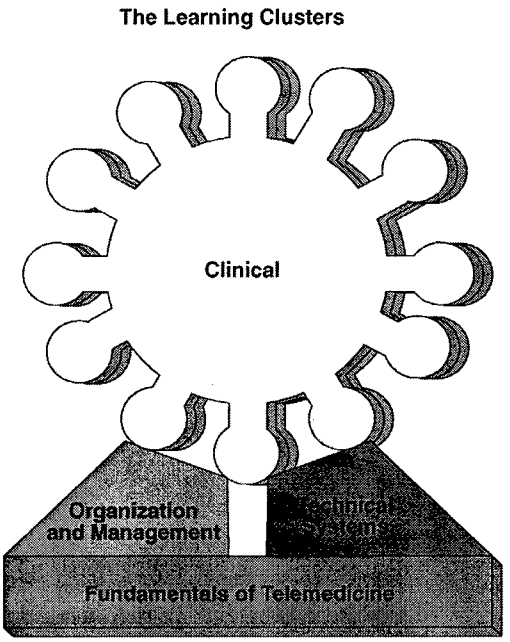

Fig. 1.

Emphasis on specialty focus is reflected in the second highest scoring learning ojective, 'Benefits to Specialties'. The layers represent the different knowledge needed by the different types of HCPs: physicians, nurses and technicians, which became apparent during the interviews and observations. The critical Clinical Applications cluster sits atop the Organization and Management cluster and Technical Systems cluster which in turn rests upon the Fundamentals of Telemedicine. The basic knowledge contained in the three base clusters is the same for all specialties and types of HCPs.

The Learning Clusters

Fundamentals of Telemedicine

The purpose of this cluster is to cover two primary topics, the patient's perspective and an evaluation of telemedicine in general. In addition, this cluster is to act as a marketing tool and motivate a learner to want to use the technology. The forum will be a study of past successes and failures in telemedicine and the reasons for that.

Clinical Applications

This cluster was determined to be the most important since it encompasses learning that directly relates to the provision of health care. It will also be the most challenging to design. Not only does each specialty, but also each level of HCPs (physician, nurse, and technician), have special learning needs. The University of Hawaii research team recommended that these modules be taught in two parts.

The first module has two primary topics. The first is for the learner to understand all the considerations, tangible and intangible, required by telemedicine examinations and consultations. Examples would be equipment set-up, lighting, and acoustics, as well as timing, participants' schedules, and body language. This analysis will take place via an examination of factors that will ultimately contribute to preferred clinical interaction and results. The second primary topic calls for the learner's understanding of how to conduct a telemedicine examination. The patient's perspective will again be considered as well as the roles and responsibilities of all stakeholders in the telemedicine experience.

Via problem-based telemedicine case analysis, module two will serve as an effective way to provide deeper understanding of the concepts relayed in module one. Through a thorough review of clinically related, telemedicine case studies, learners will be able to understand why their clinical specialty has a specific protocol.

Organization and Management

The objective for this module is, like the Fundamental Cluster, to act as a marketing and motivational tool. The primary topic is to explain the role of the 'telemedicine champion' and 'participant empowerment'. This cluster is based on the premise that project leaders and participants will have the ability to influence the managerial, organizational, and business systems, when necessary, for the successful utilization of their telemedicine system.

Technical Systems

The primary topic of this cluster is to convey the technologies presently being used in contemporary telemedicine. Short courses in store-and-forward, video conferencing/visiting, and web-based applications will be presented. Interactive skill-building exercises are the means toward competent execution of software/hardware applications before, during, and after a consultation.

CONCLUSION

Needs assessment played a vital role in the DoD's telemedicine training curriculum design. This needs assessment identified the learning needs of DoD Healthcare Providers and confirmed the appropriateness of a web-based interactive telemedicine-training program. It defined what should make up the curriculum, thus avoiding a possible 'false start'. This was accomplished through the 20 learning objectives and 4 learning clusters that replaced the 5 presupposed learning modules.

The needs assessment is the first phase of a cycle. It drives the development of the training program with its resultant learning objectives. Once developed, the training is conducted. The evaluation of the training should include whether the learning objectives are being used in the work place and if the organization is achieving the outcomes it desires. If the participants have taken the training into the work place, but outcomes are not being achieved, then the cycle starts again while striving to understand the learning needs of the HCPs.

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Telemedicine in Otolaryngology

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Summary for Table of Contents

After a series of demonstration projects, otolaryngology has started to tackle demonstrating clinical efficacy for telemedicine and is now showing sustainability. Filling a need is the single most important factor in determining success and those areas with the most need (e.g. areas of geographic or social isolation) have been most successful. Recent legislation (BIPA) has improved reimbursement while other legislation (HIPAA) has added increased security requirements for the transmission of patient information. Equipment and transmission costs have dropped dramatically, but cost effectiveness has generally been demonstrated only when patient transportation and/or time away from work is calculated. Telemedicine programs that have adopted the principles of successful business models have had the greatest success.

Telemedicine is becoming increasingly difficult to separate from the rapidly expanding field of ehealth or Internet health. Telemedicine encompasses a broad spectrum of technologies to include telementored surgery, continuing medical education, remote diagnosis, tumor boards and robotics. In its purist clinical application, telemedicine is a medical consultation and remote diagnosis and/or treatment of a patient. One of the simplest forms is the telephone consult, progressing through the more involved store-and-forward of images for asynchronous viewing by a consultant, to the more bandwidth demanding "live" form of video teleconferencing. Different levels of technical complexity are required for various telemedicine consults, and the simplest forms should be considered first. In the past, the form of the consult often depended on what technology was available and, regrettably, whether it could be reimbursed.

Telemedicine began in the 1950s and 60s, but only one project in Newfoundland persisted past those years. Bashshur[1] divides the history of telemedicine into three era's: (1) the telecommunication era, depending on broadcast and television technologies which proved to be costly, cumbersome and often unreliable systems; (2) the digital era, starting in the late 1980s with the digitalization of telecommunications and advancements in computers, but limitations in and expense of bandwidth; and (3) the internet era, which allows lower cost, is more readily available and accessible by the population and allows extensive networks. With Internet 2 (I2) or Next Generation Internet (NGI) currently being tested comes the promise of increased speed (100/1000 fold increase in bandwidth) and increased possibilities (see Figure 1).

Most telemedicine programs have closed when their external funding stopped, but with the Internet era we are starting to see sustainability. Telemedicine programs in a number of states are seeing rapid growth. In its seventh year, the Arizona telemedicine

program cites an increase of 25-30% without the internet related growth expanding from 65 sites in 2002, to 100 sites in 2003 with 60 subspecialties[2]. Since 1996, the University of California at Davis Telehealth program has grown to cover 15 community hospitals in an area covering over two-thirds of the state. The University of Texas Medical Branch in Galveston, Texas, performs 1,900 live video telemedicine conferences per month and has performed 53,000 visits to date[3]. Nesbitt[4] notes that telemedicine now exists in all fifty states. A national program exists in Malaysia. He points to the growth of telemedicine as due to decreased equipment and transmission costs, increased bandwidth, improved reimbursement, continued maldistribution of health care specialists, and a widening knowledge gap between primary caregivers and specialists due to the explosion of medical knowledge. He also points to improved outcomes in specific areas by more experienced providers, and a more Internet savvy patient population who increasingly want the expertise brought to them.

Maldistribution of health care specialists is at the central core of telemedicine and is what has driven it since it was first used in the 1950s and 60s for underserved rural areas, as well as socially and geographically isolated populations. The American Academy of Otolaryngology's Workforce 2000 study demonstrates the specialty is no exception to the trend of concentration of specialists in urban centers (see Figure 2). Despite this disparity, otolaryngology is still relatively immature in the field of telemedicine. Issues of bandwidth, equipment costs, and the inability to be reimbursed have kept the specialty from advancing.

Success in Telemedicine

The first successful fields in telemedicine were those that most closely approximated daily clinical practice of the specialty: radiology and pathology.

Krupinski[5] first admonishes us to have patience with the progress of telemedicine in other specialties since both pathology and radiology having been working on telemedicine for thirty-five years. She then points out a number of reasons for telemedicine's success in radiology including: (1) parallels with the current practice of interpreting images without the patient present, so the task has not changed; (2) the same technology as current practice, including digital acquisition, store-and-forward and real time exams; (3) Digital Imaging and Communications in Medicine (DICOM) standards which include hardware and software integration, data transmission, data security, image display and compression; (4) data on infrastructure, acquisition, displays and ergonomics; (5) efficacy in that it works with results being billed and paid for; (6) surpassing diagnostic impact to demonstrate increased report quality in one study; (7) avoids transportation of patients; and (8) integration into the radiology culture, with oral boards being given using digital images. While these reasons for success cannot all be applied directly, certainly approximating current practice where possible, establishment of standards, data, efficacy and incorporation into our culture are important for Otolaryngology telemedicine programs.

Success in telemedicine is no longer restricted to those medical specialties that do not require the patient to be present; psychiatry using video teleconferencing is considered a mature telemedicine application. Krupinski[6] points to Cardiology, Dermatology and Ophthalmology as maturing specialties. Telemedicine Intensive Care programs using video teleconferencing have been started at a number of institutions. The critical ingredient for success is need. This is probably the single most important lesson learned from past and present programs. Telemedicine is most successful where the need is greatest, generally due to geographic or social isolation such as prisons,

Native American reservations, the Military, and rural settings.[7, 8] Other examples of need include the University of Texas Medical Branch in Galveston, Texas, which established a telemedicine clinic in the corporate offices of a large insurance company headquartered in Galveston. This fills the need of reducing employee time away from work[3]. The intensive care programs fill a need due to a shortage of intensivists. Home care programs fill the need of an aging population and the increased difficulties of physically making the trip to their physician. In addition to the criteria of filling a need, successful programs follow the same guidelines as most any successful business, as pointed out by Nesbitt (see List 1).

General Concepts in Telemedicine

Telemedicine is typically divided into real time or video teleconferencing (VTC) and store-and-forward. In real time or VTC, the consultant and requesting physician see the patient at the same time. In store-and-forward, the patient is seen asynchronously. Store-and-forward has been embraced most by those specialties that rely in some part on pattern and image recognition being predominantly visual, such as pathology, dermatology and radiology. The VTC format has progressed more in those specialties requiring significant physician-patient dialogue or interaction, such as psychiatry and intensive care.

Store-and-forward allows consultants the advantage of reviewing the case at their convenience (e.g. between cases in the operating room). Store-and-forward requires the referring physician to input the patient's history, physical exam, laboratory studies and/or radiology studies, thereby having the potential to make the consultant more time efficient since examinations and studies do not have to be repeated. Store-and-forward can ease scheduling problems for programs that cover a large number of time zones. The Pacific

Island Health Care Project at our institution uses store-and-forward consultation to cover five time zones, which includes the International Date Line. Although bandwidth is less likely to be an issue in the future, store-and-forward uses less bandwidth (Table 1). It is likely that use of store-and-forward consults will increase when the reimbursement issues are resolved. Currently VTC is the more common format. The equipment and bandwidth is more expensive, but it is more readily reimbursed. It provides immediate feedback for the referring physician, and more direct interaction with the patient and referring physician. Interoperative or telementored surgery, critical intensive care patients, and consultations that may require some real-time instruction (e.g. the use of nasopharyngoscopy) demand VTC's interactivity and immediate feedback.

Telemedicine in Otolaryngology

Otolaryngology is still an emerging specialty in telemedicine, but has embraced both store-and-forward and video teleconferencing. Most of the initial projects were demonstration projects, but otolaryngology is successfully utilizing telemedicine in a variety of clinical practices. The combination of a small population spread over great distances and a high incidence of otitis media and its complications among Native Alaskans has created a need for otolaryngology telemedicine consultation in Alaska. The Alaska Federal HealthCare Access Network (AFCHAN) project connects 235 remote sites (many accessible only by plane) using predominantly satellite links. Use of store-and-forward consultation has decreased demand for limited bandwidth from remote sites, and has allowed them to transmit over two thousand ear images (Stewart Ferguson, Ph.D., personal communication, 2002).

The Southern California /Tricare Region 9 Military program uses VTC consultation with a web-based appointment scheduling system to cover seven military

bases throughout Southern California. While bandwidth is readily available in this successful model, referring military institutions such as Twenty Nine Palms, CA, may still be an hour drive to the nearest town. Otolaryngology is the most commonly requested consult with three thousand otolaryngology consults completed; 600 surgical cases have had their preoperative evaluations done remotely (Darrell Hunsaker, M.D., personal communication, 2002).

In other examples, the need for Otolaryngology is as a smaller part in larger telemedicine programs. Started in 1996, the UC Davis Telehealth program utilizing VTC reported that Otolaryngology totaled seven percent of their first 1000 consults[9]. Adopting a web-based store-and-forward consult system in 1997, the Pacific Island Health Care Project at our institution provides health care to Micronesia and American Samoa. Approximately ten percent of the first 1500 consults were for otolaryngology. Otolaryngology plays similar roles in other statewide, national and international programs. Blakeslee[10] reported use in a private practice model, but success in private practice is not as well documented.

The number of telemedicine programs in otolaryngology is not known, but the Telemedicine Information Exchange web site (tie.telemed.org, a nonprofit organization for research sponsored by the National Library of Medicine) lists 16 programs. Of the sixteen programs listed, two used store-and-forward forms of consultation and fourteen utilized video teleconferencing. The reason for a significantly larger proportion of programs using VTC may be due to difficulties in reimbursement with the store-and-forward format rather than preference for the live format. However, for "closed" models (e.g. health maintenance organizations) reimbursement concerns would not apply. It is

likely a large number of otolaryngologists use the simplest form of store-and-forward telemedicine, email, but the exact numbers are not known.

Just as certain medical specialties such as psychiatry, which require significant patient interaction, favor the VTC format, those areas of otolaryngology that require significant patient interaction are currently best addressed in this format. Rehabilitation services for vestibular dysfunction[11], dysphagia[12], cochlear implants[13], voice therapy[14] and telepresence/telementoring[15] live surgical cases currently demand the interactive capabilities of VTC. The internet tumor board provides a hybrid of store-and-forward and live interaction. The cases to be presented are loaded on a web site that can be viewed prior to and during the tumor board. A telephone conference call is utilized for the live interaction component with the web images viewed on the participants' computers. Other institutions have chosen VTC for their tumor boards with remote locations. We currently use VTC and the telephone for remote speech therapy, but plan to progress to a hybrid model. Using a web-based program and digital input from external microphones, voice therapy exercises could be monitored through a laptop computer at the patient's home or referring clinic. When the program detects the patient performing outside preset voice goals, a report would be generated and sent to the speech therapist, who would review it and decide whether a VTC session is warranted.

Clinical Efficacy Studies

Proof of concept studies have demonstrated the potential usefulness of telemedicine in otolaryngology[14]; determining clinical efficacy is the next step. One of the earliest research questions to answer is whether a remote telemedicine examination (either VTC or store-and-forward) is as accurate as an in-person clinical examination. Kappa coefficients (K) measure agreement. Sclafani et al [16] suggests that for agreement

of clinical diagnoses "a K>0.5 is excellent and a K> 0.4 is acceptable" and provide the following: "A K value approaching 1 may only indicate that the question was too broadly posed to be significant. Large variations in K can be expected when either the number of answer pairs is small or the number of expected agreements is high (caused by either extremely common or extremely rare events)." A common statistical textbook definition is given in Table 2.

Clinical Efficacy in Nasopharyngoscopy and Laryngology

In 1994, Petersen et al[17] compared 24 in-person examinations to real time VTC examinations of those patients. Only six of those patients underwent nasopharyngoscopy and no statistical analysis was performed, as there was 100% agreement in diagnosis. In 1998, Furukawa et al[18] recorded still images from twenty-nine previously videotaped nasopharyngoscopic examinations of the larynx. One set of images was printed out and examined locally, while another set was stored as JPEG images and transmitted electronically to a distant site for diagnosis. Again, no statistical analysis was performed as perfect agreement was reached in diagnosis between the local and distant examiners. In 1999, Sclafani et al[16] looked at specific physical findings, such as mass and erythema as well as anatomic location, through the nasopharyngoscopic exam. They performed nasopharyngoscopy on 45 patients comparing in-person clinical examinations to remote examinations with a 384 kbp video teleconferencing system and delayed remote examination (recorded on the same system). Kappa values varied by anatomic site and physical finding. For the true vocal cords, Kappa values were .992 for VTC exam, and .441 for delayed remote exam agreement with in-person exam. For hypopharyngeal masses, Kappa values were .337 for VTC and .429 for remote examination agreement with in-person exam. These Kappa values compared to agreement of .784 for true vocal

cords and .444 for hypopharyngeal mass when a chief resident and board certified otolaryngologist both examined the same patients in-person. Marathe et al[19] looked at 19 patients with laryngeal masses as part of a blinded nonrandomized study of 59 patients with laryngeal complaints. Video clip images were stored as .avi files and reviewed in a delayed store-and-forward format. Kappa values for agreement of laryngeal mass between "in-person" and delayed store-and-forward examination ranged from .66 to .79 with all Kappa significant, $p<0.001$. More importantly, there was disagreement on only one of the 19 laryngeal mass cases, a patient with vocal cord nodules. No laryngeal tumors were missed.

Clinical Efficacy in Video Otoscopy

Clinical efficacy data is less available in video otoscopy. In unpublished data on sixty patients, we looked at the agreement of store-and-forward diagnoses of normal ears, otitis media and perforations to in-person examinations. Kappa values for agreement of diagnosis by board certified otolaryngologists ranged from .400 to .573. In unpublished data from Alaska, using store-and-forward telemedicine for tympanostomy tube follow-up, a substantial agreement between "in-person" and still image examination was demonstrated with Kappas ranging from 0.65 to 0.76 (Chris Patricowski, M.D., personal communication, 2002).

Clinical Efficacy in Rehabilitative Otolaryngology

We are currently analyzing our data to demonstrate efficacy in voice therapy through a VTC format. Vestibular[11], dysphagia[12] and cochlear implant rehabilitation[13] have undergone proof of concept studies, but there are no clinical efficacy studies to date.

Reimbursement

Typically, private insurance companies follow the government's lead in regard to payment. Past Medicare rules had limited payment for video teleconferencing to only rural areas with a 25%/75% fee splitting formula between referring and consulting physician, and did not allow payment for store-and-forward telemedicine. The Medicare, Medicaid and SCHIP Benefits Improvement and Protection Act of 2000 (BIPA) Public Law 106-554 eliminates fee splitting, expanding Medicare payment to equal the amount the provider would receive without telemedicine. A facility fee of $20.00 is paid to the originating facility, which may include a physician or practitioner's office, a critical access hospital, a rural health clinic, a federally qualified health center or a hospital. It allows for store-and-forward reimbursement, but only as pilot studies in Hawaii and Alaska (www.aamc.org or the Centers for Medicare and Medicaid Services, formerly HCFA www.hcfa.gov). Many states are slowly adopting Medicare requirements for Medicaid reimbursement.

Despite Medicare's reluctance to embrace store-and-forward telemedicine, private insurance carriers are reimbursing physicians. While they have not yet billed for otolaryngology services, the Arizona telemedicine group regularly receives reimbursement for the store-and-forward format using standard CPT coding from private carriers. They encountered only one insurance provider in the state who denied reimbursement for store-and-forward telemedicine consults. Their payers do not require a "GT" modifier (identifying them as telemedicine), but they recommend at a minimum identifying the services within the text of the consult as telemedicine.[20] Partners™ group out of Massachusetts has billed for ENT cases in a store-and-forward format as part of a comprehensive internet consultative service which has seen over 5000 consultations in all

specialties, but this service requires a single advance cash payment of $350 for consultation and does not use CPT coding.[21]

While their familiarity with diagnoses from images have driven both the specialties of Radiology and Pathology to mature their practice of telemedicine, the Director of the Office for the Advancement of Telehealth in U.S. Health Resources and Service Administration (HRSA) points out that it is the standards, data and published efficacy that has led to their acceptance and reimbursement. She cites this as a model for other medical specialties to achieve success in acceptance and reimbursement.[22]

Licensure and Credentialing

While medical licensure requirements vary between states for the vast majority, providers are required to obtain a medical license in the state that the patient resides (Figure 3). Nursing is moving toward a federal license. Currently eighteen states have adopted the interstate compact that allows nurses to practice across state borders.

In its 2001 revisions, the Joint Commission on Accreditation of Hospital Organizations (JCAHO) established standards for credentialing and privileging in Telemedicine (see List 2).

Legal Issues

The Health Information Portability and Accountability Act of 1996 (HIPAA), Public Law 104-191, mandates that electronic health information be protected. Protections under HIPAA are to be in place by October 13, 2002, and compliance mandated after April 14, 2003. Haigh[23] asserts that video teleconferencing over ISDN and T1-3 lines will be considered "voice phone systems" and will not require encryption. Video teleconferencing over the Internet will require secure virtual private network

(VPN) technology. VPNs provide an encrypted connection or "tunnel" through the Internet that permits a user's distributed sites to communicate securely. The encrypted tunnel provides a secure path for network applications and requires no changes to the application (www.csm.ornl.gov). Store-and-forward, including its simplest form email, will require similar protection.[22]

This Act affects privacy of health information in all formats (e.g. paper, electronic, fax, voice) and therefore has likely been addressed in many otolaryngology practices already. The Act's goals include providing consumer control over their health information, making covered entities responsible and accountable for protecting the individual's health information, and placing limitations on the uses and disclosures of this information. The Act does not preempt more stringent state or federal health information privacy requirements. Specifics on HIPAA rules, including consent, access, security, responsibility and oversight, can be obtained at the United States Department of Health and Human Services, Office of Civil Rights web page www.hhs.gov/ocr/hipaa/ and the American Academy of Otolaryngology Bulletin web site www.entlink.net/press/bulletin/view-the-bulletin.cfm.

Equipment

Most otolaryngologists are familiar with charge coupled device (CCD) cameras attached to a nasopharyngoscope as input devices for telemedicine exams. The video otoscope used for input of ear exams is a rigid Hopkins rod telescope similarly connected to a CCD camera (Figure 4). These input devices are connected to VTC and store-and-forward systems (Figure 5 & 6). Due to the inability of printed text to keep up with the rapid changes in specific telemedicine equipment, the Telemedicine Information

Exchange (tie.telemed.org) and American Telemedicine Association (www.americantelemed.org) web sites are better sources of current information.

What doesn't become obsolete in equipment selection is the importance of human factor considerations. Due to the competing demands on their time, surgeons in particular have little patience for new systems that do not work easily and properly. A Ph.D. in human factors was one of the first members of our telemedicine team. Prior to commencing telemedicine studies, we examined ease of use for software and hardware. The Alaska Telemedicine project relies on health aids as referring providers rather than primary care physicians. Accordingly, their software uses touch screens with relatively few large buttons to simplify sending consults. The Arizona Telemedicine program employs a Ph.D. in human factors to ensure similar concerns are met within their program. Once the equipment is selected, training is an equally important step. Again, the goal is seamless use of telemedicine on the first consult. Proper equipment and training are essential to achieve this.

Cost

Equipment costs and bandwidth costs have dropped significantly with $60,000 VTC systems now costing $6,000. Yet Telemedicine has still only been shown to be cost effective when patient travel time and expense is taken into account.[7] Prisoner transport costs with an armed guard can significantly add to the cost of a visit for a patient. A cost analysis study in Arizona found that the break-even point was if travel costs were considered for rural patients who traveled more than seventy miles. Few cost analysis studies for otolaryngology are available. Bergmo[25] found teleconsultation cheaper in Norway where the consulting hospital was 400 km away, with more than 56 and less than 325 patients per year. When greater than 325 patients were seen, it was cheaper for the

otolaryngologist to visit the referring clinic. In a closed (HMO) model, the Southern California/Tricare Region 9 demonstrated over $400,000 saved if the patients had been transported to the Naval Hospital in San Diego, but fixed costs are not calculated (Darrell Hunsaker, personal communication, 2002). Cost analyses have generally been performed in large telemedicine organizations in which otolaryngology has played a role[7]. Fortunately, the fixed costs (e.g. equipment prices) continue to drop, thereby continually improving the business model.

Krupinski[5] points out that telemedicine may also be a loss leader (a referral source which will make you money when the patient comes in for the surgery even though the initial telemedicine consult does not make money). E-mail with or without attachments is the simplest form of store-and-forward telemedicine and is currently used by many otolaryngologists as a loss leader.

Other benefits that may add value to a practice include raising their profile with referring MDs, and an increase in unusual referrals due to a greater geographic reach.[21] An otolaryngologist with a strong interest in cleft lip and palate repair, for example, might have an increase in referrals.

Teleproctored/Telementored Surgery

Telemedicine consultation in the operating room between surgeon and specialist (or subspecialist) allows a more experienced surgeon to mentor or proctor a less experienced surgeon. Our study[15] of 45 endoscopic sinus surgery patients demonstrated cases took an average of 3.87 minutes longer per side when teleproctored, but could be accomplished with no difference in complications or safety in selected patients. Numerous teleproctored proof of concept studies have been completed. We currently

have a VTC connection between operating rooms in Guam and Hawaii to assist with difficult cases or in cases where specific specialists are not available in Guam.

Telepresence using robotics with haptic (touch) or force feedback has been accomplished in proof of concept. Telepresence refers to the use of robotic equipment to assist the surgeon at the same location. In its simplest form, a robotic arm might serve as an assistant to the primary surgeon in performing laparascopic or endoscopic surgery. The surgeon controls the arm through a foot pedal or voice commands, while the surgeon's own hands are controlling other instruments. Some might argue that this is not true telepresence, as the surgeon is not removed from the patient. More complex robotic devices assist surgeons performing highly complex technical procedures, such as heart surgery. Surgeons operate at a console in the surgical suite, with the robot placed over the patient. The robot improves the technical abilities of the surgeon by gearing precise instrument movements to larger hand movements, requiring less fine motor technical ability from the surgeon than would normally be required.

Telesurgery, a form of telepresence, utilizes robotic devices controlled from another location. Unlike in-room forms of telepresence, this increases the technological sophistication of the procedure, as the connections through switching or conversion devices will increase the delay that the surgeon will experience. Signals travel at the speed of light or 186,000 miles per second. Therefore, a distance of 5000 miles (Honolulu, HI to Washington, D.C.) will result in a delay of 0.02689 seconds due to distance alone. Conversion of analog to digital signals and digital back to analog at the receiving end will increase this delay, as will delays through switches and routers. This is not a big issue for telementoring as total delays are less than a second, but such delays for telesurgery can lead to unacceptable visual and haptic feedback for the surgeon.

Conclusions and the Future

More outcome research is needed in otolaryngology telemedicine, but it would be a mistake to stop at only determining if telemedicine is as good as an "in-person" exam. The digital image recorded in a telemedicine encounter can be manipulated to increase diagnostic information not currently available. Radiologists currently take a chest radiograph in which a chest mass or the tip of an nasogastric tube is difficult to visualize, and by inverting the gray scale or viewing other digital manipulations of that image, the mass or tube tip becomes obvious. Examples in otolaryngology might include images of the larynx manipulated to better demonstrate the inflamed tissue of reflux, or images of the tympanic membrane manipulated to better demonstrate early retraction.

Despite dramatic and likely continued decreases, cost of equipment is still an issue. Current research points to good consumer acceptance, and certainly with each new generation the technology is more readily accepted. As Nesbitt[4] points out, it is certainly not difficult to look to the future and see ubiquitous broadband with video as common as telephone, or even extreme broadband enabling robotics and virtual reality TV with three-dimensional touch. Robotics and genomics will play a greater role in telemedicine and our lives. Applications for remote diagnosis in Biologic Warfare Defense and Homeland Security are currently raising interest in telemedicine. Telemedicine will be combined with new technological advances such as virtual "fly through" computerized axial tomography examinations. Instead of performing an exploratory tympanotomy, surgeons will use computer programs to "fly through" and examine all aspects of a patient's middle or even inner ear. Spectral imaging of the eardrum, larynx or oropharynx will immediately identify bacteria without cultures, or gram stain, and potential malignancy, without biopsy. By measuring fluorescence emitted from an

oropharynx illuminated with a specific visible or nonvisible light spectrum, spectral imaging will be able to provide instant identification of bacteria or evidence of malignant changes. The underlying principles of a successful business model must continue to be applied, with the most critical ingredient for telemedicine's success being the filling of specific health care needs. As long as the need is there, telemedicine in otolaryngology will advance.

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List 1- Factors Associated with Successful Models

Clear mission and rationale for telemedicine
Support from the top of the organization
Accountable leadership and governance of program
Solid business plan with adequate financial support, with adequate start-up time allowed
Well-defined service or target population
Clear need for services offered
Well thought out operational model
Committed service providers capable of providing the needed services
Referral guidelines and protocols that assure timeliness of service and appropriate cases for telemedicine
Continuous quality improvement that includes evaluation of satisfaction and outcomes
Technology that is appropriate for the application
Reliable technology and telecommunication
Adequate procedures and personnel for technical problems
Comprehensive training program for hub as well as spoke site personnel
In the end it must deliver value to those involved
Document and report the benefits

From Nesbitt TS, "Models of Telemedicine," presentation at the American Telemedicine Association Annual Meeting, Los Angeles, CA, June 5, 2002.

List 2- JCAHO Credentialing and Privileging in Telemedicine

MS 5.16: "Practitioners who diagnose or treat patients via telemedicine link are subject to the credentialing and privileging processes of the organization that receives the telemedicine service."

MS 5.16.1: "The medical staff recommends the clinical services to be provided by telemedicine."

Intent of MS 5.16 through 5.16.1 states: "An organization may use credentialing information for another Joint Commission accredited facility, so long as the decision to delineate privileges is made at the facility that is receiving the telemedicine service."

From
www.jcaho.org/accredited+organizations/hospitals/standards/revisions/2001/medical +staff.htm, last accessed 24 Jun 02.

Table 1 - Bandwidth Speeds

Lines	Speed	Video
POTS	28.8-56 kbps	3-8 fps (compressed)
DSO (DS 2600)	64 kbps	8 fps (compressed)
Single ISDN	128 kbps	16-20 fps (compressed)
Triple ISDN	384 kbps	28 fps (compressed)
T1 or DS1	1.55 mbps	30 fps (compressed)
ATM or DS3	45 mbps	30 fps (uncompressed)

Data from Reid J. A Telemedicine Primer: Understanding the Issues. Artcraft Printers, Billings, Montana, 1996.

Bit- binary digit, smallest possible unit of information
POTS- plain old telephone service
Kbps- kilobits per second or 1,000 bits per second
Mbps- Megabits per second or one million bits per second
Fps- frames per second
ISDN- Integrated Services Digital Network allows voice, video and data transmission
T1- larger digital signal carrier defined by carrying capacity of 1.55 mbps

Table 2- Kappa Values

0- 0.20 slight agreement
0.21-0.40 fair agreement
0.41-0.60 moderate agreement
0.60-0.80 substantial agreement
0.81-1.00 almost perfect agreement

Designing Web-based, Telemedicine Training for Military Healthcare Providers

(Running title: Designing Web-based, Telemedicine Training)

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Designing Web-based, Telemedicine Training for Military Healthcare Providers

Abstract:

Background: The purpose of the study was to ascertain those learning objectives that will initiate increased utilization of telemedicine by military healthcare providers. Telemedicine is increasingly moving to the center of the healthcare industry's service offerings. As this migration occurs, health professionals will require training for proper and effective change management. The United States Department of Defense (DoD) is embracing the use of telemedicine and wishes to use web-based training as a tool for effective change management to increase utilization. This article summarizes the findings of an educational needs assessment of military healthcare providers for the creation of the DoD web-based telemedicine training curriculum.

Methods: Forty-eight (48) healthcare professionals were interviewed and surveyed in order to capture their opinions on what learning objectives a telemedicine training curriculum should include.

Results: Twenty (20) learning objectives were found to be needed in a telemedicine training program. These 20 learning objectives were grouped into four learning clusters that formed the structure for the training program. In order of importance, the learning clusters were clinical, technical, organizational, and introduction to telemedicine.

Findings: From these clusters, the five web-based modules were created with two addressing clinical learning needs and one for each of the other learning objective clusters.

Key Words:

Educational Needs Assessment, Learning Needs, Learning Objectives, Telemedicine, Military Healthcare

Introduction:

The Institute of Medicine, National Academy of Sciences, defines telemedicine as "the use of electronic and telecommunications technologies to provide and support health care when distance separates the participants."[1] While many definitions of telemedicine have been put forward, most define the concept in terms of moving medical information over distance. Telemedicine is a way of providing quality, effective and efficient diagnoses, and clinical interventions by utilizing the real-time, or near real-time, two-way transfer of medical information between places of lesser and greater medical capability and expertise.[2],[3]

Many think that telemedicine has existed for twenty years. With the emphasis on "high-tech" for the last decade, it is an understandable misconception. In fact, telemedicine has been around far longer. In 1906, Einthoven used that era's "high-technology" to transmit electrocardiograms.[4] While early applications were single-purpose in nature and accentuated technical, rather than consultative aspects of telemedicine, the present applications are beginning to offer improved access to care for rural residents, at costs which are declining with technological innovation.[5]

The organizational change that occurs within a medical care system when new technology is introduced is often difficult to anticipate. Depending upon the intrusiveness of the technology, the changes in the organization may range from minor to profound. Telemedicine is a technology of the most intrusive sort. It utterly changes

aspects of the process and structure of diagnosis and patient-doctor communication in the medical setting. It is expected that the introduction of telemedicine will have significant impact upon the medical organization at both the micro and macro level of organizational functioning, which may lead the members of the organization to reject the technology.

Successful implementation requires that individuals think differently about their job tasks – the cognitive conceptualizations of their jobs. This learning process involves dismantling old procedures and attitudes, moving to a new pattern and then cementing this new process into the procedures of the individual and groups. The decision to utilize telemedicine in the most rational manner may be diverted by selective perception, mismatch of problem solving stages, human error, and limited memory. An effective training program can aid in this cognitive shift.

There is substantial research on the costs and benefits of telemedicine[6,7,8,9,10,11]. Here the fundamental research question is how do the costs of the application relate to the benefits of the telemedicine application compared to the alternative delivery methods? The most commonly used unit of analysis is often cost/benefit ratio. The main costs of telemedicine are fixed rather than variable, and as such, are difficult to reduce. Therefore, this ratio is most effectively reduced by substantially increasing numbers of consults (a benefit). Such an outcome is a major goal of the training that was researched and designed in this study. During the last ten years, the US military has been increasingly designing, prototyping, establishing, and deploying telemedicine. In pursuing the potential benefits of telemedicine, the DoD entered into a cooperative agreement with the University of Hawaii to create a web-based training curriculum for

the DoD Health Care Providers. There are examples of organizations using computer technology for health professional education, and the DoD would like to utilize computer technology similarly.[12] The end product of the agreement is a five-module training course that is accessible on-line and not to exceed ten-hours in length. This will give DoD health professionals access to the training they need, in its dispersed environment.

Methods:

This needs assessment involved four steps: Surveillance, Investigation, Analysis, and Reporting.[13] Surveillance involved the identification of learning needs through observation of the telemedicine process, interviews with users and non-users of telemedicine, discussions with senior managers, and an Internet search.[14] The Investigation stage included collecting data via a review of existing documentation, additional interviews, and surveys. Analysis included confirmation of the need for such a training program, the selection of the methodology for developing the training program, and substantiation of the participants' need to learn. Need was expressed as learning objectives and those objectives were grouped into learning clusters. The clusters were formed primarily based upon the expertise of the four teams tasked to create the modules. Physicians comprised team one, technologists formed team two, management specialists made up team three, and team four was formed from telemedicine project managers. Reporting involved preparation of a document delivered to the DoD management office with the research team's suggested approach.

Prior to the present assessment of learning needs, a comprehensive analysis of the need for telemedicine in the Pacific region was completed for the Army by the Akamai Group at Tripler Army Medical Center[15,16]. Primarily, the vast distances in the Pacific

region result in high costs for medical evacuations. The study also found that over 50% of such evacuations were avoidable. Hence, the study concluded that telemedicine, if significantly utilized, could contribute to improved access and reduced costs of the DoD medical services. The DoD then engaged, through a cooperative agreement, the University of Hawaii to conduct research that was expected to achieve the following:

Determine if telemedicine training is needed.

- Determine what DoD healthcare providers' learning needs are.
- Determine if distance learning methods, such as web-based learning modules, would be appropriate for telemedicine training.
- Determine the content of distance education modules that will best teach healthcare providers how to use telemedicine.
- Validate or revise the DoD predicted learning modules
- Identify modules that have the highest priority.
- Identify learning objectives appropriate for the learning modules with highest priority.

Instrument:

During the surveillance and investigation steps, face to face interviews were conducted with the research subjects. The research subjects were chosen because of their position within the military healthcare system and their location in Honolulu and Washington DC, the interview sites. These interviews consisted of open-ended questions that allowed the respondents the opportunity to express their opinions on the experience or inexperience in the past, present, and/or future as it related to telemedicine. (For a list of the questions used, refer to Appendix 1.) Surveys were conducted at the conclusion of the interviews. The survey's purpose was to get an

indication of what the research subject thought appropriate learning objectives would be for a telemedicine training program.[17] (For a list of the learning objectives, see Appendix 2.) In total, there were 57 respondents involved in the needs assessment. However, because of time constraints 9 respondents were unable to complete the survey. This article will focus on the results of the post-interview surveys. The characteristics of the research subjects can be found in table 1.

The survey began with a list of eighteen objectives that the research team believed relevant to a telemedicine training program (Appendix 2, objectives 1-18). The objectives were broad and all encompassing for multi-disciplinary respondents. Each was verbally descriptive of the general concepts that may be taught in the prospective training. Respondents were asked to rank the objectives using a 5-point rating scale. The end of the survey included a section where the respondents could write-in what they believed should be included as an objective.

This needs assessment asked for the opinions of both users and non-users of telemedicine. This was due to the fact that the training curriculum was being designed for both experienced and novice users of telemedicine. Furthermore, respondents ranged in their rank within the DoD's hierarchy from Non Commission Officer to Colonel.

Data Collection:

The survey was first administered in July of 1999 and last administered in December of 1999. After the first set of surveys, due to responses to write-in question, the two additional learning objectives were included to make a total of 20 objectives (Appendix 2, #19 & #20). This number of objectives (20 total) remained throughout the rest of the needs assessment. No other topics were suggested. The needs

assessment included respondents from two areas of the country. Thirty-three (33) respondents were from DoD Tripler Army Medical Center and St. Francis Medical Center in the State of Hawaii and 15 were from Walter Reed Medical Center, Bethesda Navy Medical Center, and Telemedicine and Advanced Technology Research Center the Washington DC area. In total, there were 57 persons interviewed. However, because of time constraints, nine respondents were not able to complete the survey. The survey was given immediately after the interview.

Sample:

Table 1 below describes some of the characteristics of the subjects answering the survey.

Table 1

Sample Characteristics
N = 48
8 distinct telemedicine initiatives or background experiences
46 respondents were involved in DoD healthcare delivery
21 respondents were military personnel
24 respondents were medical doctors
32 respondents are male
42 respondents were telemedicine users or had regular contact

Findings:

The surveys were coded with a 5-point rating system. Words relevant to the need of a learning objective were used to stimulate accurate representation of the respondent's opinion, see appendix 2. Analysis on this data included the calculation of each learning objective's mean score. Table 2 below captures the average rank from the 48 respondents for each objective. The lower the score, the higher the importance to training programs. For more description of what the Learning Objectives comprised, see Appendix 2.

Table 2

Learning Objective	Rank
Telemedicine Tools	1.35
Telemedicine's Benefits to Clinical Specialties	1.48
Scheduling and Location Factors	1.54
Standard Operating Procedures	1.54
Patient's Perspective	1.63
Distance Education	1.63
How to Conduct an Examination	1.65
International Perspectives	1.69
Telemedicine Case Analysis	1.77
Organization and Management	1.77
Failures of Telemedicine	1.81
Store and Forward Technology	1.81
Technology of Telemedicine	1.83
Legal and Regulatory Aspects	1.85
Video Conferencing Technology	1.85
Future of Telemedicine	1.90
Web Page Interface Technology	1.94
Telemedicine Business Aspects	2.02
Technology Applications of Telemedicine	2.25
History of Telemedicine	2.31

The results were interpreted that learning objectives close to a mean score of 1.0 should certainly be included in any program that was created. Mean scores of approximately 2.0 were interpreted as courses that should be strongly considered in the training curriculum. Scores greater than 2.0 were interpreted as potentially useful as supporting material for training. While some respondents ranked a few learning objectives as 4 = Not Helpful and 5 = Useless, none of the twenty proposed learning objectives had an average score higher than 2.31.

Conclusions:

A mean score less than 2.31 is not concrete justification to instruct learners in all of the learning objectives. Rather, the research team primarily interprets the results as

a strong indicator that the twenty learning objectives were found to be relevant to a telemedicine-training program and should be considered at some level. Since the learning objectives were thus deemed relevant, a second interpretation of the results found how each learning objectives ranked in relation to the others establishing a hierarchy of importance to a prospective training program.

Based on the premise that the research team covered all potential, relevant learning objectives in a broad fashion, they were grouped to form learning clusters. The premise behind cluster formation was that each of the twenty learning objectives fell under one of four categories/titles:

1. Clinical Applications of Telemedicine
2. Technology of Telemedicine
3. Organization and Management of Telemedicine
4. Fundamentals of Telemedicine

Once these learning clusters were formed, the highest ranked learning objectives within the cluster were noted. Then, using the total course ten-hour time limit, modules 2, 3, and 4 listed above were each allotted two-hours. Module 1 was allotted four-hours and broken into two two-hour modules. This was because Clinical Applications was ranked as the most important and relevant to the use of a telemedicine training program. Listed in Table 3 are the learning clusters. The recommended learning objectives are noted along with their rank out of a pool of twenty.

Learning Cluster Question Groups and Rankings

Table 3

Cluster	Learning Objectives	Average
Clinical	Scheduling and Location Factors Benefits to Clinical Specialties	1.61

	How to Conduct an Examination Case Analysis	
Technology	Telemedicine Tools Store & Forward Technology Video Conferencing Technology Web Page Technology Technology of Telemedicine	1.76
Organizational	Standard Operating Procedures Organization and Management Business Aspects Funding Considerations Distance Education Legal and Regulatory Aspects	1.84
Introductory	Patient's Perspective International Perspectives History of Telemedicine Failures of Telemedicine Future of Telemedicine	1.87

Recommendations:

Practice:

A learning needs analysis is typically performed if an organization wants to:

1. overcome performance problems,
2. introduce new systems, tasks, or technology,
3. and benefit from a perceived opportunity.

This needs analysis patterns the second situation with regard to the introduction of telemedicine into the military healthcare system. If properly introduced and utilized, telemedicine has the potential to improve healthcare on three key dimensions – quality, cost, and access. Unfortunately, the short history of telemedicine abounds with stories of promising technology that failed to achieve its potential. With this understanding, the DoD has initiated the development of a set of distance learning modules that have a didactic purpose: to teach healthcare providers how to use telemedicine and hence

increase its utilization. This needs analysis, therefore, sought to identify learning needs, which may be appropriately addressed by distance learning modules.

To this end, similar to Rogers in her article on education needs for oncology nurses[18], our team has identified a broad core curriculum covered by five learning modules. The purpose of these learning modules is not to create experts in the use of telemedicine, rather the training is intended at this level to acquaint a new user with the systems generally employed by their organization.

Limitations:

The DoD is currently conducting numerous telemedicine initiatives throughout the world[19]. Our sample was limited to forty-eight people, some of which were not military personnel. The personnel who were contacted were from prominent telemedicine initiatives located in Hawaii and Washington, DC. The problem seen here is that many knowledgeable telemedicine users with military medical experience were not interviewed. Thus the conclusions drawn here are limited because of a small sample size, which is possibly biased towards certain specialties, modalities, and locations. The study design did not enable the reporting of physicians' needs compared to others.

Future Research:

The learning objectives that the needs assessment identified are broad in scope; yet, they cover most obstacles facing the military health care system as it implements telemedicine. Future needs assessment research should proceed along two paths. The first effort should encompass the learning needs of a non-military healthcare organization. For example, the military operates under different fiscal and legal control

systems and therefore are likely to have some needs that do not match the non-military sectors such as private and non-profit medical organizations. The second effort should encompass research that specifically targets the needs of various specialties. For example, while radiology and psychology can both take advantage of telemedicine, it is likely that their needs are not the same. By virtue of the fact that their primary modalities are different (graphic images for radiology and real-time video for psychology), there are certain to be different needs for the two specialties.

Lessons for Practice

Assessment of learning needs informs the designers of training programs.

Increasing the number of telemedicine consultations is central to satisfactory cost to benefit ratios, and training in the use of telemedicine is fundamental to increasing its use.

Appendix 1

Face-to-Face Interview Guide

Begin with broad questions that allow the interviewees to discuss what they felt was important:

1. To help me better understand your organization, please tell me a little about your duties at _____.
2. How are your responsibilities affected by telemedicine?
3. From your point of view, is telemedicine very effective? What is its potential?
4. Regardless how effective they are, all organizations have some things that get in the way of their success. What things get in the way of telemedicine's effectiveness?

Questions used to have the interviewees elaborate on specific areas they may have not discussed in answering the first four questions.

5. Describe how coordination occurs between you and others involved in telemedicine.
6. What about communication surrounding the telemedicine initiatives? What is like? How does it happen? What works well? What gets in the way of effective communication?
7. Focusing on human resources (people) issues and programs, tell me what is it like to work here in telemedicine.
8. Are there human resource issues or programs that need more attention?
9. Focusing on the leadership as a team, rather than individually, what do you think the leadership team needs to do more of? Less of?
10. Are there restructuring changes that you would recommend?
11. What budget reallocations seem logical?
12. What are two or three recommendations that might result in improving any the areas we have discussed?

Training Specific Questions:

13. Based on your experience with telemedicine, in the beginning, do you feel that you had a clear understanding of what telemedicine was and its potential within your project/program?
14. How did you progress to your present level of telemedicine skills and knowledge? Self-taught, informal training, formal training?
15. What format did the training take place. Book, classroom, on-line, and hands-on.
16. Based on the training described in #14, which methods do you feel is best when bringing new HCP's into your project/program?
17. What areas of training would you have liked more emphasis on? Less? Are there any areas that were of no value to you?
18. What would be more effective, an intensive training course in a couple of days or a module like training course over a longer period?

19. What would the time be for your choice in #17? 2 x 8 hour days or 1 hour a day over 2 weeks. Other?
20. Do you feel on-going training would be helpful for those above, below, or at the same level as you? Are there specific groups?
21. What amount of time should be spent?

Appendix 2

Face-to-Face Learning Objective Survey

SCENARIO: You are the manager of the _____ program's telemedicine program. You are assigned new healthcare providers (HCPs) that will be part of your program. The HCPs include doctors and nurses that have medical experience but no telemedicine experience. You decide to train them on various issues relative to telemedicine so that they can quickly understand how telemedicine affects medicine and your program. The topics below are training courses designed to acquaint the HCP with telemedicine.

INSTRUCTIONS: Consider the topics and how being trained about them may or may not have helped you in the beginning stages of your telemedicine program. Think of how they may or may not help the new HCPs. Rank them from 1 to 5 based on the value system below. Note: Some topics may not be helpful or have any use to your program.

1 - Required 2 - Recommended 3 - Not sure 4 - Not Helpful 5 - Useless

1. Patient's Perspective – Discussion on what the patient thinks of telemedicine. Examples of the patient's concerns with privacy, comfort, and safety will be presented and discussed.

2. Standard Operating Procedures – A discussion on the DoD's requirements, as well as the program's requirements for paperwork, consult scheduling, and other protocol.

3. Organization and Management – A discussion detailing the program's mission and its position in the military hierarchy. The program's power structure will be discussed, letting the HCPs know where they fit in.

4. Scheduling and Location Factors – A discussion about the special concerns with time and location when setting up consults. Factors relating to equipment set-up, lighting, acoustics, and others will be explored.

5. Telemedicine Business Aspects – A discussion on the program's cost factors and how to run a cost-effective program.

6. Funding Sources/Considerations – A discussion on reimbursement for this type of medical care.

7. Distance Education – A discussion on how education in the healthcare industry is being affected by telemedicine.

8. International Perspectives – A discussion on how telemedicine is used and affects those overseas and/or otherwise isolated.

9. Legal and Regulatory Aspects – A discussion on the ramifications of intra-state, inter-state, and international telemedicine.

10. History of Telemedicine - A discussion on how telemedicine has evolved.

11. Failures of Telemedicine – A discussion on where telemedicine has not worked and why.

12. Telemedicine Tools – A discussion on what tools and equipment are needed for the program specialty and how to use them.

13. Store and Forward Technology – A special course in the use of MPEG, JPEG, and similar software/hardware applications.

14. Video Conferencing Technology – A special course in the use of video conferencing software and hardware with special attention to clarity of pictures and sound.

15. Future of Telemedicine – A discussion on the various telemedicine applications that may soon come about.

16. Telemedicine's Benefits to Clinical Specialties (Radiology, Dermatology, Endocrinology, Cardiology, etc.) – A discussion on how telemedicine specifically effects the program and clinical specialty.

17. Web page Interface Technology - A course in the design and use of web-page data gathering options and their capabilities and limitations.

18. How to Conduct an Examination – A course on the methods used in the program's interaction with patient's and colleagues.

19. Technology of Telemedicine – A discussion on the present technological applications of telemedicine.

20. Telemedicine Case Analysis – A presentation of how similar telemedicine programs approach the program's area of expertise. Examples from the program's clinical specialty will be explored.

Are there any course titles or descriptions that you did not see but think would be appropriate for HCPs new to telemedicine? Please list below.

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Spatial Simulation Model for Infectious Viral Diseases with Focus on SARS and the Common Flu

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Abstract

This paper will focus on simulating the infectious process on a computer. To simulate how an infectious viral disease spreads not only shows how people get sick, it can also be a powerful tool in disease prevention. You can test actions such as to isolate people that get sick and analyze if the disease spread can be circumscribed or stopped. Special focus will be given to SARS and the Common Flu.

1. Introduction

Simulations that show how diseases spread can be powerful tools in disease prevention. Most available simulations use abstract representations relaying on well defined mathematical models. Commonly used parameters are infection rate, probability of getting ill, attack rate and duration of an infection. Age, family settings, school and work situation or geographic information are not considered in detail.

Furthermore, what happens if people stay home instead of going to school or work when they are sick? Can the disease spread be limited? What preventive methods such as vaccination are available and what is the effect of using these methods?

More questions arise. Where do people infect each other? How do family settings, school and work situation or geographical location of an individual change the likelihood of getting sick? How can infections be prevented? How can a disease spread be circumscribed or stopped?

This paper shows our approach in the design of an application that simulates the infectious process of a common viral disease. We allow not only input of commonly used parameter as described above but also allow to set age, family settings, school or work situation and spatial information. Our special focus will lie on the flu.

2. Related Work

The field of Epidemiology is well established and sources of information are widely available.

2.1. Characteristics of the Infectious Process

We now formulate the basic characteristics of a single disease as described in figure 1. We have five types of individuals:

- *Susceptible* – Neither infected nor immune.
- *Infective* – Infected with the disease.
- *Isolated* – Individual with no contact to others.
- *Immune* – Immune against the disease.
- *Dead* – Died because of the disease.

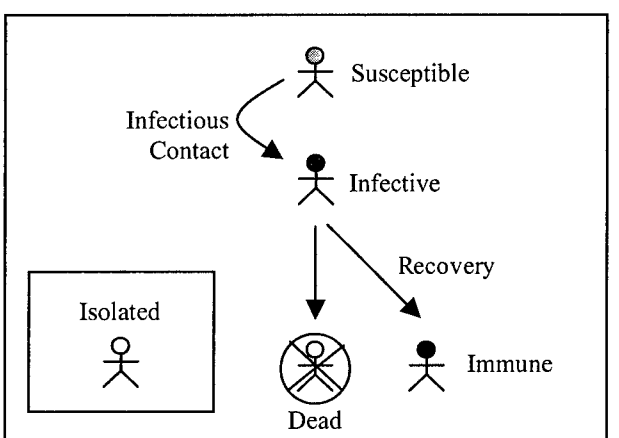


Figure 1: Characteristics of the Infectious Process

A Susceptible gets an Infective by an infectious contact. He becomes a Removal if he either gets Immune or Dead. Isolated individuals have no contact to others, thus cannot get infected or cannot infect other individuals. By the model above only a single disease is

considered. Furthermore individuals only infect each other by contact. Supercarriers or agents for disease transmission are not considered either.

Parameters that have to be taken into consideration are the following:

- *Attack distance* – Max distance where an individual can infect somebody else.
- *Attacks per Time* – How many attacks does an individual execute per day. E.g. how many times does somebody cough and spread particles with the disease.
- *Attack rate* – Defines how likely it is for a susceptible to become infective by contact with an infective.
- *Infective period* – Duration for an individual to have the disease.
- *Recovery period* – Duration for an individual to recover.
- *Death rate* – Likelihood to die from the disease.

Furthermore we can put individuals into different groups based on their social function, age and family. Individuals that go to school have many more contacts with other people than individuals that stay home most of the time. The job that you are working in or the size of your family has a great impact on the probability of infection.

Geographically crowded areas such as big towns where many contacts between individuals are possible or less crowded areas might play an important in disease spread. So to model a disease we have to put the following items on our list to be taken into consideration:

- Age of an individual
- Number and type of people an individual is living with.
- School or work situation.
- Spatial information.

Furthermore, another area of interest is disease prevention. Actions that can be taken to limit or stop the spread of a disease:

- Vaccination
- Isolation of an individual. For example staying at home while infectious.
- Quarantine

2.2. Survey of Available Tools

Commonly available tools to simulate disease spread are largely based on mathematical formulas. Computer programs that model diseases related to real life situations are available rarely. The next following paragraphs give an overview of some selected tools for simulation of disease spread.

[11] describes different mathematical models to be used for simulation of infectious disease epidemics. Computer programs are given for the Fortran language.

"Epi Info" [15] by CDC [16] is a database and statistics software. It contains a series of programs for use by public health professionals in conducting outbreak investigations, managing databases for public health surveillance and other tasks, and general database and statistics applications. It allows different types of data to be inputted and analyzed, however it is not designed to simulate diseases.

"STELLA" [17] is a computer simulation based model building tool. It is designed as learning environment and for research and science. It can also be used for other fields than Epidemiology. Models have been created for the flu that are rather simplified and don't go into details [18].

Another tool available is "SIMEX" [19] which enables a user to create micro population models. "SIMEX" is designed as a C++ library and somebody has to do programming in order to use the library package. Some rudimentary models have been created simulating the flu.

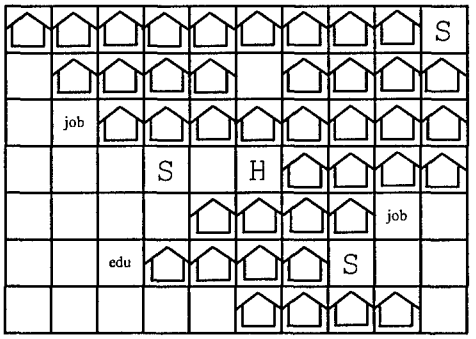
"NetLogo" [20] is a interesting tool that has the ability to model in 2D. Many models exist for different fields such as Biology, Chemistry, Mathematics and Social Science. "NetLogo" also allows to build own models. One model is available that simulates virus infection within a population.

The next section shows our approach in the design of an application that simulates diseases with special focus on the flu.

3. Simulation

For infectious diseases, mathematical models to calculate disease spread have a fundamental descriptive problem. However, mathematical models do not exactly simulate real life situations. A mathematical model is by its nature a simplification. It is abstract and ignores certain aspects of disease spread. It does not consider the environment in which people live. Spatial data such as the location of an individual at a certain time, buildings or locations of contagious contacts are left out.

Our approach in simulating a disease is embedded in an environment in which people can move around freely in 2D. The simulation uses stochastic interactions of people to determine disease spread. Consider figure 2. The environment can be arranged as grid with houses, stores, schools, work places and hospitals. The grid lines are designated as streets where individuals can move around from location to location.



edu Educational Institute

job Work Place

S Store

H Hospital

Home

Figure 2: 2D Environment

Individual and disease(s) are described in figure 3. An individual has parameters such as age, gender, health and a current location. Furthermore an individual has a home and might have a work place or a school where he is going to. He does shopping and visits the hospital if he is ill.

A disease is modeled as virus and antibody pair. An individual can get infected by a disease using stochastic interaction. An individual gets a virus and builds up antibodies. The attack rate and number of contacts with a virus define the likelihood for an individual of getting infected.

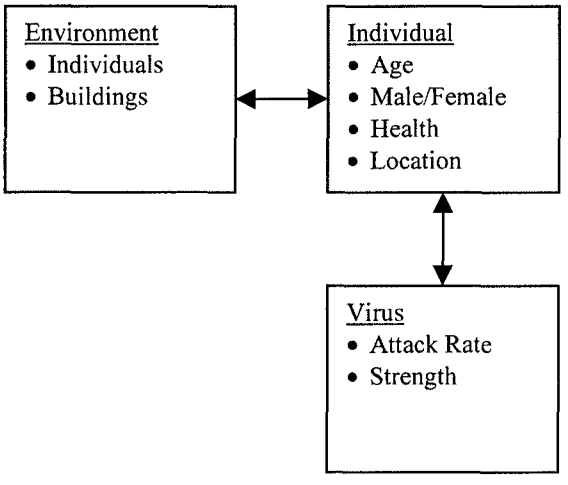


Figure 3: Environment, Individual and Virus

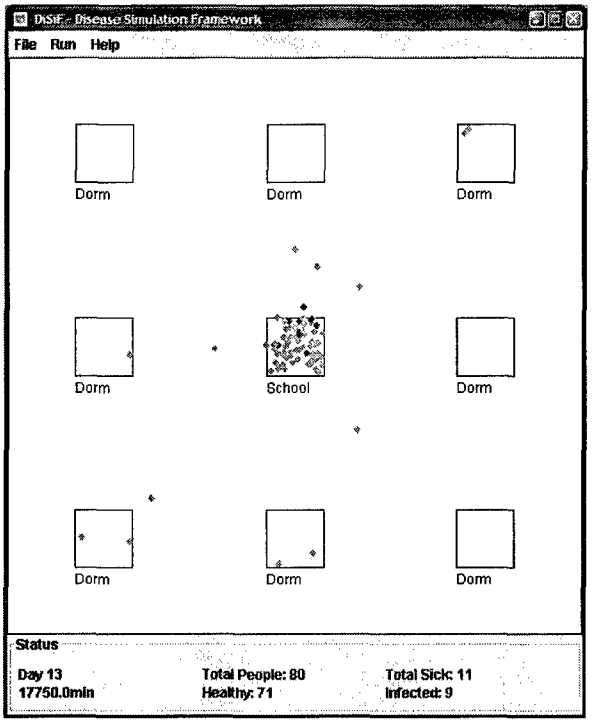


Figure 4: DiSiF Screenshot

Parameters play a role in deciding if somebody gets infected. How many people does somebody live with? Where does she go to school or work? How often does she stay at home? How many contacts does she have with her friends? How many times does she go out?

We built a simulation using the Java programming language to find out more about disease spread. The software is based on the model described in this section. We use a 2D environment where individuals can move around freely. The environment consists of buildings such as houses, schools, work places and hospitals. Individuals can have different viruses. Individuals can get infected, can recover, can die and can infect other individuals.

Figure 5 shows the parameters used for the stochastic, discrete simulation. *Infectious period*, *recovery period* and *body remaining time* can be inputted. Body remaining period donates the time where the virus still can infect other people. *Attack distance* donates the radius in which the virus can spread to other people. *Attacks per day* gives the number of time somebody is spreading out the virus, e.g. coughing. *Attack rate* donates the strength of an attack. Attack rate is the likelihood of getting infected when in contact with a virus.

Virus Parameters

Virus Name	SARS
Infectious Period [d]	6
Recovery Period [d]	7
Body Remaining Period [d]	120
Attack Distance [m]	1.5
Attack Rate [0.0, 1.0]	0.9
Attacks Per Day	48
Death Rate [0.0, 1.0]	0.05

Figure 5: Parameters

Information about the software framework is available upon request[1]. The next section shows the results obtained by the simulation.

4. Results

Figure 4 shows a screenshot of the simulation implemented. The simulation functions in 2D, it has buildings and individuals that can move around inside. One disease can be simulated at a time.

Visible in figure 4 are eight buildings designated as dorms and a school in the middle. Individuals are represented as dots. The dots have three different colors based on their status of infection:

- Green •: Never infected
- Red •: Infected
- Blue •: Previously infected and recovered

The software that runs the simulation executes the environment in discrete 60 second intervals. The individuals are executing simple tasks. They get up in the morning, go to school, move around in the school, go home in the evening, move around at home and go to sleep. Parameters can be set, so people stay at home when they are sick instead of going to school.

The created environment is simple, however it can be improved. More buildings can be created such as work places, hospitals and stores. The individuals can be changed to do more complex tasks.

Different tests have been done simulating the common flu and the SARS virus. Other viruses can be created and added to the simulation.

Figure 6 shows infections over time obtained by running the simulation, starting with only one individual infected by the flu. About 50% of all the individuals got infected in average.

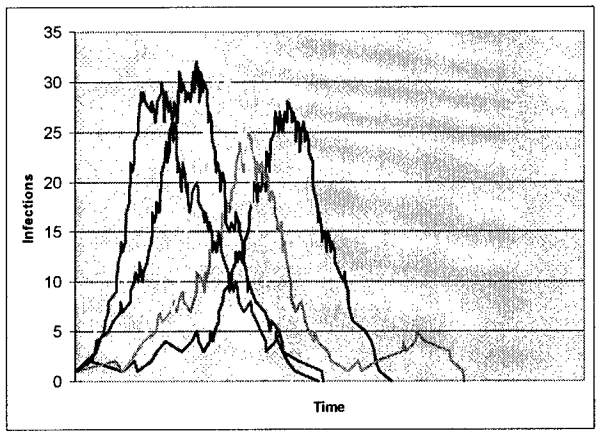


Figure 6: Common Flu

For the SARS virus various runs have been done. However, the infectious process and other parameters are not well known. Preliminary results show that in all the cases the infection spread to other individuals and infected about 90-95% of the people.

5. Evaluation

The Disease Simulation Framework, in short DiSiF, has been implemented in Java. Thus it allows running the simulation on all major Computer Systems. The software is also implemented as Applet, therefore can be run from a web browser.

The application is implemented to enable simulation of diseases in 2D. The created environment is rather simple. The individuals execute easy tasks such as moving or sleeping. The viruses added are the Common Flu and SARS.

The simulation is designed to evaluate disease spread in areas such as small towns, single buildings or universities.

Results from various runs are not consistent with each other. Comparison to real outbreaks has not been done yet. Considering the facts, in a very well modeled environment, infectious disease spread prediction might be rather hard. Weather forecast even with the most sophisticated computer hardware is not perfect and can be wrong. Disease spread forecast seems to be even harder. It is not possible to know exactly what each individual is doing at a certain point of time. As for weather forecast, *"Does the Flap of a Butterfly's Wings in Brazil set off a Tornado in Texas?"* This is called the butterfly effect, which in turn can also apply for epidemics. Can disease spread ever be predicted accurately?

In order to improve the simulation, more complex environments have to be created. The individuals need to execute more realistic tasks than just going to school,

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going home and sleeping. So far only random tests have been done to evaluate the performance of the software.

6. Contributions and Future Directions

Preliminary results show that the software is working. It can be shown graphically what people are doing. Actions can be taken in order to prevent infection. However, the simulation is rather limited and cannot be used to determine disease spread.

First, the environment needs to be designed more complex. Streets, work places, stores and hospitals have to be added. The individuals need to be made aware of that and have to be changed to the new environment. Further it should be considered to implement the Disease Simulation Framework in 3D. Buildings have to be designed that have more than only one floor. Adding animals would allow simulating other disease such as Malaria or the Mad Cow Disease.

One interesting environment to be considered to be implemented could be a single island with people living on it. A closed environment is much simpler to implement than a whole continent because the ports of entries are well defined and allow control of people entering or leaving.

Other diseases of interest are HIV/AIDS. An abstract data type for viruses has been designed and allows adding any type of disease to the simulation.

Conclusive, still major changes and further test have to be done with the software.

7. Acknowledgements

Thanks to Dr. Dennis Streveler for his support and advice in doing this project. Furthermore, Thanks to Dr. Lawrence Burgess for his ideas about disease simulation.

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HIGH ALTITUDE RESEARCH HAWAII

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High altitude research is difficult due to isolated locations with extreme environmental conditions. We are in the early stages of developing a high altitude research laboratory at the Mauna Kea Summit (4205m). A primary concern in this initial effort was to establish broadband connectivity to the summit for the real-time transfer of physiologic and other data. The summit's location has several advantages. Hilo Airport is a major inter-island airport for commercial jet aircraft, and is a short flight away from Honolulu
International Airport. Travel to the summit from the airport (and sea level) is a 90-minute drive over good roads, with snow being an infrequent factor. A hospital is 60 minutes away. Hale Pohaku (2800m) is 20 minutes from the summit, and serves as the main support area for lodging and logistics. It is ideally situated to acclimatize and support staff and subjects. The summit's main research building accommodates up to 25 people,
with the lack of plumbing being the only negative. The building has been wired with 2 phone lines and broadband IP connected to the Univ Hawaii's network with a DS3 connection. We successfully accomplished transfer of multiple types of data outside
of the Univ network to Honolulu and Stanford Univ. Data consisted of the following: live streaming physiologic data using NASA-Stanford developed systems (pulse oximetry, 2-lead EKG, heart rate, respiratory rate), live video teleconferencing, live audio from a digital stethoscope, and transmission of x-ray images. The Mauna Kea Summit is an ideal site for a high altitude research laboratory due to its unique location, good facilities,
and broadband connectivity. With further development, we hope to open Mauna Kea as an international site for high altitude research.

e-Health Utilization: Socio-Cultural Issues

by:

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And Robert Doktor,[2] Ph.D. (Stanford)

Abstract

This study discusses organizational design issues of health care systems preparing to implement e-health technologies. The cultural environment of the system proves to be an important determinant of appropriate design to enhance e-health technology utilization.

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The Problem

Modern health care organizations are confronted with the advent of new clinical e-health technologies as never before. Early evidence suggests great difficulty in the implementation of these new technological advances (Bangert and Doktor, 2000). Telemedicine is a good example of this problem. Originally conceived as a two-way video conference between a primary care provider and patient at one end, and a specialist at the other end, telemedicine has evolved into a clinical information technology sub-system in which multi-media email and web-based applications transfer precise and detailed clinical patient information between health-care providers, and sometime the patients themselves, accurately and rapidly across long distances. The result is enhanced patient access to better health care, reduced total health care costs and, as a consequence of easy access to the most appropriate specialist expertise, higher overall quality of the health care delivered (Davis, et. al 2000). Despite the great promise of clinical e-health solutions such as telemedicine, successful implementations with high utilization have been rare (Pushkin, et al., 1997).

There are many reasons for poor implementation performance (Bashshur and Gringsby, 1995, Bashshur, Sanders and Shannon, 1997). Often legal barriers prevent telemedicine from being used across political boundaries. The issue of reimbursement of HCP services is sometimes a barrier to utilization. Sometimes the technology does not perform as advertised. While all the issues listed above are real and relevant, they do not explain what we believe to be the fundamental cause of the problem.

It is our hypothesis that a primary cause of implementation problems in clinical e-health solutions such as telemedicine are organizational in their origin. We hope to demonstrate that most modern health care organizations are conceived, designed and structured to promote effectiveness and efficiency of a bygone era; a time when quality was assured by formal authoritarian control, iron-clad rules, and a one best way mentality. It is our intention to demonstrate that in many places around the globe, the most appropriate strategy for a health care organization embarking seriously into e-health solutions will be a strategy that requires a more organic and less mechanistic organization design. We intend to argue that, for many health care organizations, a more organic organizational structure and culture will better match the cultural and knowledge/ learning predispositions of the organization's members. Further, our intent is to demonstrate that it is this harmony between the predisposition of the organization's membership and it's strategic intent and organizational design that will be instrumental in achieving higher utilization of e-health solutions.

However, this may not be the case everywhere. Cross-cultural analyses are important to show that what may work in one culture, may not be appropriate in another (Hofstede, 1991). Specifically, we seek to demonstrate that the nature of the successful design of a health care organization depends upon the values of the society it serves, and one solution to the e-health implementation problem does not fit all situations.

The Theory

Organizational Design Literature:

The appropriate design of an organization depends upon many factors, but most salient among these are the strategic intent of the organization (Doz and Prahalad, 1986) and the environment in which the organization operates (Lawrence and Lorsch, 1967; Galbraith, 1973; Porter, 1990).

The research literature on organizational design (Pugh, et. al. 1963; Child, 1973; Ouchi, 1977; Weick, 1977; Daft, 1982)considers both the structural elements of design and the cultural elements of design (Pfeffer, 1982; Mintzberg, 1983). The most salient of structural dimensions are complexity, formalization and centralization (Pugh et. al. 1963; Mackenzei, 1978; Daft, 1982; Robbins, 1993; Lin and Hui, 1999). The most salient of cultural dimension are values and learning style and strength (DiBella and Nevis, 1998; Hofstede, 2000).

Organizations with high complexity are defined as those with redundant systems (Womack, et a., 1990). Organizations with high formality are defined as having high division of labor (Weber, 1964; Rehder, 1992), strict rules (Drucker, 1987) and discouraging of multiple job skills, (Drucker, 1987). High centralization in organizational design is said to exist if communication is based upon strict vertical individual command chains (Womack et. al., 1990) and a discouragement of participation in both communication and decision making (Zetka, 1992). Organizations with high complexity, formality and centralization are often referred to as highly mechanistic in their structure. Organizations with the adverse structural characteristics are said to be more organic in their structural design. There exists a strong parallel on the cultural side of organizational design. Organizations with cultures that value learning and seek to encourage both individual and organizational learning are often characterized as being more organic and usually are more open about making mistakes, encourage questions and participation, highly supportive of learning new things, willing to accept diversity and tolerant of ambiguity: (DiBella and Nevis, 1998). Organizations whose cultures do not tolerate ambiguity, are closed to admitting mistakes, punish mistakes, and seek to avoid diversity fall into the mechanistic category from the organizational cultural viewpoint.

Thus, organic versus mechanistic organizations are two ideal types, and as such never exist in totality in the real world. Rather, the issue is one of relativity. Is the organization generally more organic in its structural and cultural dimensions, or is it more mechanistic on these dimensions.

Technology Diffusion Literature:

The research literature on technology diffusion in organizations has shown low correlation between centralization, complexity, formalization on one hand and technology acceptance, adoption and implementation on the other (Rogers, 1995). Meyer and Goes (1988) studied the technology diffusion process in 25 hospitals as these organizations went about deciding to adopt medical innovations such as CAT scanners, ultra sonic imaging, laser surgery, fiber optic endoscopy and so forth. They found only

10% of the variance attributable to organization structural variables, but 40% of the variance in adoption success attributable to organizational cultural variables such as attitudes, perceptions and especially the climate for innovation created by the organizations' leadership. Organizations with a culture that encouraged its members to try new things to meet environmental demands were much more likely to adopt technical innovations. Van de Ven and Rogers (1988) point out that adoption of technology often fail because a particular innovation may not fit well with an organization's perceived problem, or the expected consequences are perceived by the organization's members as more negative than positive.

Research on computer related technical innovations in organization point to the perceived "uncertainty" created by the innovation as a source of resistance to adoption of the technology (Gerwin, 1988). The concept termed uncertainty by these researchers is akin to the notion of uncertainty avoidance (Hofstede, 2000). In a later section we expand more on the role of uncertainty avoidance in the process of implementation of new computer-related technologies such as those of e-health implementations.

Resistance to Change Literature:

Just as technology diffusion literature enriches efforts to understand the role of organization design in the implementation problem, so too the literature on resistance to change and change-management adds insight as well. This literature has a long history (Lewin, 1951) and has given rise to many successful consultancies. Primary among the tenets of this school is the concept of attitude change being a three phase phenomena. Successful attitude change requires an unfreezing, change, and refreezing. The reason attitudes change is so central here lies in the postulate that most resistance to change found in organizations are rational decisions, based upon currently held attitudes of participants re their position in the organization and the consequences of the change from the point of view of that position (Bridges, 1991).

Consistent with resistance to change literature, the conceptualization of organizational culture speaks, at a more aggregate level, to the same dynamics as do the change literature. Organizations with learning cultures are keen to adopt new things, open to diversity and embrace change. At the aggregate level, the learning culture plays the role of the unfreezing and refreezing components of the resistance to change literature. It is as if two sets of scholars were looking at the same phenomena, but at different levels of aggregation, and reaching similar perspective conclusions.

Cross-Cultural Organization Literature:

For our analyses of cross-cultural impact upon organizational designs for successful e-health implementation, we draw heavily upon the work of Hofstede (1980, 1991, 2000), who is a member of our larger research team. Hofstede (1991) has argued that organizational system work best when their design is consistent with the underlying values and culture of the society in which they function. In particular, Hofstede has pointed out that American management practices may not be appropriate or successful when implemented in societies with different cultural values than America. Hofstede (1980, 2000) identified five clusters of values (which he has termed: 1) power distance,

2) uncertainty avoidance, 3) individualism and collectivism, 4) masculinity and femininity, and 5) long versus short-term orientation. Each of these value clusters is rather complex and we refer the reader to Hofstede (2000) for a complete analysis. However, it is the second value cluster, uncertainty avoidance, which appears to be closely related to our analysis of the relationship of organizational design to successful e-health implementation, and so we shall expand upon this construct.

Uncertainty avoidance refers to the propensity of people, and collectivities, to dislike and attempt to avoid ambiguity. High uncertainty avoidance cultures do not like unpredictability. They like stability, they prefer fixed structures and clear interpretations. They like thing black and white, not gray. They do not like experimenting with unknown outcomes. They are not fond of diversity. They are not keen to be open about errors.

It will be our intention in the hypothesis which follow to show that societies with high uncertainty avoidance create an environment for organizational design that strongly favors mechanistic organizations, even when the strategic intent of the organization may pressure for a more organic organizational design.

Countries which Hofstede (2000) has measured to be high uncertainty avoidance cultures include Japan, France, and South Korea. Middle level uncertainty avoiding countries are Italy and Taiwan. Countries scoring low on uncertainty avoidance are Singapore, USA, and United Kingdom.

Drawing from the above review of the research literature, we propose the following hypothesis:

1) If e-health technology is to be implemented successfully in health-care organizations in societies with low uncertainty avoidance cultures, then more organic organizational designs are called for in these health care organizations. Formally, we state this as:

HYP I: e-health implementation success is independent of the degree of mechanistic versus organic organizational design in low uncertainty avoiding cultures.

2) If e-health technology is to be successfully implemented in health-care organizations in societies with high uncertainty avoidance cultures, then more mechanistic organizational designs are called for in these health care organizations. Formally, we state this as:

HYP II: e-health implementation success is independent of the degree of mechanistic versus organic organizational design in high uncertainty avoiding cultures.

The Method:

In this study, a mixed method approach of pooling quantitative and qualitative data is used:

Independent variables:

(i) Organizational design: Questionnaires and unstructured interviews were used to assess participants views as to the level of mechanistic versus organic design their organizations ought to manifest in order to enhance implementation of telemedicine.

(ii) Uncertainty avoidance in the general population: Archival data was used to asses the degree of uncertainty avoidance found in the general population of each nation studied. Hofstede's results are obtained by analysis of questionnaires data given to large matched samples of participants from over 50 nations worldwide (see Hofstede, 2000).

Dependent variables:

(i) Cost per consult: Archival data is used to measure the total estimated yearly expenditure of telemedicine and the total number of telemedicine consults per year for national groups.

(ii) Expert perception of telemedicine success: Unstructured interviews with leading telemedicine mangers and researchers were undertaken to determine the perception of experts as to the successfulness of telemedicine implementation in each national grouping.

Work in Progress

The researchers are embarked upon a five-year study. At the writing of this manuscript data has been collected for the USA and South Korea on independent variables (i) and (ii) and dependent variable (ii). Currently research is underway to collect data for dependent variable (i) in all study cites. Further, current research on the remaining independent and dependent variables is underway in France, U.K., and Japan.

Results:

As of the spring of 2002, data for independent variable (i) organizational design, has been collected for USA and South Korea. Data for independent variable (ii) uncertainty avoidance, has been collected for USA, S. Korea, U.K., France, Japan, and Singapore. Data on dependent variable (i) cost per consult, has proven elusive at all research sites, but efforts are still underway. Data on dependent variable (ii) expert perception of telemedicine success, has been collected for the USA and South Korea and research is underway in France, U.K., Japan, and Singapore.

Below we show the data thus far collected in the USA and South Korea:

Independent variable (ii) Organizational design:

Questionnaire results from USA:

Table 1
Physician perception of the appropriate level of organizational learning culture (organic) in a telemedicine implementation in USA.

Dimension	Score (n=6)
Involvement by leadership	4.75
Openness	4.20
Interdependence	3.67
Support for continuing education	3.58
Acknowledge performance goals	4.00
Diversity of initiatives	3.83
Support for new things	3.50

Scores ranged from 1 to 7 where 7 represents the greater propensity of this variable toward organizational learning. Scores less than 4 indicate that the organization culture is too mechanistic (does not encourage organizational learning) to enable the organization to successfully implement the telemedicine system. Four of the seven variables fell below the 4.00 threshold.

Unstructured interviews, USA and South Korea

A series of unstructured interviews were undertaken with health care providers in informal settings. These lasted from short ten-minute discussions over coffee to longer (2-3 hour) sessions at relaxed sessions. Our approach was to encourage the participants to talk about their organization and what it might take to make telemedicine work better. We have synthesized our records of their main points in List 1 and 2 below:

List 1: USA
Unstructured interview data; n=23
For successful telemedicine utilization, we need organizations that have:

- Involved leadership
- Technology champions
- Open and free communication of mistakes and successes
- Free two-way communication
- Desire to experiment with new ideas
- Love of diverse approaches
- Continuing education to understand "why", as well as "how to"

List 2: South Korea
Unstructured interview data; n=12
For successful telemedicine utilization, we need organizations that have:
Clear rules to follow
Loyal followship
Do it the right way
Eliminate ambiguity
Practice, practice, practice - makes perfect
No errors or mistakes

Train to follow formulas
Strong leader

Independent variable (ii) uncertainty avoidance:
Using Hofstede's (2000) data, we rank the research sites on their general value of uncertainty avoidance as follows:

High Uncertainty Avoidance (Top 20% rank of all 50 nations measured by Hofstede)
Japan
France
South Korea

Low Uncertainty Avoidance (Bottom 20% rank of all 50 nations measured by Hofstede)
Singapore
USA
U.K.

Dependent variable (i) Cost per Consult:
NO DEFINITIVE DATA AS YET

Dependent variable (ii) Expert Views on Telemedicine Success:
In the USA we have conducted over thirty-five unstructured interviews with leading managers and researches of telemedicine endeavors. While most interviewees were still keen champions of telemedicine, it is clear that the major view was that telemedicine has been more a failure than a success. While exceptions to this view exist, such as when telemedicine has been used to service prison populations, in general American experts give telemedicine an F grade, but hope for better performance in the future.

In South Korea, the opposite was true. Over fifteen unstructured interviews with expert managers and researchers of telemedicine left us with the impression that they view telemedicine as a great success. They report higher than expected utilization and patient satisfaction. They give telemedicine a grade of B+.

Discussion

The preliminary data do not support HYP I or HYP II. That is, the USA data (a low uncertainty avoidance culture) indicate that it is the belief of physicians that their health care organization needs to be more organic if it is to effectively implement new e-health technologies such as telemedicine. Further, USA research experts in e-health and practicing health care executives indicate that current organizational designs may be overly mechanistic from the viewpoint of effective e-health implemntation. On the other hand, research experts and practicing executives in South Korea (a high uncertainty avoidance culture) believe mechanistic organizational design to be appropriate for e-health implementation, and in fact, they believe it is currently effectively utilizing clinical telemedicine technology.

However, thus far the sample size of respondents in our research is small. There is no pretense in this manuscript that HYP I or HYP II may be rejected by the results alone.

Rather, it is suggested that these preliminary; mostly qualitative; research efforts help in our understanding of the relationship of e-health implementation to organizational design. The main purpose of our on-going qualitative research program is to raise questions rather than supply answers.

In our new information technology rich environment, it is appropriate for us to raise questions about organizational design in health care organizations. In the late 1960's, C. Perrow (1970), a highly respected sociologist, suggested that in human service organizations where new technologies are manifest, the organizational structure needs to be less bureaucratic – less programming of tasks, fewer rules and regulations, fewer levels in the hierarchy, greater coordination by feedback, greater decentralization in decision making and a tendency to employ more highly trained professionals. Perrow's ideas of the late '60's and early 70's are, perhaps, even more relevant today in the USA.

Many of today's American health care organizations were designed primarily to insure quality of care at reasonable costs. Most of the major components of these designs; level of complexity, level of formalization, level of centralization and authoritarian organizational cultures; are a product of the pre-information technology age. Most major health care organizations in the USA have not experienced an organizational design renaissance since their 1950's organizational design. There are exceptions, but most organizations design modifications have been small changes at the edges of the organization. The central tenet or organizational design in most health care organizations remains: quality results from clear rules, high formalization, redundancy, high authority and intolerance for ambiguity.

Yet research on implementation of technology in organizations, in general, point to the need to match the characteristics of the technology with the characteristics of the users rather than attempt to change the attitudes mental models, alliances or culture of the users (Hartwick and Barki, 1994; Venkatesh and Davis, 2000). This is most likely true in health care organizations as well (Hu, Chau, Sheng and Tam, 1999). In the USA, we argue, health care organizations, which have as a strategic intent the utilization of e-health technologies, need to re-address their organizational designs.

In particular, the concern for quality need not be sacrificed in an effort to redesign a more organic system. Quality Assurance research and thinking in modern health care organization research (Brook, et. al, 1985; Williamson, 1988; Shortell, 1992) call for greater decentralization so that professionals responsible for care have the power to review and implement necessary changes. This QA research also argues for more participative organizational and open and enhanced feedback of results (Luke, Krueger and Modrow, 1983).

The cultural context in the USA is one of low uncertainty avoidance. In that cultural environment, new information technologies which may require changes in the normal routine of health care delivery are best utilized by organizations which, are, we argue, more organic. In South Korea, a cultural environment characterized as high uncertainty avoiding, the organization of choice for implementation of e-health technologies appears to be a more mechanistic organization, independent of the non-routine disruptions consequent of the e-health technologies.

Nonetheless, it must be emphasized that these suggestions are relative. The divide between mechanistic and organic organizational design is not black and white, but rather gray and foggy. Our argument is only to ask executives and researchers in e-health to look at the bureaucratic structure of their organizations; to examine the level of complexity, formality, centralization and authoritarian culture and to ask: Is this the appropriate match for the people in our organization whom we depend upon to use the new e-health technologies?

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Human Factor Considerations in the Implementation of a Telemedicine Strategy

David C. Bangert
Robert Doktor

Telemedicine is more a failure than a success

People accept telemedicine as good

Access ↑
Quality ↑
Costs ↓

But people do not continue to use telemedicine

Acceptance ≠ Utilization

Cost of Implementation Failure

	Short Term	Long Term
Direct	▪ Wasted resources (Money, Time, People) ▪ Business objective not achieved	▪ Strategies not accomplished
Indirect	▪ Morale suffers ▪ Job security threatened	▪ Leadership competence questioned ▪ Lower confidence in leadership ▪ Resistance to change increases ▪ Next change more likely to fail ▪ ORGANIZATIONAL SURVIVAL?

Our focus is the Impact of Human Factors on Implementation

In particular:

1. Strategic Management
2. Organizational Culture

Strategic Management

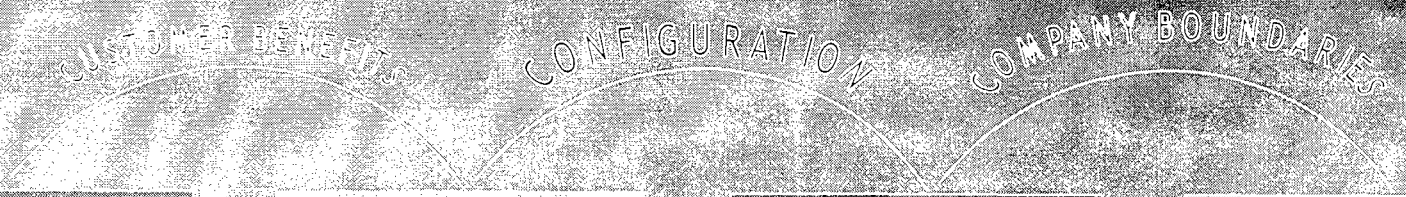
David C. Bangert

Business Model

the totality of how a company selects its customers, defines and differentiates its offerings, defines the tasks it will perform itself and those it will outsource, configures its resources, goes to market, creates utility for customers, and captures profits. **It is the entire system for delivering utility to customers and earning a profit from that activity.**

(Adrian Slywotzky)

UNPACKING THE BUSINESS MODEL



CUSTOMER INTERFACE	[illegible]	STRATEGIC RESOURCES	VALUE NETWORK
• Fulfillment & Support	• Business Mission	• Core Competencies	• Suppliers
• Information & Insight	• Product/Market Scope	• Strategic Assets	• Partners
• Relationship Dynamics	• Basis for Differentiation	• Core Processes	• Coalitions
• Pricing Structure			

EFFICIENCY / UNIQUENESS / FIT / PROFIT BOOSTERS

Core Strategy

The Business Mission encompasses the firm's purpose, its values and its vision.

Strategic Resources

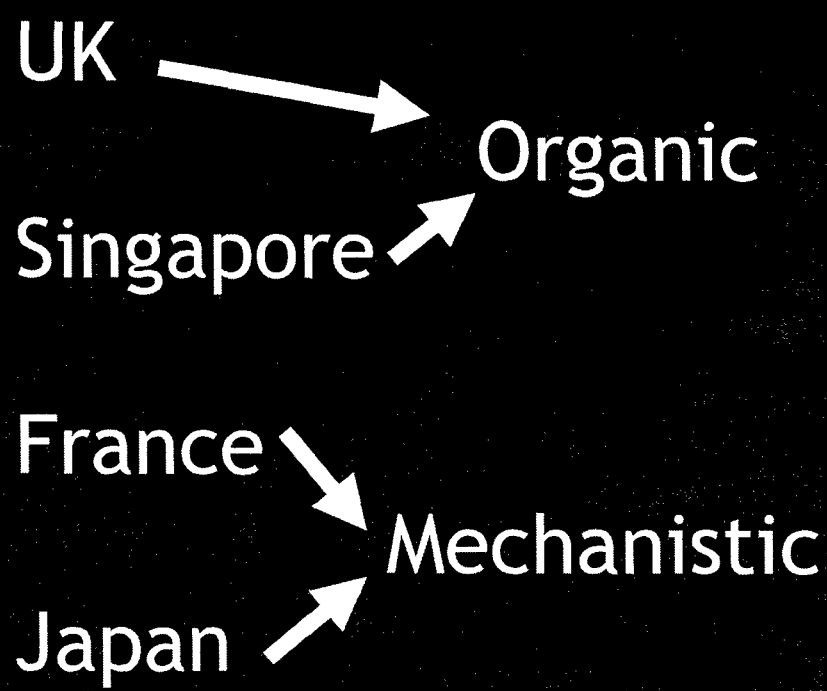
Core Processes: This is what people in the firm actually *do*. Core processes are methodologies and routines used in transforming inputs into outputs.

Configuration

Intermediates between a company's *core strategy* and its *strategic resources*. It refers to the **unique** way in which competencies, assets, and processes are *combined* and *interrelated* in support of a particular strategy. Configuration recognizes that great strategies rest on a **unique** blending of competencies, assets, and processes.

Unstructured Interviews in UK, France, Singapore and Japan to be Undertaken in the near Future

Our guess:



Organizational Culture and Human Factors: Impediments to Effective Utilization

Robert Doktor

Early Study Reported in Telemedicine and e-Health

(vol. 6, no. 3, 2000)

Organizational culture and learning variables by primary care physician

Survey Results

Involvement by leadership	4.75
Openness	4.20
Interdependence	3.67
Support for continuing education	3.58
Acknowledge performance gaps	4.00
Diversity of initiatives	3.83
Support new things	3.50

Organizational Culture is the Child of National Culture

Cross Cultural Analysis is a Mirror in which we see Ourselves anew.

Uncertainty Avoidance: Hofstede

High Uncertainty Avoidance:

- do not like trying new things
- do not like diversity
- do not like openness re mistakes
- do not like continuously learning new things
- hate ambiguity
- like stability
- like predictability
- like fixed structure
- like clear interpretation

Uncertainty Avoidance Scores of Nations with High GNP/Capita

High Uncertainty Avoidance
(top 20%)

Japan
France
South Korea

Middle Uncertainty Avoidance
(middle 60%)

Italy
Taiwan
Germany

Low Uncertainty Avoidance
(bottom 20%)

USA
UK
Singapore

Hypotheses!

If technology such as telemedicine is to be utilized:

1. In low uncertainty avoidance countries, the organizations must have a high organizational learning culture.

e.g. USA, Great Britain and Singapore

2. In high uncertainty avoidance countries, the high organizational learning culture is less needed.

e.g. France, Japan and South Korea

The Method

Independent Variable:

- Macro: Hofstede cultural variable data set
- Micro: Unstructured interviews on desired culture and strategy

Dependent Variable:

- Macro: Data on telemedicine success
- Micro: Unstructured interviews on telemedicine utilization and success

Data from Structured Interviews in USA

From Survey of Physicians in Failed Telemedicine Program

Our organization needs to be:

Low UA Nations (USA) have Cultural Preferences for

Our culture supports:

more open about mistakes ↔ likes openness of information

support continuing education ↔ likes learning new things

support diversity of initiatives ↔ likes diversity

support new things ↔ likes trying new things

Data
Unstructured Interviews in USA

For successful utilization, we need:

- Involved leadership
- Technology champion
- Open and free communication of mistakes
- Free two-way communication
- Desire to experiment with new ideas
- Love of diverse approaches
- Continuing Education to understand "why"

i.e. More Organic, less Mechanistic Healthcare Organizations

Data
Unstructured Interviews in South Korea

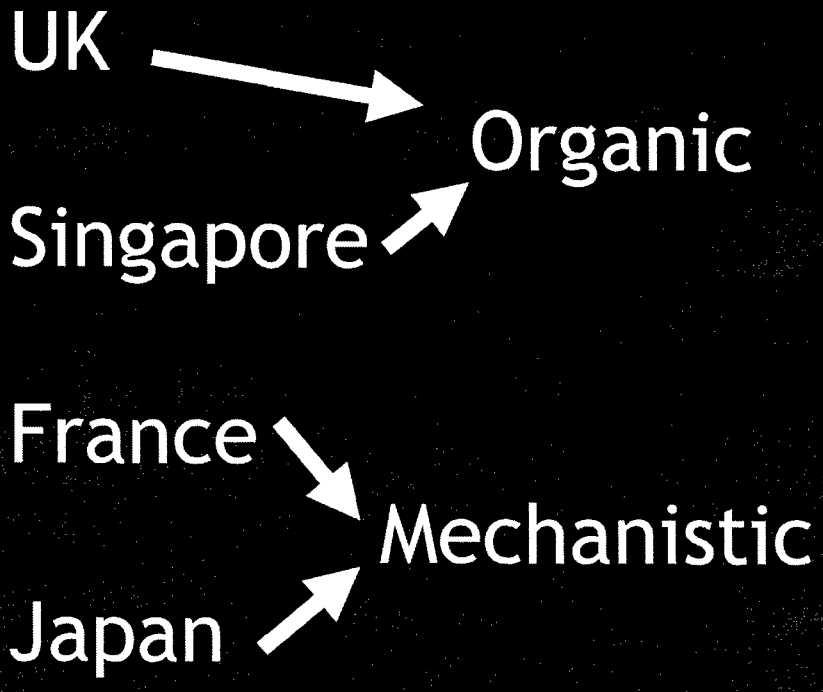
For successful utilization, we need:

- Clear rules to follow
- Loyal followership
- Do it the right way
- Practice makes perfect
- No errors or mistakes
- Train to follow the formulas
- Strong leader

i.e. More Mechanistic Healthcare Organizations

Unstructured Interviews in UK, France, Singapore and Japan to be Undertaken in the near Future

Our guess:



Causes of Human Factor Barriers to Telemedicine

David C. Bangert
Robert Doktor

Human Factor Root Causes

- Unproven Clinical Quality
- Business Management Barriers
- Organizational Barriers
- Ergonomic Barriers (not to be discussed)

Perception of Clinical Quality

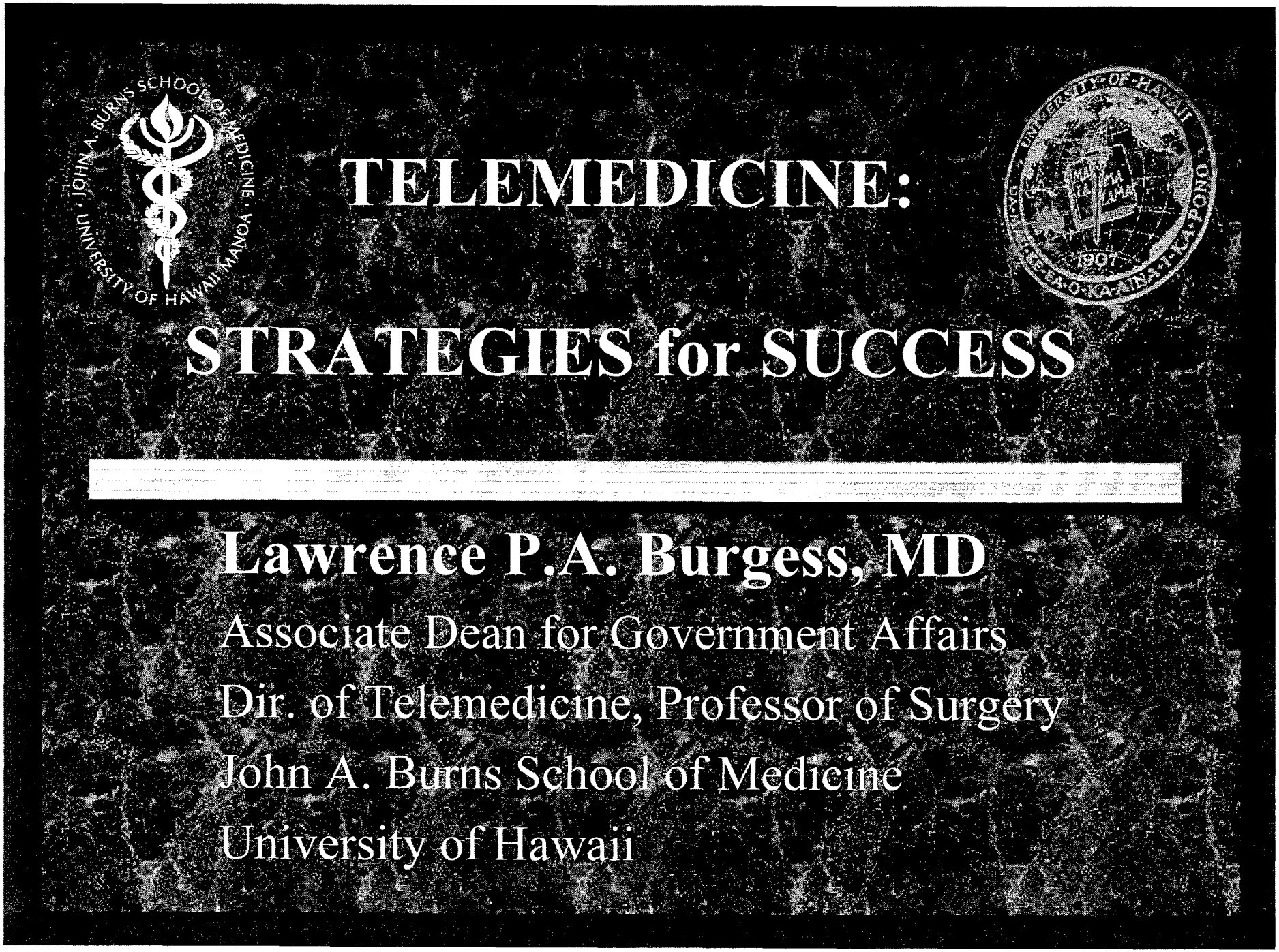
- Lack of Significant, Evaluation Studies
- Lack of Formal Training Programs
- Not all Medical Specialties are Compatible
- Disruption of Normal Work Flow
- Lack of Recognized Standards

Business Management Barriers

- Uncertainty Around the Business Case
- Inappropriate Incentives
- Missing Strategic Intent

Organizational Barriers

- Process Reengineering
- Lack of Organizational Goals
- Culture Mismatch
- Inadequate Evaluation and Feedback
- Missing Change Management Program


JOHN A. BURNS SCHOOL OF MEDICINE
UNIVERSITY OF HAWAII MANOA
TELEMEDICINE:
STRATEGIES for SUCCESS
Lawrence P.A. Burgess, MD
Associate Dean for Government Affairs
Dir. of Telemedicine, Professor of Surgery
John A. Burns School of Medicine
University of Hawaii

Communications Revolutions

- Man communicating since the dawn of his birth.
- (Tele)-Communication is more about relationships than technology. The communication tool (technology) enables the relationship.
- Initially, emerging tools are costly and only available to a few, but become less costly and more widely available over time.

Communications Revolutions

- Physical, sign, spoken language.
- Picture, written language.
- Travel: land, water, ocean; later air.
- Publishing: books, later printing press.
- Wired telecommunications: telegraph.
- Telephone.

Communications Revolutions

- Satellite communications.
- Broadband wired/wireless:
  - Television.
  - Audio-video-teleconferencing, data.
- Narrowband applications:"free" internet
- Broadband applications:"free" Internet 2

Bioinformatics (Clinical):

- A general term used to describe the field of information acquisition, transmission, storage, and analysis of patient related data.
- Within health care systems, clinical bioinformatics issues are generally managed by the Information Technology unit.

Telemedicine

- The use of technology to acquire and transmit patient data (usually visual) from one site to another.
- Data acquisition, transfer and storage must interface with bioinformatics infrastructure or Information Technology department.

Telemedicine Vision

- Practice and hospital without walls or geographic boundaries. Quality of technology will define the boundaries.
- Quality of care equals current standard of care.

Telemedicine Vision

- Point of service care: monitoring and diagnosing patients at work or home leads to timely care.
- Point of service care: significant time and $ savings for the patient, employer, and healthcare system.

Telecommunication Concepts

- Business to Business - B2B
- Business (physician, vendor, Med facility, etc.) to Patient
- Med facility (bus.) to Med facility (bus.)
- Business (physician) to Med facility (bus.)
- Patient to Physician-telemedicine
- Physician to Patient-telemedicine
- Physician to Physician-telemedicine
- Patient to Patient

Telemedicine Success Stories

- Isolated geography: rural areas with poor medical infrastructure, prison systems.
- Networking between providers: tumor boards, conferences.
- Specialty issues:
  - Telepsychiatry.
  - Radiology (now really part of IT).
  - Pathology (?standards, lack of need).
  - Dermatology (?standards, medicolegal of 3D to 2D).

Telemedicine Success

- Needs assessment is critical. The reason for telemedicine must be strong and obvious. The greater the need, the more chance for success.
- Champions are critical at both the sending and receiving end (commitment to relationship).
- Data capture and analysis is unchanged: e.g. radiology.
- Strong Clinical and Business models.

Telemedicine Pitfalls

- Value to patient care or the healthcare system may result in incremental changes (10-25%), that may not be readily apparent to the bill-payers.
- Requires supporting IT infrastructure.
- Third party reimbursement?
- Need? Benefit to patient, institution?
- Medicolegal responsibility of receiver.
- Cost of initial telemedicine infrastructure.
- 3D to 2D world.

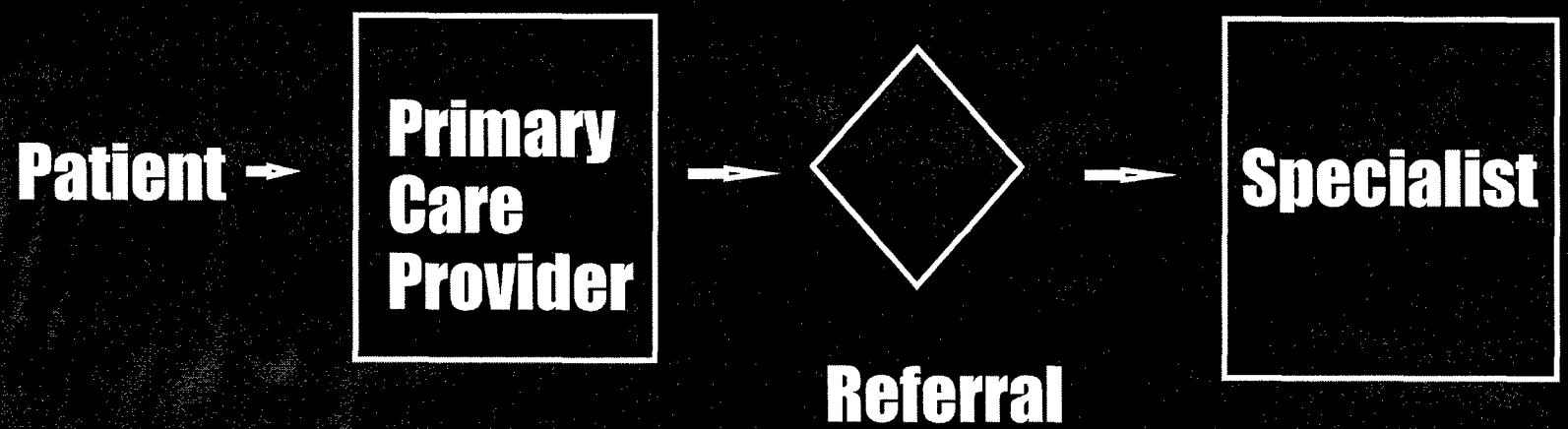
Telemedicine Strategies

- Incremental benefit (10-25%):
  - Strong business and clinical models.
  - Long-term analysis.
  - Grants for longitudinal studies.
- Requires supporting IT infrastructure:
  - Integrate early in the planning process.
- Third party reimbursement?
  - Network with third party payers. Show benefit to members, system ($$).
  - Less of an issue in HMOs.

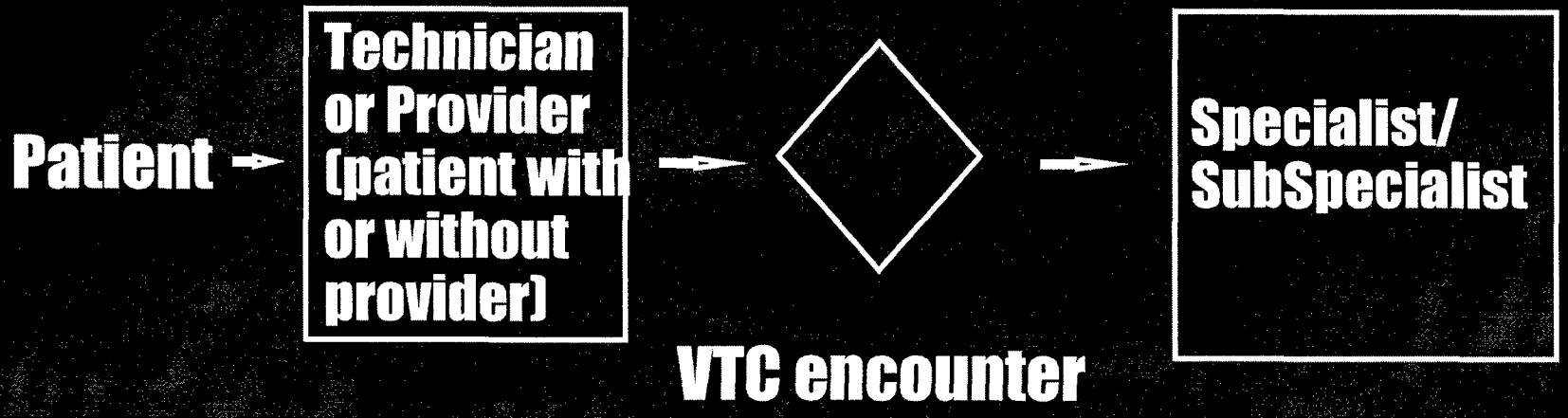
Telemedicine Strategies

- Need? Benefit to patient, institution?
  - Business and clinical models.
- Medicolegal responsibility of receiver.
  - MOAs, patient consent.
- Cost issue.
  - Grants, part of business model.
- 3D to 2D world.
  - Change paradigm when possible. Forward studies accepted as 2D. Research area?
  - For ENT: Videolaryngoscopy and videostroboscopy (normally viewed on a monitor; reading has separate code).

Current Consultation Practice



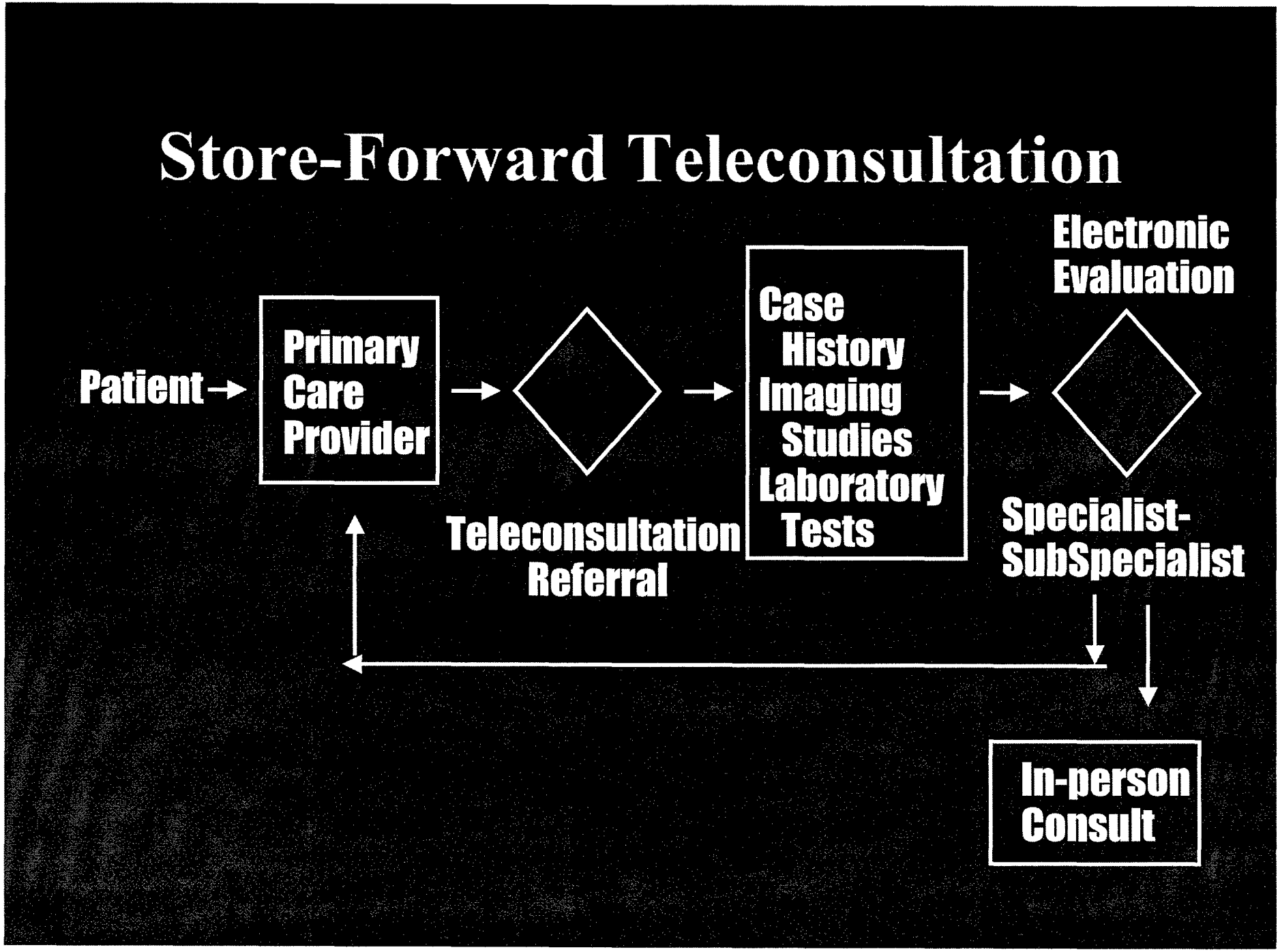
Live Audiovisual (VTC) Teleconsultation



Live VTC

- Requires synchronous presence at both sending and receiving sites =
  - Scheduling difficulties, so use regularly scheduled block time. Minimize personnel requirement at both ends.
  - Uses higher bandwidth, non-internet type connectivity = increased costs.
  - Good for low-volume, longer visits such as telepsychiatry, minimizing personnel needs.
  - Receiving provider must accept high level of medicolegal responsibility of the case.
  - Less need for IT support, unless over IP.

Store-Forward Teleconsultation



Store-Forward Teleconsultation

- Synchronous presence NOT required =
  - Scheduling difficulties largely eliminated.
  - Software platform required, so different technical requirement with security issues.
  - Must interface with IT.
  - Transmission uses regular internet, low bandwidth.
  - Medicolegal issues for receiver.
  - Amount of data transmitted could be all or or specific depending on patient needs.

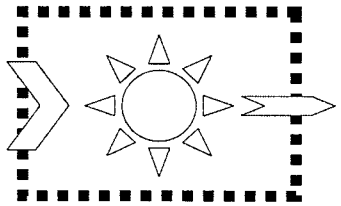
Telemedicine Horizons

- Outpatient monitoring of patients: nursing home, assisted living, work-home.
- Should decrease health care costs by shifting cost of facility care to patient.
- More frequent FU will mean more timely care: not too early, not too late.
- Needs strong business and clinical models, longitudinal study.
- Leverages widespread and inexpensive telecommunications.

Conclusion

- Need is critical.
- Telemedicine functions best when transferred data is analyzed in same format as in the real world.
- Commitment of champions and their institutions is critical.

▶ Simulation for Diseases



HICSS 2004

Pilot Project

Spatial Simulation Model for Infectious Viral Diseases with Focus on SARS and the Common Flu

Christoph Aschwanden

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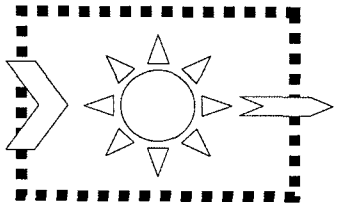
▶ Simulation for Diseases



Motivation

- Mathematical Models Limited
- Availability of Spatial Simulations for Diseases:
  - Limited/Simplified
  - Libraries (e.g. STELLA, SIMEX)
- How does a Disease Spread (2D/3D)?
- Where do people infect each other?
- How can it be prevented?
  - Vaccination
  - Isolation
  - Quarantine

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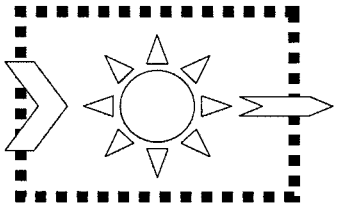
▶ Simulation for Diseases



Goal

~~SimCity~~

DiseaseCity
- 2D/(3D)
- Individuals
- Buildings
- Diseases
- Interaction

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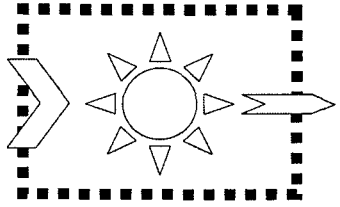
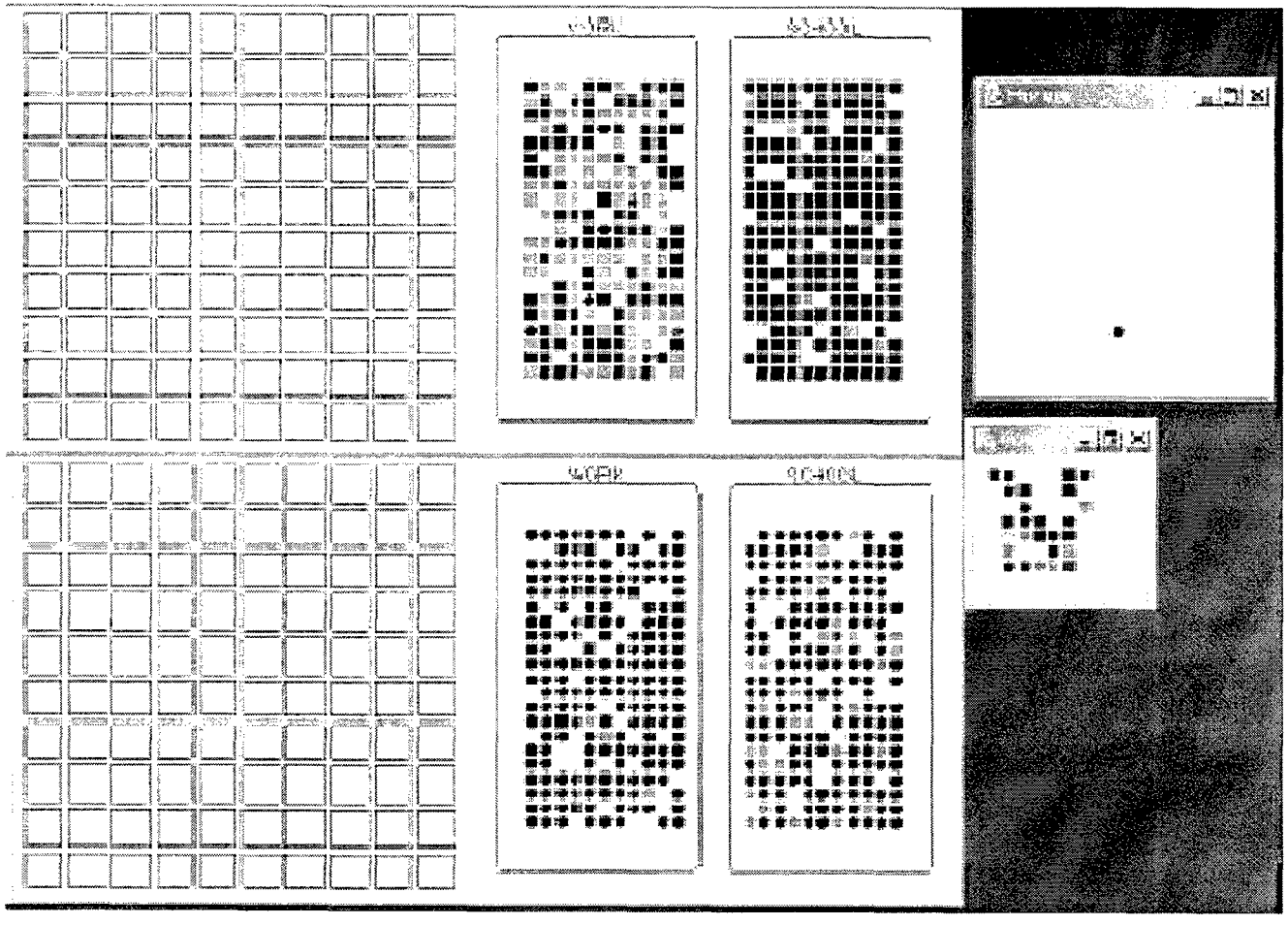
▶ Simulation for Diseases



Smallpox Bioterror by Joshua M. Epstein



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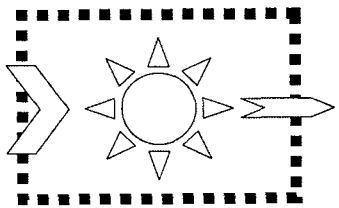

Epi Info by CDC

C:\Epi_Info\OUT30.htm

Previous | Next | Last | History | Open | Bookmark | Print | Maximize

FREQ AgeGroup

Next Procedure

Forward

AgeGroup	Frequency	Percent	Cum Percent
>1 - 11	5	10.9%	10.9%
>11 - 21	10	21.7%	32.6%
>21 - 31	1	2.2%	34.8%
>31 - 41	8	17.4%	52.2%
>41 - 51	4	8.7%	60.9%
>51 - 61	9	19.6%	80.4%
>61 - 71	6	13.0%	93.5%
>71 - 80	3	6.5%	100.0%
Total	46	100.0%	100.0%

95% Conf Limits

>1 - 11 3.6% 23.6%
>11 - 21 10.9% 36.4%
>21 - 31 0.1% 11.5%
>31 - 41 7.8% 31.4%

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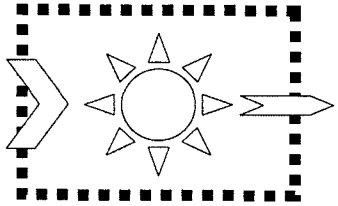
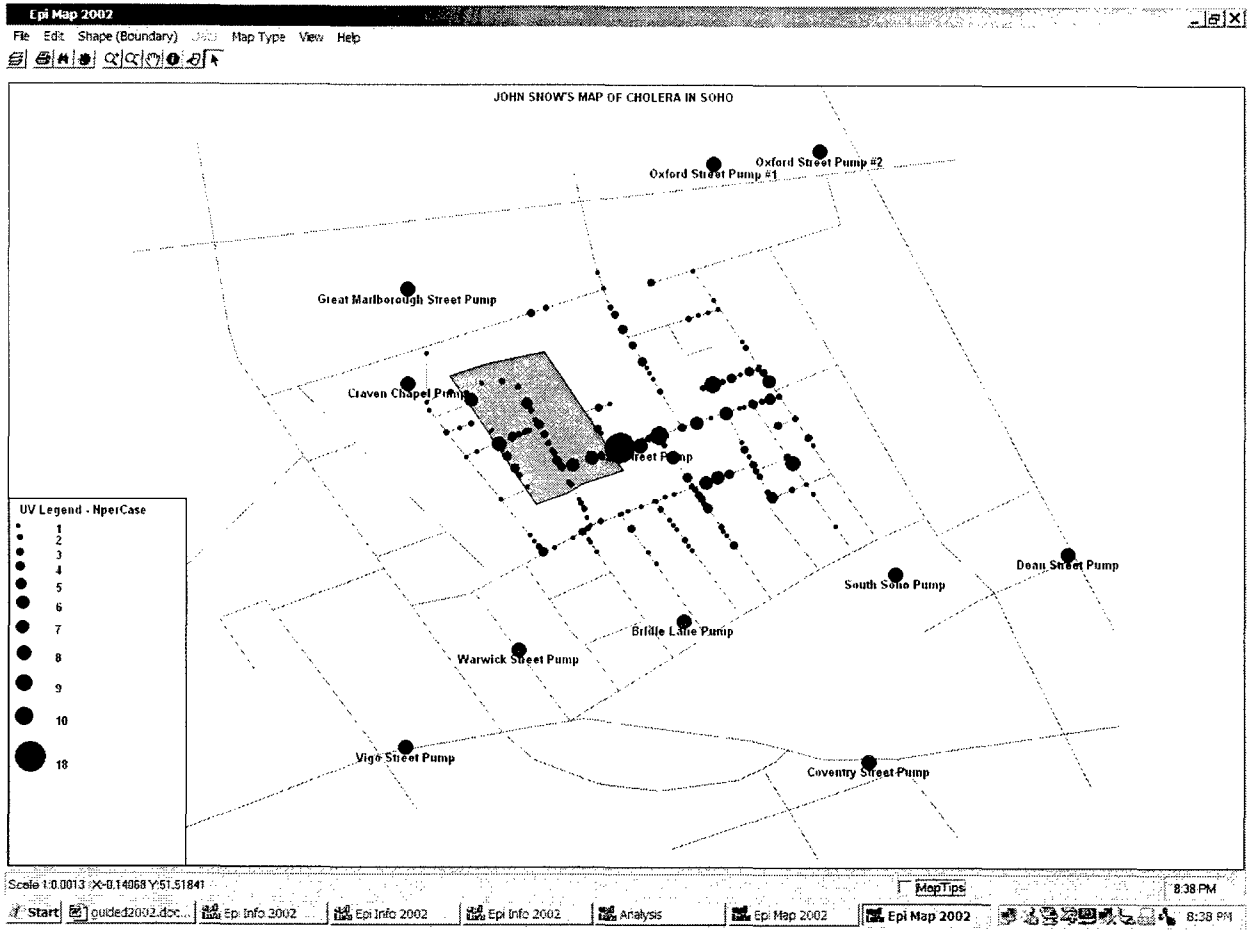
▶ Simulation for Diseases



Epi Info Map by CDC (Manual Input)



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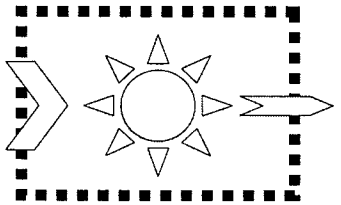
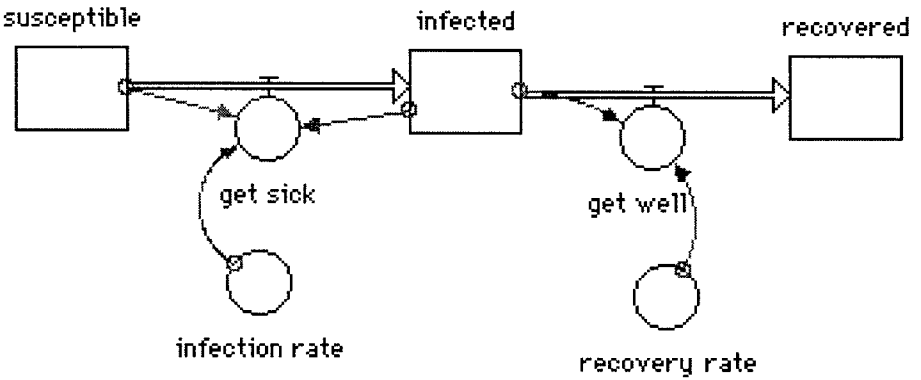


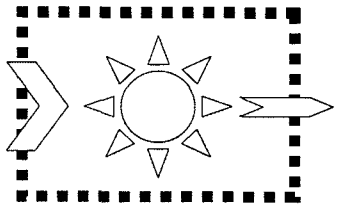
STELLA for the Flu



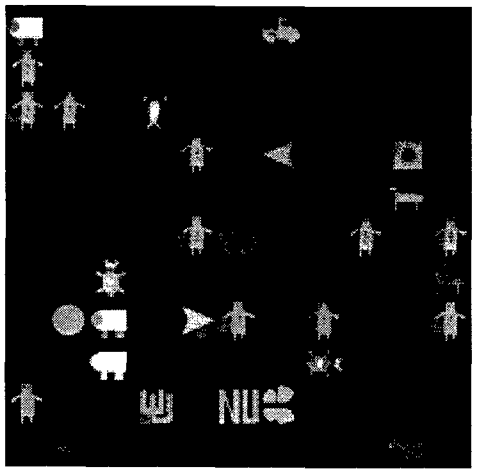
STELLA:
Computer Simulation based Model Building Tool

SIMEX:
C++ Library (Project seems to be dead)

▶ Simulation for Diseases



NetLogo



Model in 2D
- Biology
- Chemistry
- Mathematics
- Social Science

Netlogo

Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL

http://ccl.northwestern.edu/netlogo

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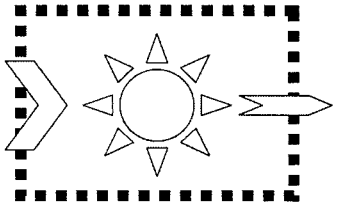
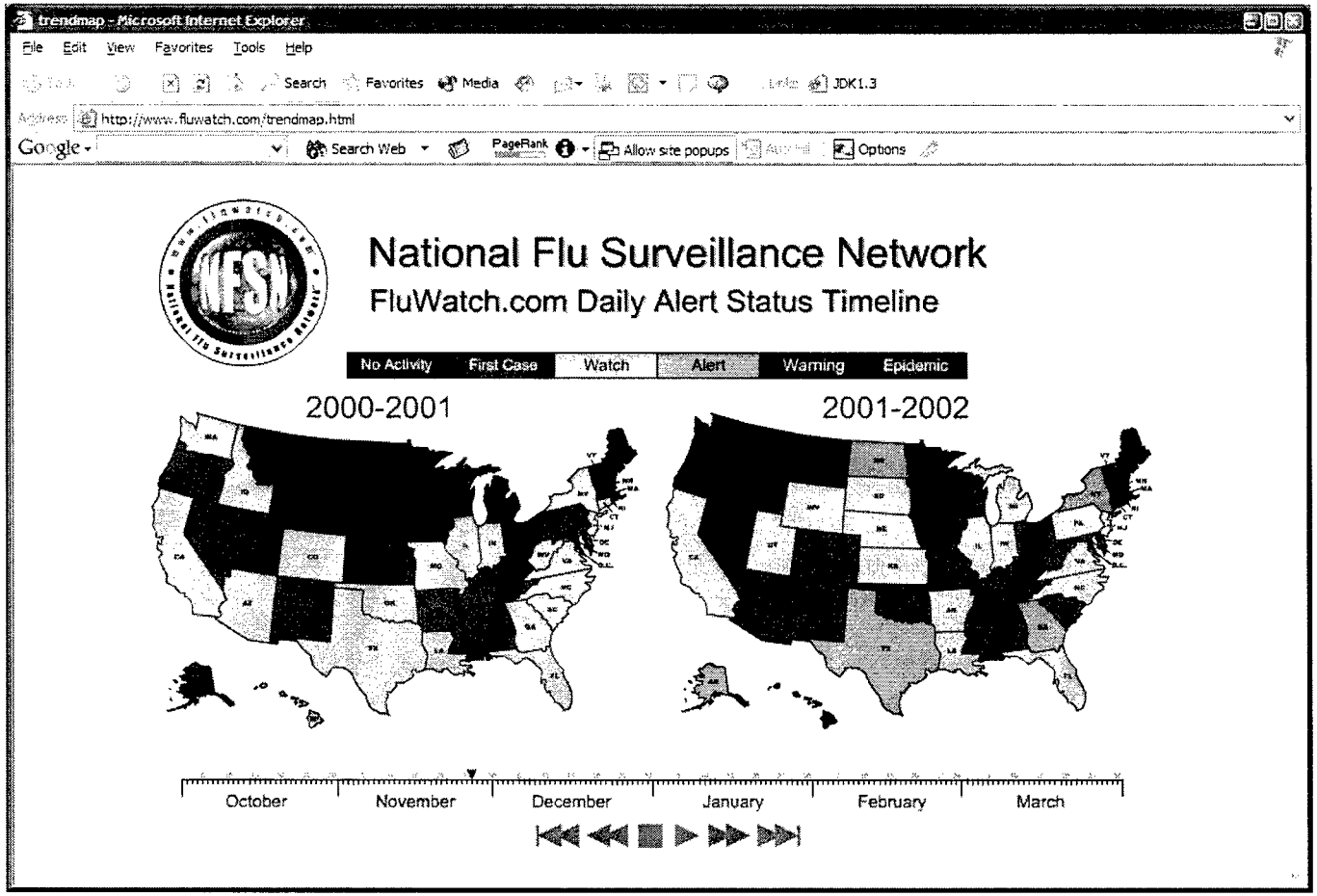
▶ Simulation for Diseases



FluWatch



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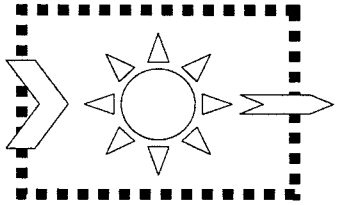
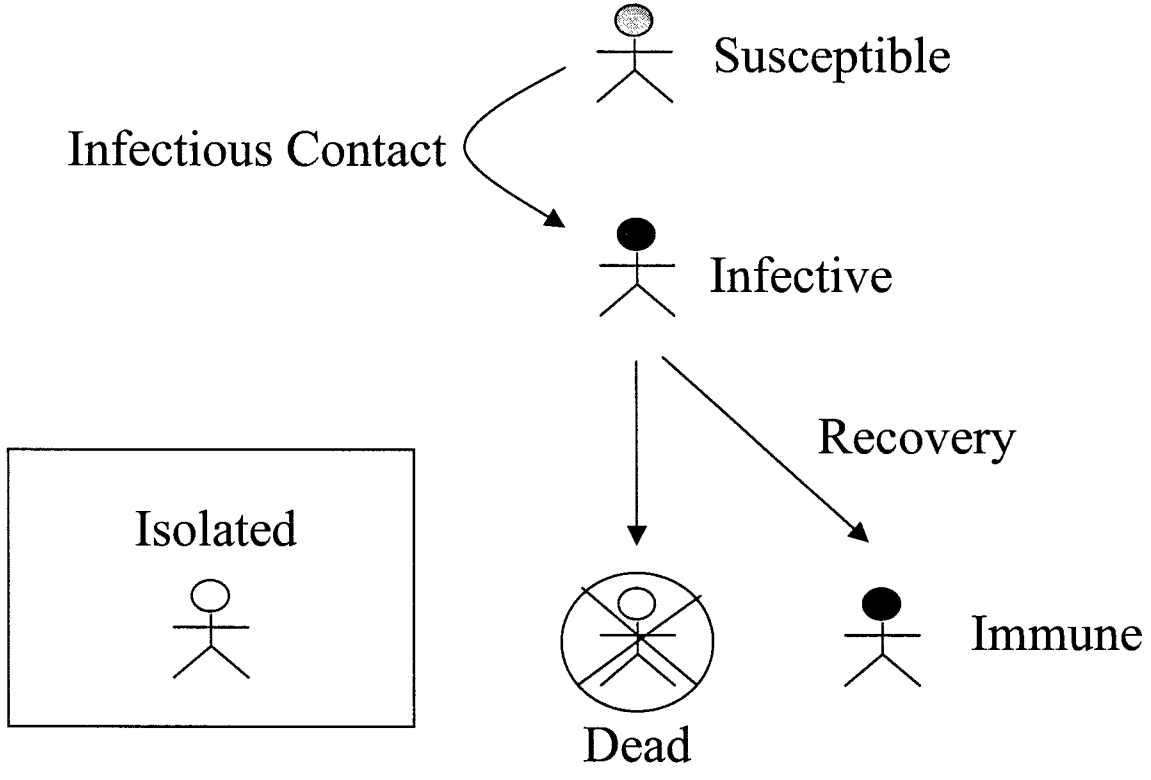
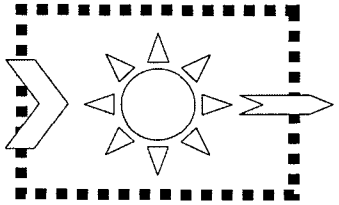


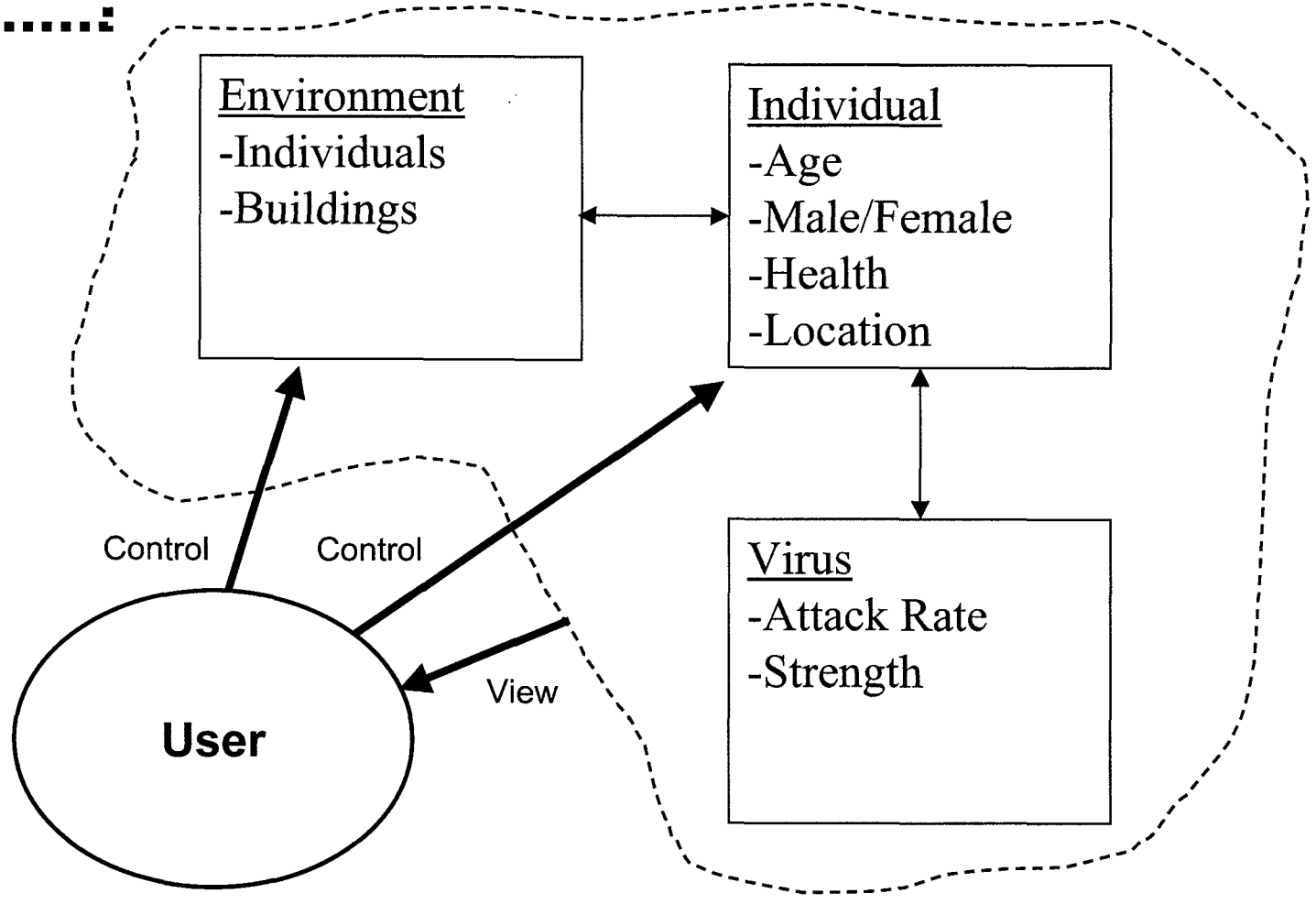
Characteristics of the Infectious Process



▶ Simulation for Diseases



Software Design



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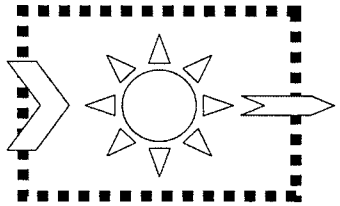
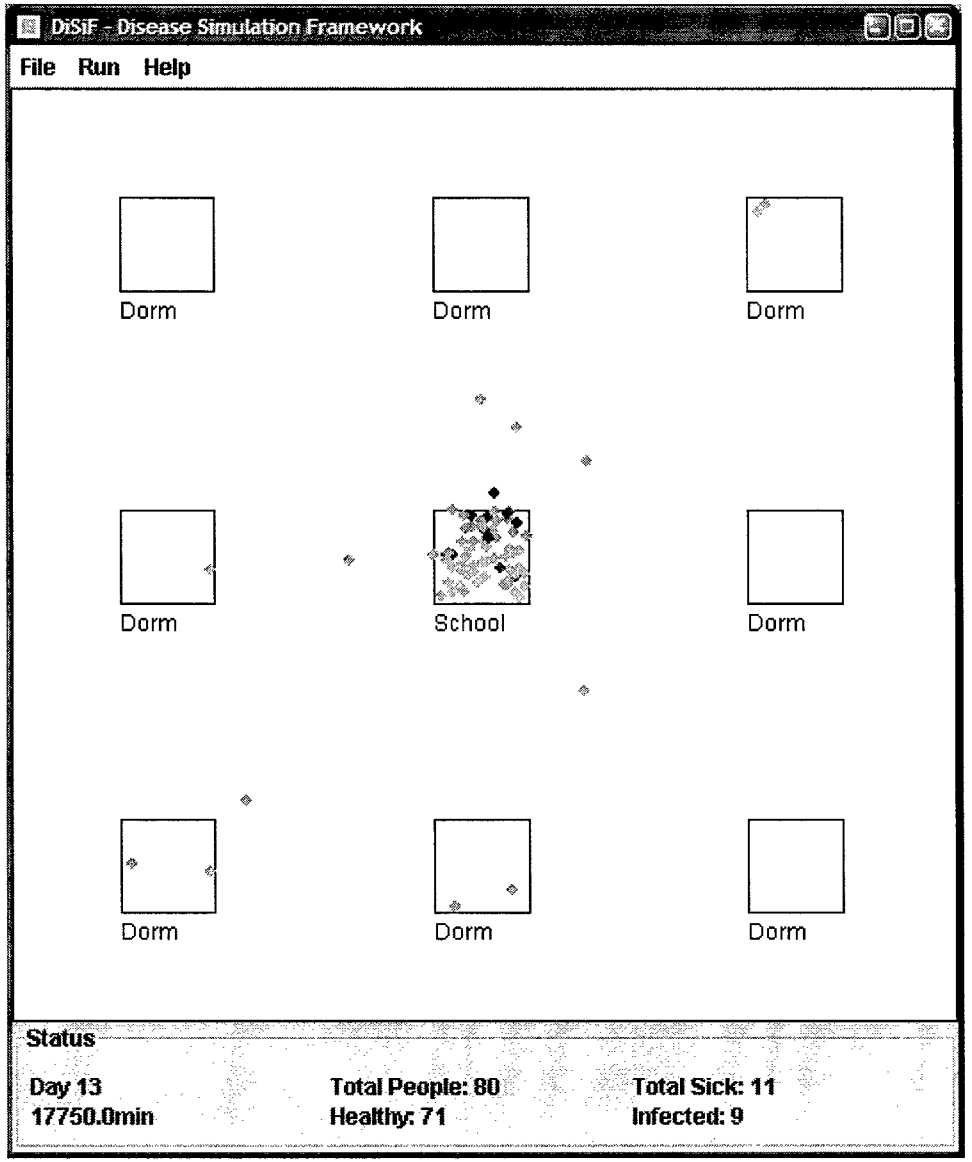


Simulation

Basic Simulation
- 2D View
- Dorms / School
- Individuals
  - Susceptible
  - Infected
  - Recovered
- Interaction



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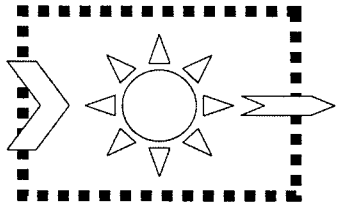
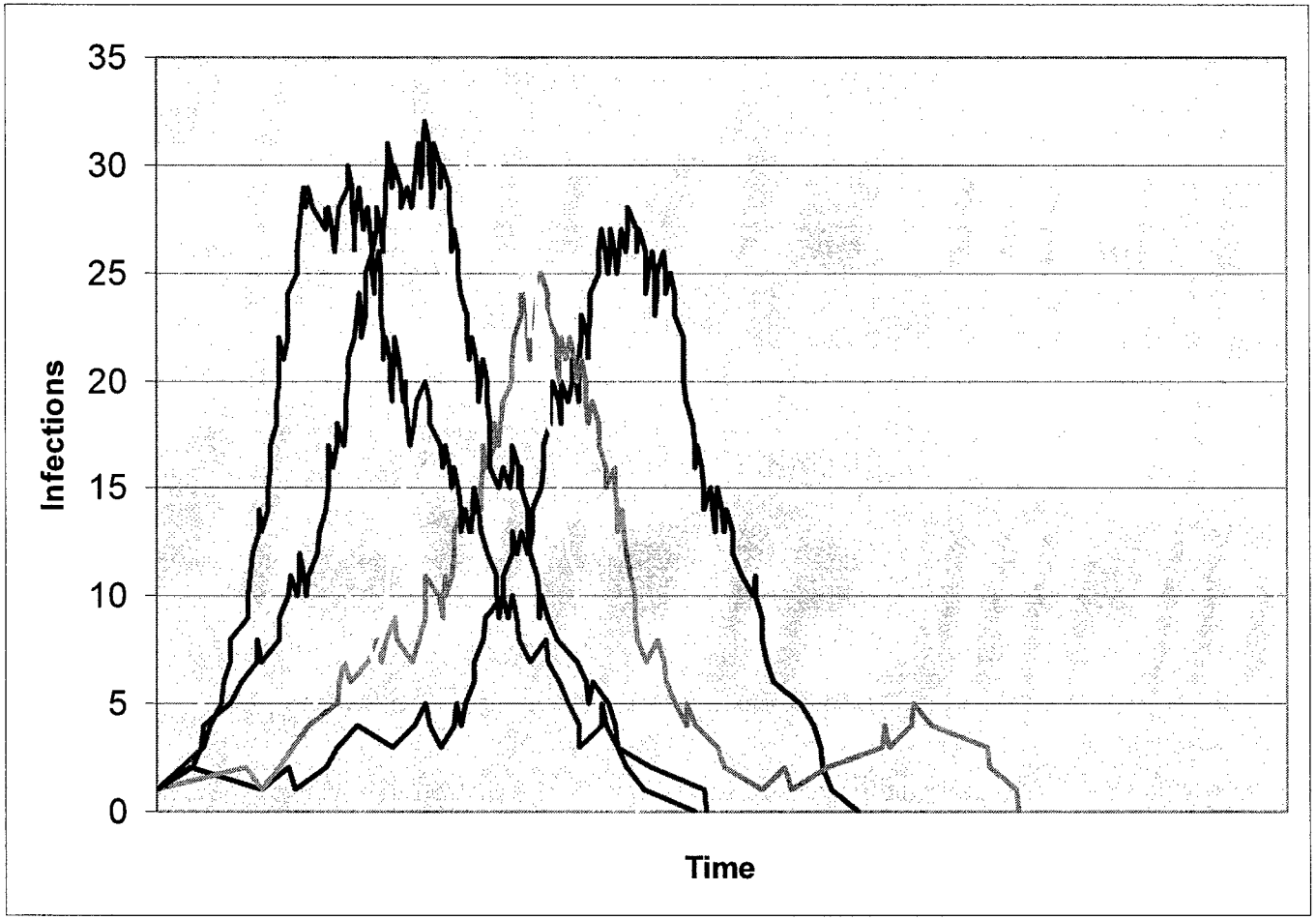


Preliminary Results: Common Flu

Infections
over
Time

(5 selected
Graphs for
Common Flu)



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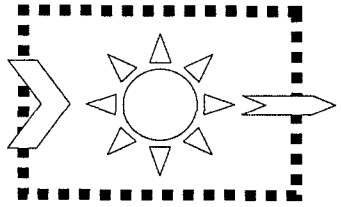
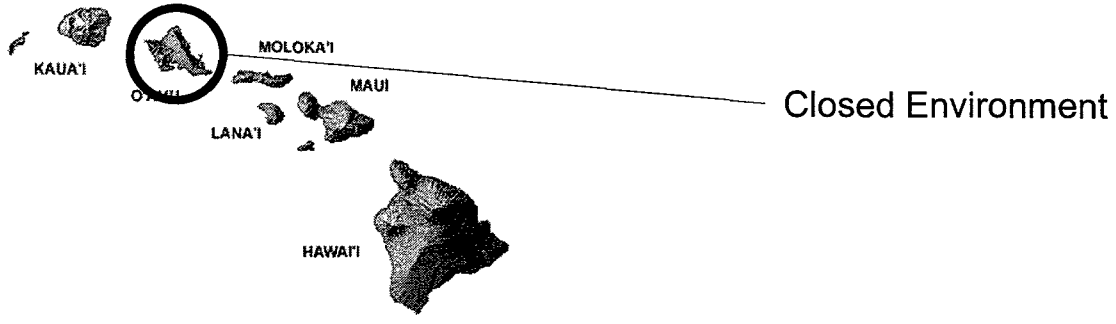


Contributions & Further Directions

- Basic Simulation (SARS / Common Flu)
- Further Directions:
  - Improvements, e.g. Viruses
  - Comparison with Mathematical Models / Real Life
  - 3D
  - Animals / Buildings: Stores, Hospitals, Streets
  - Malaria / HIV / AIDS / Mad Cow Disease
  - Interaction: Vaccination / Isolation
  - 

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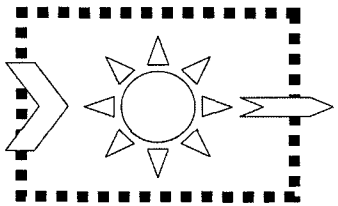
▶ Simulation for Diseases



Implications

- Analysis of a disease spread of past

  ↓

  Predict future disease spread/epidemic zones
- Find sources of infection.
- Optimal locations for hospitals and disease management centers
- Fight bio terrorism
- Disease management training

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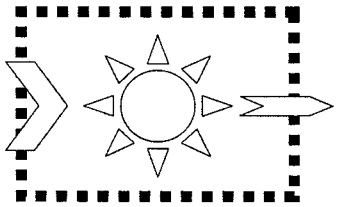
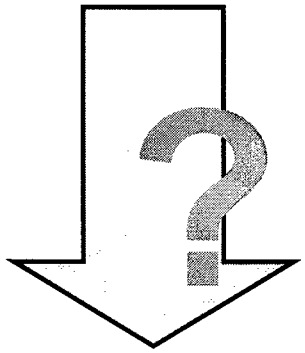
▶ Simulation for Diseases



< Forecast >

Future Goal:

Weather Forecast

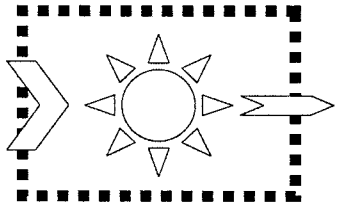


Disease Forecast

Possible?

- What is everybody doing?
  - Location Tracking
  - Who is sick?
- Disease
  - Infection Parameters?
- Butterfly Effect

▶ Simulation for Diseases



Information

Author: Christoph Aschwanden

caschwan@hawaii.edu

Internet:

http://www2.hawaii.edu/~caschwan/disif/disif.html

Java Applet & Documentation

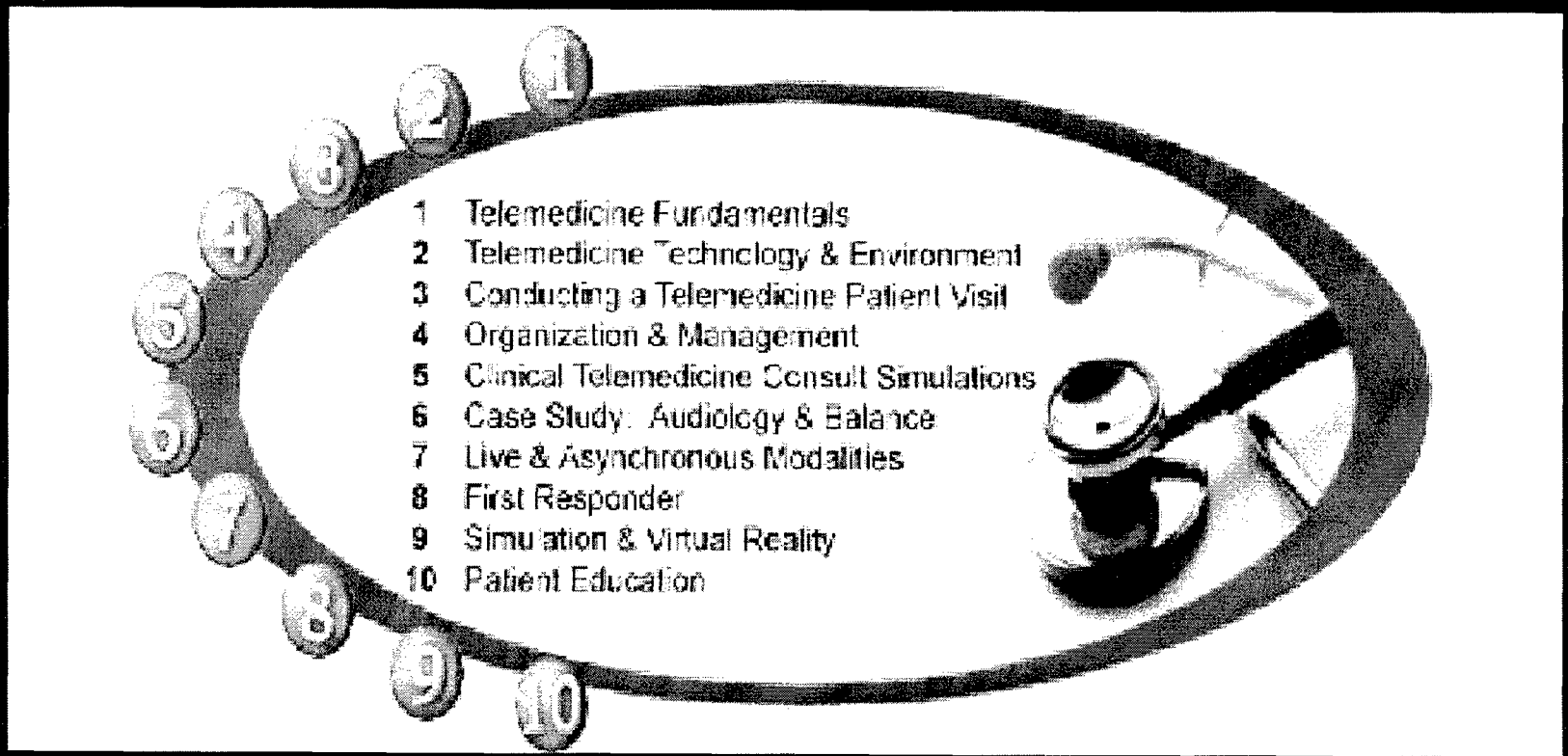
Demo?

University of Hawaii Telemedicine Curriculum

Presentation to the
Eighth CAPE Workshop for Clinical Nurse Specialists
November 17, 2003

Deborah Birkmire-Peters, Ph.D.
UH Telemedicine Project

University of Hawaii Telemedicine Curriculum



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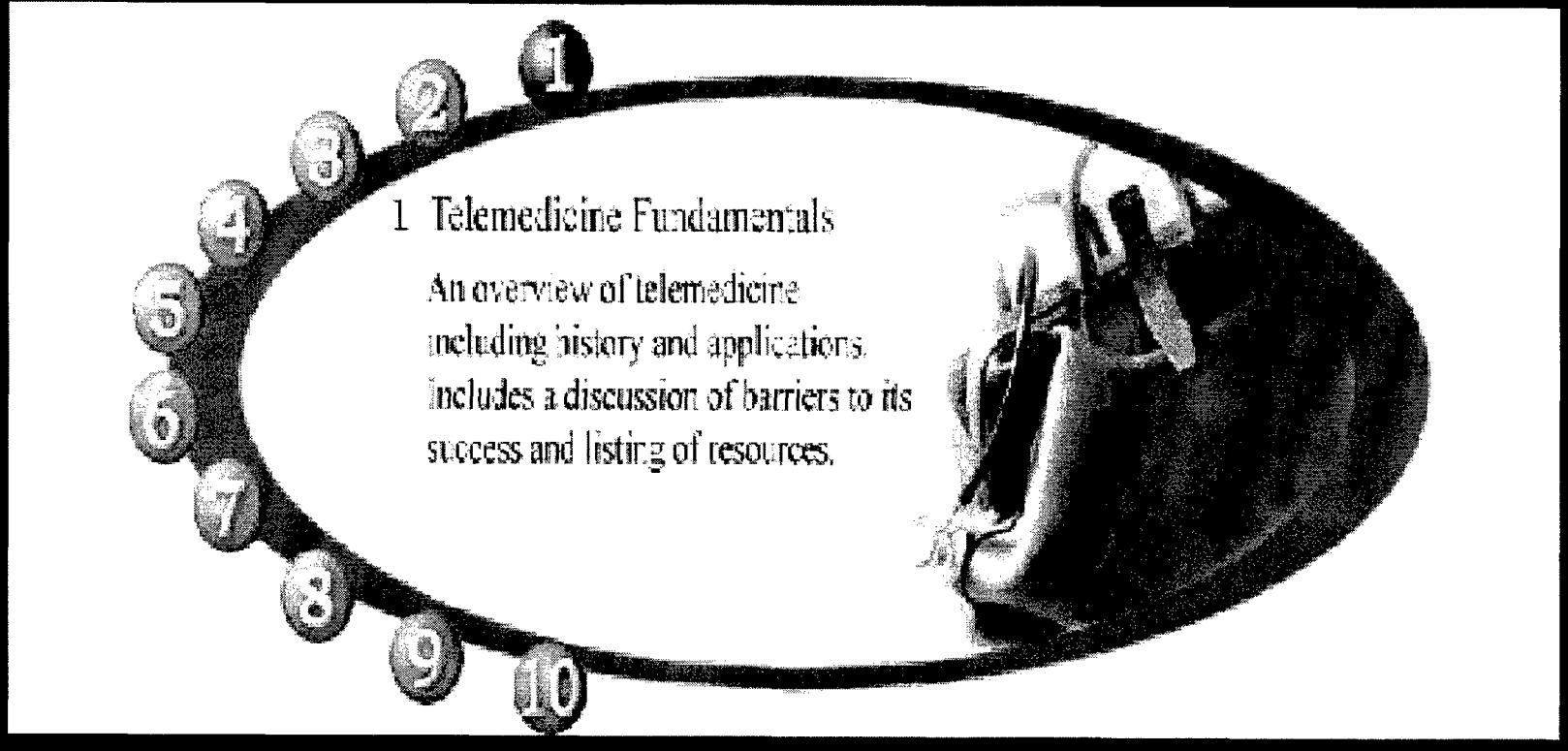

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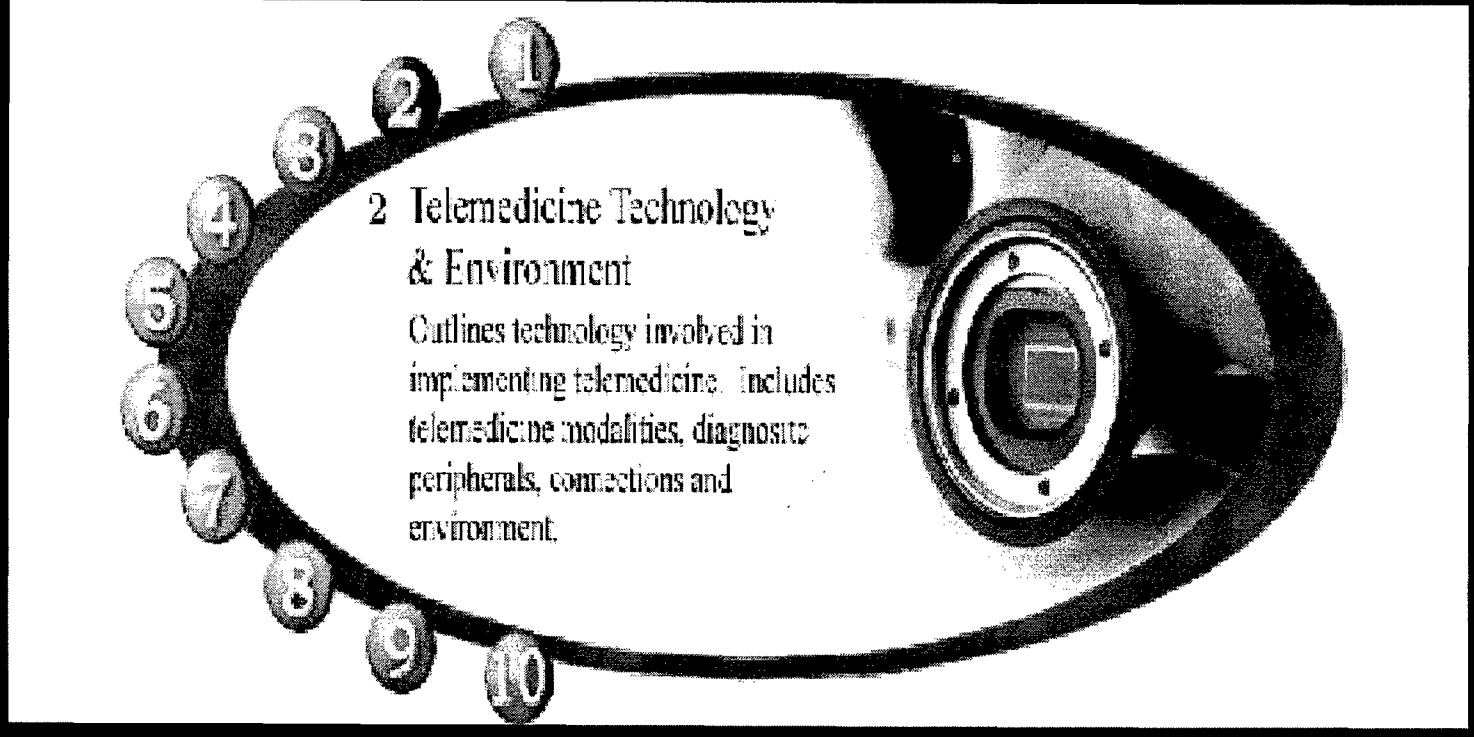

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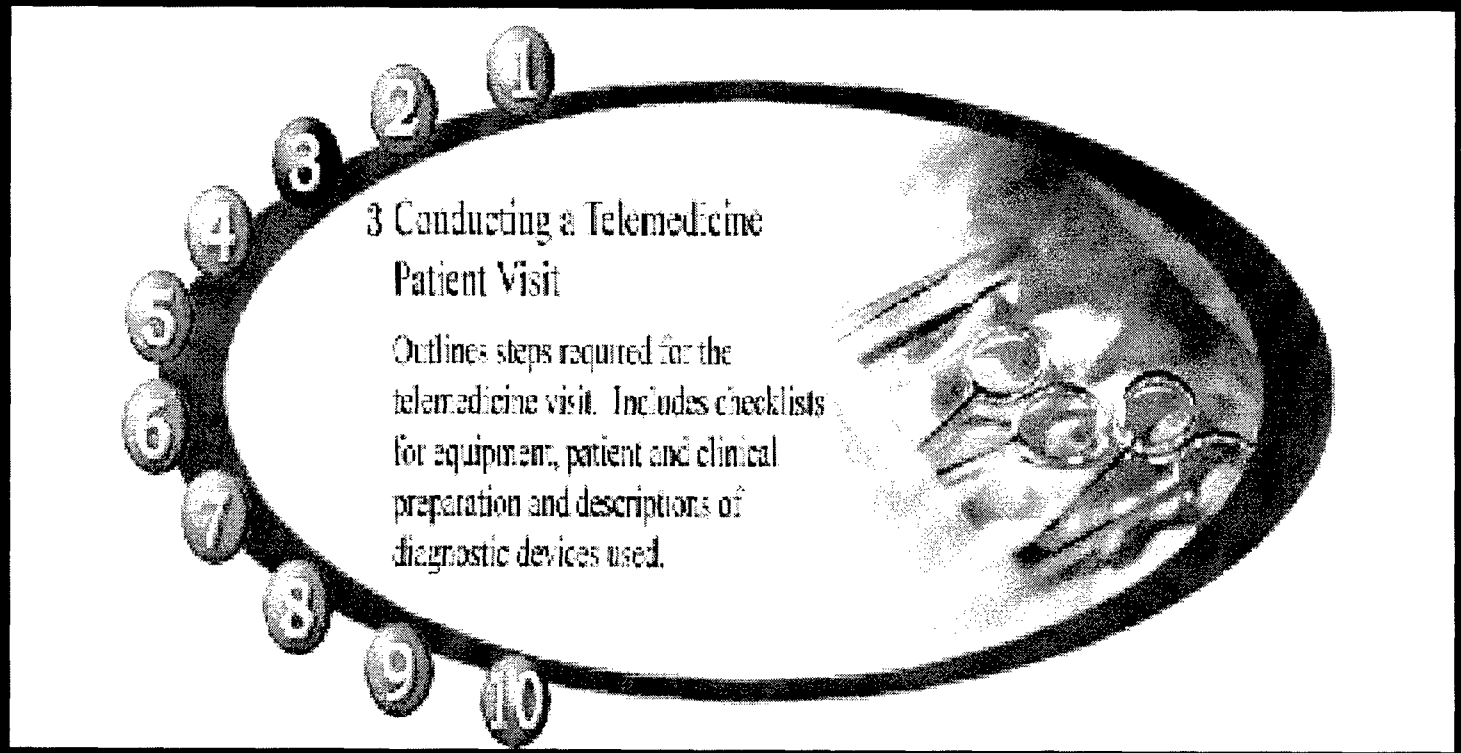

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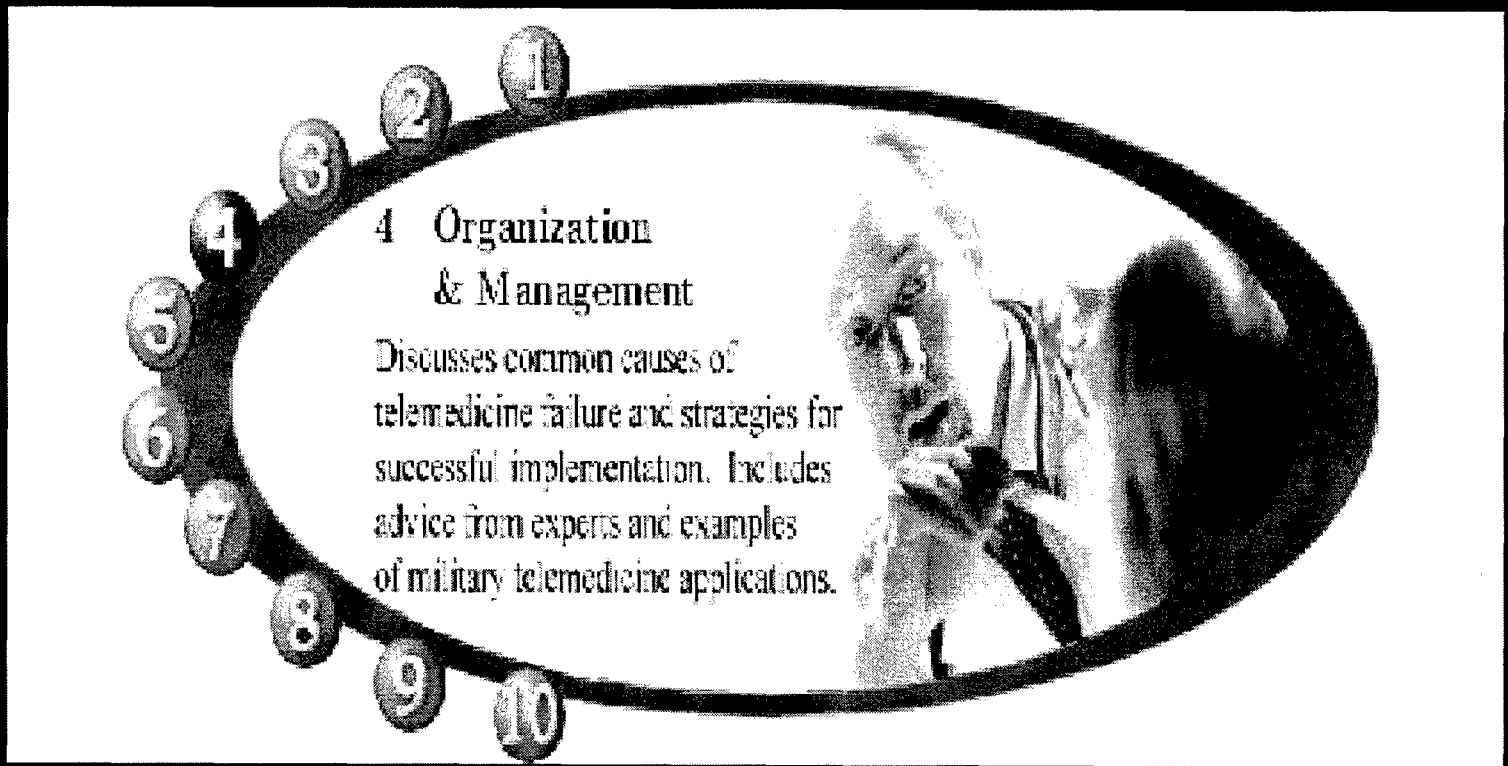
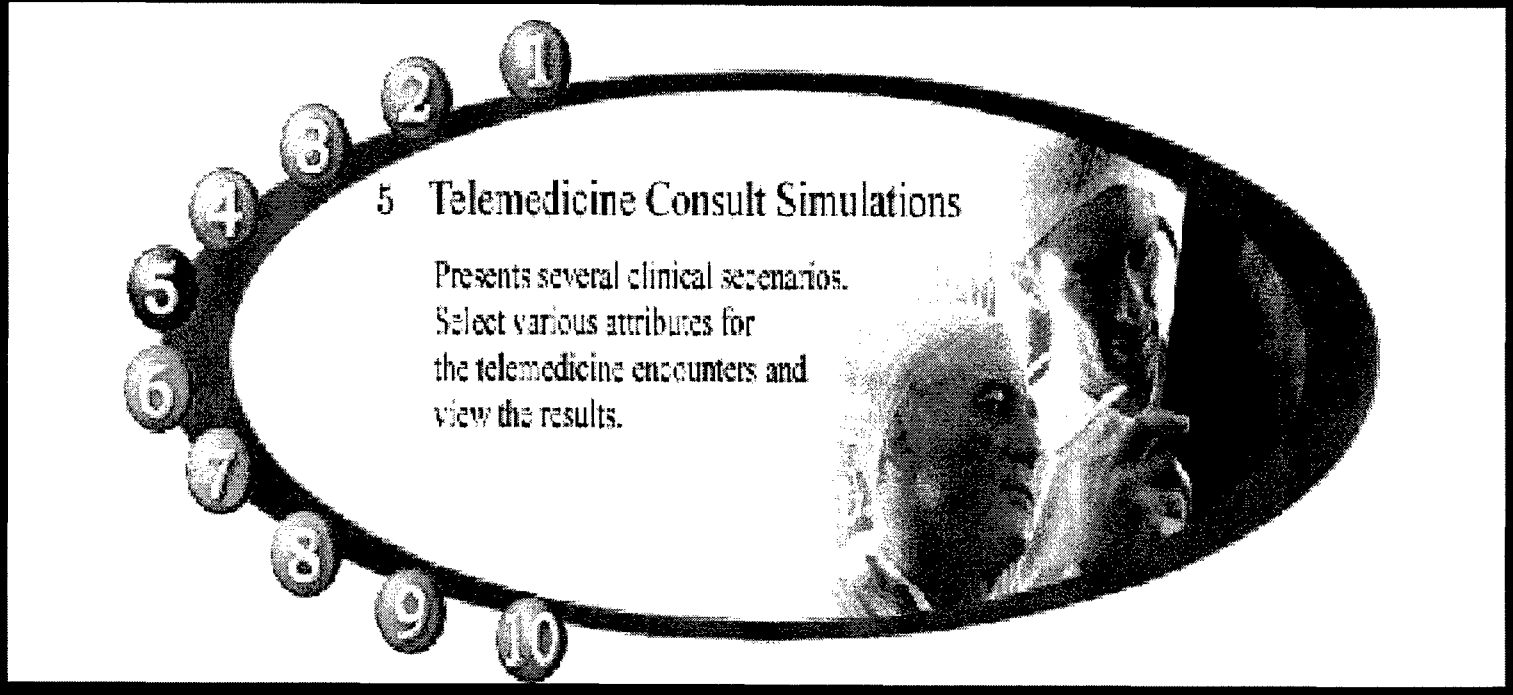
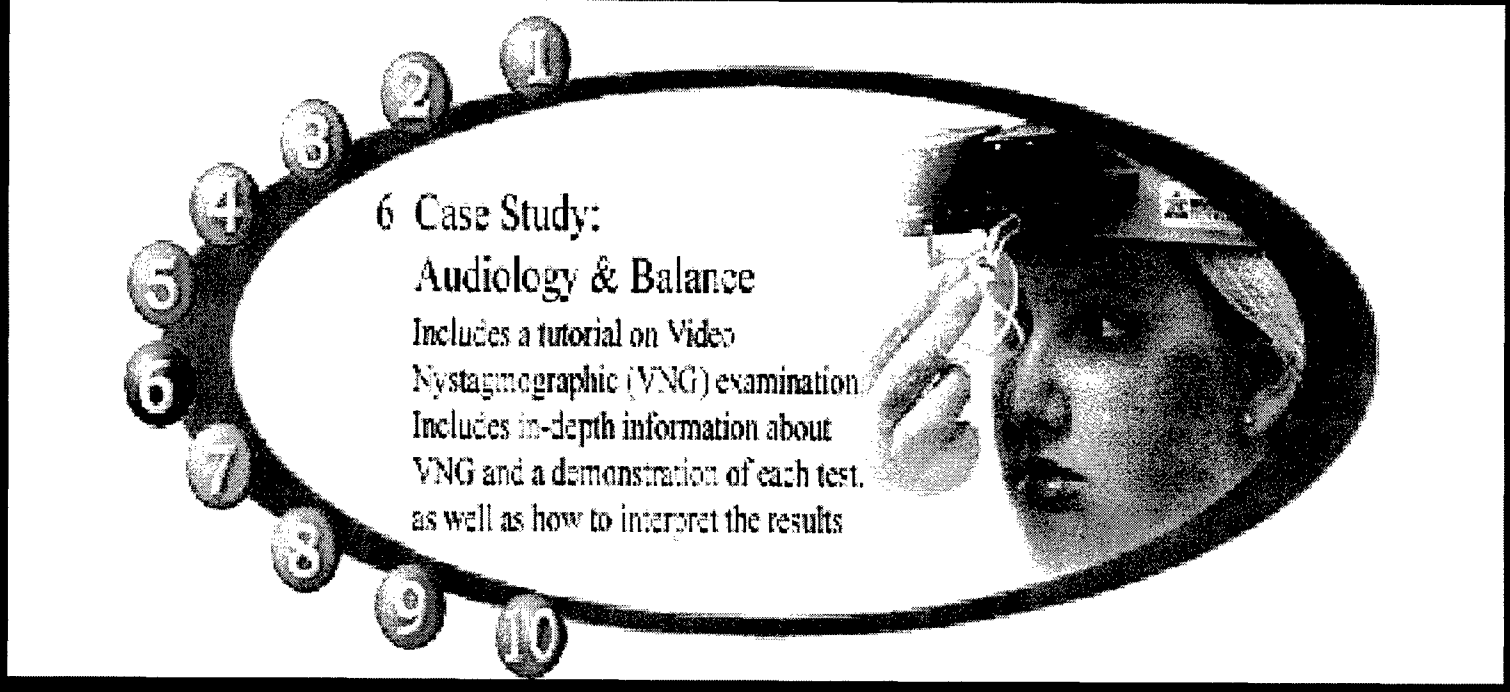


University of Hawaii Telemedicine Curriculum



University of Hawaii Telemedicine Curriculum



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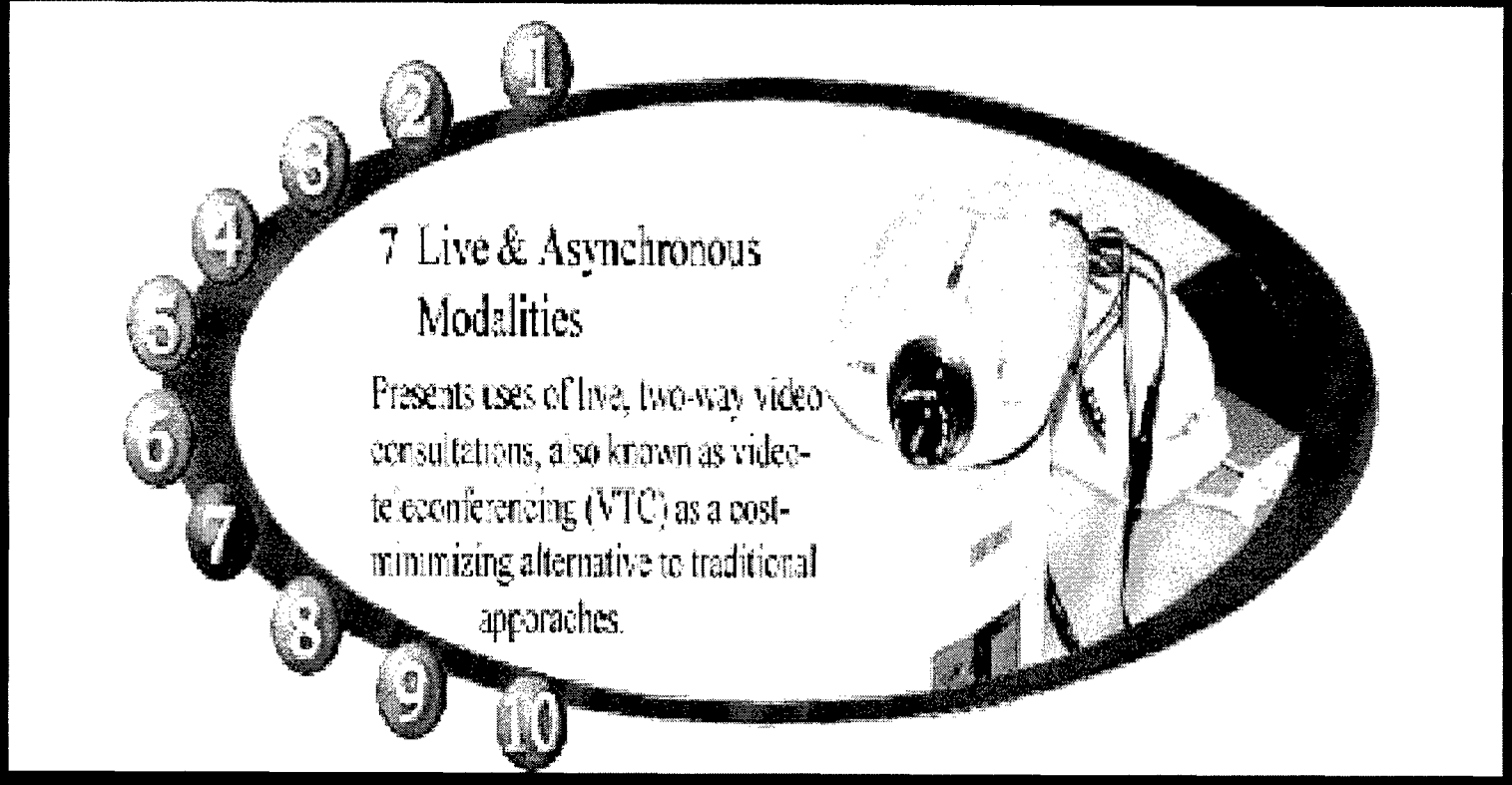
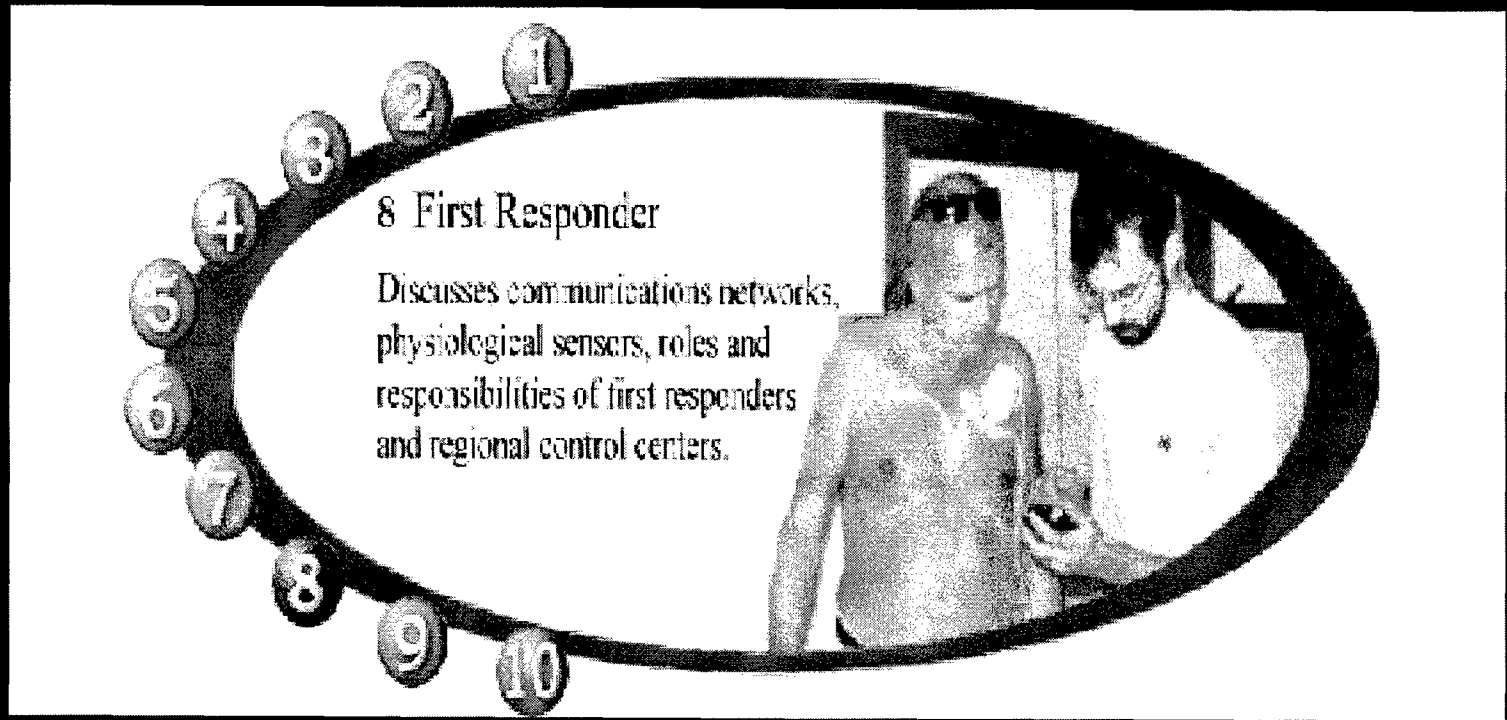


University of Hawaii Telemedicine Curriculum



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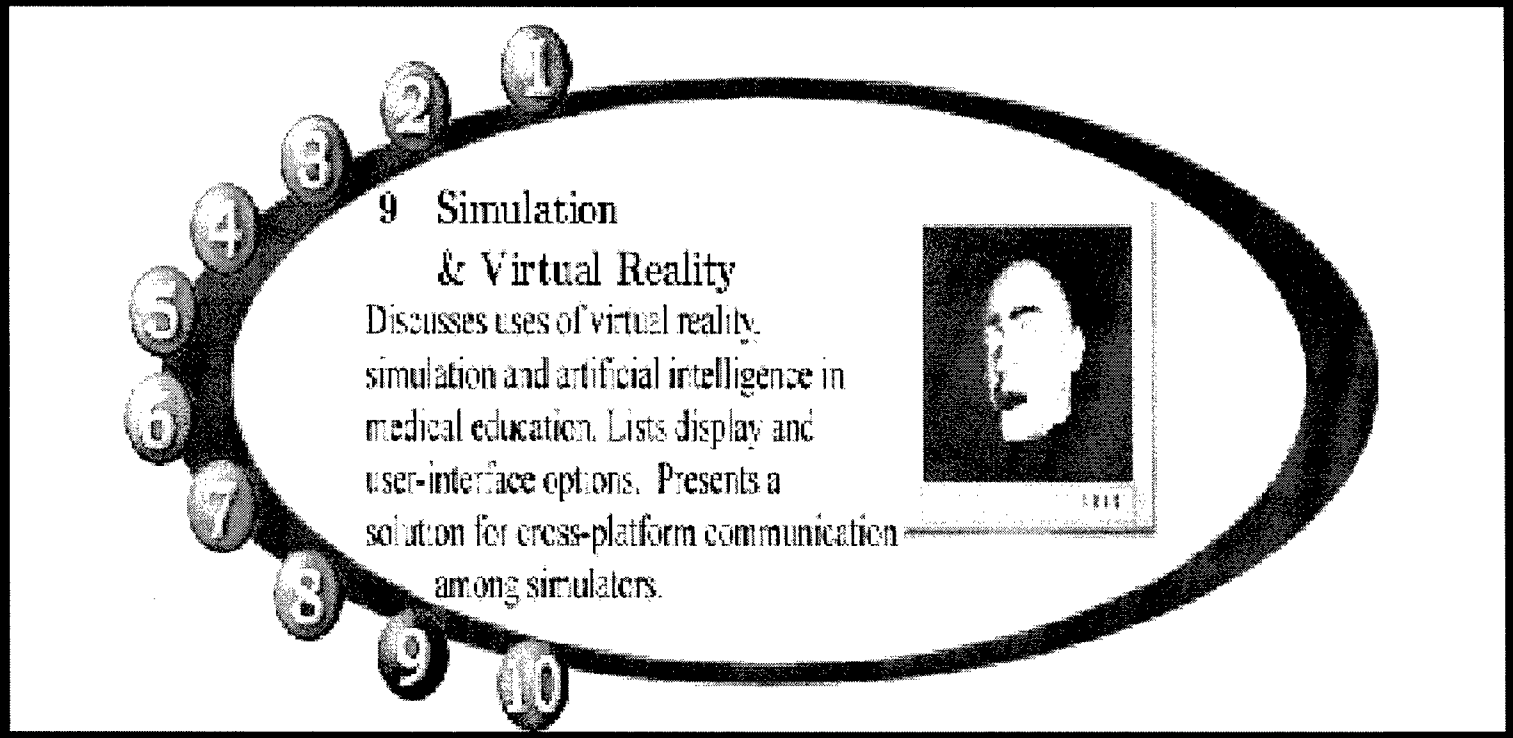
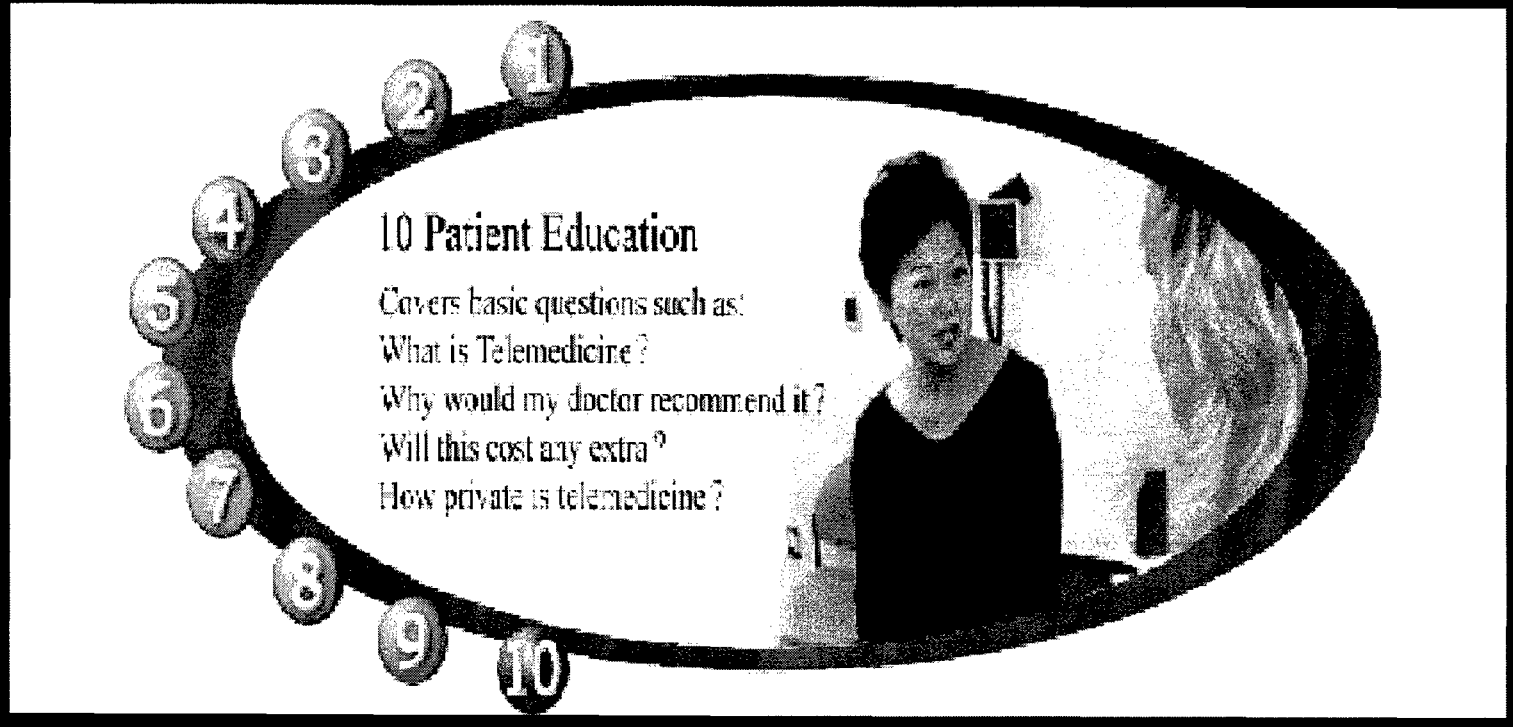


University of Hawaii Telemedicine Curriculum



University of Hawaii Telemedicine Curriculum

http://uhtelemed.hawaii.edu/curriculum/

Transcription, Voice Recognition, and the Electronic Medical Record

Lawrence Burgess, MD, FACS
Associate Dean for Clinical Affairs
Director of Telemedicine
John A. Burns School of Medicine
University of Hawaii

Needs Assessment

- Define what you want the system to do. Transcription and VR are just tools in the process in developing the medical record.
- Do you have an existing electronic medical record (EMR), or are you just starting?
- Standalone VR vs. integration with EMR

Transcription

- Provides electronic text file (high accuracy)
- Templates and macros can be used
- Costs are definable
- Emphasis is on ancillary support
- Outsourcing easy (with caveats); multiple sources available

Voice Recognition

- Same as transcription (without middle man?)
- Accuracy?
- Emphasis shifted to provider (type of practice?)
- Requires total commitment
- Outsourcing possible into high-end VR systems

Electronic Medical Record

- Time and money saved in transcription by VR is the tip of the iceberg. EMR is the real issue.
- Templates in EMR save time (for provider and transcriptionist), improve documentation, and improve coding.
- Quality care enhanced with allergy alerts, drug interaction screens.

EMR Desired Qualities

- Scheduling system for staff (older systems do this very well).
- All patient encounters (charts, messages, labs) all linked to patient electronically.
- Chart or message forwarding within the platform.

EMR Desired Qualities

- Coding package integrated with search capability, and generates superbill.
- Coding screen for E&M level.
- Fully integrates with electronic billing system (platforms will evolve to this capability).

EMR Desired Qualities

- Artificial intelligence components:
  - with stated Dx, recommends Rx medications
  - Shows history of previous Rx for that Dx

EMR in My Office

- Use Logician (GE product):
  - It was already there when I started (no proprietary interest.)
  - Office has one full time and two part time physicians, 3 full time and 2 part-time ancillary staff
  - 2 licenses obtained @$250/month each.

EMR in My Office

- Use Logician (GE product):
  - 1 MD doesn't use it (handwrites or dictates free-form).
  - 1 MD (full time) does some typing, but mostly dictates, and part-time transcriptionist fills in the EMR by confirming or modifying NL templates. MD reviews, approves, modifies, signs on-line.
  - 1 MD (L.B.) dictate HPI and Assessment-Plan, enter\modify templates for PH, ROS, PE. Find it easier to review record after transcription.

Templates

- Transcription costs cut by templates. VR could work nicely in this format. Transcriptionist could do initial review of your VR transcription, doc secondary.
- Experience of transcriptionist can be reduced, as complexity and keystrokes are reduced.
- Dictation time and review time of doc also reduced.

LINKS

- Look for in-house vs. outsource depending on needs
- Quality of electronic medical record platform.
- Integration with EMR, Billing system

General

- Dictation Hardware and Software - Comparison of various VR products
  - http://www.speechtechnology.com

General

- In-house VR vs. outsource VR
  http://www.speechmachines.com/
  - Call toll free number, dictate over the phone, VR using supercomputer, transcribed document comes back to you through email or part of database.
- Other outsourcing to conventional transcription: out of country, at home workers, combined with on-line tracking reduces cost.

Integrated VR-EMR

- AVS Technologies
  http://www.atlanticvoice.com/
- Voice Automated
  http://www.voiceautomated.com/
- Pacific Voice for Medicine
  http://www.medical-voice-products.com/

Integrated EMR-Billing

- Only matter of time.
- ConnxtMD
  - Product of billing service. Integrates scheduling, record, billing into one product.
  - http://www.teampraxis.com

Conclusion

- Know what you want
- VR requires complete commitment by the provider
- VR can work, but caveat is accuracy.

Conclusion

- Use of templates, engineering documentation process more important than VR.
- Transcription cost is a key issue, and should be thoroughly reviewed.
- Physician time for dictation and review of dictation are also important variables.

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10 June 2003

University of Hawaii Telemedicine Project: A Web-based Telemedicine Curriculum

10 June 2003

Project Information

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10 June 2003

Lab/Company/Group: University of Hawaii

Principal Investigator: Dr. Lawrence P.A. Burgess, MD

Government COR: Dr. Rufus Sessions, PhD

Government Project Officer: Ms. Jessica Kenyon

Contract Instrument: Cooperative Agreement

Period of Performance: 9 Oct 1998 – 30 Jun 2003 (a 7-month No-Cost Extension is pending)

Contract Specialist: Ms. Nita Bourne

EDMS# 2110

Program Description

- The purpose of the project is to develop a didactic, web-based curriculum to train healthcare providers in the use of telemedicine technologies and applications.

- Funding is through the Department of Defense (DAMD17-99-2-9003), U.S. Army Medical Research and Materiel Command, Telemedicine and Advanced Technology Research Center (TATRC) at Fort Detrick, Maryland.

Program Description

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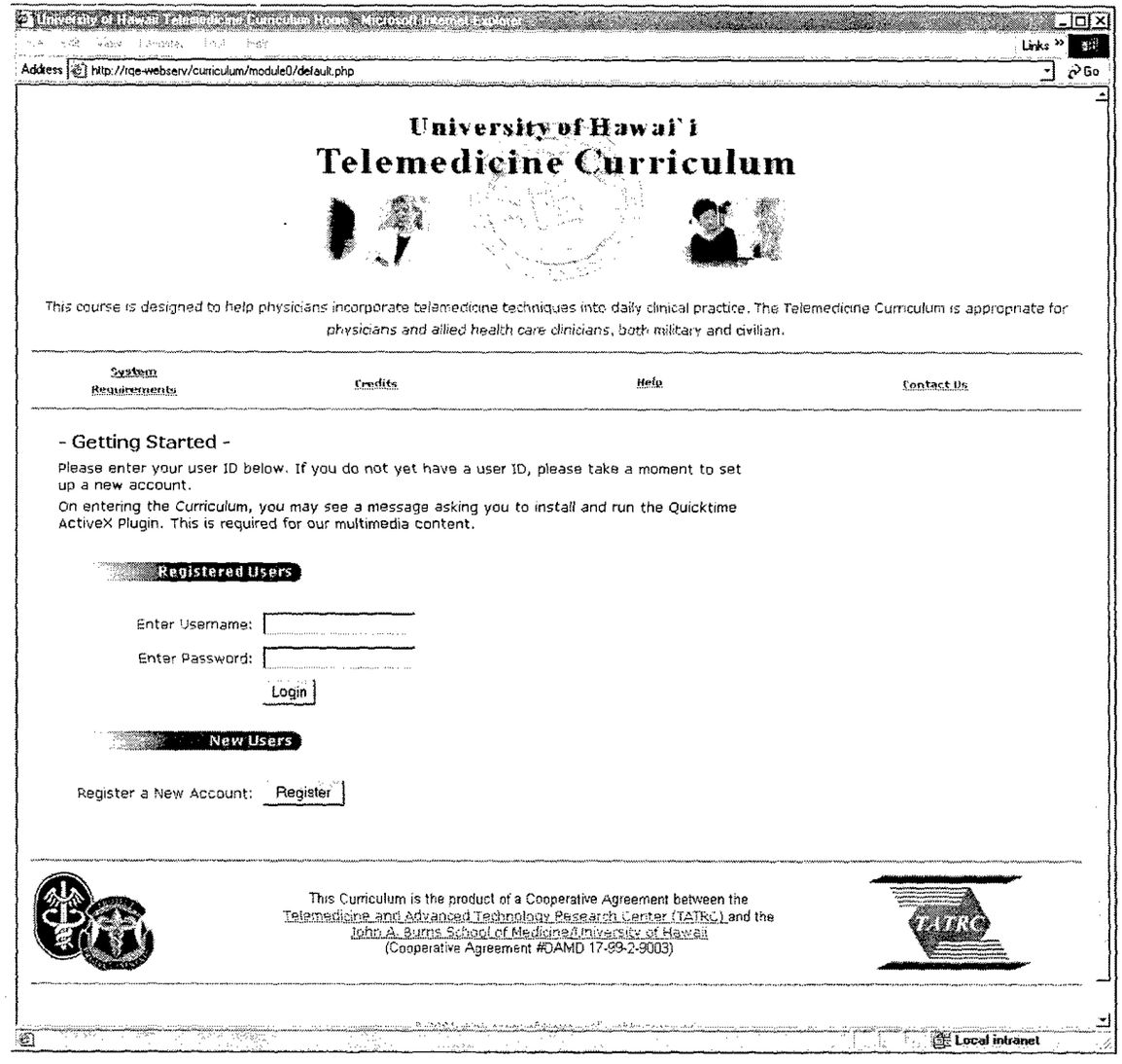

Program Description

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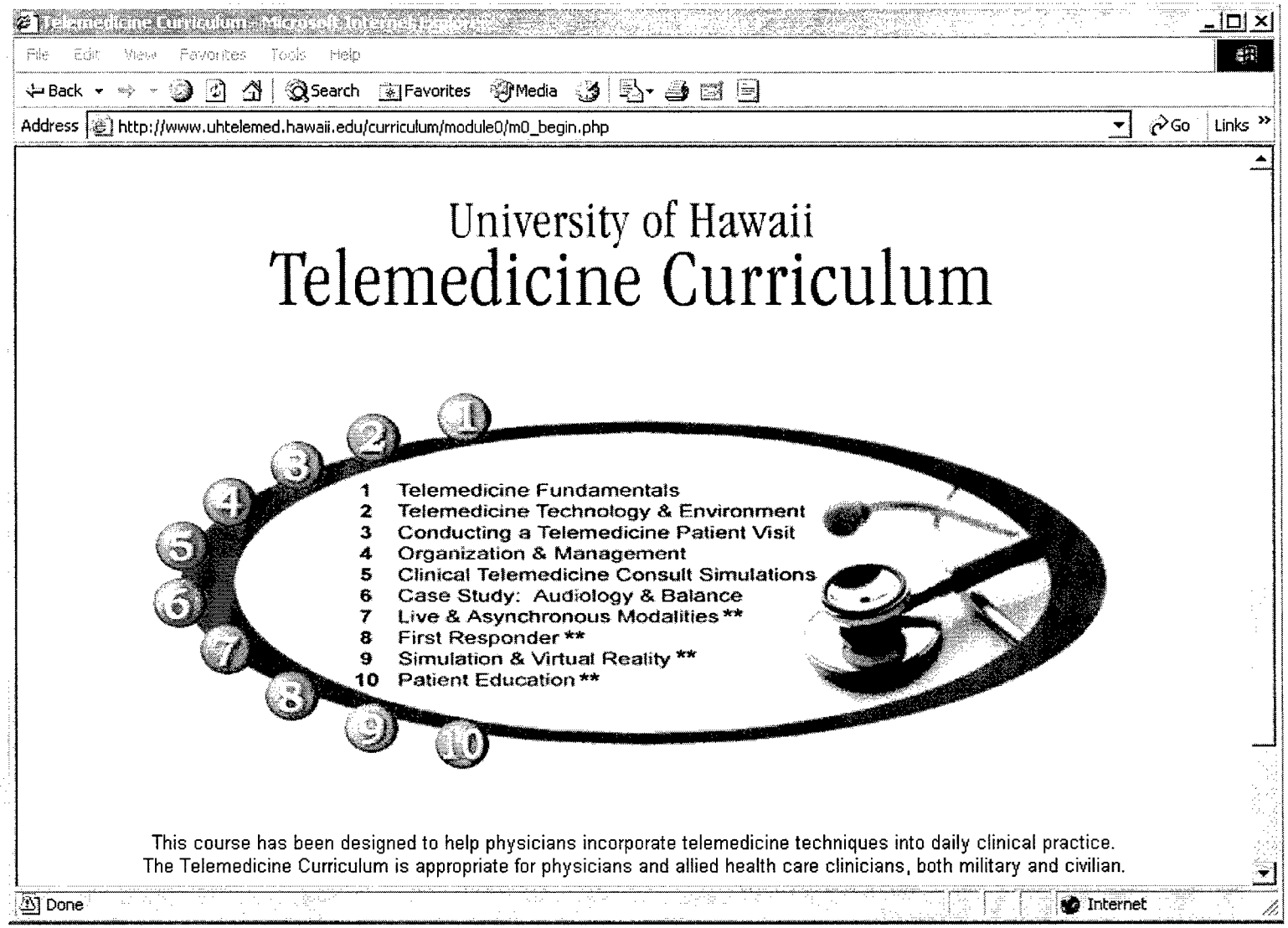

Program Description

- **Module 1: Telemedicine Fundamentals**
- **Module 2: Telemedicine Technology & Environment**
- **Module 3: Conducting a Telemedicine Patient Visit**
- **Module 4: Organization & Management of Telemedicine**
- **Module 5: Telemedicine Consult Simulations**

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Program Description

- **Module 6: Telemedicine Applied: Audiology & Balance**
- **Module 7: Live & Asynchronous Modalities**
- **Module 8: First Responder**
- **Module 9: Simulation & Virtual Reality**
- **Module 10: Patient Education**

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Potential Benefits

- Investigate advanced telemedicine concepts
- Disseminate telemedicine throughout the DoD
- Web-based
  - Easy access for all users
  - Potential CME credit with no time or geographic barriers
  - Improves distribution
  - Easier updates from lessons learned from recent telemedicine deployments
  - Allows for collection of data for user statistics
- Easily adaptable to the Army Knowledge Network (AKN)

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Military Relevance

- **Designed to address the communication and automation tools available to the military healthcare system.**

- **Provides an advanced toolkit of telemedicine curriculum modules to support the efforts of the DoD to apply the latest technological advances in commmunication and data transfer for improving healthcare delivery.**

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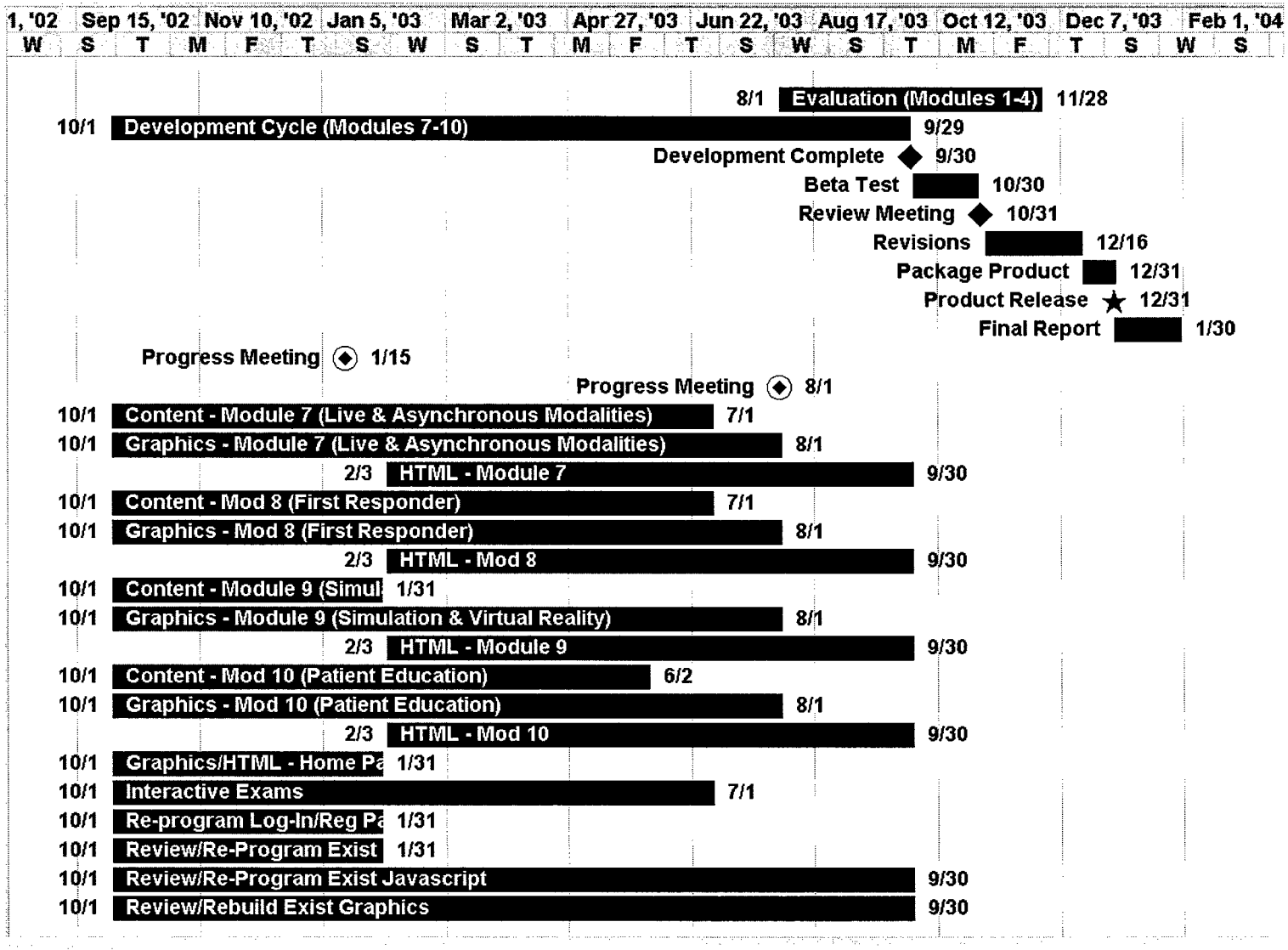
Research/Development Plan

- **Evaluate and validate following modules:**
  - ➡ **Telemedicine Fundamentals**
  - ➡ **Telemedicine Technology & Environment**
  - ➡ **Conducting a Telemedicine Patient Visit**
  - ➡ **Organization & Management of Telemedicine**
- **Develop the following four modules:**
  - ➡ **Live & Asynchronous Modalities**
  - ➡ **First Responder**
  - ➡ **Simulation**
  - ➡ **Patient Education**

Research/Development Timeline



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Successes to Date

- Completed six modules.
- Four additional modules under development.
- Incorporated on-line testing and scoring.
- Developed evaluation plan for validation of curriculum.
- Initiated contact with AMEDD Center and School for distribution of the curriculum.
- Initial 6 modules used at another university.

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Challenges

- **Awaiting approval from MRMC IRB for UH Curriculum Evaluation Plan modification.**

- **Desired subject population for evaluation not easily accessible to independent evaluators due to deployments.**

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Quality Assurance/Regulatory Issues

Animal Use – Not applicable.

Human Use - Approved by UH IRB on
8 April 2003.
Sent to MRMC RCQ on
9 April 2003.
(pending approval)

FDA – Not applicable.

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Contract Funding

FY	Commitment	Obligation
99	$1,510,523	$1,510,523
00	$989,477	$989,477
01	$857,500	$857,500
02	$857,500	$857,500

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Project Funding - Execution

	Current Budget	Expended Funds	%
PLR	$4,215,000	$3,633,652	86%

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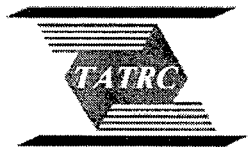
Project Coordination

- Tripler Army Medical Center
- AMEDD Center and School (COL Robin Tefft)
- Pacific Telehealth and Technology HUI (Joint DoD/VA Venture)
- Uniformed Services University of the Health Sciences



Cost Analysis/Cost Savings

- **Distribution costs**
  - **Inexpensive to update curriculum with current information**
  - **Convenient access to all users**

- **CME related costs**
  - **Travel costs**
  - **Time away from duty station**
  - **Course and registration fees**

Comparison

- **Information available in other places, but is fragmented.**
- **Telemedicine textbooks tend to be out-of-date and unavailable.**
- **On-line testing is front-leaning and compatible with the state-of-the-art.**
- **Compliments the efforts of the DoD with the Army Knowledge Network (AKN).**

Intellectual Property Status

- **Shared intellectual property status between University of Hawaii and Government.**
- **Limited license for intellectual property rights for authors.**
- **Some code, i.e., search engine, is freely distributable for non-commercial use only.**

The Market

- **Market type(s): Curriculum, Distance Learning, CME**
- **Market sizes: Unknown**
- **Competitors: None**

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Commercial Plans/Expectations

- Marketing vehicle: Transfer curriculum to TATRC and DOD
- Estimated date for transition: February 2004
- Estimated sales ($MM) & market: N/A
- Resources needed for commercialization: N/A

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Publications

Refereed Journal Manuscripts

Humphry, J. & Birkmire-Peters, D.P. The successful integration of telemedicine into the chronic disease model in a rural setting. Manuscript in preparation.

Bangert, D. & Doktor, R.H. (2002). Telemedicine as an IS implementation problem: Comparison of dynamics in the USA and India. International Journal of Healthcare Technology and Management, 4(6), 525-541.

Bangert, D., Doktor, R.H. & Johnson, E. (2002). Preparing healthcare professionals for telemedicine: Results from educational needs research. Journal of Interactive Learning Environments, 10(3), 199-216.

Burgess, L.P.A., Holtel, M.R., Saiki, S.M. & Jacobs, J.L. (2002). Telemedicine in otolaryngology: Implications, pitfalls and roadblocks. Current Opinion in Otolaryngology & Head and Neck Surgery, 10, 194-198.

Publications

Refereed Journal Manuscripts (Continued)

Holtel, M.R. & Burgess, L.P.A. (2002). Telemedicine in otolaryngology. Otolaryngologic Clinics of North America, 35, 1263-1281.

Bangert, D., Doktor, R.H. & Johnson, E. (2001). Designing web-based telemedicine training for military healthcare providers. Journal of Continuing Education in the Health Professions, 20(3), 162-169.

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Conference Proceedings

Onapa, J., LePape, M., Thonier, G., Saiki, S., Montgomery, K. & Burgess, L. (2003). High altitude research Hawaii. High Altitude Medicine and Biology, in press.

Bangert, D. & Doktor, R.H. (2002). The Role of Organizational Culture in the Management of Clinical e-Health Systems, SSGRR (Scuoloa Superiore Guglielmo Reiss Romoli) L'Aquila, Italy.

Publications

Conference Proceedings (Continued)

Bangert, D. & Doktor, R.H. (2002). Human Factors Considerations in Implementation of a Telemedicine Strategy, American Telemedicine Association Conference Proceedings, Los Angeles, CA.

Bangert, D. & Doktor, R.H. (2002). A Cross Cultural Analysis of Human Factor Impediments to Effective Telemedicine Utilization, American Telemedicine Association Conference Proceedings, Los Angeles, CA.

Bangert, D. & Doktor, R.H. (2001). Causes of Human Factors Barriers to Telemedicine, American Telemedicine Association Conference Proceedings, Ft. Lauderdale, FL.

Publications

University of Hawaii Telemedicine Curriculum

Hall, J. & Saiki, S. (2001). Module 1: Telemedicine fundamentals.

Huhta, D. & Saiki, S. (2001). Module 2: Telemedicine technology & environment.

Huhta, D. & Saiki, S. (2001). Module 3: Conducting a telemedicine patient visit.

Bangert, D. & Doktor, R. (2001). Module 4: Organization & management of telemedicine.

Friedman, R. & Saltman, D. (2001). Module 5: Telemedicine consult simulations.

Yates, J.T., Harmer, S.D., Virre, E., Campbell, K.H., & Kau, D. (2001). Telemedicine applied: Audiology & balance.

Presentations

Onapa, J., LePape, M., Thonier, G., Saiki, S., Montgomery, K. & Burgess, L. (2003, February). Poster presented to the 13th Internarional Hypoxia Symposium, Banff, Canada.

Burgess, L.P.A. (2002, December). Pitfalls in Telemedicine and Telesynergy. Presentation given as Visiting Professor, Hong Kong Polytechnic University, Hong Kong, China.

Humphry, J. (2002, May). Using telemedicine and the chronic disease model to improve quality of diabetes care in Hana. Presentation to the national meeting of the CDC Division of Diabetes Translation, St. Louis, MO.

Take Home Message

- **Web-based curriculum good vehicle for distance learning.**

- **Future projects need a stronger partnership for evaluation.**

TELEMEDICINE APPLICATIONS

Lawrence Burgess, MD
Associate Dean for Clinical Affairs
Dir. of Telemedicine Otolaryngology-
John A. Burns School of Medicine
University of Hawaii

Telemedicine: Definition

- The use of technology to:
  A. collect, store, and transmit patient information.
  B. educate and train patients and providers.

Telemedicine Vision

- Practice and hospital without walls or geographic boundaries. Quality of technology will define the boundaries.
- Effect of time diminished with store-forward.

Telemedicine Vision

- Point of service care: monitoring and diagnosing patients at work or home leads to timely care.
- Point of service care: significant time and $ savings for the patient, employer, and healthcare system.

Telemedicine Vision

- Artificial intelligence will make technology faster and smarter.
- Technology will assist providers in diagnosing and treating patients with improved efficiency and outcomes.

Telemedicine R & D

- Needs assessment drives the train with technology as the locomotive.
- Corollary 1: A train without a destination gets lost.
- Corollary 2: A train without a driver (champion) doesn't leave the station.

Telemedicine R & D

- If the need is obvious, champions to run the train will not be hard to find.
- When the need is "subtle" and disrupts the status quo, champions must be developed to spread the word.

Telemedicine Concepts

- Business to Business - B2B
- Business to Patient
- Med facility to Med facility
- Patient to Physician
- Physician to Patient
- Physician to Physician
- Patient to Patient

B2B

- Filing insurance claims on web. In 2004, $224 billion in claims projected. Being encouraged by insurance carriers.
- Purchasing instruments and supplies. In 2004, $124 billion (12% of sales vs. 0.2% in 1999)

Business to Patient

- On-line retailing of prescriptions, medical supplies.

Med Facility to Med Facility

- Electronic medical record components (laboratory data, pathology reports, history and physical, etc.)
- Radiographs: allows review by patient's physician or consultant

Patient to Physician

- Home monitoring of patient (pulse oximetry, peak flow, heart rhythm).
- Email instead of phone calls.

Physician to Patient

- Home page: professional qualifications, advertising, patient education
- Remote diagnosis and therapy of patient through audio- and video-teleconferencing.

Physician to Physician

- Store-forward or live consultation regarding a patient. Important for triage and documentation.
- Tumor board, grand rounds via audio- and video-teleconferencing.

Patient to Patient

- Chat room with controlled access and facilitator for therapy groups.
- Patient organizations reaching out to affected patients.

Statement of Problem

- Deploying telemedicine technologies in the work place can be difficult.
- Value to patient care or the healthcare system may not be readily apparent, or conflict with the status quo.
- Infrastructure may be costly.

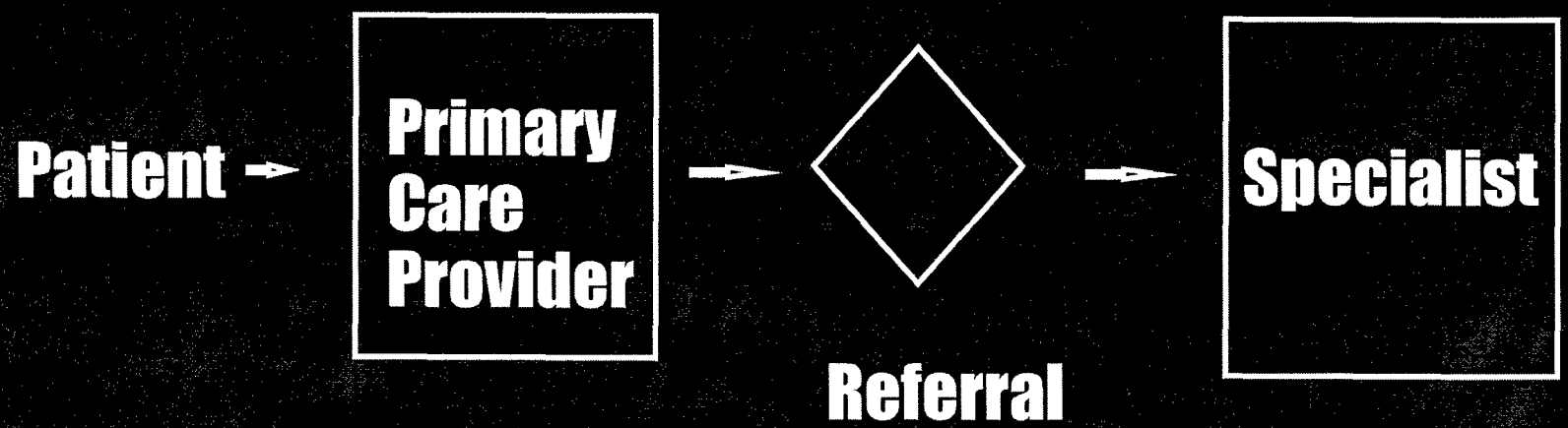
Step-wise Approach

- Needs assessment - Where can telemedicine play a role?
- Usability studies - What is the best equipment available or that can be developed for the need?

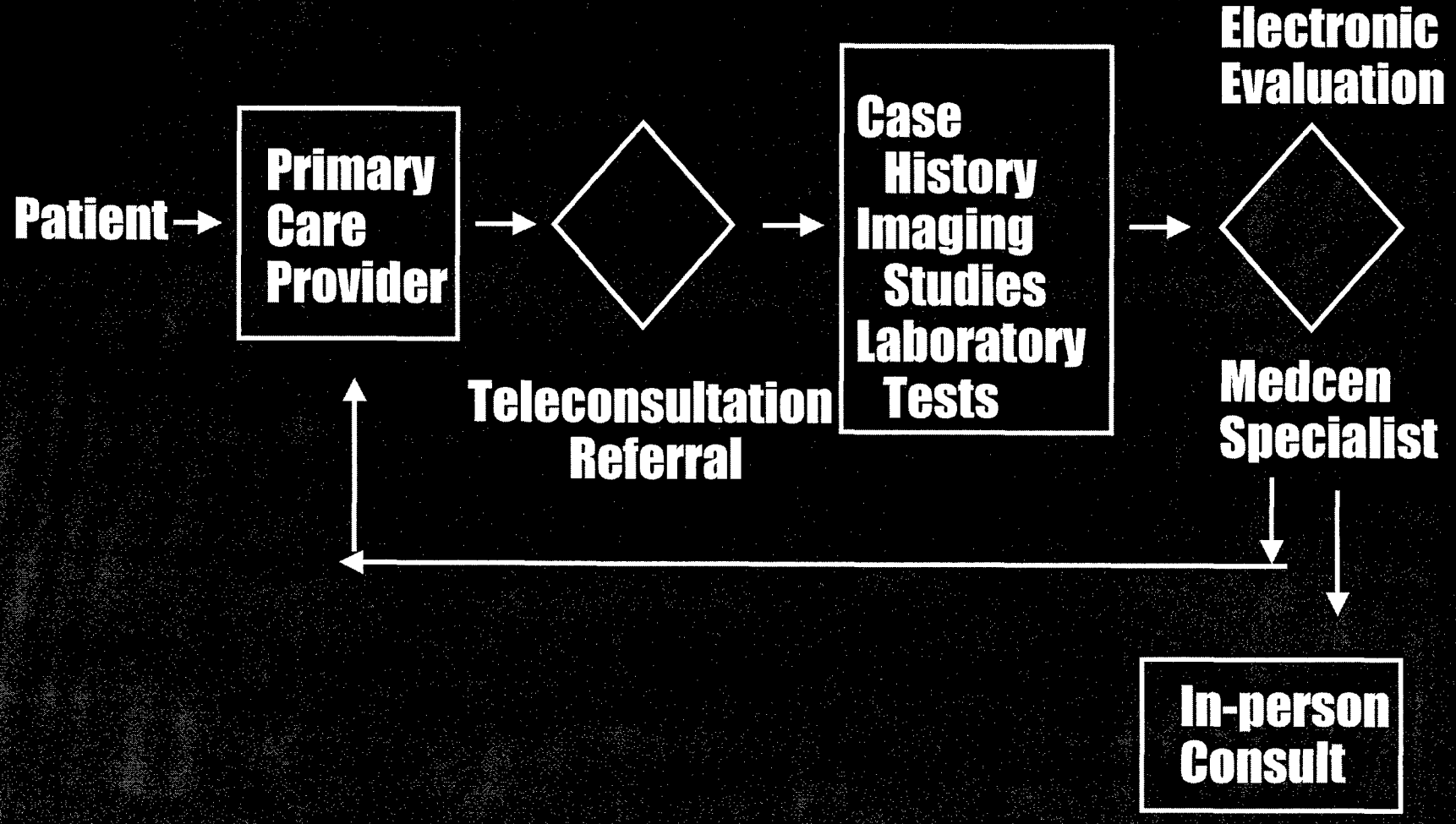
Step-wise Approach

- Proof of concept in-house - Can the telemedicine solution be normalized to the current standard of care, comparing control to experimental?
- Study remotely - Is remote utilization of technology equal to the current standard of care?

Current Consultation Practice

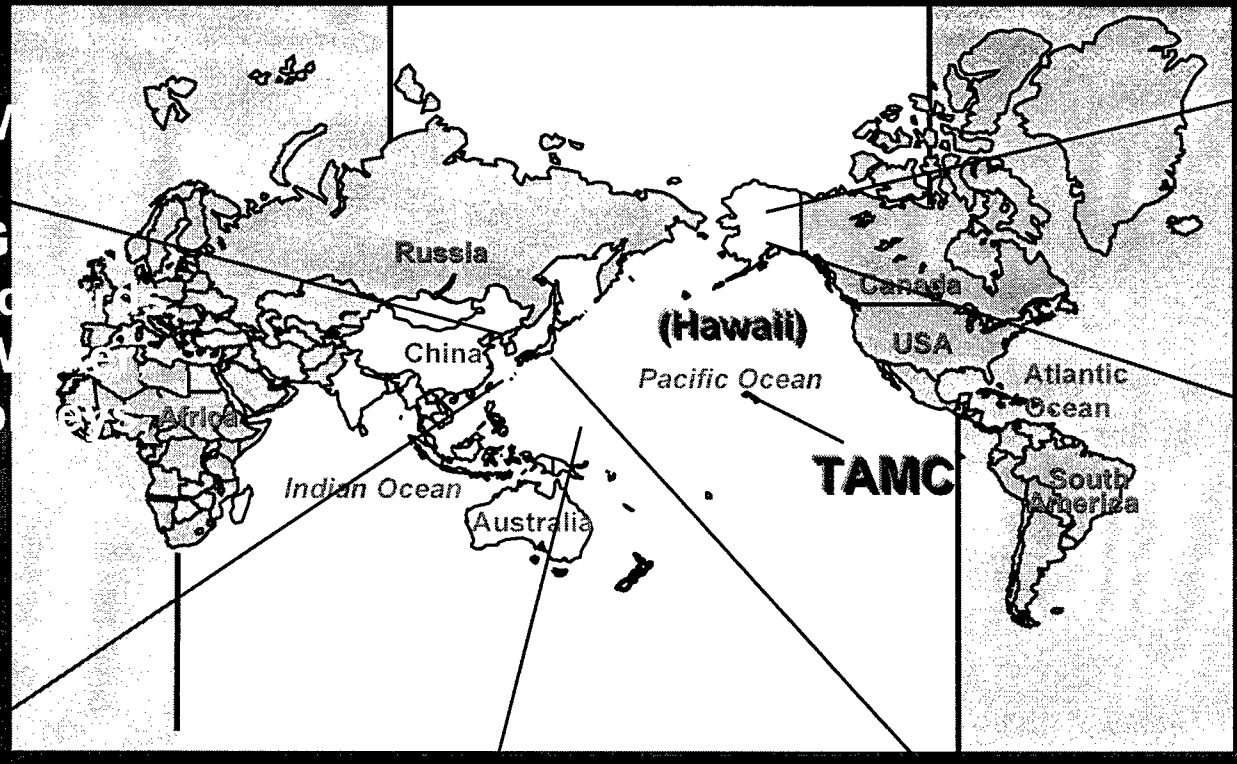


Proposed Teleconsultation



Tri-Care Pacific AOR

(ROK)
18th MEDCOM
121 Evac
51st & 8th MG
CPs Casey, Ec
Long, Page, W
Carroll, Hump
& Others



(Alaska)
Bassett
ACH
Eielson
Clinic
283 Med

ALCOM
Elmendor
Hosp
Ft Rich.

(Okinawa)
Kadena Clinic
NH Okinawa
JBPO
3 MEF Surg

(Guam)
Anderson Clinic
NH Guam

(Japan)
Yokota Hospital
NH Yokosuka
Camp Zama
Misawa AFS
Sagami Depot
Sasebo
IMRO

7th Flt Surg Medical Assets

Otolaryngology & Telemedicine

- Ear Diseases (hearing loss)
- Laryngology (vocal cord disorders)
- Speech Therapy (remote dx/tx)
- Teleproctored Surgery

Otolaryngology & Telemedicine

- Voice recognition software
- Internet Tumor Board
- Internet Grand Rounds (live)
- Internet Grand Rounds (archived)
- Internet Patient Education

Need

- Need exists to reduce unnecessary clinic visits, reducing cost and staffing requirements. Hearing loss is one area where telemedicine could play a role in accomplishing this.

Telemedicine Hypothesis

- An electronic consultation form with a history, physical examination, audiogram, and digital eardrum image can be used as a triage tool to determine the need for a physical visit for certain middle or inner ear diseases (store-foreword consults).

Status of Research

- Usability studies were conducted to identify the best device for ear drum image capture, analysis, and transmission.
- In-house study comparing digital image to otoscopy and microscopy in evaluating the ear drum.

Preliminary Results

- Pilot data in 25 ears indicates a 90% correlation between digital images and physical examination.
- Full study with 100 ears across several disease states is nearing completion.

Pitfalls

- Political fallout from specialty limits acceptance.
- Need??

Need

- No remotely based speech-language pathologists. Referrals require trans-Pacific transportation and long time periods for evaluation and treatment.

Telemedicine Hypothesis

- Remote speech therapy can be conducted through live audiovisual-teleconferencing (VTC).

Status of Research

- Need identified.
- VTC and speech therapy equipment identified and purchased, hardwiring the patient's room to the therapist's room in-house.

Preliminary Results

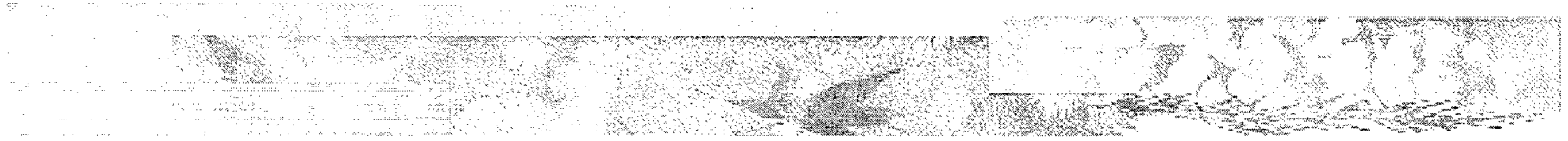
- Ten patients have completed voice therapy (6 controls and 4 experimental). Based on blinded review of pre- and post- treatment voice recordings, improved results seen in the experimental group.

Pitfalls

- Need champions at both ends. Difficult, since no speech pathologists at referring sites.
- Will save a lot of dollars, but difficult for bill payers to say go ahead when not proven from a distance.
- Small specialty lacks political power.

Conclusion

- Step-wise approach to telemedicine solutions will lead to better long-term acceptance of changes to the delivery of healthcare.
- Methodical approach is frequently complemented by price reductions in hardware and implementation.
- Administration must be willing to make technological investments based on strong research and business plans.



Developing Clinical Applications for Telemedicine, Hawai`i Experience

Daniel Saltman, M.D.
Clinical Director
University of Hawaii Telemedicine Project
USTTI Conference
January 29, 2004

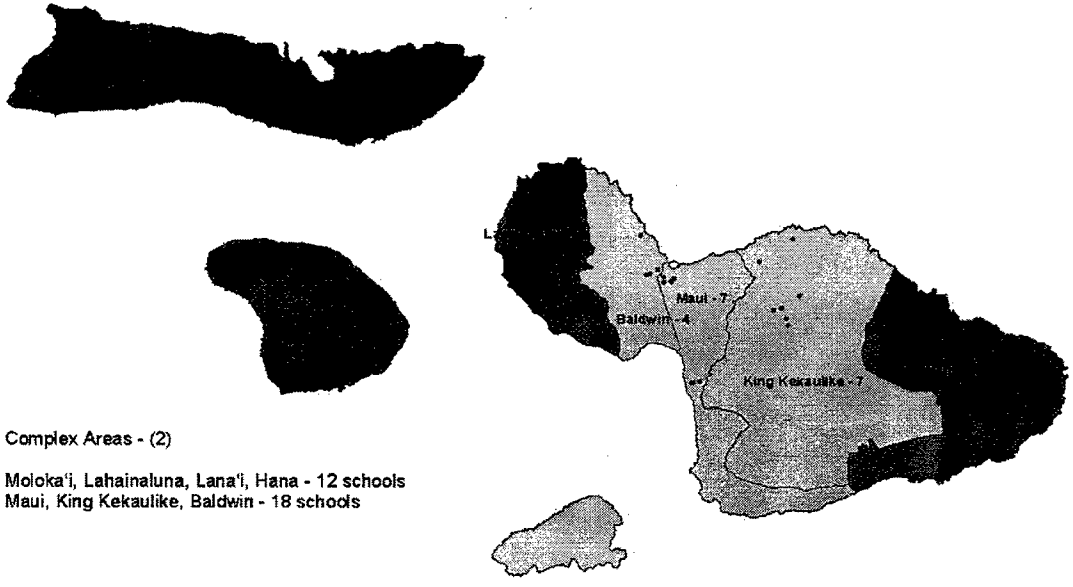
Main Points:

- Choose projects that fulfill specific needs
- Find a physician "champion"
- Start with simple technologies
- Ensure redundant systems
- Partner with major stakeholders
- Consider web-based tools to assist with logistics

Fulfill a Need

- Hawaii has 6 main islands
- 283 schools within 7 School Districts
- Average 778 students eligible for Mental Health Services each quarter

Maui School Complex Areas



Complex Areas - (2)

Moloka'i, Lahainaluna, Lana'i, Hana - 12 schools
Maui, King Kekaulike, Baldwin - 18 schools

Pediatric Telepsychiatry Pilot Project

- Contracted psychiatrists travel to provide mandated services to DOE children
- Psychiatrist champion on Maui connected with Moloka`i school children, families and staff
- Simple videoconferencing, fax and telephone used
- Partnered with Maui Community College School of Nursing, Moloka`i General Hospital Affiliate, AlohaHouse social service agency and DOE
- Low tech scheduling and logistics

Project Structure

- 75 hour project
- Weekly 4-hour blocks scheduled
- UHTP paid for ISDN calls and bridge time
- DOE personnel scheduled and delivered participants
- Moloka`I Telemedicine Coordinator facilitated logistics and evaluation

Project Toolkit

- Memorandum of Agreement
- Participant Education Brochure
- Informed Consent
- Encounter Protocol
- Evaluation Survey
- *www.uhtelemed.hawaii.edu/curriculum*

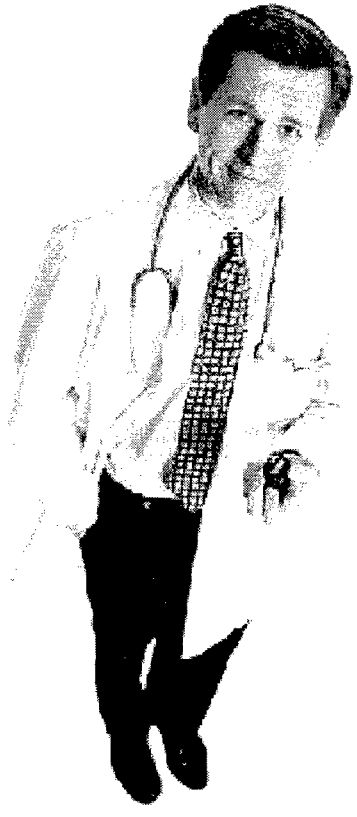
Project Results

- 7 Month Duration (now at 112 hours)
- 28 Videoconference Sessions (4 hours each)
- 219 Participant Encounters
- Average of 7.8 encounters per session *or* each encounter about 30 minutes

Project Results cont'

- Total Participants = 219
- Participants:
  - 40 Students (18%)
  - 78 Parents or Family Members (36%)
  - 101 DOE Staff (46%)
- Total Responses to Evaluation Survey = 21
- Response Rate = 10%

Find a Physician Champion

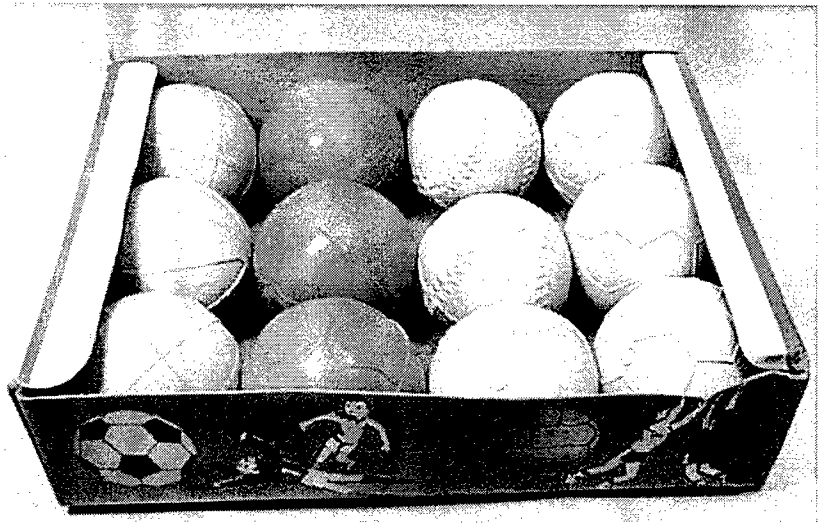


- Must have good qualifications
- Must be flexible and willing to work through challenges
- Must be enthusiastic about methodology
- Technical expertise not necessary

Keep It Simple

- Start with a focused pilot project
- Plain video-conferencing is easier than anything requiring peripheral devices
- Store-and-forward using encrypted e-mail with attachments is widely available

Ensure Redundancy

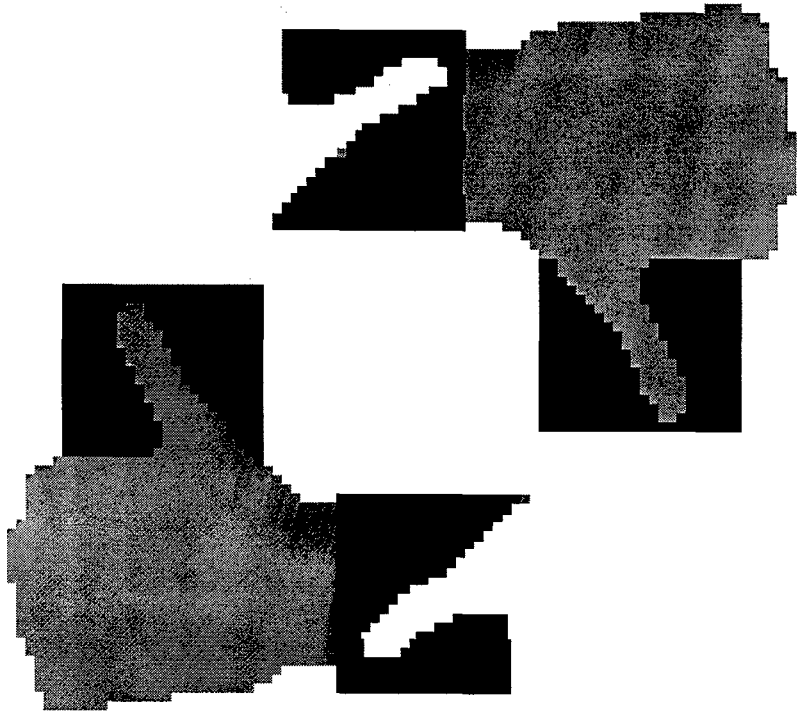


- Equipment
- Connection Points
- Networks
- Personnel
- Projects

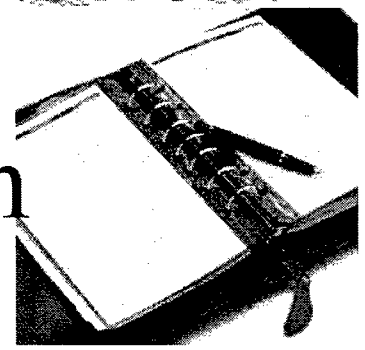
BE FLEXIBLE!

Network Effectively with Partners

- Identify organizations that share the clinical goals
- Connect with upper-level decision makers
- Don't "oversell" benefits
- Discuss financial responsibilities up front
- Be ready for legal concerns and liability disclaimers



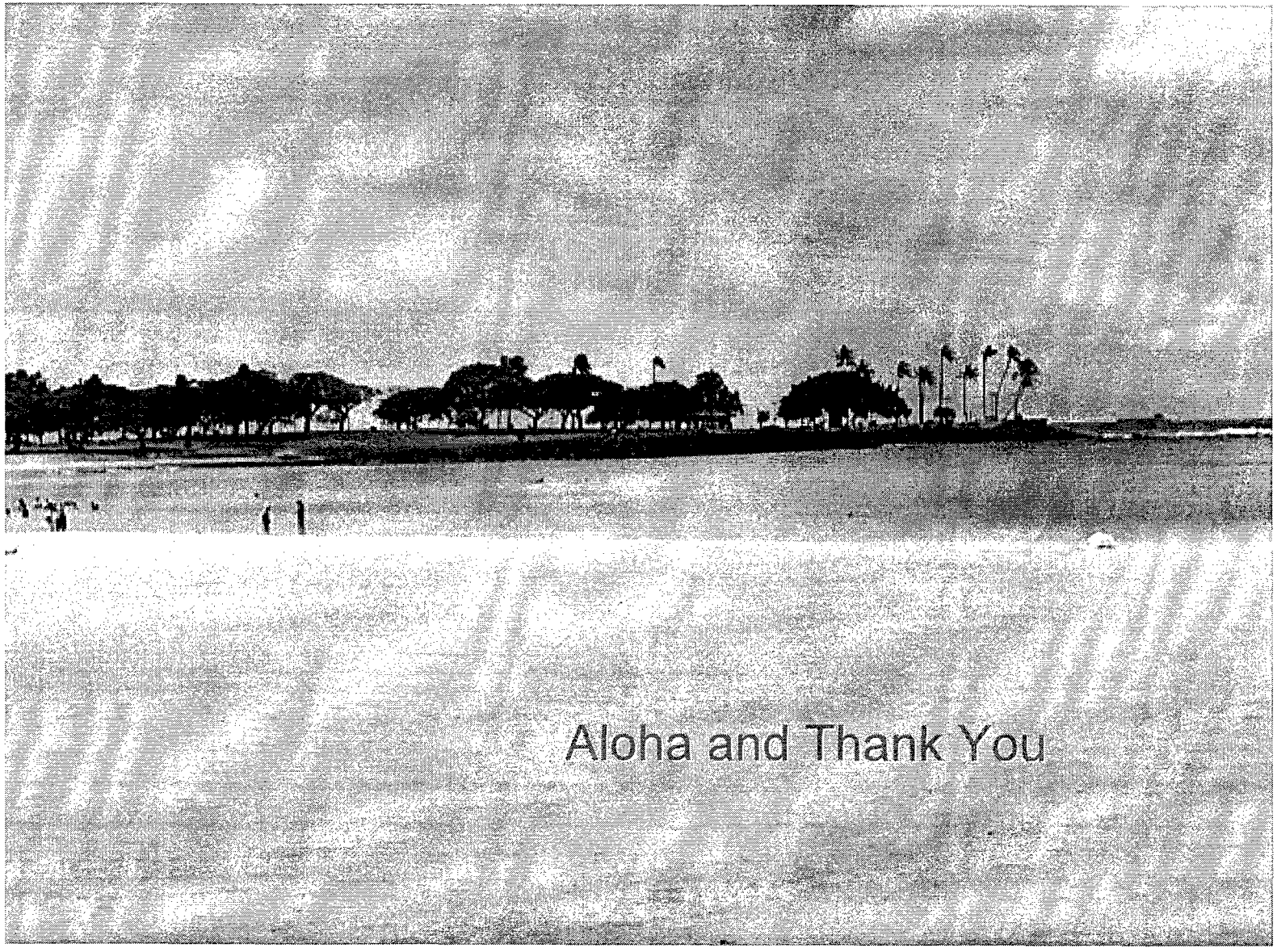
Logistics and co-ordination



- Scheduling and record-keeping are major hurdles
- E-mail is exceedingly useful
- Consider web-based tools if they are readily available
- Remember telephones and fax machines
- Remote site co-ordinators invaluable

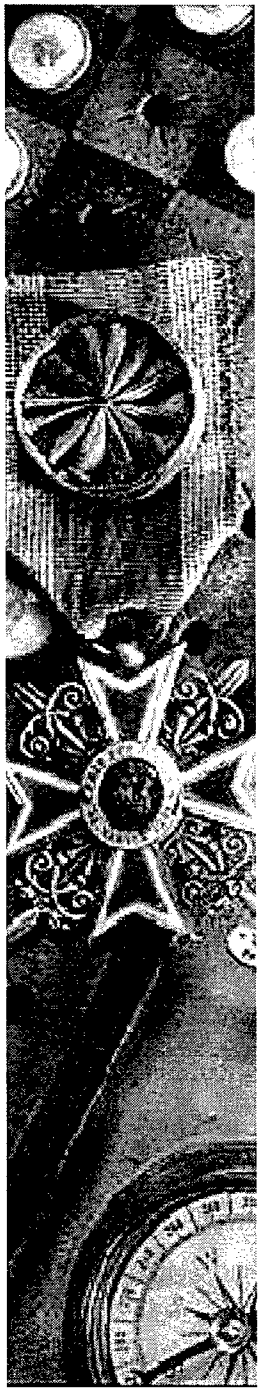
Main Points:

- Choose projects that fulfill specific needs
- Find a physician "champion"
- Start with simple technologies
- Ensure redundant systems
- Partner with major stakeholders
- Consider web-based tools to assist with logistics


Aloha and Thank You

Hawaii High Altitude Project

STANFORD UNIVERSITY MEDICAL CENTER
NATIONAL BIOCOMPUTATION CENTER



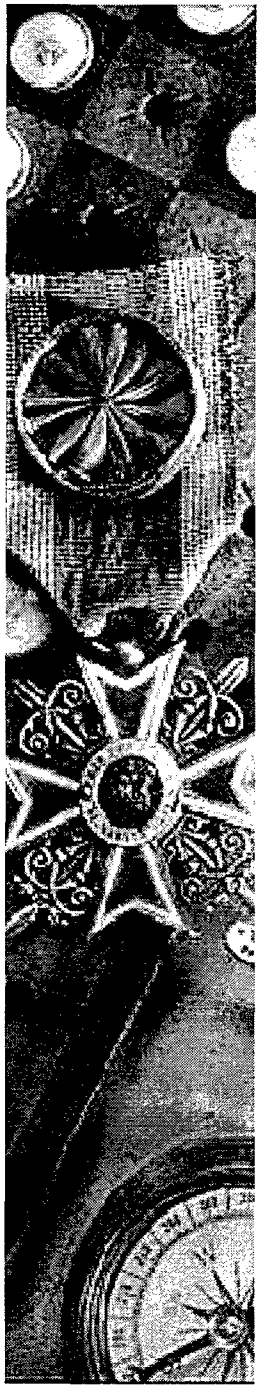
Project Overview:

Joint Telemedicine Deployment Test- Mauna Kea Volcano, Hilo, Hawaii

- Joint work with University of Hawaii John A. Burns School of Medicine:
  - POC: Larry Burgess, MD
    - Associate Dean, Clinical Affairs, UH School of Medicine
    - Director, UH Telemedicine Project
  - Spin-off of existing collaboration for surgical simulation
- Long-term goal: Evaluate idea of establishing a High Altitude Research Center on Mauna Kea summit
- Short-term research goal: Clinical trial to evaluate effectiveness of Ginko Biloba to traditional drugs (acetazolamide) in the prevention of Acute Mountain Sickness (AMS)

Why care about AMS?

- Literature shows 80% of people get sick within 48 hours of rapid ascent >12,000ft
- Other effects:
  - High altitude pulmonary edema (HAPE)
  - High altitude cerebral edema (HACE)
- Need to maintain performance even when rapidly inserted into high altitude environment



Why?

Mauna Kea volcano, Hilo, Hawaii

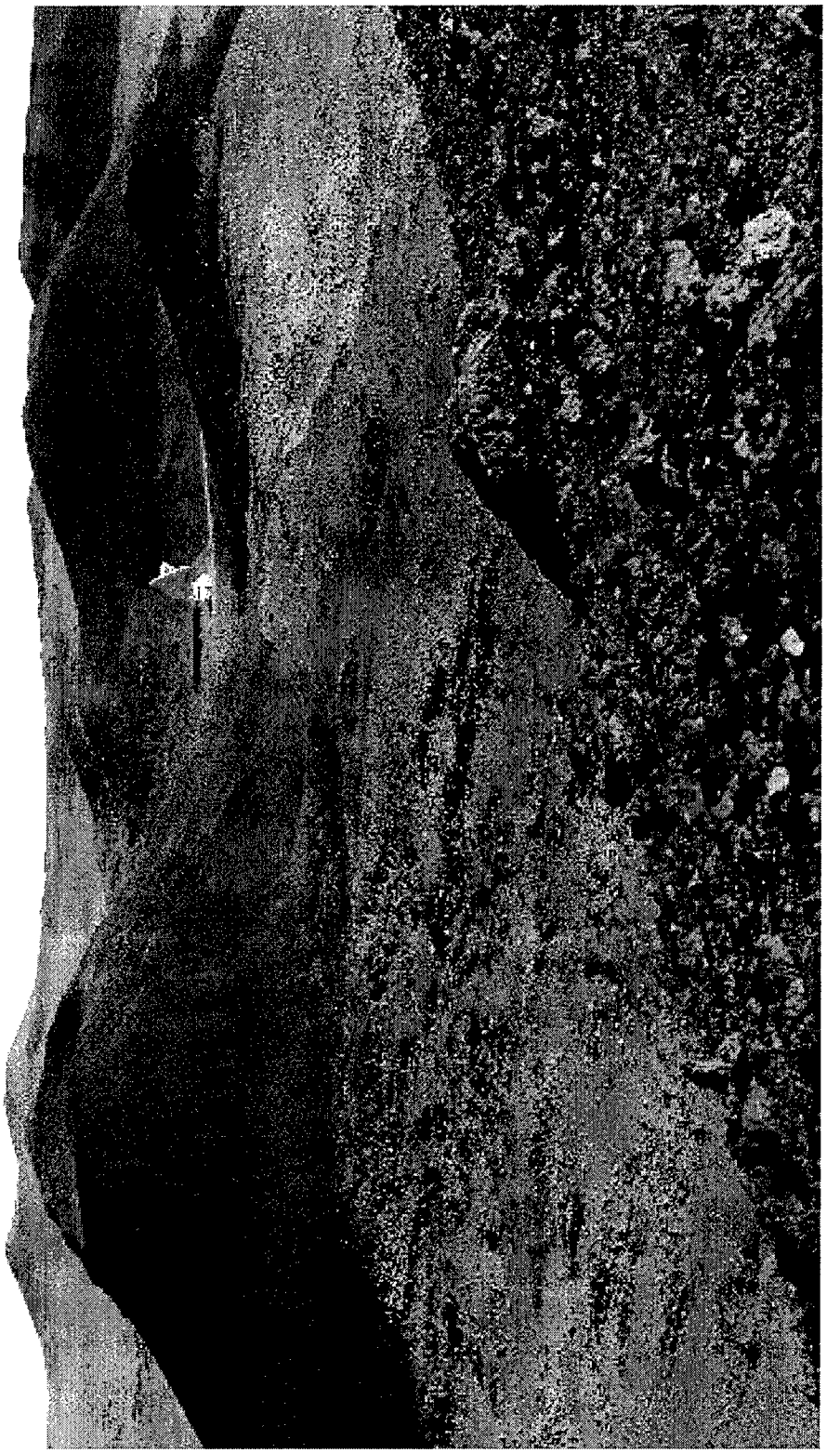
- Mauna Kea is one of only places in the world where one can go from sea level to >13,000 ft in about an hour
- Military has immediate need for high altitude physiological research
- Are rapidly taking soldiers from ~sea level and deploying in austere mountainous environments and they need to be immediately effective
- Need to develop ways to protect soldiers against effects of immediate acute mountain sickness
- Evaluate how to prepare soldiers and others for rapid high altitude insertion
- Perform physiological monitoring and use as testbed for austere, remote environments (NASA and military needs)
- Real-world testing will help us harden existing systems

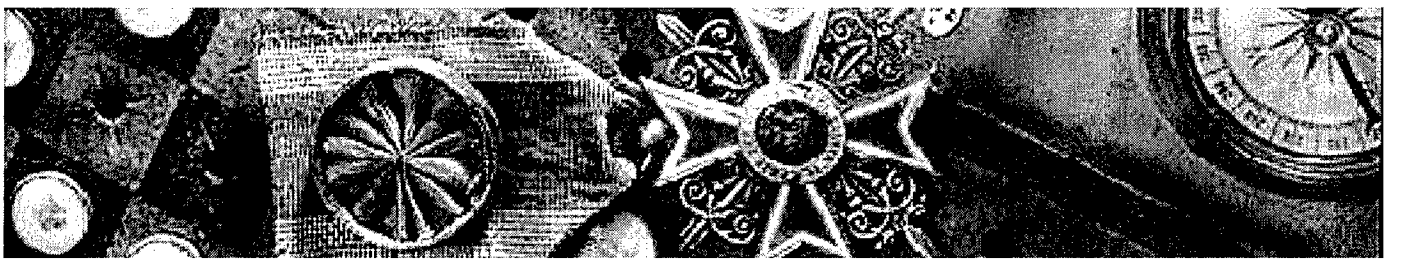
Project Details:

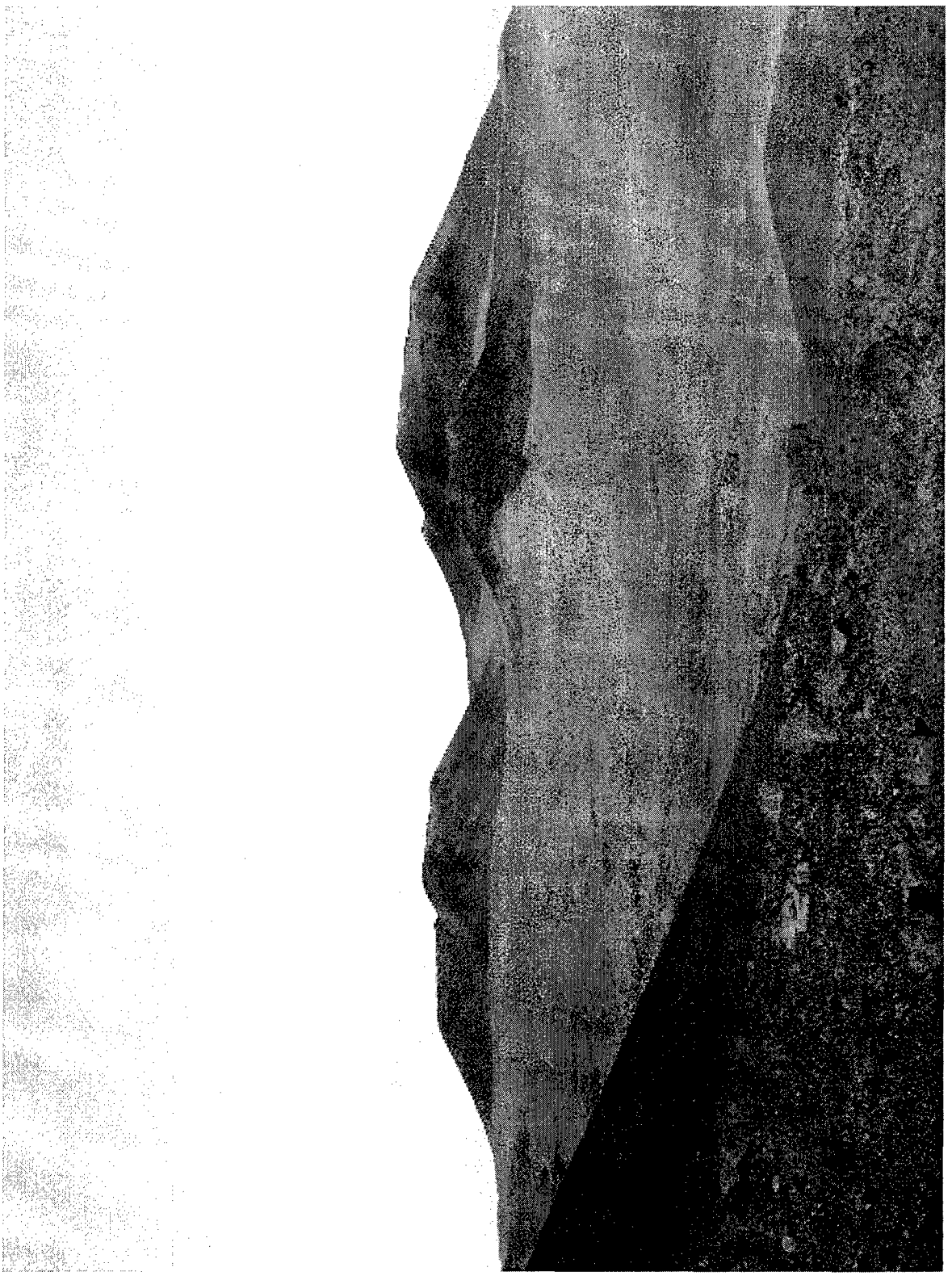
- Tests:
  - Initial trial: (October 02)
    - **6 researchers ascended Mauna Kea to test equipment, procedures, etc.**
    - **First night base camp (9000 ft.), ascend to summit next day**
  - Real study: (April 03)
    - **3 different groups of 20 climbers + 5 staff to rapidly ascent Mauna Kea**
    - **Duration of test is 30 hours**
- In both cases:
  - Subjects wear Nexan sensors wired to iPaq with local logging to CF memory card
  - Wireless is out due to interference with radio telescopes on peak
  - Measuring: 2-lead ECG, SpO2, HR, respiration rate, temperature
  - Will indicate local alarm if parameter out of range
  - Will periodically remove card, plug into laptop and view locally or downlink over net connection
  - Remote viewers at U of Hawaii with videoconference/audio link
- May also use digital stethoscope and downlink audio to UH

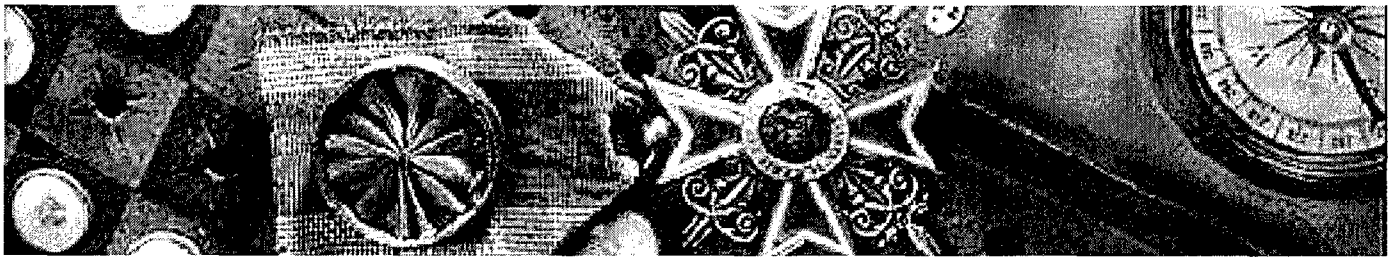
Location Details

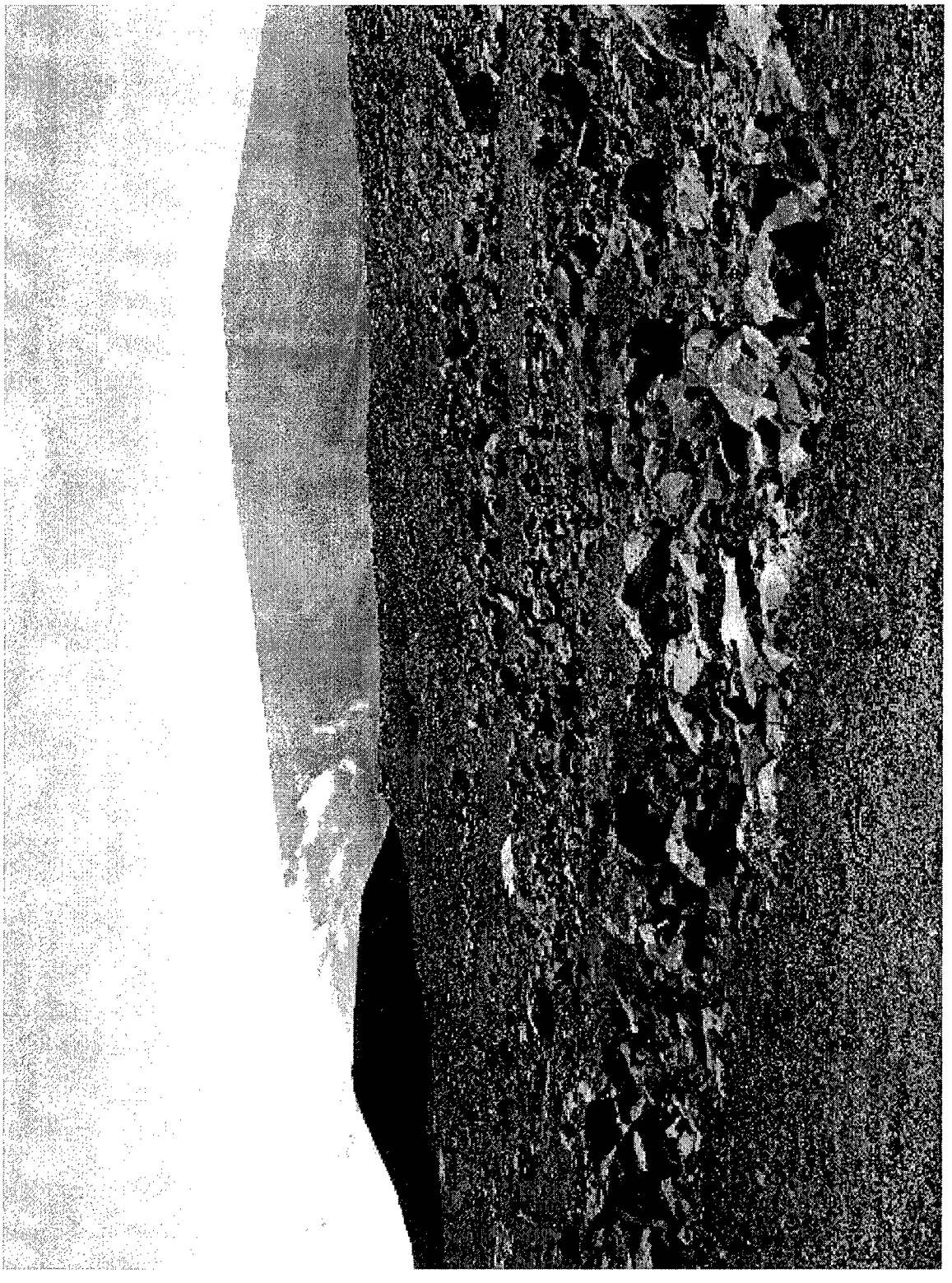
- **Mauna Kea summit: 13796ft**
  - **Base camp (Hale Pohaku): ~9000ft**
- **Part of Mauna Kea Scientific Reserve- leased from state to UH**
- **13 working telescopes**
  - **Operated by NASA Institute for Astronomy**
  - **No wireless allowed (radio astronomy)**
- **Austere, remote environment (Mars-like)**

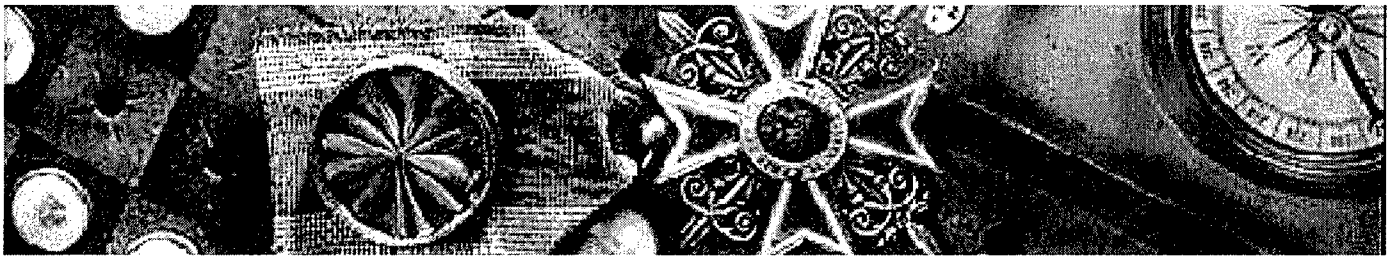


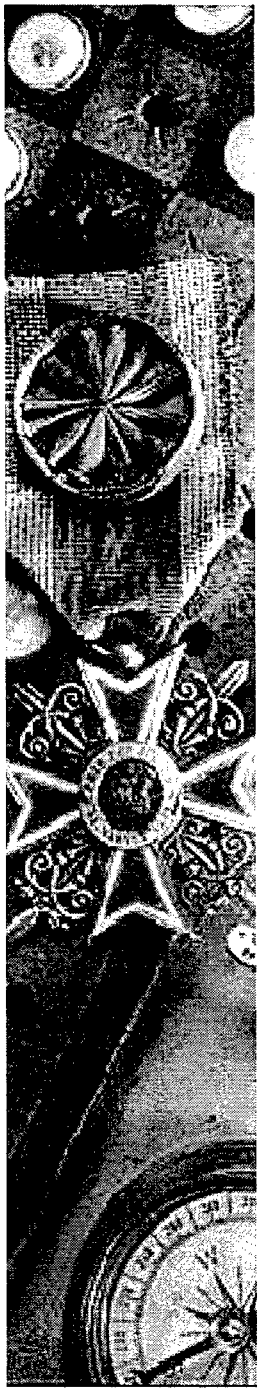






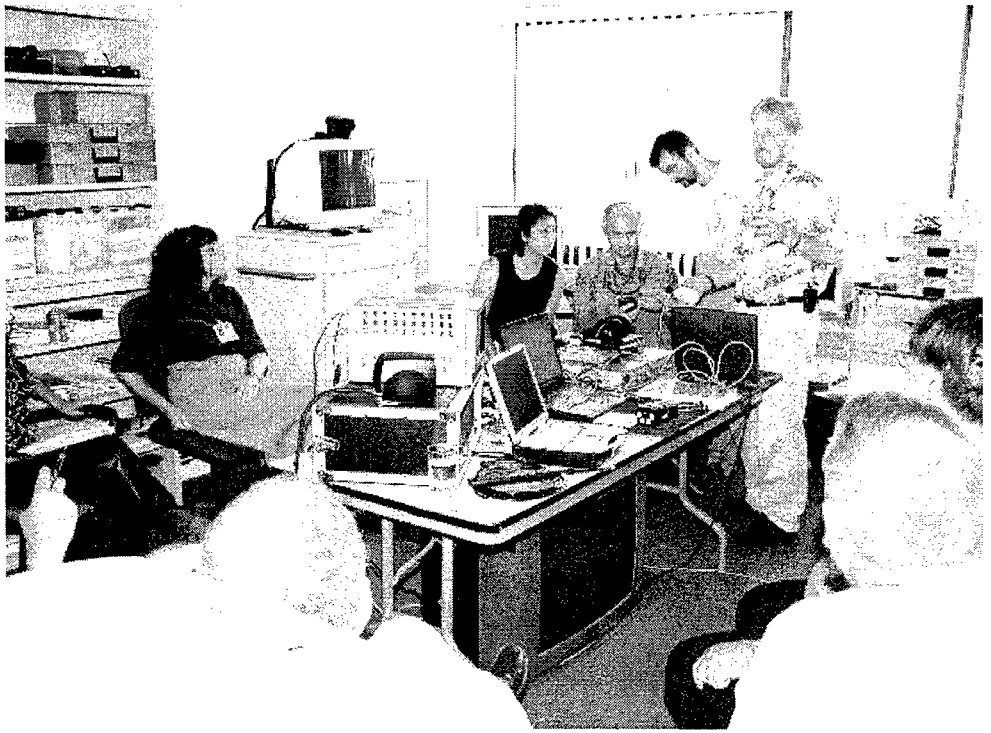




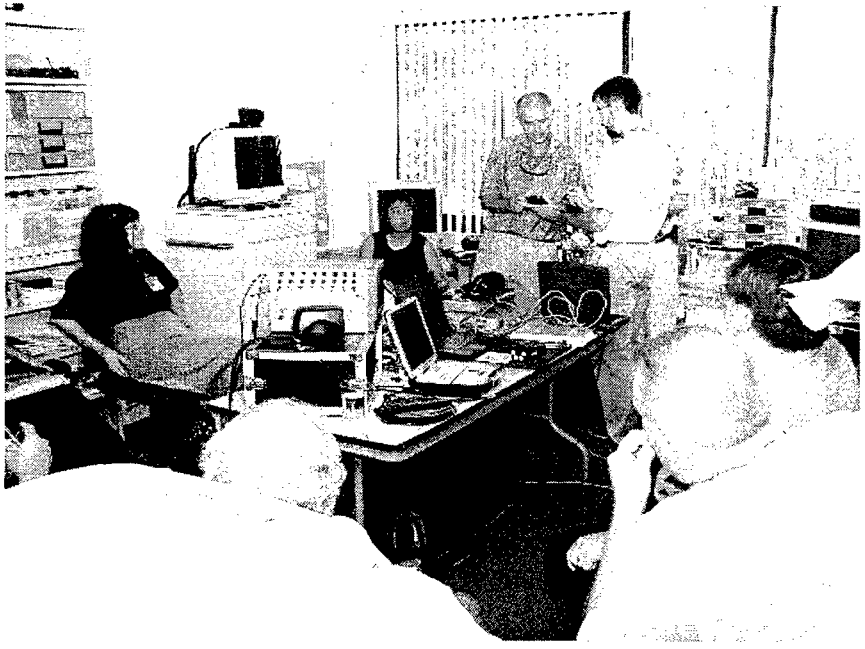


Preparation

- **UH Telemedicine Project office in Honolulu**
  - **"Mission Control"**



Team



Summit Team:

- Janet Onopa, MD - PI
- Pearl Whittaker, RN
- Guillaume Thonier
- Mike von Platen
- Mark le Pape
- John Claybaugh, PhD

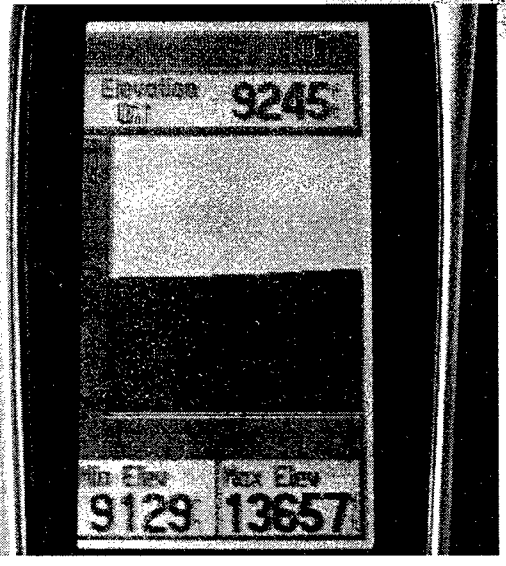
Mission Control:

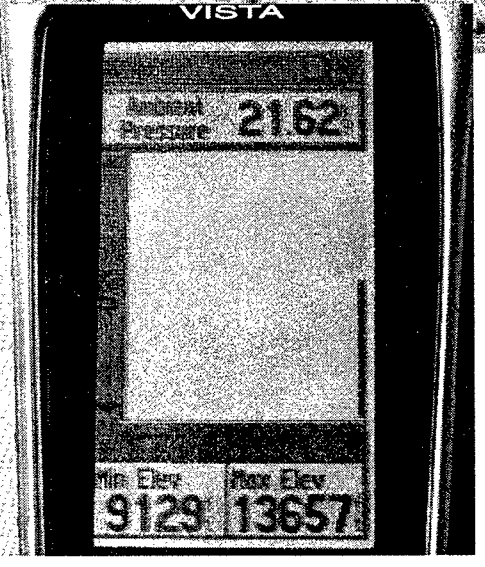
- Larry Burgess, MD
- Kevin Montgomery, PhD
- Kathleen Kihmm
- Stan Saiki, MD
- Deborah Peters, PhD

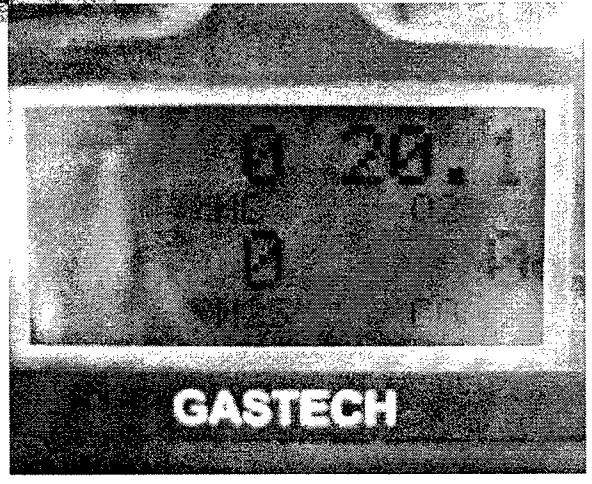
Day One - Friday

- Guillaume, Mike, and Mark ascended to top to test Internet connection while still had support
- Took environmental readings (barometric pressure, O2 %, altitude (GPS, barometric)) during ascent
- Almost all research goals accomplished on the first day:
  - Physiological logging and streaming (wired ether)
    - SpO2: Mike = 79%, Guillaume = 86%
  - Digital stethoscope deployed and tested
  - X-ray unit deployed and images transferred
- Spent 4-5 hours at SUMMIT, then slept at base

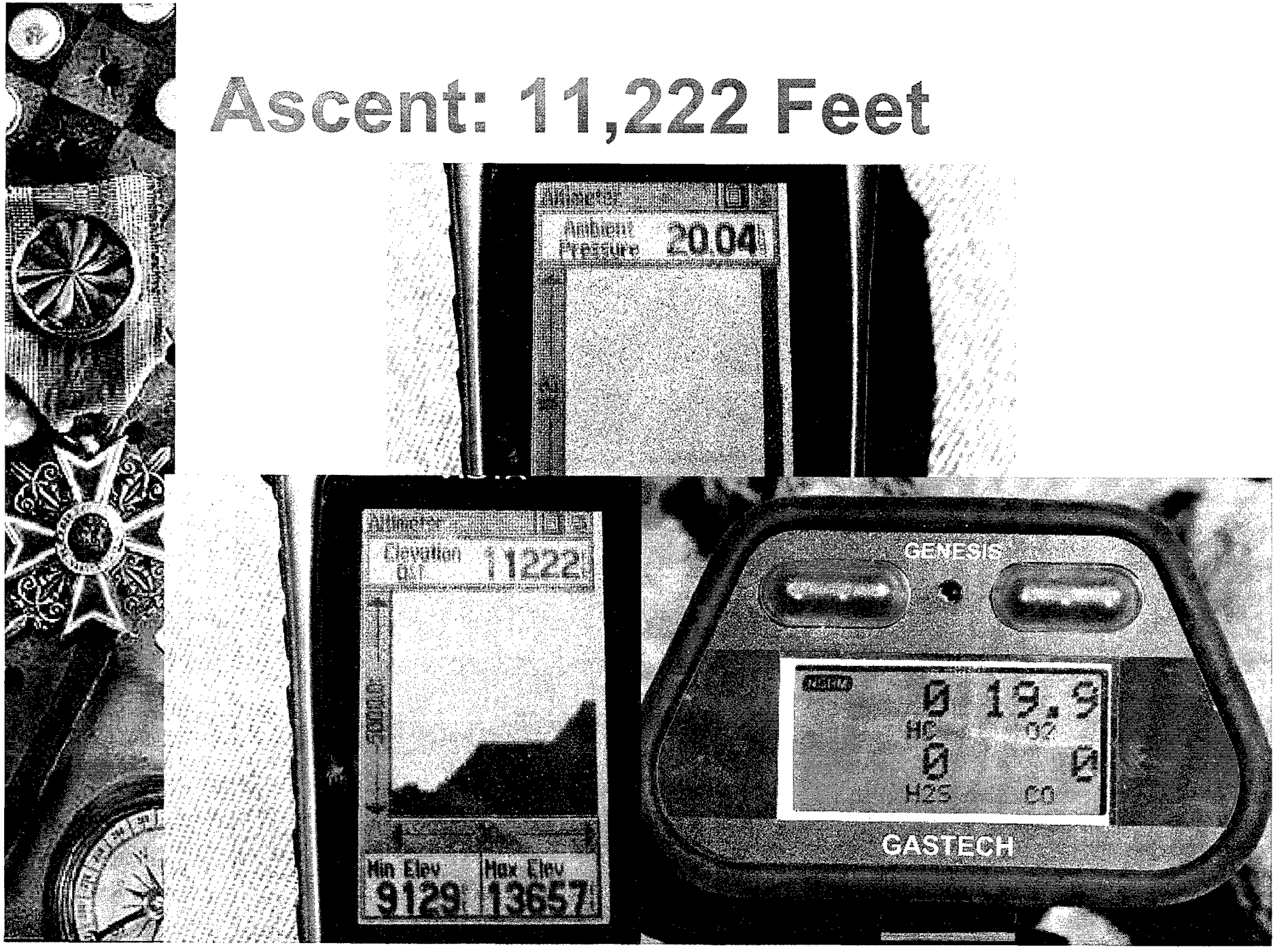
Base Camp:
Hale Pohaku 9245 Feet



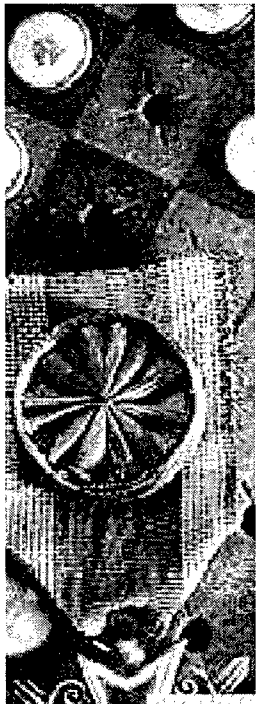


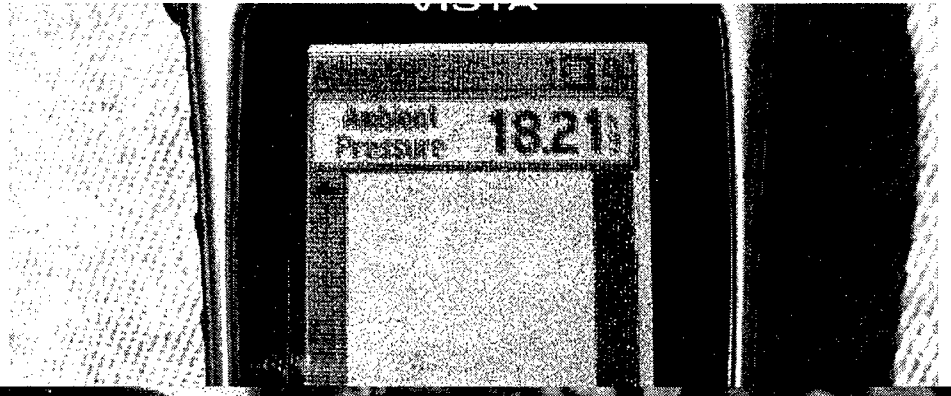


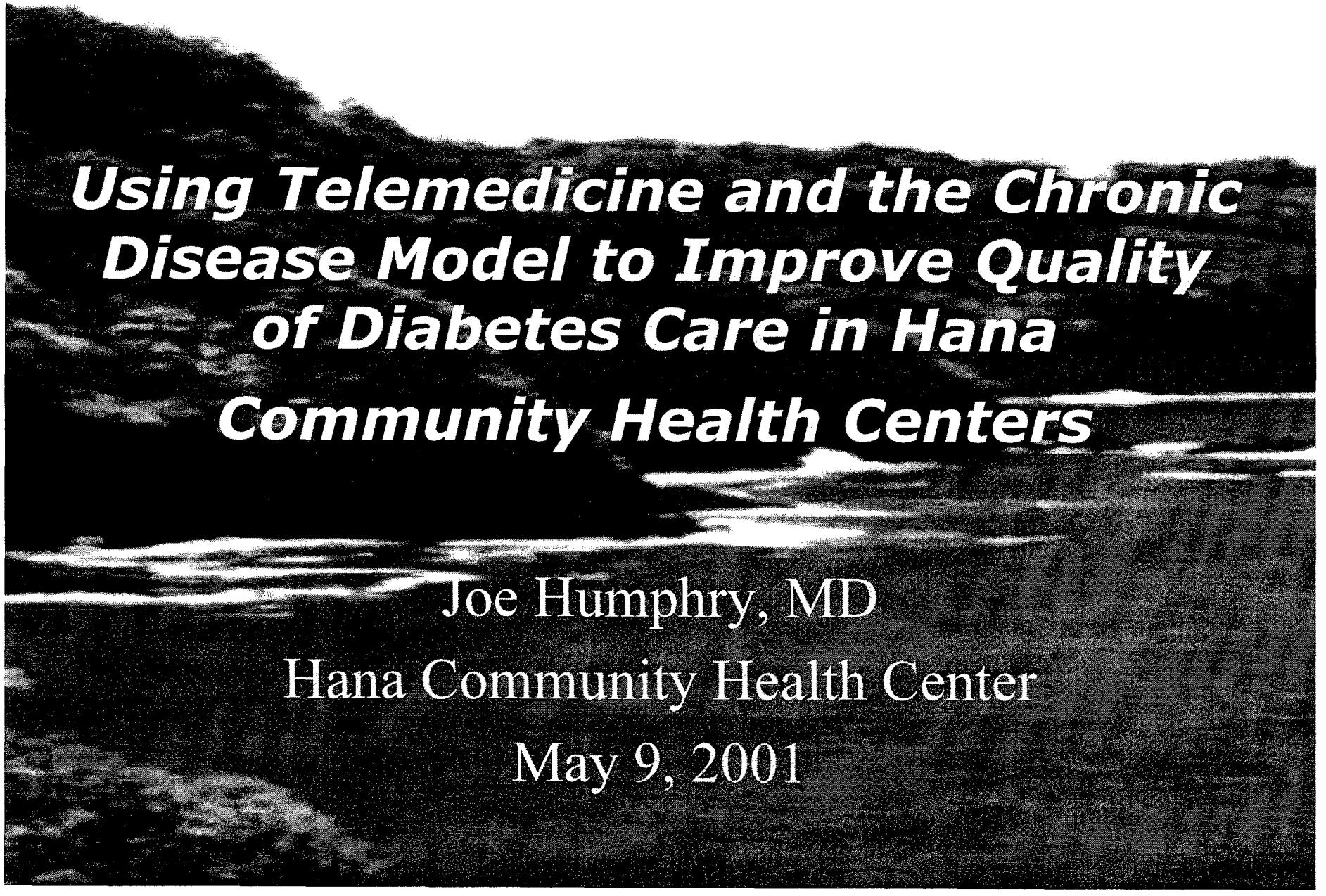
Ascent: 11,222 Feet



Ascent: Summit 13,786 Feet





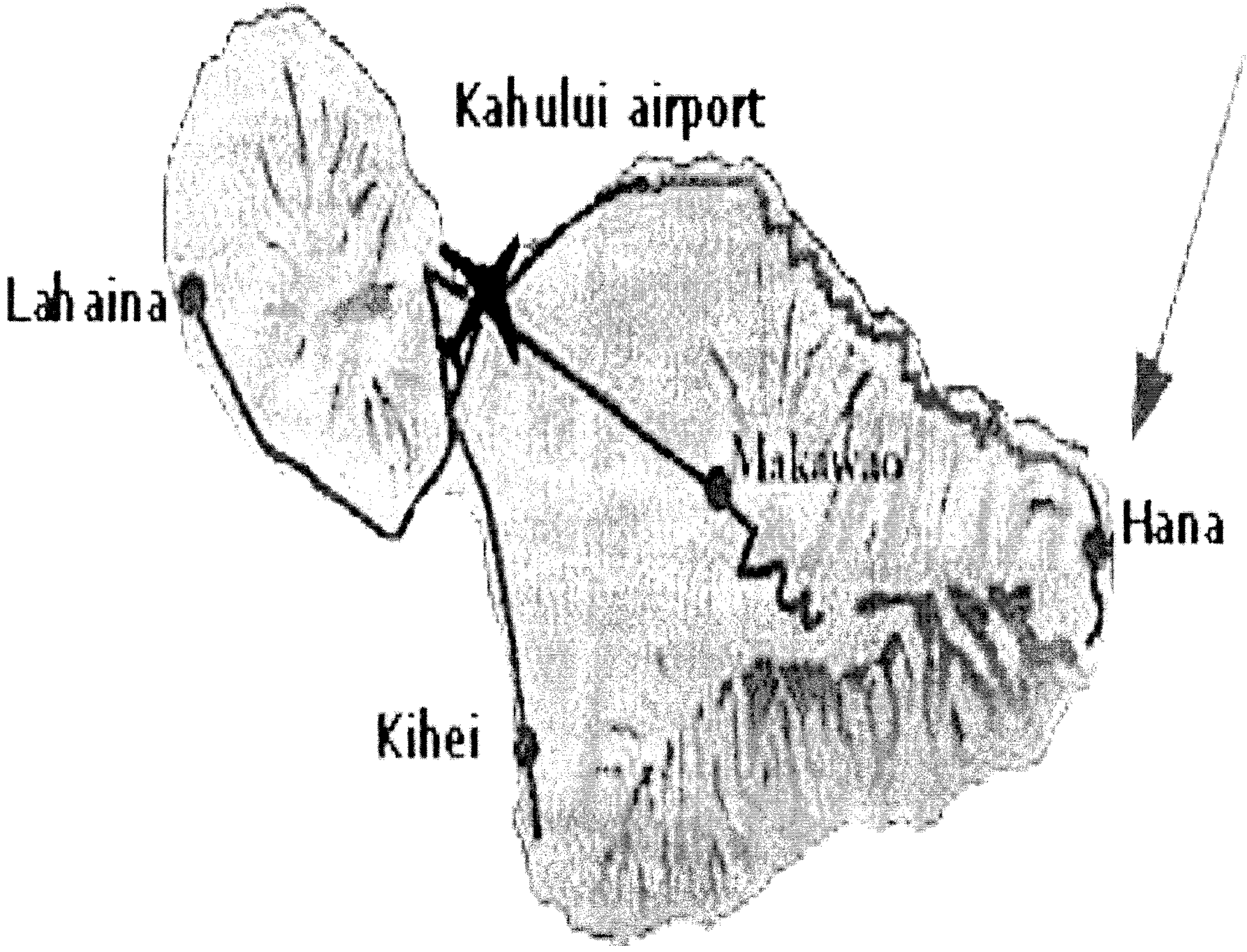

Using Telemedicine and the Chronic Disease Model to Improve Quality of Diabetes Care in Hana Community Health Centers
Joe Humphry, MD
Hana Community Health Center
May 9, 2001

Starbulletin.com

Tuesday, October 2, 2001

Dengue outbreak spreads beyond East Maui

More than 100 cases of the mosquito-borne fever are suspected from Hana to Haiku


Kahului airport
Lahaina
Makawao
Hana
Kihei

Hana Facts

- The trip takes approximately 2.5 hours along a single lane road with 617 turns and 56 one-lane bridges
- Hana is the third poorest community in the state
- . The majority of Hana's 2000+ residents, 62%, are Native Hawaiian/Part Hawaiian.

Hana Facts

- Poverty rates in Hana are 14% at the 100% level and 47% at the 200% level
- Native Hawaiians die from diabetes at a rate that is 222 percent higher than for the U.S. all races (S87, The Native Hawaiian Health Improvement Act)

Project Objectives

- Improve Diabetes care for the people in Hana through using the chronic disease model and rapid change model (Institute of health)
- Use telemedicine and a web based application to improve access to specialty care and self-management support.
- Develop a model that is effective, efficient and exportable to other rural communities.

Experience/Resource to the Community

Dr. Joe Humphry

- Primary Care Internist with special interest in Diabetes
- 19 years- CHC experience
- 3 years-Disparities Collaborative (BPHC) (2 CHCs)
- American Asian/Pacific Island Work Group Member (NDEP)
- Advisory Council-Pacific Diabetes Today Resource Center
- Previous Project Coordinator for Staged Diabetes Management in Hawaii (International Diabetes Center, MN)
- Clinical PI-Ohana Health Project (Dept of Electrical Engineering, University of Hawaii)
- Medical Director-HMSA (Guideline development, HEDIS, NCQA, Disease Management)

Hana Community Health Center

- The Health Center is the only available care provider in the Hana community
- The Health Center provides physician services 24/7 (Currently Locums)
- Professional Staff- Part time nurse
- Rest of the staff are local hires with limited health experience and OJT

Rural Health Care

Diabetes

Core Team-NDEP

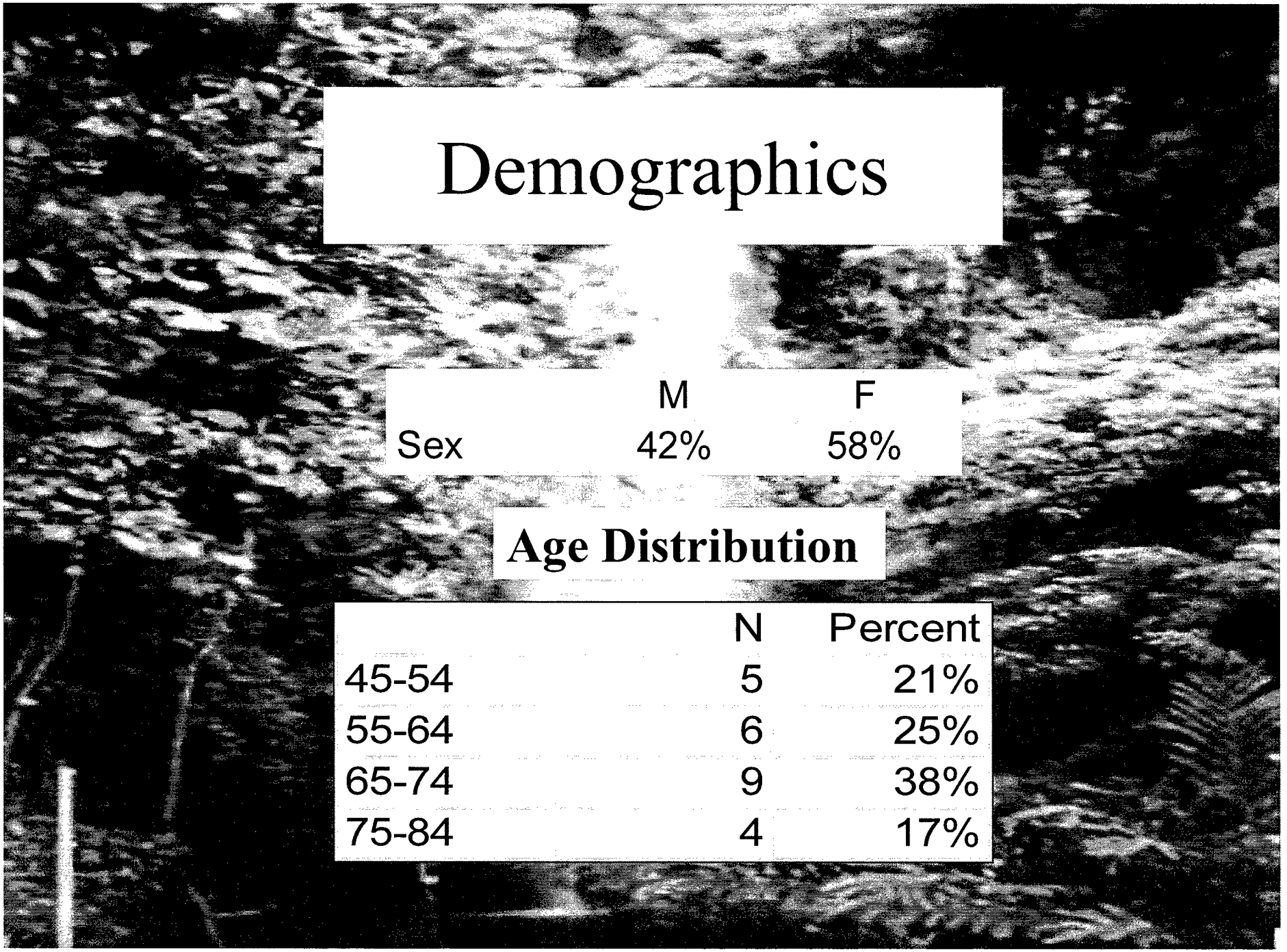
- Primary Care Provider
- Nurse
- Dietitian
- Endocrinologist/Diabetologist

RCHC Diabetes Team

- All employees at the health center
- Dr. Humphry (every other Thursday+telemedicine)
- Ophthalmologist 1 day per month
- No PCP or full-time nurse
- No Pharmacy
- No laboratory on site (blood draw only)

Hana Diabetes Program

- Just do it! December 7th, 2000
- Video-conferencing- December 14th ,2000, Patient follow-up and team building
- 2 Saturday "learning sessions" with staff to dates
- Implementing change/rapid change model- sort of



Demographics

	M	F
Sex	42%	58%

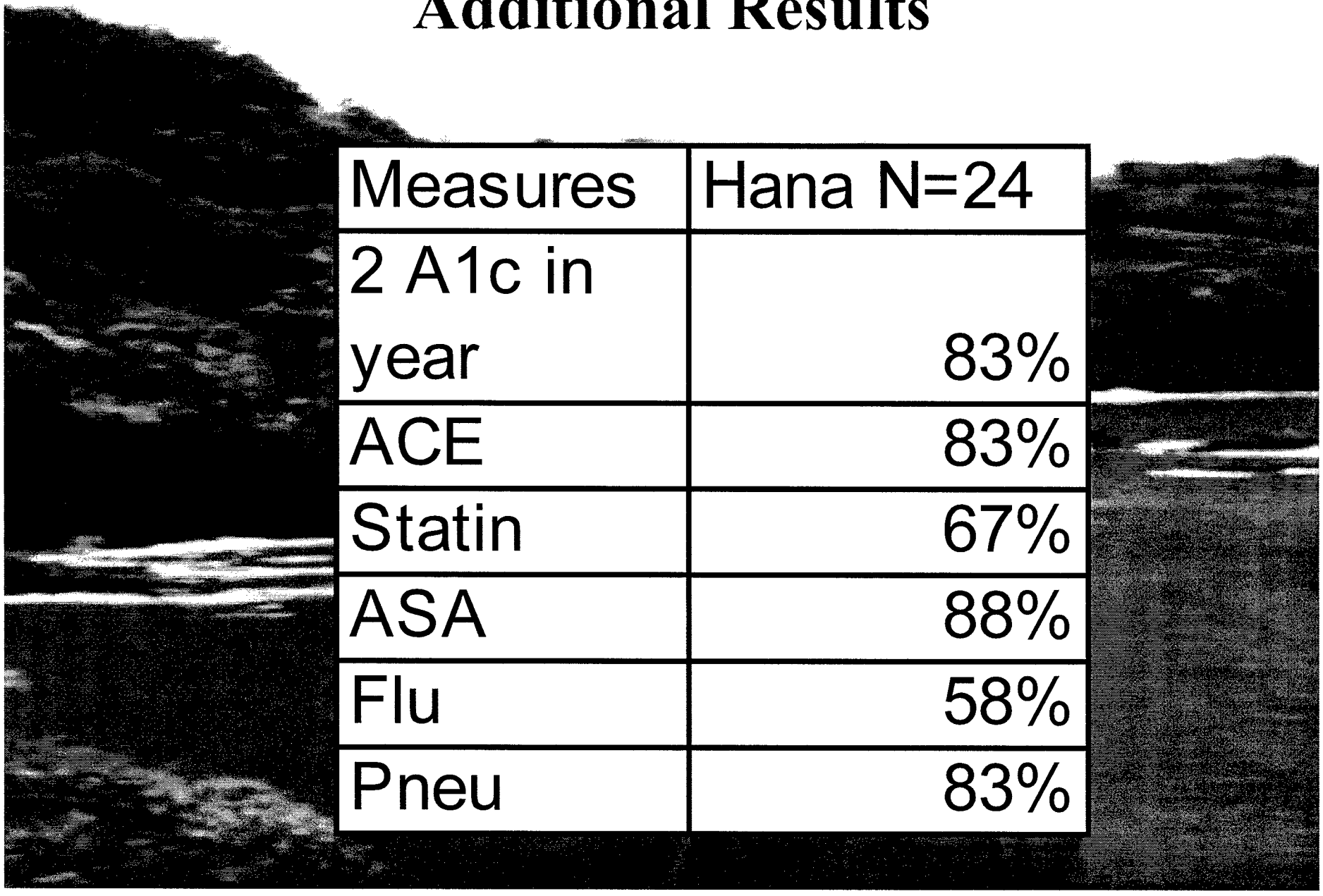
Age Distribution

	N	Percent
45-54	5	21%
55-64	6	25%
65-74	9	38%
75-84	4	17%

Results

	Frequecy	Hana N=24	ADA Rec	HI Hedis 2001
HbA1c	1 time/yr	100%	93%	79%
Proportion w/HbA1c < 8%	(most recent test)	83%	55%	
Proportion w/HbA1c > 9.5%	(most recent test)	0	≤ 21%	51%*
Eye exam	1 time/yr*	54%	61%	56%
Foot exam	1 time/yr	71%	80%	
Blood pressure frequency	1 time/yr	100%	97%	
Proportion < 140/90 mm Hg	(most recent test)	75%	65%	
Nephropathy assessment	1 time/yr	100%	73%	53%
Lipid profile	1 time/yr	96%	85%	82%
Proportion w/LDL < 130 mg/dl	(most recent test)	75%	63%	49%

Additional Results



Measures	Hana N=24
2 A1c in year	83%
ACE	83%
Statin	67%
ASA	88%
Flu	58%
Pneu	83%

A1C Changes

High to Recent

11.10	→	6.90
11.00	→	7.70
10.40	→	7.40
6.90	→	6.50
7.60	→	6.80
7.70	→	6.90
8.40	→	6.80
7.30	→	6.90
10.30	→	6.40
7.40	→	6.90
6.20	→	6.00
8.20	→	7.60
8.30	→	7.10
10.20	→	8.30
7.80	→	8.40
6.10	→	6.10
8.80	→	7.50
11.50	→	7.90
10.80	→	9.10
9.70	→	7.80
8.80	→	7.70
11.60	→	7.20
8.50	→	8.20
9.00	→	7.00

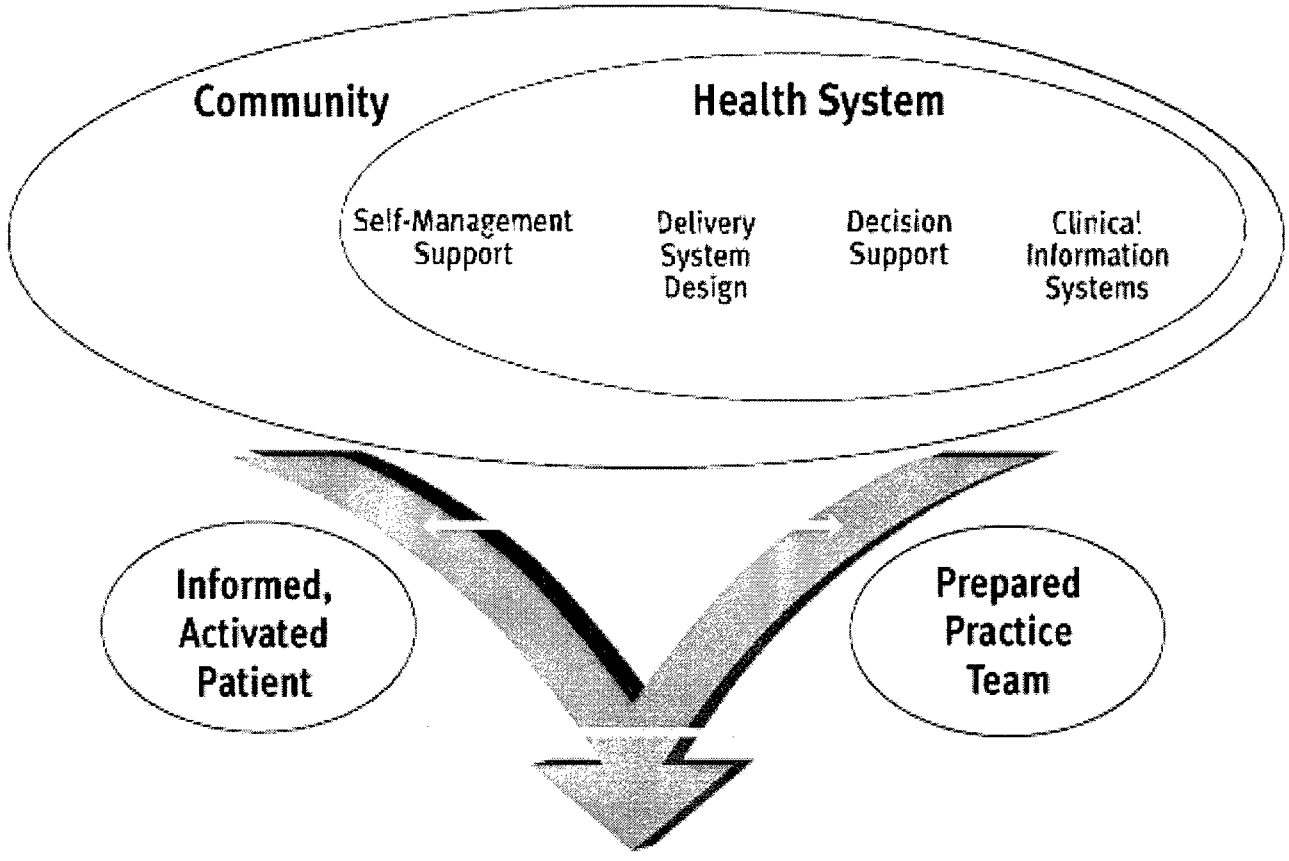
Initial Average

8.9

Current Average

7.3

Chronic Care Model



Hana
Keys to Success

- No fast food
- Strong sense of community and Hawaiian tradition
- A well structure medical record system
- Community involvement/community outreach

System Design

- Implement diabetes flow sheet borrowed from the Community Clinic of Maui (DM Collaborative)
- Multiple staff are now trained to use the Ultra meter and checking blood glucose is part of the check-in process
- The staff is trained in foot exams and we are setting up foot screening and patient foot education run by the staff (NDEP and LEAP programs)

System Design

- Telemedicine to improve access, provide timely follow-up and build relationship with the health center.
- Telemedicine is part of the change model and not a separate project

Decision Support

- Aggressive treatment to goal/ medication dose escalation and multiple insulin starts
- Staff education on standards of care/ DM flow sheet

HCHC/Community Resources

(Social Capital)

- Exercise:11 one hour classes from very low to high impact exercise 4 days a week
- Meal: Provide Health Lunch (Traditional Hawaiian Food) to Seniors 60 and over
- Home delivered meals: Hot lunch and dinner are home delivered with a medical referral
- Knowledge: Staff is trained in basic nutrition (including reading food labels, fitness, living with diabetes, glucometers, and foot exams
- Kulia Ola Kimo Maikai-Diabetes Education program taught by peer educators

Self-management

- Over 30 One Touch Ultra Meters supplied by Life Scan have been provided to patients
- Know your numbers/Self management patient information sheet including ABC goals and current lab results

Telemedicine/Lessons learned

- Most telemedicine demonstration projects have not been sustainable
- Telemedicine is used to support the chronic disease model and improve access
- Single source of compensation is a more rational approach to payment
- Telemedicine increases cost and needs to improve the quality of care to be financially viable

Moving Forward

- Improving access/improving care- alternative approaches to patients not yet in the program
- Ohana Health- web based self-management and diabetes registry-remote monitoring/improved access
- Screening and case finding

Ohana Health Online

www.the-ohanahealth.org

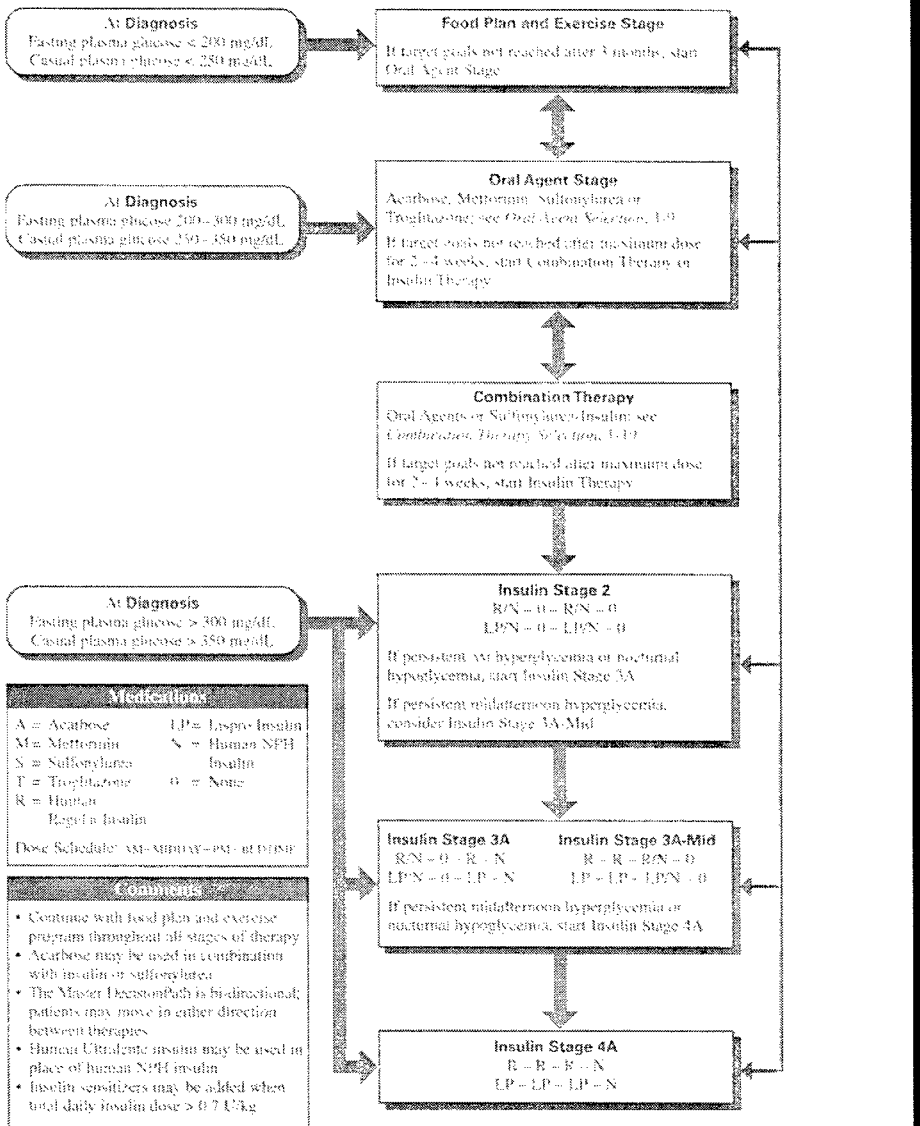
- Developed by Dr. David Yun, Professor of Computer Science in the Department of Electrical Engineering, University of Hawaii.
- Professor in software architecture and application design.

Ohana Health Online

www.the-ohanahealth.org

- **Self-management support**-patient record, Self-management goal setting
- **Information system:** Patient encounter form, population-based reporting, Glucose meter upload and automatic lab data retrieval
- **Decision support:** Stage Diabetes Management decision trees:Patient/Doctor alerts
- **Delivery system design:** Web based report generation part of office visit check in, health center web access, Messaging, remote access to health information

Type 2: Master DecisionPath



Type 2: Metformin/Start

At Diagnosis
Fasting plasma glucose 200 - 300 mg/dL
Casual plasma glucose 250 - 350 mg/dL
Obesity (BMI > 27 kg/m²)
Mild or no symptoms

From Food Plan and Exercise Stage or another Oral Agent Stage
Patient has not reached targets after 3 months

OR

History, physical exam, and laboratory evaluation by clinician

See Medical Visit, 4-1

SMBG Targets
- More than 50% of values within target range
- Pre-meal, 80 - 140 mg/dL
- Post-meal (2 hours after start of meal), < 160 mg/dL
- Bedtime: 100 - 140 mg/dL
- No severe (assisted) or nocturnal hypoglycemia

Adjust target upward if frail elderly, decreased life expectancy, cognitive disorders, or other medical concerns

HbA_{1c} Target
- Within 1.5 percentage points of upper limit of normal

SMBG Frequency
- Test 2 - 4 times/day: before and 2 hours after start of meals and at bedtime

Start Metformin

Assess food plan and exercise
See Food Plan and Exercise, 1-7

Dose (take in the AM)
Metformin 500 or 850 mg/day

Refer patient for nutrition and diabetes education
See Nutrition Education, 4-19, and Diabetes Education, 4-11

Precautions and Contraindications
- Pregnancy and lactation
- Risk of lactic acidosis in patients with:
  - Renal disease (serum creatinine > 1.4 mg/dL)
  - Liver dysfunction
  - Alcohol abuse, binge drinking
  - Acute or chronic metabolic acidosis
  - Acute cardiovascular or pulmonary disease
  - In patients > 80 years old unless creatinine clearance demonstrates renal function not impaired
  - Patients with CHF who require pharmacologic treatment
- Stop Metformin at the time of, or prior to, intravascular radiographic contrast procedures, restart therapy in 48 hours when renal function found to be normal

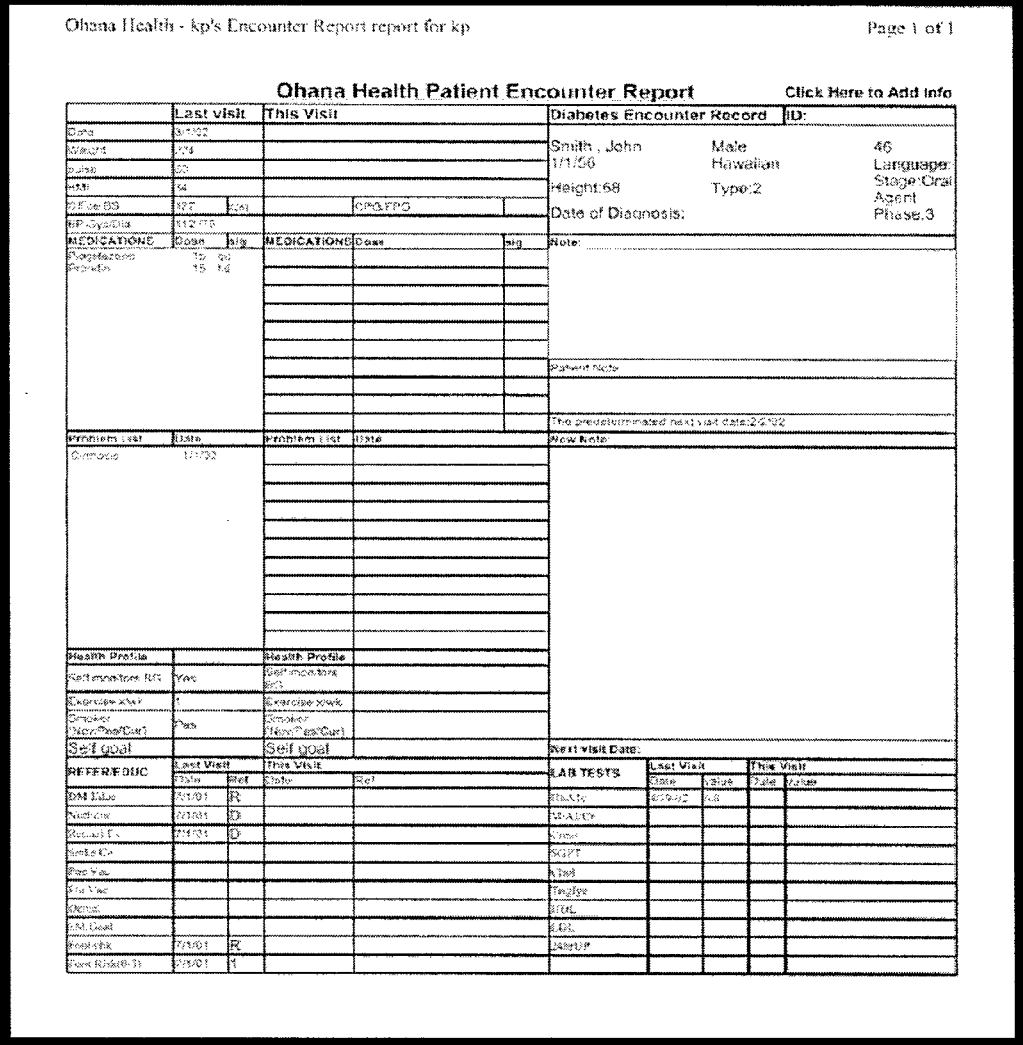
Side Effects
- Usually dose related and self-limited
- Common: Diarrhea, nausea, and abdominal discomfort
- Occasional: Metallic taste

Follow-up
Medical: Within 1 week

Move to **Metformin/Adjust, 1-11**

Encounter Form(DEMS)

www.the-ohanahealth.org



Ohana Health - kp's Encounter Report report for kp

Page 1 of 1

Ohana Health Patient Encounter Report

Click Here to Add Info

	Last visit	This Visit
Date	4/1/02	
Weight	174	
Pulse	60	
HbA1	9.4	
FBS/ BS	187	
BP Sys/Dia	112/75	

MEDICATIONS	Dose	Rtg
Progesterone	12	qd
Periactin	15	tid

MEDICATIONS	Dose	Rtg

Problem List	Date
Gynecia	1/1/93

Problem List	Date

Health Profile	
Self monitors BG	Yes
Exercise x/wk	1
Smokes (Non/Past/Cur)	Past

Health Profile	
Self monitors BG	
Exercise x/wk	
Smokes (Non/Past/Cur)	

Self goal

Self goal

REFER/F/DUE	Last Visit		This Visit	
	Date	Ref	Date	Ref
DM Educ	7/3/01	R		
Nutrition	7/3/01	D		
Retinal Ex	7/3/01	D		
Smok Ctr				
Flu Vac				
Pneu Vac				
Optho				
Ort Dent				
Podiatrist	7/3/01	R		
Foot Risk(6-3)	7/3/01	1		

Diabetes Encounter Record ID:

Smith , John Male 46
1/1/56 Hawaiian Language:
Height:68 Type:2 Stage:Oral Agent
Date of Diagnosis: Phase:3

Note:

Patient Note

The predetermined next visit date:2/1/02

New Note

Next visit Date:

LAB TESTS	Last Visit		This Visit	
	Date	Value	Date	Value
BMI/Ht	4/1/02	0.0		
WAIST				
Urine				
EKG				
A1c				
Triglyc				
TCHOL				
LDL				
Lipid/LP				

Conclusion

- Organizing care in a rural health center based on the chronic care model improves the quality of care
- Telemedicine increases access at a reasonable cost when combined with system design changes
- Web based registry and self-management support promises to further improve care

Funding

- Principle funding is from the Hana Community Health Center for the physician's clinical time and telemedicine cost
- Support is provided from the University of Hawaii Telemedicine Program/QMC
- Support from the Web-based Ohana Health Project- University of Hawaii Department of Electrical Engineering, ***Lab of Intelligent and Parallel Systems (LIPS),***

)hana Health Online System
Providing Services in Remote Health Management

Patient-centered ***web-based*** ***medical record*** with patient access to all relevant clinical information for their diabetes care.

Online support of registration, reports, demonstrations and help.

Patients can easily ***upload*** home-monitoring ***glucose data***.

Automated ***lab data uploads*** from both local testing labs.

Every ***clinical*** visit information and doctor-patient interaction, including measurements, diagnosis, treatment, medication, diet and goal setting, are summarized in an "***encounter report***".

Timely tracking of all relevant, individualized data; ***instant data analysis*** for generating reports and messages/alerts to assist both patients and doctors in ***self-management/care of diabetes***.

Interactive self-management goal setting for patients to communicate health goals to the provider on the encounter form.

Multiple level ***HIPPA security compliance*** with patients able to view their records, physicians able to view all their patient records and clinics able to view all clinic records and treatment outcomes.

Population-based reporting of process and outcome measures for physicians and clinics.

Secure messaging system that facilitates communication among all participants, patients, doctors, nurses, clinics, labs and computers

Staged Diabetes Management (of IDC) serves as an intelligent expert system that follows the clinical course of individual patients according to the "***best-practice***" decision protocols, and ***issue alerts***

Extension of services beyond the wired WWW, to include ***wireless devices, PDAs and cell phones***.

System is designed for ***scalability*** and coverage of ***other illnesses***.

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