Award Number: DAMD17-02-2-0038

TITLE: Human Factors in Telemedicine

PRINCIPAL INVESTIGATOR: Robert H. Doktor, Ph.D.
Dr. David Bangert

CONTRACTING ORGANIZATION: Bangert/Doktor, Incorporated
Honolulu, Hawaii 96825

REPORT DATE: July 2003

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	July 2003	Annual (1 Jul 02 - 30 Jun 03)

4. TITLE AND SUBTITLE
Human Factors in Telemedicine

5. FUNDING NUMBERS
DAMD17-02-2-0038

6. AUTHOR(S)
Robert H. Doktor, Ph.D.
Dr. David Bangert

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Bangert/Doktor, Incorporated
Honolulu, Hawaii 96825

E-Mail: bangert@hawaii.rr.com

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release; Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 Words)

To bring together some of the best minds in the field of Human Factors as it relates to Telemedicine. The group will explore how the utilization rates can be improved and document the thinking in the form of a book that will be valuable to the military health care system and to scholars.

Bangert/Doktor, Inc. will manage a virtual learning community that interacts continually for two years using the Internet and attends two meetings sponsored by TATRC, devoted to the theme *Human Factors in Telemedicine*. At the first meeting the invitees will explore general topics and discuss their individual "thought pieces." They will have an opportunity to react to each other's ideas. Between the meetings, the invitees will refine and prepare their articles. At the second meeting, final drafts will be exchanged and discussed. Dominant themes identified. The editors will then finalize the articles, organize the edited edition, and prepare the necessary introductory and conductive passages.

Bangert/Doktor, Inc. will review designated TATRC-sponsored projects and present conclusions pertaining to human factors issues inherent in each project.

14. SUBJECT TERMS

15. NUMBER OF PAGES
269

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

Table of Contents

Introduction

Bangert/Doktor, Inc. has solicited articles from leading experts world wide on the practice and successful implementation of telemedicine with relate to human factors. The 47 contributors from seven different countries are preparing articles as contributions to the book. Most have completed first drafts (see appendices). The drafts have been reviewed by the editors and detailed comments given to the authors. A meeting of the contributors was held at the American Telemedicine Conference in April 2003 where the guidance was provided and ideas exchanged.

Body

The overall goal of this two-year contract is to produce a book about human factors in telemedicine and e-Health. The working title is *Human and Organizational Dynamics in e-Health: A Global Perspective.*

Overview and Description

Telemedicine is at the forefront of clinical e-health systems. Globally, both in government and private sectors, professionals agree that telemedicine is a good idea and here to stay; most agree it is central to the future delivery of health care services. Yet, many stakeholders report that telemedicine seems more like a failure than a success. In case after case, soon after the implementation of telemedicine, the utilization and interest curves skate downhill – sometimes to the point where the system remains unused. While there are notable exceptions to this trend, the reported failures of telemedicine foster a reputation that distinctly challenges leaders who seek to adopt this promising technology. Further, the same dynamics relevant to the adoption of telemedicine may foreshadow adoptions of different and/or more advanced clinical e-health technology to come.

Across cultures, failures are disheartening, especially for advocates of the efficacy of telemedicine and other clinical e-health solutions. To them, telemedicine clearly presents a constellation of opportunities, some of which are: to increase access to health care of the highest quality; to improve the quality of health care by providing earlier, more effective interventions; to improve the quality of healthcare by providing a mechanism for continuing clinical learning and rapid, widespread knowledge dissemination . And, intuitively, despite a recent study in *British Medical Journal* that concludes "there is no good evidence that telemedicine is a cost effective means of delivering health care." healthcare professionals believe that telemedicine holds the promise of decreasing the cost of health care services.

Why do so many telemedicine systems fail? What are the dynamics underlying the failure to thrive; how can we preclude such failure? Why is success so rare? What enables the successes and what can we learn from them? Research, especially the examination of the impact of organizational and individual dynamics on telemedicine,

may hold the answers to these questions, not only for telemedicine but also for clinical e-health systems in general.

Normally, the root of telemedicine failure (relative to cost-effectiveness) is not the technology, but rather the human system in which the technology is implanted. When the technology is not utilized to its potential, a low number of interactions is expensed to the initial investment; the program is thus deemed too costly. Insufficient utilization is central to the failure of telemedicine: the source is neither consumer acceptance nor inadequate technology. The utilization problem is a human dynamic expressing an interesting ambiguity: healthcare providers accept the new delivery system as a good development and yet resist using it. The organizational and individual resistance may come from human-machine interface, change in organizational processes and culture, individual behavior, clinical conditions, and user preconceptions of telemedicine. Any of these dynamics within the field of human factors may stem the drop in the utilization rates to the point where cost is excessive.

This book is dedicated to understanding and resolving organizational and individual resistance to telemedicine, and prescribes specific solutions that are inordinately relevant to current challenges -- as well as to more complex clinical e-health technology of the future. The book's international comparative perspective fuels the discovery and transfer of the wisdom of diverse cultures to all others.

Facilitating utilization is a key to unlocking the potential of e-health technology. Understanding and managing people within an organization during a change of technology such as telemedicine is a complex, interactive and systemic challenge. Particularly since the reality of being able to isolate and control one aspect of an issue without impacting other aspects is highly unlikely. High rates of utilization of telemedicine significantly reduce the cost per consult and result in telemedicine being viewed as a success by healthcare leaders which then allows continuation, innovation, increased access, improved quality, and reduction of the overall cost of health care. Understanding, mediating, and managing complex human factors in the adoption of clinical e-health solutions is thus essential to the evolution of global healthcare.

Outline

In this book we identify human and organizational factor issues in clinical e-health utilization. And, we acknowledge that such artificial, analytic decomposition and disintegration belies the true interconnectedness and interactivity of the health care social system.

Having made this disclaimer, we proceed to deconstruct the real world, international phenomena of acceptance/resistance to telemedicine and construct culturally competent strategies to overcome individual and organizational resistance to such e-health technology.

We conceptualize the challenge of managing successful telemedicine and e-health adoptions as peeling an onion. Revealing (understanding) each layer contributes to achieving success at the core. In this book, we peel off each layer successively, examining each before proceeding, always recognizing that these layers are constructions of our own minds; they are helpful in our understanding of nature, but are not the reality of nature. (The map is not the territory.) The reality lies in the natural symbiosis of all these aspects as coherent whole. Thus, we view the issue as depicted in Figure 1.

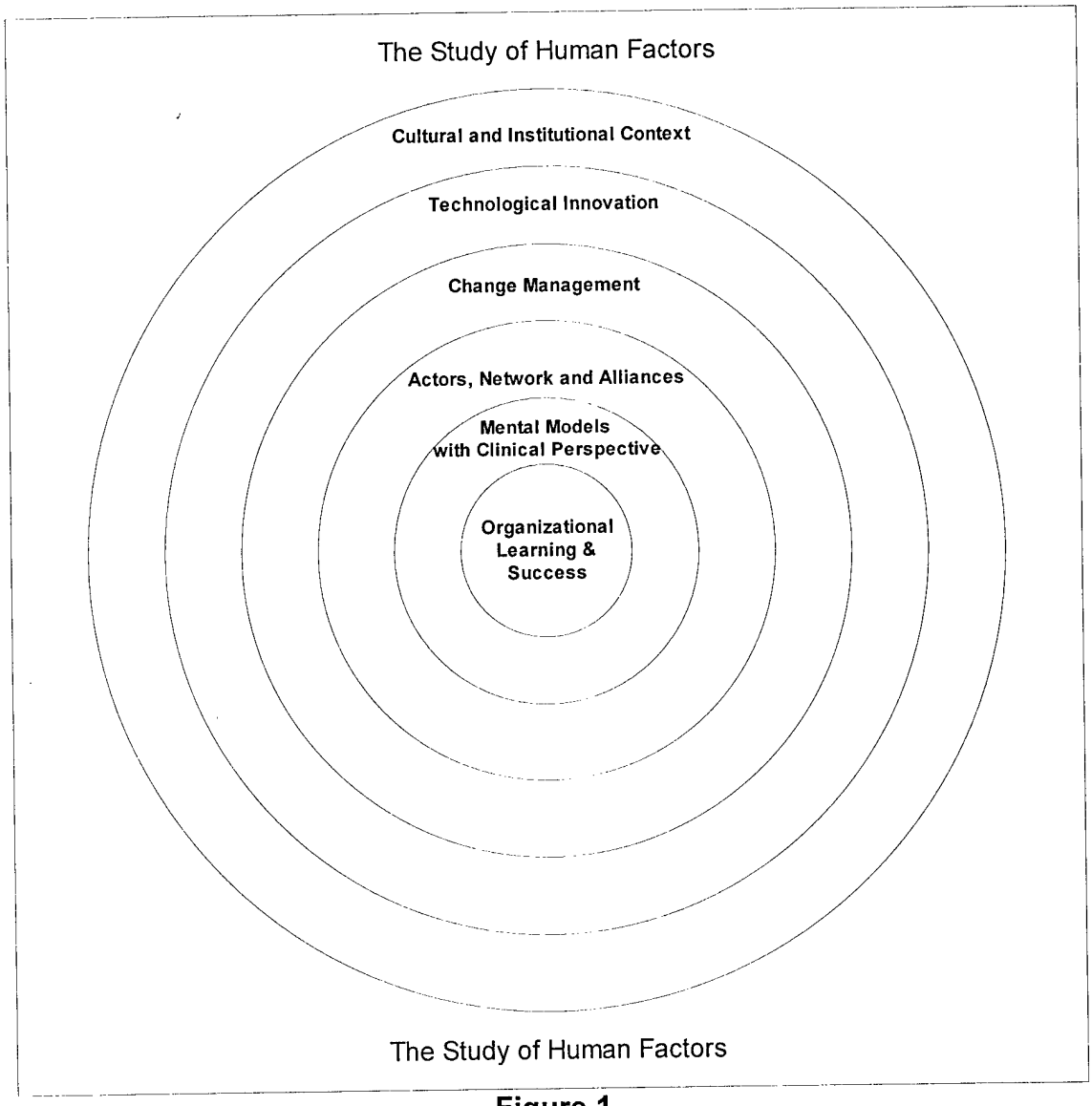


Figure 1

The design of our book seeks to present the best expert analysis of each layer of the onion in Figure 1, and to explore each layer in consideration of concurrence, sequence,

and integration with each and all other layers. That is, while each expert may emphasize one layer of the onion, s/he is encouraged to make note of its interactivity with all others. S/he may discuss it within any or all of the subfields of management and organization. Contributions from the experts may be the result of rigorous investigation, thought pieces, reviews of literature, or case studies. In addition to these expert contributions, included in discussion of each layer are "classic" articles from the broader literature on the adoption of technology and the impact of the resulting changes on the organization. Expert referrals to the "classics" will be tied to the current state of e-health and overarching principles of management and organization in editorial commentary.

In the seven sections of the edited volume, we strive to answer the following questions:

Section 1: Overview of Human Factors in Healthcare Technology Utilization
In its broadest sense, the field of Human Factors has much to contribute to our understanding of implementation and long term utilization of new technologies in Healthcare. This section categorizes and reviews traditional Human Factor approaches applicable to the technology utilization problem in e-health implementations.

Section 2: Cultural and Institutional Context of Telemedicine & e-Health
What cultures -- national, professional or organizational -- are receptive or resistant to telemedicine? What interventions are appropriate to change the cultures to facilitate a successful program? What core values those make the adoption of telemedicine successful?

Section 3: Technological Innovation in Telemedicine & e-Health
What role does innovation play in successful telemedicine? Is there a role for disruptive technologies in healthcare? What "proof" does a health care professional need in order to embrace a new technology? What actions and structures can promote high acceptance of new technologies in health care organizations?

Section 4: Managing Change in Telemedicine & e-Health
What role must a leader and/or manager play in the successful adoption of telemedicine? What support processes must be in place for an organization to accept telemedicine? How does one introduce new equipment in a healthcare setting?

Section 5: Actors, Networks and Alliance in Telemedicine & e-Health
What alliances between various actors impact or preclude the success of e-health utilization? How may alliances be constructed to promote enhanced utilization? In addition to human actors, non-human entities such as software programs may also be considered actors in networks of alliances. How can these networks be modified so as to achieve greater stability in these processes of e-health utilization?

Section 6: Mental Models and the Clinical Perspective in Telemedicine & e-Health
What standards of proof are necessary for a healthcare professional to use telemedicine? Has professionalization created fixed perspectives and mental models that limit health care providers' ability to perceive the full range of benefits derived from

telemedicine? Values as well as models of causality may be heavily influenced by the enculturation of professional training. How may such dysfunction be focused toward successful utilization of e-health systems?

Section 7: Organizational Learning and Success in Telemedicine & e-Health
What role, if any, does organizational learning play in the adoption of telemedicine? What other learning results from telemedicine? How cultural dynamics affect organizational learning? What are typical learning characteristics of health care organizations, and how might these inhibit or enhance of e-health implementation? Is there a need to balance or match learning values of the organization to those values embedded in the general society that the e-health system impacts?

Targeted Readers

The book targets five segments of readers: healthcare administrators, healthcare policy researchers, healthcare clinicians, information technology professionals, and government stakeholders and other healthcare funders. Healthcare is the largest service industry in the United States. It is in trouble: cost is running out of control; the population expects government to control its rising costs; government tries to pass the costs to industry; industry, in turn tries to pass it on to its workers. Comparisons of costs verses healthcare outcomes and results in other cultures, as for example in some European nations, raise questions in the minds of American policymakers and citizens with regard to the current management and organization of healthcare in the USA.

Healthcare and information system professionals, who are dedicated to the provision of healthcare, are seeking the types of productivity gains that other US industries are achieving through information technology. Thus, the level of interest in e-health soars!

Clinicians pressure healthcare administrators to provide the clinical technology and support services that they believe will facilitate such positive changes as increasing access, improving quality, and lowering costs. In response to investment in such expensive technology, many of the same physicians who make the demands then resist using the technology. This book will give the administrators new insight into how the physicians can be influenced to fully own and utilize e-health innovation.

Healthcare policy researchers are consistently seeking quality scholarship that assists them in the undaunting task of fueling policy decision-making. This book will provide them with a comprehensive treatment of best thinking and leading edge research in the management and organization of clinical e-health not available elsewhere.

Healthcare clinicians -- physicians, physician assistants, nurses and technicians – feel they are on a treadmill. As consumers' expectations continue to rise, finding appropriate (disruptive) technology seems the best leap off the accelerating treadmill. This book will show these clinicians how to help their colleagues and organizations to embrace e-health initiatives.

Because of the strong professional cultures within healthcare, information technology professionals find it an especially challenging industry in which to work. Not only are the healthcare cultures strong, they are different from the professional culture of information technology professional. Therefore, even through the IT professionals may feel the culture clash, they do not know how to respond to it. This book will help IT professionals work in any industry where the industry's professional culture is different from the IT culture.

Government and other healthcare funders, struggling to define appropriate, outcome-driven allocations need to understand how to be the best funding/resource partners possible. This book will give these stakeholders the fuel they need to understand how funding human factor context improvements need to be a strategic, companion investment to technology advancement.

Articles under consideration for the book are:

Section 1: Overview of Human Factors in Healthcare Technology Utilization

Wendy Rogers, Aideen Stronge, and A.D. Fisk

"Optimizing Usability in Telemedicine: A Human Perspective" Article has not been received.

Timothy A. Nichols, Aideen Stronge, Rufus Sessions, Jeanette Rasche, Wendy Rogers, and A.D.. Fisk

"Human Factors Applied to Telemedicine: Bridging Psychology and Technology in Telemedicine Applications" Article has not been received.

CLASSIC

Rashid L. Bashshur

"Telemedicine and the Health Care System"

Marilyn J. Field, Editor

"Human Factors and the Acceptance of Telemedicine" based on a background paper drafted by John C. Scott and Neal I. Neuberger. This was located in Chapter 4 "The Policy Context of Telemedicine" in Telemedicine: A guide to Assessing Telecommunications in Health Care.

Section 2: Cultural and Institutional Context of e-Health

Jim Katzenstein and Barbara Chrispin

"Designing a Telemedicine System in Tanzania – A Sociotechnical Systems Approach"

Deena Suresh and Sridhar CB

"Internet And Telemedicine For Doctors In Rural And Urban India"

Section 3: Technological Innovation in e-Health

Ville Harkke and Mikael Collan

"Structures Surrounding Electronic Health Systems: Effects of Legal and Administrative Structures on Development of IT in Health Care Services – focus on Finland"

John Fulcher

"The Use of Patient Biometrics in Accessing Electronic Health Records"

Lynne Baldwin and Malcolm Clarke

"Using ICT to Better Support the Fragmentary Nature of Healthcare"

CLASSIC

John R. Kimberly and Michael J. Evanisko

"Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations."

Section 4: Change Management in e-Health

Ton Spil, Margreet B. Michel-Verkerke

"Electronic Prescription System, USE IT or Leave it"

Kawaljeet Kaur, Cynthia Scheideman-Miller, Lori Smith and Pam Forducey

"Organizational Effectiveness of a Telerehabilitation System in Oklahoma"

John Kennedy

"The Difficult Transition form Innovation to Sustainment: A Small-Scale Case" Article has not been received.

Section 5: Actors, Networks and Alliance in e-Health

Debbie Justis, Charles Doarn, and Ronald Merrell

"Creating a Distribution Network for Successful Implementation of a Rural Telemedicine Program"

David Bomba

"A Comparative Study of the Diffusion of Computerized Health Records among General practitioners in Australia and Sweden"

Deborah Seale, Sally Robinson, Alexia Green, Glenda Walker, Bobbye Berg, Christina Esperat, Patty Ellison, and Michael Chalambaga

"A Guide to Utilization & Sustainment of Telemedicine: Answering the Question What is in it for me?"

Section 6: Mental Models and the Clinical Perspective in e-Health

Colin Mackenzie, Yan Xiao, David Lam, Peter Hu, and Claudia Oglivie
"Telemedicine in Emergencies"

Nancy Johnson, Rita Webb, Steve Moser, and Rosanne Harrigan
"Impact of Telemedicine on Progression of Renal Disease in Diabetics with Native Hawaiian Ancestry"

Robert Bulik and Sherry Wulff
"Transactional Presence in Primary Care Telemedicine Encounters" Complete article has not been received.

Section 7: Organizational Learning and Success in e-Health

Monrad Aas
"Towards Learning Organizations with Telemedicine?"

David Bangert and Robert Doktor
"The Role of Organizational Culture in the Management of Clinical e-health Systems"

CLASSICS

Paul McLaren and C.J. Ball
"Telemedicine: lesson remain unheeded"

Pamel S. Whitten, Frances S. Mair, Alan Haycox, Carl R. May, Tracy L. Williams, Seth Hellmich
"Information in practice: Systematic review of cost effectiveness studies of telemedicine interventions."

Clayton M. Christensen, Richard Bohmer, and John Kenagy
"Will Disruptive Innovations Cure Health Care?"

The schedule for the remaining work is:

September 1, 2003	Second drafts submitted to editors. Drafts will be submitted to other contributors and referees for comments
November 15, 2003	Reviews back to editors
January 15, 2004	Comments back to authors from editors
March 15, 2004	Final drafts submitted to editors
May 2-5, 2004	Final discussion at ATA. Book ready for publisher.

Key Research Accomplishments

The research accomplishments are the separate articles in the appendix. These will be enhanced and refined in the final drafts which will be available for publication in the book. These are:

- "Designing a Telemedicine System in Tanzania – A Sociotechnical Systems Approach" by Jim Katzenstein and Barbara Chrispin

- "Internet And Telemedicine For Doctors In Rural And Urban India" by Deena Suresh and Sridhar CB
- "Structures Surrounding Electronic Health Systems: Effects of Legal and Administrative Structures on Development of IT in Health Care Services – focus on Finland" by Ville Harkke and Mikael Collan
- "The Use of Patient Biometrics in Accessing Electronic Health Records" by John Fulcher
- "Using ICT to Better Support the Fragmentary Nature of Healthcare" by Lynne Baldwin and Malcolm Clarke
- "Electronic Prescription System, USE IT or Leave it" by Ton Spil, Margreet B. Michel-Verkerke
- "Organizational Effectiveness of a Telerehabilitation System in Oklahoma" by Kawaljeet Kaur, Cynthia Scheideman-Miller, Lori Smith and Pam Forducey
- "Creating a Distribution Network for Successful Implementation of a Rural Telemedicine Program" by Debbie Justis, Charles Doarn, and Ronald Merrell
- "A Comparative Study of the Diffusion of Computerized Health Records among General practitioners in Australia and Sweden" by David Bomba
- "A Guide to Utilization & Sustainment of Telemedicine: Answering the Question What is in it for me?" by Deborah Seale, Sally Robinson, Alexia Green, Glenda Walker, Bobbye Berg, Christina Esperat, Patty Ellison, and Michael Chalambaga
- "Telemedicine in Emergencies" by Colin Mackenzie, Yan Xiao, David Lam, Peter Hu, and Claudia Oglivie
- "Impact of Telemedicine on Progression of Renal Disease in Diabetics with Native Hawaiian Ancestry" by Nancy Johnson, Rita Webb, Steve Moser, and Rosanne Harrigan
- "Towards Learning Organizations with Telemedicine?" by Monrad Aas
- "The Role of Organizational Culture in the Management of Clinical e-health Systems" by David Bangert and Robert Doktor

Reportable Outcomes
The draft articles which are contained in the appendices are the major outcomes.

Conclusions
The book is on schedule and will be completed as required by the contract.

References
None

Appendix A

Designing a Telemedicine System In Tanzania - A Sociotechnical Systems Approach

By

James Katzenstein, Ph.D.
School of Business and Public Administration
California State University, Dominguez Hills
Carson, CA 90747
949-348-1986
jimkatzenstein@compuserve.com

and

Barbara R. Chrispin, Ph.D.
School of Business and Public Administration
California State University, Dominguez Hills
Carson, CA 90747

Designing a Telemedicine System In Tanzania - A Sociotechnical Systems Approach

Introduction

Tanzania contains Africa's highest mountain, Kilimanjaro, its most famous game park, Ngorongoro Crater, its largest game reserve, the Serengeti and, on its borders lay the three largest lakes on the continent. Tanzania embodies the Africa that people think of when they think of Africa. [JK1]Tanzania is also one of the poorest countries in Africa, with one of the highest infant and maternal mortality rates in the world. HIV/AIDS and malaria, one of the world's major killers of children, are rampant. The health care system is primarily government owned but because the government is chronically short of money, its health care system is perpetually short of resources. There is a shortage of doctors and other health care professionals and a national infrastructure that makes distribution of resources difficult or impossible. Building health care and educational capacity under these conditions is extremely difficult.

Within this void, Dr. Hubert C. Kairuki, a visionary African Physician, and his family started a four-bed clinic in the village of Mikocheni within the center of Dar es Salaam, the economic capital of Tanzania. Using a unique business model, that involved contracting with government owned enterprises to provide health care to their employees on a fee for service basis, Dr. Kairuki and his family made significant strides in delivering health care. In ten years, the clinic grew to become a 130-bed general medical center known as Mission Mikocheni Hospital (MMH).

In 1996, the management at MMH invited a group of faculty and students from The Fielding Graduate Institute, in Santa Barbara, California to Tanzania to help them evaluate their second ten-year Strategic Plan. Evaluating a ten-year plan turned out to be overly ambitious and presumptuous in the short period of time that the group had to work with, but the nascent partnership provided the foundation for the development of a unique consulting model, called the Kairuki Mikocheni Consulting Model (KMM), which has been used throughout the intervening years to percolate innovation at MMH. The KMM, described more fully later in this report, provides the structure whereby a team of local and international people with different specialties and expertise function as equal partners and pursue innovative health initiatives. Some of the changes initiated as a result of these partnerships included conducting project management

workshops to help senior staff function more effectively, starting a medical university affiliated with the hospital, standardizing the computers and networking the computer system, providing internet access and establishing e-mail, and establishing links with universities and individuals in the United States. Out of this these efforts grew a plan to link three outlying clinics with a hub site at MMH, mediated by information and communication technology. This system, used extensively in the United States, laid the groundwork for further study into the feasibility of using telemedicine and telemedicine systems to improve healthcare capacity in developing countries such as Tanzania.

Background

An appropriate hub and spoke technology was designed, using cameras, computers and local telephone infrastructure, which satisfied basic requirements for an effectively functioning telemedicine system. (see Figure 1) The result was a combination system consisting of an 8X8 camera to transmit and receive live interactive video between sites and a computer with a web cam to capture and transmit video clips and still pictures, over the internet, as attachments to emails. Email was used as the vehicle to transmit written data with the pictures. A modified contact manager data base was used as the patient record for the purposes of a demonstration, understanding that this part of the technology needs further refinement.

According to Field, the components of a hub and spoke system should be off-the- shelf, rather than customized; have a low level of sophistication to learn and operate; be compatible with each other and be individually upgradeable (Field, 1996 p.68). In addition, the design team identified six additional characteristics required for the technology to function in the context of MMH.

- It must be inexpensive to purchase and maintain.
- It must be compatible with local telephone infrastructure and upgradeable if and when the infrastructure improved.
- The patient and the doctor must be able to see each other in real time, for cultural reasons we will discuss later in this paper.
- Data, both text and pictures, must be able to be transmitted quickly and accurately, while the patient is still at the clinic.
- There must be a simple way of maintaining and accessing a patient record on both ends of the technology.

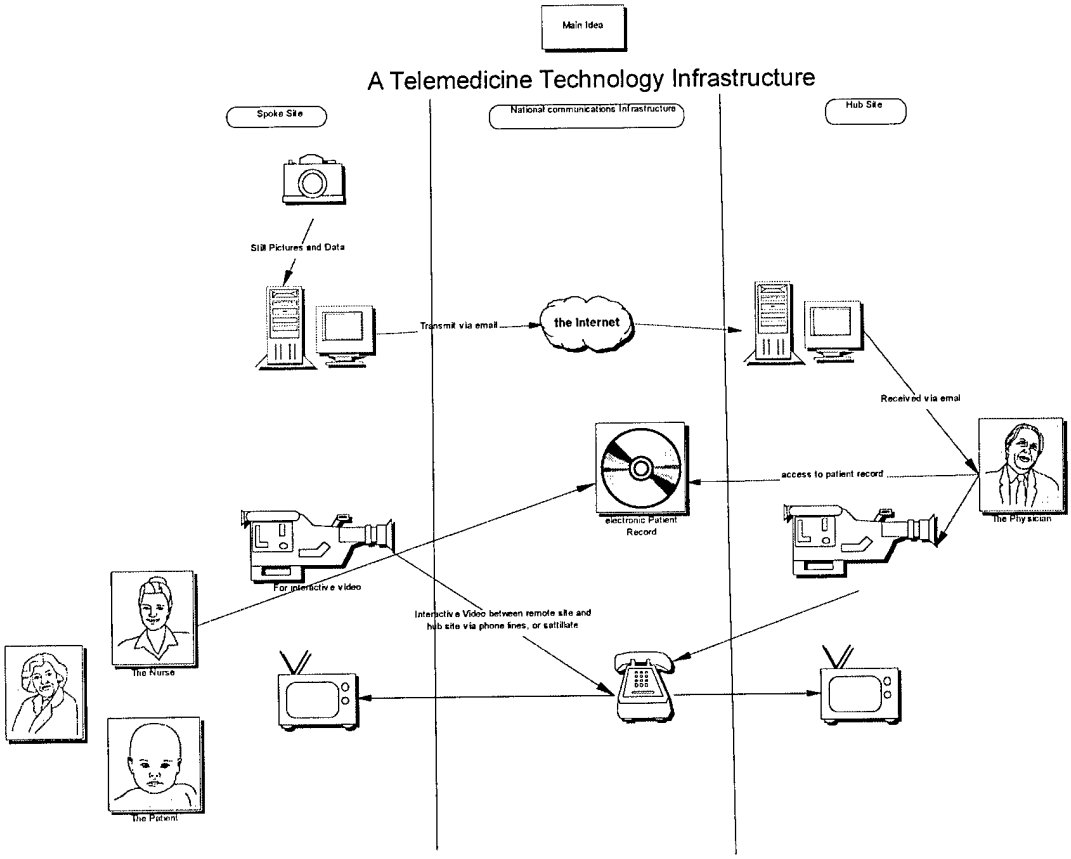


Figure 1. Telemedicine Technology Infrastructure

- Running counter to the first five requirements, which stress economy and simplicity, the technology, must be complex and expensive enough so that the people using it *perceive it* as a valuable addition.

The Problem

The "ah ha" that surfaced between these researchers, during an Interlude[1] in the project, is that working in Africa "really" is different than working in the United States—that these two different worlds each provide unique historical and cultural perspectives about development, health and wellness, health-care capacity and the role of technology. It became clear that the project was moving to greater reliance on western models of telemedicine as the solution to problems of health care capacity in Africa, and that the design of the system was technologically determined. That is to say, while the system configuration took into consideration the appropriateness of the technology for the economic development of Tanzania, it focuses on telemedicine as a technological system to provide and support health care, rather than as a sociotechnical system.

As stated in socio-technical system theory, any system requiring the interaction of people and technology rests on two premises. The first is that the desired output is achieved through the joint operation of a social as well as a technical system. The second premise is that every sociotechnical system is embedded in an environment that is influenced by a culture, its values, and a set of generally acceptable practices. (Davis and Trist, 1974, p. 163). The concept "joint" implies that the social and technical systems are so interlocked that the achievement of the output becomes a function of their joint operation. This differs from the view that the social system must be determined by the technical system. Joint also implies that it is impossible to optimize for overall system performance without seeking to optimize jointly the correlative but independent social and technological systems. In addition, the cultural environment influences the role expectations shaping organizations, groups and the individuals in them.

This suggests that a telemedicine system, in order to be effective, must seek to optimize the social system as well as the technological system. It also suggests that the cultural

environment plays an important role in determining how the social system functions--what roles will be considered appropriate for individuals and groups to play within a telemedicine system

Statement of Purpose

The goal of this research to improve the design of a telemedicine system in Tanzania so that both the social and technical systems can operate optimally. In our view, the cross-cultural interface of human beings and information using information technology presents enormous challenges and may be one of the major reasons for the failure of telemedicine in developing countries.

Definition of Telemedicine

This study defines telemedicine as "an integrated system of healthcare delivery and education that employs telecommunications and computer technology as a substitute for face-to-face contact between provider and client (Bashshur, 1995, p. 19).

Scope of the Research

The Interlude was used as a time out to look at what had happened thus far in the project and to plan the next stage—the design and implementation of an operating sociotechnical Telemedicine system in Tanzania. During the Interlude, the following research activities were undertaken:

1. Development of a cultural profile of Tanzania. Understanding the cultural environment would help us to understand potential barriers that would keep the social and technical systems from interacting optimally. To do this, we used library research and our personal interaction with the environment to construct a cultural profile of Tanzania.
2. Development of a series of health-care scenarios designed to test various hypotheses about how people in the system would interact.
3. Interviews with African nationals to provide data on how patients, doctors and nurses would respond to common health-care situations stated in the scenarios. Their answers would allow us to refine our knowledge of the social system.
    a. Sample. We identified and selected a group of Africans studying at California State University Dominguez Hills to interview. The respondents represent six African countries--Kenya, Nigeria, Senegal, Sierra Leone, and Tunisia; all have

[1] An Interlude as used here is a period of time in which the participant-consultant withdraws from the system, changes roles from participant-consultant to observer/researcher, and examines what has just been accomplished.

lived in the United States from 1-10 years and have had experience with, and knowledge of, health-care practices in their home countries. Respondents were told the central purpose of the study and the procedures to be used in the data collection. They were advised that their responses would be confidential, and that they had the right to voluntarily withdraw from the study. None withdrew.

b. Data Collection.

The researchers and students met at a prearranged time at the TV studio on campus to videotape the interviews. The researchers provided the students with an orientation to the project in Tanzania, and then proceeded to pose various health-care scenarios that had been constructed earlier. Respondents were asked to attribute meaning to what each of the participants in the scenario was thinking or doing. An interview protocol enabled the researchers to take notes during the taping session; it also helped to organize thoughts on items such as starting the interviews, concluding ideas, information on ending the interview, and thanking the respondents. The respondents seemed quite comfortable with the process and showed no reticence in answering the questions; interest and motivation was high throughout the session. At the end, each researcher was given a VHS tape of the complete session.

4. Data Analysis to identify cultural themes critical to system design.

The videos were viewed by both researches and content-analyzed for information to substantiate or refute material that had been developed for the cultural profile. The videotapes also allowed the researchers to observe the non-verbal behavior of the participants. Most importantly, the researchers were able to identify several unanticipated themes that emerged from the interviews.

5. Application of new knowledge to the redesign of the system.

The Kairuki Mikocheni Consulting Model (KMM)

The Kairuki Mikocheni Consulting Model (KMM), developed in Tanzania, has been employed throughout the evolution of this project and provides the framework within which the international team works. The KMM consists of four structural components, discussed as follows.

See Section on Methodology for further discussion.

An international organization of equal partners, called the Client Consultant System Infrastructure (CCSI), is the cornerstone of the structure of the KMM. It is through this, frequently ad hoc, organization that innovative work is done. People may move in or out of the CCSI as needed but the members are equal partners in the consulting process rather than experts from afar and users of expertise, which promotes inequality and dependence.

The second component of the KMM is a process called structural coupling (Maturana & Verella, 1987). Structural Coupling is the means through which the CCSI is connected, or coupled, to its environment, and moves and changes in response to changes in that environment.

The third component involves a process called structuration (Giddens, 1984), through which the social system evolves based on the needs of its members.

The fourth component of the model is action research (Sussman, Stringer, et al) through which the CCSI as a structurally coupled social system identifies and performs meaningful work.

The model operates within an emergent cyclical component—diagnosing, action planning, action taking, evaluating, and learning—and a planned linear component through which a project moves forward in time.

The Interlude. An interlude is the time frame that falls between periods of activity between linear components, in which the client consultant system infrastructure is not working as a unit. Interludes are particularly crucial within the international context and play a key role in facilitating the Action Research (AR). The interlude allows for a period of reflection in which the participant-consultant withdraws from the system and examines what has just been accomplished. He/she changes roles from participant to researcher.

Figure 2 provides a diagram of the KMM Consulting Model.(Katzenstein, 2000, p.11) (see Figure 2).

Findings

Developing a Cultural Profile.

One way to anticipate the probable effects of an unfamiliar culture on organizations outcomes and processes is to develop a cultural profile. As generally understood, the culture of a society comprises the shared values, understandings, assumptions, and goals that are learned from earlier generations, imposed by present members of a society, and passed on to succeeding generations. Despite differences among social scientists, there are three characteristics on which

there is widespread agreement: "...it is not innate, but learned; the various facets of culture are inter-related—you touch a culture in one place and everything else is affected; it is shared and in effect defines the boundaries of different groups." (Hall, Beyond Culture, 1977, p.16). This

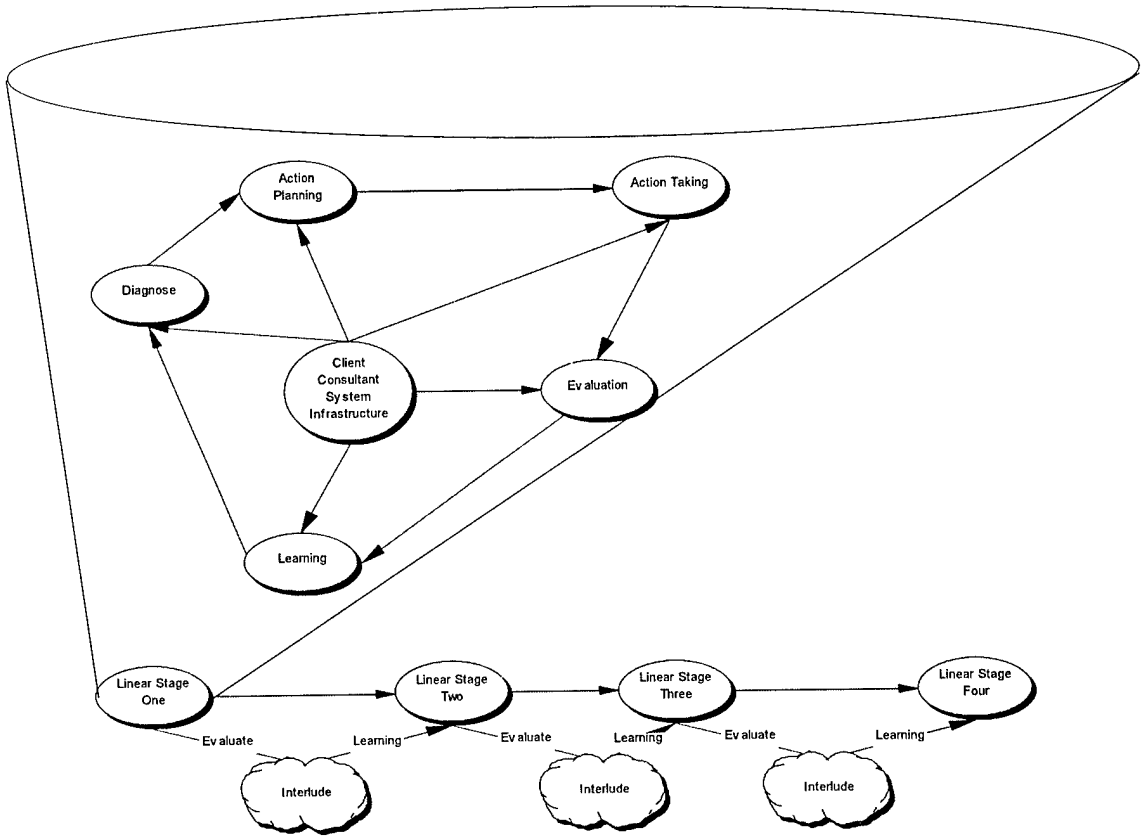


Figure 2. The KMM Consulting Model

shared outlook results in a basis for living grounded in shared communication, standards, codes of conduct, and expectations.

This cultural profile provides a snapshot of the overall character of a specific group and generally starts with gathering information about universal cultural variables found in most societies. Harris and Moran have identified eight categories that form the subsystems in any society: language, religion, values, social institutions, technology, politics and law, and economics. (1991) This systems approach to understanding cultural and national variables—and their effects on work behavior—is a good starting point for developing some tentative expectations about the mental software of a people.

The Cultural Environment of Tanzania

The United Republic of Tanzania is one of the world's least developed nations, situated on the East Coast of Africa bordering the Indian Ocean between Kenya and Mozambique, and is slightly larger than twice the size of California Dar es Salaam is the capital and largest city; Dodoma, located in the center of the country, has been designated the new capital, although action to move the capital has stalled. Tanzania's population of 36.2 million is growing at 2.6 percent annually. About one-third of the population lives in urban areas, and more than half of all Tanzanians are younger than age 20. Ninety-nine percent of the population is African, coming from some 130 ethnic groups. Non-Africans residing on the mainland and Zanzibar account for 1% of the total population. The Asian community has declined by 50% in the past decade to 50,000 on the mainland and 4,000 on Zanzibar. An estimated 70,000 Arabs and 10,000 Europeans reside in Tanzania, with Arabs most numerous on Zanzibar. People of Lebanese, Palestinian, and Indian origin dominate the merchant/trader class. Significant refugee populations from neighboring countries live in border areas.

Language. Swahili (Kiswahili) is the primary official language in Tanzania. It was developed along the coasts of Kenya and Tanzania as a trade language between Africans and Arabs. It is a mixture of various Bantu languages, Arabic, and English. English, the second official language is used in business, government, and higher education.

More than one hundred languages are spoken in Tanzania. Most people speak the language associated with their ethic group, but they generally also speak Swahili. Julius Nyerere, the country's first president, made Swahili official at the time of independence from Britain, to foster pride in the people's African identity.

Religion. On the mainland, more than one-third of the population is Christian. Another third is Muslim. On Zanzibar, nearly all inhabitants are Muslim. About one-third of the population follows indigenous beliefs, although many of these people have also accepted some Christian or Islamic beliefs. It is not unusual for professed Christians to mix their beliefs with local traditions. Thus, a local priest and a traditional healer might carry equal respect in a "Christian" village. The two belief systems are not considered contradictory because each has a place in the people's daily lives. The government is neutral in religious matters and has tried to promote religious tolerance throughout the country.

Education. Primary school instruction is in Swahili, but English is the main language in secondary schools. About 70 percent of all school-aged children begin primary school but less than 10 percent progress past the seventh grade. Boys are more likely than girls to get an education. As a result, there is a wide disparity between the male and female adult literacy rates. In 2001, President Mpaka introduced a program to provide free education to all Tanzanian children. Until then, parents had been required to pay their children's school fees, preventing educational opportunities for many. Unfortunately, there are not enough classrooms and teachers to handle the huge number of new students. The Adult literacy rate in Tanzania is 84% for males and 66% for females.

Economic system. Agriculture dominates the Tanzanian economy, employing 85 percent of the population and accounting for 85 percent of all exports. The industrial sector, accounting for only about 10% of GDP, is one of the smallest in Africa. The Government of Tanzania currently is pursuing a program of free-market reforms and has sold off most of its poorly performing parastatal businesses. Economic liberalization has encouraged private investment and the creation of new export products. Continued democratic reforms are expected to boost economic performance. However, corruption, mismanagement, and regional problems still hamper the economy.

Women tend to enjoy equal access with men to income. Overall, however, people have limited access to resources and opportunities necessary to pursue personal goals and rise above

poverty. Half of the people live in poverty and the real GDP per capita is $501. To generate some cash income, a family will often run an informal shop that sells produce, soda, soap, and sundries, or they may find odd jobs to supplement low-paying wage jobs

Political System. Tanzania is a democratic republic following a political union between Tanganyika and Zanzibar in 1964. It has three branches--an Executive, Legislative and Judicial, and contains 25 regions. The voting age is 18. A five-level judiciary combines the jurisdictions of tribal, Islamic, and British common law. Zanzibar is a semiautonomous state with a separate parliament and elected president (Amani Karume).

Tanzania is a multiparty democracy. In 1992, the Tanzanian Constitution was amended to allow for more than one political party, and the first multiparty elections were held in November 1995. Tanzania's second round of multiparty elections in October 2000 were followed by political violence on Zanzibar in January 2001, as police clashed with opposition demonstrators protesting the conduct of the elections on Zanzibar. A peaceful dialogue has since been established between leading members of the ruling CCM party and the CUF opposition party to address grievances and reach agreement on implementing future electoral reforms.

National Values Underlying Organizational Behavior.

Within this environment, certain unique sets of shared values have formed among different groups of people. Values are a society's ideas about what is good and bad, right or wrong, and will influence people to behave differently under similar circumstances. One framework for understanding how basic values underlie organizational behavior was proposed by Hofstede. Hofstede likens culture to a "collective programming" of the mind. He suggests that four dimensions of values can explain the difference among culture: Individualism/Collectivism, Power Distance, Uncertainty Avoidance and Masculinity/Femininity. (Hofstede, 1991) Exhibit 3 shows how Tanzania compares with the United States on these four dimensions.

Individualism refers to the tendency of people to look after themselves and their immediate family, rather than others. Collectivist cultures value the overall good of the group. The expectation is that people subordinate their individual interests and needs for the benefit of the group. Hofstede's findings indicate that most countries scoring high on individualism have both a higher gross national product and a freer political system than these scoring low on individualism. Additionally, all countries scoring low on individualism score high on power

distance. In Tanzania, because being part of the group is so important, it is often very clear how people in the group should behave. Typically, people look after each other in exchange for loyalty, emphasize belonging, and make group decisions

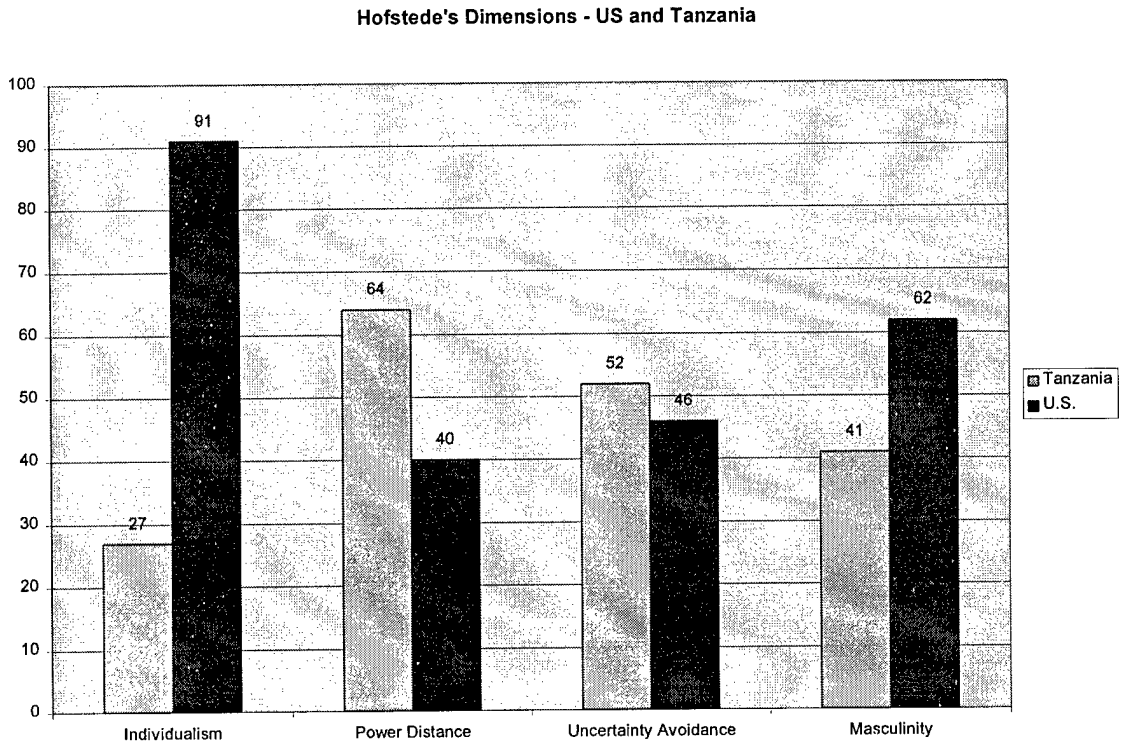


Figure 3. Hofstede's Cultural Dimensions

Power distance is the extent to which less powerful members of organizations accept that power is unequally distributed. It ranges from small to large. A small power distance society such as the U.S. is less comfortable with power differences such as social class distinction or organizational ranking. In a large power distance culture, differences among people with different ranks are accepted, and an individual's societal or organizational position influences how he acts and how others treat him. In Tanzaniz, a person in a high-level position treats those at lower levels with dignity, but the differences in rank are always clear. Delegating decision-making implies incompetence because the rank of a high status person requires him to make decisions himself.

Uncertainty avoidance, which ranges from strong to weak, indicates the preferred amount of structure. Strong uncertainty avoidance countries like Tanzania prefer more structure, resulting in explicit rules of behavior. Such countries have a high need for security, concern for doing things correctly and great respect for experts.

Masculinity refers to the degree of typical "masculine" values, such as assertiveness, materialism, and lack of concern for others. Femininity in a society emphasizes concerns for others, relationships with others, and quality of life.

Comparing the cultural profile of Tanzania with that of the U.S. on Hofstede's four dimensions, one notes they are opposite on all four dimensions. (See Figure 2)

The Health-Care Context.

The health care system in Tanzania is multi leveled with the primary system at the village level being administered by traditional health care providers using a magico religious belief system. In the magico-religious approach, health and illness are closely linked to supernatural forces. Mystical powers, typically outside of human control cause health and illness.(Lustig & Koester, p. 306) Traditional medicine consists of two broad categories of preventive/protective and curative activities. Oral treatments-what we in the west would consider magic-are combined with medicinal herbs to promote health and cure ailments. (Makinde, 1988).

The Government of Tanzania owns and operates a series of clinics and hospitals that operate on a western, disease oriented model. They were developed during the post colonial socialist period and were heavily supported by development agencies. With the reduction in the level of aid, the quality of the government system of clinics and hospitals has deteriorated. The system tends to be substandard compared with comparable western systems.

Private hospitals exist within the government health care policy but they serve specific constituencies and are generally not open to the ordinary Tanzanian villager. This is so, primarily because the lack of physical infrastructure-roads, public transit etc.-prevents the villager from getting to the private clinic, and economics-the cost of drugs and other resources-prevents him/her from being able to purchase the services that are uniquely available at private clinics.

The patient has the option of attending a government clinic or hospital, a private hospital, the village healer or some combination of each.

Family and Gender Roles in the Health-Care Context. The health care system in the United States typically focuses solely on the individual patient as the source of a medical problem in need of a cure. In a collective and group-oriented culture, by contrast, the family assumes a large role in the functioning of the health care system and the interaction of the two systems can be the basis of serious problems and misunderstandings. Cultures that value the community or the extended family, for instance, may require the involvement and agreement of other family members, not just the patient. They also may influence people's willingness to keep important health-care appointments.

Many cultures have strong expectations about modesty, and the bodily displays of women can make the medical examination itself a source of intercultural difficulties. In some cultures, role requirements governing appropriate behaviors for women do not permit undressing for an examination by male physicians or nurses.(Lustig and Koester, 1999, p.307)

Conversational Structures and Language. Because of different interaction norms, the medical interview between caregiver and patient can be another source of intercultural communication problems. Some collective or high context cultures may engage in extensive small talk before indicating their reasons for the medical interview. Similarly, direct and explicit discussions may cause the patient discomfort, while the use of indirection or other face-saving strategies may be preferred. In many cultures, doctors are perceived as authority figures that one must agree in the face-to-face medical interview. A patient may know that he or she will not be able to follow a proposed treatment plan but will be reluctant to respond to the doctor in a way that might appear to be a challenge to the doctor's authority. (Lustig and Koester, 1999, p.309)

The Health-Care Scenarios

The cultural profile was used to develop a series of health scenarios, in which a fictitious patient, living in an African village, was faced with different kinds of health problems, of varying severity. The issue for the respondents was to tell us what each of the participants in the scenario was thinking or doing, and how he/she would react based on the respondents' African heritage and the availability of health care choices. From the attributions of meaning provided by them, we would be able to deduce probable role expectations regarding the primary participants—the doctor, the nurse and the patient—in the system.

First Scenario – Different Realities. The first scenario dealt with the treatment of common ailments, such as malaria, and how a mother, would attempt to treat the illness of her child.

As the first line of defense, the respondents felt that the mother or patient would use traditional medicines—such as herbs and barks, to treat the illness. They, themselves, were familiar with these traditional remedies, and viewed them as a basic requirement for daily life. It was suggested that the patient might go to a clinic for treatment if the response of the traditional approaches to the symptoms didn't work. The decision to go to a western clinic, however, generally is made after consultation with other family members or parents, and frequently with input from the tribal elders.

The decision as to what combination of traditional medicine and western medicine is sought also depends not only on the patient's predisposition toward traditional medicines and its effectiveness in treating the problem, but also on the patients' perception of how well they will be treated at the western clinic and whether they can afford the cost of western medicines and treatment. Generally, the patient will go to a clinic for treatment if the illness doesn't respond to traditional approaches, if a clinic is available, if the patient can afford treatment and medications and if the medications are available at the clinic. Since there are more clinics in the cities than in the rural areas, the probability that patients will access western, clinic-based health care is greater in the urban areas.

The respondents discussed the deterioration of western health care in many African countries over the last several years. As the health-care capacity of many of these countries has declined, so too has trust in western health-care. As reported by the respondents, the general population does not have a very positive perception of health-care workers. Nurses are perceived as poorly trained and not well motivated. They are viewed as government workers who are interested only in doing the bare minimum work for the pay they receive. They are perceived as not motivated to care for their patients but rather to help their employers extract the maximum amount of money from the patients. The perception of doctors is better, but the chronic shortage of doctors in most African countries makes this a moot point.

Such perceptions have serious consequences for change in communal situations. The responses to Scenario 1 suggest that those who view the world through the traditional magico-religious paradigm see the western health care paradigm differently than those within the western

paradigm, even when both are within the same country, e.g. Tanzania. When one person is ill, the rest of the village observes the treatment, which may be western medications, traditional herbs or some combination of both. The knowledge gained, good or bad, becomes part of the body of knowledge of the village and will be used the next time someone gets the same illness.

Several critical themes emerge from an analysis of the responses to the issues posed in this scenario:

The most important theme to emerge from the first scenario is that most patients and health-care workers within developing African countries hold different perceptions of reality when it comes to health care. The structure of the traditional paradigm is village-based and consists of traditional healers, village elders and the patients that use the system, while the Western paradigm consists of doctors, nurses, hospitals and clinics, technology and the worldwide information about disease and wellness. The real difference, in addition to structure, is the way that people within each paradigm view health-one from a magico-religious base and the other as a disease model.

These findings indicate that the problem is considerably larger than originally conceived. The patient is part of one social system, while the health-care workers are part of another. A way must be found to reconcile these two realities before any sophisticated western medical system such as telemedicine is introduced.

Several economic and perceptual boundaries exist which make access to western medicine difficult for the patient. When a patient attempts to go to a government owned facility, he/she finds a shortage of medications, doctors, nurses and equipment. Government facilities have, in recent years deteriorated in many African countries and many clinics have few resources, poorly trained and unmotivated health-care workers. The patient perceives, rightly so, that the system is inferior. If a patient attempts to go to a private clinic, he/she in many cases can't afford the treatment and/or medications. Patients are overcharged for services and medication based on their ability to pay, channeling scarce resources to the highest bidder rather than to the neediest. The reality and the perception reinforce each other, conspiring to reduce trust between the patient and the western medical staff. This understanding becomes stamped in the village memory. In turn, the move toward change is retarded while the value of the traditional health-care system is reinforced.

Second Scenario-A Stranger in a Strange Land. The second scenario deals with an illness that has gotten worse and hasn't responded to traditional methods. A visit to a telemedicine equipped clinic is arranged. This scenario introduces the concept of a teleconsult or health care delivered at a distance using technology.

The responses to the second scenario point out many of the communications difficulties that ensue when technology becomes the channel through which the patient in one reality is expected to communicate with a doctor in another. It was suggested that mediation of the communication process with an ICT system and an unfamiliar doctor would tend to confuse and frustrate the patient. Respondents felt that if the doctor and the patient haven't met each other, face-to-face, prior to the teleconsult, the patient would have a problem trusting a doctor that is seen for the first time on a TV screen. One respondent suggested that the patient might have a higher level of trust if the telemedicine system was within an existing government clinic as opposed to starting a separate clinic for telemedicine, since the government health care system is a known quantity. Another felt trust and communications might improve if the doctor introduces himself to the village people and posted pictures of himself around the village so he would be "real."

The scheduling aspects of telemedicine are more crucial than face to face medicine. Many Africans have a more casual concept of time than westerners, and don't feel the need to keep track of, and manage it the way westerners do. This pertains not only to the patients but to the health care workers as well. All of these issues will therefore militate against keeping a strict telemedicine schedule. The consensus was that getting to a telemedicine consult would be difficult. Since the physical infrastructure in many African countries is poor, the patient who lives far from the clinic will have difficulty arriving on time for an appointment. On the other hand, if the appointment is far in the future, the patient will probably forget the date altogether, or get it wrong. Since telephones are very rare in most African countries, they cannot be reminded by phone a day in advance as is common in the U.S. Should the illness be serious, however, and the patient has not responded to traditional methods, he/she will probably show up early and wait for services.

The presence of a camera was viewed as a major barrier. It was generally felt that the presence of a camera in the exam room would be perceived as an invasion of the patient's privacy. Taking pictures in Muslim African countries is considered rude and not socially

acceptable, and disrobing in front of the camera will be even more unacceptable, particularly if the patient has not met the doctor, face to face, at some point.

Several themes relating to cross-cultural communications emerged from the issues posed in this scenario:

1. High Context vs. Low Context Cultures. Tanzania is a high context culture where the communication between patient and healer typically entails a silent language that transmits shared meaning about the relationship, trust, time, collectivism and religion. In a telemedicine system, with technology as the channel of communication, the environment become low context, and challenges most of the attitudes and behaviors inherent in the traditional system. Typically, when familiar cues are removed from the communication context, the person experiences anxiety and culture shock.
2. Trust vs. Professionalism. A "doc in a box" replaces face-to-face interaction between patient and healer. The trust in another person nurtured throughout a long-term relationship is replaced by distrust in strangers one has not met before.
3. Time: Monochronic vs. Polychronic. The polychronic pace of time in the village is replaced by the schedule of a western organization. Lack of transportation and telephone systems militate against getting to an appointment on time. The more relaxed concept of time that ensues in most collectivist cultures, where primary importance is put on relationships, runs counter to the rules of scheduling that protect the valuable time of the doctor.
4. Rules of Modesty. Finally, the rules of modesty inherent in the religious beliefs are seriously compromised if the patient is expected to disrobe or bear parts of her body before a stranger. The issue of being photographed by a movie camera raises additional taboos.

Third Scenario - An Ethical Dilemma. The third scenario deals with the treatment of a life threatening illness such as HIV/AIDS, and raises the issue of how traditional approaches to health care differ from western approaches in diagnosing, treating and caring for the patient.

With this situation, as with the others, the predisposition of the patient is to consult with the traditional healer first. In this case, however, the family might seek western medicine when the traditional medications don't work. The patient will still balance the advice of the doctor

with that of the healer and, taking charge of his own health care, deciding what combination to follow.

Traditional healers don't have the capability of diagnosing HIV, and when AIDS develops the traditional healers will probably misdiagnose the illness as the flu or some other common ailment and treat accordingly, using traditional medicine and magic. When that doesn't work, the patient will likely think he is cursed, which will be confirmed by the traditional healer. The healer will attempt to use magic to attack the curse that he perceives to exist within the patient and his family. When magic fails, the patient may give up and die or, he may go to a hospital for treatment. At the western hospital, fear of the AIDS virus results in the patient being isolated by nurses and doctors. The treatment involving fear and isolation compared with treatment by traditional medicine—herbs, spells and ritual—may reinforce the sense of trust in traditional medicine and the sense of mistrust in western medicine. Neither cures the illness but the death that follows traditional medicine seems more humane than the one that results from western medicine.

The most important theme to emerge from this scenario is who is ultimately responsible for health care and which approach is more humane. If no cure exists, is it better not to know and die with hope or is it better to hope and die in isolation?

Conclusions

When this research began, we saw the development of a telemedicine system in Tanzania as a technological problem. We believed that opening clinics in remote areas and connecting them to a hub site in a western style hospital would involve issues of technology such as bandwidth, national infrastructure, equipment maintenance and camera selection. We believed that, once physical access to clinics and technology was accomplished, the successful integration of technology into the African health care environment would be a function of training and systems design. With this thought in mind we designed a technology infrastructure for a telemedicine system in Tanzania.

During a project Interlude, we recognized that the social system was determined by the technology infrastructure and was transported from a western model. We recognized that social organizations in Tanzania would likely operate differently than those in the United States and decided that sociotechnical systems theory would provide a more appropriate model to use.

Subsequently we developed a cultural profile of Tanzania and a series of health care scenarios. We then interviewed a number of African nationals to get data by which to validate our understanding of the cultural profile and the social roles and interaction patterns of the doctor, nurse and patient. We then used the information obtained to make systems design choices.

We found that the social system was far more complicated than originally conceived. The system is made up of two health sub-systems, traditional and western, populated by people with two separate paradigms of health and wellness. Rather than being part of the same social system, the doctor and nurse are part of the western subsystem while the patient is in the traditional subsystem.

This means effectively that the potentiality of telemedicine to address issues of capacity without taking account of the two operating realities is severely compromised. In order for telemedicine to work, the barriers separating these two subsystems must be bridged. The means by which these barriers can be bridged begins with changes in values attitudes, and behavior.

We also found that the use of a telemedicine system, using technology as a channel of communication, inhibits communication between people from these two different paradigms and people at a distance. Barriers of context, trust, modesty and time are perceived differently in each of the two systems and are made more impenetrable by the introduction of technology mediation. The roles of the doctor and nurse need to expand to include more contact and education with the patient and the other members of the village based system. The doctor and the nurse need to structurally couple with the traditional system before the communication barriers can be penetrated.

A diagram of the social system, based on the results of this research, can be seen in Figure 3 (see Figure 3).

Further research is needed to connect the two social paradigms and to better integrate the technology infrastructure with the needs of the resultant social system.

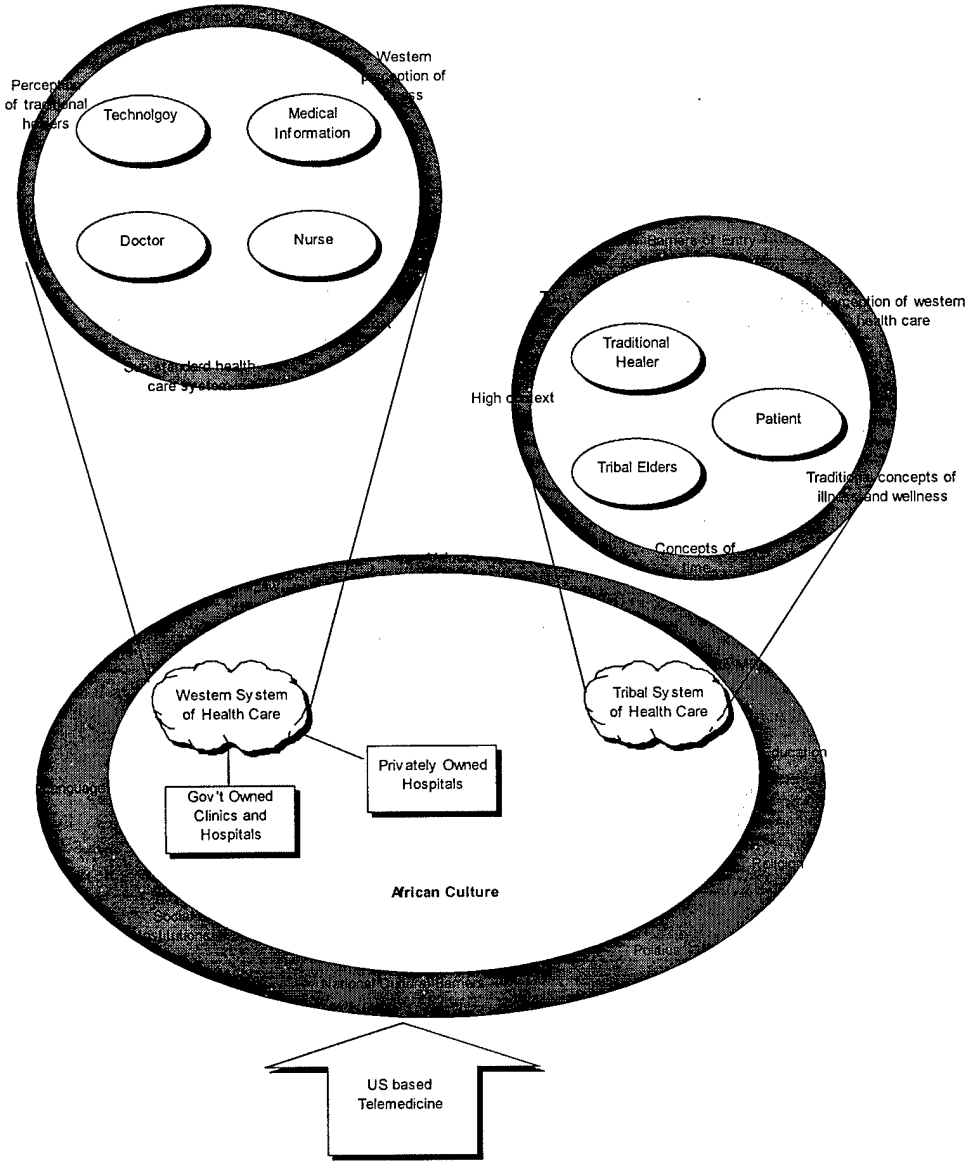


Figure 3: A Model of African Health Care

REFERENCES

Airhihenbuwa, C. O. (1995). *Health and Culture Beyond the Western Paradigm*. Thousand Oaks: Sage.

Bashshur, R. L. (1995). On the Definition and Evaluation of Telemedicine. *Telemedicine Journal, 1:19.*

Bodeker, G., Kabatesi, D., King, R., & Homsy, J. (2000). A regional task force on traditional medicine and AIDS. *The Lancet, 355*(April 8th), 1284.

Davis, L. E., & Trist, E. (1974). Improving the Quality of Working Life: Sociotechnical Case Studies. In J. O. O'Tool (Ed.), *Work and the Quality of Life* (pp. Chapter 11, pp 245-280): MIT Press.

Field, M. J. (1996).*Telemedicine: A Guide to Assessing Telecommunications in Health Care*. Washington, D.C.: National Academy Press.

Giddens, A. (1994). *Central Problems in Social Theory*. Berkeley, California: University of California Press.

Hall, E. T. (1990). *Understanding Cultural Differences*. Yarmouth, ME: Intercultural Press

Harris, P. R., & Moran, R. T. (1991). *Managing Cultural Differences*. (Vol. 3rd edition). Houston, TX: Gulf Publishing

Hofstede, G. (1993). Cultural Constraints in Management Theories. *Academy of Management Executive, 7*(1), 81-94.

Katzenstein, J. (2000). *Developing an Innovative International Consulting Model within a Private Health Care System in Tanzania.* Unpublished Doctoral Dissertation, The Fielding Graduate Institute, Santa Barbara, California.

Kubukeli, P. S. (1999). Traditional healing practice using medicinal herbs. *The Lancet, 354*(December), S24.

Lustig, M. W., & Koester, J. (1999). *Intercultural Competence: Interpersonal Communication Across Cultures*. (Third ed.). New York: Addison Wesley Longman.

Makinde, A. (1998). *African Philosophy, Culture and Traditional Medicine*. Athens, Ohio: Ohio University Center for International Studies.

Maturana, H. R., & Varela, F. J. (1987). *The Tree of Knowledge The Biological Roots of Human Undrstanding*. (Revised ed.). Boston: Shambhala.

Mogotlane, S. (2002). The American experience: With the culture in South Africa. *Journal of Multicultural Nursing & Health, 8*(Winter), 42-44.

Morris, K. (2001). Treating HIV in South Africa--a tale of two systems. *The Lancet, 357*(April 14th), 9263.

Stringer, E. T. (1996). *Action Research:A Handbook for Practitioners*. Thousand Oaks, Ca.: Sage Publications.

Susman, G. I., & Evered, R. D. (1978). An Assessment of the Scientific Merits of Action Research. *Administrative Science Quarterly, 23*, 582-603.

Appendix B

INTERNET AND TELEMEDICINE FOR DOCTORS IN RURAL AND URBAN INDIA

Sridhar CB and Deena Suresh

The Information Age has made profound changes in the society and is gradually penetrating into the healthcare segment. The Internet, the World Wide Web (www), and telemedicine are some of the significant areas where rapid transition is occurring. Millions of physicians, healthcare providers, and patients are accessing the web daily for patient information, consultation, and distance learning.[1]

Since India's independence from the British rule in 1947, the country has made significant progress in the field of health and its delivery to the masses. For example, Smallpox has been completely eradicated, the infant mortality rate has been brought down, life expectancy has gone up, pre and postnatal care facility has improved and there is overall progress in disease control and establishment of modern health infrastructure. There is extensive network of dispensaries, hospitals and institutions providing specialist curative care. There is a large number of well-qualified medical and paramedical staff available and a very significant indigenous capacity has been established for production of drugs, vaccines, hospital equipment, etc.[2] The private sectors have joined hands with the government in augmenting this health facility. High standard of healthcare comparable to that occurring in the developed countries are being offered to patients at affordable costs. Yet a lot remains to be done. There is scope for improvement in practically every area of health care. Each day, the numbers of online medicine-related documents grow, and many can be accessed via the Internet. This powerful free-flow of information holds the promise of improving the standard of healthcare in many ways. [5]

Information technology has played a vital role in hastening the spread of healthcare to urban and rural areas in India. The Internet originated in 1969 as a project by the defense [1]department to connect geographically dispersed US military computers and various government laboratories. The Internet was demilitarized in 1983, when the defense functions were transferred to another network. In 1995, large telecommunications companies formed the long-distance networks, which became the backbone of the Internet as it went global. [3] Internet – 'an interconnection of networks' has revolutionized the communications world like never before. The invention of the telegraph, telephone, radio, and computer set the stage for this unprecedented integration of capabilities. The internet has a world-wide broadcasting capability, a mechanism for information dissemination, and a medium for collaboration and interaction between individuals and

---

Dr. CB Sridhar, B.Sc., MBBS., MD. Professor, and Head Department of Medicine, Diabetes, Endocrinology. MVJ Medical College and Research Hospital. Channasandra, Whitefield, Bangalore, India sridharcb@vsnl.net

Deena Suresh, M.Sc. Manager – Medical Services, Recon Healthcare Ltd., 2/2, South Cross Road, Bangalore 560004, India. deena@zydusrecon.com

their computers without regard for geographic location. This represents one of the most successful examples of the benefits of sustained investment and commitment to research and development of information infrastructure [4] and its dissemination.
India has a total area of 3,287,590 sq km, of which land area is 2,973,190 sq km, and water comprises of 314,400 sq km. Climate varies from tropical monsoon in south to temperate in north.

- Population of 1,045,845,226 (July 2002 est.) [6]
- Birth rate - 23.79 births/1,000 population (2002 est.) [6]
- 8.62 deaths/1,000 population (2002 est.)
- Infant mortality rate of 61.47 deaths/1,000 live births (2002 est.) [6]
- The total life expectancy of total population: 63.23 years. Female: 63.93 years (2002 est.) male: 62.55 years [6]
- 71.6 % of the population are in rural residence [7]
- Population per physician is 1916 [8]
- Total Expenditure on Health (THE) as % of Gross Domestic Product (GDP) - India spends only 0.9 per cent of the GDP on the health sector [9]

Communication System in India [6]

Telephones - main lines in use: 27.7 million (October 2000)
Telephones - mobile cellular: 2.93 million (November 2000)

Local and long distance service provided throughout all regions of the country, with services primarily concentrated in the urban areas. Major objective is to continue to expand and modernize long-distance network to keep pace with rapidly growing number of local subscriber lines. Steady improvement is taking place with the recent admission of private and private-public investors, but, with telephone density at about two for each 100 persons and a waiting list of over 2 million, demand for main line telephone service will not be satisfied for a very long time.

Domestic: local service is provided by microwave radio relay and coaxial cable, with open wire and obsolete electromechanical and manual switchboard systems still in use in rural areas. Starting in the 1980s, a substantial amount of digital switchgear has been introduced for local and long-distance service; long-distance traffic is carried mostly by coaxial cable and low-capacity microwave radio relay. Since 1985 significant trunk capacity has been added in the form of fiber-optic cable and a domestic satellite system with 254 earth stations.

International: Satellite earth stations - 8 Intelsat (Indian Ocean) and 1 Inmarsat (Indian Ocean region); nine gateway exchanges operating from Mumbai (Bombay), New Delhi, Kolkata (Calcutta), Chennai (Madras), Jalandhar, Kanpur, Gaidhinagar, Hyderabad, and Ernakulam; 4 submarine cables - LOCOM linking Chennai (Madras) to Penang; Indo-UAE-Gulf cable linking Mumbai (Bombay) to Al Fujayrah, UAE; India-SEA-ME-WE-3,

SEA-ME-WE-2 with landing sites at Cochin and Mumbai (Bombay); Fiber-Optic Link Around the Globe (FLAG) with landing site at Mumbai (Bombay) (2000)

Internet is proving to be a very popular networking technology universally. The phenomenal advances in communications and information technology in India are resulting in a new look at how secondary and tertiary health care can be provided to the underprivileged masses. Following a proof of concept validation ISRO (Indian Space Research Organization) in conjunction with the Apollo Hospitals is ready to use satellite technology to provide specialist care not only to suburban and rural India but to other countries as well, by using the large number of highly qualified and trained specialists in urban India. [10]

With an aim to spreading medical information to a large number of doctors in urban and rural India, we at Recon Healthcare Ltd, Bangalore, India, initiated a system of sending the required information quickly and in a cost effective manner. A model has been established towards for the process of information dissemination. Two projects were taken and successfully completed. The following are the two projects that have been carried out –

PROJECT 1

Internet As A Tool To Procure And Spread Medical Information To Doctors In India

Data procured in the year 2002 reported that there are 7 million Internet users in India.[6] In this paper; the percentage of requests by doctors for medical information from the Internet has been compiled for the period July 01, 1998 to July 09, 2002. The doctors consisted of physicians, surgeons, medical students, and postgraduate trainees. Invariably, the information has been used by doctors to update medical care, emergency care, thesis / dissertation, publication of case reports, articles, and presentation of data.

From the data on file regarding medical queries from doctors we separated, medical information Internet requests from medical information non-internet requests.

Medical information from Internet was pertaining to diagnostic techniques, conference details, withdrawal of molecules, surgical techniques, guidelines for treatment, abstracts of clinical studies comprising of efficacy, safety, and tolerability, case reports and update on emergency care.

Exclusion criteria in this population were medical information not procured from Internet and inclusion criteria were medical information procured from the Internet. Two hundred seventy eight such requests were received. This data was compared with information sought from non-internet requests as procured from standard journals, textbooks, and from our literature on file.

Results and Discussion

Statistical analysis

Bar diagrams: Annual increase in number of Internet requests, Internet request from India, Internet request from South, West, East and North India, Internet vs non- internet requests. Pie Chart: The percentage distribution of Internet requests split into 4 regions in India is brought out. The statistical analysis was done using the Student's 't'-test.

Results

There is an annual increase in number of requests (Fig. 1).

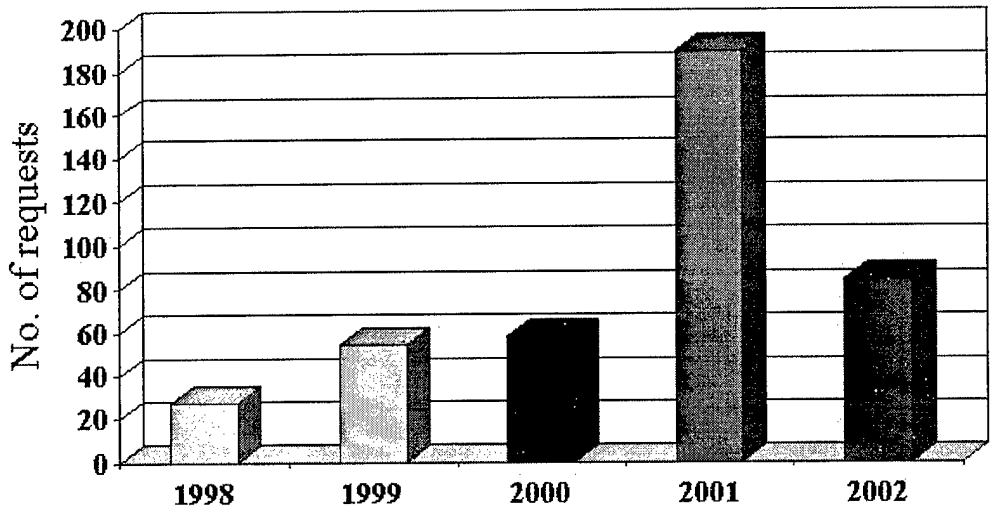


Fig 1 Annual increase in the number of requests

The number of requests was segregated based on the four zones – east, west, north and south. The percentage request is depicted below –

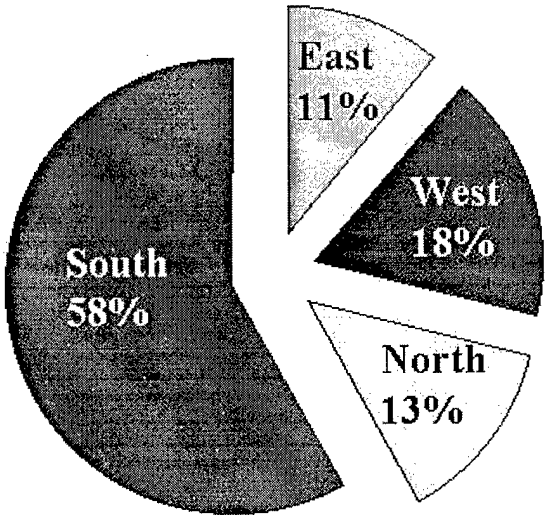


Fig 2 Percentage distribution of internet requests

Amongst the numbers of requests in the various cities- the following results appeared. We observed that the maximum requests were from metropolitan cities - Bangalore (131) followed by Mumbai (23) Kolkata (14) and Delhi (25).

An increasing trend in Internet requests was observed in this study. From the data on file, we compared the Internet requests with the non-internet and found that over a period of 4 years, there was an increasing trend in 2001.

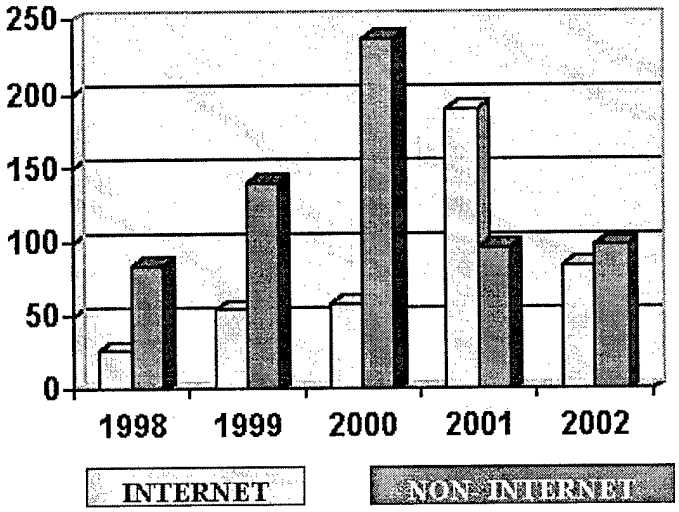


Fig 3 Internet Vs Non-internet requests

While comparing non-internet requests with Internet requests through the years 1998, 1999, 2000, 2001, 2002, one is observing a very interesting trend. During the first 3 years non-internet requests were distinctly more than Internet requests and this was statistically significant for the year 1999 (p 0.05) and 2000 (p 0.005). From January 2001, the medical department sent regular e-mails to doctors informing of the Internet facility being made available free of cost. It is clear that the above approach of doctors being contacted has paid its dividend in the form of more Internet requests coming up in the year 2001 and 2002. Added to this, continuing medical education programmes were conducted and at these programmes the medical information services offered by us was informed to the doctors. Consequent to this, we saw a rise in the number of requests.

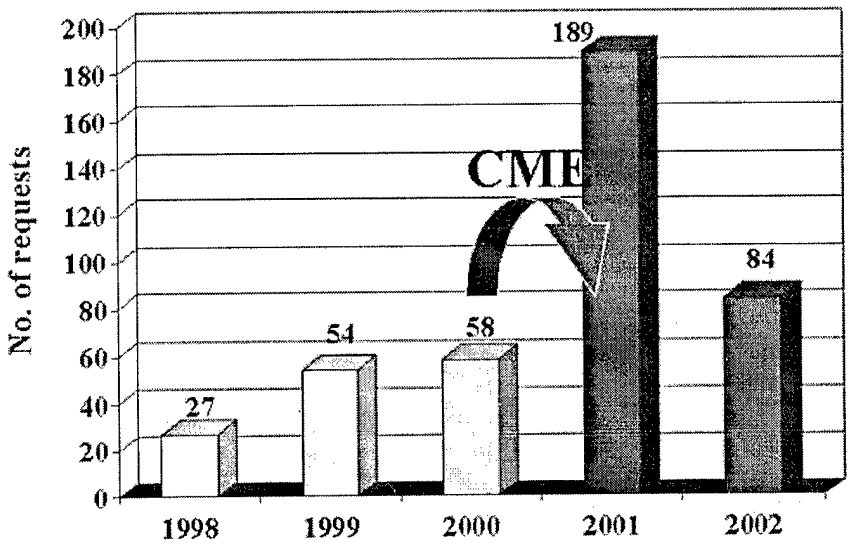


Fig 4 Increase in internet requests following CME

It has been our interest to assess the impact of continuing medical education in rural cities. For purposes of definition of rural, in this study we have defined rural, as that area where a large percentage of people are dependent upon agriculture for income and livelihood. We are aware; in today's world of globalization this might not be an appropriate criteria. For want of a better definition, we have taken this for our presentation.

Among the rural Indian cities, it was observed that Tumkur in Karnataka tops the list with 34 requests. This is a very encouraging trend and sure to add on to the knowledge of such doctors in the field of medicine where the developments are occurring in an explosive way.

In a paper published by Thakkar[11], an interview on Internet usage among Mumbai training hospitals revealed that amongst 182 medical students interviewed, approximately 40% surfed the Internet. Of those using the Internet, only 15% surfed for medical information. Of the 180 medical interns interviewed, at least 65% surfed the Internet. Of these, less than 25% used the Internet for medical information. Of the 106 resident doctors interviewed, almost 50% surfed the Internet. Of the 56 lecturers, only about 25% used the Internet to search for medical information. Of the 28 professionals, only about 25% found time to access the Internet on a fortnightly irregular basis. The above paper focuses on the access to Internet knowledge by the students, interns, resident doctors, and lecturers in teaching hospitals in Mumbai and the inadequate usage of the same for furthering their knowledge.

Our communication in sharp contrast is focusing on the practicing doctors in urban and rural India. More than 90% of our requests are from practicing doctors. In the Thakkar study, the group had to access information themselves. However, in our study we received requests to access information for doctors. This difference can be explained by the fact that in the Thakkar study, residents reported few good facilities for accessing the Internet on campus, on call almost every other day, and had very little time to do more

than check e-mails. No wonder a busy practicing doctor in urban and rural area would find impossible to spare his valuable time to browse the Internet for medical information. It is in this context that our communication assumes tremendous importance. We have shown that it is possible for us to directly communicate with the doctors at their doorsteps - such of those who have an Internet facility in their chamber or cyber café near their area of practice. [25, 26]

With the increasing availability of Internet facility and usage, one is confident that the medical knowledge of doctors at all levels can be enhanced very quickly. Necessarily, such a rapid transmission of knowledge especially to doctors in rural areas will be of great benefit towards patient care. Industry by directly communicating with the doctor as a part of their service and commitment to patient care can make a very significant contribution in building up their knowledge base and apply the same to patient care.

PROJECT 2

Recon Healthcare Bangalore Model in spreading information from World Health Organization Reproductive Healthcare Library to Doctors in India

The WHO-RHL is one of the major sources of information pertaining to reproductive health care knowledge. It is the product of interaction between the WHO-RHL, research centers in developing countries and the Cochrane Collaboration. It is the first specialist database project for the Cochrane Collaboration, as well as for the WHO and has followed evidence-based medicine. The information is stored in the electronic form-diskettes and CD –ROM; and updated annually and is available free of cost to developing countries. [12]

The WHO RHL contains systematic reviews of controlled trials on priority reproductive health topics, expert commentaries on the relevance of the findings for developing countries, and practical advice on the management of reproductive health problems. The systematic reviews come from The Cochrane Library. The commentaries and practical advice are prepared by researchers from developing countries or by persons with extensive knowledge of the conditions and practice in those countries.

As this is in an electronic medium, one has to evolve methodologies by which this vast content of knowledge could be spread to doctors working in various parts of India – both rural and urban.[13] Those doctors in rural India and many parts of urban India do not have an easy access to this information. Therefore, it has become essential to come out with an effective system by which this could be done. Akademeia usually have enormous knowledge base without much of facility to disseminate this rapidly. Industry, on the other hand has facilities to communicate rapidly with doctors through their marketing executives, and e-mail. The combination of these two organizations becomes an effective method to spread knowledge rapidly to doctors whenever needed. When done this turns out to be a good example of Akademeia-Industry Interaction (AII). Akademeia such as

the WHO providing the knowledge base, and industry offering support for its dissemination. To the best of our knowledge, such an exercise of AII to spread medical knowledge in developing countries or developed countries has not been published.

Evidence based healthcare involves deriving questions from clinical problems searching systematically and thoroughly for best relevant evidence, critically appraising the evidence, and applying new knowledge in the clinical context. Although, most clinicians support the notion of evidence based healthcare in principle and wish to use this information generated by others, only a tiny fraction seek to acquire all the requisite skills themselves. A study in British General Practice found that the commonest reason sited for not practicing evidence-based healthcare was lack of time followed by personal and organizational inertia.[14]

Materials And Method

At Recon Healthcare, Bangalore the medical department has taken the initiative to spread the information in the WHO-RHL to doctors particularly gynaecologists and obstetricians. This was done jointly with the marketing executives. Three topics were chosen from eighteen topics after a consensus amongst the non-medical executives of the organisation.

- Routine antenatal care for low-risk pregnancy
- Routine iron and folate supplementation in pregnancy
- Episiotomy policies in vaginal birth

The titles were printed on a sheet and sent to 313 Business Officers of Recon Healthcare working all over India, with instruction to handover the format to gynaecologists and obstetricians in their area. Each Business Officer received ten such formats. The doctors were requested to put down their preferences and handover to the officer who would mail it to the Bangalore office. Through this, we expected response from 3130 gynaecologists and obstetricians would emerge.[26]

This study was initiated in the month of September 01, 2001 and as of March 31, 2002, 1346 doctors have responded and the faculty in medical department has received these forms. This is analyzed and presented in the communication.

Results

Following is the response to the requests

Doctors choice of single topic	
Routine antenatal care for low-risk pregnancy	32%
Routine iron and folate supplementation in	14.48%

pregnancy	
Episiotomy policies in vaginal birth	25.78%

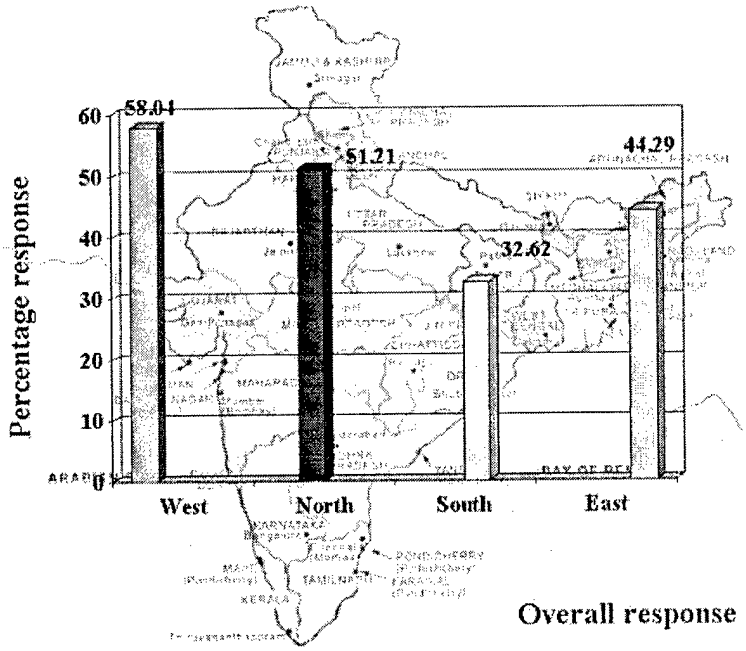
Doctors choice of two topics	
Routine antenatal care for low-risk pregnancy Routine iron and folate supplementation in pregnancy	4.82%
Routine iron and folate supplementation in pregnancy Episiotomy policies in vaginal birth	2.3%
Routine antenatal care for low-risk pregnancy Episiotomy policies in vaginal birth	6.5%

Doctors choice of three topics	
Routine antenatal care for low-risk pregnancy Routine iron and folate supplementation in pregnancy Episiotomy policies in vaginal birth	14%

The overall response in the four regions was as follows: West 58.04%, North 51.21%, South 32.62% and East 44.29%.

Response

Received	Expected	Percent
1346	3130	43



To get a feedback on the WHO-RHL information given to doctors the following questions were sent to the doctors.[15]

	Yes	No
Did you receive the WHO-RHL Updates?	94%	6%
Was the write up useful?	88.87%	7.13%
Did this help you in improving patient care?	83.73%	10.7%
Was the information applied in your practice?	78.48%	13.4%
Would you like to share this knowledge with your other doctor colleagues?	58.32%	34.6%

DISCUSSION

This model worked out to be cost effective. The existing infrastructure being utilised for routine office work, was made use of for the model. The postal charges amounted to Rs. 32,520/=, stationery including cartridge and paper amounted to Rs. 29,500/=. Hence, the total amounts to Rs. 62,020/=. The expenditure incurred for disseminating medical information works out to Rs. 46 per doctor. So, this model is a cost effective one.

Postal & stationery	
Postal	Rs. 32,520
Stationery (cartridge & paper)	Rs. 29,500

Total	Rs. 62,020
In dollars In Rupees	$ ~1240 Rs. 46 per doctor

We have established a clear methodology by which knowledge could be disseminated, making use of the already existing facilities such as Microsoft Windows 98, CD ROM drive, and a printer. Thus, no additional expensive inputs have been brought into this. As we have established this as a model, we propose naming this Recon Healthcare Bangalore Model (RHBM) for disseminating medical knowledge to doctors in India.[24]

Following are the high points of RHBM:

- Making use of the available facility in the Corporate, which is used for other official work of the organisation.
- Interaction with doctors, which is an already existing exercise.
- To this has been added dissemination of WHO-RHL information.
- 1346 doctors have been serviced within a short period of 7 months at a cost of Rs. 46 per doctor.

It is not possible for us to compare this with any other data, as it is not yet available anywhere in developing countries. We are not aware of such data from a developed country either.

Conclusion

WHO-RHL information has been communicated to doctors across India. This is one of the primary objectives of WHO. Without any additional inputs, and with the methodology put down in the RHBM, it should be possible for the Akademeia -Industry to interact and spread the knowledge of WHO-RHL to a very large number of doctors in India within the shortest possible time. Our model has demonstrated that this is possible. Thus, making use of the already existing information technology in our country, we should be able to improve the standards of healthcare all over India. Similar models could be evolved to spread the health knowledge in other developing countries in all spheres of health knowledge.[13]

TELEMEDICINE IN INDIA'S HEALTHCARE

Alexander Graham Bell's notebook entry of March 10, 1876, describes the first successful experiment with the telephone, during which he spoke through the instrument to his assistant, Thomas A. Watson, in the next room. Bell writes, "I then shouted into M [the mouthpiece] the following sentence: 'Mr. Watson--come here--I want to see you.' To my delight he came and declared that he had heard and understood what I said." [16] From then on telecommunication has made rapid strides – starting from making a call to our neighbors to communicating to astronauts in space.

The term "telemedicine" is derived from the Greek '*telly*' meaning '*at a distance*' and from the Latin '*mederi*' meaning '*healing*'. Telemedicine enables people in one geographical area to have access to a trained medical specialist in another geographical location. Understood in this mode telemedicine can be of a very simple nature or can assume a very complex form depending upon the purposes and the types of technologies used.[2]

Telemedicine understood in this simple form is really nothing new. Medical advice through correspondence, letter, etc. has been in practice for several years. It is a routine system to communicate with letters to referring doctors. These letters used to be thorough, extensive and very informative pertaining to the care of patients referred. The doctors were encouraged to follow the guidelines given in the letter and keep in contact with the doctors as and when needed. In fact, this system of communication got so well established that it was expected of all consultants to follow this procedure. Failing to do so, called for punitive measures from the hospital board.[17] The busy resident doctors in the hospital are encouraged to discuss patient problems on phone with senior consultants

and put this in writing with the date, and time on the case file. Thus it is possible to offer high quality service to patients on a regular basis.

Doctors providing tips on diagnosis or treatment of ailments through newspaper columns or through radio and TV broadcasts also hardly need a reminder because they are so widespread. Telemedicine through correspondence involved considerable time lapse between the patient's query and the advice of the doctor, but protected the privacy of the patient. Telemedical advice through the print media made it more widespread, but ceased to be one to one. The response to the queries through radio and TV broadcasts accelerated the spread of information and like the newspapers had the advantage of being both specific to the query as well as it being shared by other members of the audience.

Telemedicine is a system of health care delivery in which the physicians examine distant patients through the use of telecommunication technology. This communication bridge can take several different forms. It can be live or it can be offline. It can be delivered via a two way interactive audio and video mode or two-way time delayed, stored and forward multi-media electronic mail. Basically it means that the patients' data ranging from description of the symptoms in a text form or medical data in the form of simple X-rays and electroencephalograms to more advanced angiograms, magnetic resonance images, and histopathology slides can be transmitted from a distant location to the medical specialist located practically anywhere in the world. The specialist studies all these medical data and conveys his diagnosis and the treatment to the patient through the doctor at the patient-end.

Telemedicine is used for a variety of purposes. Some of the more common purposes include: (1) Remote consultation; (2) Second opinion; (3) Interpretation services; (4) Continuing education and exchange of clinical information; (5) Home care and (6) Online surgery in some very rare cases. Of all these, the first three are the more common uses of telemedicine the world over. Telemedicine is open to a variety of medical specialties such as cardiology, pathology, neurology, psychiatry, dermatology, ophthalmology, oncology, and practically every other branch. [2]

What cultures - national, professional, or organizational, are receptive or resistant to telemedicine?

Telemedicine to be really useful in India would mean to reach the rural areas rather than merely enhancing the facilities of those who already have better means of obtaining medical services. If telemedicine is merely going to serve the needs of a few rich patients in cities like New Delhi and Mumbai, it will have little relevance. This is not to say that these segments should not have these facilities, but only to underline that they already have such facilities available and they could afford to have telemedicine not only within the country, but also even with the best of super specialists in any other part of the world. Certain amount of infrastructure/facilities is pre-requisites of telemedicine programme.

These include: minimal availability of

- Medical/para-medical staff
- Electricity
- Communication lines like telephone
- Clinical investigation facilities

Looking at the Indian conditions, if you look for a place with this minimal infrastructure, one also sees that there are doctors available. In other places you have neither doctor nor the infrastructure and facilities. This creates a peculiar condition. Efforts have to be made to overcome this contrasting situation.

Some hospitals, either government, private or charitable trust owned, is available in any district town. A reasonable number of medical staff and associated medical facilities are also available in these towns. So telemedicine facilities (patient end) will have to be created in such district towns. Patients from the nearby villages visit these hospitals and may have to come for telemedical purposes also. These patients end can be linked to super specialist end in any other part of the country/world (where the best of doctors would be available) and interaction can be established between these two ends. Telemedicine can be expensive in the initial stages, but over a period of time as the technologies develop, the human power gets used to using these facilities, the cost will gradually decrease.
For the telemedicine programme to be effective and successful in India, the following criteria will have to be met:

- It should benefit the masses
- Medical data transfer be error-free and reliable
- Medial technology should be user-friendly
- There should be a complete system — properly equipped patient-end, super specialists, links, etc.
- There should be proper storage and retrieval system for the medical data
- The medico-legal rules
- Its economic sustainability should be looked into from the beginning
- Maintenance aspects are important but often neglected at the planning stage. This can lead early death of the project after birth
- It should be able to meet the felt and observed needs of the community [2]

In a study it was found that an e-mail link with the facility to send high-resolution digital images is a cheap and uncomplicated telemedicine method. The Swinfen Charitable Trust helped establish such a link in Patan Hospital Kathmandu, Nepal in March 2000. Over 12 months using these links, 42 telemedicine referrals were sent to specialists throughout the world. Referrals were: 36% respiratory medicine; 21% neurology, 21% dermatology; 14% cardiology; 5% nephrology; and 3% radiology--28 had digital pictures attached, of which 96% were of high enough quality on which specialists were able to comment. Thirty-nine replies were received. The average time for a specialist reply was 2 days, and 45% were answered within 24 hours. All replies were judged by independent assessors to be helpful or very helpful for diagnosis, management, and education. The assessors decided that in 50% of cases the advice if acted upon would have shortened hospital stay. This pilot study has shown that a low-cost telemedicine link is technically feasible and

can be of significant benefit for diagnosis, management, and education in a developing world setting. [18]

What interventions are appropriate to change the cultures for a successful program?

Web based Telemedicine solutions are gaining popularity owing to internet's low cost and almost universal availability [19]. Internet is proving to be a very popular networking technology universally.

Some of the bottlenecks with regard to the growth of Telemedicine in India are:
1. Lack of health infrastructure and services.
2. Shortage of computer savvy healthcare personnel.
3. There are about 60,000 and 35,000 Indian doctors in United States of America and United Kingdom respectively.
4. Lack of training facilities with regard to the application of information and communication technology in medicine. Terms like Hospital information System (HIS), Radiology Information System (RIS) and PACS (Picture Archiving and Communication System etc are unheard of by the medical/healthcare community.
5. Virtually no exposure to the applications of information and communication technology (ICT) in curriculum of medical colleges.
6. Poor quality of communication services in most of the cities.

While telemedicine in India is still in its embryonic stage, the government has taken a series of steps to make sure that it turns out to be one of the biggest success stories. For instance, recently, the department of information technology framed guidelines for telemedicine in India. These guidelines also take care of legal issues that can arise from using this technology.

The framing of the guidelines has given a boost to an industry, which is seen by many as the only practical solution to India's healthcare problems. Says Sood, "India's healthcare industry is worth over $16 billion, and is expected to grow by 13-15 percent annually. The telemedicine guidelines will encourage the application of the system, and infuse confidence in users and beneficiaries." Additionally, the launch of an exclusive satellite by ISRO to service healthcare needs is revolutionary—the satellite can address the issues of connectivity for remote villages in India.

Dr Saroj Mishra who has been involved in telemedicine R&D since 1999, said "ISRO's announcement will provide a major boost to the growth of the telemedicine industry in India. If connectivity access is provided it can create a national health information highway that will provide state governments with access to high bandwidth communications." [20]

Success stories in Telemedicine

Gujarat: The Online Telemedicine Research Institute (OTRI) provided telemedicine links for teleconsultation, thereby establishing 750 sessions in a period of 30 days in Bhuj after the earthquake in January, 2001.
Uttar Pradesh: During the Kumbh Mela festival held every 12 years, which drew over 25 million pilgrims to the banks of river Ganga, the OTRI transferred data (cardiology and radiology data) of over 200 ailing pilgrims, besides sending microscope images of microorganisms to monitor levels of cholera-causing bacteria in the river.
Bangalore: Asia Heart Foundation has successfully been practicing Telecardiology between Bangalore and cities in eastern India. Paramedics are guided to save the patients suffering from Acute Myocardial Infarction by performing life-saving procedures as per directions from doctors over video conferencing.
Chennai: Apollo is providing expert opinion from its tertiary level hospitals in bigger cities to those in the far-flung towns of India. In the period of around 27 months at Apollo over 4,000 patients had been benefited through teleconsultations and over 75 percent of those teleconsulted were treated in their respective cities.[20]

Are there core values that make the adoption of telemedicine successful?

The drivers for adoption of telemedicine could vary from country to country based on various factors. Some of the factors that would expedite the telemedicine revolution in India are:

Topography: Think of a patient in Tinsukiya, Assam or Aragonda, Andhra Pradesh who requires a consultation with a specialist at Bangalore or Mumbai. The cost of travel and the travel it self could be a deterrent to the poor patient in these rural settings. Even if a specialist were available at the nearest town, reaching the interiors of such a far-flung village would be a challenge. This is where telemedicine could be utilized as an effective medium for healthcare delivery. India with a diverse collection of landscapes with mountains and valleys and high altitudes, telemedicine could well be a boon for the patients.

Travel time/ cost: There is a shortage of specialist/ super-specialist professionals in India, especially in rural areas. It might not be good time management on the part of the specialist to travel all the way to the rural areas without having enough patients to be attended to there. Travel time can be cut down dramatically while the expertise is made available in real time via technology. The specialist's physical presence becomes necessary only when a surgical procedure is planned. In reality even surgical procedures are being conducted with guidance from the specialist who is at a remote location. For a patient cost of travel is a major worry especially if she has to fly in to a specialist care center in a city.

Pressure to reduce costs: Cost of healthcare and questions on who will bear the burden of care are issues across the world, developed countries included. The incidental expenses related to patient care, i.e. the cost associated with factors other than the actual medial

care such as travel, accommodation for relatives, food etc also contribute substantially to the cost of treatment. In a country where health insurance is yet to catch up, cost of acre is borne by patients, in many cases by selling property and livestock. If hospitals can reduce these costs associated with treatment it would go a long way in reducing the burden of care on the patient. Telemedicine seems to be the answer. [21]

Given the scarcity of medical facilities in rural areas, efforts will have to be made to take this technology to rural areas. There will have to be a planned intervention programme dedicated to this end. Development and Educational Communication Unit (DECU) of Indian Space Research Organisation (ISRO) is now trying to set up a need based telemedicine project in different parts of the country. ISRO has recently initiated a GRAMSAT ('satellite for villages') programme. It is aimed at reaching out to the villages for development and educational purposes. A variety of satellite-based technologies/applications will be used for this purpose. [2]

In a study done during an 18-month study period, teleconsultations were conducted by email between a neonatal intensive care unit at an urban teaching hospital in western India and a rural primary care centre 40 km away. There were email consultations about 182 newborn babies; these consultations comprised 309 messages sent from the primary care centre and 272 messages from the teaching hospital. The average reply time was 11.3 h. Thirty-eight babies were referred to the intensive care unit at the teaching hospital after these consultations. The remaining 144 babies were managed at the primary care centre. Telemedicine helped in the diagnosis, referral, treatment, and follow-up of patients. The cost of the email service was estimated to be Rs 12,000 and the savings in avoided transfer were estimated to be Rs 546,000, a cost-benefit ratio of 1:45. [22]

CONCLUSION

This chapter highlights our attempt to improve spread of health information in the area of healthcare in rural and urban India. Our country with its diverse culture, large population, definitely has to increasingly look into such technologies to acquire and spread knowledge in health field very rapidly. Adequate infrastructure facilities are available in our country. It is a question of channelling this in a proper direction by establishing methods to disseminate health knowledge into rural and urban India. One has to establish models to do this. We have worked towards establishing a model called Recon Healthcare Bangalore Model. Without incurring additional expenditure the existing infrastructure was effectively harnessed and a good model established. Developing countries must get interested in establishing such models. If done the world will definitely move one step forward in ultimately improving the healthcare facilities very rapidly.

Time alone will tell whether Telemedicine is a "forward step in a backward direction" or to paraphrase Neil Armstrong "one small step for IT but one giant leap for Healthcare". [23]

REFERENCES

1. Angood PB. Telemedicine, the Internet, and World Wide Web: Overview, Current Status, and Relevance to Surgeons. *World J Surg*. 2001;25:1449-1457
2. Subhash Joshi. Telemedicine: What, Why And For Whom http://www.orbicom.uqam.ca /in_focus/columns/en /archives/2001_juil.html. Accessed April 10, 2003
3. Glowniak JV. Medical Resources on the Internet. Ann Intern Med 1995; 123:123-131.
4. Leiner BM, Cerf VG, Clark DD, et al. A Brief history of the Internet. http://www.isoc.org/internet-history/brief.html Accessed August 04, 2001
5. Akatsn H and Kuffner J. Medicine and the Internet. West J Med 1998; 169:311-317.
6. The World Factbook 2002, CIA Publication. http://www.cia.gov/cia/publications/factbook/geos/in.html. Accessed April 15, 2003.
7. Asia And The Pacific In Figures 2001, Statistics Division, United Nations Economic, and Social Commission for Asia and the Pacific (ESCAP). http://www.unescap.org/stat/statdata/apinfig.htm Accessed April 15, 2003
8. Population and Vital Statistics. http://w3.whosea.org/eip/annex1ind.htm. Accessed April 14, 2003.
9. Indian Council of Medical Research (ICMR) Bulletin. Tuberculosis and Poverty. March 2002; 32 (3). http://icmr.nic.in/bumarch02.pdf Accessed April 14, 2003.
10. Ganapathy K. Telemedicine and Neurosciences in Developing Countries. *Surg Neurol*. 2002; 58:388-394
11. Thakker N. Internet Usage in India. The CyberMed Catalyst. http://www.amip.org/catalyst/cc_thakker2_html Accessed August 04, 2001
12. The Cochrane Collaboration http://www.update-software.com/RHL. Accessed on September 26, 2002

13. Deena Suresh, Sridhar CB. Presented at SSGRR 2002s International Conference on Advances in Infrastructure for e-business, e-education, e-science, e-medicine on the Internet. L'Aquila, Italy; July 2002.
14. Greenhalgh G, et al. A comparative case study of two models of a clinical Informaticist service. British Medical Journal 2002; 324:524-9
15. Dr. Vishwanath Anantraman, Harvard University. Personal communication, 2002
16. American Treasures of the Library of Congress. http://www.loc.gov/exhibits/treasures/trr002.html Accessed April 12, 2003
17. CB sridhar, Personal Communication, 2002
18. Graham LE, Zimmerman M, Vassallo DJ, et al. Telemedicine -- the Way Ahead for Medicine in the Developing World. T*rop Doct*. 2003;33:36-38
19. Sanjay P. Sood & J.S. Bhatia, Internet as the backbone for Telemedicine: How far/close are we? Presented at All India Seminar, Challenges ahead with Information Technology, organized by IE & SLIET, Longowal, 19 - 20 January, 2002.
20. Srikanth R P. Telemedicine: Emergence of the virtual doctor. http://www.express-computer.com/ 20030310/ focus1.shtml Accessed April 10, 2003
21. Saji Salam. Telemedicine: Hype Vs reality. http://www.expresshealthcaremgmt.com/20020630/medtech1.shtml *Accessed April 10, 2003*
22. Deodhar J. J. Telemedicine By Email - Experience in Neonatal Care at a Primary Care Facility in Rural India. Telemed Telecare. 2002; 8 (suppl. 2): 20-21
23. Dr K. Ganapathy. No limits to healing. http://www.hinduonnet.com/thehindu/mag/2002/01/06/stories/200201060053070.htm Accessed April 14, 2003
24. C B Sridhar, and Deena Suresh. Model for Bangalore helped disseminate information to doctors in India. In Letters, BMJ 2003; 326:337.
25. C B Sridhar, D Suresh, RN Gowda. Internet: A Powerful Tool In Disseminating Medical Knowledge In Urban And Rural India. Karnataka Journal of Medical Sciences. 2001; 4(4): 9- 13
26. C B Sridhar, and Deena Suresh. Presented at the XVIII Asian and Oceanic Congress of Obstetrics and Gynaecology. September 5 to 10, 2002. Bangalore, India.

Appendix C

Structures Surrounding Electronic Health Systems: Effects of Legal and Administrative Structures on Development of IT in Health Care Services – focus on Finland.

Ville Harkke M.Sc
TUCS / IAMSR
Åbo Akademi University
ville.harkke@abo.fi

Mikael Collan M.Sc
TUCS/IAMSR
Åbo Akademi University
mikael.collan@abo.fi

The authors work as researchers in the Institute for Advanced Management Systems Research In the Åbo Akademi University in Turku, Finland and in the Turku Center of Computer Science.

Introduction

During the latter half of the 20th and the beginning of the the 21st centuries developments in information technology (IT) and automating work have changed the work processes in most information-heavy fields of human activity, resulting in huge gains in productivity and reducing the effects of human error. This has generally not been the case for the health care sector, except for automating some financial and administrative tasks. The level of technologies for reorganizing work even in this sector have existed for some time, but wide adoption of these technologies has been slower than one would expect. As the world economic growth has slowed down after the 90's, health care systems in most of the industrialized world are facing increased pressure towards enhanced efficiency due to diminishing public financing and aging population [1]. The need for increased use of new technology and new work methods is clearer than ever.

Introduction of new technology does, of course, not solve the problems of the field as such, proper implementation and wide enough use of the systems are an important requirements.

The use of semi-automated processes and partially implemented systems can even have adverse effects on efficiency and quality of care, as suggested by Lederman and Morrison[2].

There is an observable difference in IT usage between public and private health care institutions, at leas in Finland. The private clinics have a direct financial incentive to cut costs and to maximize the

satisfaction of their customers, whereas the public institutions are constantly struggling with financing problems and understaffing and generally lack the ability to invest in the newest technology. The health service providers are, however, not the only players in the field of healthcare. Insurers, pharmacies, laboratories and regulating bodies all have their stake in the structure of health care systems.

The critical changes of the processes and implementation of better systems will not be even possible until the information systems in different organizations are able to function together and the critical information flows between the organizations are automated.

This article is composed as follows: firstly, we describe the organizational framework in Finland within which the mobile and e-health services (also referred to as e-health) exist, and look at administrative issues within the framework that are not supportive of advancement in the sector. Secondly, we will elaborate some issues particular to e-health from a legal perspective, and thirdly, we will address the discussed issues from the point of view of some of the actors in the sector. We base the third part on a small (non-representative) survey sent to actors in the field of health services in South Western Finland. Finally we draw some conclusions and summarize.

Organizational environment in Finland

In Finland health care is basically organized around publicly financed organizations and supported by private institutions in larger cities. The universal health insurance provided by the Social Insurance Institute of Finland (SIIF) covers use of the public health care services fully and a percentage of the privately produced services [3], for example 60% of private doctor's fees [4] The primary unit of control, the municipality, has since the 1990's the right to choose how the services demanded by law are produced, including buying the services from a private service provider [5].

The private service providers act as a catalyst for restructuring even the public systems by showing in practice that the same services can be produced with a smaller use of resources.

Despite the existence of an universal health insurance the citizens tend to be insured even in private insurance companies, either themselves through home insurance healthcare packages (covering mainly accidents etc.) or by their employers. This complicates the administrative processes in cases of work-related illnesses, acute injuries and other situations where a patient is insured by several organizations.

Due to the independence of the municipalities the health systems in different parts of the country are very different from each other , all naturally providing the level of service required by law. In most districts there are organizations for everyday illnesses, for special care, in-patient wards etc. that have all been founded in different times and there is no generally applied organizational structure even within the municipalities or health districts. The existence of different organizational cultures within the bigger health care structures cause some administrative problems of their own, but even make development of information systems difficult due to differences in work processes and information requirements.

Information systems compatibility is a major issue in developing functional health care systems [6] In Finland the fragmentation of information systems has been a major obstacle on the road towards systems that would significally alter the processes of the health care system, increasing efficiency and effectivity. This situation has been noted by the governing authorities, and the Ministry of Social Affairs and Health has started a project for preparing a nation-wide electronic health record system. The project is organized as a work group and the main objective is to define the contents and criteria for a national electronic health record system and to maintain a cooperation network for implementing the system. By Dec 31. 2003 the work group is to present a strategy for advancing implementation of functionally and contentually compatible information systems in cooperation with the municipalities union, health districts and municipalities. [7]This is a step towards the right direction but as one of the governing bodies, the SIIF is not included into the planning process there is a risk of developing another short-sighted solution.

Some examples of IT use in the Finnish Health Care System

Electronic descriptions

Delivering drug descriptions electronically has been possible in principle since the 1995 Ministry of Social Affairs and Health regulation of delivering prescription drugs. The regulation allowed electronic data transfers on a general level with no specific guidelines as how the system should work.

There has been two major publicly financed pilot projects around electronic prescriptions in Finland: the SIIF smart card project in 1989-1993 and the health care cooperation project in Satakunta region 1998-2000 called Satakunnan Makropilotti. The smart card project used personal health cards as data storage for prescriptions. It was a limited success, but the system was never intended to be the default system for the whole country. [8] The Makropilotti project had as main

goals to develop information technology (local information system, reference database, secure email and local service portal) to support service development in health and social services. A special law was enacted to enable patient data transfer between the different organizations within the seven municipalities partaking in the pilot. The electronic prescription service never got to wider pilot use and the project was terminated 2000. The project cannot be described as a success as such but it unveiled a number of obstacles in the way of developing health systems: there is no clear structure for service development, unclear limits of responsibilities and no authority governing the whole customer service process. The processes and visioned improvements should be documented with more detail. [9]

One of the central obstacles in developing electronic prescriptions has been the absence of clear norms and standards about among other things electronic signatures which would verify the identity of the describing doctor.[8] The law governing electronic signatures was passed in the parliament 24. Jan 2003, defining the acceptable forms of verification for electronic interaction with public servants and government organizations.[10] This alone will not remove all the problems but now there is at least basic jurisdiction on which the future guidelines can be built.

Telemedicine

There are a number of telemedicine applications in use in Finland, especially in northern parts. Finnish Office for Health Care Technology Assessment (FinOHTA) together with Northern Ostrobothnia Hospital District organized a project to assess the effectiveness and cost-effectiveness of telemedicine, focusing on applications in radiology, psychiatry, surgery and ophthalmology. The results show that in some special focus areas the processes can be handled remotely, and the patients are content with the service they get. The main advantages lie in reduced travelling of the personnel, making telemedicine applications financially viable only over considerable distances as

in northern Finland. [11] The telemedicine applications have to struggle with the same legal and organizational problems as the rest of the health care informatics: the electronic connection is understood as an extension of the presence of the doctor/patient and the transfers of medical data between organizations is still subject to several data secrecy laws and regulations.

Electronic patient records and image processing

There are several different electronic patient record systems in use, as well as different image processing systems. One of the main tasks of the work group mentioned above is to create guidelines for nation-wide compatibility. Most of the electronic imaging systems in use in Finland are compliant with the DICOM (Digital Imaging and Communications in Medicine) standard, and the EHR (ectronic health records) systems built today are following the HL7(health level 7) structures. There are functioning region-wide radiology information systems (RISs) in the Turku and Helsinki regions, enabling remote consultations and digital archiving of the images, and similar systems are under development in other regions.[12] These systems will probably not function exactly alike as the regulation governing them is very vague, and the systems are naturally developed by competing systems development companies, each trying to add features their competitors did not include. The basic structures should follow the international guidelines so a general mishmash like the one created in the hospitals of Finland in the seventies by a large number of in-house development projects should be avoided.

Legal issues effecting E-health implementation

E-Health services are made of parts that actually are not strange to legislation, however as a combination of it's parts E-health is unique, and there are very few laws that are specifically drafted to answer to the special circumstances of E-health or cyber medicine. The major parts that make E-Health are telecommunications, information technology and health services. Each one of these is governed by a set of laws, which are special to each one of the parts, E-health is, therefore, governed by a combination of the laws governing it's parts. This means that there are a number of both regulatory and other legal issues that govern E-health directly or indirectly.

Below we present some issues that are special for E-health and are known to cause hinders in implementing E-health services:

1. Medical data and patient data enjoy in many legal systems a high level of protection of privacy. For controlled substances identification of the buyer is important.

When patient information is transmitted between doctors within the same company, usually there seems not to be any problems with regulation and jurisdiction as the systems are imagined to be closed. However, when patient data is transferred from one service provider to another (e.g. public to private or vice versa) there may be problems of compatibility between systems and different security measures in place. The systems of the public organizations are required to keep archives of every document connected to their actions.[13] The archives do not need to be on paper anymore but in some organizations most of them are. This causes some administrative problems in trying to create seamless information flows. It is not unacceptable to think that the systems used in private

sector are of, at least, the same quality if not higher from the point of view of security than in the public sector, but as the legal requirements are different, systems compatibility is not easily achieved. It seems that protection of anonymity of patients and the secrecy of information is not an issue that creates obstacles, however, the discussion is about what kind of cryptography and other security measures need to be in place for growing flows of patient information.

The marketing and selling of controlled substances (e.g. certain medicines) brings forth another issue, validating the identity of the buyer is necessary to ensure that the substances are not ending up in the wrong hands. If, for example, medication is sold through the Internet it is plausible to think that the service must at some point include an identity check - how this is accomplished is not clear. Another issue, although connected to selling of controlled substances the issue of electronic drug prescriptions. If a doctor electronically transfers information to pharmacies (or to a data base, where pharmacies can check prescriptions for patients) problems with counterfeit prescriptions can be circumvented, providing that the practitioners using the service operate according to the law, and can be identified. Now as the new law governing electronic signatures is in place, the communication between doctors and pharmacies can be arranged, but as the SIIF is involved in most of the medication transactions and there is yet no paperless system (or even precise guidelines for developing one) of delivering the insurance claims to the SIIF, or the National Agency for Medicines (NAM) which requires records of all the delivered drugs as well as 10 year archiving of prescriptions (original paper documents, not telefax-or telephone prescriptions) of certain drugs affecting the central nervous system as well as classified narcotics.[14]

2. There is no universal licensing system for medical practitioners which would govern international medical consultations made through the Internet

Because there is no international community for medical practitioners that would or could give licenses to practitioners that ensure the quality of the service it is difficult for a user of E-health services offering medical consultations to be sure of the quality of the product. If there is a risk that someone is posing as a medical practitioner (doctor) it jeopardizes the credibility of E-health.

Another issue that may play an important role in the acceptance of E-health services is the position that different patient insurance systems take towards them. If insurance will cover consultations made through the Internet or perhaps a mobile device, there is considerably less hinders for adaptation by users. In case of private insurance the step to accept, at least, some selected E-health services may be low, however, in cases of public insurance (e.g. Finland) the process of acceptance may be a long registration and regulatory process.

3. Issues of contracts between parties in transactions made through the Internet may in some cases resemble transactions not made through the Internet, however, in cases of litigation Internet presents problems.

Important questions, like where a transaction or in the case of E-health, a consultation has taken place when a patient resides in another location as the service. In other words, which country's jurisdiction is applied in, e.g., malpractice suits filed on consultations made over the Internet? This type of problems are avoided if services operate within national borders, however, as the Internet is global it is not hard to imagine problems arising from enforcing and litigating contracts signed only on the Internet..

The number of issues that do not have a clear answer is large, this means that there is considerable uncertainty as to what can, and what cannot be done by actors offering E-health services. This

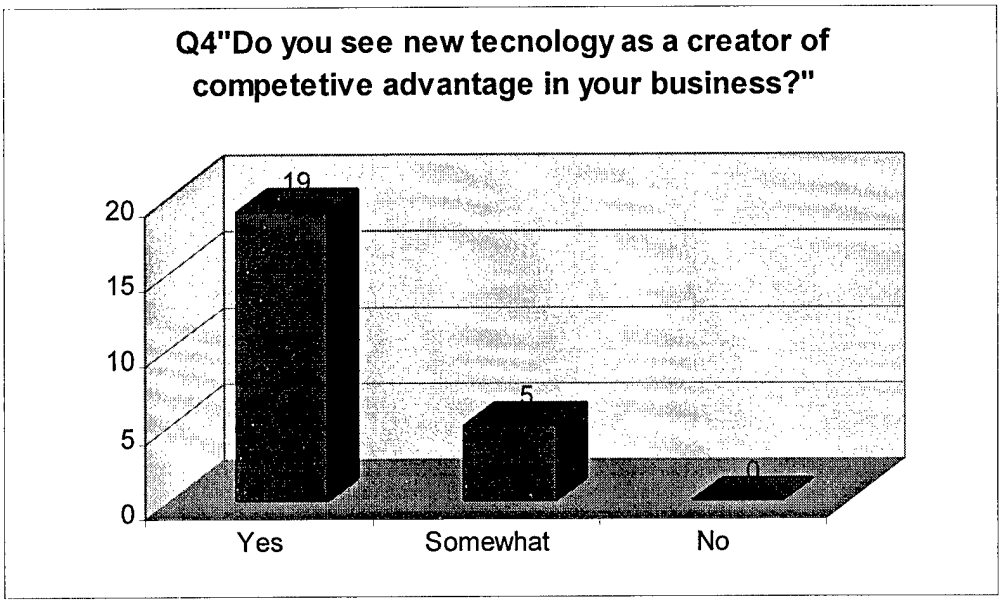
translated to management decisions about investments in the sector, means that investments are postponed, because the companies do not wish to find themselves in situations where their investments are suspended by regulatory decisions. Paradoxically it seems that it is not possible to get binding pre-investment information about the regulatory status of projects, or getting such information will take so long that the investment is no longer actual or getting the information is a very exhausting process. The initial answer from regulatory bodies concerning a number of possible projects is ex-ante negative, which means there are very few actors who will even begin innovations other than those that they know are possible.

Views of actors about the administrative and judicial framework governing IT in health services.

In order to understand better the feelings and thoughts of the actual actors in the field of health services production an exploratory survey about the use of E-Health was made in cooperation with students from the Turku School of Economics and Business Administration. The survey was sent to approximately one hundred recipients and answer received from 25 respondents. The questions of the survey varied from basic questions about the readiness of the respondents to take different E-Health innovations (in connection with the Internet) and what their attitudes are towards E-Health as an addition to their business generally and specifically. One of the issues that was taken up in the questionnaire was the interest of parties to engage in using e-prescriptions. The reason for this was that the authors were aware of the difficulties in the development of systems regarding e-prescriptions and the administrative hinders that are slowing the progress of the use of e-prescriptions. The authors wish to point that the survey is not a representative survey and the results are only exploratory, therefore they can only be used in creating a basic understanding of the attitudes of the community of health service providers in Finland.

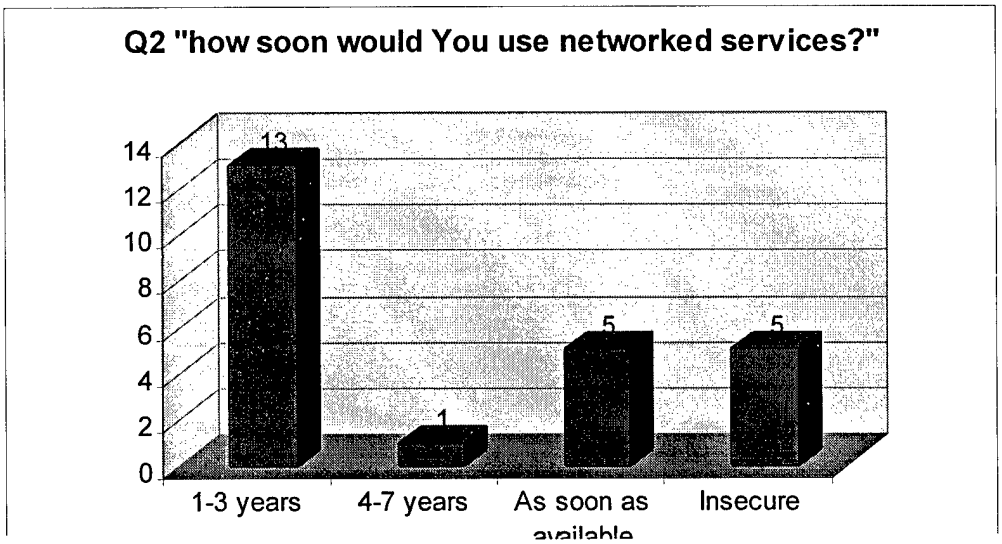
In the following we will go through the results from the survey in four phases, according to issues that were thought relevant by the authors:

i) It seems that the actors are positive about the use of IT and feel that it has potential in enhancing their productivity.



Three fourths of the respondents (75%) indicated that they were either ready immediately or ready within 1-3 years to take E-Health services to use. Only one respondent answered that it would take them more than 3 years. The rest were not sure how long it would take. More than 86% of the responses indicated that the respondents already have the needed infrastructure and readiness for launching E-Health services. More than 87% of the respondents reported that they feel that new technology gives at least to some extent a possibility to gain competitive advantages in the field. The term E-Health in itself is not very commonly known to the companies in the field.

ii) In-house tasks are often already done with IT-solutions, and there are positive experiences.

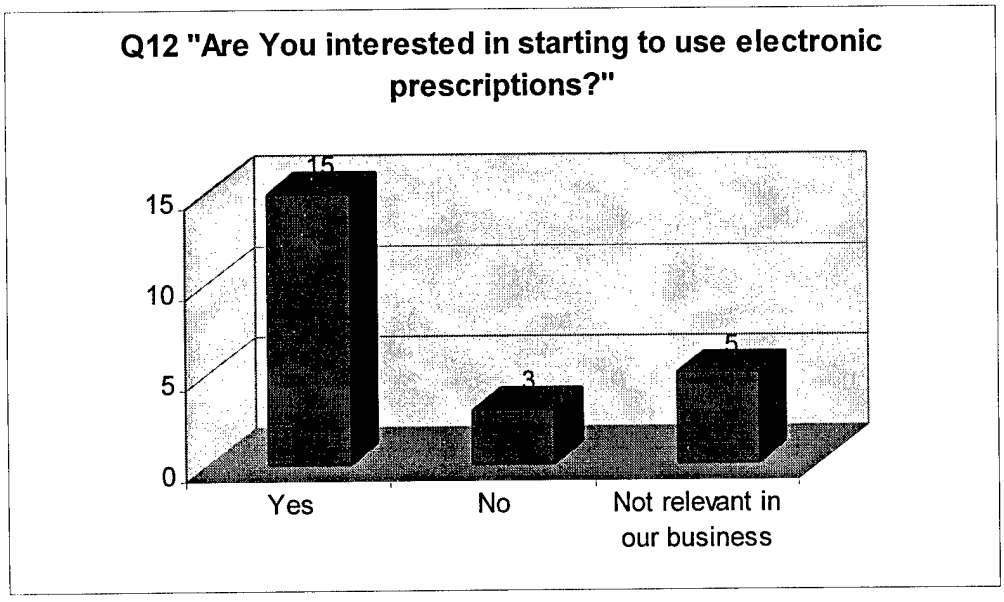


All the answers indicated that the respondents feel that an information system is or would be important to their operations and more than 86% stated that they have a functioning information system at work in their business. Roughly 54% of the respondents said that they either were thinking about using the Internet as a marketing channel for their products or are already using it (~21%). The number of answers that were negative to using Internet as a marketing channel has partly to do with the fact that a lot of the responding firms are pharmacies. Pharmacies are highly regulated in Finland and it seems that even if regulation is not prohibitive in all aspects of marketing via the Internet it seems to be a hindering factor. For those respondents who have already been using Internet as a channel for their marketing the experiences have been mostly positive. 25% of the respondents indicated that they have plans to sell their products in the Internet, but only one indicated that they have actually sold their products via the Internet. They had positive experiences due to enhancements in routines of ordering and delivery with customers who were using the Internet service. From the answers of the pharmacies that had not sold their products in the Internet the comments specified that this was due to administrative and regulatory hinders, selling of drugs on the Internet is not allowed. Further comments stated that the actual delivery of the drugs would have to be realized by a credible and trustworthy company. One response suggested that the products that are the most probable to be sold over the Internet would be products already most well known to the customers (at least in the case of retail customers). On a further note, some of the respondents are actually service providers and do not per se concentrate in selling any products. The attitudes towards Internet as a way to enhance their business were varying from mildly reserved to very positive. Also a concern over the truthfulness of information mediated through the Internet was voiced in one answer.

iii) In a number of occasions it was mentioned that the administration by the Social Insurance Institution of Finland (SIIF) and the National Agency for Medicines (NAM) are hindering development.

From the limited material at our disposal we could detect a feeling of frustration from among the respondents. It seems that there is a wall that the service providers and especially pharmacies are facing when trying to launch new innovations in the level of preliminary acceptance from the administrative bodies. It seems to us that as companies' internal information systems do not fall under the jurisdiction of the governing bodies they seem to be experiencing constant development and are used to enhance the operational efficiency of the companies. The thought just expressed is not based on any extensive research material but is rather a derivation from the loosely structured information by the authors based on the survey results.

iv) Most of the respondents specify that taking electronic drug prescriptions into use would be an important step. This is, however, not possible due to administrative hinders.



Nearly 80% of the answers stated that the businesses would be interested in taking electronic drug prescriptions into use. One answer stated that based on observations from a longer period of time it seems quite hard to expect any changes in the near future due to lack of cooperation from administrative bodies.

In general it can be said that most of the respondents have an information system in use and that they have a positive picture of IT in production of health services. However, it was quite obvious that actors feel uncertain about pursuing development in IT as the administrative and legal frameworks are not transparent.

Discussion and conclusion

We have introduced the main setting of the Finnish administrative framework for health care services and seen that the service production is divided into the services provided by private actors and the public services. There is a gap between the productivity of private services and the public services, and we feel that one of the reasons for the existence of the gap can be more advanced use of IT. One factor hindering the development in the public sector – and indirectly even the private sector as the systems will need to communicate with each other- is the existence of administrative and legal barriers that do not take into account the possibilities offered by the technologies available today. Legislation and administration have not been able to develop in pace with technical innovations. This has caused a bottleneck in areas such as production of health care services that have a strong focus on privacy and customer (patient) protection. The lack of up-to-date governance (laws and administration) of IT in health care is a major source of uncertainty and a serious hinder for development in the sector. The obvious conclusion is that in order to work optimally from the point of view of all actors, the legislation and administration of IT in health care service production

should be brought up-to-date with the technological advances. Otherwise we will most likely see a stagnation in the development of such systems. The legislation, of course, has as a main goal to secure the quality and accountability of care, and the laws in the health field cannot be changed radically overnight as the organizational structures are built around the existing ways of practicing medicine. But without proper standards , guidelines and legislation even incremental changes may be deemed impossible. The processes within the tradition-bound and complex health care organizations are difficult enough to change due to organizational inertia and resistance to change, so every hindering factor from the surrounding society may turn into a major obstacle. The very slowly diminishing uncertainty about the legal and administrative issues in implementing and designing IT infrastructure in Finland has been felt by companies operating on the sector. Our survey finds that companies would be interested in implementing new systems but are sometimes unable to do so, because of institutional constraints. The latest developments in legislation and the government projects aiming at developing guidelines for IT in health care do offer some hope, but the health care sector will nevertheless probably remain a few years behind the rest of our society in the field of information technology usage.

References:

1. Hurst, Jeremy and Jee-Hughes Melissa(2000): Performance measurement and performance management in OECD health systems, DEELSA/ELSA/WD(2000)8 OECD 2000

2. Lederman, Reeva and Morrison, Iain (2002): Examining Quality of Care – How Poor Information Flow can Impact on Hospital Workflow and Affect Patient Outcomes, Proceedings of the 35th Hawaii International Conference on System Sciences – 2002

3. Suomen terveyspolitiikasta, STM Esitteitä 1999:13
   URL:http://www.vn.fi/stm/suomi/vastuual/vast01fr.htm

4. SIIFinland homepage, accessed 25.5.2002
   URL:http://193.209.217.5/in/internet/english.nsf/NET/150502164636EH?openDocument

5. Suomi, Reima & Tähkäpää, Jarmo: The Strategic Role of ICT in the Competition Between Public and Private Health Care Sectors in the Nordic Welfare Societies - Case Finland,Proceedings of the 35th Hawaii International Conference on System Sciences - 2002

6. Harkke, Ville & Landor, Pär: Mobile E-health: The Challenge of Eight Obstacles, DSIAGE proceedings, 2002

7. Ministry of Social Affairs and Health homepage/ projects, accessed April 2003
   URL:http://www.hare.vn.fi/mHankeListaSelaus.asp

8. Sähköistä reseptiä koskeva esiselvitys (report on electronic prescriptions), Ministry of Social Affairs and Health, 02.01.2002

9. Jukka Ohtonen (toim.)Satakunnan Makropilotti: tulosten arviointi, FinOHTAn raportti 21/2002

10. Laki sähköisistä allekirjoituksista 24.1.2003/14 (Law about electronic signatures)

11. Telelääketieteen arviointi Pohjois-Pohjanmaan sairaanhoitopiirissä FinOHTAn raportti 20/2002

12. IMPAKTI 4/2001:Tietoa terveydenhuollon menetelmien arvioinnista

13. Arkistolaki 831/94 (law about Archives)

14. NAM order(MÄÄRÄYS) 1/2003: 10.3.2003, MÄÄRÄYKSEN 10/2002 (LÄÄKKEIDEN TOIMITTAMINEN) MUUTTAMINEN

Appendix D

Author and contact information:

John Fulcher
University of Wollongong
+61 242 213811 (phone)
+61 242 214170 (fax)
john@uow.edu.au

Working title:

The use of Patient Biometrics in Accessing Electronic Health Records

Abstract:

Access, ownership and privacy of medical records are fundamental to the success of any real-world telemedicine application. Such considerations are discussed within the context of smart devices - such as smartcards and iKeys - which are admirably suited not only for providing access to remotely stored Electronic Health Records, but also in emergency situations (Fulcher, 2002). Smart devices offer a limited amount of on-board storage, encrypted and/or compressed as required. Emergency information in the case of cardiac or diabetes patients can be read on any suitably configured computer (i.e. smartcard reader or simply USB port) (e.g. www.smartcard.com.au). In non-emergency situations, such as consultations in doctor's surgeries, the smart device can serve as a secure accesss mechanism for patient data stored remotely on a centralised server, thereby providing a much more comprehensive picture than that given by the limited record stored on the smart device itself. Unique Patient Identifiers need to be defined before such a scheme would receive widespread adoption. The broader community would also need assurance as to compliance with privacy and other similar legislation (Kara, 2001). It is further suggested that rather than use (random) digit identifiers, patient biometrics would provide a much better access mechanism - in other words comparing freshly captured biometric identifiers with those stored on the smart_device. The overriding considerations then become accuracy, efficiency, non-intrusiveness and the amount of additional computer equipment needed to implement such a smart_ID system. Experiences gained from a field trial involving the use of USB iKeys for remote access of diabetes patient records are reported upon (Bomba *et.al.*, 2002), and recommendations made for the future adoption of such systems.

1. Introduction

In the eHealth field, technical solutions to perceived problems must often take

second place to social, political and/or legal considerations. In the case of the three-year (2000-02) Smart_ID project, the technical solution revolved around the use of USB iKeys to remotely access patient records stored remotely from the doctor's surgery (Bomba *et.al.*, 2002). The industry partner in this applied R&D project was the Illawarra Division of General Practice – IDGP. Such Divisions correspond roughly to Local Government areas, with responsibility for health in Australia being spread across Local (regional), State (NSW in this case) and Federal governments. Federal responsibility is for primary care (community health, aged care, nursing homes etc.), whereas States have responsibility for secondary health care (hospitals).

Now whilst the use of iKeys *per se* proved relatively straightforward, it has become apparent that the overriding factors affecting widespread adoption are non-technical – impact on GP workflow processes, Electronic Health Record formats, Unique Patient Identifiers, and more especially Privacy Legislation impacted significantly on this R&D project (Fulcher, 2002).

2. Diabetes Field Trial

This collaborative R&D project built on a pre-existing relationship between the University and the industrial partner – the Illawarra Division of General Practice (Cromwell *et.al.*, 2002). More specifically, it expanded upon an IDGP Diabetes Project which commended at the end of 1999. This project involved the collection of patient HbA1C, cholesterol, triglyceride, weight, height and blood pressure from individual doctor's surgeries and subsequent storage back on a server at the Division. The underlying premises of this Project were:

(i) data needed to be not only accurate, but also comparable,
(ii) the system needed to be automated, and
(iii) patients could move around between surgeries, in the knowledge that this data would follow them.

By the end of the 12-month trial, a total of 40 GPs and 540 (type-2) diabetes patients were enrolled. Of these, 6 doctors and 13 patients proceeded onto the Smart_ID Diabetes Field Trial. It should be noted here that the latter group were essentially computer-literate and pro-technology

To place the latter study in context, it should be emphasized that IDGP was primarily interested in issues to do with access - namely currency, portability and ability to be informed. These were seen as facilitating the movement of patients around the region, and providing them with a means for accessing their own medical (diabetes) records. IDGP views such a system as assisting in their vision of becoming a Division of Primary Care by 2005.

The access mechanism was a USB iKey, although smart cards have been used in similar (cardiac) trials in the past (e.g. www.smartcard.com.au).

In between the 1999 pilot and commencement of the 2002 diabetes field trial, both GPs and patients were surveyed (Spinks *et.al.*, 2001 and Bomba & DeSilva, 2001, respectively). Basically, both groups indicated a willingness to use smart devices, for relevant organizations to also have access to their electronic medical records, and moreover for biometrics to be incorporated onto the smart device (we shall return to the latter issue in Section 4).

A communications link is established initially between the doctor's computer and the IDGP server via dial-up modem access. Java applets running on both machines then enable the transfer of patient data. This does not happen until firstly the GP, followed by the patient, insert their iKeys into the GP computer USB port. Access to a specific patient's diabetes record is thus granted only if *both* doctor and patient have been previously enrolled in the project (which, by the way, facilitates movement of patients between different surgeries). Note that no patient data is stored on the iKey itself – it is simply used as the secure access mechanism (more on this is Section 8). The applet running on the GP's computer searches for new data entered into Medical Director (the de facto case management software package used in the Illawarra), thence transfers this to the IDGP server. A web interface has also been developed which enables patients to access this data consistent with the NSW Health Clinical Management Guidelines for type-2 diabetes.

Despite some technical and operational glitches early in the 2002 Diabetes Field Trail, coupled with the low numbers of participants, we were nevertheless able to draw some significant conclusions, namely:

(i) both GPs and patients agreed that the Smart_ID system had the potential for improving information management in medical practices,
(ii) the use of iKeys did not significantly affect consultation times,
(iii) all expressed a preference for iKeys over Smart Cards,
(iv) patients viewed computer-based medical records as being an essential technology for health care in the future; likewise the adoption of a Unique Patient Identifier.

Doctors were less enthusiastic than patients, with non-participants citing lack of available time to be trained in system usage, and participation in enough projects already (sic), whilst nevertheless expressing confidence in using computing technology in their practices. The key consideration from a busy GP's perspective however is the impact on consultations – time is money, after all (i.e. efficient workflow processes).

Patients were more enthusiastic, but recall that only computer-literate members of the public participated in this Diabetes Field Trial. It should also be pointed out that 10% thought that incorporation of biometrics into the iKey system was a good idea, which contrasts markedly with Bomba & DeSilva's earlier (2001) finding (this issue of greater public acceptance will be revisited in Section 4).

Lastly, the effectiveness of the Smart_ID system used in the Diabetes Field Trial was evidenced by an unexpected side benefit: some patients who accessed their diabetes records on the IDGP website were able to report back to their GP that certain entries were in error. Not surprisingly then, patients on the whole regarded the iKey as an empowering tool.

3. Smartcards *versus* iKeys

Over the past few years, the (Federal) Health Insurance Commission (HIC) has been conducting a "Digital Certificate" scheme, whereby participating GPs are issued with unique (random number) identifiers, residing on either Smart Cards or USB iKeys. We chose iKeys in preference to Smart Cards for the Diabetes Field Trial, largely on the basis of cost (both media have similar storage capacities, (PKI) security capability and access times). Since most modern-day computers come fitted with USB ports, this obviates the additional cost associated with external Smart Card Readers, despite the cost per card being much lower than USB iKeys if purchased in bulk. We selected the same type of iKey used by the HIC (Rainbow Technologies iKey1000 www.rainbow.com/ikey1000_sw.html); it should be mentioned here that difficulties with the SDK for their iKey2000 range prevented the latter device being used in the Diabetes Field Trial. We further observe that USB iKeys are becoming more accepted by the general public, as general-purpose, portable storage devices (Bretz, 2002).

Similar issues exist regarding loss or theft of either type of smart_device. On occasions during the Diabetes Field Trial, patients forgot to bring their iKey with them to the doctor's surgery. There is the additional problem with either device of a "plan-B" backup - what happens in the case of a collapsed patient, for example? If they have their Smart Card or iKey on their person, then it may be feasible to insert this device into a nearby computer (again, such a computer is likely to be fitted with a USB port, but not necessarily with a Smart Card Reader). This will not be much good if the smart_device is password protected, but it could work if a (some, not all) biometric has been encoded within the device (we will return to this consideration in Section 4).

Chan *et.al.* (2001) point out that smart cards have been used previously primarily *within*, rather than *across* organizations (such as hospitals, health insurance companies and medical groups). One factor that has hindered the more widespread adoption of smart cards in a health environment is the plethora of (incompatible) protocols and Application Programming Interface standards (e.g. the open MULTOS standard, Microsoft's Windows for Smartcards, Java Bytecode, Java Card Web Servlet, ISO7816). Nevertheless, 80 million smartcards are currently being used within Germany's healthcare system (Sheifer & Procaccino, 2002). Chan *et.al.* observe however that "more research is needed on privacy and security".

4. Incorporation of Biometrics in the Future

The access mechanism commonly employed with both Smart Cards and iKeys is user name/password, similar to the Personal Identification Numbers (PINs) used on more primitive - yet ubiquitous - magnetic stripe Automatic Teller Machine (ATM) cards (see Section 7 below). PINs are essentially random digits, whereas passwords are alphanumeric, with security further enhanced by use of PKI.

The advantage of biometrics is that they are universal (everyone has them), unique (no two people have exactly the same characteristics), permanent (they don't change over time) and collectable (readily quantifiable). (Hong *et.al.*, 2000).

Now rather than use (random) digit identifiers, patient biometrics have the potential of facilitating a much more secure access mechanism - in other words by comparing freshly captured biometric identifiers with those stored on the smart_device. This potential is due to the fact that we always have our biometric identifiers with us – they cannot be forgotten, lost or stolen (and subsequently misused by an impostor), as can cards (Bolle *et.al.*, 1999). Biometrics do not eliminate the possibility of a security breach, but they do lead to systems which are difficult to compromise.

Incorporation of biometrics onto smart_devices offers another potential advantage, in relation to lost or misplaced iKeys (or smartcards). In the eventuality of a patient losing consciousness, it may be possible to compare (certain) stored biometric characteristics with freshly captured versions. This is feasible for fingerprints, iris, hand geometry and perhaps face, but obviously not for voice or handwritten signatures. However the responsible hospital staff/health professional would need to (a) be able to access the health computer system, and (b) override any inbuilt security in the iKey (smartcard).

The overriding considerations in the public acceptance of biometric systems are accuracy, efficiency, non-intrusiveness and the amount of additional computer equipment needed to implement them. In regard to the latter, in-built microphones can be used for speech recognition, and commonly fitted peripherals such as webcams can be used for iris and face recognition; handwritten signature and fingerprint recognition however require more sophisticated peripheral devices (tablet and scanner, respectively).

This begs the question as to whether the field has matured to the point where biometrics can be effectively employed for secure access of EHRs. Industry proponents appear to take it for granted that it has; others, such as the American Civil Liberties Union (ACLU), err on the side of caution.

Ted White, Managing Director of TSSI (UK) states: "The biometrics industry needs to provide wide education on biometrics; for example, that verification systems cannot, in general, be used for forensic purposes, or that their civil liberties are not being eroded or threatened. Until this is widely understood there will be public pressure against biometrics." (Hamilton, 2002). Hamilton sees the most active vertical market for biometrics as healthcare. Moreover, healthcare providers in the US are being driven by the recently introduced Health Insurance Portability and Accountability Act – HIPAA – which mandates both the privacy of Electronic Medical Records and limits access to only those people authorized to view them (www.hhs.gov/ocr/hipaa). He sees biometrics as a key technology for achieving HIPAA compliance, namely by means of strong authentication of remote users over a network.

By contrast, the American Civil Liberties Union opposes the use of face recognition software in airports, due to its ineffectiveness and also to privacy concerns. The ACLU further observes that several U.S. Government Agencies (e.g. Immigration & Naturalization on the US-Mexico border) have abandoned facial recognition systems after finding their performance failed to match claimed levels, with unacceptably high levels of both false positives and false negatives being reported (www.aclu.org/Privacy/PrivacyMain.cfm). Sydney airport, by contrast, uses face verification rather than face recognition per se in their SmartGate system (i.e. fresh facial capture versus passport photo). Some other airports have chosen alternative biometric techniques (e.g. London Heathrow & Amsterdam Schiphol have opted for iris scanning, whereas Kennedy, Los Angeles and Miami use hand geometry).

Apart from privacy and security considerations – and to an extent, cost - the bottom line from a consumer's (the public's) point of view, is accuracy and reliability. In relation to the former, accuracy rates vary with biometric type. False Acceptance and False Rejection Rates (FAR & FRR) are commonly used to measure accuracy. The most accurate biometric features are, in decreasing order: iris (0% FAR; 2% FRR), followed by fingerprints (0.001% FAR; 6% FRR), with both face and signatures being much worse (Fulcher, 2002). By contrast, current biometric usage rates vary from fingerprints (39%), hand geometry (37%), speech (16%), face (7%), iris (4%) and signatures (3%) (*Economist* newspaper, September 2000). The ultimate biometric is probably DNA, but at this point of time would be far too intrusive to be practical.

The other major impediment to the widespread adoption of biometric systems is lack of standardization, although BioAPI (www.bioapi.org/BioAPI_home.htm) has been making inroads in recent times.

5. Ownership and Access of Patient Records

In April 2003, the US Department of Health & Human Services introduced the

first-ever comprehensive federal regulation that gives patients sweeping protections over the privacy of their medical records. In the words of HHS Secretary Tommy G. Thompson: "Patients now will have a strong foundation of federal protections for the personal medical information that they share with their doctors, hospitals and others who provide their care and help pay for it." (www.hhs.gov/ocr/hippa). Under the privacy rule:

(i) patients must first give specific authorization before entities covered by the regulation can use or disclose protected information,

(ii) covered entities need to provide patients with written notice of their privacy practices and patients' privacy rights,

(iii) pharmacies, health plans and other covered entities must first obtain an individual's specific authorization before sending them marketing materials, and

(iv) patients will be able to access their personal medical records and request changes to correct any errors.

The legal position within Australia is that medical records are *jointly* owned by both doctor and patient. The key aspects of the recently enacted Guideline on the Privacy Health Sector (www.privacy.gov.au) are access, collection, disclosure and use, with particular emphasis on "voluntary, informed consent". The Australian Privacy Commissioner is of the view that "to ensure all consumers can confidently take maximum advantage of the information economy while allowing them to protect their privacy with minimum inconvenience" (Crompton, 2002). There are widely differing views as to whether the addition of biometrics is privacy enhancing or privacy restricting (Crompton, op.cit.; Tomko, 1998). Such privacy concerns override questions of access and ownership, which in turn override the technical issues surrounding remote access and security. What are the consequences of unauthorized eavesdropping on confidential medical records? For example, "outing" of people's specific medical problems could have dire consequences, even in the case of de-identified data.

6. Electronic Medical/Health Records (EMR/EHRs)

Half of the patients surveyed prior to the Diabetes Field Trial stated they would be happy to have (partial) medical records stored on the smart device itself, and one third said they would not object to concurrent storage of their records on both smart device and centralized database (Bomba & DeSilva, 2001).

The irony with electronic storage of health (medical) records (EHR) is that whilst most stakeholders agree on the general principle, there is no consensus on *specific* formats. A recent US study, for example, found that the annual toll from preventable errors exceeds the combined number of deaths and injuries from road and air crashes, suicides, falls, poisonings and drownings (Kohn *et.al.*, 1999). Given this, the widespread adoption of EHRs is thus seen as having potential for significantly increasing consumer safety.

Duty-of-care principles dictate access to medical records within the Australian context. The Federal Department of Health and Aged Care acknowledges that the increased computerization of general practice is occurring in an *uncontrolled* environment. Likewise, the Australian EHR Task Force acknowledges that more work needs to take place with messaging standards. They further suggest that (a) HL7 be adopted as the messaging standard, and (b) XML be adopted as the preferred technology medium for health information interchange (www.noie.gov.au/projects/ecommerce/ehealth/index.htm).

The linking of various EHRs cannot proceed without the confidence of the public. With this in mind, The Federal Government has recently conducted trials in two Australian States, with the longer term aim of developing a national eHealth information network (www.healthconnect.gov.au). One of these trials was conducted with remote indigenous (Aboriginal) health services in the Katherine region of the Northern Territory, and the other with an aging population residing in Hobart, Tasmania.

7. Unique Patient Identifiers (UPIs)

Approximately half of surveyed patients believe that UPIs would lead to improved health care, while two thirds expressed concern over their associated risks – namely the possible compromising of privacy and security (see Section 5).

Unfortunately, as with EHRs, there is a lack of agreement on exactly how "uniqueness" is quantified. The practice of assigning random digits, as with 16-digit credit card numbers, or Automatic Teller Machine (ATM) Personal Identification Numbers (PINs), is the de facto standard in some jurisdictions. In the case of the US, social security numbers serve as a de facto identifier, whilst in New Zealand and Malaysia, true national identity cards have been is use for some time. By contrast, there is considerable opposition to the introduction of a National ID Card in the USA (e.g. see "5 Reasons Not to Create a National IDS Card www.aclu.org/Privacy/PrivacyMain.cfm). In Australia an attempt to introduce a similar national identity card came unstuck during the late 1980s (Clarke, 1987). France and Germany have both been using Health Smartcards for some years now.

In the wake of the public hysteria surrounding the failed "Australia Card", people's tax file numbers have come to serve a similar purpose. Birth Certificate, Passport or Driver's License numbers are alternative potential "unique" identifiers. The Australian national Medicare number is not in fact unique, and doctor's surgeries, hospitals, pathology companies and so forth use incompatible identifiers and formats.

In an attempt to progress towards a UPI, in 2002 the NSW State Government

commenced the rollout of a local government (regional) UPI, which was later expanded state-wide. Choice of UPI was left to Area Health Services, but was essentially random-number based. It is interesting to note in passing that in this State-based UPI rollout, an earlier proposal to use a "health smart card" as a means of increasing consumer control over information has been dropped (Privacy Committee NSW, 1995; NSW Health Council, 2000).

For the Diabetes Field trial, the small number of participating doctors and patients meant that the (Divisional) random-digit identifiers used previously on the Diabetes Project sufficed.

Ultimately, the problem with randomly assigned digits, just as with credit card numbers or PINs, is loss or theft. A *truly* unique identifier is not possible with the assignment of random digits, but *is* possible if patient biometrics are incorporated. Traditionally, the most secure systems are based on a threefold approach, namely by utilizing (a) something we are (e.g. biometric), something we possess (e.g. physical key) and something we know or (e.g. password or PIN) (Pfleeger, 1997). Focus on (a) would ensure both uniqueness and permanency, and thereby enhance patients' security and privacy.

8. Lessons Learnt to Date

Kara (2001) used the Internet Protocol IPsec layer and Secure Socket Layers (SSL) without compromising accessibility or performance, with bandwidth-on-demand (and appropriate MPEG compression), depending on the dynamic audio-visual streaming demands in their Japanese remote monitoring trial. Performance and quality-of-service are essential for providing accurate live information to the monitoring side. Should an eavesdropper uncover the origin of remote monitoring activity however, they could deduce that the monitor is not currently residing at the same premises as the patient. Kara concludes by observing that security issues in such remote monitoring systems constitute a serious privacy problem. This is somewhat of an understatement.

Chan *et.al.* (op.cit.) advocate the storage of complete medical histories and vital records on smart cards within Hong Kong – more specifically, record management, security and authentication, and clinical alert system. This is in direct contrast with the IDGP SPIRT Project reported earlier, where the smart device was used *solely* as the secure access mechanism to medical records stored *remotely* on a secure site. Whilst smartcard protocols are still in a state of flux, Chan *et.al.* nevertheless envisage a future where smartcard and internet technologies have become integrated, thus enabling anywhere/anytime/anyplace access (in order to cater for increased patient mobility). I wonder whether this is a *desirable*, let alone feasible objective? They summarize the technical challenge as follows: "the exchange of electronic medical data requires the establishment

of a canonical medical structure with supporting data abstraction processes, to provide unified views of medical information."

However the social, legal and ethical obstacles are even more daunting, as outlined earlier. For example, Shiefer & Procaccino (op.cit.) paint a scenario whereby a citizen's driving record could be updated within minutes of committing a parking violation, say, where smart cards are used for authentication. They go on to observe – correctly in my view – that "such an application could present some interesting legal issues, depending on which country or state issued the license" (sic). An even more pertinent scenario is the use of smart cards for authorization in a health care setting. More specifically, "configuration for dialysis equipment, as well as medical information, could be stored on smart cards and inserted into a smart card-enabled dialysis machine anywhere in the world (Fancher, 1996). Of course, privacy, technology, legal and cost issues must be addressed before such healthy related applications become widespread." - indeed! Once again, we come up against social, legal and privacy issues potentially overriding any technical ones.

Lessons learnt from the 2002 Diabetes Field Trail were summarized in Section 2; the two critical findings were (i) both GPs and patients agreed that Smart_ID devices had the potential for improving information management in medical practices, and (ii) the use of iKeys did not significantly impact on consultation times. This experience of a certain (computer-literate, pro-technology) cross-section of the public should be contrasted with more global public attitudes: between 10% (Bomba *et.al.*, 2002) and 42% (Bomba & DeSilva, 2001) previously indicated they would be in favour of using biometrics for accessing Electronic Health Records (and in the case of the latter, 25% both biometric and smart_device together; and 22% smart_device only).

It should be emphasized here that it would only take *one* disastrous field trial to sway public opinion against using biometrics. The importance of pilot system trials cannot be overemphasized. Positive outcomes can include the resolution of potential interoperability problems; negative outcomes (i.e. poor experience which doesn't match expectations) can set back the entire field for decades. Indeed, an unrealistic buildup of expectations can be quite counterproductive (witness the effect of the dotcom crash in the early decades of this century on the IT field generally, or the perpetual non-delivery in the field of Artificial Intelligence (Fulcher, 2001). To an extent, this has already occurred with regard to face recognition for airport security (Boston Globe 18.7.02, reporting on the Logan Airport experience).

9. Conclusion

Is the public willing to accept 95% (99%, 99.5%) accuracy? In practice, it boils down to a balance between security and accessibility to achieve an acceptable

level of risk - more specifically, are patients willing to sacrifice some privacy for greater security? Operation & system integration are other challenges which if not adequately addressed can render biometric solutions unworkable in real-life deployment. Further, there are limitations due to background lighting for face/iris, background noise for speech, and so on. It should also be pointed out that there is nothing to be gained by combining different biometrics, since this leads to diminishing accuracy overall (the whole being *less* than the sum of the individual parts) (Daugman, 2002).

So what are the key considerations for the acceptance and widespread adoption of this new technology within a health care context? In a nutshell, the best catalyst for acceptance would be successful practical demonstrations and field trials. To date we have established the viability of using iKeys (smartcards) for remote, secure access of patients' Electronic Health Records. Further field trials are needed to confirm the benefits to be gained from incorporating patient biometrics onto such smart_devices. Apart from providing a technical solution, it is suggested that biometrics could provide true "uniqueness" - in the sense of UPIs - for secure access of EHRs. Lastly, incorporation of biometrics has the potential for *enhancing*, rather than reducing, patient security and privacy.

Acknowledgements

This work was funded by the Australian Research Council, under their Strategic Partnerships with Industry Research and Training (SPIRT) scheme – grant number C00001904. The permission of the Illawarra Division of General Practice to publish this work is gratefully acknowledged.

References:

R. Bolle, A. Jain & S. Paqkanti (eds) (1999) *Biometrics: Personal Identification in a Networked Society*, Kluwer, New York.

D. Bomba & A. DeSilva (2001) "An Australian Case Study of Patient Attitudes Towards the use of Computerised Medical Records and Unique Identifiers" *Proc. World Medical Informatics Conf.*,London, 1430-1434.

D. Bomba, J. Fulcher & A. Dalley (2002) "Lessons Learnt from the UoW-IDGP Smart_ID Project" *Proc. Health Informatics Conference – HIC2002*, Melbourne, 4-6 August.

E. Bretz (2002) "Tons of Storage on a Key Ring" *IEEE Spectrum*, **39**(11), 49.

A. Chan, J. Cao, H. Chan & G. Young (2001) "A Web-enabled Framework for Smart Card Application in Health Services" *Communications ACM*, **44**(9), 77-82.

R. Clarke (1987) "Just Another Piece of Plastic for Your Wallet: The 'Australia Card' Scheme" www.anu.edu/people/Roger.Clarke/DV/OzCard.html

M. Crompton (2002) "Biometrics and Privacy: the End of the World as We Know it, or the White Knight of Privacy?" *Proc. Biometrics – Security and Authentication Conf.*, Sydney, 20th March (Keynote Address).

D. Cromwell, D. Bomba, H. Tu & A. Dalley (2002) "Dividends for Care Coordination from Investments in Information Technology: Lessons from the Illawarra Coordinated Care Trial" in *The Australian Coordinated Care Trials: Recollections of an Evaluation*, Commonwealth Department of Health and Aged Care, 249-261.

J. Daugman (2002) "Combining Multiple Biometrics" Cambridge University www.cl.cam.ac.uk/users/jgd1000/combine/combine.html

C. Fancher (1996) "Smartcards" *Scientific American* (on-line www.sciam.com)

R. Fox (2002) "Let Your Fingers Do The Paying" *Communications ACM*, **45**(10), 9.

J. Fulcher (2001) "Practical (Artificial) Intelligence" *Proc. 5th National Thai Computer Science & Engineering Conf.*, Chiang Mai, 7-9 November (Invited Keynote Speech).

J. Fulcher (2002) "Privacy Issues Arising from a Smart_ID Application in eHealth" *Proc. Intl. Conf. On Advances in Infrastructure for eBusiness, eEducation, eScience and eMedicine on the Internet – SSGRR2002S*, L'Aquila, Italy, 29 July – 4 August (invited paper).

W. Hamilton (2002) "Biometrics Technology" www.scmagazine.com March, p.15.

L. Hong, A. Jain & S. Pankanti (2000) "Biometric Identification" *Communications ACM*, **43**(2), 91-98.

A. Kara (2001) "Protecting Privacy in Remote-Sensing Monitoring" *IEEE Computer*, **34**(5), 24-27.

L. Kohn, J. Corrigan & M. Donaldson (1999) *To Err is Human, Building a Safer Health System* National Academy Press, Washington, DC.

J. Kumagai (2002) "Talk to the Machine" *IEEE Computer*, **39**(9), 60-64.

A. Naszlady & J. Naszlady (1998) "Patient Health Record on a Smartcard" *Intl. J. Medical Informatics*, **48**, 191-194.

R. Neame (1997) "Smart Cards – the Key to Trustworthy Health Information Systems" *British Medical J.*, **314** (22), p.573.

NSW Health Council (2000) *A Better Health System for NSW – The Menadue Report*, NSW Government.

C. Pfleeger (1997) *Security in Computing*, Prentice Hall, Upper Saddle River, NJ.

Privacy Committee of NSW (1995) "Smart Cards: Big Brother's Little Helpers" www.austlii.edu.au/au/other/privacy/smart/index.html

K. Sheifer & J. Procaccino (2002) "Smart Card Evolution" *Communications ACM*, **45**(7), 83-88.

K. Spinks, J. Fulcher & A. Dalley (2001) "Survey of GP Attitudes to Smartcards" *Proc. 10th Health Informatics Asscociation NSW Conf.*, Hunter Valley, 17-18 February.

G. Tomko (1998) "Biometrics as a Privacy-Enhancing Technology: Friend or Foe of Privacy?" www.dss.state.ct.us/digital/tomko.htm

Appendix E

Lynne P. Baldwin
Centre for Health Informatics and Computing
Department of Information Systems and Computing
Brunel University
Uxbridge, Middlesex UB8 3PH
England, UK.
Telephone: 00 44 (1)895 203290
Fax: 00 44 (1)895 251686
Email: Lynne.Baldwin@brunel.ac.uk

and

Malcolm Clarke
Centre for Health Informatics and Computing
Department of Information Systems and Computing
Brunel University
Uxbridge, Middlesex UB8 3PH
England, UK.
Telephone: 00 44 (1)895 274000 ext.2354
Fax: 00 44 (1)895 251686
Email: Malcolm.Clarke@brunel.ac.uk

Working title: Using ICT to better support the fragmentary nature of healthcare

Suggested section: Technological innovation in telemedicine and e-health

Introduction

Patients are, obviously, central to any national healthcare service. As we live in an age where people are living longer, and demanding a better quality of life in terms of health throughout their lives, the demands placed on any healthcare service are therefore great. The financial burden on either the patients themselves or the government to keep patients in hospital or in institutions such as care homes for the elderly, the mentally impaired or others who require full-time care and assistance is great. Such care cannot, at present, be provided in their homes, although it is hoped that when or if technology is installed in our homes, this will allow the healthcare service to deliver the same (or better) quality of care but without the enormous costs involved. It is not, however, just a matter of financial cost. Involving us more in our own healthcare at an earlier age or stage has two advantages. One, being at home or, at least, as near to home as possible, has psychological advantages that positively impact on our mental, and thus physical, health. Two, there is the possibility that, as we feel more comfortable with the technology and/or our confidence grows in approaching healthcare professionals or health issues (many people fear both), we might take a more proactive role in our own healthcare and thus either delay the need for intervention or, at best, manage a potential problem away.

Every country claims that the needs of patients come first, and the UK is no exception. The National Health Service (NHS) in the UK published its NHS Plan in July 2000 (http://www.nhs.uk/thenhsexplained), saying that patients and people were central to its radical

reform of healthcare and that although this included more hospitals and beds, shorter waiting times and improved care for older people, an essential element was that patients should have more power and information. The NHS Plan is permeated with words and phrases that emphasise the need to involve patients more in their own healthcare. Although it would seem difficult to see how patients could be anything other than involved given that it is their body/mind that is being seen, treated or managed, this suggests that patients are currently viewed more as 'cases' rather than as individuals, as people. That is, that they come in to the doctor's surgery with a problem, and that it is the problem, rather than the patient, that is being seen. While in some sense this is naturally necessary, as patients want the health problem 'solved' in some way, as in the case of, say, a broken finger being mended or a minor injury being treated, not all patients present things which might be seen as a 'problem to be solved'. Indeed, it might be argued that much cannot be 'solved' anyway; asthma, psoriasis, mental health conditions and the like do not, and cannot, go away and it is more that these need to be managed, as effectively as possible, by both the patients themselves (who are, after all, dealing with their healthcare day in and day out), and, on occasion, with the assistance of various healthcare professionals. However, healthcare is as much about dealing with a wide range of 'everyday' issues, such as helping a first-time mother with her new baby or helping someone deal with the death of a loved one. Whether borne out or not, there is a perception, at least, that doctors and consultants, in particular, are viewed by their patients as somewhat distant, over authoritative and dispassionate. Indeed, the word 'clinical' does not only mean 'relating to health' but also detached, lacking in empathy. Whether stated explicitly or implicitly, there seems to be a call for healthcare professionals to engage more fully with their patients, and to see them more as some kind of 'partner' in their healthcare rather than someone 'in authority'. Patients are somewhat in awe of doctors and, in particular, consultants and this is raises issues with regard to the patient/healthcare relationship.

The UK Health Service

It is first necessary to provide some background as to how healthcare is organised in the UK, as this varies from country to country. One vital aspect of healthcare in the UK is that for the vast majority of the population it is paid for not via private medical insurance but instead through the system of taxation. It is thus seen as 'free', in some sense, by patients as they do not need to pay for any treatment direct to either the local doctor/general practitioner or any other healthcare professional. Whilst patients may regard it as 'free', it is nonetheless extremely expensive for the government to provide, particularly in a country where the number of taxpayers is decreasing in relative terms, the population of those over 65 is significantly greater than in previous generations and the fact that healthcare 'solutions' such as drugs or surgery are now that much more expensive. In addition, patients expect and demand more of the healthcare services these days, and with the advent of the internet are much more informed as to the choices available. In other countries, both in Europe and elsewhere, patients can see a specialist/consultant in a hospital without needing to be referred there by their own local doctor, and may enter the health system directly at the secondary or tertiary care level of figure 1. In the UK, this is not possible; a patient must enter the system at the primary care level and first see his or her own doctor, known as a general practitioner, whose surgery/clinic is normally located close to the home of the patient. The local doctor/general practitioner is, then, a kind of 'gatekeeper' (Forrest, 2003) to other services should these be needed. In the US this would correspond to managed care.

<< take in figure 1>>

The health service provided at this level is known, in general, as primary care. It is the responsibility of the doctor/general practitioner to refer the patient on to what is known as secondary (or tertiary) care, usually a hospital, where more specialised equipment, and specialists/consultants are on hand. As with any healthcare system, there are potential drawbacks, and these have implications for the speed and accuracy of the treatment both at primary and secondary care level. Referring the patient from primary care to secondary care normally involves a lengthy process of letter writing between the doctor/clinician and the specialist/consultant in the hospital in trying to book an appointment. The specialist/consultant in the hospital then has to contact the patient to tell them of the time and day of the appointment. It goes without saying that this is a lengthy process, and time, for those with serious illness, may be in short supply. The doctor/clinician is somewhat divorced from what happens from that point on and, given the problems associated with relying on a postal service (normally efficient enough, but the UK has suffered from postal strikes in recent

years) to relay communication between consultant/hospital and patient, there is the danger of information either arriving late or, worse, not arriving at all. A patient referred to secondary care may have moved house in the time between first seeing their doctor/general practitioner and the first consultation with the specialist/consultant. Although this may seem trivial, cases have been reported in the media where this new information has not been conveyed, and that this has adversely affected the healthcare of the patients concerned. Patients themselves are unaware of the processes going on behind the scenes, so to speak, and so it is not difficult to see that they would not necessarily realise the importance of informing anyone of their change of address. Moreover, although they may consider reporting such information to their own doctor/general practitioner at primary care level, they would not know whom to contact at secondary care level as the name of the specialist/consultant or their place of work would likely not be known.

<< take in figure 2>>

Current Role of Technology

Information and communication technology (ICT) can (and does) play a role in both primary care and secondary care. And, with the move to involve patients further in their care, patients themselves may well, in the future, make their own contributions in some way, perhaps from their home computer. That information systems are becoming increasingly more sophisticated is uncontested. Indeed, Rodger and Pendharkar (2000) describe a variety of fascinating technological developments used by the Department of Defense in the US. However, whether it is sophisticated, which somehow carries with it the assumption that it is somehow 'better' or, at least, 'good' in comparison to whatever was in place before, is of little value, particularly in terms of healthcare. As a report by Payton and Brennan (1999), on a phone-accessible web-based computer network that was developed for the use of those caring for patients suffering from Alzheimer's disease, demonstrates, an 'unsophisticated' response answered the needs. It revealed that what carers actually wanted was "someone to converse with and share ideas" (page 88) and that access to an encyclopedia into the disease or even a decision-making utility was not regarded as useful by this particular set of users. This has important implications for those developing information systems, namely, that when we are ill or request intervention of one sort or another from healthcare professionals, we do not ask for sophistication but rather that we receive an appropriate, timely and accurate response.

Whatever the role that technology will play in the modernisation of the NHS or any other global, national or local healthcare system, none can doubt that it is perceived as vital to its success. Quick to grasp this have been the technology multinational companies, eager for business. Huge multinational organisations involved in producing computer technology for industry, particularly in a financial climate where competition is fierce and there has recently been a significant downturn in business, are keen to promote any service as, naturally enough, they are in the business of selling technology. They would understandably claim to be in the business of improving the health of patients, although the cynical among us might recall the very many horror stories of extremely expensive information systems that not only took far longer to build than their designers said at the outset but also that they did not deliver what their customers expected; some did not even work at all and had to be shelved. That said, the future of technology looks bright, as illustrated in the following story. Recounting the speech made by Bill Gates, founder of the world's most well-known software company, Microsoft, Hawkes (2001) reports that Gates, who is currently actively seeking to develop new products for the NHS in the UK and likely elsewhere, tells a story of how things might be in the future, technology-led and managed, health service. In this wonderful technology-enriched future, a businessman is knocked down by a cyclist, but is not so seriously injured that he cannot use his mobile phone to gasp "Call my doctor now !". The mobile phone, upon recognising his voice, dials Dr X's surgery, and the female receptionist somehow verifies his identity, locates him (from the mobile phone signal) and calls an ambulance. While on his way to hospital, the receptionist sends his medical records electronically, so that the Accident and Emergency team have them to hand upon his arrival. The businessman's own doctor calls up the record of the treatment online, offering his patient reassurance that he has had the best possible care and treatment.

As Baldwin et al note (2002), the businessman has been very lucky on at least four counts. One, the accident happened during normal opening hours of the surgery. Two, the technology worked

perfectly. Three, the ambulance was able to reach the spot quickly. Four, the patient records were correct and up to date. This seems to be an excellent example of how such technology could be successfully used. However, for such a scenario to play out, it would seem that the context in question is not beset by the practical difficulties that, we suggest, permeate our professional and personal lives. This scene is based on the premise that either such accidents happen only during normal working hours (while we have no research to back up our view here, common sense leads us to conclude that this seems highly improbable) or that in this new NHS, the clinic/surgery of our local doctor is open 24 hours a day. Given budgetary and other constraints, clinics/surgeries of local doctors in the UK are open for only a few hours in the morning and a few hours in the late afternoon/early evening Mondays to Fridays (and not at all at the weekend), for the most part. It would also be difficult if not impossible, at least for those of us who use technology extensively, to imagine an environment where technology worked perfectly, all of the time. Indeed, some would likely be grateful if it worked reasonably well, some of the time ! Until the advent of technology which functions so wonderfully, relying on technology alone should not form part of any vision of a healthcare system, surely. Ambulance services in many countries in the west are very good indeed, so perhaps we do not need to suspend our disbelief too much when envisaging the speedy arrival of an ambulance. That said, however, the patient must live in a reasonably urban setting; ambulances cannot respond so quickly (if at all) in a rural one, and it is not peak time. Luck must also play a part; good weather conditions, and little traffic in this scenario. Correct and up to date records is yet another aspect of the world of work which is a worthy goal but rarely (if, indeed, it is possible) to achieve. However careful, professional or whatever we are with administration, errors are made and/or things are not entered in a timely fashion. Imagining ourselves as that businessman (we are by nature, fairly selfish; something well understood by image makers enticing us to buy), it is easy to see how we might be seduced by such a picture of healthcare in the future. The message to the taxpayer/government is, then, invest heavily in (very expensive) technology and we will all get the right treatment at the right time and, it would follow from this, though of course not explicitly made, live a long, healthy and happy life. On a slightly less optimistic note, we see that some things in life will not change that much according to the example given. The doctor is male. The receptionist is female. The patient, chosen as someone worth saving, is a businessman. There is a crumb of comfort in this, however; we will not need to suffer the mental anguish associated with the task of altering our mental models of the stereotypical healthcare professional or who is valued more highly in our western society.

While there is plenty of information about healthcare available in print or, increasingly, on the internet, when faced with a healthcare issue which requires intervention, in the vast majority of cases, today at least, we need to deal with a healthcare professional face to face. The importance of the doctor/general practitioner in primary care is clear; it is the first port of call for the patient. Although the appropriate response may not require further intervention from other n patient, doctor/general practitioner and (normally) specialist/consultant is key. For the patient, who may well have built a good relationship with their doctor over a long period of time, being referred to a specialist/consultant in a hospital is not without its difficulties. Among these is the fact that the patient has never met the specialist/consultant; building a new relationship with a stranger is, for many, not easy. This is made more problematic by the fact that they are probably very anxious or upset, and thus not at their best in terms of expressing themselves well, clearly or, importantly, accurately. Yet the value of that initial visit depends not only on what the specialist/consultant knows about that particular illness or disease but on the quality of the information provided by the patient. And patients, naturally enough, do not necessarily know what is, or is not, relevant information which would help the specialist/consultant in their diagnosis and subsequent treatment or care. One of the most vital aspects of effective and efficient care is an accurate (as is possible) record of patient care up to the time when the specialist/consultant sees the patient. It is at this time that the specialist/consultant makes the vital decision as to what treatment is or is not appropriate, and when this needs to be carried out. The decision(s) made at that time are crucial to the patient's subsequent care and health, and it is clear that the knowledge and information available to the specialist/consultant needs to be as accurate and as full as is possible. As Summerton (2000) notes, inefficiency and/or inaccuracy can adversely affect not only prognosis but also the nature of any intervention(s), and the earlier those choices (that is, decisions) are made, the better.

Such information is stored in three (at least) different places. One, informally, by way of the knowledge and experience gained by the doctor (and/or, perhaps, another clinician in the primary care surgery/clinic, such as a nurse) who has been involved in the care of the patient up to that

time. Two, formally, by way of the written records that are kept, in the primary care surgery/clinic. These records are (for much of the UK, at least) kept only in handwritten and not electronic form, although there is currently a move towards the keeping of these electronically. Three, informally, by way of what the patient knows about their own health, history and experiences. As described earlier, the information currently available to the specialist/consultant when meeting the patient for the first time is limited to only two of the three sources available. One, formally, by way of the written records that are kept in the primary care surgery/clinic and which are sent before (hopefully) the patient arrives. Two, informally, by way of what the patient knows about their own health, history and experiences. Gaining information by way of only these two sources means that there is the potential for a breakdown (at worst) or a lack of richness in information-sharing between those working in primary care and those working in secondary/tertiary care, and, vitally, between patient and healthcare professional. Effective communication both *amongst* healthcare workers and *between* healthcare workers and their patients in both primary and secondary care is vital. Information in the current NHS is stored in various places and access is restricted; there is no central, complete, patient record that is accessible to all healthcare professionals at the various levels of care. There is also no mechanism for allowing the patient to interact both with their local nurse and/or doctor/general practitioner (at primary care level) while at the same time engaging with the specialist/consultant (at secondary/tertiary care level). The knowledge/information that the specialist/consultant has to hand during the first consultation is shown in table 1 below. Also shown is what is *not* currently available across the healthcare sector in the UK to assist the specialist/consultant in their decision-making:

knowledge/information currently available to specialist/consultant
• A brief letter of referral from the doctor/general practitioner • Information gleaned from the patient during the consultation
knowledge/information that specialist/consultant does *not* have
• Full, formal written/other patient record from the doctor/general practitioner • Information gleaned from the doctor/general practitioner other than that contained in the formal written/other patient record • Information gleaned from any other healthcare professional (such as a nurse) who has been engaged in the care of the patient
knowledge/information that specialist/consultant *may not* have
• Information from diagnostic tests • Information from previous visits to the hospital

Table 1: information available at the specialist/consultant <-> patient consultation

The AIDMAN Platform

In this chapter we describe a clinical ICT system called AIDMAN that has been successfully used both in the UK and elsewhere in Europe and which can provide the third, vital, source of information lacking in consultations that are not tele-mediated, that is, informally, by way of the knowledge and experience gained by the doctor (and/or, perhaps, another clinician in the primary care surgery/clinic, such as a nurse) who has been involved in the care of the patient up to that time, and also the full formal, written patient record held by the healthcare professionals at primary care level. AIDMAN (Advanced Informatics Distributed Medical Access Network) was designed to offer the patient the advantage of a 'virtual' consultation (Clarke and Jones, 2001; Clarke et al, 2000a; Clarke

et al, 2000b; Clarke et al, 1999a; Clarke et al, 1999b). Face-to-face consultation offers particular advantages over other channels of communication, and although AIDMAN is in essence a clinical ICT system involving video-conferencing, it also has high definition images, shared access to data applications and other peripherals or medical systems that might be considered useful in presenting clinical data. AIDMAN is unusual in that it is technology independent and in this case employs satellite technology; vital if the infrastructure in a particular region or country is not able to provide the links required by more conventional means.

<< take in figure 3>>

Part of the novelty of the approach is that much of the healthcare is nurse-led, rather than doctor/general practitioner-led at primary care level and it brings together the isolated 'islands' of knowledge and information held by both the patient and healthcare professionals involved in their care. During the consultation, the patient has at their side a medically trained person; this person can therefore use their hands or nose to provide the information gained by way of touch and smell, and can also operate the camera should the specialist/consultant wish to view a particular aspect of the body in order to aid diagnosis (see figure 4).

<< take in figure 4>>

Although AIDMAN is in essence a clinical information system involving video-conferencing, it also has high definition images, shared access to data applications and other peripherals or medical systems that might be considered useful in presenting clinical data to either the medically-trained person at one end, or the specialist/consultant at the other. It is an end-to-end solution and impacts on process at each stage of the pathway of care.

<< take in figure 5>>

Communication technology is general and TCP/IP networks are used. However, satellite links have been tested to successfully deliver to remote regions of Greece and, more recently, to cruise ships in the Mediterranean as part of the Medaship project. AIDMAN was initially set up to investigate the provision of digital telemedicine in an area of the world where patients find themselves remote from consultants/hospitals in some way, in this case, four hospitals in Greece; one in the capital, the KAT Hospital in Athens, and the other three in healthcare centres in Corfu, Mykonos and Mytilini (all 'remote' islands off the coast of mainland Greece). It is also used in the UK, and its centre is the Chorleywood Health Centre, not far from London. Figure 6 illustrates its application and use in the primary and secondary care sectors at the current time:

<< take in figure 6>>

In terms of the more technical aspects of AIDMAN, the initial design for the virtual workstation is based on a Pentium II machine and includes desktop video conferencing (Proshare Version 5), a digital video camera for simultaneous analogue video and high resolution digital still image, flat bed scanner, soundcard and hands-free speaker phone. Figure 7 provides an illustration of its architecture:

<< take in figure 7>>

Many consultants appreciate diagnostic information in advance of the consultation, so that they can consider their diagnosis and then use the time with the patient more effectively. They also have the opportunity to ensure the quality of the information and that it is complete. This allows them to be able to request further information before the consultation. The system can access data from sources such as digital images, ultrasound, ECG or digital or digitised X-ray or ct-scan for use in the consultation. These can also be transmitted by other means in advance, for example, attachments

to email or DICOM. There is, naturally, scope to install all manner of other diagnostic equipment in order to support the interaction between the patient/medically-trained person and the consultant.

The technology described here is unique in that it combines both 'store and forward' and 'real-time video' to bring all of these together, virtually speaking, by way of teleconsultation.

Experience with AIDMAN suggests that there are many benefits that are not currently provided by way of the traditional management of healthcare. They may be physical in nature, or more psychological. The benefits not only for the patient but also for healthcare professionals more generally are now outlined.

For the patient:

- By the end of the tele-consultation, they know whether, or when, they will be referred; the decision is made at that point.
- The advantage of being diagnosed both quickly and with minimum disruption to everyday life and work.
- No need to wait (and worry) about when the letter from the hospital will arrive.
- The patient has 'met' the specialist/consultant, and has started the initial, important, process of building a relationship with the person who will play an important role in their future treatment and care.
- The patient has the opportunity to ask questions ahead of their meeting with the specialist/consultant. This helps to manage their expectations and reduce anxiety about the unknown, that is, what is likely to happen.
- As the patient is sitting in a familiar clinic, with a familiar doctor/healthcare professional, the psychological and physical trauma associated with the subsequent visit to the specialist/consultant is alleviated.
- It may help patients to better understand consultation *before* they undertake it, and thus to better prepare for it, as well as to help to 'de-mystify' what is, to many, the unknown processes involved in their healthcare.
- It provides added reassurance, as they have been closely involved in the dialogue between the doctor/healthcare professional and the specialist/consultant, and can thus have confidence that both share a common view of their care and treatment.
- Management of the case is negotiated and agreed by all parties, that is, consultant, doctor and patient, thus the potential to make consultation more effective for all participants.
- It may help change the current perceptions that patients have of healthcare, namely, that they are relatively passive participants in the process. This brings with it the notion of 'advocacy'. Tele-consultation is a physical (at least) demonstration of the central role that *they* play in the process, and that they are (or should be) *active* participants who engage in the management of their own health.

For the specialist/consultant and the doctor/healthcare professional:

- They are in the same room (virtually speaking) at the same time; with the patient.
- It is interactive; the consultant and/or doctor can ask the patient as many questions as is necessary to get the information needed to make what is hoped to be the correct diagnosis.
- As full a history as is possible is available from patient/health professional (doctor, nurse, or other)/records.
- The patient may be unable, or unwilling, to explain their symptoms or feelings. The doctor/healthcare professional, (who will have had a longer and closer relationship with the patient), will thus have greater insights into the patient with regard to both their physical and mental state which may be of use to the specialist/consultant.
- No need for the doctor/healthcare professional to amass physical documents and send ahead to the specialist/consultant; this information is available to both at the time of the tele-consultation.
- The opportunity to call up/bring in new information as the tele-consultation progresses. For example, an old x-ray which, until that point, was not seen as significant/useful.

- By the end of the tele-consultation, they know whether, or when, the patient will be referred; the decision is made at that point.
- Confidence that the patient has received the message about referral.
- The specialist/consultant has 'met' the patient, and has started the initial, important, process of building a relationship.
- The specialist/consultant asks questions ahead of their meeting with the patient. This provides an opportunity for the specialist/consultant to help the patient to manage their expectations and reduce anxiety about the unknown, that is, what is likely to happen.
- As the patient is sitting in a familiar clinic, with a familiar doctor/healthcare professional, it provides an opportunity for the specialist/consultant to alleviate the psychological and physical trauma associated with the subsequent visit.
- It provides an opportunity for the specialist/consultant to help patients to better understand consultation *before* they undertake it, and thus to better prepare for it, as well as to help to 'de-mystify' what is, to many, the unknown processes involved.
- It allows for the doctor/healthcare professional and the specialist/consultant to have confidence that both share (or not !) a common view of their care and treatment.
- Management of the case is negotiated and agreed by all parties, that is, consultant, doctor and patient, thus the potential to make consultation more effective for all participants.
- It may help change the current perceptions that doctors/healthcare professionals and specialists/consultants have of patients and/or healthcare, namely, that patients are relatively passive participants in the process. This brings with it the notion of 'advocacy'. Tele-consultation is a physical (at least) demonstration of the central role that *they* play in the process, and that patients are (or should be) *active* participants who engage in the management of their own health.
- An opportunity for doctors/healthcare professionals and specialists/consultants to learn from each other more about patients, disease, treatment and related aspects of the management of healthcare.
- An opportunity for doctors/healthcare professionals and specialists/consultants to 'bridge the gap', psychologically speaking, that is seen to exist between primary and secondary/tertiary healthcare.

Limitations of Telemedicine Platform

As for limitations with regard to AIDMAN, as with the adoption of any information system, there are the difficulties associated with using technology in the workplace. Although research demonstrates that patients accept teleconsultation as a medium for communication and decision-making about their health, rolling out AIDMAN for use in other surgeries/clinics or other healthcare settings is not just a matter of installing the equipment, although there are technical issues which might limit its uptake on a national scale. One of these limitations is the cost not only of installation but also of maintenance and, as anyone who uses computers and related technology knows, a high level of ongoing support is required given the inevitable breakdowns. If there are too many breakdowns, then doctors, nurses and other healthcare professionals will not want to use it, however useful it might be to their clinical work. Another limitation to a system such as AIDMAN is that it necessarily changes the relationships between all involved. Although the teleconsultation brings the doctor/general practitioner (and/or nurses, for example) and the specialist/consultant together, virtually speaking, it has to date been used with healthcare professionals who are positive and enthusiastic, who have (or feel that they have) the necessary interpersonal and other skills to effectively carry out the interaction and who do not mind having their own weaknesses exposed to others, in particular, to the patient. So, for example, a newly-qualified doctor/general practitioner might feel threatened by having to discuss, in front of the patient, an aspect of healthcare with which they are unfamiliar, or admit that they have not carried out certain checks, administered certain treatments already, and so would be reluctant, or even refuse, to use AIDMAN. Installing a system such as AIDMAN provides an opportunity for all concerned to learn from each other more about disease, treatment and related aspects of management of care; but some are more resistant to change (which is what learning is all about) than others. There is thus the need for further research into the perceptions of a range of healthcare professionals in a variety of healthcare settings in order to ascertain the types of organisations, and people within them, who will be more (or less) likely to embrace such technology. It is also necessary to find out how, precisely, such technology should be brought onstream in a new setting; it has been installed over several years at

Chorleywood in the UK and installing and using it elsewhere will likely need new, and perhaps different, methods and approaches. An information system such as AIDMAN does, of course, cost money. In order for other healthcare professionals to consider its use in their own healthcare settings, there will be a need to provide further explanation as to what particular clinical issues are likely candidates for tele-consultation and which are not. So, for example, although teledermatology has been used with much success, there are some dermatological cases which do not lend themselves to such intervention; the doctor/general practitioner should instead immediately refer the patient to the specialist/consultant.

The majority of telemedicine projects span aspects of healthcare as diverse as mental health, diabetes or foetal monitoring. Each system is designed differently, is unlikely to be compatible with another and needs different technical support and user training. Whilst such individual systems have proved useful in a particular context (see, for example, Gilmour et al, 1998; Jones et al, 1996; Lesher et al, 1998; Loane et al, 1998; Lowitt et al, 1998; Oakley et al, 1998), the implications for a national healthcare system mean that each clinic, hospital or other healthcare setting would need to purchase a different technological device for each particular healthcare issue. So, a system for diabetes, another for mental health and yet another for foetal monitoring, and so on. In addition, each device would need different technical support and different user training and would, naturally, take up a great deal of space in the workplace. Maintaining such systems would be problematic and expensive, particularly given the rapidly-changing nature of information systems today. It would also be very expensive. In a country such as the UK, where (scarce) financial resources for healthcare come from the taxpayer, it is difficult to see how those managing the healthcare budget would justify the cost in investing in such single, one-issue systems. Another difficulty of such one-issue systems is that a great deal of effort would have to be made in persuading doctors/general practitioners or specialists/consultants to use such systems; only around 12% of these healthcare professionals have computers on their desks and, like many, may not embrace technology with the same enthusiasm as their designers.

The Significance of the Telemedicine Platform

The significance and value of AIDMAN is that it can be applied/used for *every/any* healthcare issue. Indeed, one of the limitations of other systems is that they will not be cost-effective if health service providers have to buy a separate system for different healthcare issues. Doing so would not only be more expensive but it would likely mean a clinic/surgery cluttered with technological devices, each of which would require different training and support. It is difficult to see how, in a healthcare climate where technology is little used that healthcare professionals would be tempted to invest in such a seemingly bewildering array of technological 'kit', particularly at a time when it is claimed that the health service is regarded as struggling. Although much of this work is carried out with patients and healthcare professionals in the workplace, usually the hospital or clinic, telemedicine is perceived to become even more useful in the future in the care of people in their homes.

Our experience leads us to conclude that AIDMAN has demonstrated its use and efficacy across a variety of healthcare issues as diverse as dermatology, cardiology and vascular surgery; oncology is soon to join these. It has proved a versatile platform, and as such should prove cost effective when used in this way. The physical and psychological benefits of AIDMAN to both patient and healthcare professional are such that it allows for richer communication between the patient and the specialist/consultant and between doctor/healthcare professional and the specialist/consultant involved in the health and care of their patient. The roles of both the doctor/healthcare professional and the specialist/consultant differ from the traditional ones, in particular, the role played by the doctor/healthcare professional in primary care. Here, they act more in the role of 'advocate' for the patient during the consultation. Our future research agenda includes looking at how, precisely, the consultation process is changed and, importantly, to explore the impact of this on health outcome. Further research and analysis of tele-consultation sessions so far carried out will reveal to what extent these do, or do not, mirror more 'traditional' consultations and whether such a model varies according to clinician, illness or any other factor(s). In order to roll out AIDMAN for use in other surgeries/clinics or other healthcare settings, there is a need to find out the technical, social and other issues which might limit its uptake on a national scale. Another is to explore to what extent AIDMAN can be used by healthcare professionals to learn from each other more about disease, treatment and related aspects of management of care, and how this affects the quality of their decision-making.

Referral to a specialist is an important aspect of healthcare, regardless of how healthcare is organised at local and/or national level. That said, there are important differences related to context. By way of example, Forrest (2003) reports that patients in the US are twice as likely as patients in the UK to see a specialist within any twelve-month period although rates of keeping appointments are almost identical. This makes discussion of the role of innovation in successful telemedicine somewhat problematic as what is 'successful' in one context may be regarded differently in another. Telepsychiatry in Canada (Bishop et al, 2002) is regarded by patients as highly successful for a variety of reasons. It would likely be reasonably easy to find plenty of studies in telepsychiatry which could be used to provide evidence that 'telepsychiatry is good', and that given these success stories healthcare organisations around the world should put into place such a service as soon as they can. However, on closer examination of the study, the success, as measured by patients, can be attributed to the fact that the alternative is no psychiatric service at all, or at least not without travelling considerable distance, as the patients live in the remotest regions of Canada. For such patients, *any* service, even if the level of service provided is regarded as poor (by clinicians) when measured against psychiatric services elsewhere, will be rated highly. Geographical location is but one factor which complicates discussion of what is meant by 'success'. Another is who is being asked. Having said that 'success' is problematic in that it does not exist per se but is instead dependent on context and who we ask to guage any telemedical intervention, innovation is another such issue. Technology plays a vital part in all of our lives these days, and this is as true for the healthcare services as anywhere else. What is important, of course, is that we, as humans, do not allow ourselves to be so seduced by the technology that we lose sight of what it is, that is, a tool. And, like all tools, they are not useful or 'good' in themselves. A spoon is, for instance, a great tool if you want to eat icecream but useless if you want to speak to someone in another country. People, in this case patients, do not want innovation, they want to be made better, and as efficiently and effectively as possible. And governments or organisations who pay for healthcare want it done as cheaply as possible. Cost, however, is problematic. It can be measured (with difficulty) in terms of dollars perhaps, with low cost being seen as synonymous with 'success'. Indeed, Whitten et al (2002) make it clear from their study of 612 articles which attempted to measure actual cost benefit data of telemedicine services that there is absolutely no good evidence that such benefits exist. We might conclude from this that telemedicine on a wider scale, nationally and internationally, might thus be doomed. However, one of the difficulties with this evidence is that it is naturally gathered only from small-scale projects, in one location, for one particular healthcare issue. Given this, it is unsurprising that these have not proved cost-effective; they are measured as stand-alones, and contrasted with normal practice for a particular cohort of patients undergoing a particular type of treatment or path. Instead, we need to envision something far more radical; the AIDMAN system (if it can be called that) as *the* system, on a national scale. Unfortunately, a randomised clinical trial, so often seen as the only reasonable and/or reliable method of testing a new service or drug in journals the healthcare sector is clearly not going to be possible. What is proving, to us at least, far more difficult to model is the cost (economically and otherwise) of having such a system operating across the whole healthcare sector in the UK. We are working on it, however !

It would seem to us that implementing a local, national or even global information system, in this case a healthcare one such as AIDMAN, is not about healthcare per se but instead about the ability to successfully manage change. As Fitzgerald et al (2000) note, this cannot be reduced to a set of 'critical success factors'; human behaviour (and that is what we are talking about with information systems) is far more complex than that. However, successful information systems might be characterised as having the following:

1. Driven by the business need rather than the technology.
2. Clear backing and commitment from many within the organisation.
3. Any project, big or small, must have its champions, and at different organisational levels. Such 'movers and shakers' must be prepared to carry their vision through and to be accountable for its implementation.
4. Teamwork within the organisation more generally.
5. Teamwork at the level of the development itself.
6. Humour and common sense (this is in extremely short supply in any organisation, unfortunately !).
7. Involve the users of the ICT when designing it.

8. Project management is clearly a vital factor in ensuring a project's success. However, 'project management' is as much about 'people management' as managing the actual product, the system, itself.
9. Central to the success of any new system, whether an ICT one or otherwise, is the management of people's expectations.

In the end, all systems development, or indeed any change, is about the management of risk. Do those 'movers and shakers' exist in the National Health Service and the government in the UK ? Do they have a vision and the skills and abilities to make it work in practice ? The cynics amongst us would perhaps doubt that such organisations, loathe to change as they are, have such people. As patients, we can only hope that they do !

REFERENCES

Baldwin L. P., Eldabi T. and Paul R. J. (2002) Clinical information systems: augmenting case management. Proceedings of the *Seventh Annual Conference of the UK Academy for Information Systems (UK AIS)*, Leeds, UK, 10-12 April 2002.

Bishop J. E., O'Reilly R. L., Maddox K. and Hutchinson L. J. (2002) Client satisfaction in a feasibility study comparing face-to-face interviews with telepsychiatry. *Journal of Telemedicine and Telecare* 8, 4, 217-221.

Clarke, M. and Jones, R. W. (2001) What route to viability for telemedicine in the UK ? *Proceedings of the Healthcare 2001 Conference*, Harrogate, UK, March 2001, 190-195.

Clarke, M., Lioupis, D., Kanellopoulos, N., Jones, R. W. and Nassiopoulos, A. (2000) AIDMAN – Advanced Informatics Distributed Medical Access Network. *Proceedings of the Geomark 2000 Conference*, Paris, France, April 2000, 203-206.

Clarke, M., Jones, R. W., George, S. and Cairns, D. (1999) Teledermatology – the UK experience of setting up an integrated teledermatology service. *Proceedings of the Medical Information and Education 1999 Conference*, Ljubljana, Slovenia, August 1999, 274-277.

Clarke, M., Jones, R. W. and Lioupis, D. (2000) The AIDMAN project: a practical investigation of some of the challenges in telemedicine. *British Journal of Healthcare and Information Management* 17, 5, 24-26.

Clarke, M., Jones, R. W., Kanellopoulos, N., Lioupis, D. and Nassiopoulos, A. (1999) AIDMAN – Advanced Informatics Distributed Medical Access Network. *Proceedings of the Medical Information and Education 1999 Conference*, Ljubljana, Slovenia, August 1999, 625-630.

Fitzgerald G., Baldwin L. P., Klecun-Dabrowska E. and Siddiqui F. (2000) IT at the heart of business; a strategic approach to information technology. *The IS Management Series* volume 1, The British Computer Society, Swindon, UK.

Forrest C. B. (2003) Primary care gatekeeping and referrals: effective filter or failed experiment ? *British Medical Journal* 326, 692-695.

Gilmour, E., Campbell, S. M., Loane, M. A., Esmail, A., Griffiths, C. E., Roland, M. O., Parry, E. J., Corbett, R. O., Eedy, D., Gore, H. E., Mathews, C., Steel, K. and Wootton, R. (1998) Comparison of teleconsultations and face-to-face consultations: preliminary results of a UK multi-centre teledermatology study. *British Journal of Teledermatology* 139, 1, 81-97.

Hawkes, N. (2001) Gates unveils vision for online NHS of the future. *The Times*, 7 December 2001, 10.

http://www.nhs.uk/thenhs explained. *The NHS Explained.* Date accessed: 24/01/2002.

Jones D. H., Crichton C., Macdonald, A., Potts, S., Sime, D., Toms, J. and McKinlay, J. (1996) Teledermatology in the highlands of Scotland. *Journal of Telemedicine and Telecare* 2, 1, 7-9.

Jones, R. W., Clarke, M., Kanellopoulos, N., Lioupis, D. and Fowles, R. (1999) The AIDMAN project – a telemedicine approach to cardiology investigation, referral and outpatient care. *Proceedings of the Telemed 1999 Conference*, London, UK, November 1999, 32-34.

Lesher, J. L., Loretta, S., Davis, F. W., Gourdin, D. E. and Thompson, W. O. (1998) Telemedicine evaluation of cutaneous diseases: a blinded comparative study. *Journal of the American Academy of Teledermatology* 38, 1, 27-31.

Loane, M. A., Corbett, R., Bloomer, S. E., Eedy, D. J., Gore, H. E., Mathews, C., Steele, K. and Wootton, R. (1998) Diagnostic accuracy and clinical management by realtime dermatology; results from the Northern Ireland arms of the UK Multicentre Teledermatology Trial. *Journal of Telemedicine and Telecare* 4, 2, 95-100.

Lowitt, M. H., Kessler, I. I., Kauffman, C. L., Hooper, F. J., Siegel, E. and Burnett, J. W. (1998) Teledermatology and in-person examinations: a comparison of patient and physician perceptions and diagnostic agreement. *Archives of Dermatology* 134, 4, 471-476.

Oakley A. M., Duffill M. B. and Reeve P. (1998) Practising dermatology via telemedicine. *New Zealand Medical Journal* 111, 1071, 296-299.

Payton, F. C. and Brennan, P. F. (1999) How a community health information network is really used. *Communications of the ACM* 42, 12, 85-89.

Rodger, J. A. and Pendharkar, P. C. (2000) Using telemedicine in the Department of Defense. *Communications of the ACM* 43, 3, 19-20.

Summerton, N. (2000) Diagnosis and general practice. *British Journal of General Practice* 50, 995-1000.

Whitten P. S., Mair F. S., Haycox A., May C. R., Williams T. L. and Hellmich S. (2002) Systematic review of cost effectiveness studies of telemedicine interventions. *British Medical Journal* 324, 1434-1437.

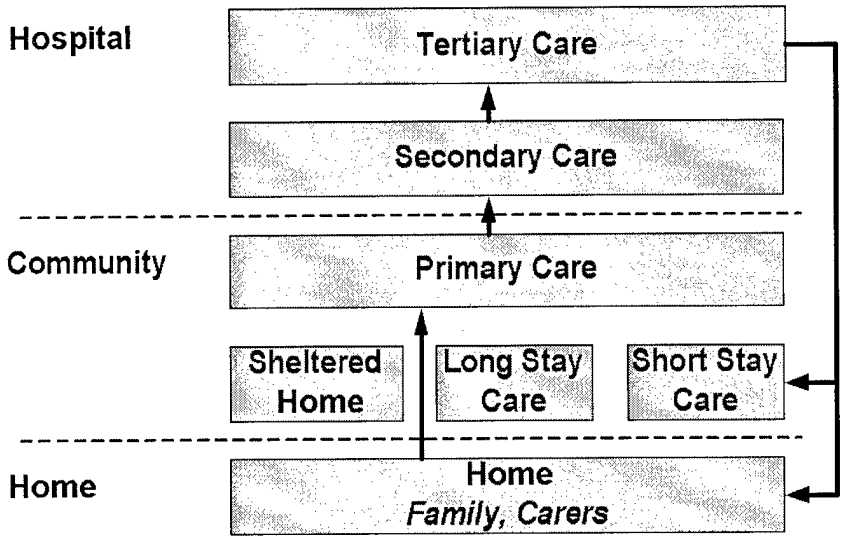


Figure 1: Health care structure

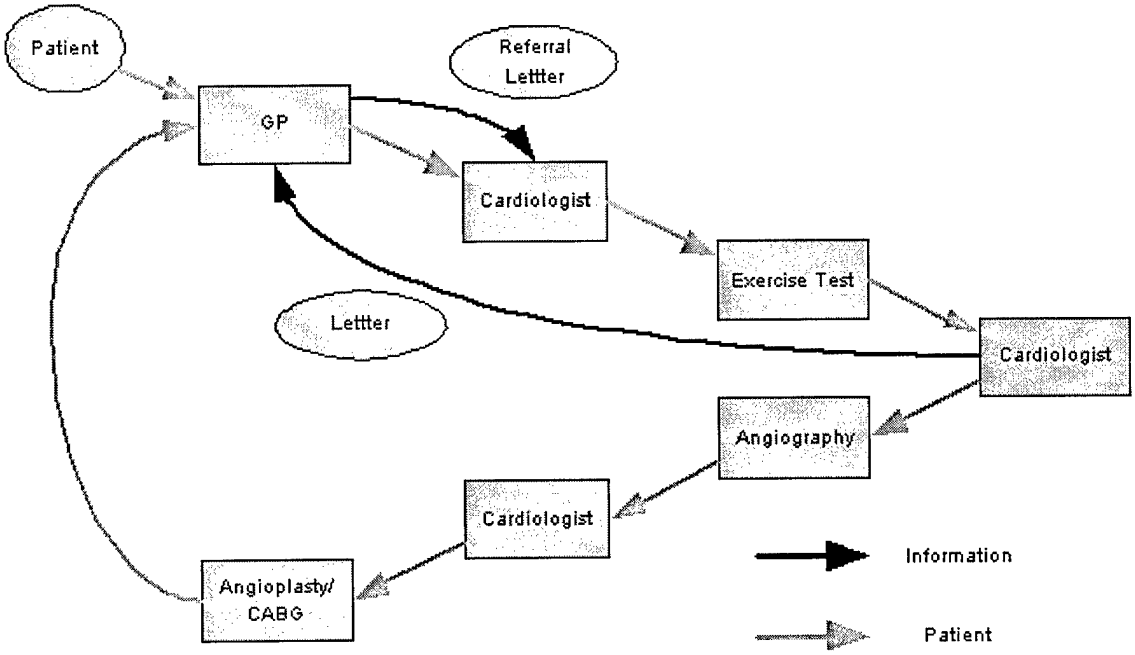


Figure 2: Pathway of Care for Coronary artery Disease

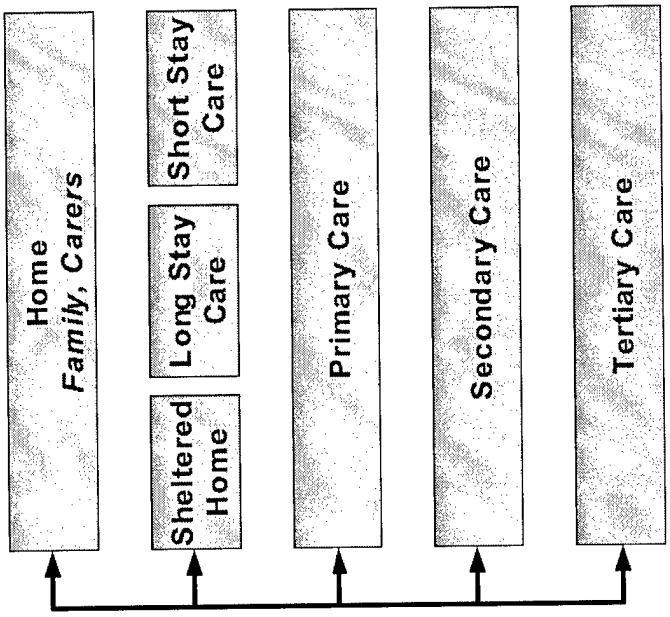


Figure 3: Health Care Structure of the AIDMAN Platform

Figure 4: Patient (left) and local nurse (right) during a dermatology teleclinic. There is a digital camera which gives real time analogue video and can capture very high resolution digital image of same scene. A second camera on top of monitor is used for "talking heads".

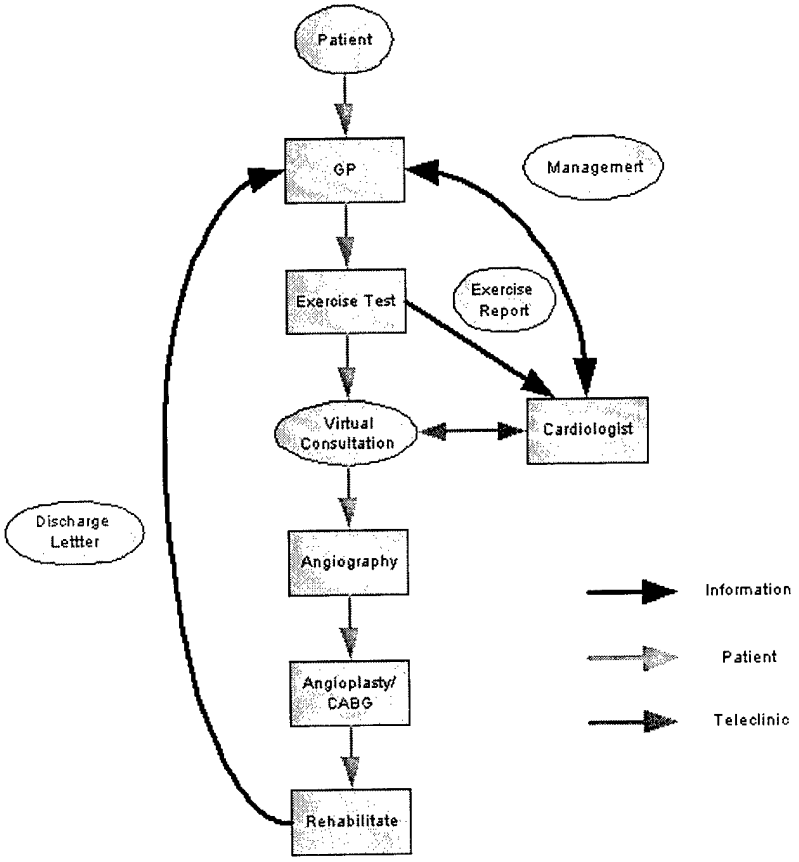


Figure 5: Technology supported Pathway of Care

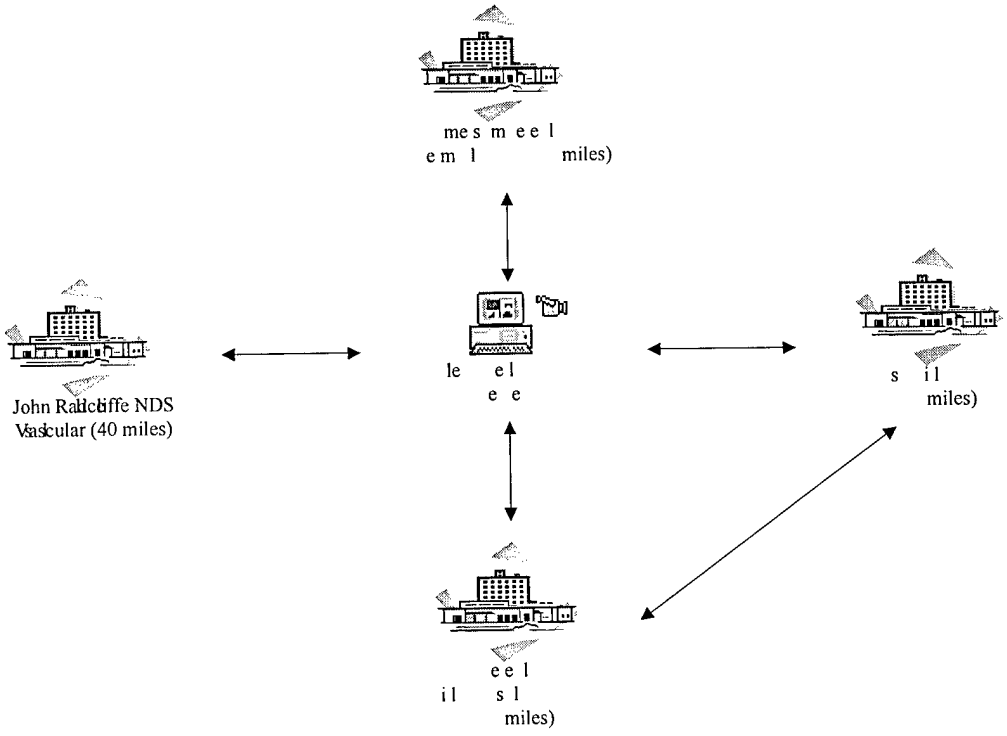


Figure 6: An Illustration of the current AIDMAN Project between the Primary Care and the Secondary Care Levels.

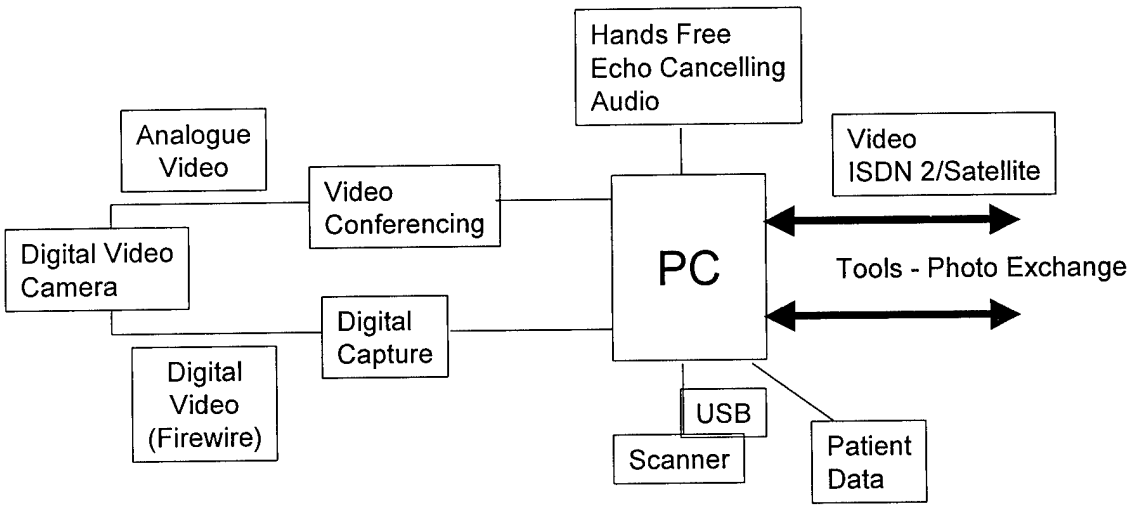


Figure 7: The Architecture of a teleclinic in an end-station

Appendix F

Electronic Prescription System, USE IT or Leave IT

Ton A.M. Spil
Roel W. Schuring
Margreet B. Michel-Verkerke
University of Twente
Department of Technology and Management
PO BOX 217
7500 AE Enschede THE NETHERLANDS
phone: +31 -53-4893497, fax. + 31 53 4892159
e-mail: a.a.m.spil@utwente.nl

Managing People in Telemedicine and e-Health:
A Global Perspective

April 2003

Electronic Prescription System, USE IT or Leave IT

Abstract

User-adoption of new IT-applications is the proof-of-the-pudding when it comes to IT-success in Healthcare. As a consequence, many studies are made of the role of the users in the introduction of new IT in both theory and practice. User satisfaction is widely accepted as a criterion for IS success. However, to understand IS success or failure, it is necessary to recognize its social and technical causes.

*The **USE IT** model has four determinants that have to be balanced in assessing the diffusion and use of information systems. **Resistance** is defined as the degree to which the surroundings and locality negatively influences the users of IT and the degree to which IT-users themselves are opposing or postponing the IT change. **Relevance** is the degree to which the user expects that the IT-system will solve his problems or help to realize his actually relevant goals. Micro-relevance is the degree to which IT-use helps to solve the here-and-now problem of the user in his working process. **Requirements** are defined as the degree to which the user needs are satisfied with the product quality of the innovation. **Resources** are defined as the degree to which material and immaterial goods are available to design, operate and maintain the information system.*

*The empirical results of this qualitative study with 56 cases show that time and communication are the most important factors for General Practitioners for the diffusion and use of an Electronic Prescription System (**EPS**). The social aspects and technical aspects have to be balanced to get to real use of the information system. The (job) relevance of the EPS to the working process of the professional was in all 56 cases the most important determinant. The resistance of the professional that is often used as main reason for plateaued diffusion showed to be the cumulative effects of the other determinants. For instance a GP with limited resources (like a slow PC) will get annoyed by the waiting time and will resist the new system using a lot of processing time. At first the technical determinants, requirements and resources, seemed to be a prerequisite for the social determinants. Analysis of this presumption showed that a thorough check on resources is necessary and that a user-provider contract on requirements would help bridging the information gap.*

Introduction

Successfully implementing information systems in healthcare organizations appears to be a difficult task (Berg, 2001). Information Technology is seen as an enabler of change in healthcare organizations (Pare and Elam, 1999). Southern (1999) suggests that (information) technology adoption decisions in healthcare are complex because of the uncertainty of benefits and the rate of change of technology (Walley & Davies, 2001).

Thornett (2001) describes benefits as improve quality of care, disease prevention and disease management of chronic physical illnesses. Why then, these systems do not

diffuse into the health organizations? The adoption of information technology in healthcare has increased which underlines the importance of user requirements (Beuscart-Zephir et al, 97). In later work she links the adoption to the activities of the healthcare professionals (Beuscart-Zephir et al, 2001). Fleisner and Hofkircher (1998) refer to the same problem when they conclude that relevant information will not be improved unless additional requirements are met.

A multiple case study amongst 56 general practitioners (GP's) on the influence of resistance, relevance, requirements and resources on the introduction of an Electronic Prescription System (EPS) demonstrates that the EPS is not used in at least 72% of the cases. First, a broad background of the model is given. To explain the non use of the system we combine the notions of information usage of Delone and McLean (1993) and Davis (1988) and the notion of innovation from Rogers (1983). We use the semantic ladder from Stamper (1973) and information levels from Shannon and Weaver (1949) to straighten them out. To explain relevance we use the notions of Saracevic (1975). This will be described in the definition and framework section. Together these concepts build up an interview model that we used in all cases as described in the case study method just before the empirical results. Finally we make conclusions for every determinant of the model.

Background

We can use a wide range of sources that discuss user-perspectives in IT-introduction. This section gives a short overview of intriguing literature. The aim is to demonstrate that the four determinants explained separately in the next section should be handled as a whole dynamic interrelated set of quality criteria. One of the ultimate goals of our research project in this field is to propose a model that neatly balances the role of such factors.

First, such factors may be looked for in general literature on change and on the introduction of new technologies. For example, in the balance model of organizational change risks, Leavitt (1965) introduced four domains in which these risks will occur: tasks, structure, technology and people. Offenbeek & Koopman (1996) connect people with resistance potential because they can feel that the quality of their working life will be decreased. Mumford (1995) observed that user participation contributes to effective organizational change. Wissema (1987) defines resistance as willingness to change and the difference between results and expectations.

When we focus on IT introduction more specifically, we again see a number of interesting literature sources. Thong & Yap (1995) discuss the user-satisfaction approach to IT effectiveness. They mention the debatable operationalization, poor theoretical construct and misapplication as critics to the approach. On the basis of their review, they conclude that attitude is the construct that lies at the root of user-satisfaction, and suggest ways to improve operationalization and measurement of attitude. Paré & Elam (1999) studied attitudes, expectations and skills in relation to physicians' acceptance of IT systems. Physicians with formal training on computers were more knowledgeable about informatics concepts and reported that computers would be more beneficial to health care, although it is not clear whether the training causes this attitude. Also, it becomes clear that user-priorities regarding IT-innovations vary strongly. The functional uncertainty is often described in information systems literature. It occurs in the task domain of Leavitt. In each

situation, the interpretation and the meaning can be different. Therefore, it is necessary to establish a functional specification with user and providers of the information systems. Henry & Stone (1999) state this to be information quality. Larsen (98,p.413) notes however "the quality of the IS/IT product is a necessary but not sufficient prerequisite for IS innovation success. The *people* within the organizations determine the outcome." Within the healthcare sector, Walley & Davies (2001) conducted a study to the internal barriers to technological IT-advancement in the healthcare sector. The involvement of stakeholders is arguably one of the most distinctive characteristics of IT projects. There are instruments to identify user-needs, but they question whether they are actually used. Van der Pijl (1994) shows that there is more to say about people than just resistance or user participation. Both users and providers of information systems have their own targets, not necessarily going hand-in-hand. A central question is whether the provider intention is the same as the user interpretation (Sperber & Wilson, 1986).

Finally resources (human, physical and monetary components, Ansoff, 1965) are needed to implement the new information system into the organization. The human resources can both be insufficient in time and in experience (risk of technology). Insufficient material resources (Offenbeek & Koopman, 1996) will have a limiting influence on the other three risk domains.

In this chapter, we will focus on all four determinants of user-adoption of IT in healthcare, i.e., resistance, relevance, requirements and resources. It is most important to elaborate the construction of a framework that brings these factors together. Saarinen & Sääksjärvi (1995) point out that different factors act as critical success factors under different circumstances and make a distinction in process fcators and product factors. This will also apply when a framework of success factors is limited to user-related factors. Figure 1 gives an overview of the USE IT model.

USE IT model	User Domain	Information Technology Domain
Product	Relevance	Requirements
Process	Resistance	Resources

Figure 1 – USE IT model.

USE IT: Definition and Framework

Resistance

The tendency of human beings to resist and fear new and unknown things and the willingness to stick to the familiar procedures has been studied widely. (e.g., Goodstein and Burke 1997; Lanning 1996; Lewin 1952). Attributing the rejection of innovations only to anxiety and fear of change, however, is an oversimplified view of the process of technology transfer (Raghavan and Chand 1989)
Carey (1988) finds a correlation between acceptance of change and variables such as previous use (experience), education, and current usage of a new system. She also reports commitment, exposure to change, and preparation for change are important for successful implementation of new technologies and systems. So a much broader view on the subject of resistance is appropriate.

We start with the first known published reference to research on resistance to change in organizations by Coch and French (1947). They were early explorers in the world of resistance when they concluded that "by preventing or greatly modifying group resistance to change, this concomitant to change may well be greatly reduced". Besides taking notion of resistance influencing successful change they state that it can be different on group and individual level. Later change management literature categorizes into the individual, group and organizational (structure) levels.
On the group level, Lewin (1952) refers to "group standards" when looking for reasons for resistance to change. He concludes that the more individuals take group standards of their environment, the greater will the resistance to change of an individual group member be. Lewin further continues that group standards with social values are often referred to as "social habits". The mean for reducing the level of resistance may thus be either to diminish the strength of the value of the group standard or to change social habits itself.

Both Lawrence (1954) and Zuboff (1982) conclude that resistance is not simply an irrational phenomenon to be overcome (Malinconico, 1983). Zuboff sees positive and negative aspects to resistance. This healing effect of resistance is described by more authors (deJager, 2001, Folger & Skarlicki (1999), Piderit, 2000, Binney 1995). Insightful and well-intended debate, criticism, or disagreement do not necessarily equate to negative resistance, but rather may be intended to produce better understanding as well as additional options and solutions.

Kotter & Schlesinger (1979) diagnose resistance from the negative viewpoint as:

- Parochial self interest (fear to loose something worthwhile (Wisssema, 1987));
- Misunderstanding & lack of trust;
- Different assessments (believe that change is worthless (Wissema, 1987));
- Low tolerance for change.

Fuller (1969) also discovers different levels of concern regarding resistance. Self concern can be seen in awareness, personal commitment and personal consequences. Task concern is related to controlling the change and cooperation concern sees both concerns in collaboration and reengineering. Schmidt (et al, 2001) whose study was a mirror of control for this study refers to Zmud (1979) who adds a fourth environmental category. Lapointe (et al., 2002) applies these categories in explaining the dynamics of IT adoption in healthcare. She based her theory on the theory of reasoned action where "individual behaviour is directly determined by one variable-intention-which, in turn, is determined by two variables: attitude and subjective norms". In line with Scott (1985), Prasad and Prasad (2000) make the distinction between formal and informal (routine) resistance. Strebel (1996) already described this as personal compact, formally a job description and appraisal but informally psychological (mutual expectations) and socially (cultural values).This brings us back to the notion that change is intensely personal (Duck, 1993) and therefore our empirical material is gathered very close to professional coping with the change.

Kotter & Schlesinger are mainly interested in the self concern. Mittelstaedt (et al, 1976) adds the inability of either individual or group to cope with the change. Also the situation can call for postponement. The situational factors we see as mainly emerging on organizational level.

1. Not for them (reject)

2. Unwilling or unable (accept)
3. Postpone (time and situation) (accept)

Gatignon & Robertson (1989) and Szmigin & Foxall (1998) use sort like distinctions, the latter introduce opposition instead of unwilling or unable. Ram and Sheth (1989) call this habit resistance and also relate to Rogers (1983) when they state that often an initial resistance has to be overcome. Please note that most of the literature in this paragraph is based on resistance of consumers. It might not always apply in a healthcare environment.

Offenbeek & Koopman (1996) introduce the resistance potential and make a distinction between change-ability of the problem system and desired change. This potential of resistance would be people-determined resistance according to Marcus (1983), System determined resistance is handled in the technical determinant of IS success but the interaction determined resistance which is mainly political (inter)organizational resistance can only be seen within the reasons to postpone of Mittelstaedt (et al, 1976).

Other publications on the subject of resistance challenge or enhance the "accepted" concepts (Dent E.B. & Goldberg S.G, 1999). Piderit (2000) suggests that resistance to change is a complex, multidimensional response with emotional, cognitive, and intentional components. For example no participation or not enough communication, may result in an emotionally resistant attitude to the changes, even though the changes make good business sense (cognitive). Alternatively, initially enthusiastic (emotional) and clearly seeing the need for change (cognitive), people give up (i.e., our intentions change) because they are not given the support they expect and think they'll need in order to make the changes happen. It is rare that employees are all negative or all positive across the three dimensions. It is important to remember that resistance to change is normal and frequently functional.

"Moving too quickly toward congruent positive attitudes toward a proposed change might cut off the discussion and improvisation that may be necessary for revising the initial change proposal in an adaptive manner." In other words, discussion, disagreement and experimentation consistently can lead to more successful change, whereas effective communication and participation are powerful tools for overcoming and avoiding misunderstandings (Binney, 1995).

Zaltman and Duncan's (1977) resistance framework discusses four categories of barriers, "cultural, social, organizational, and psychological" that can obstruct change. These categories are in turn broken down into a total of eighteen resistance factors, which disrupt change efforts and distort adopter perceptions of innovations.

This framework can be useful because it explores change from the opposite perspective to most other models. By focusing attention on factors that erect barriers to change, Zaltman and Duncan help to recognize such obstacles as they arise or even to identify and address their underlying issues before they arise. It is important to note that a given individual can harbor intense pro-change and pro-resistance sentiments simultaneously.

Though detailed in its 18 factors, this framework is not suitable for the goal of this study. More appropriate is a model with its roots in change management, educational and training literature, structuring resistance and affection into three categories; Ability, Attitude and Opportunity. (Metselaar et al, 1996) describes this used in

training against (negative) and with (positive) resistance based on a concept from the social psychology (Ajzen and Madden, 1986). Lanning (2001) comes with the same result in an empirical study for a planned change approach. We adopt these findings into our "framework for resistance to IT change" where we should reckon that the main focus of these shifts from (inter)organizational, to group, to individual. In line with the USE IT model (Schuring & Spil 2002) this subdivision is made into macro –and micro relevance.

Attitude(Will) to change

People who are expected to participate in the change project must have personal motivation and a sincere will to engage themselves in the development. Comprehension and acceptance of the basic idea in the project is an important condition. Will does not occur unless real effort at developing the organization can be perceived.

Ability to change

The level of knowledge and skills of those who are involved in a "change" project needs to be high enough to be able to contribute to the project. Job specific skills enabling people to use new tools and technology and to act according to new procedures and tasks must be adequate. But ability also means comprehension of project vision and understanding one's own role in implementing the new technology. The user experience also adds up to his ability to change.

Opportunity to change

Organizational systems (surrounding people and structures) to support the development process and implementation of the new technology. Sufficient resources, top management support and commitment are essential to giving everybody the feeling that change and development can be achieved.

These sub-dimensions of resistance fit underneath the user satisfaction research model of Mahmood (et al, 2000) as they call it user background and organizational support. The perceived benefits that complete the user satisfaction are in the USE IT model situated under the relevance determinant (Schuring & Spil, 2002) and not described in this paper.

Relevance

Saracevic (1975) defines relevance is a measure of the effectiveness of a contact between a source and a destination in a communication process. This is a somewhat abstract wording of what we would call the degree to which the user expects that the IT-system will solve his problems or help to realize his actually relevant goals. There are three dimensions that are kept implicit in Saracevic' definition that we wish to stress. We use the word "expects" since we want to stress that relevance is a factor that is important in the course of the adoption process, not only in evaluation. Second, instead of effectiveness we use "solve problems and goals". By doing so, we imply that effectiveness has two dimensions: to take away existing negative consequences (problems) and, to reward with positive consequences (reach goals). Third, the word *actual* is crucial in our view of relevance. Relevance is not to be confused with the degree to which the user considers outcomes as being positive. The set of outcome-dimensions that someone considers "positive" is larger bigger than the set of

outcome-dimensions that are relevant. Imagine a physician, who basically considers IT-outcomes of a computer decision support system, such as, assistance in diagnosis, disease prevention, or more appropriate dosing of drugs (Thornett, 2001), as " positive". This does not automatically imply that the IT-adoption is relevant to him. It is only relevant if these dimensions are high on his goal agenda. That is why we use the word actual. Again, this is a more explicit wording of a dimension that is implicitly included where Saracevic' uses the word effectiveness in his definition. The actually relevant goals may be a mix of short-term goals and long-term goals. If, for example, smooth communication with hospitals or pharmacy is his prime actual problem or goal, he will only consider the IT-innovation as relevant when it actually helps to improve that communication, notwithstanding the fact that he might have a positive attitude towards that innovation as long as the innovation helps to solve other problems or other goals that are on the lower positions in his agenda-ranking. We discovered in our case-studies that it is not sufficient for an innovation to effectuate a positive attitude amongst users. The IT-innovation should be relevant.

Micro-relevance is a related concept that can be used to describe a similar phenomenon once the new IT is installed. Micro-relevance is defined as "the degree to which IT-use helps to solve the here-and-now problem of the user in his working process". The use of new equipment or new IT-procedures is a conscious activity. In every conscious activity that is goal-oriented to a specific goal, there is a reason why that course of action is being chosen. Similar to what was discussed above on "relevance", not every course of action that a user basically considers as "positive" is "micro-relevant". Again, let's illustrate this with an example. Imagine a patient with virus infection visits a physician. The physician might notice the similarity to a number of other patients he has met that week and decide on diagnosis and treatment fairly quickly. To this doctor, the use of a decision support system to determine diagnosis is not micro-relevant. However, a colleague of his may not feel so confident and thus use the system. We discovered that micro-relevance is a key factor in explaining IT-use in our case-studies. Box 1 gives an overview of relevance as we propose to use it.

Relevance and micro-relevance are notable refinements of the way the role of the user is being discussed in the existing literature. Thornett (2001) implicitly refers to relevance and micro-relevance when he states discusses limited adoption and use of DSS by primary physicians where "consultation time is lengthened by their use and there is no appreciable impact on patient satisfaction". It is an example where other outcomes that are basically considered as positive (as mentioned above: better diagnosis, more appropriate dosing of drugs, and other) are overruled by limited relevance and micro-relevance.

Saracevic (1975) provides a historic positioning of relevance. The roots lay in the 1930's and 40' where the distinction between information and relevant information is made by Bradford (Saracevic 1975:324). In order to make the distinction between relevant and non-relevant information, he discusses the nature of communication. By doing so, he recognizes that relevance to a subject depends on specific dimensions, like for example, the subject's knowledge, representation and values. He discusses a number of (philosophical) approaches to relevance. The elaboration we propose above builds on the radical pragmatism-perspective or, more specifically, Cooper (1971)'s utility function "Relevance is simply a cover term of whatever the user finds to be of

value about the system output, whatever its usefulness, its entertainment, or aesthetic value, or anything else". Wilson (1973) adds to this that relevance is situational. Ballantine (et al.,1999) put it in the following way: "Depending on the type of task, the information generated by the system may be more or less appropriate, which will affect its success or failure". Saracevic (1975) distinguishes various other approaches to relevance, of which a number focus on the basic source of relevance, like, logical relevance, the nature of interference and the pertinence view of relevance. We are very much aware of the fact that our elaboration of relevance does not in full retain the differences between those point of views. It is merely a practical elaboration that we use to predict user-adoption.

The pragmatic perspective of relevance that we choose resembles the notion of "relative advantage" as discussed in the Innovation Diffusion literature by Rogers. Rogers (1983, 1997) reserves a central role for "relative advantage", which is the user's view of "the degree to which an innovation is better than the idea it supersedes". Relative advantage can be economic or social. Rogers: "The nature of the innovation largely determines what specific type of relative advantage is important to adopters, although the characteristics of the potential adopter also affect which dimensions of relative advantage are most important. Based on a review of hundreds of empirical studies, Rogers concludes that relative advantage explains 49% of the rate of adoption of innovations.

It is most notable that the organizational factors are not explicitly included in our user-relevance framework. It should be kept in mind that user's agenda of problems and goals depend of his role in the society (Barnard, 1938) The influence of the organization on this agenda depends on many aspects, including the involvement with other organizations, on time and on place. As a consequence, our framework reflects the actual impact that organizational goals and preferences have on the user, and thus, on organizational behavior.

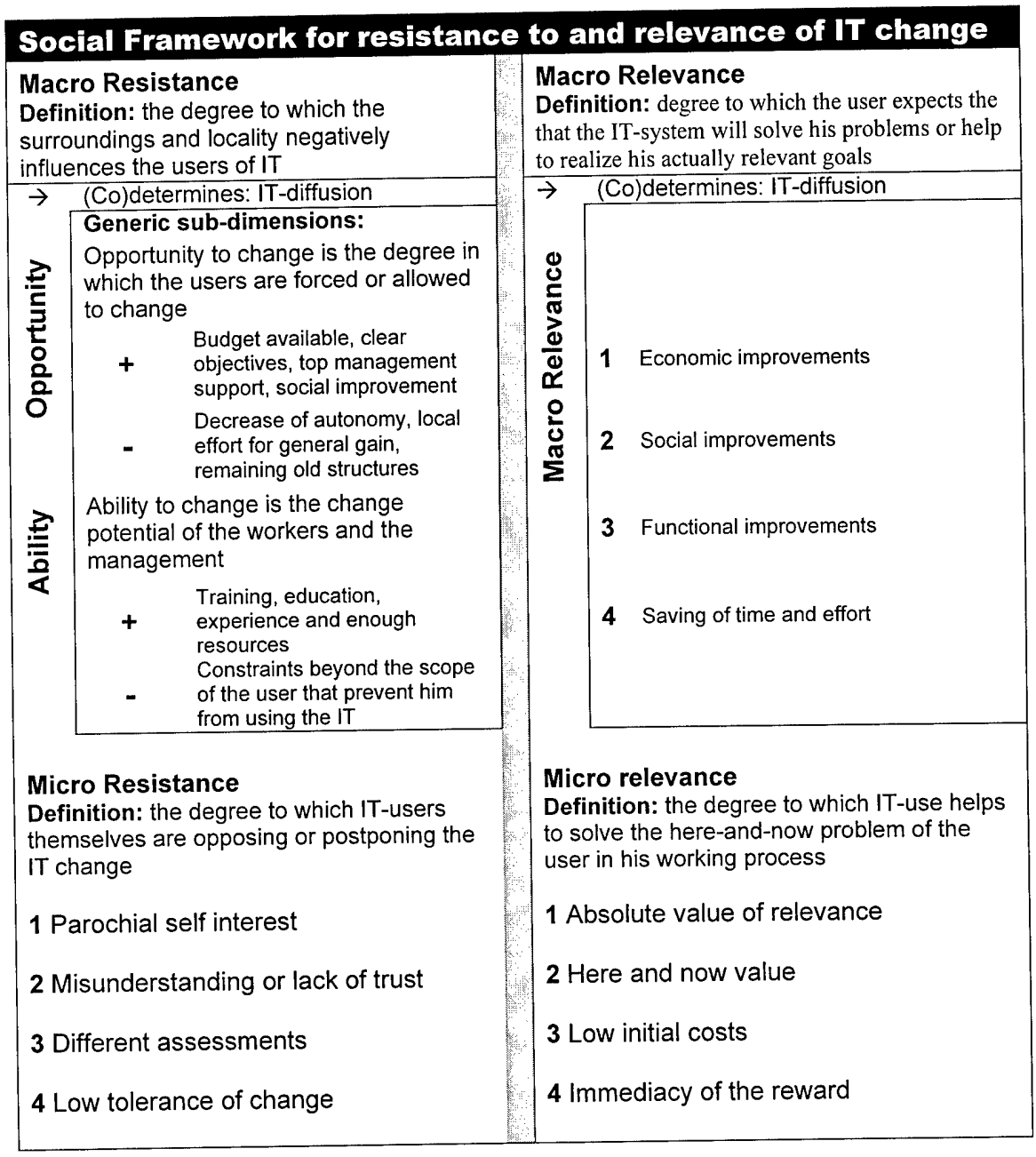


Figure 2 – Social Framework for resistance and relevance

Requirements

At the semantic level (Shannon & Weaver, 49, Stamper,73, DeLone & McLean, 93) we are concerned with how pattern-types relate to what happens in the world. On this level we deal with the meaning of the system but this term brings along a lot of different meanings about its definition (Cohen, 62). The meaning of a sign relates to the response the sign elicits in a given social setting (Liu, 93). It is situational of nature since we have a range of pattern-types that signify a certain meaning and a user (group) that interprets the expression (Spil, 93). Therefore it is necessary to establish

requirements as thorough as possible. Wieringa (1996) defines requirements as *desired properties needed to achieve the desired composite system properties.* Pressman (1982) makes a distinction between normal requirements, expected requirements and exiting requirements. Before defining requirements ourselves we want to study the problem at a deeper level.

'Many system designers do not appear to realize that with their present approach they are designing only partial systems' (Mumford, 95). She argues that all needs of the end users should be identified. The notion of variance emerged from some early socio-technical work design experiments in Norway (Mumford, 95). A variance is defined as *a tendency for a system or subsystem to deviate from some desired or expected norm or standard.* Key variances are the deviations on goals and functions, operational variances stem from the organizational problems. Together they get close to the main problem that we are addressing, the information gap between designer and user.

Iivari and Koskela (1987) include three quality constructs on semantic level which they call the input/output requirements: informativeness, accessibility and adaptability. Informativeness describes the potentiality of the information systems, accessibility the quality of the user-IS interaction and adaptability points to the ability of the systems to change.

DeLone and McLean (1992) enumerate the criteria from nine earlier studies. They declare themselves that there is not "one" measure of IS success but there are many dependent variables. They call their taxonomy on semantic level information quality. Usefulness or relevance is mentioned eight times in the nine studies. Schuring and Spil (2002) have studied the importance of relevance and made it a separate determinant on the pragmatic level. Timeliness is empirically used five times and adopted in our model. We keep using the term accessibility as a broader term including convenience of access. Accuracy is studied four times and adopted under informativeness. We do not understand why there is no notion of adaptibility or ability to integrate in the DeLone & McLean study. We adopt ability to integrate as the degree that the new system is imbedded in the organization.

Brender and McNair (2001) use the ISO 900x structure and use the strategic, tactical and operational level to perform their user requirements specification. Larsen (1999) also makes this distinction. The strategic level is concerned with the problem definition, including objectives and global task description. The tactical level is interpreted as a preferred approach and the operational level includes a set of functional, performance and capacity criteria.

Requirements are defined as *the degree to which the user needs are satisfied with the product quality of the innovation.* We divide the requirements into macro and micro requirements:

- Strategic general requirements and tactical approach is the degree in which the users agree with the objectives and methods used.
- Functional requirements and performance requirements specify what the content of the innovation should be. In this study we chose timeliness (accessibility), accurateness (informativenes), ability to integrate and content as main quality criteria but we acknowledge that this is more a framework than a complete list.

Resources

Under the semantic level most researchers situate the syntactical level (Iivari & Koskela, 87). They give efficiency criteria to measure the quality of the information system on this level (design costs, operations costs and maintenance costs). Shannon and Weaver (1949) call it level A, the technical problem and Stamper (1973) divides it into three levels (syntactic, empirical and physical). Main quality criteria on these levels are formal specification, reliability and costs.

Resources are defined as *the degree to which material and immaterial goods are available to design, operate and maintain the information system.*

The design costs can mainly be seen as time and capability of users and designers (Salmela, 97) but also the size of the project and the complexity of the problem could be measured to assess the risk of the innovation design. Also hardware and software costs fall under this header. Formal specification on syntactic level can be checked on semantic level with the quality criterion accurateness (data, system and information).

The operations costs are mainly human resources but the abnormal costs can be derived from the reliability of the system (Iivari and Koskela, 87).

The maintenance costs can be shown with the quality criteria adaptability and portability that also link to the ability to integrate on a higher level.

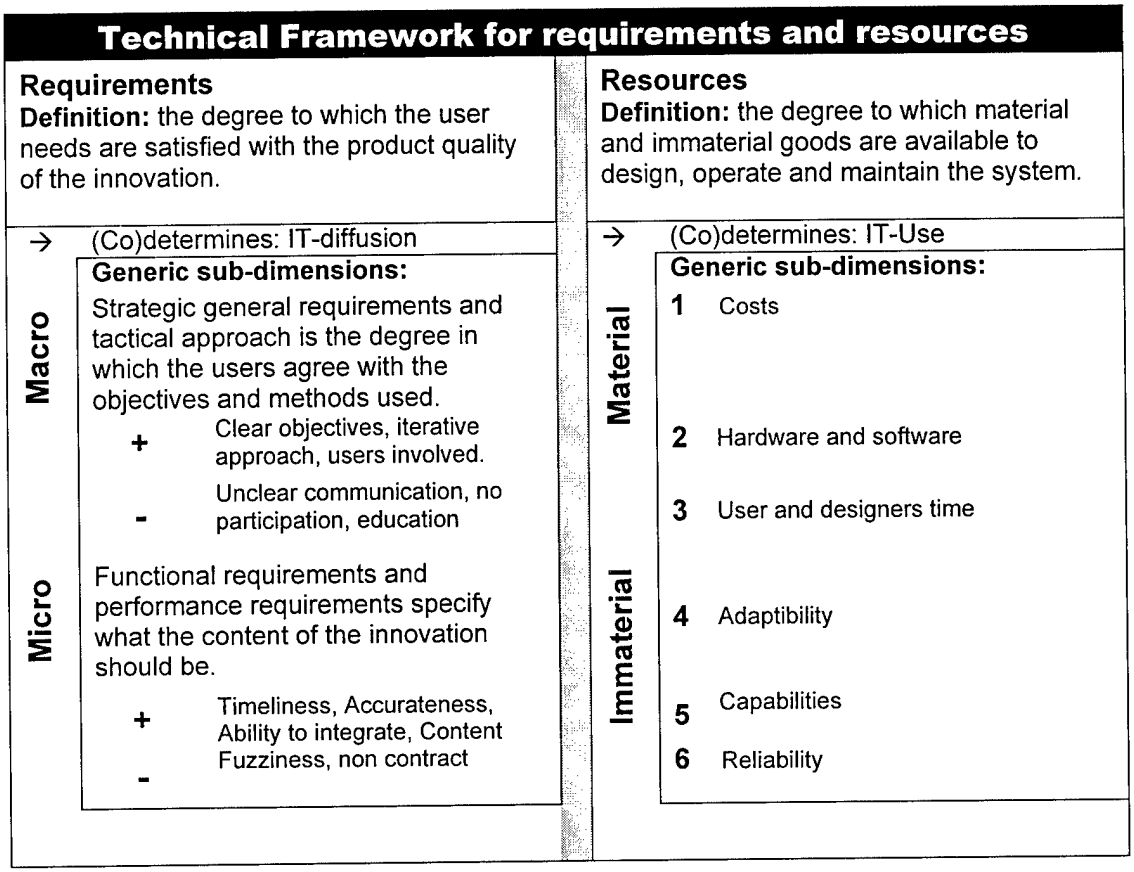


Figure 3 – Framework for requirements and resources determinants

Multiple case studies results

Case Study Method

Nykänen (2000) distinguishes four major evaluation perspectives: goal-oriented, standardized, effectiveness-based and stakeholder-based perspective. In goal-oriented evaluation the emphasis is on rationality: measurement criteria and means to achieve the goal can be derived from the goal itself. This is possible if there the criteria are clear and there are no conflicts of interests among the stakeholders. The downside of goal-oriented perspective is the inability to see other than the anticipated consequences of actions. In standardized (or normative) evaluation, causes and consequences are not in the scope of interest, but compliance with rules, agreements, budgets and principles is monitored (e.g. quality systems). In effectiveness-based view the input/output ratio of actions is economically evaluated. The problem with this perspective is in expressing intangibles (e.g. health) in monetary terms. According to the stakeholder-based perspective, all actions are not always rational, aiming at one mutual goal, and therefore the criteria should be collected from several stakeholders' view. The perspective has a lot of qualitative characteristics and it can be a quite laborious framework for a study design (Hakkinen et al, 2003).
This study used the stakeholder-based perspective and was set up to both assess the situation regarding the electronic prescription system "EVS" in the Netherlands and the theory that is described above, that was set up to provide an instrument that could be used to unravel the diffusion-situation of the prescription system. This resulted in a case-study protocol that covers all the topics that are mentioned in the framework in open-ended questions. In line with the case-study approach by Yin (1984) we discerned different case-situations on the basis of our theoretical framework. Particularly, the network-situation (individual, group practice, health-care center) of general practitioners and the degree of adoption of previous ideas (laggard (no computer) to innovator (using ICPC codes and electronic patient record)) served as a basis to make categories of general practitioners. A total of 56 case-studies were conducted. Each general practitioner was visited in his/her own working situation and interviewed for over an hour. We agree with Brender (1999) that the kernel point of assessment is that of understanding the process. We had data available on the size of each category, which enabled us to quantify the qualitative data that we gathered.

Empirical results GP electronic prescription system

Empirical Resistance of GP

The main problem formulation for this study was to find the obstacles of implementation of the EPS system. Under the header resistance of the GP, questions were asked about problems or wishes that the GP experienced as important at the moment of asking, during implementation of the Electronic Prescription System. Figure 1 gives an overview of all the situational resistance factors mentioned. Here we will summarize the results of the main five:

- Time (55%)
- User interface 33%
- Free choice 30%

- ICPC 27%
- Unwilling 20%

Fifty five percent of the case population said to be under immense time pressure. We think that this made the EPS less relevant to the GP's (Schuring & Spil, 2002) but it also levered the resistance because the GP's thought they would need more time for a consult using the EPS in stead of less time. These statements are confirmed by British research (Sullivan & Mitchell, 2001).

Thirty three percent of the GP's had problems with the quality of the software. Main problems were not related to the new EPS but more to the old GP IS that was not able to give a good user interface. The EPS we described in (Lagendijk, Schuring and Spil, 2001) as "spoilers on a T-ford".

Thirty percent of the GP's say they do not want to be written the law by a new system and want to remain free choice in prescribing drugs to their patients. Some say the advises are too conservative, others say they want to be able to try out new ideas. All of them say they want the freedom of choice.

Twenty seven percent of the GP's thinks that ICPC, the international primary code, is a problem when using the EPS system. Some state that it is rather difficult to find a related ICPC to the diagnosed disease. Other state that it is not necessary to use ICPC for general diseases like flue because it costs time and it does not help the process.

Twenty percent of the GP's is unwilling to use the EPS in principle. That means that they have not looked at it and will not look at it just because they do not like the change.

Empirical Relevance to the GP

Under the header relevance for the GP, questions were asked about problems or wishes that the GP experienced as important at the moment of asking, during implementation of the Electronic Prescription System. Figure 1 gives an overview of all the situational relevance factors mentioned. Here we will summarize the results of the main seven:

1. Communication
2. Time
3. Money
4. Software
5. Free Choice
6. International Code Primary Care (ICPC)
7. Formulary

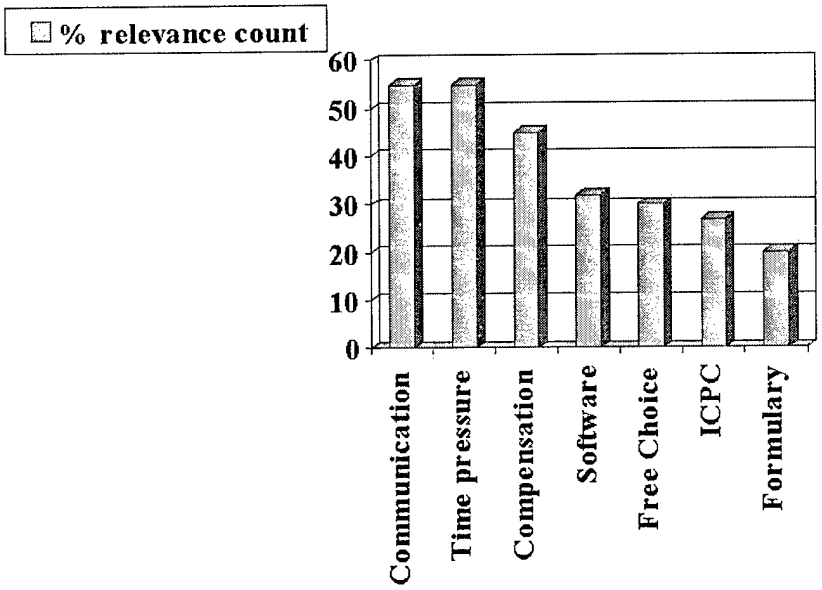


Figure 4 – Case study results on relevance

In more than half of the cases that improvements have to be made to communication with colleagues, pharmacists and hospitals. They state that a standard way of working is very important to reach such a communication. The EPS system does not deliver these features. Saarinen and Saaksjarvi (1992) measured the improved internal communication and improved inter-organizational communication under the header "impact of the IS on the organization". None of these success factors was satisfied in our cases.

In 55% of the cases and independently of each other (the term was not mentioned by the interviewee) the GP's stated that there should be a diminishing of the time pressure. Both in the description of the EPS, as in international literature it is made assumable that EPS will not diminish the time of consult (Mitchell and Sullivan, 2001, Thornett, 2001).

Forty five percent of the case studies reported that the GP expected a fee in return for going through the trouble of implementing and using EPS. At the moment of interviewing it was not clear what financial profit the new system would deliver for the GP. What was known was that it would deliver government a large amount of money on costs of medicine.

In about twenty case studies lack of trust in the existing software and in the software supplier were mentioned as a barrier for (wanting to) use the new EPS. They said that first things had to change in the GP-IS market and in the GP-IS itself before EPS could be a success.

About the same amount of GP's want to remain freedom of choice for medication of the patient. Although this seems to be a resistance matter it is also a relevance matter because the EPS does not comprehend new ideas and new treatments which are already known in the general practice.

Although the use of ICPC seems useful to many GP's (in structuring and communicating) the time that it will cost to find the right code and the omissions of some codes will form a barrier for EPS use.

Twenty percent of the GP's make use of a personal or regional formulary. The EPS makes use of a formulary of the Dutch council for GP's and often does not have the possibility to keep the own formulary when an update of the software is installed.

Finally, once the computer-system was installed, use of the system was mostly sparse. The way of working was relatively complicated and added relatively little value in most patient-doctor contacts.

Empirical Requirements to the GP

General requirements

The objectives for this innovation were mainly money driven. The system should decrease prescription costs with 150 million euro yearly. To the GP's we interviewed, the goals were not clear.

Functional and Performance Requirements

Content

The functionality of the system can be divided into administrative functionality and medical functionality. We observed that the administrative use of the system has the overhand. Only 15 GP's(27,3 %) made use of the SOAP (subjective, objective, assessment, plan) module in the systems which is a prerequisite for the use of the electronic prescription system.

Communication with other GP's, hospitals and pharmacists is a requirement that is high on the agenda of the GP (55%). Still, the new EPS does not support the communication at all.

Timeliness

The time pressure is one of the most important problems of the GP today. Timeliness of the system is therefore an important performance criterion. Due to a bad user interface the GP's are not able to work several records parallel and therefore loose time in opening and closing the patient's record.

Accurateness

The accurateness of the system is good and might be too good. The system was rigidly designed to avoid failures and therefore has many signal functions. For instance, when prescribing medicines for influenza, the GP gets a lot of alternatives and warnings where he or she already exactly knows what to prescribe.

Also the accurateness of input is a problem because 30 percent of the GP's think it is unnecessary and sometimes difficult to generate a code for all "vague" diseases like stomach ache, headache and so forth.

Ability to Integrate

The electronic prescription system is delivered on CD-ROM as a stand alone system. This means that it is not integrated in the GP information system and also not in the communication configuration of the GP. The GP therefore has to start the program for each patient and cannot work parallel even more because the system is not window based.

Empirical Resources to the GP

Costs

For the GP's there are no costs involved in getting the system but they need to time to install and operate the system. In general 30 million euro was spend in designing and implementing the system. Strangely all system suppliers said they did not get money to change their GP information system. The operating and maintenance costs are not seen as a problem by the GP. The reward for using the system is seen a problem. Extra office support was promised by the government but in practice not given and not clear.

Hardware and Software

The GP's have no faith in the suppliers of GP information systems. Caused by fusions and take-overs, the suppliers and GP's are in a deadlock situation where maintenance seems to be the only thing that happens. Thirty percent of the GP's call the quality of the GP information system an obstacle for using the new EPS. We described it as "spoilers on a T-Ford".

User's and designer's time

From our questions to the GP's it is very difficult to analyze the time spend in designing the system. In operating the system the GP loses time because he or she has to put more information in the computer and uses some time in consulting the system. With a average time of 6 minutes per consult this will a big problem.

Adaptability

From maintenance point of view, the system is very adaptable since a new version just has to be distributed without having to change the rest of the GP systems. Nevertheless we advised that the GP system itself had to be updated with the EPS as an integrative communicative subsystem within.

Capabilities

One of our final conclusions in the main report (Lagendijk et al, 2001) is that we think it is crucial in the continuance of the project that the average GP is addressed in stead of the innovative GP. In designing the system GP's were involved but only voluntary GP's that are bound to be pro bias focused.

We also found big differences in IT capabilities. Some GP's still used the "green card" and no computer and some GP's did all their activities on the computer.

Different introduction scenario's therefore are needed to diffuse the system into all GP practices.

Reliability

According to the General Practitioners, the system is reliable. Breakdown of the systems seldom occurs. The maintenance is reasonable although one GP states: "We have to be at a patient's house in 10 minutes and they can stay away for 10 days".

Conclusions

Resistance of GP's is not **the** determinant of the use of the EPS (only 27%). Resistance is the cumulative consequence of effects of the other determinants and therefore it looks as if resistance is the most important determinant. This means that many studies work on the effect and not on the cause of the lack of IT use.

Relevance has long since been a central notion to IT-theory. The elaborated approach that we proposed in this paper was used in 56 case studies. These cases provided us with enough evidence that for this particular (electronic prescription) system in this particular (healthcare) branch, relevance was the most important determinant for failure of diffusion and use of the system.

Although in many studies the social criteria of success are mentioned as more important than the technical criteria we cannot confirm this for these 56 cases. In most cases the resources were not sufficient to use the new electronic prescription system. On top of that the requirements of the users were not sufficiently met by the system. We like to draw the following conclusion for the healthcare organizations: before starting a new project to build or buy a new information system in healthcare organizations it is necessary to explicitly measure the resources available. Next step is to make a contract containing functional and performance requirements both agreed upon by a broad (laggards and innovators alike) group of end users and the responsible designers of the system.

Finally, we can conclude that assessing the IT diffusion and IT use of the electronic prescription system with the USE IT model was a multiple case study balancing the socio-technical determinants. The model has been used in two other healthcare situations and is now been used in a telecare project for stroke patients and a diffusion project of an electronic patient record in a hospital. We stimulate other researchers to work with the model in other environments (also outside healthcare) and we would be happy to provide them with the interview schedule.

References

Ajzen, I & Madden, T J (1986)"The prediction of goal directed behavior: Attitudes, intentions and perceived behavioral control", *Journal of experimental psychology,* 22, pp 453-474.
Althuis, T R & Rikken, S A J J (2000) "Electronic support for general practitioners in prescribing drugs", *Health information developments in the Netherlands,* April, pp62-66.
Ansoff, I (1965)*Corporate Strategy,* McGraw Hill, New York
Ballantine, J, Bonner, M, Levy, M, Martin, A, Munro, I & Powell, P L (1998) "Developing a 3D Model of IS Success", IN Garrity, & Sanders, (1999) *Information*

Systems Success Measurement, Idea Group Publishing

Barlow, C (2001) "Following and accelerating the design evolution curve in Healthcare", First international conference on management and healthcare and medical technology, Enschede.

Barnard C.I., 1938 *The functions of the executive*, Harvard University Press, Cambridge (Mass.)

Berg, M (2001)"Implementing information systems in healthcare organizations: myths and challenges"*International Journal of Medical Informatics,* 64, pp143-156.

Bergeron, B P & Bailin, M T (1999) "Medical Information Technology: a vehicle for change", *International journal of Healthcare Technology and Management*,1,1,pp29-45.

Bergeron, B P & Bailin, M T (1999) "Medical Information Technology: a vehicle for change", *International journal of Healthcare Technology and Management*,1,1,pp29-45.

Beuscart-Zephir, MC, Anceaux, F, Crinquette, V & renard, JM (2001)"Integrating users' activity modeling in the design and assessment of hospital electronic patient records: the example of anesthesia",*International Journal of Medical Informatics,* 4, pp157-171.

Beuscart-Zephir, MC, Brender, J, Beuscart, R & Menager-Depriester, I (1997)"Cognitive evaluation:How to assess the usability of information technology in healthcare",*Computer Methods and Programs in Biomedicine,*54, pp 19-28.

Binney, G & Williams, C (1995) "Leaning into the future. *Changing the way people change organizations*", London N. Brealey Publishing.

Bogucki, DN (1995)"Capturing flexibility of information technology infrastructure: a study of resource characteristics and their measure", *Journal of MIS,* 12, 2, pp37-57.

Brender, J & McNair, P (2001)'User requirements specifications: a hierarchical structure covering strategical, tactical and operational requirements", *International journal of Medical Informatics,* 64, pp 83-98.

Brender, J (1999)"Methodology for constructive assessment of IT-based systems in an organisational context", *International Journal of Medical Informatics*, 56, 67-86.

Carey, J. M., (ed.) (1988) *Human Factors in Management Information Systems*. New Jersey: ABLEX Publishing Corporation.

Coch, L & French, J R P jr (1947)"Overcoming Resistance to Change", *Human relations; studies towards the integration of social sciences,* 1, 2, pp512-532.

Cohen, LJ (1962)*The diversity of meaning,* Methuen, London.

Cooper, W.S. (1971) "A definition of Relevance for Information Retrieval" Information Storage and Retrieval, 7 (no.1: 19-37)

Davis, F D (1989)"Perceived Usefulness, perceived ease of use, and User Acceptance of Information Technology",*MIS Quarterly,* September.

Delaney, B C, Fitzmaurice, D A, Riaz, A & Hobbs, F D R (1999)"Can computerized DSS deliver improved quality in primary care?", *British Medical Journal*, 312, pp 1008-1012

DeLone, W H & McLean (1992)"Information Systems Success: The Quest for the Dependent Variable,"*Information Systems Research,*3, 1, pp60-95.

Dent E.B. & Goldberg S.G.(1999) "Challenging "Resistance to Change" *Journal of Applied Behavioral Science*, March 1999, vol. 35, no. 1, pp. 25-41(17)

Duck, JD (1993)"Managing Change: The art of balancing", *Harvard Business Review,* November-December, pp109-118.

Feeny, DF & Willcocks, LP (1998)"Core IS capabilities for exploiting IT"*Sloan*

Management Review, Spring, pp 9-21.
Finley, P.N. & M. Forghani, (1998) "A classification of success factors for decision support systems" Strategic Information Systems, 7: 53-70.
Fleisner, P & Hofkircher, W(1998)"The making of the information society: driving forces, 'Leitbilder" and the imperative of survival", *Biosystems*, 46, pp 201-207.
Fuller, F F (1969) "Concerns of Teachers" *American Educational Research Journal,*
Garrity, & Sanders, (1999) *Information Systems Success Measurement,* Idea Group Publishing.
Gatignon, H & Robertson, T S (1989)"Technology diffusion: an empirical test of competitive effects",*Journal of Marketing,* 53, pp35-49.
Gelderman, M (1998)"The relation between user satisfaction, usage of is and performance", *Information & Management,* 34,pp11-18.
Ginneken, A M van (2002)"The computerized patient record: balancing effort and benefit" *International Journal of Medical Informatics,* 65, pp97-119.
Hakkinen, H, Turunen, P & Spil, TAM (2003)"Information in healthcare process – evaluation toolkit development" Proceedings of HICSS 36, http://www.hicss.hawaii.edu/diglib.htm
Henry, J W & Stone, R W (1999)"End user perception of the impacts of computer self-efficacy and outcome expectancy on job performance and patient care when using a medical information system" IJHTM, *Special issue on advances in the management of technology in Healthcare*, Vol.1,Nos1/2, pp 103-124.
Hu, P J, Chau, PYK, Sheng, OR & Tam, KY (1999)"Examining the Technology Acceptance Model using physician acceptance of telemedicine technology", *Journal of Management Information systems,* fall, 16, 2, pp91-112.
Iivari, J & Koskela, E (1987)"The PIOCO model for IS design" *MIS Quarterly, s*eptember, pp400-417.
Kotter, J P & Schlesinger, L A (1979)"Choosing strategies for change" *Harvard Business Review, march-april,* pp106-113.
Lagendijk, P.J.B., R.W. Schuring, A.A.M. Spil (2001) "Het Elektronisch Voorschrijf Systeem, van kwaal to medicijn", Universiteit Twente, Enschede
Lanning, H (2001) Planning and Implementing Change in Organisations - a Construct for Managing Change Projects. Dissertation, Helsinki University of Technology (Espoo, Finland).
Larsen, T J (1998)"Information Systems Innovation: A Framework for Research and Practice" In Tor J. Larsen and Eugene McGuire (1998). *Information Systems Innovation and Diffusion.* Idea Group Publishing. Hershey, USA
Leavitt, H J (1965)"Applied organisational change in industry: structural technological and humanistic approaches. IN March JG(ed)*Handbook of Organisations,* Chigaco, Rand-McNally, pp1144-1170
Limburg, D.O. & Katsma C.P. (2002) "Tailoring Telework" *Designing a new work space: sustainability and ethical dimensions*. Badajoz, Spain.
Linnarson, R. (1993) "Decision support for drug prescription integrated with computer-based patient records in primary care" Medical Information, 18, 131-142
Liu, K (1993)*Semiotics applied to information systems development,*PhD thesis, University of Twente, Enschede.
Lorenzi, N M & Riley, R T (1994)*Organizational aspects of Health Informatics,* Springer Verlag, New York.
Mahmood, M A, Burn, J M, Gemoets, L A &Jacquez, C (2000)"Variables affecting IT end-user satisfaction: a meta-analysis of the empirical literature"*Int.J.Human-*

Computer-Studies, 52, 751-771.
Malinconico, S M (1983)"Hearing the resistance"*Library Journal,* 108, 2, pp111-113.
Markus, ML (1983)"Power, Politics and MIS Implementation", *Communications of the ACM,* 26, 6, pp430-444
Mason, R O (1978)"Measuring Information Output: A Communication Systems Approach, *Information & Management,* 1, 5, pp219-234.
Mata, FJ, Fuerst, WL & Barney, JB (1995)"Information Technology and sustained competitive advantage: a resource based analysis", *MIS Quarterly,* 19, 4, december, pp487-505.
Metselaar, E E, Kolk, J M van der & Wortelboer, F Q C (1996)"Werken aan veranderingsbereidheid" (in Dutch), *Handboek effectief opleiden,* 9, pp135-158.
Miller, C A (1999)"Bridging the Information Transfer Gap: Measuring goodness of information fit", *Journal of Visual Language and Computing*, 10, pp523-558.
Mitchell, E & Sullivan, F (2001)"A descriptive feast but an evaluative famine: systematic review of published articles on primary care computing during 1980-97"*British Medical Journal*, 322, pp 279-282.
Mittelstaedt, R A, Grossbart, S L, Curtis, W W & Devere, S P (1976)"Optimal stimulation level and the adoption decision process, *Journal of Consumer Research,* 3, pp84-94.
Mumford, E (1995)*Effective Systems Design and Requirements Analysis,* MacMillan, London.
Mumford,E (1983)*Designing Human systems for new technology,* Manchester Business School.
Newton, J, Graham, J, McLoughlin, K, Moore, A & McTavish, D (2000)"Change in primary health care: new wine in old bottles?, *Journal of Management in Medicine,* 14, 1, 2000, pp 37-47.
Newton, J, Graham, J, McLoughlin, K, Moore, A & McTavish, D (2000)"Change in primary health care: new wine in old bottles?, *Journal of Management in Medicine,* 14, 1, 2000, pp 37-47.
Nykänen P (2000) *Decision support systems from a health informatics perspective.* Academic dissertation. Department of computer and information sciences, University of Tampere. Tampere, Finland.
Offenbeek, M van & Koopman, P (1996)"Interaction and decision making in project teams", IN West, MA ed (1996)*Handbook of Work Group Psychology*, John Wiley & Sons Ltd.
Pare, G & Elam, J J (1999) "Physicians' acceptance of clinical information systems: an empirical look at attitudes expectations and skills", *International journal of Healthcare Technology and Management*,1,1,pp46-61.
Pettigrew, A, Ferlie, E & McKee, L (1992)*Shaping Strategic Change – The case of the NHS,* Sage, London.
Piderit, S K (2000)"Rethinking resistance and recognizing ambivalence: A multidimensional view of attitudes toward an organizational change" *The Academy of Management Review*, Vol. 25, # 4, 783-794.]
Pijl, G J van der(1994)"Measuring the strategic dimensions of the quality of information", *Journal of Strategic Information Systems,* 3,3,pp179-190.
Prasad, P & Prasa, A (2000)"Stretching the iron cage: The constitution and implications of routine workplace resistance"*Organizational Science,* 11, 4, july-august, pp 387-403.
Pressman, R S(1982)*Software engineering, a practitioner's approach,* McGraw-Hill.

Raghavan, Sridhar A., and Donald R. Chand(1989) "Diffusing Software Engineering Methods." IEEE Software, July: 81—90.
Rogers, E M & Scott K L (1997) "The Diffusion of Innovations Model and Outreach from the National Network of Libraries of Medicine to Native American Communities", http://www.nnlm.nlm.nih.gov/pnr/eval/rogers.html
Rogers, E M (1983) "*Diffusion of innovations*", The free press, New York.
Saarinen, T & Saaksjarvi (1992) "Process and product success in information system development", *Journal of Strategic Information Systems,* **1,** 5, pp266-277.
Saiedian, H & Dale, R (2000)"Requirements engineering: making the connection between the software developer and customer", *Information and Software Technology,* 42, pp419-428.
Saracevic, T. (1975). Relevance: A review of and framework for the thinking on the notion in information science. *Journal of the American Society for Information Science, 26* (6), 321 – 343.
Saracevic, T. (1996, October 13-16). *Relevance reconsidered: '96 Proceed-ings of COLIS 2: Second International Conference on Conceptions of Library and information Science: Integration in Perspective* (pp. 201-218). Copenhagen, Denmark: The Royal School of Librarianship.
Schamber, L. (1994). Relevance and information behavior. *Annual Review of Information Science and Technology, 29*, 3-48
Schmidt, R, Lyytinen, K, Keil, M & Cule, P (2001), "Identifying Software Project Risks: An International Delphi Study"*Journal of Management Information Systems,* Spring, 17, 4, pp5-36.
Schuring, R W & Spil (2002A)"Assessing Relevance and micro-relevance to the profesional's working process as a determinant of IT-diffusion and IT-use in healthcare"*Proceedings of International Information Resource Management association conference, Seattle.*
Schuring, R W & Spil, T A M (2001)"*Relevance as a major driver of Innovation and diffusion of ICT in Healthcare Organizations,* First international conference on management and healthcare and medical technology, Enschede.
Schuring, R W & Spil, T A M (2002B)"Explaining plateaued diffusion by combining the user-IT-success factors (USeIT) and adopter categories: the case of electronic prescription systems for general practitioners", accepted at *International Journal of Healthcare Technology & Management*, 44, 3, pp303-318.
Schuring, R W & Spil, T A M (2003)," Relevance and micro-relevance for the professional as determinants of IT-diffusion and IT-use in healthcare", IN Apicello, A (ed)(2003), *ERP & Data Warehousing in Organizations: Issues and Challenges*, pp 218-231, Idea Group Publishing, Hershey.
Schutz, A (1970)*Reflections on the problem of relevance,* Yale university press, New Haven.
Scott, J (1985)""Weapons of the weak: Everyday forms of peasant resistance, *Yale University Press,* New Haven, CT.
Shannon, CE & Weaver, W (1949)*The mathemathecial theory of communication,* University of Illinois press, Chicago.
Southon, G, Sauer, C & Dampney, K (1999)"Lessons from a failed is iniative:issues for complex organisations"*Medical Informatics,* 55, pp33-46.
Sperber, D & Wilson, D (1986) "*RELEVANCE, communication and cognition*", Basil Blackwell, Oxford.
Spil, T A M (1996) "*The effectiveness of strategic information systems planning in*

professional organizations", PhD thesis, Enschede.
Spil, T A M, Schuring, R W & Katsma, C (2002)" Assessing resistance of professionals as a determinant of IT-diffusion and IT-use in healthcare", *Proceedings of the ninth ECITE conference*, Paris.
Spil, TAM (1993)"The evaluation of SISP; From a quality undergrowth to a semiotic clearing, proceedings of the first ECITE conference, Henley on Thames.
Stamper, RK (1973)*Information in Business and Administrative Systems,* John Wiley & sons, New York.
Strebel, P (1996)"Why do employees resist change?", *Harvard Business Review* may-june, pp86-92.
Sullivan, F & Mitchell, E (1995)"Has general practitioner computing made a difference to patient care?"*British Medical Journal*, 311, 848-852.
Suomi, R (2001)"Streamlining Operations in Healthcare with ICT" IN Stegwee, R A & Spil T A M eds *Strategies for Healthcare Information Systems,* Idea Group Publishing, Hershey
Symon, G, Fitter, M, Radstone, C, Kunkler, I & Hancock, B (1992)"The process of deriving requirements for a hospital information system" *Behaviour & Information Technology,* 11, 3, pp131-140.
Szmigin, I & Foxal, G (1998)"Three forms of innovation resistance: the case of retail payment methods" *Technovation,* 18, 6/7, pp459-468.
Tange, H (1997)*Medical narratives in the electronic medical record,* PhD Thesis, Maastricht.
Thong, J Y L & Yap, CS (1995)"CEO characteristics, organizational characteristics and IT adoption in small businesses", *Omega*, 23,4, pp429-442.
Thornett, A M (2001)"Computer decision support systems in general practice, *International journal of Information Management,* 21, pp39-47.
Timpka, T. (1989) Introducing hypertext in primary healthcare: A study on feasibility of decision support for practitioners *Computational Methods and Programs in Biomedicine* 25 pp.49-60
Toussaint, PJ, Bakker AR & Groenewegen, LPJ (2001)"Integration of information systems: assessing its quality", *Computer Methods and Programs in Biomedicine*, 64, pp9-35.
Walley & Davies (2001) "Implementation IT in NHS Hospitals – internal barriers to Technological Advancement" *paper presented on the 1st Hospital of the Future Conference*, Enschede, The Netherlands
Walley & Davies (2001) "Implementation IT inNHS Hospitals – internal barriers to Technological Advancement" paper presented on the 1st Hospital of the Future Conference, Enschede, The Netherlands
Whyte, G, Bytheway, A & Edwards, C (1997)"Understanding user perceptions of IS Success, *Journal of Strategic IS,* 6, pp35-68.
Wieringa, R J (2001) *Requirements Engineering:Frameworks for Understanding,* Wiley, Chichester.
Wilson, P (1973)"Situational relevance", *Information Storage and Retrieval,* 9,8, pp457-471.
Wissema, J. G. (1987). *Angst om te veranderen? Een mythe!* Assen: Van Gorcum
Yin, R.K., (1984) *Case study research, design and methods*, Sage Publications, London
Zmud, R W (1979)"Individual differences and MIS success; a review of empirical literature",*Management Science,* 25, 10, October, pp966-979.

Zuboff, S (1982)"New worlds of computer-mediated work" *Harvard Business Review,* march-aprilpp142-153.

Zviran, M & Armoni, A (1999)"Integrating hospital information systems: a bottom up approach" IJHTM, *Special issue on advances in the management of technology in Healthcare*, Vol.1, Nos1/2, pp 168-179.

Appendix G

Organizational Effectiveness of a Telerehabilitation System in Oklahoma

Telemedicine is the use of electronic communication and information technologies to provide or support clinical care at a distance. Diffusion of telemedicine remains low despite demonstration of efficacy and feasibility of telemedicine modalities. (1) Rehabilitation is the process of restoring someone to a state of health or useful activity through training, therapy, and guidance. Telerehabilitation is defined as the remote delivery through telecommunication technology, of a variety of rehabilitative services for persons with disabilities. It is a versatile interdisciplinary medium that is used by health professionals to facilitate post-acute rehabilitation in the home and community settings. (2;3) Telerehabilitation interventions primarily occur in real time via two-way interactive audio-visual linkage, as opposed to a "store and forward" method. Nineteen different programs surveyed by the Office for the Advancement of Telehealth (OAT) in 2001 included some kind of telerehabilitation activity at their site. Services included occupational therapy, physical therapy, speech language therapy/pathology, physical medicine/physiatry, and vocational rehabilitation. The majority of these programs are currently funded by federal or state grants, however, long-term feasibility of the programs is dependent on the economic and organizational sustainability of the program.

Barriers to implementation of complex information technology applications are described by Tanriverdi (4) as economic, technical, organizational, and behavioral. There are four components of integrated organizational design, all of which should be addressed for a balanced approach to change. These components are *strategy, structure, people*, and *processes*. The culture of an organization is the product of the interaction between these components. The customer is the hub around which these components interact and evolve. The interrelationship of these components is shown in Figure 1. This article describes the implementation of a telerehabilitation program in Oklahoma focusing on the different components of the organizational design. Lessons learned during the process are included in the corresponding sections.

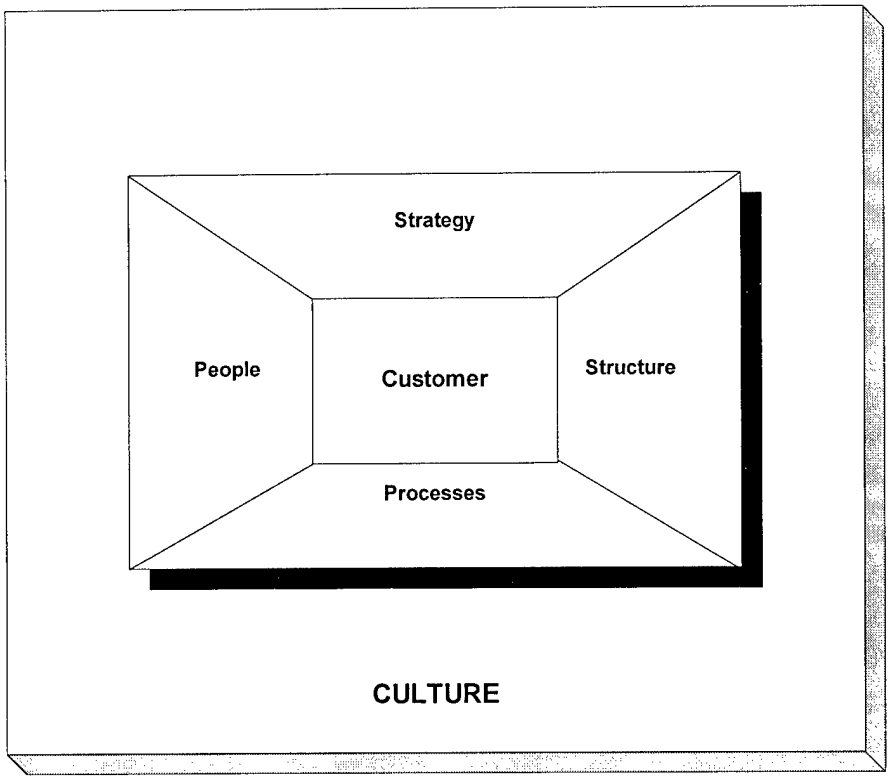


FIGURE 1
Interrelationship between Components of Change and Culture

Facility Background

INTEGRIS Health Inc. is an Oklahoma based not-for-profit health-care organization with hospitals, rehabilitation centers, physician clinics, mental health facilities, independent living centers, and home-health agencies throughout most of Oklahoma. INTEGRIS Health created Oklahoma's first telemedicine network in 1993 by connecting several rural INTEGRIS Health hospitals for voice, video, and data connectivity. INTEGRIS Rural Health received a rural telemedicine grant (1997-2000 and 2000-2003) from the Health Resources and Services Administration (HRSA), OAT to improve access to healthcare for rural individuals across the life span, reduce isolation of rural practitioners, and to collect and disseminate this data. The INTEGRIS Telehealth Network (ITN) was primarily used for continuing medical education (CME), administrative and community services applications prior to the Rural Telemedicine Grant. ITN is self-supporting with a staff to cover it 24 hours, seven days a week. The system recently expanded its quality

and capabilities with the addition of a bridge that is H323 capable. INTEGRIS Health provides for ownership and maintenance of telemedicine equipment.

Needs Assessment for Telerehabilitation in Oklahoma

Telemedicine is most likely to succeed if the healthcare needs of the community are not adequately met by conventional medicine. Needs assessment should be a reflection of the organizational strategy, mission, and vision. Executive buy-in is easier if the change fits into the long-term strategic objectives of the organization. However, a program should be build on "demand" and not on "need". The need may be there, but it takes a demand for the service to generate business.

Oklahoma is a predominantly rural state with 63 of the 77 counties federally designated as rural. Rural patients receive fewer home health services and attain less favorable discharge outcomes as compared to the urban patients; a factor primarily attributed to resource constraints and a lower availability of skilled care disciplines. (5) Twenty-four of these counties are designated as medically underserved areas (MUAs), three counties are designated as health professional shortage areas (HPSAs), and 28 counties are designated as both MUA and HPSA. Telemedicine can be used in HPSA, MUA, prison inmates, school systems, worker's compensation or self-insured industries, general population, and specialist consultation with other facilities. Seven of the 77 counties are designated as frontier counties with less than six people residing per square mile. Besides the distance barriers, there are sociological and economic factors that play a part. The eastern part of the state primarily has agriculture and lumber industries. These lifestyle components expose people to a high risk of injuries with little local specialized services available for rehabilitation and recuperation. Since 1981, 15 Oklahoma hospitals, usually the sole hospital in their communities, closed secondary to low patient census and closure of physician practices. Twenty-three more rural hospitals are in danger of closing in the next three years. (6)

Financial constraints imposed by the Prospective Payment System (PPS) mandate inpatient rehabilitation facilities to reexamine resource utilization and organizational

effectiveness. According to one study, charges at rehabilitation facilities are increasing an average of seven percent each year, but the length of stay is decreasing by approximately eight percent annually. (7) This translates to the fact that patients with chronic medical conditions may be leaving acute inpatient rehabilitation facilities before they are functionally ready, which results in increased reliance on community-based rather than hospital-based resources. Liss et al. (1) suggest that telecommunication-based interventions may be used efficiently and effectively for populations with chronic disability including those who do not have previous experience with the technologies. Rosen (8) points out that the individual can stay in his/her community without losing the expertise available in the larger hospitals, which would result in reduced travel expenses for the physician/therapist and patient; possible delivery of a greater proportion of therapy by less expensive community providers with occasional teleconsultation by specialists; as well as a shift of the overhead of housing a patient from the service provider to the family.

Identification of stakeholders and champions

Stakeholders are individuals, groups, or organizations with an interest in the issue area. For the telerehabilitation program, this group included hospital administrators, clinicians/therapists, clinical support staff, information technology professionals, third party payers, patients, and their caregivers. Stakeholders were identified and their diverse interests defined, understood, and updated as the situation changed. Recognizing and working with the underlying concerns, desires, or fears that motivate an individual are critical for their participation in the change process. All stakeholders will have a different set of concerns and questions, which need to be addressed. One frequently overlooked group of stakeholders is the knowledge-holders who possess critical skills to contribute to the problem-solving process. This group generally includes the researchers, clinical development specialists, and policy-makers. Knowledge-holders can play a key role of educating and facilitating discussion between other stakeholders. Change acceptance starts with the stakeholders; and education of the stakeholders is vital. Change champions are stakeholders who buy-in the new concept or idea, and play a pivotal role of championing the project.

INTEGRIS Telerehabilitation program focused on gaining support from the top, but the program was built from the ground up. The program had an administrative and a clinical champion. The director of the Telemedicine program was the administrative champion, educating the key administrative people about telemedicine program and services, thus creating administrative and executive buy-in. The administrative champion also communicated with the rural sites and the system support people. The director of Clinical Development served as the clinical champion, focusing on educating and gaining support of therapists and clinicians. Both champions had the ability to think outside the box, and adopt alternate methodologies to get things done. A technical champion is beneficial if relying on high technology systems, although use of low technology systems diminishes the need for a technical champion.

Strategy

Strategy is a pattern in a stream of decisions, positioning an organization within its environment and resulting in the "behavior" of the organization. It is future oriented and sets direction for the organization. Strategy ties the organization together with a common sense of purpose of shared values; enabling the organization to develop a clear concept, specific goals, and consistency in decision-making. Setting clear strategy goals is the most crucial component of any change. Strategies should align with the mission, vision, and values of the organization. Strategy should be *simple* as it is a template for decision making; *competitive* as it defines the product and services at which the organization will excel; *innovative* as it requires new perspectives from both outside and inside the organization; *responsive* as it defines the organization in terms of stakeholders and the competition; *evolving* as it requires room for improvising; and *involving* as it should not be isolated to the top levels of the organization.

The vision of INTEGRIS Health is *to be the health care delivery system of choice, committed to caring service, quality outcomes and cost competitiveness*. Specific INTEGRIS Health goals for the next five years that directly relate to the INTEGRIS Rural Telemedicine Project include patient goals, physician goals, and community goals.

Patient goals include providing geographic accessibility, creating demonstrably better outcomes, and providing cost effective care. Physician goals include providing technology and sophisticated tools for care management. Community goals include providing care that exceeds stakeholder expectations, and improving the health status of the community.

INTEGRIS Rural Telemedicine Project concentrated on four areas in order to achieve these goals:

1. Solidify the growing reputation of INTEGRIS in the telerehabilitation field
- By the formation of a Telerehabilitation Planning Group including a patient advocate,
- Through collaborations with other rehabilitation and academic centers in clinical applications and research,
- With publications and presentations at the state and national levels to government departments, healthcare associations and providers, and at related conferences.

2. Establish a market presence by
- Proving efficacy, cost savings and improved accessibility through the pilot study,
- Marketing indirectly through articles in national publications and local newspaper as well as news reports on television,
- Direct marketing through brochures distributed to healthcare providers by the Oklahoma Healthcare Authority and contact with school districts, and
- Marketing directly to the patients and caregivers by working through special interest groups, such as the Brain Injury Association, and Rural Health Association.

3. Develop services based on the needs of the rural facilities
- Need assessments based on Joint Commission for Accreditation of Healthcare Organizations (JCAHO) deficiencies
- Needs indicated by rural primary care physicians and other healthcare professionals
- Shortages as indicated by state statistics
- Needs indicated by government and community members

4. Promote Telemedicine on a state level
- Work with the Governor's Telemedicine Advisory Council to promote telemedicine to third party payers, legislators, and general public

- Help build the Oklahoma State Website and INTEGRIS website, which includes projects and services available through INTEGRIS
- Work with the Department of Health and other state departments to promote a state-wide network of telemedicine providers.

The primary reasons for misalignment of mission, vision and values are unclear strategic direction, lack of cohesion and open communication channels in the senior management team, leadership that is too top-down or lenient, ineffective vertical communication between management levels in the same department, lack of institution-wide coordination and integration, and lack of down-the-line leadership development and training. To prevent misalignment, most of the system goals are echoed by the individual hospital goals. The INTEGRIS telerehabilitation strategy is revisited annually and modified according to the current needs and circumstances.

Development of the TeleRehab™ Program at INTEGRIS Health

A public school at Hugo was started as a pilot study in 1999. Schools are federally mandated to provide speech therapy services to the students, however, hiring a speech therapist is not only economically difficult for the schools, it is not feasible due to lack of therapist availability in the rural areas. This rural school was already using audio-visual equipment for distance learning, so they were familiar and comfortable with the equipment. Permission for a pre-pilot program was obtained from the school board, and eight school children were offered speech therapy in the local rural hospital, which was already using telemedicine for emergency room visits. Speech therapy was provided for four weeks, and the results, including complete cost analysis were presented to the school board. Based on these results, the school board approved therapy services via TeleRehab™ for one year. Expansion of services to other schools followed the same pattern of demonstration of efficacy resulting in approval by the school board.

Ideally, before venturing into a new territory, it is important to do basic research. Learning from the experience of other organizations is beneficial. This information can be obtained by web sites, trade journals, focus groups, phone calls, and site-visits. It is also helpful to find a mentoring organization of a similar nature doing telemedicine. However, when INTEGRIS Health started its telerehabilitation program, there was very

little telerehabilitation activity in the country. Since INTEGRIS was treading unchartered territory, it was decided to focus on one small area that would be less controversial and more likely to succeed. This area proved to be school speech therapy services. Once these services were successfully in place, the program proceeded to build success upon success by adding other disciplines and expanding the market. The TeleRehab™ program has subsequently expanded to include physical therapy, occupational therapy, vocational rehabilitation, and neuropsychology. The tool used for process development by INTEGRIS Health was PDCA, which goes through iterative cycle of planning the process improvement, doing process improvement, collecting data, and analyzing data (Figure 2).

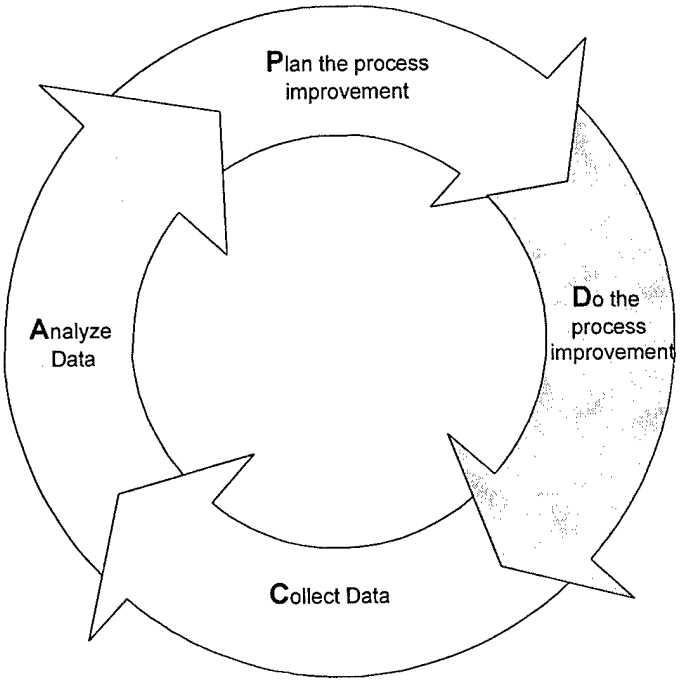


Figure 2
PDCA Model for Process Development

Services are currently offered to schools, workman compensation or self-insured industries, and the general public. The current TeleRehab™ network covers north-central, northeastern, southeastern, south-central, and western Oklahoma. (Figure 3) Services fall under one of the three categories:

- Direct patient intervention where the therapist either works directly with the patient or guides the remote therapist or caregiver.

- Mentoring with the patient present, which includes teaching management strategies, activity selection with grading, and handling training and development.
- Consultation where the patient is not present, which includes concepts and practice discussion, session analysis and feedback, and planning.

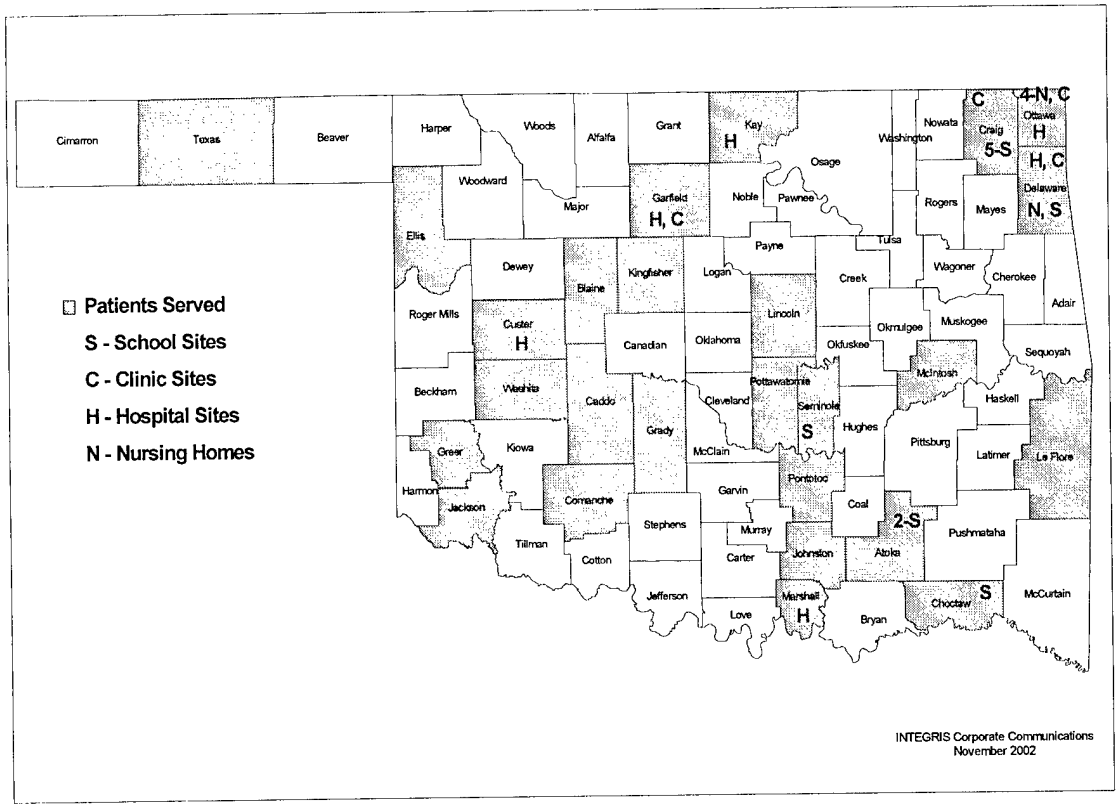


Figure 3: Coverage of INTEGRIS TeleRehab™ Network as of November 2002

There is currently little competition for telemedicine services in the state of Oklahoma. There was an original effort to have one central telehealth network for the state, but early disagreements and reduced grant funding cause reality to fall short of expectations. A state telecommunications network was formed, but major issues of service, reliability, scheduling and limitations of when the network was available (weekdays only) kept healthcare providers from using the system. There are fragmented services in Oklahoma, mostly related to research grants. The two state universities have the most activity after INTEGRIS Health, and it is primarily limited to store-and-forward applications.

INTEGRIS is gaining recognition as the most active provider of clinical applications in Oklahoma.

People

Effective management of people during a change process is often the key to a successful change initiative. People can be categorized as innovators, early adopters, and late adopters. Innovators are the risk takers who can cope with a high degree of uncertainty during adoption of a new innovation, and are highly suitable as champions for a new project. Early adopters are the target population for education and conversion during a change process. The late adopters wait for the change to be a proven concept before adopting it. (9) People involved in the TeleRehab™ program are the administrators, therapists/clinicians, information technology professionals, researchers, patients, and the support staff. Education and user involvement at all levels of the change process are critical. Individuals have difficulty sustaining new behaviors in an old environment, so the goal must be to change the environment as well. The environment should expect, encourage, and support personal accountability, diversity, open expression, conflict as a source of creative tension and growth, participation at all levels, and caring and respect for all members of the organization.

Therapists

Therapist acceptance and utilization is the cornerstone of a successful telerehabilitation program. Experienced interdisciplinary teletherapists identified attributes important for a productive and meaningful teletherapy intervention. Attributes of successful teletherapists include flexibility, professional maturity, creativity, motivation, clinical competence, sense of humor, good interpersonal skills, person first philosophy, intuition, tenacity, excellent problem solving, empathy, and good communication skills. Unfamiliarity with technology and an inability to touch the patient for examination are potential sources of therapist dissatisfaction. Therapist resistance can be overcome by proper education and training. Proper orientation of the new therapist is paramount. A TeleRehab™ staff member is usually present during the first session to assist with any questions or problems with the equipment. Motivation in healthcare goes beyond monetary incentives. Quality of care and patient satisfaction reinforce clinician

satisfaction. Technology is only a 'tool' to provide service; the people involved determine the success of the program.

Patients

Patients and their caregivers are an important and often overlooked component of a telerehabilitation program. Certain inclusion criteria have been identified for patients who participate in teletherapy. TeleRehab™ patients have generally participated in successful inpatient hospitalization. Patients should be medically stable, and a support person is generally required if the patient requires supervision for physical and/or cognitive impairments. The patient's support person is trained about the operation and basic troubleshooting of the audio-visual equipment being used. Further, this support person must be able to comprehend audio-visual instructions, should be physically able to help with therapy, and should be compassionate towards the patient. Whenever possible, the initial evaluation of the patient is done face-to-face in the presence of their caregiver, which facilitates the subsequent teletherapy sessions. Involvement of distant health care providers in the initial patient encounter via TeleRehab™ is beneficial.

Remote therapists

Development of collaborative efforts with the rural therapists is of paramount importance. Despite generalization, each rural area has a unique culture and unspoken rules. Having a local person as a guide or mediator often facilitates gaining trust and overcoming resistance or hesitancy on the part of the users to try an alternative healthcare delivery model. Territorial issues sometimes arise when partnering with rural therapists. Rural therapists are generally independent and lack of peer support. Cultivation of a symbiotic relationship requires patience and education on the part of teletherapists.

Dealing with Resistance

Resistance to change is a common phenomenon that accompanies a change initiative. Resistance can be deliberate or subconscious, and it typically interferes with the successful implementation of a change initiative. Resistance can be encountered at all levels of the organization. The reasons for resistance can be economical, psychological,

social, intellectual, prior unfavorable experiences, organizational, or operational. (10) User involvement and education facilitates the change process. Honest and open communication is key to dealing with the user's concerns.

Structure

Structure provides the building blocks for the program.

Business Model

The INTEGRIS TeleRehab™ business model is not static, but keeps on evolving as technology, consumer and clinician acceptance, and reimbursement components change. The business model defines the scope, goals, competitive advantage, value constellation, and value chain of the business unit. At INTEGRIS, there is a separate cost center for telemedicine with a dedicated director and a telemedicine coordinator. Establishing telemedicine as a separate cost center facilitates management of the program. However, this should be done once the program is well planned and implemented. Making the program autonomous allows easier financial tracking. Having telemedicine as a separate business unit also addresses the ambiguity of program ownership secondary to diverse stakeholders.

Both the grant-based telemedicine projects, and the start-up telemedicine companies should have a clear business plan. The content of the plan varies based on the specific program; however, it generally incorporates information about the company profile; principal services being offered; target customers; projected sales or consultations; partnerships with other organizations if any, overview of needs assessment, cost profiles, contractual agreements if any, quality measures; risk management; competition; sales and marketing techniques; company management; financial management; and research and development (R&D). (11)

Organizational Commitment

Telemedicine implementation and sustainability require interdepartmental support and resources. Organizational commitment is required at all stages of conception, implementation, and management of the program. Education of the executives and the

stakeholders is paramount for continued organizational commitment. The telemedicine program at INTEGRIS has mixed executive buy-in. The program was accepted at its inception largely because of the funds coming from the HRSA grant. However, the program is increasingly gaining support. After five years of initiation of the program, telemedicine has been included as part of INTEGRIS Health strategic plan at the organizational level. TeleRehab™ has also transitioned from being a project to a program, and is now considered part of the normal INTEGRIS Health business, instead of being an experimental model. Beginning in 2003, each rural site participating in TeleRehab™ sessions has established a separate cost center for telemedicine activities, thus participating in consolidation of the program.

Economic Model

Sustainability does not always equate to profitability in the initial phase of telemedicine implementation; however, a stream of revenue and profit is essential for long-term sustenance of the program. Grant funding is helpful as seed money to help with one-time costs associated with the initial set-up. A significant number of telemedicine interventions are not reimbursed. Currently, Center for Medicare and Medicaid Services (CMS), the primary federal funding agency for healthcare, requires face-to-face evaluation for reimbursement, except for image applications such as radiology. A number of demonstration grants are currently underway to establish the efficacy of telemedicine as an alternative healthcare delivery model, and make a case for reimbursement initiatives and legislature. Long-term viability depends on contracts and third-party reimbursements. Diversifying sources of revenue; with a combination of stable but marginal revenue sources, with a revenue source with an intermittent but high return on investment is a safe strategy.

Contracts

Contracts are often associated with agencies or organizations that require interventions for a number of people over an extended period of time, such as schools or prisons. Contracts can be based on a flat fee model, or an hourly rate. The contracts for school therapy program at INTEGRIS underwent four stages of evolution. The first stage comprised of a flat fee, regardless of the number of hours used or the number of students

seen. At one point, when extensive technology problems precluded service delivery for six weeks, billing adjustments had to be made. The next year, the contract was modified to bill based on the number of hours used. However, this model had the negative effect of school teachers canceling speech teletherapy session at will, which resulted in unproductive time for the speech teletherapist that could have been spent with other patients. A hybrid contract model was introduced in the third year. This required reimbursement of half of the anticipated sessions, whether they were used or not. The hybrid contract reduced the number of cancellations, thus increasing compliance and benefiting both the students and the teletherapy program. The final modification to the contract was a slight increase in charge to help pay for the extra time for paperwork required for schools to receive Medicaid reimbursement for some students. This has been a popular feature of the INTEGRIS speech teletherapy program as it helps the schools receive funds for special education that would be otherwise unavailable to them. Clear outline for the service care delivery, agreements on quality standards, and regulatory requirements should be addressed in the contract. Table 1 provides a template for cost analysis of telemedicine as a substitute for face-to-face visits, along with estimated value for each variable(12).

No.	Questions Concerning Variable Costs	Estimated Value
1	How often is the telemedicine system a successful substitute for a face-to-face visit?	90%
2	What %age of patients would drive to a specialist if TM was not available?	70%
3	How many miles will patients drive (round trip) to the telemedicine facility?	16
4	What is the cost of transportation per mile ?	$0.31
5	How many hours of a patient's time will a telemedicine consultation take?	1.14
6	What value do the employers and patients' place on their time?	$13.44
7	What is the average payment to physicians per telemedicine consultation?	$65
8	What is the hourly cost of telemedicine broadcasts?	$35
9	How many hours of technical support are needed for each hour of consultation?	1
10	What is the average number of consultations per hour?	4
11	What is the hourly cost of technical personnel who operate the system?	$30
12	What is the hourly cost of having a nurse at the spoke site?	$20
13	How many minutes of nurses time will be used for each consult?	20
14	What is the cost of the spoke's supplies used for each consult?	$8

15	How much additional hub overhead is generated for each consult due to billing etc?	$2
16	How much spoke overhead is generated for each consult for record keeping etc?	$5
17	What is the average total fee paid to a physician's clinic for a face-to-face consultation?	$65
18	How many hours will a visit for a face-to-face consultation take?	7.63
19	How many miles (round trip) will patients drive to see a specialist?	304
		Example
	Questions Concerning Fixed Costs	
20	What is the cost of equipment and improvements?	$144,128
21	What is the average life of the equipment and improvements?	8
22	What is the organization's cost of capital?	5%
	Implied annual amortization of debt used to purchase fixed assets	$21,238
23	What is the annual cost of the hub's administrator?	$27,000
24	How many fixed hours of technical support per week are needed to maintain the system?	16
25	How many square feet of hub office space is needed?	500
26	What is the value of the hub's office space per foot?	$11
27	How many square feet of office space is needed at the spoke?	350
28	What is the spoke's cost of office space per square foot?	$11
29	What is the annual cost of the spoke's administrator?	$4,000
30	How many hours of administrative assistant time will be needed per week?	10
31	What is the hourly cost of administrative assistant time?	$11.70
32	How much will be spent on training and travel?	$2,000
33	What is the amount of hub overhead for phones, system overhead etc.?	$5,000
34	What is the amount of spoke overhead for phones, system overhead etc.?	$2,500
35	What are the hub sites annual fixed telecommunications costs?	$5,724
36	What are the spoke site's annual fixed telecommunications costs?	$4,728
37	How many hours of line time will be needed for telemedicine administration?	24
38	What percentage of the overhead will be allocated to consults?	50%
		Estimated Cost
	Comparable Face-to-face Visit Cost	**$183.34**
	Telemedicine Visit Cost	**$144.34**
	Savings per TM Visit	**$39.01**
	Total Fixed Costs	**$113,046**
	Break Even Point (Telemedicine Consults)	**1,449**

Table 1: Template for Cost Analysis of Telemedicine and Face-to-Face Visits with Estimated Values

Fee for Service

Reimbursement through the third party payers is the largest source of revenue for telemedicine programs. Rules governing reimbursement for telemedicine services vary from state to state and the type of service provided. Under current Medicare regulations, only physician and psychology telemedicine services are reimbursed. Beginning in 1999, Congress mandated CMS to pay for telemedicine services to patients in HPSA. Efforts have also been underway at the state level pushing reimbursements for telemedicine consultations. California, Oklahoma, and Texas have now eliminated face-to-face evaluation as a requisite for reimbursement. Reimbursements are limited to the interventions at the remote clinic settings, and do not include therapy provided at the patient's residence. Third party payers are now reimbursing telemedicine services in several states, and about 12 states have partial Medicaid reimbursements. (13) At INTEGRIS, therapists work with the administrative sections of the organization for billing and compliance purposes. Current Procedural Terminology (CPT) codes, documented therapy procedures, service units, and costs for TeleRehab™ sessions have been developed and are documented for reimbursement purposes. TeleRehab™ therapists have given numerous presentations for state legislature and CMS to educate and build a case for reimbursement for telerehabilitation based interventions.

Infrastructure and Equipment

Setup costs include the costs of the infrastructure including audio-visual equipment, lease lines, phone bills, hiring of new personnel if needed, marketing, and training costs. Infrastructure cost associated with the implementation of a telemedicine program can be significant. Infrastructure should be adapted to the technological needs of the application, cost, comfort level of the users, and availability of resources in the remote areas. If targeting rural populations, it is advisable not to invest in the computer or Internet based platform since the majority of rural population is limited in their access and knowledge of computers. Simplicity of installation is preferred. Universal Access Fund provision of the 1996 Telecommunications Deregulation Bill provides funds to subsidize certain telecommunication services to rural, non-profit healthcare providers. (14) INTEGRIS

telemedicine system interfaces with OneNet, the Oklahoma Telecommunications backbone, which also links Oklahoma public schools and several hospitals. Connections have also been made to various educational and hospital networks in other state for conferencing and research training.

Bandwidth consideration is an important aspect of designing the infrastructure. When using videophones, there is a great disparity in the quality of video. This is important when looking at fine motor movements as in speech therapy. There is also individual tolerance level among therapists as to the level of clarity and smoothness of motion that will be acceptable. The therapists are therefore involved in equipment selection. Bandwidth is directly proportional to the data carrying capacity and the cost. INTEGRIS Health Rural Telemedicine project began with a focus on high-end technology. H.320 video conferencing systems with T1 lines were used. While the first pilot study was successful, it identified challenges associated with the use of this technology. Patients had to travel to the nearest site where this equipment was available, although this was still considerably less than the distance to a specialty rehabilitation outpatient site. This was a highly reliable technology utilizing a transfer rate of 384 kbps at 30 frames per second. The cost of equipment and the line lease were the major limiting factors. Travel by patients was not always feasible, so the focus shifted to exploration of technology options that could be utilized at home.

Low technology equipment was experimented in 2000, and rapidly gained favor by metro and rural healthcare providers because of increased convenience, ease of scheduling, and increased application potentials. "Plain Old Telephone System" (POTS) was used for the telerehabilitation connections. H.324 desktop videophones were utilized for these interventions. Desktop videophones are easy to install, and require the user to just plug-in the videophone into any ordinary phone jack. Operation involves dialing a telephone to establish an audio connection and then pushing a button for video. The unit provides real time video communication with adequate quality video and audio connection. The maximum transfer rate is 33.6 kbps with video streaming at 18-22 frames per second and costs $1,600 to $2,500 depending on the model and capabilities. Home-use equipment

should be compatible with the phone systems in the area. A complete list of different camera equipment including the recommended specifications, benefits, drawbacks, and approximate cost for each is available at http://telehealth.hrsa.gov.

Purchase and implementation of the system does not alone constitute the infrastructure. Factors such as network management responsibility, equipment insurance, and room design should be taken into consideration. Room design including lighting, sound, and video placement is important. Light should be on the patient, and not behind them. Half of the teletherapy sessions conducted by INTEGRIS have been in the residential settings. The camera should face away from the windows and ceiling lights. Background movements such as fans, and any fish tanks in the room, should be avoided as they result in excessive disconnects. Backgrounds and paints should be flat, and preferably monochromic.

Processes

Processes complement and frequently overlap the program structures. Processes for establishing a telemedicine program should focus on protocols and service delivery, training, outcome measures, and regular evaluation and feedback.

Protocols

INTEGRIS Health TeleRehab™ program has developed protocols for telerehab referrals, screening, admission, evaluation, recertification, discharge, billing, coding, documentation, and use of data for research purposes. This has been a constant learning process, which has been developed over time from experiences with the program. The protocols have followed refinement and written documentation of the workflow. A team of managers, therapists, and other support staff meet biweekly to refine strategy, and discuss cases, coding and billing issues.

Training

The majority of implementation and operational problems associated with telemedicine can be traced to inadequate training. Training modules should be prepared for

telemedicine coordinators, clinicians, and support staff. The primary focus of training is on therapist comfort and familiarization with the new technology including operation, installation, and troubleshooting of the equipment. New verbal skills including unambiguous description and instruction are necessary to compensate for the lack of hands-on demonstration or examination. Training also covers cognitive knowledge, physical examination skills, ability to communicate with the patients through audio-visual means, and suitable documentation of a telemedicine encounter. Education of target healthcare providers and consumers is accomplished via direct demonstrations, continuing medical education (CME) or continuing education unit (CEU) courses, and brochures. Training can be imparted through a combination of direct demonstration, instructional tapes, or written materials. It is advisable to develop a formal training program over time that includes skills assessment and trainee evaluation.

Documentation and Outcomes Measures

Anecdotal evidence is not enough to scientifically establish the efficacy of a program. Collection and analysis of outcomes measures helps in establishing the efficacy of the program, and aids legislators in reimbursement issues. Outcomes measures also highlight any inherent deficiencies in the program and provide a framework for further program improvement and refinement. Outcomes measures collected for TeleRehab™ focus on clinical outcomes, subjective and objective quality of life, customer satisfaction, and research opportunities. Cost analysis outcomes include revenue dollars, frequency of hospitalizations, number of consultations, travel costs saved; and value added to the institution's mix of services. Technical outcomes include mean time between failures, connection and display problems, and rate of usage. INTEGRIS Health is also investing in developing a database for outcomes measures for telerehabilitation. A prototype is currently being developed in Microsoft Access that will be later upgraded to Structured Query Language (SQL) with a Java front end.

Results

As of March 2003, a total of 3397 TeleRehab™ sessions were conducted by INTEGRIS in a variety of settings.

Table 1: Patient Interventions by Discipline		
Discipline	**# Consults**	**Hours**
Audio/Verbal Therapy	82	77
Neuropsych	23	19
Occupational Therapy	39	21
Physiatry	126	32
Physical Therapy	473	397
Speech Language Pathology	2651	1619
Vocational Rehabilitation	3	3
Total	**3,397**	**2,165**

User satisfaction

Satisfaction surveys are routinely given to providers, patients, and caregivers. Patient satisfaction ratings have generally been positive. Nine out of ten negative comments were related to technology issues. Analog lines are affected by weather conditions, especially wind, which can be a considerable problem in Oklahoma. Overall, students were slightly less satisfied than the patients (Figure 4), which can be attributed to the fact that they were not given an option to choose between TeleRehab™ and face-to-face interventions. The relationship between the student and the therapist also influenced the satisfaction rating. The satisfaction of patients was also affected by increased accessibility and travel costs saving.

Among the therapists, speech therapists rated telerehabilitation lower than other allied health disciplines (Figure 5). These lower ratings have been traced to technology problems during the early phases of the school teletherapy program. The technology issues have subsequently been addressed resulting in higher speech therapy ratings. TeleRehab™ forces therapists to interact with patients verbally rather than through tactile means, which can be less satisfactory for some therapists during the initial period.

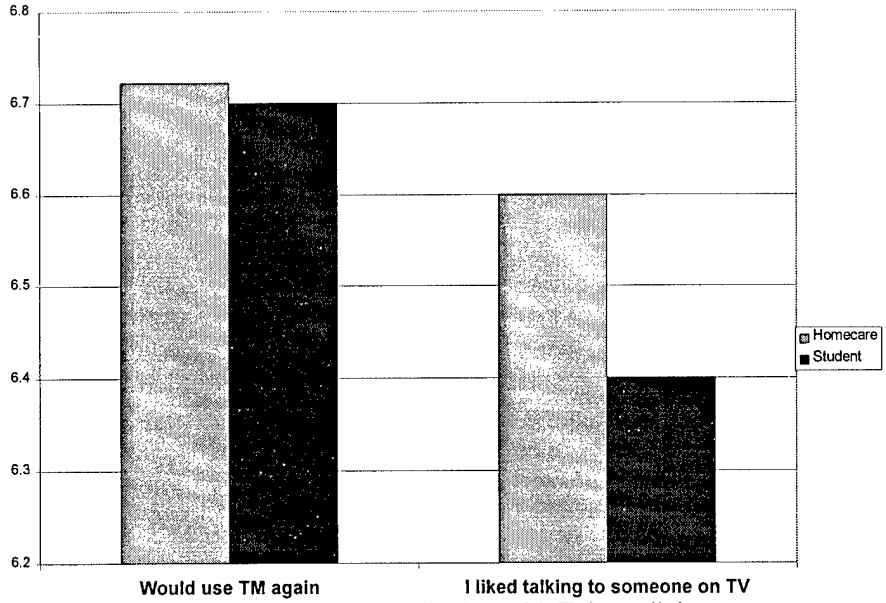


Figure 4: Patient Satisfaction with Telemedicine
1= Dislike 7= like very much

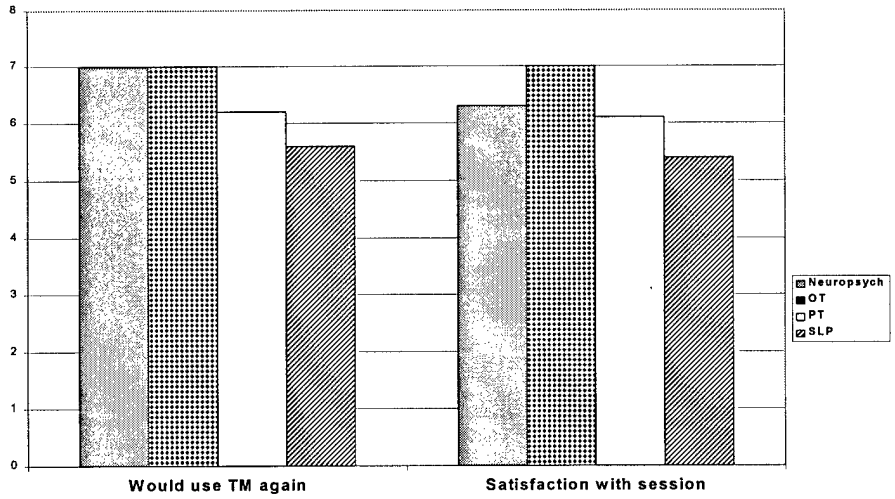


Figure 5: Provider Satisfaction with Telemedicine by Discipline
1= unsatisfied 7=very satisfied

Figure 5: Provider Satisfaction with Telemedicine by Discipline

1 = unsatisfied 7 = very satisfied

Constant user feedback and evaluation are important for reassessing, rethinking, redesigning, or reengineering the program. The TeleRehab™ program implementation is a constant change process. Feedback and evaluation are crucial during the initial phases. The business plan and the workflow processes should be reassessed periodically based on the feedback.

Cost savings

Cost savings can be direct (reduced provider travel) or indirect (reduced length of stay or adverted emergency department admissions because of early intervention). If the program is considered a cost of doing business because of the value it adds to the institution, this should be documented. TeleRehab™ is a resource to other departments to help increase their revenue or decrease costs. Revenue is a combination of grant funds, reimbursements, and educational programs. Value of telemedicine should also be assessed in terms of visibility and stability it provides to the organization. Savings during a six-month period included:

- Home care miles saved: 13,874 ($49,946 saved at 0.36/mile)
- Home care productivity saved: 231 hours ($4,158 saved at $18/hr)
- Hospital readmissions reported as averted: ($10,000 saved: 2 at $5,000/admit)
- Provider (not home health) miles saved: 36,912 ($13,288 saved at 0.36/mile)
- Provider productivity saved: 615.20 hours ($14,760 saved at $24/hr)

Total savings in travel, productivity, and adverted non-pay hospital admissions: $92,152

.

Cost Savings to other departments

Clinical services (home health /hospice/wound care/averted no-pay)	– $266,500
Telecommunications (Network line lease reimbursement)	$200,000
Administrative travel	$361,527
	$828,027

For patients, savings in terms of travel costs were $64,366 (178,794 miles at the rate of $ 0.36/mile). Average mileage to provider was 36 miles, 71 percent of the patients did not have their own transportation, and 25 percent would not have received help without TeleRehab™.

Conclusion

Adequate change management is a necessity in today's dynamic healthcare environment. Change efforts fail by trying to short cut the steps in the organizational change process. Strategy, people, structure, and processes are the four cornerstones of change. Strategy should always be finalized first as it lays the groundwork and outline for the rest of the change process. When implementing a new initiative, people frequently make the mistake of changing the structure first as it is the most visible of the change elements. However, without adequate groundwork, purely structural change is not successful or sustainable.

A new change initiative should always start with the need assessment for change. Identification and involvement of stakeholders are important at all points of the change process and during the maintenance phase. People are the keystones of successful change initiatives and majority of change failures can be traced to human factors. Education and user training are essential for the users to be comfortable with the change process. Structure and processes are the building blocks of the long-term change process, and they frequently overlap. Program strategy, personnel, structure, and processes should be revisited regularly, with changes made as needed.

While contracting for services, it is important to promise only what can be delivered. The program should preferably be started small with a niche area, and then build on that. Diversifying the services offered is an important component. Having frequent milestones with short timelines keeps the people focused, however, the timelines should be realistic and practical. TeleRehab™ should be viewed as a support service with rehabilitation as the primary or actual service, and TeleRehab™ an extension of the traditional rehabilitation services.

A sustainable change is a function of attention to the big picture, stakeholder buy-in, skills, managed risks, and continued action. Continuous feedback and evaluation resulting in continuous process improvement is essential. The new change effort must be anchored in the culture and process of the organization, only then will it result in a long-term successful change implementation.

Reference List

1. Liss, S. J., Glueckauf, R. L., and Ecklund-Johnson, E. P. Research on Telehealth and Chronic Medical Conditions: Critical Review, Key Issues, and Future Directions. Rehabilitation Psychology 2002;47(1):8-30.

2. Burns, R. B., Crislip, D., Daviou, P., Temkin, A., Vesmarovich, S., Anshutz, J., Furbish, C., and Jones, M. L. Using Telerehabilitation to Support Assistive Technology. Assistive Technology 1998;10(2):126-33.

3. Glueckauf, R. L.; Nickelson, D. W.; Whitton, J. D.; Loomis, J. S. Telehealth and healthcare psychology: Current developments in telecommunications, regulatory practices, and research. Boll, T., Baum, J., and Frank, R. Handbook of clinical health psychology: Models and perspectives in health psychology. Washington, DC: American Psychological Association; 2002.

4. Tanriverdi, H. and Iacono, C. S. Diffusion of Telemedicine: A Knowledge Barrier Perspective. Telemedicine Journal 1999;5(3):223-44.

5. Schlenker, R. E., Powell, M. C, and Goodrich, G. K. Rural Urban Home Health Care Differences Before the Balance Budget Act of 1997. The Journal of Rural Health 2002;18(2):359-72.

6. Carter, R., Republicans' Outline: 2000 Rural Agenda. Oklahoma City, Oklahoma: 2000.

7. Schopp, L., Johnstone, B., and Merveille, O. C. Multidimensional Telecare Strategies for Rural Residents With Brain Injury. Journal of Telemedicine & Telecare. 2000;6(S1):146-9.

8. Rosen, M. J. Telerehabilitation. Neurorehabilitation 1999;12(1):11-26.

9. Rogers, E., Diffusion of innovations. 5th ed. New York: Free Press; 1995.

10. Worthley, J. A. Managing User Resistance. Managing Information in Healthcare: Concepts and Cases. 1st ed. Chicago: Health Administration Press; 2000. pp.165-203.

11. Darkins, A. W.; Cary, M. A. The Business of Telehealth. Telemedicine and Telehealth: Principles, Policies, Performance, and Pitfalls. 1st ed. New York: Springer Publishing Company; 2000. pp.204-15.

12. Stensland, J., Speedie, S. M., Ideker, M., House, J., and Thompson, T. The Relative Cost of Outpatient Telemedicine Services. Telemedicine Journal. 1999;5(3):245-56.

13. Kane, J., Marken, J., Boulger, J., and et al. Rural Minnesota Family Physicians' Attitudes Towards Telemedicine. Minnesota Medicine 1995;78:19-22.

14. Brecht, R. M.; Barrett, J. E. Telemedicine in the United States. Viegas, S. F. and Dunn, K. Telemedicine: Practicing in the Information Age. 1st ed. Philadelphia: Lippincott Raven; 1998. pp.25-30.

Appendix I

Creating a Distributed Network for Successful Implementation of a Rural Telemedicine Program

Authors:

Debbie Justis, RN, MSHA
Charles Doarn, MBA
Ronald Merrell, MD

Although the concepts of telemedicine and telehealth have been around for many years, it has only been in the past decade or so that it has become an option for rural health. Each year the capability increases and the cost continues to decline. In rural communities throughout the United States equipment and telecommunication links are increasingly available to the smaller facilities. With grant funding and Federal assistance for telecommunications costs, even rural communities can afford to start telemedicine programs. In addition, telemedicine is being reimbursed more today than perhaps only five years ago.

Sustaining these programs is another challenge altogether. Studying health care in rural communities is paramount in creating successful networking strategies for a telemedicine project to be sustainable. The role of a network in the rural community is much bigger than the connections created through telecommunications. The dynamics of the health care providers, patients and others within the community can benefit the network, or tear it apart.

In the Commonwealth of Virginia, nothing illustrates the challenges of rural medicine more that the Three Rivers Health District in Eastern Virginia. This area consists of ten rural counties surrounded on three sides by rivers and the Chesapeake Bay. The population is diverse, within

the ten counties. A few of the counties serve as retirement communities, one of the counties is a "bedroom community" for Richmond. On the other hand, all the counties have a lower income than the state average, and all are medically underserved. The community of Three Rivers Health District has a saying about people who live in their community. If you are from Three Rivers, you are a "from here", if you have moved into the area, you are a "come here". As is typical of many rural areas, it is much more difficult to find acceptance as a "come here."

When the Virginia Commonwealth University Health System (VCUHS) began to investigate the idea of creating a Telemedicine Network in Three Rivers, it knew that being a "come here" was not going to help establish a successful, sustainable network. The VCUHS studied the health statistics and the number of visits to the VCUHS clinics from Three Rivers. Over 16,000 visits were made in 2001 from the ten counties included in the Three Rivers Health District. In addition, the health statistics were alarming. The death rate of the citizens in Three Rivers is much higher than in the Commonwealth of Virginia for cardiovascular disease, pulmonary disease, and many types of cancer.[1] These health disparities, and the high number of clinic visits prompted the VCUHS and several health care providers in Three Rivers to begin to formulate a plan for implementing a telemedicine program to link providers and patients in a distributed telemedicine network in the area.

In such a distributed network, as opposed to a hub-and-spoke model, members can connect to each other, providing education and/or consultations to and from any network site. In the hub-and-spoke model, all peripheral sites (spokes) connect to a central site (hub) to receive care/education. Three Rivers has several discipline specialists and three hospitals serving the

area. It is well documented that rural physician recruitment and retention is a problem, therefore, it was made clear from the beginning that the VCUHS did not want to take patients from the rural physicians, but rather, to enhance their ability to provide care, and supplement specialty care where it was not locally available. Hicks describes the importance of rural community pride to the rural population, as "Members of the community often view their local hospital with civic pride and recognize that the hospital is a key factor in efforts to attract and retain physicians and other health care personnel and resources."[2] Recognizing this, the VCUHS sought and received the support of the Health Director during the early planning stages, and worked closely with hospital administrators, community physicians, patients, and health departments determining the area health care needs and possible solutions. It was determined early that some health care needs could be met by local physicians and practitioners, and some needs would require the VCUHS staff support.

Another need identified by the rural community of physicians was the lack of available continuing education opportunities. In order to meet the needs of the physicians and other health providers in the area, the network will be used for providing education, as well. One site will be set up for only education during the first year. The network members hope that the experience with receiving education via video will increase the number of telemedicine referrals by the same groups of practitioners. The use of the network for education will also provide a potential source of revenue for the network, as well as a recruitment and retention tool for the area. Grigsby points out, "Expanded continuing education is often seen as a pre-requisite for attracting and retaining professional staff."[3]

Based on the assessed needs, Three Rivers Telehealth Network has two purposes, to provide consultative specialty care via telemedicine to the residents of Three Rivers Health District, and to provide educational opportunities to the health practitioners in the area as well as community members. Two community hospitals, both under 100 beds, a community health center and public health clinic (combined), a senior center, along with an urban academic medical center have all joined together to form this network. During the year spent preparing to initiate the Three Rivers Telehealth Network, the VCUHS telemedicine coordinator met with several groups, including physicians, to listen to the physicians' specific needs for specialty consultations. The telemedicine coordinator was also able to teach the physicians about what is available. Since most medical schools do not include telemedicine in their curriculum, many of the physicians in the rural community were not aware of the numerous opportunities offered through a telehealth network. New reimbursement opportunities were also explained, and well received by these physician groups. Each rural health care facility has identified a medical champion and an administrative champion for telemedicine. Puskin stresses the importance of the clinical champion, "Minimally, there must be clinical leadership or these systems are doomed to failure, since it is practitioners who drive telemedicine use."[4] These champions have a vested interest in the success of the network, as they have invested time and promised in-kind donations to ensure its long-term success. Mascovice agrees, "If the major purpose of the network activity is service integration, the rural physician group practice, rather than the hospital, may be the main coordinating element."[5]

In the rural community, where recruitment and retention is especially difficult, it is vital to comprehend the importance not forming a network, which competes with local providers for

patients, especially those who have insurance. If the network takes the paying patients from the local safety-net providers, but does not provide care for the uninsured, the safety-net collapses. It follows that the network will not thrive in the area, as long as there is a choice of provider by the local insurer.[6] It is just as vital to promote the perception of the local hospitals. According to Hicks, when a patient is transferred to a larger urban facility, especially if tests are repeated, the confidence in the rural hospital is decreased, which can result in the patient bypassing the local hospital and go straight to the urban medical center.[2] With telemedicine, the local hospital can provide a more advanced assessment, which increases confidence from the local patients, potentially avoiding loss of patient revenue to the academic medical center. Hicks goes on to point out that network development is one way to redefine the rural hospital for survival in the managed care environment, by providing more services through telemedicine links.

Understanding the motivation of a rural health care provider to join a network, and identifying the benefits they are expecting are important steps in forming network relationships. Retention of network members will be easier if expectations are made clear from the beginning of the relationship. Moscovice lists three motivations for forming networks in rural areas. A "resource dependence model" assumes that during a time of financial uncertainty, it is beneficial to reduce dependence on one source outside the organization. Control of the environment, then, is one motivation to join a network. A second model assumes a reduction in transaction costs, or "the costs of running the economic system". The third model holds that the belief that networks improve access and quality of health care is widespread, therefore communities expect health care providers to collaborate.[5] The Three Rivers Telehealth Network formed for many of the reasons stated. Each of the members will contribute to and receive benefits from the network.

Each member has clearly stated that the goal of the network is to see an improvement in the health of the population it serves.

Forming a successful rural health network also involves acceptance of change, a difficult concept for some rural communities. In order for this change to be accepted by the rural community members, they must "feel ownership for the project"[4]. Mueller lists three main ingredients to mold change in a rural community: resources, leadership and community capacity.[6] When the Three Rivers Telehealth Network was created, the planning team took into account that resources to provide care via telemedicine would have to be provided, and applied for a Federal grant to purchase needed equipment, pay for consultations for uninsured, help with telecommunications cost, and support salaries to create and sustain the infrastructure of the network. Local leadership is the second ingredient mentioned by Mueller. When requesting feedback from the community about the network idea, one county administrator was present, additionally, the Health Director for the Three Rivers Health District has been a key player in the planning of the network. The third ingredient is community capacity. Mueller suggests looking to Medicare and Medicaid for incentives to increase capacity. Since reimbursement is always a question when the idea is presented, the network members are well-versed in Medicare and Medicaid policy regarding reimbursement for telemedicine from the rural areas. This will provide incentive for the involved urban and rural physicians alike.

The Three Rivers Telehealth Network is just beginning to scratch the surface of the wealth of opportunities for improving the health of the Three Rivers population. For example, the network will be able to take advantage of economies of scale as it grows to include other providers in the

area. Defining the relationships between the network members is an important first step in creating the network as its own entity. The options for defining relationships in a network vary from ownership to informal ties between care providers. Moscovice defines "an integrated rural health network as 'a formal organizational arrangement among rural health care providers (and possibly insurers and social service providers) that uses the resources of more than one existing organization and specifies the objectives and methods by which various collaborative functions will be achieved.'"[5] In order to clarify the relationship between network members in the Three Rivers Telehealth Network, every member has signed a Memorandum of Understanding (MOU). This helps each member solidify their commitment to seeing the network succeed. The health care providers in the area include two hospitals owned by a corporation, one privately owned hospital, several private physician offices and county health departments. The members have no interest in establishing relationships which involve vertical or horizontal integration, but will continue in this symbiotic relationship, "supporting each other in the provision of their services and help each other to achieve joint competitive advantage."[5] The strategic advantage for each network member, enhanced by the telehealth links include an increase in the referral base for each facility, revenue incentives including facility fees for providing consultation presentation, and enhanced recruitment and retention for health care providers through increased educational opportunities.

As a network matures, the relationships between the members will change. The MOU's that were signed to initiate the relationships are not legally binding, and do not involve an exchange of fiscal resources. As the network matures, the goal of the members is for the Three Rivers Telehealth Network to become its own entity. The members agree it will be necessary to support

the infrastructure by contributing financially to sustain the network's infrastructure. Each member will pay in proportion to the benefit it receives. For example, since this is a mixed rural and urban network, the urban facility (VCUHS) stands to gain more than the rural facilities in billable services, so the contribution to the network itself should be higher. Moscovice[4] and Hicks[2] remind us that the operation of a rural health network takes time and dedication to succeed. Human nature looks to each idea for "what's in it for me?" Since each network member will be financially contributing, the incentive to participate in care via telemedicine, and thus reap the financial rewards is greater.

Successes of the Three Rivers Telehealth Network include the enthusiastic support for the network from the members and their parent organizations. Support was sought and received from each of the network sites in the area. One potential user has reviewed charts for possible cases. The testing of current equipment has begun, with donated time and effort from involved sites. Presentations to community members, including potential users in three counties, as well as local physicians was well received. Overcoming the barriers of working in a rural community has begun by gaining the acceptance of the physicians and patients, both potential users of the network.

The goals of the Three Rivers Telehealth Network include continuous assessment. The initial plan was developed based on needs assessed from the potential network users. "Ongoing assessment of rural practitioner needs by the specialty centers and their rural partners must be built into the management of telemedicine systems for them to be successful."[4] There are more people who are already expressing a desire to be part of the network. The first phase could not

accommodate everyone, but as needs are assessed, the network members will continue to look for ways to incorporate others into the network. As Dena Puskin so aptly summarizes, "Telemedicine is a tool to break down barriers to patient care and professional education. It is the highway of the 21st century by which we are moving information, not patients. Community needs and health care requirements-not technology-should drive telemedicine system development." [4]

[1]

[2] Hicks, L., Bopp, K. *Integrated pathways for managing rural health services.* Health Care Manage Review 1996 Winter;21(1):65-72.

[3] Grigsby, W. *Telehealth: an assessment of growth and distribution.* The Journal of Rural Health 2002; 18(2):348-358.

[4] Puskin, D. *Opportunities and challenges to telemedicine in rural America.* Journal of Medical Systems 1995 Feb;19(1):59-67.

[5] Moscovice, I., Wellever, A., Christianson, J. *Understanding integrated rural health networks.* The Milbank Quarterly 1997; 75(4):563-586.

[6] Mueller, K., Coburn, A., Cordes, S., Crittenden, R., Hart, J., McBride, T., Myers, W. *The changing landscape of health care financing and delivery: how are rural communities and providers responding?* Milbank Quarterly 1999; 77(4):485-510, ii.

Appendix J

Author and contact details
Dr David Bomba, PhD
School of Information Technology and Computer Science
University of Wollongong
+61 242 214879 (phone)
+61 242 214170 (fax)
bomba@uow.edu.au

Working title:
A comparative study of the diffusion of Computerised Health Records among General Practitioners in Australia and Sweden: How should we understand the process of innovation and what can we learn?

Suggested Section:
Section 4: Actors, Networks and Alliances in Telemedicine and e-Health

Abstract

Computerised Health Records systems are seen as a fundamental building block for primary health care globally. In order for grander visions of global telemedicine and e-health to take place, CHR adoption and use among General Practitioners is therefore seen as a key linking element. As with any major paradigm shift in work practices, from paper records to electronic records, there will be inherent political conflicts. This will be explored through the findings of a study which looked at the diffusion of CHR use/non-use among GPs in Australia and Sweden.

A comparative study was undertaken so as to verify the state of adoption of CHRs among GPs in Australia and Sweden. Responses were gained from a mailout questionnaire to random samples of GPs in both countries (N=600/country). The main findings of the survey indicated that there was a high rate (72%) of diffusion of computers and CHRs among GPs in Sweden and a low rate (14%) of diffusion among GPs in Australia. Moreover, use of computers by Australian GPs was predominantly confined to front desk applications (e.g. accounts/billing, word processing) as opposed to clinical CHR use (e.g. patient notes, script writing, recall and referral, test ordering). In Sweden, CHR adoption can be seen as more of a result of direct funding availability (a type of authority decision) mandated by governments (local and national) while in Australia the decision to adopt CHRs is more of an individual optional or collective group practice business decision.

Results also indicated what could be called an attitude-behaviour paradox. In the Swedish results, among non-users, a positive attitude was associated with an intention to adopt in the near future (within 3 years). In the Australian results, even when non-users indicated to having a positive attitude they had no intention of adopting CHRs. This finding supports the general belief that new knowledge and attitudes by themselves are not necessarily sufficient to bring about a change in behaviour. Other social and political

reasons need to be considered, education and training, CHR standards, record ownership, legal status, patient access rights and responsibilities as well as GP loss of power issues and government funding models. For this reason the Australian Government introduced a Practice Incentives Project to get GPs in Australia computerised and in 2002 introduced Health Privacy Legislation through amendments to The Privacy Act (1988) to cover the private sector handling of patient information, patient access rights and health provider responsibilities.

Through an analysis of the data collected in this study, I argue that CHR diffusion needs to be seen as more than just the diffusion of a technical artifact (Winner, 1977, 1980; Latour and Woolgar 1979; Callon and Law 1989; Bijker and Law 1992). CHRs are essentially a social (de)construction of meanings and artifacts by actors in social and professional networks through time. Social and professional networks can further be conceptualized as networks of actors belonging to various language or discipline trees, for example, health/medical informatics. Conflict over both the shape and form and therefore meaning of CHRs is inherent in any political change process as not all actors are homogenous. Conflict between actors and actor networks is reflective of the continuing struggle to gain control over the meaning and organization of society, social structure. Technical artifacts can be seen as the physical manifestation and imposition of this power struggle. The focus therefore should not be so much upon the spread of technical artifacts alone, as in past diffusion studies (Rogers, 1995) but more on the spread of information about the meaning and consequences of the artifact and how this is politically communicated among actors.

In sum, CHR diffusion in healthcare globally, needs to be viewed and understood as belonging to a more broader landscape of the theories of technology, epistemology and society. The development and diffusion of CHRs, telemedicine and e-health (or lack of) are not only a reflection upon the motivations and attitudes of the actors within social and professional networks but also upon government policy, legislation and funding.

PROPOSED BOOK CHAPTER

What is health, health informatics, e-health and how do they all fit together?

Health is a complex social phenomenon. Health is not just about medicine or the practice of medical methods by doctors. Health is much broader than just medicine, inextricably related to political, economic, legal, environmental and social issues through time. Evidence of this argument is provided by the World Health Organisation's (WHO) definition of health:

> ... a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity, is a fundamental human right and that the attainment of the highest possible level of health is a most important world-wide social goal whose realisation requires *action of many social and economic sectors in addition to the health sector.* (World Health Organisation, 1978)

From the outset, this implies a broader approach to the study of health which goes beyond traditional disciplinary boundaries. Health is not the exclusive domain of medical practitioners. Thus, it is argued that health informatics, which is defined by Mandil (1993: 4) as "... an umbrella term used to encompass the rapidly evolving discipline of using computers, networking and communications – methodology and technology – to support health related fields ..." rather than medical informatics, is more reflective of an approach which tries to embrace a multidisciplinary approach to the study of health care provision. This is not to deny the importance of medical clinicians, however health needs to be viewed as a partnership made up of network alliances involving many actors. The following definition of primary health care has been adopted:

> primary care is the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing sustained partnership with patients, and practicing in the context of family and community. (Van Bemmel et al., 1997: 159)

The term e-health has also emerged more recently as another umbrella descriptor which attempts to portray the convergence, collaboration and alliance building between numerous actors and disciplines; this book being an example of this idea. Telemedicine is seen to play a significant role in future e-health activities, despite its poor utilization to date (Bangert and Doktor 2000). The WHO in their 1993 report have indicated the importance of telemedicine at a global level. However, research into the utilisation of Computerised Health Records (CHRs) among General Practitioners (GPs) is seen as a critical area of study in an emerging e-health vision. The term GP as used hereafter can be used interchangeably with the terms family practitioner/physician as is the practice of the World Organisation of Family Doctors (WONCA, 1991). Dickinson (1991) indicates that in Australia, 80 to 85% of the population will visit their GP within any given year. GPs can be considered as the main point of entry to primary health care in most health systems around the world and therefore GPs can be seen as the gatekeepers (Strasser 1992) of health information, both locally and nationally. This health information is presently an under-utilised information resource in Australia and is generally buried away in hand written files stored in various isolated paper card file systems at disparate GP

sites. General Practice in Australia has been described as a black hole, "so big and impenetrable is this black hole that those charged with the job of analyzing the nation's health needs at a grassroots level are practically working in the dark." (Leech, 1998: 42). The cost of health care in Australia (GP visits, prescriptions, pathology tests, radiology and specialist visits) was estimated at approximately $7.5 billion (Australian dollars) and the problem of trying to collect some structured information about these events is further exacerbated by the low levels of computer use by GPs.

The use of CHRs in General Practice could lead to new processes and ways of looking at health care, for example: epidemiological research; analysis and tracking of disease trends by database queries; prescription pattern monitoring; calculation of patient and health treatment costs; and providing greater scope for teleconsultations and telemedicine. The central argument is that CHR systems are seen as a fundamental building block for primary health care globally. In order for grander visions of global telemedicine, virtual hospitals and e-health to take place, CHR adoption and use among General Practitioners is therefore seen as a key linking element and needs to be explored. This chapter explores the discrepancies in the utilization of CHRs, specifically, how can high and low rates of CHR adoption among GPs in different countries be explained? All too often in the medical informatics literature, there is a preponderance of technical or black box studies of CHRs, technics. This is not to say that technical approaches are not informative but they need to be balanced with approaches which give CHRs a wider social and political context of understanding as to why some technologies may or may not be adopted. The process of technology design, ie why has a technology been designed in a particular way as opposed to another design is inextricably linked to the alliances and actors involved in technology construction.

The meaning of health is to a large extent a reflection upon the (de)constructions made by GPs through patient health care records over time, for example, identification of novel types of diseases, classification of diseases, disease trends, etc. It can be argued that what happens at the micro level within GP practices is the basis for shaping macro level national health policy developments, allocation of resources and identification of priority care needs. Macro level health policy in turn shapes micro level GP activities, for example, availability of funds and grants for priority research areas. Information technology can be designed and used to aid this policy process, for it is the information and how it is captured and made available to others that is the central element in the technology design debate. Privacy concerns can be seen as a manifestation of technology design debates (Westin 1976; Donaldson and Lohr 1994; Safran et al., 1995).

Historically, the patient record has been the documentational building block for health care and medical practice as is often traditionally attributed to Hippocrates 5 B.C. The patient health record as such can be considered as a minimum documentational practice. This minimum standard is set by governments through legislation such as Health and Health Services Acts thus, making the record a legal document created by health care workers during the provision of health care to a patient. Traditionally, these have been centred upon a paper-based paradigm of health care, despite patch-work revisions to legislations designed to be more reflective of contemporary technological changes.

Computerisation of the patient record is an attempt to move from a paper based paradigm of health care provision to a computerised or electronic based paradigm. This fundamental change is not without problems and consequences. Linnarsson (1993) indicates that the computerisation of the patient record needs to be seen as much more than just the simple automation of a manual process. The process of change has many legal, political, health, economic, organisational, technical and social implications and barriers. This is demonstrated in the work of Berg (1997), who examined the rationalisation of medical work practices. This is a major change in the organisation of how health care is practiced, divisons of labour, funding mechanisms and the way organisations operate; hospitals and GP practices being examples of such organisational structures. CHRs are representative of information systems that allow greater control over patient and practice information and respectively greater accountability and evaluation (Feinglass and Warren-Salmon 1990).

What is a Computerised Health Records (CHR) system?

Various authors have looked at the potential role of computers in medical practice over the decades, examples include Best (1962), Fitter and Cruickshank (1982, 1983), Brownbridge et al (1984, 1985) and Crampton (1995). The actual meaning of CHRs is however reflective of a social and political process through time, (de)constructed by actors who have an interest or stakehold in CHRs. Hence, conceptually, the patient record should be considered as a socially constructed technology which exists within a larger system of health technologies, networks and actors. For this reason various individuals and organisations have attempted to define and shape the debate over CHRs. A key organisational actor has been the Institute of Medicine (IOM) in the United States of America. The IOM (1991, 1997) defines the Computer-Based Patient Record in the following way:

> an electronic patient record that resides in a system specifically designed to support users by providing accessibility to complete and accurate data, alerts, reminders, clinical decision support systems, links to medical knowledge, and other aids. (IOM, 1991)

This definition is a rather ambitious, broadly ranging ideal. It does not necessarily exist in practice, despite systems which may try to approximate this ideal. There is also a tendency to focus on clinical systems rather than on a more holistic organisational or practice management system which also includes non-clinical components such as accounting and budget management. This will come under the spotlight more so in coming years especially in health care systems where GPs operate, or may be encouraged to operate, as private business entities rather than government funded employees.

The significance of information and telecommunications systems within health care cannot be denied. In the USA, Schneider et al (1992) argue that telemedicine could save billions of dollars by using the telecommunications system to exchange health information between providers. In Australia, the telemedicine vision can be characterized by a growing number of pilot and experimental projects (Watson 1989; Brauer 1992; Crowe 1993; Allen 1994). Pradhan (1996) provides a useful account of the area and some of the issues.

Theoretical Background for Understanding Actors, Networks and alliances in e-health

In Badham's (1986) analysis of industrial society the meaning of technology is often historically embedded in notions of progress, rationality, industrialisation and modernity. Within what can be termed as the sociology of technology literature there exists conflict over prescribed meanings of technology, for example technological determinism, technical systems and social reality (see, for example, MacKenzie and Wajcman, 1985, Jones 1982, Hughes and Mayntz 1988). As a further example, D. MacKenzie (1996) argues that there is a difference between social shaping thinking about technology and social constructivist thinking, which is captured in the idea, "contingency of design", that is in how things can be designed differently, for example, houses, bicycles, cups, bridges, windows. At times this interpretation may lead to some confusion since it implies a certain neutrality in technology, design independence, which is not necessarily the case. Winner (1980) can be seen as one who argues that technological design, for example, bridge building, is an inherently political process which suggests that technology is not neutral but embodies the motivations of the designer(s) involved. When more heterogenous designer(s) are involved in the shaping/design process the result could be reinterpreted as MacKenzie's shaping or contingency of design thinking. The diffusion of an innovation or technology should be seen as both a local (micro) and global (macro) process occurring among actors in different frames of meaning, at one and the same time, therefore, it involves the communication of information about artifacts and the adoption or rejection of artifacts themselves, for example, CHRs. Inherently this embodies the ideas of change, conflict and social (re)organisation which arise as a result of a clash between actors with different frames of meaning and network alliances. This interpretation can be historically traced back to the thinking of Marx and Hegel about social development, hegemony, and the dual dialectic, contradiction (conflict) and meaning resolution (conflict resolution), or in technology debates as closure and stabilisation (see, for example, Bijker et al., 1987, Bijker 1995). This has also more recently been reinterpreted into organisational and class politics, the politics of difference, and the battle over the control of economic modes of production and information markets, the health sector being one such market (see, for example, Zuboff, 1988; Milner, 1996). Hence, CHRs can also be explained as a development within a more competitive market framework; information as a commodity which gives competitive economic advantage and reduces uncertainty (e.g. Porter and Millar, 1985, Porter, 1980, 1985, 1990; Arrow 1980; Lamberton, 1990; Eliasson 1990). Therefore, technology studies can be interpreted as being reflective of theories for understanding the organisation of market and social structure (Giddens, 1984, Callon and Latour 1981), hence, e-health should be seen as an extension of this thinking in health care. For afterall, as Rigby (1999: 98) indicates:

> "Healthcare organizational structures are frequently seen as a hierarchy of networks and alliances. The individual healthcare organization has a network relationship to other health care organizations. Additionally, there will be alliances with related organizations. Internally, the health organization can be viewed as a network of departments or clinicians liaising directly with one another ..."

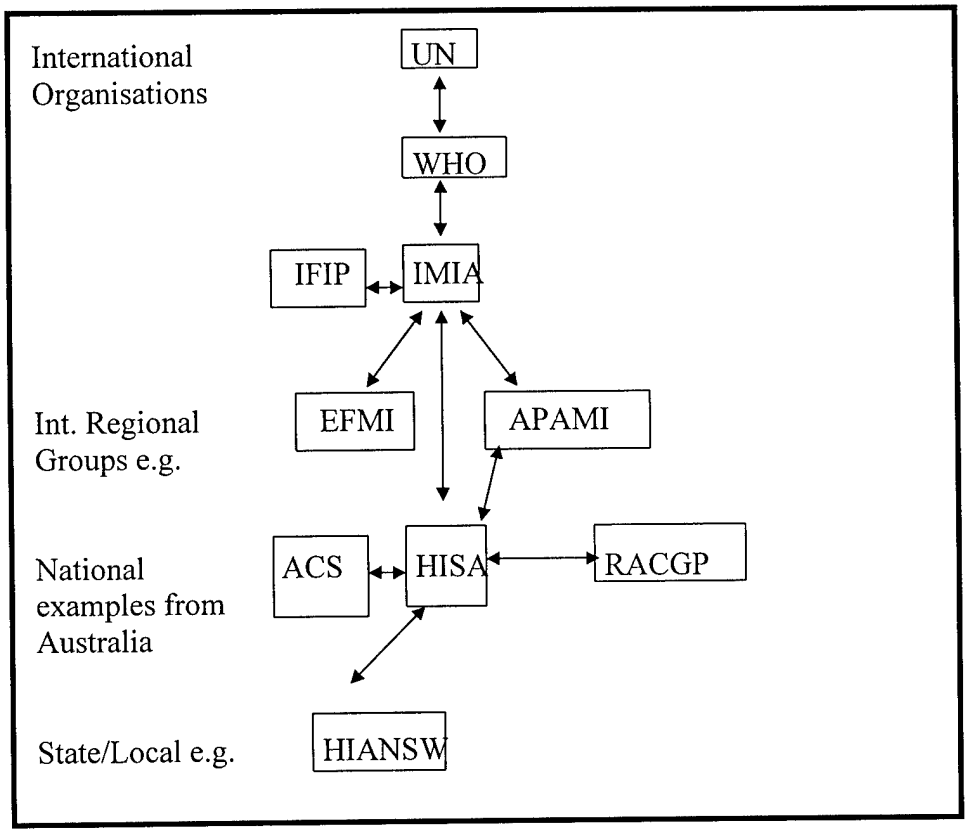
Furthermore, e-health organizations in the future may be defined more by their telecommunications networks rather than just their physical presence. The idea of "frames of meaning" is essentially derived from Collins and Pinch (1982) and Bijker et al. (1987: 172) who use the term "technological frame" to represent "... the *interaction* of various actors ...". Hence, as used here, this frame is representative of the negotiation space or (de)construction space, of meaning between actors and actor networks in different meaning frames. This builds upon the idea of actor networks within different meaning frames (Callon and Law, 1989; Bijker et al., 1987). For example, GPs are essentially actors in organizational, professional and social networks, formal and informal e.g. the general practice setting; or professional bodies like the Australian Medical Association (AMA), the Royal Australian College of General Practitioners (RACGP) and the Health Informatics Society of Australia (HISA). All attempt to shape the meaning and artifactual form of patient records with other actors both within meaning frames and between actors within other professional networks e.g. government administrators, policy planners, strategists, third party insurers, patients, nurses, pathologists, pharmacists, radiologists, CHR vendors, software standards bodies, and others. Conflict is therefore inherent in this negotiation of meanings and artifact translation process. This creative disruption is perceived as benefiting some professional groups of actors more than others, and as a possible destabilisation of the status quo. Some perceive a possible gain in power over other actors while some perceive a loss in power, restructuring, hence the utility of a socio-political paradigm of understanding CHR diffusion and non-diffusion. Technical black box design, translation and diffusion is a socio-political process among various actors and needs to be understood as such.

CHRs need to be viewed as an organizational construct. At a theoretical level, the question then arises as to whether actors can also be inanimate objects such as software programs like computerised health records systems. CHRs should be considered as actors as they embody inherent political and social ideals about how GPs should organize their health/medical thinking and work behaviour, directly and indirectly by way of the design. A software standard (e.g HL7) may be embodied by a CHR program and therefore reflects a set of particular values as espoused by other actors in professional networks (for example standards organizations such as the European Standards Organisation (CEN), ANSI, IEEE, ISO, ITU). Along similar lines, decisions about the type of organisational schema to be used to structure a patient record, for example Weeds (1969) problem oriented record and the medical nomenclature to be used for diagnosis (e.g. SNOMED, ICD-10, Read). These all reflect attempts to structure not only the GP-patient consultation but also promote a particular way of thinking. Hence, the technology is symbolic of the embodiment of these ideals and not just a neutral tool to be used, CHRs are actors themselves since they influence work behaviour in a particular direction. It must be acknowledged that CHRs may be put to uses never envisioned by actors at the design stage and this should be seen as the creativity or novelty process of re-invention and change over time. Thus, the deconstruction of what CHRs mean also occurs in order to reflect changes in thinking about health care systems and to reposition the value of CHRs accordingly in a global e-health environment. It may well be argued that CHRs are both a threat and an opportunity for GPs to either increase or decrease their personal and

professional self interest both individually and as a profession. This will be a reflection upon how GPs, individually or collectively, shape the debate over CHRs. The outcome of this is still hard to predict as some actors are more vigilant and powerful than others in looking after their own self interest. More interesting is the interaction that takes place among actors, especially when those actors cross disciplinary and market boundaries as a result of converging interests and motivations. From an actor network point of view the crossing of market boundaries represents a communication interaction and information exchange between actors from different networks, and a gradual convergence or closer integration of various actor networks in a global e-health system.

The International Medical Informatics can be seen as an international alliance of actors pursuing various health informatics agendas. IMIA was initially established in 1978 as a special interest group of The International Federation for Information Processing until 1989 when it gained status in its own right. It has many national and corresponding institutional members and links to the WHO. Figure 1 below is a simple overview of the linkages between various organizational actors and their relationship to each other.

Figure 1. Overview of some organizational actors and alliances constructed to promote health/medical informatics utilisation



New networks (or the realignment of existing networks) and organizational alliances are forming all the time in e-health as governments and patients have greater expectations

over how computer technology and telecommunications can be utilized, for example, use of the WWW. Consumer health informatics is reflective of this thinking (Bomba and Land 2003; Eysenbach and Kohler 2002; Slack 2001; Jadad and Gagliardi 1998). The table below provides an interesting view on how network alliances may further develop and the types of impacts they may have:

Organisation identity	**Information enablement**	**Effects**
Internal departmental unit	Expert knowledge bases; telecommunications	Departments work to external standards; can "trade" widely
Local alliances	Local area networks, etc.	"Virtual" organization, but no overall control
Global and national trading	Telemedicine and Internet	Bigger business, but unresolved control and accountability issues

Source: Rigby (1999: 101)

CHRs in a diffusion context

Through the work of Rogers (1995) we can begin to think about *what* happens, the rate of diffusion (as depicted by the S-shaped curve) and *why* the rate of diffusion may vary in different settings but not always *how* the process of diffusion actually happens despite Rogers (1995: 207) providing a useful framework of analysis such as the perceived attributes of innovations: relative advantage, compatability, complexity, observability and trialability; type of innovation decision: optional, collective, authority; communication channels (e.g. mass media or interpersonal); nature of the social system (e.g., its norms, degree of network interconnectedness, etc.); and the extent of change agents' promotion efforts.

It would be somewhat optimistic, given current knowledge about information systems failure (Sauer 1993), to think that there exists a general unifying pattern of diffusion which serves to explain *what* happens, *how* it happens and *why* for all cases. There will be varying rates of diffusion between individuals, organizations and national systems. For example, in studies of military e-health systems, well designed formal bureaucratic structures were not sufficient to insure acceptable utilization rates of e-health technologies, research yielded that organizational and cultural dimensions related to uncertainty avoidance and may explain some variance in utilization rates (Bangert and Doktor, 2001). Therefore, cross national studies are useful for helping to identify the reasons for utilisation variance. Straub (1994) also looked at the effect culture has on diffusion by examining the diffusion of e-mail and fax in Japan and the USA. Furthermore, Gefen and Straub (1997) looked at gender differences in the utilisation of e-mail using a cross sectional survey instrument. They argued that gender needs to be added to an IT diffusion model since gender differences may be related to beliefs and use of computer based media. The findings indicated that men and women differ in their perceptions but not in the use of e-mail. This work adds to the Technology Acceptance Model (TAM) proposed by Davis et al., (1989) which is essentially a casual model trying

to correlate system use with perceived ease of use and perceived usefulness. The origins of this model can further be traced back to the Theory of Reasoned Action by Ajzen and Fishbein (1975). Another approach is offered by Heikkilä (1995: 30) who argues that "... the willingness to adopt is more dependent on the adopter-technology fit, and the sustained use is more dependent on the task-technology fit", possibly with peers serving as a moderating reference group. This also points to learning processes as being vital to sustained utilization as advocated by several authors (Walker 1993, 1997). Kidd et al (1994) also argue that the learning process is incremental and full utilization of CHRs takes time. Rogers (1995) argues that information exposure is the most important explanation for diffusion. Valente (1995) takes this one step further and argues that exposure (contagion) is not enough but rather that the focus needs to be on the frequency of exposure. The more a person is exposed to an idea or technology the greater likelihood there is that utilization at some level may take place. But this is not to deny that it may also serve to reinforce an individual's decision to reject the idea.

Studies of EDI are also informative, Emmelhainz (1990) argued that organizations with low utilization and knowledge of EDI tended to postpone EDI adoption until there was only one type of standard in the industry. This may also be the case with CHRs and needs to be investigated further. A Swedish survey conducted in 1994 identified 27 different suppliers of CHRs of which only a few were deemed able to meet reasonable user requirements (Spri, 1996, 1997: 15). Finally, in a market environment, competition between GPs may lead to greater utilization rates of CHRs as those GPs who adopt and learn to use CHRs strategically may squeeze non-users out of the market place. This interpretation is more reflective of a more competitive advantage way of thinking as characterized by Drucker (1970), Porter (1980, 1985) and Ansoff (1987).

GP computer utilization

It would appear that a great number of discussion papers, reports, and studies have been published since after 1991 in Australia. The main impetus for this sudden movement would appear to be a series of overseas events, primarily the work of the IOM and their landmark study into the computer-based patient record. The only publication work of any significance in this context before this time in Australia were the RACGP study (1985) and the CAPP (1986-1990) project. These spawned the work of O'Toole (1988), Crampton and Lord (1988) and the Crampton (1990) RACGP Survey. It must be noted that, despite chronological appearances, some of the work may have been stimulated by events in the USA prior to publication of the IOM's report in 1991. This also needs to be seen in the broader context of initiatives which took place in the U.K and Europe such as the work of IFIP and IMIA and, prior to the work of the IOM, the work of Greisser et al. (1980) on data protection in health information systems. Another significant initiative was the UK Government's "micros for GPs" scheme, established in 1972, which, after a long gestation period, received an injection from the government of 24 million pounds in 1989, to allow GPs to purchase computers and software (O'Toole, 1988; Roberts, 1991). Tied into this initiative was the Government supported development of Read Codes, to try and structure the clinical input of medical terms used by GPs in their computer

systems (Read and Bensen, 1986) to allow analysis of clinical data, (un)aggregated, so as to help in health service planning, epidemiological research and auditing.

The RACGP (1985) study revealed that 54% of the RACGP respondents viewed computers as having some potential to improve practice management but not clinical records. Only 19% agreed that computerising patient records would improve the quality of patient care and only 14% supported the sharing of information among other health care actors. Also of interest was that only 20% of RACGP respondents agreed that patients had a right to see their entire record.

O'Toole (1988) provides an initial attempt to document the field of medical record computing in Australia from a GP's point of view. O'Toole argues that the generalist practitioner of the 1980s faces a situation of growing information overload relative to practitioners in previous periods. This tension is characterised as the generalist-specialist dichotomy with ever increasing levels of specialisation and the fragmentation of knowledge. One attempt to try and deal with this information processing dilemma is through the use of computer technology. O'Toole optimistically argues that the computer is the answer to these problems.

The Computer Assisted Practice Project (CAPP) represents one of the largest attempts to explore computer implementation and use issues in General Practice Australia. It is from this study that a number of various spin-offs continue to have relevance even to the present day, e.g. computerised prescribing, computer age/sex/disease registers, computerised drug databases, attitude surveys, coding and standards issues. Conducted over a five year period (1986-1990) the CAPP study primarily consisted of a number of sub-projects. In essence, 22 general practices across Australia were evaluated for their use of a practice computer system, (*Medrecord*), and their opinions and experiences were analysed using both qualitative and quantitative methods. The project showed that computerised accounting and medical records achieved a high level of acceptance among doctors, staff and patients. This was followed up by a report in 1994 by the RACGP which extended the project timeline (1986-1993) and focused somewhat more on the usage and problems surrounding computer records. The main problems identified centred around data entry, accidental data loss and presentation.

Also of significance was the national survey of computer use among RACGP members by Crampton (1990). The basic finding was that 41% of GPs used a computer in their general practices for such activities as accounts, billing, word processing, but only 2% used computers for clinical purposes. Younger GPs and those in group practices were more likely to use computers. Also, cost had a bearing on the attitudes of GPs towards use of computers.

Other relevant surveys which have looked at various aspects of computerisation in General Practice in Australia include the work of Douglas and Saltman (1991), Liaw (1992), Fry (1993), Cacek (1994) and Bolton and Gay (1995). In the Douglas and Saltman (1991) study of 1900 GPs, respondents indicated they used computers mainly for front desk type applications such as accounts (34%) or word-processing (33%) while only

5% used the computer for recording clinical information. Furthermore, many GPs were found to be using traditional, paper based 8" x 5" cards and less than half were using any accredited medical records system at all.

Based on previous studies, RACGP (1985), Crampton (1990), Bolton and Gay (1995), it has generally been claimed that the adoption rate of CMRs by GPs in Australia has been low, ranging from 2% to around 8%, with computerisation levels to be around 40% (Bolton and Gay, 1995). This is in contrast to the U.K. where 50% of primary practitioners use the computer for clinical notes and 90% of primary care practitioners work in computerised practices (Hayes, 1993). As a further comparison, in Singapore, the adoption rate is said to be somewhere between 30-50% (Lun and Goh, 1993).

A brief introduction to the United Kingdom (U.K), Australian and Swedish Health systems

It must never be forgotten that the critical longer term questions facing e-health researchers are not just how technologies can be designed to help patients but whether the use of technology leads to actual improved patient health outcomes and how can these be measured?

Generally, governments are involved in the management of health care resources, costs, outcomes and equity issues. Nevertheless, these may all be interpreted differently, for example, equity may be seen as the redistribution of health care costs as opposed to accessibility to health care services. Health systems and health policy are often reflective of a complex historical and political mix of changes to the organisation of funding arrangements and responsibilities between various levels of government (e.g. national, state and local), for example, the Australian Health Care system. The Australian health care system can be described as reflective of a philosophical position located somewhere between the U.K. National Health Service and the USA health system, with a gradual movement away from government funding and public health insurance to a more privatised system based on individual private health insurance (Australian Institute of Health and Welfare, 1992; Bates, 1983).

It would appear that the U.K, the Swedish and Australian health systems share some common features but also have some distinct variations. It becomes evident that the more health systems devolve from a centralised system to a more decentralised regional/local system the more variation and experimentation in budget devolution and patient needs-assessment planning is evident across counties in Sweden, the U.K or across States and GP Divisions in Australia.

The health care system in the U.K. is based on a system of care provided by GPs who can be seen as private contractors paid by the National Health Service, just as GPs in Australia are paid by the Australian Health Insurance System (Medicare). Experimentation with the idea of purchasers and providers is evident in both the U.K and Swedish health care systems where local councils purchase health care services from their regional and national organising bodies in order to tailor provisions to the specific

health care needs of their respective communities. GPs are essentially given a budget to work with in order to try and buy the health services required for their patients. This can be problematic since patient needs will vary, for example, between rural and urban areas. However, problems of definition and classification over what constitutes rural areas serves to add more complexity to the problem, especially since government funding formulas are tied into such definitions (see for example, Nichol, 1990). DRGs can be seen as a manifestation of this attempted tailoring process at the hospital level.

The Swedish Health Care system, makes use of a patient registration list system by which a list of patients (about 2000/GP, variations do occur) is assigned to each district GP. The Swedish system has experimented (1994/95) with the house doctor system (a patient can choose which GP they wished to belong to) but with only mixed success in that some GPs had excessive lists while others had diminishing list numbers. Some counties have adopted the system (e.g. Uppsala) while others have reverted back to the old district doctor list system.

The U.K and Swedish systems can be characterised as systems in a state of continuing flux (Calltorp 1989; Berleen et al 1992,); similarly the Australian system is one facing mounting economic pressure to change. The cost of the publicly funded Medicare System in Australia is rapidly escalating well over $7.5 billion (Leech, 1998: 42). This can be seen as a problem arising from an over- supply of GPs leading to over-servicing and outright rorting of the system by some GPs. As indicated, this problem is escalating as more medical doctors are pumped out of educational institutions every year leading to a mismatch between supply and demand. This over-supply of GPs places more of an economic burden on the National Medicare health bill that taxpayers eventually have to help fund (through a levy on taxable income) since more medical doctors equates to greater consumption of various medical services. Hence, both GP over-servicing behaviour and supply need to be constantly monitored (Bridges-Webb 1992). This would suggest some form of direct regulatory strategy from the Government. There is predominantly an imbalance between rural and city areas in that there is an over-supply of GPs in large city areas and an under-supply in smaller rural regions (Shepherd, 1995).

Historically, rural areas in Australia have been disadvantaged in terms of access to health services (see for example, Humphreys, 1988; Humphreys and Weinand, 1991). This stems in part to the fact that political, legislative and economic power in Australia is generally located in the National and State capitals rather than at the Local government levels. Thus, health budget devolution to local government can be viewed as an attempt to try and re-address part of this power imbalance. Financial responsibility is shifted over to local government, but this does not necessarily address the need for more revenue to fund increasing demand for health care services.

Good health and equal access to health services for everyone are the goals of both the Australian and Swedish health care systems as articulated through national policy and a range of legislations including the National Health Act, the Health Insurance Act and the Medicare Levy Act in Australia and the Health and Medical Services Act in Sweden. A fundamental principle of both systems is public sector responsibility to provide and

finance health services for the entire population. In Sweden health is organized in a decentralized way through bodies called Landstinget which are situated in each of the twenty five Counties. The responsibility and operational management for health care services rests primarily with the local County Councils who have the power to levy taxes to raise the finances required to run these services. This is a reflection of the Swedish Welfare State ideology and also a reason for the generally high tax regime used to fund social services. The Australian Health Care system is administered by the Federal Government in conjunction with the respective State Governments and Area Health Services (who are responsible for public hospitals) through funding grants and the Medicare Levy. The history of Australian welfare programs has been one of targeted welfare rather than universal social programs as in Sweden. Hence, GPs in Sweden operate mainly under a public umbrella health care system funded by the County Councils while GPs in Australia mainly operate as private businesses within a public system. They thus receive minimal direct financial assistance with CMRs, however the Practice Incentives Program is an attempt to readdress this issue.

Questionnaire Design

Field visits and interviews were conducted with GPs both in Australia and Sweden in order to help with the identification of the issues to be investigated. The questionnaire itself went through several drafts and pilot testing for face validity before distribution. Responses were sought for questions relating to demographic data, educational background and training, computer use/non-use, adoption barriers, computer security awareness, software/hardware platforms as well as present and possible future trends in the use of CHRs. The questionnaire comprised of a common section for all respondents and then two nested sections, one for GPs who were CHR users and another for those who were non-computerised. Both open ended and closed questions were included where appropriate. The design of the questionnaire included a coding schema for easier transcription into a spreadsheet and imported subsequently into SPSS for data analysis. All mail out questionnaires were accompanied by covering letters and prepaid return address envelopes. The questionnaire was developed in English and Swedish.

Sample Selection

Sample selection can take various forms, random, non-random or some quasi combination of the two. A random sample of GPs was chosen as being an appropriate approach based on the experience of other researcher in the area (Crampton 1990, 1995; Cacek 1994; Bolton and Gay 1995).

The Swedish GP sample and mailing list was made available courtesy of the Department of Family Medicine, Uppsala University. The survey was sent to a random computer generated sample of GPs in Sweden (N=600). The first and only mailing was conducted in November 1994 for return before mid December. A 50% (n=298) response rate was gained and there were no follow up or reminder notices to increase the response rate.

The Australian mailing list was made available courtesy of the Commonwealth Department of Human Services and Health. A random computer generated sample was provided and the state of New South Wales was also randomly chosen for sampling (N=600). The first and only mailing was carried out in November 1995 for return before mid December. A 49% (n=293) response rate was gained and there were no follow up or reminder notices to increase the response rate.

Survey findings and discussion

"It is perhaps easiest to begin by stating what statistics is not. Statistics first of all is not a method by which one can prove almost anything one wants to prove." (Blalock, 1979: 3). Statistical testing and presentation of the data only provides for one level of analysis and reporting. It is also important to present the response breakdown by gender since it is hypothesised that men and women perceive CHRs differently which influences their decision to adopt or not to adopt the technology. Gender could be a crucial element not just in CHR utilisation among GPs but also an attribute that may need to be added to diffusion model proposed by Rogers (1995: 207). However, as with any analysis, "The best data analysis comes not from keystrokes and printouts, but from spending time thinking." (Axford et al., 1996: 361).

The main findings of the survey conducted indicate that there has been a high rate (72%) of diffusion of computers and CMRs among GPs in Sweden and a low rate (14%) of diffusion among GPs in Australia. Moreover, use of computers by Australian GPs is still predominantly confined to front desk type applications (e.g. accounts/billing, word processing) as opposed to clinical CMR use (e.g. patient notes, script writing, recall and referral, test ordering). On further analysis, only 16% of the Australian computer user respondents (14% overall) indicated that their main computer use was for patient records as opposed to 93% of the 72% of Swedish respondents. This means that of the 14% of Australian respondents who do use computers only 2% use them specifically for clinical purposes while the rest of the 12% make some use of CMRs but it was not considered to be their main use. This supports the more general findings of the survey work conducted by Cacek (1994) who found that of the 35% of Australian GPs using a computer, 78% were using computers for word processing and 63% for financial management.

Findings further indicate that the high rate of diffusion in Sweden has mainly been achieved by direct financial funding schemes from the Swedish Government and County Councils. Furthermore, 80% of the Swedish respondents indicated a strong belief that CMRs will be an essential technology for health care in the future as compared to only 55% of Australian respondents. This finding supports the idea that perceived belief about a technology could be an important characteristic in the adoption process, hence a possible extension of the 5 characteristic model of adoption as proposed by Rogers (1995: 207). Nevertheless, Rogers (1995) does capture this thinking in the idea of homophily and heterophily used to describe actors in similar or different social network groupings based on belief, education, social status, etc. Therefore, the relationship between belief and adoption/non adoption needs to be investigated further. It may well be that belief, above all else, influences an actor to want to adopt. Nevertheless, it may also

be the case that there is no generalisable association between belief and actual adoption since availability of funding may in fact be the key adoption factor, therefore availability of funding may need to be added to the adoption model proposed by Rogers (1995).

Among GPs who are CMR users, results from both samples support the claim that CMRs are helping to improve the way GPs work (Australia 82% and Sweden 69%) but the consensus is less than overwhelming. Both samples indicated improvements in the following areas: having increased quality control over patient information (as opposed to hand written notes); faster access to patient records; and easier access to patient information when dealing with telephone enquiries. These can be considered as relative advantage attributes of CMRs (Rogers 1995: 216), or even long term economic advantages, due to savings in time, effort and organisation (whether of information or staff). Overall, 92% of Australian respondents still process patient records manually while 95% of the Swedish respondents process records electronically using a computer. Only one respondent in Sweden indicated keeping hand written patient records. Table 1 provides a comparative view of beliefs and adoption rates.

Table 1. Beliefs and CMR adoption rates

	AUSTRALIA (NSW) N=293			SWEDEN N=298		
	Total	Males	Females	Total	Males	Females
Q1* Q15 % of GPs who believe CMRs are an essential technology for health care in the future	**55** n=158	73 n=115	27 n=43	**80** n=236	61 n=144	39 n=92
Total responses Missing	286 7			294 4		
Q1 * Q24 % of GPs who use CMRs	**14** n=42	90.5 n=38	9.5 n=4	**72** n=215	57 n=123	43 n=92
Total responses Missing	292 1			298 0		
Q1 * Q34 % of GP CMR users who believe CMRs have improved work practices	**82** n= 36	94 n=34	6 n=2	**69** n=140	59 n=83	41 n=57
Total responses Missing	44 249			204 94		

Statistical testing indicated significance at the .05 level for cross-tabulation of Q1*Q24 in the Australian sample, as can be seen in Table 2. This is the only response which supports the hypothesis that a relation exists between gender and CMR use. Nevertheless, no such

relation was found in the Swedish sample. Furthermore, no other correlations between belief about CMRs and gender were found to be significant in either sample.

Table 2. Tests of significance for Q1*Q24

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.366[b]	1	.004		
Continuity Correction[a]	7.327	1	.007		
Likelihood Ratio	9.974	1	.002		
Fisher's Exact Test				.003	.002
Linear-by-Linear Association	8.337	1	.004		
N of Valid Cases	292				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.79.

There are also similarities between the makeup of GPs in both the Swedish and Australian samples, especially in relation to employment status, 77% of respondents in both samples regard themselves as being employed full time and 23% of respondents regard themselves as being employed part time! The male to female ratio in Australia was 72:28 while the Swedish ratio was 60:40. Hence, GPs tend to be male, employed full time and are aged in their mid forties (Australia: mean = 45 years, standard deviation = 5.6 years; Sweden: mean = 46 years, standard deviation = 10.5 years). In Sweden GPs tend to cluster to form group practices more than in Australia (Sweden, mean = 5, s.d. = 2: Australia, mean = 3, s.d. = 2) where GPs predominantly operate more in solo or partnership practice. In fact 50% of the respondents in Australia operated in practices with three or less members. The most obvious difference between the two samples is in the type of practices. In Sweden 92% of GP respondents are predominantly in public practice while 95% of GP respondents in Australia are in private practice. Furthermore, the numbers of staff employed per practice was significantly higher in Sweden (mean = 18, s.d. = 13) than in Australia (mean = 5, s.d. = 5), reflective of the larger public service and pro-government employment policies in Sweden versus cost controlled and profit oriented operations in Australia.

The claim that in both Australia and Sweden the trend is towards the clustering of GPs with other allied practitioners (for example, dentists) in one centre or practice (Jeffreys and Sachs 1983: 174-190; Fitter 1986: 74-75) is also supported by the survey. In Sweden this is seen to aid cooperation and the sharing of medical resources among primary care practitioners while in Australia this move is not merely for cooperation but more importantly to create super clinics which achieve greater economies of scale, throughput and returns. In this scenario, over servicing by GPs could become a problem, especially under the publicly funded Medicare system. Australian respondents also indicated seeing a lot more patients per week (mean = 132, s.d. =7 3) than GPs in Sweden (mean = 63, s.d. = 19). This can be seen as a further reflection of the attitude that primary health care is

more of a business so that throughput becomes a measure of financial return which is clearly opposed to that of sharing among public sector GPs in Sweden who have a set list of patients for their area for each of whom they are paid a set amount from the public purse. Nevertheless, patients more so in Sweden than in Australia also have to make a co-payment when visiting the GP which may act as a deterrent for patients from seeing a GP. Greater application of compulsory co-payments in the Australian GP scene could be worth investigating further but not as another revenue stream for the GP on top of the existing Medicare payment. Instead, the patient co-payment could be used to help pay for the Medicare payment which in turn would be a contribution to helping to reduce the Australian Medicare bill.

The non-computerised samples offer some distinct differences in GP attitudes. In the Australian sample, of the overall non computerised respondents (86%), 63% believe CMRs will improve the way GPs work but 67% do not plan to implement CMRs within the next 3 years. This is somewhat similar to the "KAP-gap" (Knowledge, Attitudes, Practice) problems of family planning diffusion surveys carried out in Third World countries during the 1960s in that there is a relatively high level of favourable attitudes but a relatively low rate of adoption (Rogers, 1995: 71). This may be due to a combination of a low degree of observability of the long term benefits and socio-political drawbacks such as gradual loss of ownership, power and control over patient data access. Follow-up questions indicated that 65% did not feel that they had a problem managing patient health records which may, if answered truthfully, account for why non-computerised GPs felt that they did not need to computerise. This supports the findings of Cacek (1994) which showed that GPs considered their manual systems as adequate and saw little benefit from having CMRs. This is clearly the case with a significant number of Australian GPs who are obviously not convinced of the benefits of CMRs over paper records. This type of rejection is explained by Rogers (1995) as a combination of active (CMRs as an innovation are considered but rejected) and passive rejection (CMRs as an innovation are never really considered). It is not surprising then that 77% indicated that they have taken no planning steps towards implementing CMRs whatsoever. Respondents indicated that they were concerned over lack of software standards and data portability between software systems. These add further reasons as to why GPs are reluctant to computerise, namely fear of choosing software that may become obsolete or incompatible with other systems. There was also some concern over the problem of converting from paper to computer and the time, cost and effort involved in such an endeavour especially if there was no support involved.

In contrast, 68% of the Swedish non-computerised respondents indicated they were having problems managing patient records and that CMRs were perceived as helping to resolve these problems. Within the Swedish non-computerised sample (28%), 72% believe that CMRs will improve the way GPs work and 90% plan to introduce CMRs within the next three years. Table 3 provides a comparative view of non-computerised attitudes of GPs towards CMRs.

Table 3. Non-Computerised attitudes towards CMRs

	AUSTRALIA (NSW) N=293			SWEDEN N=298		
	Total	Males	Females	Total	Males	Females
Q1*Q24						
% of non-computerised respondents	**86** n=250	69 n=172	31 n=78	**28** n=83	68 n=56	32 n=27
Total responses	292			298		
Missing	1			0		
Q1*Q42						
% of non-computerised respondents who have problems managing patient records	**35** n=93	73 n=68	27 n=25	**68** n=56	68 n=38	32 n=18
Total responses	268			82		
Missing	25			216		
Q1*Q41						
% of non-computerised respondents who believe CMRs will improve the way GPs work	**63** n=164	73 n=119	27 n=45	**72** n=55	71 n=39	29 n=16
Total responses	259			76		
Missing	34			222		
Q1*Q43						
% of non-computerised respondents who plan to implement CMRs within the next 3 years	**33** n=82	72 n=59	28 n=23	**90** n=71	66 n=47	34 n=24
Total responses	246			79		
Missing	47			219		

In both samples there were some respondents who indicated that they kept no backup records or had no disaster recovery plan for patient records. In the case of keeping backups, Australian respondents (81%) were found to be more guilty of this than Swedish GPs (19%). This is attributable to the fact that Australian GPs are predominantly non-CMR users and do not keep paper based backup records. Nevertheless, both samples overwhelmingly consider themselves as responsible for the accuracy of patient information contained in patient records. Again, ideological differences become apparent in that of the Australian sample, 95% believe that it is the GP who owns the patient record while 44% of the Swedish respondents believe that the Government owns the patient record. Clearly, GPs feel that they are responsible in some way for the patient information but interestingly Australian GPs, much more than their Swedish counterparts, do not seem responsible enough in protecting this valuable resource. A legal precedent may yet be set in this area, along with the testing of the validity of CMRs in the courts. Legislation is traditionally based around a paper based paradigm rather than an electronic one. Only 3% of Australian respondents indicated that they thought the patient owned the information and no respondents thought that the government owned the information. Swedish responses more strongly favoured a model of joint ownership of patient

information between government, GPs and patients than did the Australian sample. This may be linked to the funding mechanisms for CMRs, since 88% of the Australian respondents indicated receiving no government help with computerisation as opposed to 77% of Swedish respondents who did receive financial help to computerise from central and local governments. Table 4 provides a comparative view of general security, responsibility, ownership and support issues among all GPs surveyed.

Table 4. General security, responsibility, ownership and support issues among all GPs

	AUSTRALIA N=293			SWEDEN N=298		
	Total	Males	Females	Total	Males	Females
Q1*Q19a % of all GPs who have no backup records	**81** n=226	71 n=161	29 n=65	**19** n=54	65 n=35	35 n=19
Total responses	279			284		
Missing	14			14		
Q1*Q19d % of all GPs who have no disaster recovery plan	**90** n=158	75 n=119	25 n=39	**91** n=32	72 n=23	28 n=9
Total responses	176			35		
Missing	117			263		
Q1*Q22 % of all GPs who consider themselves responsible for accuracy of patient information	**98** n=286	71 n=204	29 n=82	**99** n=287	60 n=173	40 n=114
Total responses	292			291		
Missing	1			7		
Q1*Q23 % of all GPs who believe they own the patient record	**95** n=275	72 n=198	28 n=77	**14** n=37	62 n=23	38 n=14
Total responses	289			264		
Missing	4			34		
Q1*Q21 % of all GPs who have received Government help with computerisation	**12** n=34	71 n=24	29 n=10	**77** n=216	60 n=130	40 n=86
Total responses	276			280		
Missing	17			18		

Computer using respondents indicated having had a wide range of computer experience. Despite the low use of CMRs among respondents in Australia, experience with CMRs was longer (mean = 44 months, s.d. = 41 months) as compared to Sweden (mean = 25 months, s.d. = 23 months).

The general software/hardware trend is towards PC Windows based platforms with software that integrates CMRs with other functions, e.g. accounts/billing, appointments scheduling, word processing, electronic mail, etc. The potential for a *GP Office* like software is apparent. In the Australian sample, computers being used solely as standalone workstations were as common as those in a multi-user network configuration. In Sweden, however, 97% of respondents had their computers set up in a multi-user network configuration. This is a reflection upon the larger staff and GP numbers needing to share computers in a practice. The password remains the most common form of security protection in both samples. Table 5 provides an comparative overview of computerised GPs.

Table 5. Computerised GPs

	AUSTRALIA N=293			SWEDEN N=298		
	Total	Males	Females	Total	Males	Females
Q1*Q32 % of computerised GPs who use a coding scheme to classify patient morbidity (e.g. ICD-10, etc)	**19** n=9	100 n=9	0 n=0	**89** n=185	55 n=101	45 n=84
Total responses	48			209		
Missing	245			89		
Q1*Q35 % of computerised GPs who follow some type of patient information management guidelines or practice	**25** n=11	100 n=11	0 n=0	**75** n=147	58 n=85	42 n=62
Total responses	44			195		
Missing	249			103		
Q1*Q36 % of computerised respondents indicating that passwords are their main form of computer security	**98** n=34	91 n=31	9 n=3	**94** n=186	56.5 n=105	43.5 n=81
Total responses	38			198		
Missing	255			100		
Q1*Q39 % of computerised GPs who encrypt their patient database	**27** n=11	82 n=9	18 n=2	**33** n=51	61 n=31	39 n=20
Total responses	41			156		
Missing	252			142		
Q1*Q40 % of computerised GPs who have outside dial-in	**24** n=10	90 n=9	10 n=1	**13** n=26	69 n=18	31 n=8

access to their patient database		
Total responses	42	196
Missing	251	102

Within both samples, very few had to undertake any computer-related subjects as part of their medical education. This may well be attributable to the fact that desk-top computers were not around nor as accessible when the majority of respondents were undergoing their medical education (the mean year of medical education completion in the Australian sample was 1974, s.d. = 10 yeras; and in Sweden 1977, s.d. = 6 years). Nevertheless, this would indicate that there is no predisposition to adopt CMRs by having undertaken computer-related subjects at university and subsequent later CMR adoption. The Swedish results would indicate that high CMR adoption is possible without there necessarily being an association between computer use at university and CMR adoption. In the Swedish case the decision to adopt CMRs is more of a result of direct funding availability (a type of authority decision) from the government while in Australia the decision to adopt CMRs is more of an individual optional or collective group practice decision.

The most common sources of information about keeping up to date about computers was through colleagues, journals and conferences. It is interesting to note that journals preceded colleagues in the Australian sample (51%:18%) while in the Swedish sample it was the reverse (26%:48%). This is significant since in that according to the innovation decision process model presented by Rogers (1995: 197), mass media awareness is considered to be the main communication channel for creating knowledge awareness. In this model, persuasion to adopt occurs at a more interpersonal level usually after mass media knowledge awareness has taken place. The Australian sample responses would appear to support this model but the results from the Swedish sample suggest that mass media channels do not play such a key role in knowledge awareness and that from the outset interpersonal communications with colleagues are more significant in the formulation of attitudes. This would also indicate a more collective based decision-making process among the Swedish sample as opposed to a more individualised process in Australia. This is possibly a significant point worthy of follow up since more respondents in the Swedish sample have adopted CMRs; hence, the innovation-decision process model proposed by Rogers may need to be modified or rejected. Future studies may wish to follow up on this aspect by including another, more specific follow up question about how respondents found out about CMRs in the first place rather than just about computer developments (e.g. mass media, interpersonal or other).

In the context of spatial diffusion, another question worth pursuing may be to see if proximity to colleagues plays a role in persuasion to adopt or reject; for example, do the colleagues from whom information was received work within the same practice, live in the same city, or elsewhere. Furthermore, this implies that word of mouth can be seen as an important form of communication among GPs, possibly more so than mass media communication channels when considering making a decision to adopt or to reject. In Australia, this could be attributable to internalising something a GP may have read in a journal and then testing that information with colleagues prior to either accepting or

rejecting information and ideas. It could also point to a mistrust of mass media sources and preference for reliance on the opinions and experiences of colleagues. Thus, face to face communication, conferences and workshops must be considered as an important part of the process of communicating information to others. The slow rate of CMR adoption in the Australian sample could further be interpreted as a possible mismatch between perceived complexity of the innovation by GPs and the communication channel selected to convey information. CMRs may be perceived by GPs as a highly complex technology. Therefore, interpersonal communication may be more important in communicating information about a technology which may be perceived to be complex rather than communicating the information through mass media channels.

Results would suggest that financial investment or reimbursement for the purchase of computer equipment would benefit some GPs but there would still be some who would not know what to do with the technology even if they had a computer on their desk. A computer on a GP's desk needs to be seen as more than just an symbolic ornament. A decision to adopt could, for example be reflective of a perceived need to keep up with the latest fashion and status symbol to giving the appearance of being modern and keeping up with the times, that is, as a form of passive rather than active adoption. This may reflect a lack of computer literacy and knowledge about what computers can do (the second most important barrier indicated in both surveys). GP respondents in Sweden indicated that the lack of a CMR software standard among GPs was their main barrier to adoption while Australian respondents indicated that cost was the major inhibiting factor. The results therefore support the conclusions of another Australian study (Bolton and Gay, 1995) that "non computer users do not know enough about the benefits of computerisation to make an informed decision about computerising" and that cost was a "high priority". Rogers (1995: 167) concurs with these, indicating that an individual may not know enough about an innovation for it to be regarded "... as relevant to the individual's situation, and as potentially useful ... the individual's attitudes or beliefs about the innovation have much to say about his or her passage through the innovation-knowledge process." This further supports the conclusions of Moidu (1993: 44) that "training is a crucial factor for dispelling fears in the transfer of technology particularly when the end-users have a high interest but a low level of awareness." Hence, information and knowledge about CMRs is needed so that an environment of persuasion is created in which adoption can take place. More difficult to determine is whether an individual need for a CMR precedes the technology or whether knowledge of CMRs creates a need for the technology. It is also of interest to note patient reactions to GP computer use. Fitter (1986: 73) for example, indicates that "... studies suggest that the overall impact on patients is small ... patients experiences in computer use have more positive attitudes towards doctors using computers." This would seem to be reflective of a wider conditioning process occurring in society.

Another barrier to adoption that arises from the qualitative responses is finding the time to transfer over from a paper based patient records system to a CMR system, especially the laborious task of having to enter patient information into the CMR system. This can be somewhat difficult to overcome since trying to scan hand written notes on a card file, which may only be legible to the GP, is not really an option. It implies a longer term

phasing-in process, possibly associated with patients' visits to the GP. As each patient comes to see the GP their paper records can gradually be transferred to the computer.

Careful consideration needs to be given to the argument that cost is a major barrier to adoption. Certainly, cost is an issue and past research has indicated that adopters underestimate the actual cost of adoption (O'Toole, 1988; Heikkilä, 1995), but is it the barrier that we are led to believe? It may well be that the perceived benefits do not outweigh the perceived costs involved for it would follow that GPs would pay if the advantages were equal to or greater than the cost. A secondary line of thought, therefore, may be that cost is used as a strategy to divert attention from the real issue and that the perceived cost of having to learn something new outweighs any potential monetary benefit from using CMRs. Time sunk into learning to use computers and CMRs cannot necessarily be quantified but still counts as a perceived cost of adoption. This highlights some of the problems with conducting cost-benefit analyses since not all benefits or costs can be quantified; there may be qualitative benefits which in subtle ways may influence the overall process of work but are not directly connected with improvement, e.g. improved appearance and quality of patient records, improved editing capability, timesavings and improved data security. Benefits and costs are therefore essentially a matter of perception. The danger in just using a cost-benefits analysis to justify the use or non-use of CMRs on a quantifiable basis is open to serious limitations and critique.

Results from the survey data indicate what can be called an attitude-paradox. In the Swedish survey, among the non-users, a positive attitude is associated to an intention to adopt in the near future. In the Australian survey, even when non-users indicate a positive attitude they have no intention of adopting. Therefore, a positive attitude is not sufficient for adoption but may only be desirable. This finding supports the general belief that new knowledge and attitudes by themselves are not sufficient to bring about a change in behaviour. Other socio-political reasons need to be considered rather than just behavioural or technical reasons. The survey work shows a need to clarify legal, social and political debates over CMR ownership, CMR legal status, stakeholder access rights, responsibilities, GP loss of power issues and funding models.

Limitations and suggestions for future research design

Mention needs to be made of the limitations of this study and the limitation of using a survey as a research methodology. Limitations help to understand and locate some of the survey findings in a more meaningful context as well as to help other researchers with the design of future diffusion surveys. The works of Kaplan and Duchon (1988), Leedy (1993) and Neuman (1997) are informative in this respect.

One key point needs to be made before undertaking a mail-out survey: the investigator(s) need to know that a mailing list sample can be compiled from a comprehensive list of the target population. This is not to say that a sample cannot be composed without a list of the relevant population but it may have implications for both the design methodology and the feasibility of the project. There may be a cost involved or the actual mailing list may not be available to the public (i.e., it may be seen as a closely held organisational asset).

Respondents may have a vested interest in responding to the survey and hence distort the picture of events. If possible, it would be worthwhile to investigate the non-respondents and the reasons for their non-response. Some GPs may well be reluctant to disclose they are non-computerised because they perceive the survey to have a positive bias towards computers and CMR usage. Those who are computerised, therefore, may well be more inclined to respond in order to promote CMR adoption. Furthermore, since the focus of this survey was on CMR usage rather than just computer usage, only those using CMRs are likely to have been positively inclined to respond. A different target audience could yield a different perspective, for example, instead of GPs who may or may not have a vested interest in CMRs, a survey of practice patients or the general public could be useful in order to ascertain another picture as to the state of computer and CMR usage among GPs since they could be seen as a more objective third party.

Home computer adoption was not examined, future research may wish to include questions about home computer usage as this could have some bearing on computer use in the workplace. Also, a question about GP income levels may need to be included to see if there is an association with computer and CMR adoption. The work of Bolton and Gay (1995) indicates a possible association between income level, practice size and CMR adoption. Larger practices with high incomes tended to adopt CMRs more readily.

Errors can also creep into the survey due to a lack of understanding of the terminology, through definitional problems, and differences over what the respondents perceive they use the computer for, especially in cross cultural studies requiring translations. Respondents may, for example, equate computer usage with CMR usage, hence resulting in an over representation of CMR usage. This also suggests another limitation in that self administered questionnaires about computer usage can also be somewhat problematic in that users may base their answers on what they think they may do or would like to do rather than on what they actually do in practice. Hence, the need to provide specific definitions of terms as part of the cover letter and also the possible need for further follow-up through observation and interviews. This may only be possible in longitudinal studies and where respondents are willing to identify themselves.

Conclusions and Recommendations

As the Australian survey findings showed, a high awareness and favourable attitudes towards CHRs are not necessarily associated with the action to adopt as can be seen in the case of the Australian non-computerised respondents. This may in part be due to the fact that such individuals do not consider their existing paper record management practices as a problem. The Australian results may further be associated with perceptions of possible undesirable consequences following from the adoption and implementation of computers in the minds of GPs. On the other hand, the Swedish results demonstrate a different situation altogether as can be seen from the Swedish non-computerised respondents where a high level of awareness and favourable attitudes are associated with a direct intention to adopt.

The paradoxical finding between the Australian and Swedish study demonstrably shows that a positive belief about CHRs does not necessarily correspond to actual adoption. This can further be described as a discrepancy problem between attitude and practice, that is, between rhetoric and action. Direct interventionist strategies such as standards setting, reimbursement schemes, training programs and the offering of grants can only provide a partial means for controlling the work practice behaviour of GPs. Other strategies involve greater information flow through professional networks, journals, conferences, training sessions etc. This effort involves the mobilization of many organizational networks and disciplines: the (re)creation and merging of journals, courses, degrees and organizations so as to reflect this reorientation or change in thinking about the role of CHRs in an e-health environment.

The results from the Swedish study support the argument that the process of diffusion can be controlled at least to a certain extent. In Sweden, a direct financial incentive has been provided by the governing bodies at the County Council level for GPs to adopt CHRs. This can be interpreted as a direct policy initiative to computerise GPs, whether they like it or not, similar to the "Micros for GPs" scheme in the UK (Jones in O'Toole 1988), also a type of forced regulatory obligation. In return the Councils expect standardised monthly aggregated reports from the GPs in order for them to be paid. The Swedish result is even more interesting in that, despite being forced to computerise, GPs still have a positive attitude towards using CHRs. This reflects a deeper belief that the utilization of CHRs is an improvement upon past work practices.

Since this study as reported in this chapter, the Australian Federal Government's Practice Incentives Program, introduced in 2000/2001 is helping to increase the utilization of computers for clinical purposes. Government payments are made to GPs who use computers essentially for prescription writing and electronically sending and receiving clinical information. The Government also introduced Health Privacy Legislation as part of its amendments to the Privacy Act (1988) which now covers the collection, storage, use and disclosure of patient information by which GPs have to abide by. This came into force in December 2001 (Bomba and Hallit 2002). At a national level, the most recent study of GP computer utilisation was the Western et al. (2001) study, which found that 89% of Australian GPs use computers and that computers are more likely to be used for administrative purposes than clinical purposes. This is a substantial increase on the results reported in an earlier national study by ACNeilson (1998) which indicated the computerisation level to be at 31% and that a combination of administrative and clinical use of computers was common, however, less so for clinical purposes. Clinical notes were seen to be the least common.

Suggestions for increased utilization and future research

There is a long standing need to decide upon a national standard for an integrated CHR and practice management software for GPs in Australia and to encourage other health providers to adopt the same standard. The national standard should fit into the general development of a future health communications infrastructure, the Health Connect project (Commonwealth Department of Health and Aged Care 2000), between GPs,

hospitals, pathology, insurers, government and other health care providers. The Australian Coordinated Care Trials were in part an attempt to experiment with CHR use in a more comprehensive and integrated way (Commonwealth Department of Health and Aged Care 2002).

The following are some specific suggestions that resulted from the data collected and despite being context specific to the Australian scene can be more generally extrapolated to other health care systems:

- need for an integrated CHR system, must meet GP (and other stakeholder) needs and cater for patient confidentiality/privacy, must be an easy to use GUI, screen displays should be easy to read and not cluttered with too much information.

- CHR use should not interfere with the physician-patient encounter, the CHR system should have appropriate security features built into the design (e.g. encryption, passwords, audit logs).

- The system must include a comprehensive query and statistical generation component so that GPs are able to interrogate the practice population database.

- If a CHR standard cannot be agreed upon, a standard should be encouraged, *de facto*, or, at least, a minimum data standard should be established for the transmission of health data (e.g. HL7) and security (e.g. public or private key encryption).

- National Health Policy should specifically address and indicate the importance of CHRs in its vision for a reformed health care system. There is a need to develop uniform national legislation for patient information and CHR use, the amendments to the Privacy Act (1988) which came into force in December 2001 are a step in the right direction.

- A national CHR Institute should be set up for greater coordination of resources and research into CHRs. Representatives from the wider community and all interested stakeholder should be involved.

- A comprehensive national health data dictionary would inevitably be a valuable public resource but this has social implications beyond the mere collection and retrieval of information. Issues of centralisation, control, ownership and confidentiality are inevitably associated with such developments. Efforts to develop a standard GP Data Dictionary can also be considered important and this should be a subset of the greater national health data dictionary. Careful thought will be required to determine what data elements are needed both now and in the future, in order to accommodate all stakeholders involved.

- GP Divisions in Australia need to be treated as social diffusion networks. Pilot GP Practice success centres within GP Divisions can be established and showcased as centres of excellence.

- Target technology champions and opinion leaders as the key information diffusers within GP Divisions; these may be the pilot success centre GPs. Each success centre can act as a regional support site for interested GPs to visit.

- Enlist technology diffusion mediators and facilitators. These individuals should ideally have a broader awareness of health informatics, technology diffusion and an understanding of GP settings and e-health developments nationally and internationally.

- Set up a national GP IT "help centre" which GPs can call toll free when needing help and advice with CHR implementation.

- A wider mass media strategy is desirable (TV, radio, newspapers, WWW) so as to create greater awareness of CHRs, telemedicine, health informatics and e-health within the community.

- Sufficient conference forums presently exist at the national level (e.g The Australian Health Informatics Conference, The RACGP Computer Conference) for general health informatics information diffusion. What is needed is greater consolidation of the various initiatives, research findings, clinical trials and so on in order to provide a greater sense of direction. Otherwise, islands of uncoordinated, disparate research will proliferate among private research organizations and universities.

- There is a need for the development of a bibliographic directory of past efforts, as well as existing on-going research into CHRs and telemedicine, both within Australia and internationally. This could be a home page sitting on the WWW which would be easier to update than a paper based publication and could contain hyperlinks to the associated project, the researchers and reports.

- Computer and CHR education, information dissemination, debate, training and support are vital within the GP Divisions in Australia. There is a need to develop and integrate computing and statistical competencies into future medical training qualifications and programs. This would allow for more and better epidemiological studies by GPs operating at the practice level.

- Greater involvement of professional bodies in Australia such as HISA, RACGP, AMA and interaction with the Federal and State Health Departments.

- Need for more financial incentive schemes for GPs to computerise, for example, Medclaims ($500 rebate from the Australian Health Insurance Commission). This sum could be increased.

- Financial incentives from Government, RACGP, AMA, HISA, industry and other possible stakeholders. Financial support (public and private) to encourage CHR development and diffusion is important and cost sharing among stakeholders should be encouraged. As a start, financing issues should be addressed by GP Divisions within their IT strategic plans, i.e. how to obtain sources of funding through, for example, collaborative grant applications. Voluntary adoption may be preferable to mandated adoption. The key is to create an environment in which GPs will voluntarily adopt without direct coercion. The alternative is for the Federal Government to regulate CHRs as a national standard for GPs, which would undoubtedly create some dissent.

- Greater visibility of pilot projects documenting CHR adoption before, during and after implementation. These can be written up as case studies. This allows for verification of the rhetoric about CHR technology against social reality and current practice, for example, e.g. costs, benefits, design problems, unintended consequences, loss of power issues and general practice impact studies.

- Greater collaboration between GPs, researchers, professional bodies, local area health services and government needs to be encouraged especially in grant applications.

- Research into the use and development of consumer health portals, smart tokens/cards, biometric identification and PDA applications by patients and healthcare workers all need to be carefully evaluated as do accompanying workflow process models.

The central argument of this chapter has been that CHR systems need to be seen as a fundamental building block for primary health care globally. In order for grander visions of telemedicine and e-health to take place, CHR utilization among GPs is seen as a key linking element. Successful adoption strategies drawn from countries with a high rate of adoption, such as Sweden, can serve as useful learning models for devising national plans. The caveat is that it is still necessary to carefully examine the attitudes of local GPs (the main users) towards CHRs with an eye on international developments in e-health. The development and further diffusion of CHRs, telemedicine and e-health are not only a reflection upon the motivations, attitudes and alliances between the actors involved within social and professional networks but also upon government policy, legislation and funding mechanisms.

References

AC Nielson (1998) *A Study Into Levels of, and Attitudes Towards Information Technology in General Practice.* Vol 1 & 2, prepared for the General Practice Branch of the Commonwealth Department of Health and Family Services. Canberra.

Ajzen, I., Fishbein, M., (1975) *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research.* Addison-Wesley Publisher. Colorado.

Allen, A. (1994) Evaluating Telemedicine: The Cooperative Model. *Telemedicine Today*, 2(1): 8-9.

Ansoff, HI. (1987) Strategic Management of Technology. *Journal of Business Strategy*. 7: 28-39.

Arrow, K. (1980) The Economics of Information. In Dertouzos, M., Moses, J. (Eds.) *The Computer Age: A Twenty-Year View.* MIT Press. London.

Australian Institute of Health and Welfare (1992) *Australia's Health 1992.* Australian Government Publishing Service. Canberra.

Axford, R., Grunwald, G., Hyndman, R. (1996) Information Technology in Research. In Hovenga, E., Kidd, M., Cesnik, B. (Eds.) *Health Informatics: An Overview.* Churchill Livingston. Australia.

Badham, R. (1986) *Theories of Industrial Society.* Croom Helm. London.

Bangert D., Doktor R., (2000) Implementing Store-and-Forward Telemedicine: Organizational issues. Telemedicine Journal and e-Health, 6, 3: 355-360

Bates, EM. (1983) *Health Systems and Public Scrutiny: Australia, Britain and the United States.* Croom Helm. London.

Berg, M. (1997) *Rationalising Medical Work: Decision Support Techniques and Medical Practices.* Doctoral Dissertation. Mastricht University, MIT Press, Cambridge.

Berleen, G., Rehnberg, C., Wennström, G., (1992) *The Reform of Health Care in Sweden.* Spri Report No. 339. Spri, Stockholm. Sweden.

Best, WR. (1962) The Potential Role of Computers in Medical Practice. *Journal of the American Medical Association*, 182: 994 - 1000.

Bijker, W. (1995) *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change.* MIT Press. Cambridge.

Bijker, WE., Hughes, TP., Pinch, T. (Eds.) (1987) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology.* MIT Press. Cambridge.

Bijker, WE., Law, J. (Eds.) (1992) *Shaping Technology/Building Society: Studies in Sociotechnical Change.* MIT Press. Cambridge.

Blalock, H. (1979) *Social Statistics.* McGraw-Hill International Editions. Washington.

Bolton, P., Gay, G. (1995) Review of Computer Usage Among RACGP Members. *Australian Family Physician*, 24 (10): 1882-1885.

Bomba D., Land T. (2003) A Survey of Patient Attitudes Towards the Use of Computerised Medical Records and Unique Identifiers in Four Australian GP Practices. *The Journal on Information Technology in Healthcare* 1(1): 31-45.

Bomba D., Hallit G. (2002) Will The New Australian Health Privacy Law Provide Adequate Protection? *Australian Health Review*, 25(3): 141-151

Brancheau, JC., Wetherbe, JC., (1990) The Adoption of Spreadsheet Software: Testing Innovation Diffusion Theory in the Context of End-User Computing. *Information Systems Research.* 1(2): 115-143.

Brauer, G. (1992) Telehealth: The Delayed Revolution in Health Care. *Medical Progress Through Technology*, 18(3): 151-163.

Bridges-Webb, C. (1992) General Practitioners and Over-Servicing. *Medical Journal of Australia*, 156: 140-141.

Brownbridge, G., Fitter, M., Sime, M. (1984) The Doctor's Use of a Computer in the Consulting Room: An analysis. *International Journal of Man-Machine Studies*, 21: 65-90.

Brownbridge, G., Herzmark, G., Wall, T., (1985) Patients Reactions to Doctors' Computer Use in General Practice Consultations. *Social Science and Medicine*, 20: 47-52.

Cacek, J. (1994) *A Survey of the Attitudes of Australian General Practitioners to Computerisation of Medical Records*. Masters Thesis. Department of Community Medicine, Monash University. Australia.

Callon, M., Latour, B. (1981) Unscrewing the Big Leviathan, or How Do Actors Macrostructure Reality? In Knorr-Cetina, K., Cicourel, A. (Eds.) *Advances in Social Theory and Methodology toward an Integration of Micro- and Macro-Sociologies*. Routeledge and Kegan Paul. London: 277-303.

Callon, M., Law, J. (1989) On the Construction of Sociotechnical Networks: Content and Context Revisited. *Knowledge and Society: Studies in the Sociology of Science Past and Present*, 8: 57-83.

Calltorp, J. (1989) The "Swedish Model" Under Pressure - How to Maintain Equity and Develop Quality? *Quality Assurance in Health Care*, 1(1): 13-22.

Collins, H., Pinch, T. (1982) *Frames of Meaning: The Social Construction of Extraordinary Science.* Routledge & Kegan Paul. London.

Commonwealth Department of Health and Aged Care (2000) *The National Electronic Health Records Taskforce. A Health Information Network for Australia.* Canberra.

Commonwealth Department of Health and Aged Care (2002) *The Australian Coordinated Care Trials: Recollections of an Evaluation.* Canberra.

Crampton, M. (1990) Survey of RACGP Members' Use and Attitudes towards Medical Practice Computing. In *RACGP 1990 Computer Conference*, Sydney.

Crampton, M. (1995) The Computer on Your Desk: General Practice Computing in the 1990s. *Australian Family Physician.* 24(3): 296-297.

Crampton, M., Lord, T. (1988) *Standards for Computerised Medical Records Systems.* Royal Australian College of General Practitioners.

Crowe, B. (1993) *Telemedicine in Australia.* Australian Institute of Health and Welfare, Canberra.

Davis, FD., Bagozzi RP., Warshaw, PR (1989) User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, 35(8): 982-1003

Dickinson, J. (1991) Validity of Measurements and Research. *Australian Family Physician*, October, 20(10): 1491-1494.

Donaldson, M., Lohr, K. (Eds.) (1994) *Health Data in the Information Age: Use, Disclosure, and Privacy*. Institute of Medicine. National Acdemy Press. Washington, DC.

Douglas, R., Saltman, D. (1991) *W(h)ither Australian General Practice?*. National Centre for Epidemiology and Population Health. Canberra.

Drucker, P. (1970) *Technology Management and Society*. Harper and Row, New York.

Eliasson, G. (1990) *The Knowledge Based Information Economy*. The Industrial Institute for Economic and Social Research. Sweden.

Emmelhainz, MA. (1990) *Electronic Data Interchange: A Total Management Guide*. Van Nostrand Reinholm. New York.

Eysenbach G, Kohler C, (2002) How Do Consumers Search for and Appraise Health Information on the World Wide Web? Qualitative Study Using Focus Groups, Usability Tests, and in-depth Interviews. *British Medical Journal* 324 pp. 573-577.

Feinglass, J., Warren-Salmon, J. (1990) Corporatisation of Medicine: The Use of Medical Management Information Systems to Increase the Clinical Productivity of Physicians. *International Journal of Health Services*, 20(2): 233-252.

Fitter, M. (1986) Evaluation of Computers in Primary Health Care: The Effect on Doctor-Patient Communications. In Peterson, HE., Schneider, W. (Eds.) *Human-Computer Communications in Health Care*. Elsevier Science Publishers: IFIP-IMIA 1986: 67-80.

Fitter, M., Cruickshank, P. (1982) The Computer in the Consulting Room: A Psychological Framework. *Behaviour and Information Technology*, 1: 81-92.

Fitter, M., Cruickshank, P. (1983) Doctors Using Computers: A Case Study. In Sime and Coombs (Eds.) *Designing for Human-Computer Communication*. Academic Press, London.

Fry, F. (1993) IPC Survey Results. *Australian Family Physician*. 22(2): 87.

Geffen D., Straub, DW. (1997) Gender Differences in the Perception and Use of E-mail: An Extension to the Technology Acceptance Model. *MIS Quarterly*, 21(4): 389-400.

Giddens, A. (1984) *The Constitution of Society: Outline of the Theory of Structuralism*. University of California Press. Berkeley.

Greisser, GG., Bakker, A., Danielsson, J., Hirel, JC., Kenny, DJ., Schneider, W., Wassermann, AI. (Eds.) (1980) *Data Protection in Health Information Systems, Considerations and Guidelines*. North -Holland Publishing Company. Amsterdam.

Hayes, G. (1993) GP Computing - the UK Scene, Present and Future: Achievements and Incentives. *Proceedings of the RACGP 7th Computer Conference*, Melbourne, 15-19.

Heikkilä, J. (1995) *The Diffusion of a Learning Intensive Technology into Organisations: The Case of Personal Computing*. Helsinki School of Economics and Business Administration. Helsinki.

Hughes, TP., Mayntz, R. (Eds.), (1988) *The Development of Large Technical Systems*. Westview Press. Boulder, Colorado.

Humphreys, JS (1988) Social Provision and Service Deleivery: Problems of Equity, Health and Health Care in Rural Australia. *Geoforum*, 19(3): 323-338.

Humphreys, JS., Weinand, HC (1991) Health Care Preferences in A Country Town. Medical Journal of Australia, 154: 733-737

Institute of Medicine (1991) *The Computer-Based Patient Record - An Essential Technology for Health Care*. Dick, RS., Steen, EB., (Eds.) National Academy Press. Washington DC.

Institute of Medicine (1997) *The Computer-Based Patient Record - An Essential Technology for Health Care*. Dick, RS., Steen, EB., (Eds.) Revised Edition. National Academy Press. Washington DC.

Jadad AR, Gagliardi A. (1998) Rating health information on the Internet: navigating to knowledge or to Babel? *JAMA* 279(8):611-4.

Jeffreys, M., Sachs, H. (1983) *Rethinking General Practice: Dilemmas in Primary Medical Care*. Tavistock Publications. London.

Jones, B., (1982) *Sleepers, Wake! : Technology and the Future of Work*. Oxford University Press. Melbourne.

Jones, B. (1987) Micros for GPs Scheme: The Outcome. *Conference Proceedings of the RACGP 5th Computer Conference*, Melbourne: 14-18.

Kaplan, B., Duchon, D. (1988) Combining Qualitative and Quantitative Methods in Information Systems Research: A Case Study. *MIS Quarterly*. 12(4): 571-586.

Kidd, M., Carson, N., Crampton, R., Cesnik, B., Bearman, M. (1994) New technology in Primary Care: Benefits, Problems and Advice. In Fry, J., Yuen, N. (Eds.) *Primary Care and Family Medicine*. Radcliffe Medical Press, Oxford.

Lamberton, DM. (1990) *Information Economics : 'Threatened Wreckage' or New Paradigm?* CIRCIT. South Melbourne, Victoria.

Latour, B., Woolgar, S. (1979) *Laboratory Life: The Social Construction of Scientific Facts*. Sage. Beverly Hills.

Leech, G. (1998) Beachhead for Data on Black Hole Opening Wide for GPs. *The Weekend Australian*, April 4-5: 42.

Leedy, P. (1993) *Practical Research: Planning and Design*. 5th Edition. Macmillan, New York.

Liaw, S. (1992) *How Is Information Managed in General Practice?* Study for the RACGP (South Australian Faculty).

Linnarsson, R. (1993) *Methods, Design and Components for a Computer-Based Patient Record to Promote Quality Care in General Practice*. Doctoral Dissertation. Department of Biomedical Engineering, Medical Informatics, Faculty of Health Sciences. Linköping University, Sweden.

Lun, K., Goh, L. (1993) GP Computing; The Singapore Scene: Present and Future. *Proceedings from the 7th RACGP Computer Conference,* Australia.

Mackenzie, D. (1996) *Knowing Machines: Essays on Technical Change*. MIT Press. Cambridge.

MacKenzie, D., Wajcman, J. (1985) *The Social Shaping of Technology*. Open University Press, Milton Keynes.

Mandil, SH. (1993) A Global Perspective of Informatics in Health in Developing Countries. In Mandil, SH., Moidu, K., Korpel, M., Byass, P., Forster, D. (Eds.) *Health Informatics in Africa: HELINA 93*. Excerpta Medica. Amsterdam: 3-8.

Mandil, SH., Moidu, K., Korpel, M., Byass, P., Forster, D. (Eds.), (1993) *Health Informatics in Africa: HELINA 93*. Excerpta Medica. Amsterdam.

Milner, A. (1996) *Literature, Culture & Society*. University College London. Great Britain.

Mintzberg, H. (1987) Crafting Strategy. *Harvard Business Review*. 4: 6-75.

Moidu, K. (1993) Informatics in Support of primary Health Care Management.. In Mandil, SH., Moidu, K., Korpel, M., Byass, P., Forster, D. (Eds.) *Health Informatics in Africa: HELINA 93*. Excerpta Medica. Amsterdam: 3-8.

Neuman, W. (1997) *Social Research Methods*. Third Edition. Allyn and Bacon. Boston.

Nichol, W. (1990) What is Rural? Centre for Rural Welfare Research. *Rural Welfare Research Bulletin*: 4: 4-5.

O'Toole, C. (1988) *Computerised Medical Records*. Thesis. Deakin University. Australia.

Porter, ME. (1980) *Competitive Strategy, Techniques for Analyzing Industries and Competitors*. The Free Press. New York.

Porter, ME. (1985) *Competitive Advantage. Creating and Sustaining Superior Performance*. The Free Press. New York.

Porter, ME. (1990) *The Competitive Advantage of Nations*. Billing & Sons Ltd. Worcester.

Porter, M., Millar, V. (1985) How Information Gives You Competitive Advantage. *Harvard Business Review*. July/August.

Pradhan, M. (1996) Telemedicine. In Hovenga, E., Kidd, M., Cesnik, B. (Eds.) *Health Informatics: An Overview*. Churchill Livingston. Australia.

Read, J., Bensen T., (1986) Comprehensive Coding. *British Journal of Health Care Computing*, 3: 22-25

Rigby M., (1999) The Mangement and Policy Challenges of the Globalisation Effect of Informatics and Telemedicine. *Health Policy* 46: 97-103.

Roberts, J. (1991) General Practice: Feeling Fine, Getting Better. *British Medical Journal*: 302.

Rogers, EM. (1995) *Diffusion of Innovations*. 4th Edition, The Free Press, New York.

Royal Australian College of General Practitioners (1985) *The Vision of General Practice Now and in 1995*. Arthur Anderson and Co. Melbourne.

Safran, C., Rind, D., Citroen, M., Bakker, Ar., Slack, WV., Bleich, HL. (1995) Protection of Confidentiality in the Computer-Based Patient Record. *MD Computing*, 12: 187-192.

Sauer, C. (1993) *Why Information Systems Fail: A Case Study Approach.* Alfred Waller. Henley-on-Thames.

Schnieder, M., Mann, N., Schiller, A. (1992) *Can Telecommunications Help Solve America's Health Care Problems?* Arthur D. Little. Boston.

Shepherd, J. (1995) Whither Rural Practice. *Medical Journal of Australia*, 162: 232.

Slack W., (2001) *Cybermedicine: How Computing Empowers Doctors and Patients for Better Health Care.* Jossey-Bass. San Francisco.

Spri (1989) *Vad Kostar Patienten*? Spri Report No. 262. Spri, Stockholm. Sweden.

Spri (1996) *User Requirements on Electronic Health Care Records.* Spri. Sweden.

Spri (1997) *Vad Gör Spri*? Spri. Sweden.

Strasser, R. (1992) The Gatekeeper Role of General Practice. *Medical Journal of Australia*, 156: 108-110.

Straub, DW. (1994) The Effect of Culture on IT Diffusion: E-Mail and Fax in Japan and the US. *Information Systems Research*, 5(1): 23-47.

Valente, T. (1995) *Network Models of the Diffusion of Innovations.* Hampton Press. Creshill. New Jersey.

Van Bemmel, J., Musen, M., Helder, J. (Eds.) (1997) *Handbook of Medical Informatics.* Springer. Heidelberg.

Walker, D. (1993) To Succeed, Computers Need to Become Irresistible. *Informatics in Healthcare Australia*, 2(5): 5-6.

Walker, D. (1997) Health Informatics in Australia. *Informatics in Healthcare Australia*, 6(4): 135-138

Watson, D. (1989) Telemedicine. *Medical Journal of Australia*, 151(2): 62-66.

Weed, L. (1969) *Medical Records, Medical Education and Patient Care.* Case Western University Press. Cleveland.

Western M, Dwan K, Makkai T, del Mar C, Western J (2001) *Measuring IT use in Australian General Practice 2001.* General Practice Branch, Commonwealth Department of Health and Aged Care, 2001

Westin, AF. (1976) *Computers, Health Records and Citizen Rights.* Washington DC: National Bureau of Standards.

Winner, L. (1977) *Autonomous Technology: Technics-Out-Of-Control as a Theme in Political Thought.* MIT Press. Cambridge.

Winner, L. (1980) Do Artifacts Have Politics? *Daedalus* 109 (1): 121-136.

WONCA (1991) *The Role of the General Practitioner/Family Physician in Health Care Systems.* World Organisation of Family Doctors. Melbourne.

World Health Organisation (1978) *Primary Health Care: Report of the International Conference on Primary Health Care, Alma-Ata.* WHO. Geneva.

World Health Organisation (1993) *Implementation of the Global Strategy for Health for All by the Year 2000*, Second Evaluation, 8th Report on the World Health Situation. Geneva.

Zuboff, S. (1988) *In the Age of the Smart Machine - The Future of Work and Power*. Basic Books. New York.

Appendix K

Managing People and Organizations in Telemedicine and e-Health: A Global Perspective

David C. Bangert, Ph.D. and Robert Doktor, Ph.D., Editors

Working Title: A Guide to Utilization and Sustainment of Telemedicine: Answering the Question, "What is in it for me?"

Suggested Section: Section 4: Actors, Networks and Alliances in Telemedicine & e-Health

What alliances between various actors impact or preclude the success of e-health utilization? How may alliances be constructed to promote enhanced utilization? In addition to human actors, non-human entities such as software programs may also be considered actors in networks of alliances. How can these networks be modified so as to achieve greater stability in these processes of e-health utilization?

Author(s) and contact information for corresponding/primary author:
Deborah E. Seale, M.A.
Assistant Professor
Information and Communication Sciences
Southern Illinois University
School of Medicine
217-545-7830 (Main office)
217-545-7839 (Office fax)
dseale@siumed.edu

and
Sally S. Robinson, MD
Professor
The University of Texas Medical Branch
Department of Pediatrics
Center for Restorative Care
Galveston, Texas
and
Alexia Green, RN, PhD
Texas Tech University Health Sciences
Center
School of Nursing
Lubbock, Texas
and
Glenda Walker, RN, DSN
Stephen F. Austin State University
Division of Nursing
Nacogdoches, Texas
and
Bobbye Berg, RN, MSN, PNP
The University of Texas Medical Branch
Department of Pediatrics
Center for Restorative Care
Galveston, Texas
and
Christina Esperat, RN, PhD, CSFNP
Texas Tech University Health Sciences
Center
School of Nursing
Lubbock, Texas
and
Patty Ellison, MSN, RN, CFNP
Stephen F. Austin State University
Division of Nursing
Nacogdoches, Texas
and
Michael Chalambaga, BS, BA
Lamar University
Department of Nursing
Beaumont, Texas

A Guide to Utilization and Sustainment of Telemedicine: Answering the Question, "What is in it for me?"

ABSTRACT

Despite a general consensus that many health care needs can be addressed through telemedicine, most telemedicine systems remain underutilized and provision of services are difficult to sustain. Five critical success factors for establishing baseline utilization and assuring long-term growth and sustainability are outlined along with field-tested techniques for achieving each. The five critical success factors are identifying strategic partners, developing local champions, engaging the project team, securing executive buy-in, and garnering community support.

Techniques for achieving each are based upon over ten years of experience in building telehealth programs. Founded in exchange theory and reliant upon community development and mobilization methods, these techniques aim to answer the question, "What is in it for me?" at the individual, organizational, community, and societal levels. To achieve each critical success factor, techniques are described for assessing and responding to the relative value of money, power and prestige for each level and key player. Effectively implemented, this approach assures that once the "deal is sealed" the leadership understands the risks and the opportunities, and the people on the ground floor have the resources and dedication to succeed.

Scenarios based in real life experience are presented that demonstrate the ramifications of using and omitting some of these techniques. When fully implemented, these techniques result in projects that are built upon strong partnerships that distribute the risks, share resources and support multiple uses of the technology. In addition, the role of each partner — whether an individual, organization or community — is aligned with its respective mission and strategic direction.

The scenarios presented are based upon three projects for which these techniques were applied. One case study involves a regional network of 7 rural hospitals linked to a community college and regional hospital. The second is an academic health center linked to the nursing programs in two universities. The third involves an academic health center, two universities and five public schools.

A Guide to Utilization and Sustainment of Telemedicine: Answering the Question, "What is in it for me?"

FIRST DRAFT

The ability to develop sound partnerships is a core competency for establishing and sustaining successful telehealth services. There are five steps to developing sound partnerships.

If faced with developing and implementing telemedicine on a limited budget, funding can be leveraged through partnering and collaborating. In addition to distributing the cost and sharing the risks, partnering secures the necessary buy-in for sustaining telehealth activities over the long-term. Five steps will be presented for developing sound partnerships.

1. Build upon existing relationships
2. Develop local champions
3. Engage the technical team
4. Get executive buy-in
5. Garner community support

Proven techniques for accomplishing each step will be described. These techniques will assist program developers in identifying the key players, designing the project, securing the resources, and operating and sustaining telemedicine services. Techniques for building "grassroots" support at the organizational and community levels as well as gaining the support of upper level leadership in the organization and community will be demonstrated. This "ground-up", rather than "top-down" approach assures that once the "deal is sealed", the leadership understands the risks and the opportunities and the people on the ground floor have the resources and commitment to succeed. These techniques have been developed, used and refined over an eight year period. A case study format will be used to demonstrate how techniques have been successfully applied to each step.

1. Build upon existing relationships

The strongest and most lasting telehealth partnerships are often built upon existing relationships, i.e., people or organizations with which you or your organization already has a relationship. The existing relationship can be personal, professional or organizational. Scan your organization to get a sense of the outreach or community-based activities with which your organization is already involved. These activities may be clinical, educational, research-oriented, or community service activity.

Students may be placed in a community practice, clinic or hospital to gain community-based training experience. You may have an Area Health Education Center (AHEC) or similar community-based organization who works in the schools to recruit students into the health professions. Faculty members may be collaborating on research projects with faculty in another institution. Your nursing or allied health program may be offering distance education degrees at a local college or university. A provider or administrator in your organization may sit on the board of a local company or vice versa.

By building upon an existing relationship, there is an already established degree of trust and understanding. There is already an identified need that the relationship is already addressing. The most natural next question is whether the existing relationship can be enhanced with the

addition of telehealth or if that person or organization can "introduce" you to other community members with whom you would like to work.

2. Develop local champions

- **Identify a power broker and an operations expert**

Once you have established an entrée into the organization with whom you wish to establish a telehealth service, identify two champions within the potential partnership organization to assist you in developing the project. One champion should have access to the power structure within their organization and the community. By this I mean, a person who can get the "right" influential people to the negotiating table. The other champion should be more oriented toward "operations" with strong skills and interest in working with patients, students and colleagues. These two champions need to communicate and work well with each other.

This is also true within your own organization. That is, you will need a co-champion. You or your co-champion will need to have access to the power structure, i.e., be able to get the appropriate people in the room. In a health provider organization, this person is often a physician. Similarly, you or your co-champion will need to understand, or recruit someone, who understands the operations side. One of the most important skills that one of the co-champions at the initiating organization must have is relationship-building and maintaining skills.

- **Answer the question: "What is in it for me?" (WIFM)**

There may need to be several meetings, phone calls and emails with the champion who has access to the power structure – or the power broker. You will need to understand the power broker's own personal/professional goals in working with the project, their organization's interests, potential benefits and challenges, and the benefits to the larger community. Essentially, you will need to understand and find acceptable the WIFM (What's in it for me?) at the personal/professional, organizational and community level.

To be a true partnership, each party will need to be willing to help the other achieve their goals. So, you are going to want to find those common interests that overlap the personal/professional, organizational and community/societal realms.

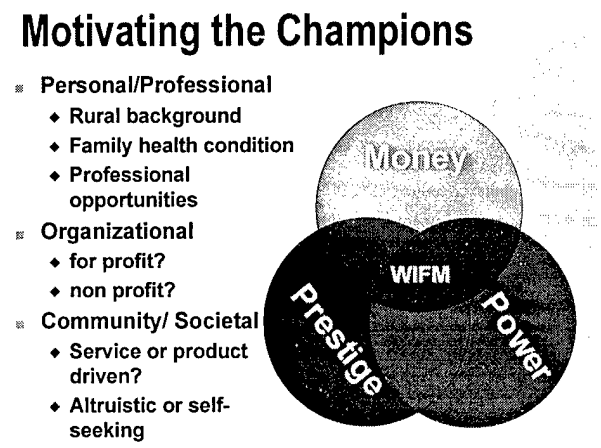
To help you get to the WIFM for your partners, reveal your own. What attracted you to health care, education, or public service? To focus on rural/underserved, health care access for everyone? How does your role in your organization align with your values and or professional goals? How can this project support both your personal/professional goals and the organization's direction? Is there an altruistic or public good that will come from the project that is bigger than you or the organization?

- **What motivates people, organizations, communities? Power? Prestige? Money?**

You and your partners must be clear about what you are in this project for. Is it money? Power? Prestige?

What is the relative importance of money, power or prestige to you personally? To your organization? To the community, region, industry of which your organization is a part?

As you share your own interests, your potential partners will be interested in exploring their own. You can then help them explore what is in it for other key stakeholders, such as the chief executive officer, chief financial officer, and chief operating officer. Also, don't forget to understand what is in it for the technicians, nurses, allied health and administrative staff.



Recognize that everyone has desires and needs. Asking them to explore how this project may help them achieve their goals, gives legitimacy to their needs while opening the door to engage them in helping find solutions to assure the project's success. You will approach people and organizations differently based upon whether they are motivated more by money, power, or prestige. Every job and organization has varying levels of these dimensions. Each dimension is essential to the success of every project.

- **Examples: Plumber, police officer, doctor**

For instance, a plumber or electrician makes good money, doesn't have much prestige and does have substantial power, but over limited realm which in most cases is not life-threatening. A police officer has a great deal of power – over your life and liberty, which is significant. They don't get paid much relative to their power and their prestige is moderate. Physicians are highly respected and so have high prestige, make good money and wield significant power. Where they work or the composition of their practice may tell you, which one of the three dimensions they value most.

Physicians in an academic institution may value prestige or power more than money. You will have to get to know them to find out which they value most, but once you know, you will know whether to get their picture in the paper or on television (prestige), get them in a meeting with other power brokers (power/prestige), get them where they can help more patients or reach more students (power) or if they will want to see the "bottom line" (money).

- **Seek to understand; not judge**

Power, money nor prestige is bad or good. Your project will need to be visible, well positioned and solvent. Understanding how an individual or organization values each dimension allows you to plan and implement a project that will keep them invested in the project's success because it is linked to their success.

Knowing what drives people allows you to match them with the appropriate role and to give the information they need and want to succeed using their definition of success.

- **Organizations, communities and countries value power, money, and prestige**

Not only occupations possess varying levels of these qualities. So do organizations, communities, regions, states, and countries. It is important to understand how these qualities are valued differently by for-profits vs. non-profits, economically depressed versus economically prosperous communities, rural versus urban, inner city versus suburbs, academic health centers versus community health centers, etc.

Once the "what's in it for me" (WIFM) in each of these realms of interest (personal/professional, organizational, community/societal) is understood and you know what motivates people, the organizations with whom you work and the communities they serve, the local champions and the representatives from the telehealth provider organization work together to develop plans for initiating the project.

- **Local control and ownership**

After plans have been developed that clearly articulate what you want to accomplish through telehealth, how you are going to accomplish it, and how you are going to sell the idea within and outside of each of the member organizations, the local champions convene the remaining meetings. The telehealth provider organization offers support and helps develop strategy, but the local champions are spearheading the project within their own realm of influence. The project champions from the telehealth provider organization are guests and helpers. This point is critical and may be difficult to achieve given the relative importance of power, money and prestige to each of the players from the telehealth provider organization.

It is difficult to take the second chair when you feel you know more about telehealth, but the community partner organization knows more about the local community. Furthermore, when the provider organization representatives go back home, someone in the community will need to continue advocating for the project. Therefore, the local champions must become the knowledgeable promoters for the project within their organization and community. And it is the provider organization's responsibility to position them as such. This means that they must understand enough to approach the leadership within their organization and community and be seen as well informed, trustworthy and reliable.

Once champions are identified, work with them to develop the:

1) Plan for gaining the support of the upper level administration within their organization and leadership within the local community, and
2) Process, structure and systems for operating the clinic.

3. Engage the technical team

The next phase will involve engaging the technical team. The local champions invite their technical team to a meeting with the technical team from the telehealth provider organization, which is also attended by the provider organization's co-champions. The purpose of the technical meeting is two fold. First, the existing technical capabilities along with the needs and costs for undertaking the proposed project need to be established. Second, rapport needs to be

built between the technical support personnel from each organization so that they become a team.

Again, the telehealth provider technicians should work with technicians at the partner organization to increase their level of knowledge and expertise so that the status of the partner representative is enhanced within their own organization. Other benefits are that you are building a competent remote site technical support person who will be invaluable to you as the project progresses and valuable to the partner organization and community where there is likely to be a shortage of skilled technicians.

4. Get executive buy-in

Once the project leaders at both sites are comfortable with the technical solutions, the local champions arrange for an executive briefing with the leadership within their organization. The purpose of the executive briefing is to inform the leadership about the project so that they are able to converse with community members, resolve any unanswered questions, and gain reassurance about the partnership by meeting the players from the telemedicine provider organization.

This is the meeting to "seal the deal", which implies that all questions have been answered ahead of time. This meeting should be a morale booster in which support for the project is demonstrated from the top of the organization to the operational level. The deal that is being made could be an agreement to seek funding, deploy infrastructure, expand existing services, etc.

5. Garner community support

The last phase in partnership building is with stakeholders in the community. The purpose of the community briefing is to inform community members who can influence the success or failure of the project about the project, address their concerns before the project begins, and to gain their support. Again, this meeting is convened by the local champions with the participation and support of members of the telehealth provider organization.

In one project, local champions visited physicians and leaders in the community on a one-on-one basis giving an overview of the project and answering any questions. In a second project, the partner organization held an evening forum for community practitioners and leaders with telehealth provider organization members in attendance in person and through a live videoconference. In a third project, champions from each of the project sites made round robin site visits to each community to meet with community leaders.

BIBLIOGRAPHY

Literature Review
Exchange Theory
Community Development and Mobilization
Organizational Development
Human Factors (Chapanis; Nichols etal)
Distributed Decision-Making
Shared Mental Model (Orasanu 1990; Salas, 1993; Serfaty, Entin, & Volpe, 1993)
Notes from review of other chapters:
CMR Barriers: lack computer literacy and knowledge of benefits
-exposure through education, seminars, site visits, round robin meetings
Lack of situational awareness/achieve congruent mental models of situation – training presenter/provider work site by side
Extended role of presenting provider – "Towards Learning Organizations with Telemedicine"

Aas IHM. A qualitative study of the organizational consequences of telemedicine. Journal of Telemedicine and Telecare 2001a;7: 18-26.

Aas IHM. Telemedical work and co-operation, Journal of Telemedicine and Telecare 2001b; 7:212-218.

Aas IHM. Changes in the job situation due to telemedicine. Journal of Telemedicine and Telecare 2002a; 8: 41-47 .

Aas IHM. Learning in organizations working with telemedicine. Journal of Telemedicine and Telecare 2002b; 8: 107- 111.

Aas IHM. Telemedicine and changes in the distribution of tasks between levels of care. Journal of Telemedicine and Telecare 2002c; 8 (Suppl. 2): 1-2.

Aas IHM. Working with telemedicine: User characteristcs and attitudes. Journal of Telemedicine and Telecare 2000(Supplement1);6: 66-68.

Aas IHM. Organizing for remote consultations in health care - the production process. Behaviour & Information Technology 2003; 22: 91-100.

Aas IHM. Organizational change: decentralization in hospitals. International Journal of Health Planning and Management 1997; 12: 103-14

Bangert D., Doktor R., (2000) Implementing Store-and-Forward Telemedicine: Organizational issues. Telemedicine Journal and e-Health, 6, 3: 355-360.

Bijker, W. (1995) *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*. MIT Press. Cambridge.

Bijker, WE., Hughes, TP., Pinch, T. (Eds.) (1987) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. MIT Press. Cambridge.

Bijker, WE., Law, J. (Eds.) (1992) *Shaping Technology/Building Society: Studies in Sociotechnical Change*. MIT Press. Cambridge.

Brauer, G. (1992) Telehealth: The Delayed Revolution in Health Care. *Medical Progress Through Technology*, 18(3): 151-163.

Callon, M., Law, J. (1989) On the Construction of Sociotechnical Networks: Content and Context Revisited. *Knowledge and Society: Studies in the Sociology of Science Past and Present*, 8: 57-83.

Carr, V.H. Jr. *Technology Adoption and Diffusion.* http://tlc.nlm.nih.gov/resources/publications/sourcebook/adoptiondiffusion.html.

CDC?, Economic Consequences of Diabetes Mellitus in the U.S. in 1997. American Diabetes Association. Diabetes Care 1998, 21(2): 296-306.

Clark, Roger. (1999) *A Primer in Diffusion of Innovations Theory.* http://www.anu.edu.au/people/Roger.Clark/SOS/InnDiff.html.

Eliasson, G. (1990) *The Knowledge Based Information Economy*. The Industrial Institute for Economic and Social Research. Sweden.

Finn KE, Sellen AJ, Wilbur SB (1997). Video-Mediated Communication. Mahwah, NJ: Lawrence Erlbaum Associates.

Grigsby, W. *Telehealth: an assessment of growth and distribution.* The Journal of Rural Health 2002; 18(2):348-358.

Heydebrand WV. New organizational forms. Work and occupations 1989; 16: 323-57

??, Human Factor Education. The Naked Pilot.

Jha, Ashish K., Duncan, Bradford W., Bates, David W. *Similator-Based Training and Patient Safety.* Making Health Care Safer: A Critical Analysis of Patient Safety Practices. Evidenced Report/Technology Assessment, No. 43.

Klemm, William R. Leadership: *Creativity and Innovation.* Concepts for Airforce Leadership.

Kotter, John P. (1998) *Winning at Change.* Leader to Leader Institute (formerly the Drucker Foundation).

MacKenzie, D., Wajcman, J. (1985) *The Social Shaping of Technology*. Open University Press, Milton Keynes.

Moscovice, I., Wellever, A., Christianson, J. *Understanding integrated rural health networks.* The Milbank Quarterly 1997; 75(4):563-586.

Mueller, K., Coburn, A., Cordes, S., Crittenden, R., Hart, J., McBride, T., Myers, W. *The changing landscape of health care financing and delivery: how are rural communities and providers responding?* Milbank Quarterly 1999; 77(4):485-510, ii.

Nikula RE. Organisational learning within health care organisations. Medical Informatics 1999; 56: 61-6

Nordhaug O. Human capital in organizations. Competence, training, and learning. Oslo: Scandinavian University Press, 1993

Orasanu J (1990). Shared mental models and crew decision-making. Tech. Rept. 46. Cognitive Science Laboratory, Princeton University, Princeton, NJ.

Orasanu J, and Salas E (1993). Team decision making in complex environments. In: Klein G.A, Orasanu J, Calderwood R, and Zsambok CE (Eds.), Decision-Making in Action: Models and Methods. Norwood, NJ: Ablex.

Pizzi, Laura T., Goldfarb, Neil I., Nash, David, B. *Promoting a Culture of Safety.* Making Health Care Safer: A Critical Analysis of Patient Safety Practices. Evidenced Report/Technology Assessment, No. 43.

Pizzi, Laura T., Goldfarb, Neil I., Nash, David, B. *Crew Resource Management and its Applications in Medicine.* Making Health Care Safer: A Critical Analysis of Patient Safety Practices. Evidenced Report/Technology Assessment, No. 43.

Puskin, D. *Opportunities and challenges to telemedicine in rural America*. Journal of Medical Systems 1995 Feb;19(1):59-67.

Rasmussen J, Brehmer B, and Leplat, J (Eds.). (1991). Distributed Decision Making: Cognitive Models for Cooperative Work. Chichester: Wiley.

Rasche, Jeanette D. *An Introduction to Human Factors: The Center for Total Access Experience.* www.cta.ha.osd.mil

Rogers, EM. (1995) *Diffusion of Innovations.* 4th Edition, The Free Press, New York.

Sauer, C. (1993) *Why Information Systems Fail: A Case Study Approach*. Alfred Waller. Henley-on-Thames.

Schnieder, M., Mann, N., Schiller, A. (1992) *Can Telecommunications Help Solve America's Health Care Problems?* Arthur D. Little. Boston.

Segal LD (1994). Actions speak louder than words: How pilots use nonverbal information for crew communications. In: Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 21-25.

Senge PM, Kleiner A, Roberts C, Ross RB, Smith BJ. The fifth discipline fieldbook. Strategies and tools for building a learning organization. New York: Doubleday, 1994.

Serfaty D, Entin EE, and Volpe C (1993). Adaptation to stress in team decision-making and coordination. In: Proc Human Factors and Ergnomics Society 37th Annual meeting. 1228-232.

Stead WW. The networked health enterprise: A vision for 2008. Journal of the American Medical Informatics Association 1998; 5: 412-5

Valente, T. (1995) *Network Models of the Diffusion of Innovations.* Hampton Press. Creshill. New Jersey.

Valikangas, Liisa, Hamel, Gary. (2001) *Internal Markets – Emerging Governance Structures for Innovation.* Strategos Institute. Paper presented a the Strategic Management Society, 21st Annual International Conference.

Wallston BS et.al. The development and validation of the health related locus of control (HLC) scale. Journal of Consulting and Clinical Psychology 1976; 44: 580-585.

Appendix M

Telemedicine in Emergencies

Colin F. Mackenzie, MB, ChB, FRCA, FCCM
Yan Xiao, PhD
David Lam, MD
Peter Hu, MS, CNE
Claudia Oglivie, RN, MS

Charles Mc. Mathias, Jr. National Study Center for Trauma and Emergency Medical Systems
Human Factors Research Group
Department of Anesthesiology
University of Maryland School of Medicine
Baltimore, MD 21201

Work performed under MRMC Contract DAMD 17-01-1-0758 of the Army Medical Research and Material Command, Fort Detrick, Maryland. The opinions expressed in this chapter are those of the authors and do not represent the opinion of the Department of Defense.

This chapter reviews the human and organizational factors associated with real-time, distributed medical decision-making, the telecommunication mode that is likely to occur in wartime or other emergency states. We address two questions, one general to distributed decision making, the other specific to medical application of real-time decision-making using telecommunication technology in emergencies. The objectives of describing real-time distributed medical decision-making are to: characterize the relative importance and priority of certain medical information for remote decision-making: to assess the impact of domain expertise (surgeons, anesthesiologists, nurses) on information-gathering and data interpretation; to determine how medical performance could be evaluated or mentored remotely and identify uncertainties among remote decision-makers viewing events through multimedia telecommunication links; to make recommendations that have implications for the design of medical telecommunications in support of real-time distributed decision-making.

1.1 REVIEW OF DISTRIBUTED DECISION-MAKING

Telemedicine provides or supports clinical care at a distance from the provider who is co-located with the patient, by use of electronic communication and information. The provision and support of clinical care is achieved through audio, data and imagery transfer between the co-located provider and the remotely situated provider or supporter of clinical decision-making. How distance impacts the abilities of the remotely situated clinical decision-maker to perceive the same cues, and understand the dynamics and coordination of the co-located providers is unclear. The effects of distance on performance of widely distributed decision-making is of importance for situations, such as wartime, disasters, chemical or biologic weapons attack, when dynamic real-time decision-making about medical triage, resource management and coordination of rescue efforts (for example, military, fire, EMS) will be needed. This review of the background of distributed decision-making considers the situation when telecommunications will be used dynamically, for remote emergency medical decision-making. We believe that in the future, real time telemedicine communication links will be used for monitoring medical performance, just-in-time training, task-specific telementoring as well as coordination of medical responses (in the broadest sense, for example, triage, resource management, etc.) in wartime, disasters, chemical and biologic attack and other emergencies.

Such distributed decision making is a research paradigm for understanding organizational, group, and decision making when members are distributed in several senses including: physical location, access to information, authority, expertise and access to resources. Field military medicine missions in wartime, in disasters or secondary to terrorist activity are prime examples of distributed decision making, as collaborating members are distributed in all of these five senses. Telecommunication advances in recent decades have overcome many of the technical barriers to communication over distance and time. Increasingly telecommunication systems have become an integral part of many professions, enabling remotely located

individuals to collaborate on problem-solving with expertise unavailable locally. Yet our understanding of how people work together when using communication technologies has been lacking (National Research Council, 1990; Rasmussen et al., 1991; U.S. Congress, Office of Technology Assessment, 1995). Interesting and challenging research issues arise and surprising uses of telecommunication systems for medical decision-making and problem solving occur. For example, the agent used in the Sarin attack in the Tokyo subway, was diagnosed by a Japanese physician with knowledge of previous organophosphorous poisonings, seeing the poisoned victims' responses on television news coverage. Telecommunication advances enable remotely situated individuals to collaborate on problem solving with expertise that is not available locally.

Communication and Shared Mental Models

Lack of a shared situational awareness is one of the difficulties in using telemedicine communications to facilitate provision of, or support for, clinical care from a distance. Medical providers co-located with the patient share information through many verbal and non-verbal means. These medical providers have often worked together previously and they know the domain and the context of the current situation, whereas, remotely situated decision-makers are very unlikely to have trained with the co-located providers or know the ethos of their military unit, because they may be making the telemedicine communications to this location for the first time. How such remotely situated experts can rapidly get up to the same, or an acceptable level, of understanding to communicate and coordinate activities with the co-located care providers, remains uncertain. In order to understand how this can best be achieved from a distance, we first need to understand how such communication and coordination occurs among co-located medical care providers.

The shared mental model (Orasanu 1990 & Salas, 1993) is an emerging concept to capture how co-located members of a team could function together, often with little overt communication. The underlying assumptions are that team members, through training, experience and communication, achieve congruent mental models of the current situation, choices available, relevant goals, and future steps. Xiao et al (1998a, 1998b) described several ways in which co-located medical team members were able to coordinate without explicit communication. Serfaty et al (1989) described the effect of workload on communication processes. Under high workload, team members adopt strategies that reduced the need for explicit communications.

These studies all demonstrate that in highly trained teams with experienced members, communication patterns varied and there are ways for leaders to exert influence without explicit communication. In contrast to many previous studies on leadership, verbal activities are usually the only ways in which leaders function. Such difference would have direct bearing on the potential impact of new communication technologies on leadership.

Verbal communications have often been studied as the major form of coordination process (Kanki, Folk, & Irwin, 1991). The concept of "implicit coordination" was introduced when teams were found to be able to coordinate with reduced communications (Serfaty, Entin, & Volpe, 1993), especially under high workload

situations. To investigate factors promoting implicit coordination, it has been hypothesized that "shared mental models", or **shared** understanding of goals and tasks, is a key, since division of labor in most work settings may have prevented team members from understanding other people's tasks. Volpe et al (1996) tested this hypothesis and found that cross training, in which team members were trained in other people's tasks, improved team performance by prompting implicit coordination. The concepts of shared mental models and implicit coordination and related empirical data highlight the issue of communication cost. When workload and time pressure is high, reducing the cost or workload related to communication has obvious advantages (Segal, 1994). If it is important for team members to share an understanding of each other's tasks and goals, which are relatively stable, it is equally important for team members to be aware of task situations and each other's activities, plans and work focus, all of which are changing in dynamic work settings.

1.2 REAL-TIME TELEMEDICINE DISTRIBUTED DECISION-MAKING IN WARTIME OR OTHER EMERGENCY STATES

In the current military, the remote teleconsultant does not give medical direction – the "guy-on-the-ground" is in charge. However, future military doctrine may change to enable telemedicine communications to be used for real-time telementoring and just-in-time training and decision-aiding for emergency responses to disasters, chemical or biologic weapon deployment, other terrorist attacks and war. To assess the needs of telemedicine in such situations, we explored the cognitive demands and information use of decision-makers in emergency, real-time, medical diagnosis and treatment. Existing videotapes of real trauma patient resuscitation and management at the Shock Trauma Center were used as the stimulus material to recreate dynamic decision-making situations where the impact of the telecommunication media on situational awareness and remote decision-making could be determined. There are clearly differences between the military medicine mission environment and a trauma center, but there are similarities in that emergency life-saving medical interventions occur that could potentially be telementored by remotely situated experts (Tiech et al 2002). There can be physical deterioration of the field military team members due to fatigue or injury. In the field, unlike the trauma center, there are finite supplies and limited and fixed resources. As a result, there are limited options available to deal with unanticipated events. However, using audio/video records of human processes in real life trauma patient resuscitation as surrogate material allows testing the understanding of decision making by remote experts, and examining how these experts view the multidisciplinary teams' function in dynamic and stressful situations. In addition, we used such an approach to identify the information that remote decision-makers can extract from audio/video records.

For acute events, human factor resemblances between team members in a military medicine mission and a multidisciplinary trauma resuscitation team are quite strong (Mackenzie, CF, et al, 2000). The military medicine team has to deal with both the enemy and with many complex and interacting systems within their team. They are required to understand system data in stressful conditions when their capabilities for comprehension can be overloaded with a multitude of signals whose priorities for attention may be ambiguous. During prolonged medical missions, the changing

emotions of military team members and anxieties associated with specific tasks or being under enemy attack may result in impairment of decision-making and problem solving. Interactions with an expert, but remotely distributed colleague may be able to modulate such stressors and anxieties by providing psychological support and allowing maintenance of cognitive performance.

There is relevance of trauma patient resuscitation to military medical missions for acute events, because of performance shaping factor resemblances between military medicine and a multidisciplinary trauma resuscitation team. The domain of trauma patient resuscitation is high risk; tasks may need to be carried out under severe time pressure with many additional stressors, including noise and uncertainty. The trauma patient resuscitation area (13 feet x 12 feet) is space-limited like military wartime resuscitation areas, so allowing activity monitoring of other care providers and a shared event space. The trauma team, like the military team, has specific domain-expertise. In both trauma resuscitation and in military missions, there is a need for a widely shared mental model that allows for diverse, often non-routine decisions to be made with imperfect information. Both the trauma team and military team members have to maintain cognitive performance despite physiological stressors (such as sleep deprivation), and emotional disturbances. For the trauma team, this includes dealing with combative and abusive patients and those with severe injuries.

Like military missions in wartime there are many uncertainties confronting the trauma team decision-makers. There are unknowns about the emergency patient (site and extent of intracerebral, thoracic and abdominal injury, past medical history in unconscious patients), and because emergencies are unpredictable, the incoming patient workload is unpredictable. In an analysis of the impact of uncertainty on trauma team performance (Xiao & Mackenzie, 1997), In 40 patient resuscitations, we found patient related and team/organization related uncertainties. In acute events, similar uncertainties will probably exist for the on-site field military medicine team.

Generalizability of Findings to Military Medicine Missions

The domain of trauma resuscitation was used as a "laboratory" to develop and test general characteristics of how remotely situated decision-makers understand events in dynamic domains such as are present during wartime, in disasters, and chemical or biologic attack with weapons of mass destruction. Although the domain of trauma resuscitation is a highly specialized medical domain, it shares many similarities with military medicine missions as described above. In order to understand how real teams function in real, stressful situations, the "laboratory" we studied can be a valuable surrogate to provide insight into the medical environment that might occur in war and other emergencies. We paid special attention to the underlying theoretical concepts, such as task urgency, and uncertainty so that our results can be generalizable.

These data yield insights into the cognitive processes involved in skilled performance and decision-making, during distributed decision-making in trauma resuscitation. They have interest to the military and the medical community because urgent diagnosis and treatment of medical problems and coordination of medical

resources by telecommunication links will need to occur in wartime, disasters and as a result of chemical or biological attack with weapons of mass destruction.

Our previous findings (see Mackenzie, et. al.,2000) suggest the possibility that the involvement of a remote expert, depending upon the information available to him/her, may assist the on-site team in avoiding certain pitfalls. For example, some errors in this task environment have been attributed to the team fixating inappropriately on suspected instrumentation problems, at the expense of continued observation and physical examination of the patient (Xiao, et al., 1998b). A remotely located expert might be less prone to being caught up in such inappropriate allocations of collective attention. Trauma teams functioning in high stress, emergency cases have been shown to take procedural short cuts, which can be counterproductive, e.g., failing to make use of available instrumentation. Remote experts, to the extent that they retain a "big picture" perspective of the case, might more readily detect procedural oversights or other errors that are due to the stress of the moment rather than to lack of knowledge. Likewise, it may be easier for the more detached, remotely located expert to focus on trends in patient vital signs, and to formulate diagnostic conclusions there while the on-site decision-maker may be burdened with concurrent tasks to the extent that he/she only has the working memory capacity to monitor moment to moment.

1.3 RESEARCH EFFORT QUESTIONS FOR DISTRIBUTED DECISION MAKING

This effort addresses two research questions, one general to distributed decision making and the other specific to medical applications of dynamic distributed decision making, such as would occur during wartime or other emergencies, e.g., disasters, chemical or biological attack with weapons of mass destruction.

As a first general question, the effort was directed at answering the question, what information is used by a remote decision-maker? For a decision-maker to effectively participate in a decision making process, a prerequisite is to be able to assess the situation and problems at hand. In a distributed decision making context, this requirement means that the decision maker has to rely on telecommunication links (e.g. computer, telephone, and video networks) to achieve situation assessment and to understand problems to be tackled. This requirement may be fulfilled relatively easily when events evolve slowly, but it can be difficult to satisfy when situations change rapidly (a similar argument is put forward by Allely, 1995). Little empirical data have been reported on how people can assess dynamically changing situations and problems through telecommunication links. Therefore, there is little empirical basis existing to guide the design of telecommunication systems in support of distributed decision-making.

A second question, specific to medical applications of distributed decision-making is also addressed: how should we make use of remote expertise? This question is related to a broadly defined field of telemedicine. With the development of technologies, many of the long-time desires of medical practice seem to come true: the physicians can see and talk to the patient over long distances, physicians themselves can use video teleconferences to save travel costs. Much of the efforts on telemedicine have been driven by technology and have been based on untested assumptions about the impact of technology. As evidenced in the research on the impact of technology and on the use of video teleconferencing systems in organizations (Finn, et al, 1997), each use of technology is an experimentation with unexpected outcomes and it creates a new work environment with new tasks and requirements. New modes of errors and new patterns of workload will result when technology is deployed, sometimes seemingly innocently replacing or automating a component in the work environment.

It is unclear what information a remote medical decision-maker requires to management of medical emergencies and how effective remote management is at producing appropriate and timely diagnosis and management of humans with medical problems. It is also not known how different types of medical subject matter experts (surgeons, anesthesiologists, nurses) function as independent remote decision-makers and thirdly, how the response of the on-site trauma patient managers affects the remote decision-maker is also uncertain.
As a preliminary step to address these research questions, our project examined the ability of trauma experts to remotely manage trauma patients through telecommunication links, and identify how telecommunication systems should be designed to facilitate such tasks. Important features of the domain of trauma patient resuscitation are that the patient's condition changes rapidly and is often uncertain, and that the resuscitation effort is carried out by a multi-disciplinary team. Apart from being used as a research "laboratory", trauma patient resuscitation could benefit from telecommunication because in many situations injured patients are spatially remote from expert care providers.

Specific Aims

We used our existing videotapes and database (see below-under video library) including transcriptions of reviews of the management by participant and non-participant subject matter experts (SME's) and summaries of diagnostic and surgical findings and laboratory and radiological data (Mackenzie, CF, et al, 1996a). From these data, we examined the following specific aims:

Specific Aim 1: Characterize the importance of various information-providing factors in remote decision-making for the emergency management of the trauma patient. These results would address questions about the relative importance of patient vital signs (heart rate, blood pressure, oxygen saturation, etc.), and physical examination in determining appropriate emergency medical management of the trauma patient.

Specific Aim 2: Assess the effects of different types of subject matter experts (surgeons, anesthesiologist, trauma nurse) functioning independently as the remote decision-makers. This specific aim would examine how strategies of information-gathering data interpretation and integration differ among medical subject matter experts working independently.

Specific Aim 3: Determine how team coordination and breakdowns in coordination might impact on the decision-making of a remote expert and to identify what remote experts were uncertain about when viewing events through multimedia telecommunication links.

The studies were carried out by the National Study Center for Trauma and EMS investigators working at the R Adams Cowley Shock Trauma Center of the University of Maryland. This facility is a Level One trauma center that is regarded as one of the pre-eminent facilities of its kind in the world and is the Primary Adult Resource Center for the State of Maryland trauma system. As such, it serves as a training ground for trauma anesthesiology and surgery residents and faculty from all over the world.

Video Library

Audio/videotapes in the library were earlier developed in this real Shock Trauma environment under a grant funded by the Office of Naval Research (ONR#N00014-91-J-1540) and supplemented by video clips as a result of other funding sources (NASA grant #NCC2-921, ARI Grant # DASW01-99-K003 and AHRQ grant # U18HS-11279-01).

A unique feature of the video recordings was that the video images contained overlaid patient vital signs (Figure 1). The images in the video-acquisition systems network (VASNET) are overlaid with patient vital signs obtained from a serial interface on the patient's monitors (Mackenzie, Hu, Horst, et al, 1995). These vital signs are essential to understanding of the decision-making process of the Resuscitation Team. They include heart rate, oxygen levels in the patient's blood (SpO_2), measures of ventilation (end-tidal CO_2) and blood pressure, temperature and filling pressures of the heart. Such a recording method makes video analysis efficient as trauma resuscitation activities are initially guided by the goals of diagnosis of the causes of abnormality in the vital signs and normalization of vital signs.

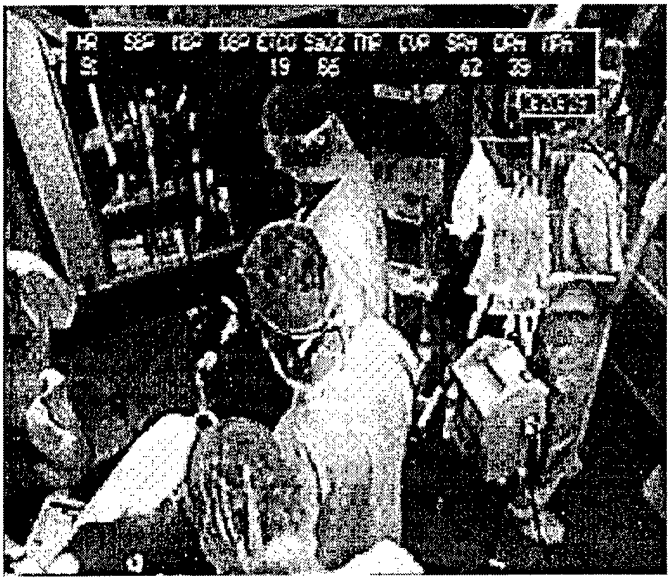


Figure 1. *Video image of trauma patient resuscitation. This patient had a flail chest and major intra-abdominal bleeding. Vital signs show heart rate (HR) 91/min on extreme left. End-tidal CO_2= 19 mmHg, O_2 saturation = 86%, and non-invasive BP = 62/39 shown on the right side of overlay. Time code is shown beneath BP.*

The audio/video acquisition system has been in operational use for more than eleven years and it is reliable and easy to use. Our research team established rapport among the care providers in the Trauma Center for audio-video taping. The system is turnkey operated and we believe this does not interfere with patient care, nor does the videotaping from cameras affixed to the ceiling appear to influence the behavioral aspects of the trauma team. The trauma team members expressed their lack of remembrance that they were being videotaped on review of the events. Rather, they were concentrating on the tasks at hand. One of the useful parts of videotape review was that the participants noted events that during resuscitation they had not recognized because of their selective attention to other aspects of care.

Using the VASNET system, we have established a video library of team performance during trauma patient resuscitation. The video library contains over 200 cases of real trauma patient resuscitation. These existing videotapes and other materials were used as stimulus material in this study of distributed decision-making. Aside from video and audio recordings, medical records (e.g. patient admission records, anesthetic and surgical records, discharge summary, vital signs, and blood chemistry) were also collected. After patient identifiers were removed, these were copied and became part of the database. A majority of these cases were reviewed by subject matter experts, both neutral (i.e. not in the recorded cases) and participant (i.e. in the recorded cases). It was this database that was used to examine the three specific aims.

1.4 EXPERIMENTS ON REAL-TIME DISTRIBUTED DECISION MAKING IN EMERGENCIES

The results discussed here are based on a study (Xiao et al, 1999) that was funded by NASA (grant # NCC 2-921)

1.5 GENERAL METHODOLOGY

The general methodology adopted in the experimentation was to present the subjects with video segments of real-life trauma patient resuscitation from our video library. The subject's ability to assess the status of the patient and the progress of the resuscitation effort was then measured. Experiment subjects were all subject matter experts (SMEs). The video presentation was to **simulate** remote diagnosis through telecommunication in which experts would be provided with live video images. Patient history on admission to the Shock Trauma Center was given to the SMEs at the start of each experiment. During the course of the presentation of the stimulus materials, stop points were inserted, at which the subjects filled in questionnaires specially designed to capture their understanding of patient status and resuscitation activities contained in the stimulus materials. The questionnaire contained open questions and were generic (i.e. same across all stop points and not case-specific).

Stop points were chosen in each case segments based on the stages in the resuscitation effort. For each stop point, 1-3 items of descriptions were generated based on the analysis results to represent the ideal understanding of the status of the patient and of the resuscitation activities, and these items were used to score the questionnaires filled by the subjects (Table 1.1). Thus even though questionnaires were generic, the scoring items were dependent on the specific stop point (see Table 1.2).

Four case segments (5-8 minutes each) were used in the experiment; with 3-4 stop points in each case segment. These case segments were selected to represent a wide range of trauma patient resuscitation scenarios, and they were relatively complex.

The rationale for case selection was to find cases that allow testing of the abilities of the subjects as remote decision-makers to, (1) anticipate out-of-viewing range events, (2) identify team coordination problems, (3) anticipate potential risky plans, (4) track patient status dynamically, (5) detect pressure for aggressive approaches, (6) identify failed task status, (7) recognize positive and negative cues for task status, (8) anticipate team's decisions, and (9) identify patient problems from trends in the patient's vital signs.

1	I would describe the current patient status as (list up to 5 most important descriptors, in the order of decreasing importance)
	The following is unclear to me (list up to 3 most important, specific areas, in the order of decreasing importance)
2	I would describe the current team activities as (list up to 3 most important descriptors, in the order of decreasing importance)
	The following is unclear to me (list up to 3 most important, specific areas, in the order of decreasing importance)
3	I would describe the decisions just made by the team as (list up to 3 most important decisions, in the order of decreasing importance)
	The following is unclear to me (list up to 3 most important, specific areas, in the order of decreasing importance)
4	The team at the moment should consider the following differential diagnoses (list up to 5 most important differential diagnoses, in the order of decreasing importance)
	The following is unclear to me (list up to 3 most important, specific areas, in the order of decreasing importance)
5	I am anticipating the following immediate patient problems (list up to 3 most important, specific problems, in the order of decreasing importance)
6	List, in priority order, three most important objectives of the team and the instructions you would give to achieve the objectives.
7	List, in priority order, three decisions that the team could be making next.
8	List, in priority order, three most important pieces of information you would like to obtain, and the reasons why you need them.
9	Please rate your responses to the following statements on the five-point scale: • I am comfortable to giving instructions to the team. • Given the opportunity, I would obtain more information. • I know the tasks being carried out by the team.

Table 1.1. Questions in the questionnaire used in the experiment to measure the subjects' understanding of remote events and activities.

Case	Stop Points	Time	Scoring Items
Case 1	SP 1	1'13"	Detected the acute hemorrhage Anticipated "MAST[a] off" event Detected the slow progress of the surgeons
	SP 2	3'13"	Detected "MAST off" event Detected the urgent need for rapid infusion
	SP 3	5'03"	Detected ACP[b]'s effort in establishing IV accesses
Case 2	SP 1	1'18"	Detected the pressure on ACP to intubate Detected the lack of IV[c] access and obstacles to intubation
	SP 2	2'10"	Detected nasal intubation and IM[d] injection in the tongue Anticipated possible patient vomiting
	SP 3	3'26"	Recognized IV established
	SP 4	5'21"	Detected the delay in achieving patient muscle relaxation Put forward differential diagnoses for the delay
Case 3	SP 1	3'16"	Identified cues for missed intubation Identified cues for confirming correct ETT[e] position
	SP 2	4'32"	Detected the lack of positive ETT position confirmation Put forward differential diagnoses for the lack of positive ETT position confirmation
	SP 3	6'26"	Detected the need to remove ETT
Case 4	SP 1	0'38"	Detected the need for IV bolus
	SP 2	4'28"	Detected the increasing, very high BP[f] Detected the need for intervention
	SP 3	8'05"	Detected the decreasing, very low BP Detected the need for intervention

Table 1.2. Items used for scoring questionnaires at stop points (SP 1-4) for the four case segments (case 1-4). a: MAST = military anti-shock trousers; b: ACP = anesthesia care providers; c: IV = intravenous; d: IM = intramuscular; e: ETT = endo-tracheal tube; f: BP = blood pressure.

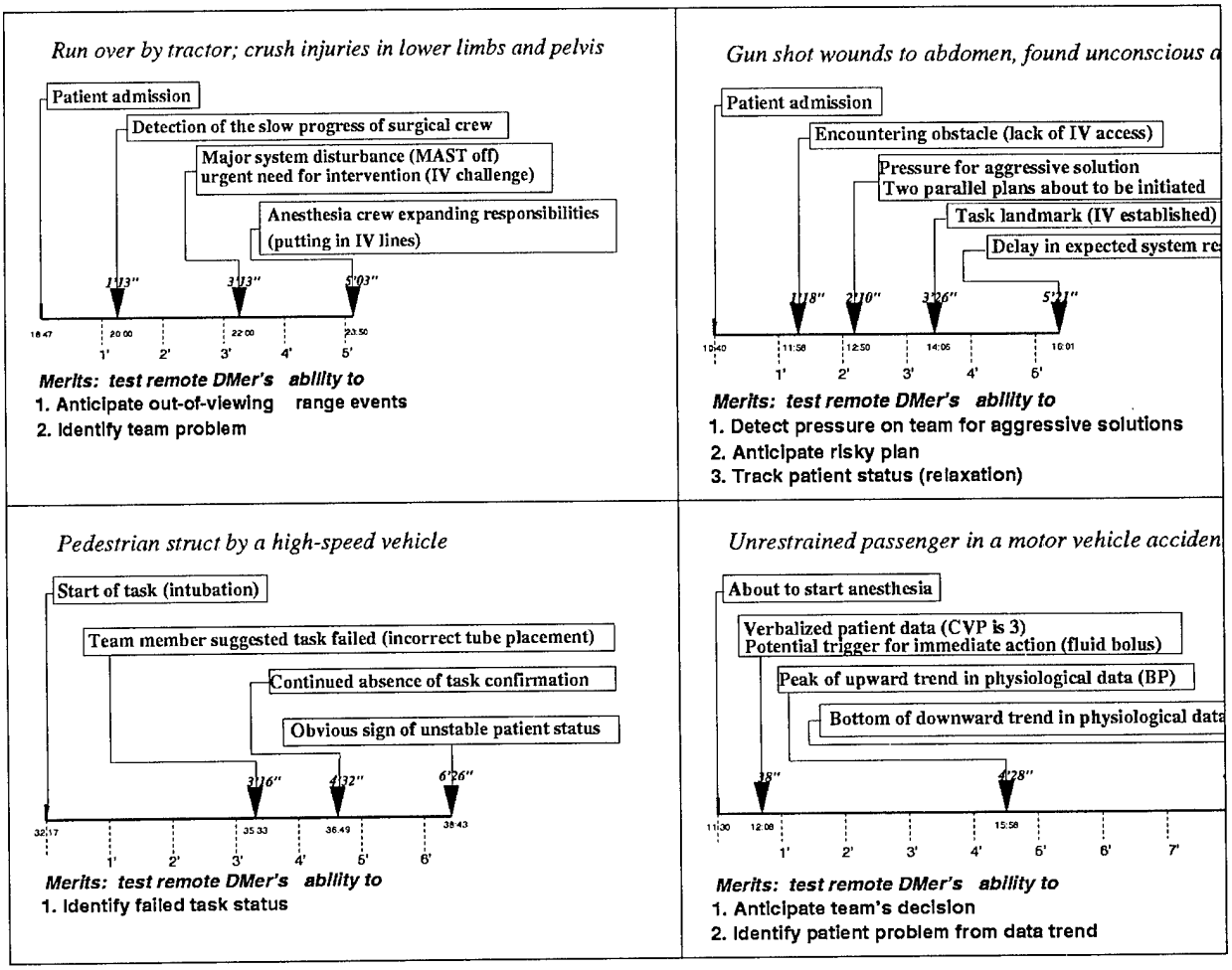


Table 1.3 Overview of the four cases selected in the experiments (top row: case 1 and case 2; bottom row: case 3 and case 4).

1.6 METHODS FOR EXPERIMENTS PERFORMED

Experiment 1

Three subjects went through a total of 12 experiment sessions (4 case segments each subject). An overview of these cases is shown in Table 1.3. There were four stop points when questionnaires were completed. Two subjects had one year and one 10 years of Shock Trauma experience. This experiment was designed to address what cues were detected and missed by experienced subjects.

Experiment 2

Four trauma nurses, four trauma anesthesiologists and four trauma surgeons participated in this experiment to assess the effect of experience background on remote diagnosis. This experiment followed up a hypothesis that was generated from experiment 1 as the reason why cues were missed.

The stop point questionnaire asked SMEs to describe current patient status, current team activities, anticipated patient status and anticipated team objectives. Written or audio recorded responses were used and answers divided into: airway, breathing, circulation, patient status and injuries, team activities, other.

Experiment 3

Twelve subjects, four attending trauma anesthesiologists, three attending trauma surgeons, three experienced trauma nurses and two medically naïve graduate students (control) participated in this experiment. An eye tracker was worn by the subjects to evaluate video as a medium to convey information; to assess domain expert visual scanning patterns during remote diagnosis and to compare information gathering from the same scenarios viewed by anesthesiologists, surgeons and nurses. Two measures of visual scanning patterns were analyzed: fixation and dwell. A fixation was described as a cessation of eye movement; a dwell as a consecutive sequence of fixations within a given area of interest. The dwell time (start of first fixation to end of last) was taken as an indication of how focused the subjects were on a particular area of interest of the videotaped scenarios.

Experiment 4

In this experiment, we assessed team coordination and breakdowns to examine how a remote decision-maker could collaborate as an important member of the distributed trauma resuscitation team. The first part of the experiment examined how the trauma team coordinated and when coordination breakdowns occurred. The second part of the study examined uncertainty in resuscitation and team communication. This experiment was driven by the fundamental question of how it was possible for the trauma team to function so smoothly most of the time with so little apparent effort spent on coordination. Three types of critical incidents were included in the stimulus material. These were decision points, high workload periods, and apparent problems in team coordination. The qualitative data were reported in two areas. First, task coordination or the distribution and delegation of tasks and information flow and second; the passage of information regarding patient status and contingency plans.

Experiment 5

This experiment was conducted to determine the impact of uncertainty on team performance. Using previous reviews of the stimulus material videotapes from those present during the real patient management and commentary provided by SMEs not involved as participants in this experiment, we categorized uncertainties in the case segments as follows: mechanism and extent of injury, patients prior medical history, working status of patient monitors, the effect of treatment, availability of team members, task distribution among team members, intentions of team members, availability of resources (e.g., operating room, radiology), what occurred during transport and the status of the patient during field management.

1.7 FINDINGS OF EXPERIMENTS

Experiment 1 investigated what cues were detected and what was missed by remotely situated expert decision-makers.

The results showed that missed cues occurred for several reasons, including degradation of verbalizations and verbal communications because of background noise interference (as in Donchin et al, 1999); viewing range for the remotely situated subject was restricted with a fixed camera location; visual access from this fixed location was not secure because care providers moved in and out of the camera line of sight and sometimes obstructed the view at critical moments when the cue was presented; typical video imagery used, showed the activities of 3-5 crew members of the trauma team working on patient resuscitation and such multiple actions, appeared to overwhelm the remotely situated expert decision-makers causing visual information overload.

Some clues were not picked up by all remote decision makers. Difficulties in recognizing these cues included: lack of an adequate dynamic mental model of patient status because they had not participated in patient care and were therefore cognitively "out-of-the loop" in regard to their information seeking (Endsley and Kins, 1995); there was lack of context information in comparison to the on-site providers. It was not as obvious to the remotely situated person what other team members were doing or how to extrapolate their intentions; because not all concurrent activities could be simultaneously followed.

Experiment 2 addressed the question: What is the effect of the remote decision-makers experience background on the capability to extract information from these audio/video sources?

Nurses, surgeons and anesthesiologists understanding of the identical audio/video material was compared by responses to questions about the current patient status, team activities, future patient status and team objectives. The analysis of nurses, surgeons and anesthesiologists responses compared performance of correct answers against an ideal understanding of the cases and content of the answers categorized into airway, breathing circulation, patient status and injuries, team activities and other.

The performance analysis showed that anesthesiologists performed better than the other two groups. Performance scoring items that presented difficulties included detection of conflicting plans, and anticipation of nursing plans. Surgeons and nurses did poorly in determining task status of placement of a breathing tube, traditionally the responsibility of the anesthesiologists.

Content analysis showed that the distribution of answers across the six categories (above) among all three groups of subjects was similar. The surgeons provided more general comments; the anesthesiologist subjects used a higher proportion of phrases describing airway related issues whereas the nurses were consistently more focused on teamwork.

All subjects experienced, at one time or another, similar difficulties to those in Experiment 1. An explanation for why anesthesiology subjects out performed the nurses and surgeons is that the videotapes selected for this experiment all contained the activities of airway management, a role performed by anesthesiologists on the trauma team. The traditional divisions of labor within the trauma team may have constrained the nurses and surgeons and prevented them from detecting critical cues. The nurses performed better than surgeons, this may have been motivational. The surgeons may have used different types of descriptions than nurses, but in general, surgeons provided fewer written and verbal responses than nurses or anesthesiologists.

These results suggest that experts with different experience backgrounds may appreciate different aspects of events and activities presented in audio/video sources.

Experiment 3 used an eye-tracking device to determine visual scanning patterns of domain expert observers.

Information extracted from video was identified by use of the eye tracker. Nurses, surgeons, anesthesiologists and medically naïve undergraduates (control group) participated. They provided verbal comments and answered questions about the current patient status and team activities and future patient status and team objectives, as in Experiment 2, while wearing the eye-tracking device.
All subjects spent the majority of the time looking at the head and faces of the care providers on the video. The eye movements of the control group were rapid over large areas of the video in comparison to the expert subjects. Subjects with different experience backgrounds among nurses, surgeons and anesthesiologists had different visual scanning patterns. The distribution of total time spent on the area surrounding the patients' head was just over 40% and on the care providers' under 40% of the total viewing time. The nurse subjects scanned more around the patient and the anesthesiologists looked most at the airway manager. Viewing of the vital signs data occupied about 10% of the total viewing time.

The eye tracking data corroborated the hypothesis of the effect of experience background on information extraction during remote diagnosis.

Experiment 4 was conducted to understand team coordination.

As a result of understanding team coordination, a remote decision-maker might be able to identify decision points, high workload periods and problems in team coordination (Xiao et al 1996).

Videotapes were reviewed and several non-communication task coordination activities were noted including: following the protocols, following the leader, anticipation of future events, activity monitoring the task status of team members. Explicit verbal communications regarding situational assessment and future plans were relatively rare in comparison to non-verbal communication. When team members voluntarily provided their views, it occurred when the team was clearly at a decision point. There was considerable variation among team leaders in plan verbalization with some leaders providing clear intentions; while others appeared to let the events drive the team actions and the goals were inferred by these actions.

Coordination breakdowns occurred in a number of crisis situations including when: extreme difficulties or unexpected patient responses were encountered which prevented the implementation of routine procedures; the team was under pressure to seek alternative solutions; there were unexpected attempts to adopt novel solutions to acute emergency situations. These breakdown situations compromised the abilities of the supporting team members to provide assistance because of their lack of anticipation of the need. Coordination breakdown occurred when the patient was so unstable that the treatment plan had to be abandoned, such changes in plan occurred during crisis and under great time pressure, and required the team to change their process from diagnostic activities (hypothesis seeking) to action activities (hypothesis testing) rapidly.

Verbal communication was viewed as only one of many ways teams use to coordinate their activities. Other communication media include; activities, workspace, events and focus of attention of team members. In most circumstances, team coordination was achieved with a minimum of explicit verbal communication.

Experiment 5. Analysis of Uncertainty in Resuscitation Events and Team Communications.

Forty videotaped cases were reviewed from our video library that identified a wide range of sources of uncertainty. A total of 76 uncertain items were identified by examining verbal communications and subject matter expert reviews. These uncertainties were categorized as patient related uncertainty (26%), including reports provided by distributed pre-hospital team members, effect of treatment interventions and mechanism of patient injury; and team/organization related uncertainty (41%), including task distribution among team members, interaction of other team members, status of team members task accomplishment, and resource availability and schedules. Many of these factors would also probably be causes of uncertainty for the military medicine team. It seemed that lack of communication among team members and among personnel work in nursing, surgery, and anesthesiology contributes to many of the uncertainties identified. In addition, technological issues such as signal interference of patient vital sign monitors cause uncertainty in many

crisis situations because of patient factors (low blood pressure, combativeness, etc.) cause signal detection failures (Mackenzie, et al, 1996). Lastly, because of overlap in task distribution among team members, uncertainties occur about who should do what and when.

1.8 CONCLUSIONS AND RECOMMENDATIONS ON REAL-TEAM DISTRIBUTED DECISION-MAKING IN EMERGENCIES

The findings from these experiments have implications for the design of telecommunication systems in support of distributed decision-making.

Experiment 1 identified the importance of optimizing capture of communications and eradication of background noise interference.

Such objectives could be achieved by:

- Use of capture of individual care providers' communications through a microphone worn during telecommunications.
- Use of directional microphones and noise cancellation technology.

The restrictions in viewing range and insecure viewing access could be overcome by:

- Use of multiple cameras including a pan/tilt/zoom camera providing a close-up detail and multiple fields of view.
- A fixed camera providing an overview of the entire area and team activities.

The visual information overload detected by Experiments 1 and 2 could be improved by:

- Providing non-video supporting information to help remote decision-makers comprehend video images and to compensate for the lack of complete data about remote events and activities.
- Having a team of remote experts with different experience backgrounds to address concurrent tasks when remote activities are multi-disciplinary.
- Training of the remote decision-maker to appreciate tasks outside of their traditional domain specialty and division of labor in clinical practice.

The analysis from Experiment 3 revealed that:

- When situations evolve rapidly and multiple care providers are carrying out tasks, all of what is presented on video will not be perceived by the remote decision-maker.
- The cues missed by the remote decision-makers will be biased by their experience background.
- Training or cueing teleconsultants to systematically scan video sources may overcome such difficulties.

Experiment 4 concluded that non-verbal communication was an important implicit form of team coordination.

- The shared event space is an important media for non-verbal communication and the design of the workplace should not interfere with this.

Experiment 5 identified a wide range of sources of uncertainty during trauma patient resuscitation. Uncertainty may be improved by:

- Better intra-team communication (e.g. communication protocols at key points, checklists, etc.).
- Verbalization of explicit intentions and plans to all team members.
- Enhanced patient vital sign monitor technology to minimize signal detection interference.
    - Detailed understanding of the cognitive activities involved in the medical domain is necessary for the best use of telecommunications technology in healthcare.

Allely EB. Synchronous and asynchronous telemedicine. *J Med Systems*, 19:207-212, 1995.

Donchin Y, Gopher D, Olin M, Badihi Y, Biesky M, Sprung CL, Pizov R, and Cotev S. A look into the nature and causes of human errors in the intensive care unit. *Crit Care Med*, 23:294-300, 1995.

Endsley MR, and Kins EO. The out-of-the-loop performance problem and level of control. *Human Factors*, 37:381-394, 1995.

Finn KE, Sellen AJ, Wilbur SB (1997). Video-Mediated Communication. Mahwah, NJ: Lawrence Erlbaum Associates.

Kanki BG, Folk VG and Irwin CM. Communication Variations and Aircrew Performance International *J Aviation Psychology* 1:149-162, 1991.

Mackenzie CF, Jefferies MJ, Hunter WA, Bernhard WN, Xiao Y and The LOTAS Group (1996a) Comparing of Self-Reporting of Deficiencies in Airway Management with Video Analysis of Actual Performance. *Human Factors* 38:623-635.

Mackenzie CF, Hu PF, Horst RL, and the LOTAS Group. An audio-video acquisition system for automated remote monitoring in the clinical environment. *J Clin Monitoring*, 11:335-341, 1995.

Mackenzie CF, Jaberi M, Dutton R, Hu PF, Xiao Y. Overview of simulation in comparison with telementoring for decision-making. *Am J Anes* 27: 186-194, 2000.

National Research Council. (1990). Distributed Decision-Making. Washington, DC: National Academy Press.

Orasanu J (1990). Shared mental models and crew decision-making. Tech. Rept. 46. Cognitive Science Laboratory, Princeton University, Princeton, NJ.

Orasanu J, and Salas E (1993). Team decision making in complex environments. In: Klein G.A, Orasanu J, Calderwood R, and Zsambok CE (Eds.), Decision-Making in Action: Models and Methods. Norwood, NJ: Ablex.

Rasmussen J, Brehmer B, and Leplat, J (Eds.). (1991). Distributed Decision Making: Cognitive Models for Cooperative Work. Chichester: Wiley.

Segal LD (1994). Actions speak louder than words: How pilots use nonverbal information for crew communications. In: Proceedings of the Human Factors and Ergonomics Society 38th Annual Meeting, 21-25.

Serfaty D, Entin EE, and Volpe C (1993). Adaptation to stress in team decision-making and coordination. In: Proc Human Factors and Ergnomics Society 37th Annual meeting. 1228-232.

Teich JM, Wagner MM, Mackenzie CF, Schafer KO. The Informatics Response in Disaster, Terrorism, and War. *J Am Med Informatics Assoc* 9:97-1104, 2002.

U.S. Congress, Office of Technology Assessment. (1995). Bringing Health Care Online: The Role of Information Technologies (OTA-ITC-624). Washington, DC: U.S. Government Printing Office.

Volpe CE, Cannon-Bowers JA, Salas E and Spector PE. The impact of cross training on team functioning: an empirical investigation. *Human Factors.* 38:87-100, 1996.

Xiao Y, Hunter A., Mackenzie CF, Jefferies N, Horst R and the LOTAS Group. (1996). Task complexity in emergency medical care and its implications or team coordination. *Human Factors*, 38:636-645.

Xiao Y, Mackenzie CF, and Spencer R (1997b). The effect of experience background on remote diagnosis. In: Proceedings of Human Factors and Ergonomics Society 41st Annual Meeting, 254-258. Santa Monica, CA: Human Factors and Ergonomics Society.

Xiao Y, Mackenzie CF, and the LOTAS Group. (1995). Decision making in dynamic environments: Fixation errors and their causes. In: Proceedings of Human Factors and Ergonomics Society 39th Annual Meeting, 469-473.

Xiao Y, Mackenzie CF, Orasanu J, Spencer R, Rahman A, Gunawardane V and the LOTAS Group Information acquisition from audio-video data sources: An experimental study on remote diagnoses. *Telemedicine J,* 5:139-155, 1999.

Xiao Y, Mackenzie CF, Orasanu J, Spencer R, Gunawardane V, & The LOTAS Group (1998a). Visual scanning patterns during remote diagnosis. Proceedings of Human Factors and Ergonomics 42nd Annual Meeting, pp. 272-276.

Xiao Y, Mackenzie CF, Patey R, & LOTAS Group (1998b). Team coordination and breakdowns in a real-life stressful environment. Proceedings of Human Factors and Ergonomics 42nd Annual Meeting, pp. 186-190.

Xiao Y and Mackenzie CF. Uncertainty in trauma patient resuscitation (1997a). Proceedings of the Trauma Factors and Ergonomics Society 41st Annual Meeting, 168-171. Santa Monica, CA. Human Factors and Ergonomics Society.

Appendix N

Impact of Telehealth on Progression of Renal Disease in Diabetics with Native Hawaiian Ancestry

Nancy Johnson, MSN, APRN, Rita Webb, MSN, APRN, Steve Moser, Rosanne Harrigan, EdD, APRN-Rx, FA
Partial funding from HMSA Foundation and Hui No Ke Ola Pono

Introduction

Implementing a diabetes monitoring and management delivery system that reaches a large rural population and results in behavior change is a significant challenge. Telehealth strategies including e-health care may provide access to the individual patient, and as importantly, the patient's family and support system in their home environment.

Specific Aims

This qualitative and quantitative clinical study sought to identify impact of telehealth (E-health) on the progression of renal disease in diabetics with Native Hawaiian ancestry.

Research Question

Will telehome care visits with structured educational protocols have a significant impact on progression of renal disease in Type II Native Hawaiian diabetics?

Background and Significance

Rapid increases in the aging population, 34 million today and projected to increase to 70 million by 2030 (1) suggests a significant increase in the demand for services to those with chronic illness. The percent of population over 65 will increase from 12.4% in 2000 to 20% by 2030. In addition, minority populations will increase from 16.4% to 25.4% with the largest increase (285%) occurring in Asians and Pacific Islanders. (1)

The Hawaii Department of Health reports chronic diseases in Hawaii to be at or below the national average for the total population. However, the incidence of diabetes is significantly higher for those with Filipino and Pacific Islander ancestry (2). The cardiovascular and renal complications of diabetes significantly increase the incidence of chronic disease in Hawaii. (2)

The incidence and prevalence of chronic disease in the elderly, and studies that document ability of elders to remain in their homes with adequate support suggest that tools such as Ehealth care need to be explored to manage disease, promote health, and reduce health care costs for this population. Ehealth is the delivery of health care using the internet. Ehealth is one type of telehealth. Although there is extensive literature on telehealth and its applications, there is limited research documenting clinical outcomes associated with this intervention. The data based research related to telehome care, the most commonly used term for delivery of care in the home using telehealth technology, is summarized below in relationship to the major themes addressed: cost, satisfaction, and outcomes.

Cost: The literature indicates cost savings associated with the implementation of telehome care both in elder and maternal child populations (3, 4). Cost comparisons with traditional care for outpatient services for patients with chronic diseases did not vary significantly. However, this investigation took place over 1 ½ years and included equipment costs that could have amortized over a longer period of time, resulting in a significant cost savings for the telehome group. Hospital costs for the telehome

group were less ($1,087 vs $1,940) (5). Cost comparisons on telehome care provision for mothers with preterm labor documented significant cost savings ($14, 459) per pregnancy (4).

Satisfaction: Patient satisfaction and nurse satisfaction were consistently high (6, 7, 8). Although one investigation documented initial provider resistance to telehome care the intensity of the resistance improved over the duration of the investigation (5).

Outcome

No outcome data were specifically reported in a number of investigations. However, Morrison's study regarding management of preterm labor using telehome methodology clearly documented reduced numbers of infants admitted to the NICU. It should be noted that significant differences were found between study groups in this trial for marital status and race. It is possible that these differences rather than group assignment could have explained differences in outcome. The analysis did not reveal any negative clinical outcomes.

Clearly a need exists to further evaluate the efficacy of Ehealth interventions to reduce health disparities related to diabetes in Native Hawaiian and Asian Pacific Island peoples. Sample sized for the few investigations that exist are relatively small. Many investigations are retrospective in design and measurements of clinical outcomes are inconsistent. Data reported in the published literature are inconsistent. At this time no clear evidence base for Ehealth practice related to care of any clinical population including diabetes. However the possibility this methodology could improve health outcomes especially for those with chronic disease is high.

Diabetes

Comprehensive data on Type II diabetes mellitus for Pacific Islanders are sparse, although the prevalence rate for pure Hawaiians is nearly 50 per thousand, which is twice the rate of white residents of Hawai'i (10, 11). The Behavioral Risk Factor Surveillance System reports a rate of 52 per thousand of all adults in Hawai?i ever having been told they have diabetes, a number which is twice as high as the Healthy People 2000 goal (12). Further data shows that native Hawaiians die of diabetes at a rate of 117 per 100,000 compared to the average rate of 53 per 100,000 for other ethnic groups (13).

Although the overall rate of Type 1 diabetes in children is 1.16 per 1000 (14), diabetes shows higher rates in some ethnic groups in Hawai'i than in others. The rate for Type 1 diabetes in part-Hawaiian children is 2.5 times as high as white children and ten times higher than the rate for Japanese children in the same environment (15). Despite these alarming discrepancies, emphasis on Type 1 diabetes is overshadowed by the rapidly increasing rates of Type 2 diabetes in Pacific Islander populations in Hawai'i. Indeed, the age-adjusted prevalence rates for Type 2 diabetes in Hawaiian Polynesians are among the highest reported for any Polynesian or part-Polynesian population in the world (14). Furthermore, mixed Hawaiian ancestry has not been shown to diminish the risk of Type 2 diabetes, unlike in other Native American populations. This discrepancy may be due to inaccurate ethnic self-reporting or to the mixed ancestry including other ethnic groups also known to have high rates of Type 2 diabetes (14). An increasingly Westernized and sedentary lifestyle is correlated with the increasing prevalence of diabetes in other populations and may be a factor in the high diabetes rates in native Hawaiian populations. A study comparing Japanese-American men who maintained either traditional Japanese or a modern American lifestyle demonstrated the influence of a Western lifestyle on diabetes risk.

Japanese-American men who maintained a more Japanese lifestyle had lower rates of diabetes than those Japanese-American men who were more acculturated to a Western lifestyle (15). Other literature further suggests that traditional cultural beliefs about the caretaking of ill family members and the concept of the spiritual unity of a person with the environment may prevent individuals from taking preventive measures and/or from seeking conventional medical care (16).

Further research on diabetes in other ethnic groups in Hawai'i is also needed. Available data suggests higher rates of diabetes for ethnic groups in Hawai'i than for their counterparts in their native countries, which is perhaps attributable to the more Western lifestyle available here. Furthermore, while data from specific ethnic groups living on the mainland USA may be extrapolated to the same groups living in Hawai'i, the unique location and cultural influences of Hawai'i makes applying statistics from elsewhere to Hawaiian ethnic groups potentially inaccurate and misleading.

Diabetes Mellitus (DM) is chronic illness and there is no cure, only adherence to diet, exercise, and medication can modulate the impact of diabetes. An association exists between DM and kidney failure (ESRD: end stage renal disease), coronary heart disease (CAD), cerebral vascular disease (CVD), hypertension (HTN), loss of visual acuity or blindness, lower leg amputations, and neuropathy (17).

About 17 million people in the United States have DM, (35% of these individuals are currently undiagnosed (18). Approximately 2,739 new cases of diabetes are diagnosed every day in the United States (18),.

The Hawaii Department of Health provides the following Diabetes Facts:

- An estimated 80,000 people in Hawaii knowingly and unknowingly have diabetes (12, 19).
- Prevalence of diabetes varies markedly among ethnic groups - Hawaiian (63 per 1,000), Filipino (61 per 1000), and Chinese (60 per 1,000) (19).
- Mortality rates for Hawaiians are more than two times as high as the rate for Caucasians, Chinese, Filipinos, and Japanese (117.1 per 100.000 for Hawaiians vs. about 50.2 per 100, 000 for the other four major ethnic groups) (13).
- 50% of the people with kidney failure in Hawaii have diabetes.
- The rate of newly diagnosed ESRD cases in Hawaii in 1994 was more than three times higher than the national average (20).

According to the CDC, the direct (medical care) and indirect (lost productivity costs of diabetes in Hawaii was $613,000,000 in 1993 (21). Individuals with DM are at high risk for many complications, which are gradual, insidious and may be irreversible. An example is diabetic end-stage renal disease (ESRD). Once symptoms of ESRD present the individual has kidney failure. It is only a matter of time until hemodialysis is required to sustain life.

Through stringent self-monitoring blood glucose (SMBG), blood pressure (BP), and adherence to diet, exercise, and medications diabetic ESRD and other complications can be minimized. A 10-year study conducted by the American Diabetes Association (ADA) on Type I diabetics, entitled Diabetes Comprehensive Control Trial (DCCT) study found that DM complications can be stabilized or reversed with tight daily glycemic control within normal range (17). These recommendations were

incorporated into the Hawaii State Practice Recommendations for Diabetes Mellitus. These recommendations were used to guide the Advanced Practice Nursing protocols developed for this investigation.

Locus of Control

Health behavior is thought to be a function of belief about the degree of control on believes they have over life events. Three components of control are proposed internal, powerful others and chance. Wallston suggests that health locus of control is useful for predicting some health behaviors but not others(22). The Wallston et al (1976) scale has been previously used in diabetic populations and measures the conceptual construct of locus of control used in this investigation (22). Numerous investigations have reported on the psychometric reliability and validity of this tool. (22)

Design and Methods

This qualitative and quantitative clinical trial monitored the progression of renal disease in two groups of diabetics of Hawaiian ancestry. The experimental group received telehealth (Ehealth) visits 2 times per week, in addition to usual care by their physician. The control group received usual care by their private physician. No attempt will be made to control "usual care".

Sample

Letters were sent to private physicians and community groups inviting referrals into the project. These physicians and groups were provided screening questionnaire sheets and consent forms. Potential participants were identified. Patients were randomly assigned to groups by pulling numbers out of hat.

Procedures

Written evidenced-based advanced practice nursing protocols were developed including monitoring, education, counseling, support, and referral components. The focus of the interventions was on lifestyle modification resulting in healthy adaptation reflected by decreased progression of diabetic disease. The protocols are available from the Principle Investigator. Three advanced practice nurses (APN's) participated in developed the protocols based on published evidence to assure face validity. Reliability was assured because only these 3 APN's provided care using Ehealth methods. Validity was further affirmed by having the protocols reviewed by a nephrologist. The telehome visits included a diabetic education protocol that focused on patient and family education, support, medication management, and monitoring.

An Internet website was created for the project. The site included pictures of project staff, diabetes information, instructions on use of glucometer, icons for obtaining diabetic information on the Internet, and use of email.

Subjects in the experimental group attended an orientation, and established appointments for computer installation. All participants in this group were given a computer, glucometer and blood pressure cuff.

The experimental group received telehealth visits 1-2 times per week, in addition, to usual care by their physician. An APRN conducted telehealth "Ehome" visits via video conferencing using an

Internet connection. Telehealth visits were funded through a grant from a Hawaii Medical Services Foundation.

Equipment

E-Health visits were conducted using NEC 466 Cache Pentium PC computers with 64 Mb memory and modem connection to the internet. Intel Cameras and NET Meeting software allowed videoconferencing. Computer technology students provided technical support. The technical support team made telephone, videoconferencing and home visits.

Measures

Physiologic, experiential and behavioral variables were measured to assess the dependent variable progression of the disease. Physiologic data including: urine microalbumin (reported as ratio of microalbinuria/urine creatinine--specific for the progression of renal disease), blood glucose, weight, and blood pressure were collected. Standard laboratory analysis were used to measure urine microalbumin, downloadable Lifescan glucometers were used to measure blood glucose. Weight and blood pressure were self-reported following the orientation program and demonstration of reliability. Experiential data included qualitative assessment (questionnaire) of computer competence, satisfaction, ability to use diabetic Internet resources and an locus of control (Wallston, 1976). Demographic data, lifestyle (questionnaire), and beliefs (questionnaire) toward health care data was collected at the onset and at the conclusion of the study.

Results

Demographic

The initial control group included 34 individuals 53% were male. At the conclusion of the study, researchers were able to locate and obtain data for ten of the control subjects.
The experimental group included 30 individuals 50% of the subjects were male. Twenty-one of the experimental subjects participated in the project for the entire year for a 70% retention rate. Seventy-five percent of the subjects did not have a computer or Internet access prior to the study.

Microalbinuria/creatinine Ratio

Changes in albumin/creatinine ratio are reflected in Tables 1 and 2. Improvement was demonstrated in 48% of the experimental group and 25% of the control group. More importantly, 52% of the experimental and 75% of the control group demonstrated progression of renal disease. The average change in ratio was -110% in the experimental group and –870% in the control group. The microalbinurai/creatinine ratio increased more rapidly in the control group, indicating more rapid progression of renal disease in the control group. Four of the experimental subjects had less that 3 mg//l. No ratio could be calculated. These four subjects demonstrated improved renal function.

Table 1 Microalbinuria/Creatinine Ratio Experimental Group

	Study Onset			Post Study			
Subject	Microalbinuria	Creatinine	Ratio	Microalbinuria	Creatinine	Ratio	% Change
1	6.3	110.9	5.7	5.1	65.7	7.8	-37
2	49.3	54	91.3	154.9	131.9	117.4	-29
3	13.2	183	72	150.8	100.7	149.8	-108
4	15.7	87.4	18	<3*			
5	4.6	78.3	5.9	4.2	91.1	4.6	22
6	26.5	166.4	15.4	83.5	138.9	59.9	-289
7	29	151.6	19.1	3.9	180.7	22	-15
8	12.6	97.5	12.9	29.2	167.8	17.4	-36
9	23.3	46.9	49.7	23.2	114.1	20.4	59
10	4	97.2	4.1	5.6	115.7	4.8	-40
11	9.6	83.4	11.5	60.3	127.2	47.4	-523
12	4.6	67.5	6.8	6.4	77.9	8.2	-33
13	4.3	110.8	39.9	<3*			
14	3.3	132	25	<3*			
15	36.2	51.1	70.8	14.9	79.1	18.8	73
16	4.7	112	4.2	<3*			
17	9.2	66.6	13.8	41	157.5	26.1	-89
18	11.2	100.3	11.2	7.5	167.8	4.5	60
19	34.7	73	47.5	4	24.1	16.6	65
20	460.7	60.1	766.6	878.5	81.2	1081.9	-41
21	500	87	6	4.3	139.1	3.1	48

- Urine Albumin <3mg/l Unable to calculate Ur Alb/Cre Ratio

Table 2 Microalbinuria/Creatinine Ratios Control Group

	Study Onset			Post Study			
Subject	Microalbinuria	Creatinine	Ratio	Microalbinuria	Creatinine	Ratio	% Change
1	11.6	180.5	6.4	28.6	165	17.3	-49
2	309.1	38.4	1039.3	875	29	3017	-876
3	49.6	17	29.1	17.1	134	12.7	74
4	23.1	170.2	13.6	28.1	125.7	22.4	3
5	23.6	36.5	64.7	31.9	67.3	47.4	-101
6	5.9	25.2	23.4	22.7	73	31.1	-427
7	7.1	26.2	27.1	89.9	162	55	-675
8	9.9	127.2	7.8	1022.4	155.2	658.8	-6546
9	119.4	87.9	135.8	90	146	61.6	48
10	275	170.4	352.3	6.7	169.9	346.6	-26

Locus of Control

Table 3 reflects the average scores for the locus of control measures pre and post telehealth intervention. Eighteen of the 21 experimental subjected completed Locus of Control questionnaires before and after the project.

Table 3 Health Locus of Control

	Before	After
Internal	361	354
Chance	249	277
Powerful Others	304	311

*t=-0.238 Probability of this result assuming the null hypothesis is 0.8

Satisfaction

All experimental subjects reported that the nurse involved them in their plan of care and 93% shared information gained during the project with family and friends. All subjects answered "no" to the question, "Did you feel that this care delivery system invaded your privacy?" Ninety-three percent indicated they would recommend this program to other diabetics, 66% indicated they wanted to continue in the program in the future.

Technical support was important to the success of the program. Most subject utilized technical support for questions and assistance, 86% indicated they were able to obtain technical support they needed and 93% indicated their questions were answered adequately.

Conclusion

Telehealth, in the form of e-health videoconferencing visits was well accepted by a population of patients who had little prior computer experience. Diabetic subjects who participated in the structured telehealth educational protocols demonstrated slower progression of renal disease (measured by ratio of microalbinuria/creatinine) than did the control group. Effectiveness of nursing telehealth strategies in supporting patient management of chronic diseases can be validated with further randomized controlled studies.

References

1. Administration on Aging, Future Growth, Available at: http://www.aoa.dhhs.gov
2. Hawaii Department of Health Diabetes Facts. Available at: *http://www.hawaii.gov/health/resource/diabetes/hp-dcbur.html*
3. Dimmick, Susan et.al. A case study of benefits & potential savings in rural home telemedicine. Home Healthcare Nurse 2000;18(2): 125-135.
4. Morrison J et al. Telemedicine: cost-effective management of high-risk pregnancy. Managed Care 2001; 10 (11): 42-6, 48-9.
5. Johnston, B. Outcomes of Kaiser Permanente tele-home research project. Archives of Family Medicine 2000; 9(1): 40-5.
6. Allen, A Home health visits using a cable TV network: User satisfaction. Journal of Telemedicine & Telecare 1996;2(Suppl1): S1:92-94.
7. Shaul, M. What you should know before embarking on telehome health lessons learned from a pilot study. Home Healthcare Nursing 2000; 18(7): 470-5.
8. Rooney, E. A model for nurse case-managed home care using televideo. Journal American Geriatric Society 1997; 45(12): 1532-3.
9. Naylor, M., Brooten, D., Campbell, R, et al. Comprehensive discharge planning and home follow-up of hospitalized elders. JAMA. 1999;281(7):613-620.
9. Grandinetti A., Chang H, Mau M, et al. Prevalence of glucose intolerance among native Hawaiians in two rural communities. Diabetes Care. 1998;21(4):549-554.
10. Hawaiians. Public Health Rep. 1996;111(2):53-55.
11. Adult Diabetes in Hawaii: A Surveillance Report, Hawaii State Diabetes Control Program. Hawaii Department of Health. January 2000. Honolulu, Hawaii.
12. Maskarinec, G. Diabetes in Hawai'i: Estimating prevalence from insurance claims data. Am Public Health. 1997;87(10):1717-1720
13. Department of Business, Economic Development and Tourism. Hawai'i Data Book 1996. Honolulu, HI.
14. Patrick S, Kadohiro J, Waxman S, et al. IDDM incidence in a multiracial population: The Hawai'i IDDM registry.
Diabetes Care. 1997;20(6):983-987
15. Huang B, Rodriguez B, Burchfiel C, Chyou P,Curb J, and Yano K. Acculturation and prevalence of diabetes among Japanese-American men in Hawai'i. Am J Epidemiol. 1996; 144(7):674-681
16. Wang C, Abbott L, Goodbody A, Hui W, Rausch C. Development of a community-based diabetes management program for Pacific Islanders. The Diabetes Educator. 1999;25(5):738 746.
17. The Diabetes Control and Complications Trail Research Group: The effect of intensive treatment of diabetes on the development and progression of long-term complications in Insulin-dependent diabetes mellitus. N Engl J Med 1993; 329(14): 977-986.
18. National Diabetes Fact Sheet. Available at: *http://www..cdc.gov/diabetes/pubs/estimates.htm.*
19. Hawaii Diabetes Data Network: Final Report, Pacific Health Research Institute. January 1998. Honolulu, Hawaii.
20. Transpacific Renal Network, Annual Report, 1994. ESRD Network #17.
21. Economic Consequences of Diabetes Mellitus in the U.S. in 1997. American Diabetes Association. Diabetes Care 1998, 21(2): 296-306.

22. Wallston BS et.al. The development and validation of the health related locus of control (HLC) scale. Journal of Consulting and Clinical Psychology 1976; 44: 580-585.

Appendix P

THE REMOTE CONSULTATION OF TELEMEDICINE

ORGANIZATIONAL CONSEQUENCES AND VIABILITY

I H Monrad Aas
The Work Research Institute,
PO Box 6954, St. Olavs plass,
0130 Oslo, Norway

(Phone: 47 23369200; fax: 47 22568918; email: maa@afi-wri.no)

Abstract
The remote consultation of telemedicine has actuality in a number of the disciplines of medicine. In the future the necessary technology will be available everywhere. It is important to know how well the remote consultation functions. Empirical studies have demonstrated no major co-operation problems, the production process works well, the job situation problems can be tackled, and learning is a clear effect of telemedicine work. The remote consultation can be classified as viable and there is little reason to refrain from its use. If the many other applications of telemedicine will be equally rich in organisational consequences as the remote consultation the effects on health service organisation may become large.

Introduction

Telemedicine may be defined as the use of telecommunications in health care. The new development in telecommunications has given a new form of consultation: the remote consultation. In the remote consultation images and sound are transmitted live. A common application for the technology is to consult specialists. This may occur for example between primary care and hospitals, home health care and hospitals, nursing homes and hospitals, local hospitals and university hospitals, and ships at sea and hospitals. The remote consultations have actuality in a number of disciplines, like dermatology, psychiatry, otolaryngology, surgery (for example guidance during surgery), gastroenterology (endoscopic examination), ophthalmology, geriatrics, acute medicine, and rehabilitation. In the last decade telemedicine has been in its early stages of development, but in the future the technology will be available everywhere, either as mobile technology or fixed installations. The volume of use may become much higher than today. The question of how well remote consultations function becomes important. In Norway the interest for telemedicine is great and several applications are in use. This makes it possible to analyse the remote consultation. The present analysis is based upon seven empirical studies of four applications of telemedicine published in international journals (Aas 2000; 2001a;b; 2002a;b;c; 2003).The applications of teledermatology, telepsychiatry, remote frozen-section pathology, and teleotolaryngology represent quite different remote consultations.

Co-operation

When co-operation occurs via telecommunication this represents a new situation for medical co-operation. Whether such co-operation works poorly or well will be important with an increasing volume of telemedicine. Co-operation may be defined as working together with

Summary

For the post-industrial society, the knowledge and information society, learning is an important activity. We speak about learning organizations and even a learning society. In health care dissemination of knowledge may be a tool for improved patient care. Working with telemedicine has been proposed to result in learning, but research on this is limited. To investigate learning in telemedicine a study was performed with qualitative interviews of 30 persons working with telepsychiatry, teledermatology, a telepathology frozen section service, and teleotolaryngology. The results clearly show that working with telemedicine gives learning. More than 80% of the respondents tell they have learnt something new by using telemedicine. They learn about the discipline in which they are involved, but also other things. All GPs told they had learnt something new, but also nurses, psychologists, other categories of personnel, and even medical specialists tell they learn. When all within psychiatry tell they learnt something new the future learning potential of telemedicine may look promising for psychiatry. Two of three cannot tell that the learning make them perform tasks they previously needed assistance for, but the answers may be dependent on type of telemedical work and educational background. The potential for learning by telemedicine is not emptied as two of three tell things can be done to promote learning further by telemedicine. Starting with telemedicine does not require more than just instructions in the start. In a future with the many possible applications of telemedicine implemented, health care organizations may become important arenas for learning and leaders will have to focus on learning.

INTRODUCTION

An essential trait of the industrial revolution was the massproduction of goods. In the post-industrial society, the knowledge and information society, this may be replaced by production of knowledge, information and services (Castells 2000). In the new society learning will become important. There is talk about learning organizations (Nikula 1999; Davies & Nutley 2000) and even a learning society (Gates 1999). The capital of organizations is not only financial, but also the human capital (Nordhaug 1993).

In health care information has already become easily available for the patients through the Internet. Many doctors have experienced patients coming to the visit with information found on the Internet (Hjortdahl et al 1999). The situation is more demanding for the doctors' competence. Remote education is already an important part of telemedicine in Norway (Vaagland 1999; Bach 1999; Aasebø et al 1998) and in other countries (Fulmer 1992; Orusild 1999; Sherwood et al 1994; Sixsmith et al. 1999; D'Souza 1999). Modern telecommunications may make learning less dependent of place and we may see *anywhere learning* (Gates 1999).

In Norway the organizations of health care are geographically very spread as the population is. This does not make the dissemination of knowledge neither easier nor less important. Dissemination of knowledge and experience may be a tool for improved patient care (Danielsen 1997). Dissemination of knowledge does not only occur as a result of programs for education, but communication in the work situation plays a role. Employees of health care may be participants of informal networks. In such networks some doctors may be especially influential and important for learning (Anderson et al. 1994). Working with telemedicine has been proposed to result in learning (Harrison et al. 1996; Jøsendal et al. 1991; Wootton et al. 2000). Such possible connection between communication technology and learning in health care is little investigated. In the present study four qualitative questions were asked to obtain information on actual learning from telemedical work, consequences of the learning, what can be done to promote learning, and how participants learnt to use the telemedical equipment.

METHODS

The present paper is a part of a larger study and material and methods have been described previously (Aas 2000; 2001a;b; 2002a;b;c; 2003). Sampling was done by first contacting a local hospital where telemedical work was done. The participants of the telemedical work gave the details of persons and organizations they had a telemedical cooperation with. These people were contacted and they provided the details of others working with telemedicine. All who were identified were contacted and asked to participate in a qualitative interview. Each of the respondents cooperated telemedically with at least one of the others in the sample. The data were collected in the period from September 1998 to April 1999. The interviews were tape-recorded and the larger investigation consists of 39hrs 20 min of recorded interviews. On the basis of transcripts all information considered to be of interest was coded and to ease the review transferred to a statistical package, i.e. SPSS (SPSS Inc., Chicago) (Qureshi 1992). Totally 960 elements of information were considered sufficiently interesting for registration.

This resulted in an SPSS file with 30 cases and 960 variables - for the present paper 67 variables were examined.

RESULTS

Two of the 32 contacted persons refused being interviewed owing to lack of time giving a response rate of 94%. The 30 respondents worked for 13 organizations (seven hospitals, four municipalities, one county-owned health centre and one private general practice) all found in the five northernmost of Norway's 19 counties. For each of the 30 respondents mapping was performed of whom they cooperated with. Totally there were 28 telemedical networks, which were different by at least one respondent, and seven telemedical networks, which were totally separate with no respondent in common. Three of the qualitative questions with a summary of responses are given in Table 1. The respondents' distribution on the four types of telemedical work and their experience with telemedicine was:

(1) 12 worked in psychiatry - three psychiatrists, one general practitioner (GP), three psychologists, four psychiatric nurses and one assistant nurse with training in psychiatry. They had worked with telemedicine for on average 3.9 years and had on average 41 such remote consultations;
(2) six worked in dermatology - three dermatologists, three GPs. They had worked with telemedicine for on average 4.2 years and had on average 638 such remote consultations;
(3) 10 worked in the frozen-section pathology service - four pathologists, three surgeons and three laboratory technicians. They had worked with telemedicine for on average 4.3 years and had on average 43 such remote consultations;
(4) two worked in otolaryngology - one otolaryngologist, one GP. They had worked with telemedicine for on average 3.5 years and had on average 450 such remote consultations.

The hypothesis of age differences in the answers was analysed. The median age of the 30 respondents was 45.5 years, Q_1 quartile=42 years (25% of the respondents have a lower age than the Q_1 value) and the Q_3 quartile = 52 years (25% have a higher age than the Q_3 value). The sample was split according to age in two ways. The answers of those above and below median age were compared. The answers for those below the Q_1 quartile and above the Q_3 quartile were compared. For both ways of splitting age differences in the answers to three of the qualitative questions were difficult to identify. For the question 'Have you started to perform tasks yourself which you previously were seeking assistance for?' age difference in the answers was suspected. Further analysis showed those who answered yes to the question to have a mean age of 44.6 years and those who answered no a mean age of 46.9 years, but this is not at statistically significant difference ($p<0.05$).

70% (n=21) of the respondents were men and 30% (n=9) women. The material was split according to sex, but sex differences in the answers to the four questions were difficult to identify.

The hypothesis of the answers to be dependent on volume of use was analysed. Median for the number of remote consultations was: telepsychiatry = 22.5, teledermatology = 525, telepathology frozen section service = 22.5. Quartiles for the number of remote consultations were: telepsychiatry Q_1=4.8 and Q3=72.5, teledermatology Q_1=169 and Q_3=1125,

telepathologic frozen-section service Q_1=20 and Q_3=65. With only two respondents in teleotolaryngology values for median and quartiles are not given. For all four types of use the sample was split in high and low volume of use. For telepsychiatry, teledermatology and telepathology the sample was split in two ways. The answers above and below median number of remote consultations were compared. The answers of those below the Q_1 quartile and above the Q_3 quartile were compared. For the different ways of splitting volume of use differences in the answers were difficult to identify.

The four qualitative questions on learning with answers

'Have you learnt anything new by using telemedicine? If yes what?'
Of the five in teledermatology who answered yes all three GPs told they had learnt more dermatology. Two said they had learnt more technology and one specialist told that: «use of two different settings makes me reflect over the methods we use».

All twelve within telepsychiatry said they had learnt something new. Seven told they had learnt more psychiatry. Each of the following was mentioned by one respondent: Learn each time (e.g. from the psychiatrist how to ask and from different angles being represented), learn from the instruction, learnt that planning is important, learnt how to behave in front of a camera, and learnt more technology. Also within psychiatry one said that use of two different settings gives reflection over methods used. Each of the following factors were mentioned by one respondent: «have learnt about cooperation with the patients, about measures concerning patients' social setting, and strengthening of self care», learnt from working in a group with other professionals, learnt from cooperating with the specialist in psychiatry, learnt from participating in remote education, and learnt from using telepsychiatry.

Within the telepathology frozen section service seven were of the opinion that they had learnt something new. Three told they had learnt about the frozen section service. Two said they had learnt more about making sections for microscopy. Each of the following answers were given by one respondent: learnt more pathology, have got a repetition of pathology, "in the start I learnt from cooperating with other professionals like engineers and sociologists", gives a basis for reflection on what we stress in diagnostic work with less information in the images, and telepathology is a new way of diagnosing although it is quite similar.

The one in teleotolaryngology who answered the question with yes said he had learnt more otolaryngology and technology.

'Have you started to perform tasks yourself which you previously were seeking assistance for?'
Within dermatology the three GPs answered they now did more themselves within the discipline. One said he now sent fewer patients to the hospital with a dermatology department.

Of the five within psychiatry who answered the question with yes each of the following factors were mentioned by one respondent: «I have got more difficult patients», «I am frequently used in other connections too», «only to be in control of the technology», and «to a certain degree, but still leaves much over to the specialist».

Within the telepathologic frozen section service one surgeon at a local hospital said they admitted fewer patients to the university hospital.

Within otolaryngology one said only to a certain degree, but that he still left much over to the specialist.

One of those who answered the question with no told: «No, but maybe I become more confident and dare to diagnose on my own».

'Can anything be done in telemedical work which promotes your own learning?'
Within dermatology two GPs answered they could learn more by extending telemedicine to include also other areas of medicine. One GP was of the opinion that other GPs who referred patients to him for teledermatology could themselves participate in the studio, and that this would have better learning effects for them. One said more is learnt about communication by working via a screen.

Within psychiatry two told more teaching should occur by telematics and two were of the opinion that they could learn more if the instruction was done by telematics. Two psychiatrists told they could have learnt more by telemedicine meetings with specialised expertise. Two were of the opinion that there was a need to summarize and describe the experiences with telemedicine. One GP who worked within telepsychiatry found he could learn more by extending the use to other medical fields. Each of the following factors were mentioned by one respondent: Bring along other therapist in the studio as observer, more frequent use leads to more learning, greater possibility for bringing in external competence, and more experience with telemedicine.

Within pathology two pathologists and one laboratory technician mentioned they could learn more with more experience. One of the laboratory technicians would have liked to visit the department of pathology more for learning. One surgeon told that if the technology had been better they could have had more remote teaching. Another surgeon wanted the pathologist to speak loud about what he saw during the telemedical sessions and that (the name of an experienced pathologist) gave a course. One of the pathologists would have liked to have telemedical discussion groups for pathologists.

'How did you learn to use the telemedical equipment?'
Nineteen told that when they were new to telemedicine they received instructions on how to use the equipment. Eight said they received no education or organized education. Eight told they had access to a technician. Three had learnt by trial and error. Only two had attended a course. Each of the following was told by one respondent: had three hours with instruction during a few afternoons, have participated in the development of the equipment, and «responsibility for the telemedicine equipment has been given to the responsible for the studio. Do not feel this to be our responsibility».

Within the telepathologic frozen section service the three laboratory technicians had been trained at a department of pathology to prepare frozen sections for telepathology, and two had also learnt by visits from the department of pathology.

DISCUSSION

For qualitative methods the situation has developed in a positive way in the last decade. Criteria for qualitative research are discussed, leading medical journals (e.g. British Medical Journal) present such methods, and an issue of Health Services Research was used on the subject(Barbour 2001; Devers et al. 1999; Mays & Pope 2000). Qualitative data may also have a quantitative dimension. The Results section shows some quantification of the qualitative data. The number of interviewees who gave the same information is given. This way of reporting gives a more accurate image of the results. The percentage figures given for three of the questions represent a summary of the findings (Bryman 1992). The sample constitutes much of the telemedical activity in Norway within the studied disciplines at the time for collection of data (Aas 2001a). The sample can be considered quite large for a qualitative study. Large samples suited for statistical analysis are impossible to obtain with the present volume of telemedicine. We also hardly have information to know which questions are relevant for inclusion in quantitative questionnaire. With the limited information about cases and what characteristics to look for, purposive sampling could not be performed (Barbour 2001). The sample can be considered a convenience sample (Dunn 1964). Technically it would have been possible to obtain a true random sample by first identifying the population of all involved in these types of telemedical activity in Norway and then choosing individuals for the sample with all members of the population having the same probability for inclusion. The experience in the project was that already after having performed 10-12 of the qualitative interviews little in principle new information could be added by performing more interviews. After having performed 15 interviews nothing was told the researcher which he had not heard before. The extension of the sample to 30 increases the possibility that the types of information found in the population, which these qualitative questions can release, are represented in the sample. The external validity of the sample is increased. When 94% said yes to a qualitative interview this can be considered a good response rate. That two persons denied participating in the investigation owing to lack of time is considered unlikely to influence the results. The author has no knowledge of the sample being biased when it comes to the results. The data are presented more or less merged for the four types of telemedical work. A completely separate presentation for the four specialities was evaluated, but the findings were not always considered to be dependent on speciality. The interviewees represent several organizations and several telemedical networks. The results cannot easily be claimed to be representative only of the situation in a few organizations and a few telemedical networks.

Many of the present users were of a quite mature age. In a study of IT it was proposed that older employees may find changes in the work situation more difficult, view implementation of IT as a threat, have problems with the understanding of functions, manuals and IT terminology (Solberg et al. 1998). Such findings may be related to a lower educational level of older employees (Solberg et al. 1998). A previous study showed increasing age to be significantly correlated with decreasing anxiety about the use of telemedicine technology (Aas 2000). In the present study age differences in the answers could not be identified, but splitting

of the sample gives small subgroups. In the present sample higher age also is associated with higher educational level (14 were specialists in medicine) and with more experience. In a study of IT it was proposed that women may find it easier to learn to use IT (Solberg 1998). In the present study no sex differences in the answers could be identified, but splitting of the material into subgroups based on sex gives small sample sizes.

The average experience with telemedicine should be enough to answer the questions. The variability in telemedicine experience in the material is not necessarily negative. Also in the future users will use the technology to different degrees. Selection of the respondents with the highest and lowest number of remote consultations could not confirm them to answer in different ways to the qualitative questions. But such splitting of those working within the four disciplines results in very small subgroups. In the future a larger volume of use may influence the answers to such questions.

The questions on learning

Learning for the rest of the life is not the product of a health care education. Renewal and further development of the knowledge are necessary. A previous study showed that joint consultations outside of telemedicine may lead to substantial educational gains for participants (Harrison et al. 1996). A disadvantage with such joint consultations is the need to travel for the joint consultation. With four of five in the present study telling they had learnt something new, the main impression is that learning does occur in telemedicine. The limited time used on teleconsultations per week is of clear educational value. Such diffusion of knowledge contributes to learning in the organizations and may improve services offered to the patients. The result may also be fewer return visits to the GP after a joint consultation between GP and specialist (Harrison et al. 1996). It is known that employees working with telemedicine may share their experiences with each other (Aas 2001a). The social capital (knowing one another) of the organizations may improve. The transfer of knowledge from one organization to another may give organizational learning creating a collective memory across organizational borders. The consequences of the learning do not need to be that they now perform tasks which they previously were seeking assistance for, but 1/3 of the respondents tell about such effects. The learning potential in telemedicine is not emptied. Two of three respondents answered yes to the question if something can be done in the telemedical work which promotes own learning.

In the future the many possible applications of telemedicine (Aas & Geitung 1998; 1999) may be implemented in one and the same health service, and distance education may play a greater role. Work organizations may become important arenas for learning and may have to focus on learning (Harman 1979). Leaders may have to develop a leadership facilitating organizational learning. Management to promote the intellectual capital of the organization may include a management of relationships between employees to promote knowledge sharing and to develop a learning organization culture and infrastructure (Snow et al. 1999; Senge et al. 1994). It has been proposed that a clearly hierarchic organization may represent a hurdle for the flow of knowledge in organizations and that this is often the case in health care (Nikula 1999; Nordhaug 1993; Stead 1998). The answer may be decentralization of functions, change in organizational structure to a less centralized form, and delegation (Aas 1997). Use of multidisciplinary teams may also promote learning (Stead 1998; Ovretveit et al. 1997).

'Have you learnt anything new by using telemedicine? If yes what?'
When 83% of the respondents tell they have learnt something new by working with telemedicine, this can be characterised as a high figure. Most frequently the respondents learn from the discipline they are involved in. They may also learn other things, e.g. about technology and cooperation. It has been proposed that remote consultations, with GPs and specialists as participants, may result in a considerable learning (Harrison et al. 1996). Questions to Scandinavian hospital leaders showed 59% to be of the opinion that telemedicine gave better education of GPs (Danneskiold-Samsoe et al. 1998). It should be noticed that all GPs of the present study told they had learnt something new. The existence of learning effects for GPs is clearly confirmed. The GPs' professional isolation may be reduced (Pedersen et al. 1994), and a decentralised development of competence promoted. The one to one relationship in the teaching situation may be important for the clear result for learning (Pedersen et al. 1994). Specialist and GP form a coach and apprentice relationship to take care of the patient. Other categories of personnel also learn, e.g. nurses and psychologists. Even the specialists may learn from telemedicine.

In the present study all GPs in teledermatology told they had learnt more dermatology. Learning by the GPs in teledermatology has also been proposed by others (Jøsendal et al. 1991). Also for the specialists the new work situation may be interesting and one of the specialists said: «use of two different settings makes me reflect over the methods we use». In psychiatry the technology may be said to represent a considerable potential for learning. The health service should consider taking advantage of this to a greater degree. All in telepsychiatry told they had learnt something new. Some even told they learnt something new every time they worked with telepsychiatry. Most of the ten within the telepathologic frozen section service were of the opinion that they had learnt something new, and even the specialists report of learning. Surgeons may get a repetition of pathology, and for the pathologist the new situation gives a basis for reflection on what to stress with less information in the images. The present paper gives information about learning for four types of use of telemedicine. If similar learning is found for other applications, expansion of telemedicine could result in considerable learning.

'Have you started to perform tasks yourself which you previously were seeking assistance for?'
Informal, flexible work-systems have been proposed to become the dominating organizational form of the 21st century (Heydebrand 1989). The unit one person-one function (or specific set of functions) may constitute a basic building block for organizations. But such organization limits the flexibility and adaptability to new situations. An extension of employees' roles makes health care organizations more flexible to e.g. changes in demand. It is a common opinion among Scandinavian hospital leaders that telemedicine means local doctors can perform a more precise diagnosing (Danneskiold-Samsoe 1998). Learning in telemedicine may give local participants the necessary knowledge to take decisions without consulting specialists. When two of three in the present material did not tell about an extended own role, it is possible that this gives account of limits for the learning. For the involved in the telepathologic frozen section service extension of roles may have less actuality. When the telepathologic frozen section service is excluded from the sample 45% (9/20) tell about an extended role.

In a study of teledermatology it was proposed that learning benefits for GPs could result in an average reduction of referrals of 20% (Wootton et al. 2000). In the present study one of three GPs in teledermatology told he sent fewer patients to the hospital with a dermatologic department, and all GPs answered they now did more themselves within the discipline. Fewer referrals and own performance of tasks they previously were seeking assistance for are examples of consequences of learning. The learning leads to changes with clear importance for economic analysis of telemedicine. It has been proposed that GPs working with remote consultations become semi-specialists (Akselsen & Lillehaug 1993). The specialists function as role models for how work within a speciality should be performed (Akselsen & Lillehaug 1993). If a semi-specialist is someone able to take care of 50% of the patients without referral to specialist, calling GPs semi-specialists may be going to far.

The supply of psychiatric expertise may be limited. Telepsychiatry may improve access to the limited resource. When personnel perform tasks they previously needed assistance for the total capacity of the mental health service may increase. Discharge of patients to their local community may improve quality of life (Dobson 2000). Follow up may occur with telepsychiatry, and an extended role for local personnel reduces the daily dependency of psychiatric expertise. It is also possible that extended roles improve job satisfaction (Aas 2000).

It has been proposed that teleotolaryngology will lead to a better quality examination technique for the GP and that this will decrease demand for expert services (Pedersen et al. 1994). In the present study the GP in otolaryngology told he still left much over to the specialist.

'Can anything be done in telemedical work which promotes your own learning?'
The more informed patients as a result of the Internet (Hjortdahl et al. 1999) are more demanding for the personnel's competence. In the remote consultation specialist and GP work in same time, with the same patient, have the same information about the patient, and there is only one teacher and student. For clinical learning this may be a good situation. The technology may contribute to a more seamless care and the personnel come in direct contact with more of the total episode of care. Two of three respondents answered the question with yes. Learning could be promoted by extending the use of telemedicine to other areas. More remote teaching is also wanted. Telemedicine seems to represent a potential for learning not fully exploited.

'How did you learn to use the telemedical equipment?'
In a previous study 90% told they found the technology easy to use (Aas 2000). This in spite of few having learnt to operate the technology by attending a course. The finding may in part be explained by some having access to a technician. More extensive training seems unnecessary to work with the technology. Instructions in the start may be enough. The equipment can be switched on as the light is switched on. Calling a hospital can be done by pressing a button with the name of the hospital on. Still the belief that operation of the technology is difficult may represent a barrier for its use, and it is possible that more information could remove this and contribute to a more rapid expansion of telemedicine. A

further expansion of telemedicine could also be promoted by economic incentives with a per consultation method of payment (Aas 1995).

CONCLUSIONS

By using telemedicine learning undoubtedly occurs. More than 80% of the respondents tell that they have learnt something new by using telemedicine. Most frequently the participants learn of the speciality in which they are involved, but this is not the only they learn. The learning does not necessarily change behaviour as two of three of the respondents cannot tell that the learning make them perform tasks they previously needed assistance for. When two of three expressed that something can be done in telemedical work to promote learning, this means that the potential for learning by telemedicine is not emptied. Learning can be promoted further by extending the use of the technology to other areas. More remote teaching and instructions by telemedicine are also wanted. All GPs learn, but so do also nurses, psychologists and other categories of personnel. Even for the specialists working with telemedicine may be useful. When all within psychiatry learn taking the full advantage of this belongs to the future. It may look exaggerated to claim that the GPs become semi-specialists by working with remote consultations. The volume of patients they take care of on their own is hardly that large. To start working with telemedicine instructions in the start seem to be enough, and a more extensive teaching programme is not necessary. Scrutiny gave limited reason to suspect age, sex, and volume of use differences in the answers to the four qualitative questions. In the future work organizations may become important arenas for learning, and leaders may have to focus on learning.

REFERENCES

Aas IHM. A qualitative study of the organizational consequences of telemedicine. Journal of Telemedicine and Telecare 2001a;7: 18-26.

Aas IHM. Telemedical work and co-operation, Journal of Telemedicine and Telecare 2001b; 7:212-218.

Aas IHM. Changes in the job situation due to telemedicine. Journal of Telemedicine and Telecare 2002a; 8: 41-47 .

Aas IHM. Learning in organizations working with telemedicine. Journal of Telemedicine and Telecare 2002b; 8: 107- 111.

Aas IHM. Telemedicine and changes in the distribution of tasks between levels of care. Journal of Telemedicine and Telecare 2002c; 8 (Suppl. 2): 1-2.

Aas IHM. Working with telemedicine: User characteristcs and attitudes. Journal of Telemedicine and Telecare 2000(Supplement1);6: 66-68.

Aas IHM. Organizing for remote consultations in health care - the production process. Behaviour & Information Technology 2003; 22: 91-100.

Aas IHM. Organizational change: decentralization in hospitals. International Journal of Health Planning and Management 1997; 12: 103-14

Aas IHM. Incentives and financing methods. Health Policy 1995; 34: 205-20

Aas IHM, Geitung JT. Telemedisin: Teknologi med mange anvendelsesområder. Del 1: Introduksjon, fysiske nettverk, kliniske anvendelsesområder, medisinske servicefunksjoner. [Telemedicine: technology with many applications. Part 1: Introduction, physical networks, clinical applications, medical service functions]. HMT Tidsskrift for Helse Medisin Teknikk 1998; nr 6: 24-28,30-31

Aas IHM, Geitung JT. Telemedisin: Teknologi med mange anvendelsesområder. Del 2:Extramural anvendelse, kompetanseutvikling, administrasjon og styring, organisatoriske konsekvenser. [Telemedicine: technology with many applications. Part 2: Extramural applications, development of competence, administration and management, organizational consequences]. HMT Tidsskrift for Helse Medisin Teknikk 1999;nr1: 20-23,26-29

Aasebø U, Opdahl R, Strøm HH, Arild E, Bach B. Decentralisert spesialistutdanning i lungesykdommer. [Decentralized education of specialists in pulmonary diseases]. Nordisk Medicin 1998; 113: 237-9

Akselsen S, Lillehaug S-I. Teaching and learning aspects of remote medical consultations. Telektronikk 1993;89 (no 1): 42-7

Anderson JG, Jay SJ, Perry J, Anderson MM. Modifying physician use of a hospital information system. In: Anderson JG, Aydin CE, Jay SJ. Evaluating health care information systems. Methods and applications. Thousand Oaks: Sage Publications, 1994: 276-87

Bach B. Møteplassen for helseutdanninger. [The meetingplace for health care educations]. Proceedings for Norsk Telemed '99, Tromsø 13-15 oktober 1999: 67

Barbour RS. Checklist for improving rigour in qualitative research: a case of the tail wagging the dog? British Medical Journal 2001; 322: 1115-7

Bryman A. Quantitative and qualitative research: further reflections on their integration. In: Brannen J, ed. Mixing methods: qualitative and quantitative research. Aldershot: Avebury Ashgate Publishing Limited, 1992: 57-78

Castells M. The rise of the network society. Second Edition. Volume 1. Oxford: Blackwell Publishers, 2000

Danielsen HE. Telemedisin - kostnad og nytte. [Telemedicine - costs and benefits]. The Norwegian Medical Journal 1997; 117: 1582-3

Danneskiold-Samsøe B, Hatling M, Arnlind M, Palsson T, Lukander M. Telemedicine in the Nordic countries - Attitudes and diffusion. NIS-report 4/98, Trondheim: SINTEF Unimed, 1998

Davies HTO, Nutley SM. Developing learning organisations in the new NHS. British Medical Journal 2000; 320: 998-1001

Devers KJ, Sofaer S, Rundall TG, eds. Qualitative methods in health services research. A special supplement to HSR. Health Services Research 1999; 34: Number 5 Part II

Dobson R. Psychiatric patients enjoy better life in community. British Medical Journal 2000; 320: 1228

D'Souza R. A pilot study of an educational service for rural mental health practitioners in South Australia using telemedicine. Proceeding of Telemed 99, London 28 November - 1 December 1999: 187-9

Dunn OJ. Basic statistics: A primer for the biomedical sciences. New York: John Wiley & Sons, Inc, 1964.

Fulmer J, Hazzard M, Faan SJ, Keene K. Distance learning: an innovative approach to nursing education. Journal of Professional Nursing 1992; 8: 289-94

Gates B. Ledelse med t@nkens hastighet. [Business @ The speed of thought]. Oslo: Egmont Hjemmets Bokforlag, 1999.

Harman WW. An incomplete guide to the future. New York: WW Norton & Company, 1979

Harrison R, Clayton W, Wallace P. Can telemedicine be used to improve communication between primary and secondary care? British Medical Journal 1996; 313:1377-80

Heydebrand WV. New organizational forms. Work and occupations 1989; 16: 323-57

Hjortdahl P, Nylenna M, Aasland OG. Internett og lege - pasient - forholdet - fra «takk» til «hvorfor?». [Internet and the doctor-patient relationship - from «thankyou» to «why?»]. The Norwegian Medical Journal 1999; 119: 4339-41

Jøsendal O, Fosse G, Andersen KA, Stenvold SE, Falk ES. Fjerndiagnostisering av hudsykdommer. [Remote diagnosing of skin diseases]. The Norwegian Medical Journal 1991; 111:20-2

Mays N, Pope C. Assessing quality in qualitative research. British Medical Journal 2000; 320: 50-2

Nikula RE. Organisational learning within health care organisations. Medical Informatics 1999; 56: 61-6

Nordhaug O. Human capital in organizations. Competence, training, and learning. Oslo: Scandinavian University Press, 1993

Orusild E. Undervisning på distans av AT- och ST läkare - ett telemedicinskt pilotprosjekt på Visby lasarett och Huddinge sykehus. [Remote teaching of AT- and ST doctors- a telemedicine pilotproject at Visby and Huddinge hospitals]. Proceedings for Norsk Telemed '99, Tromsø 13-15 oktober 1999: 68

Ovretveit J, Mathias P, Thompson T. Interprofessional working for health and social care. London: MacMillan Press Ltd, 1997

Pedersen S, Hartviksen G, Haga D. Teleconsultation of patients with otorhinolaryngologic conditions. A telendoscopic pilot study. Archives of otolaryngology: Head & Neck Surgery 1994; 120 (No 2): 133-6

Qureshi H. Integrating methods in applied research in social policy: a case study of carers. In: Brannen J, ed. Mixing methods: qualitative and quantitative research. Aldershot: Avebury Ashgate Publishing Limited, 1992: 101-25

Senge PM, Kleiner A, Roberts C, Ross RB, Smith BJ. The fifth discipline fieldbook. Strategies and tools for building a learning organization. New York: Doubleday, 1994

Sherwood GD, Armstrong ML, Bond ML. Distance education programs: Defining issues of assessment, accessibility, and accommodation. The Journal of Continuing Education in Nursing 1994; 25: 251-7

Sixsmith A, Beer M, Green S. An occupational therapy Internet school. Proceeding of Telemed 99, London 28 November - 1 December 1999: 175-7

Snow CC, Lipnack J, Stamps J. The virtual organization: Promises and payoffs, large and small. In: Cooper CL, Rousseau DM, eds. Trends in organizational behaviour. The virtual organization. Volume 6. Chichester: John Wiley & Sons Ltd, 1999: 15-30

Solberg LA, Natvig H, Endestad T, Løvåsdal C, Birkeland M. IT-endringer i Norske Bedrifter: IT- kvalitet og brukeres mestring av ny teknologi. [IT changes in Norwegian firms: IT Quality and Users' Mastering of a New Technology]. STF 78 A98405. Oslo: SINTEF Unimed, 1998

Stead WW. The networked health enterprise: A vision for 2008. Journal of the American Medical Informatics Association 1998; 5: 412-5

Vaagland O. Nasjonale satsinger innen fjernundervisning. [National efforts in remote teaching]. Proceedings for Norsk Telemed '99, Tromsø 13-15 oktober 1999: 62

Wootton R, Bloomer SE, Corbett R, Eedy DJ, Hicks N, Lotery HE, Mathews C, Paisley J, Steele K, Loane MA. Multicentre randomised control trial comparing real time teledermatology with conventional outpatient dermatological care: societal cost-benefit analysis. British Medical Journal 2000; 320:1252-6

Table 1 – Summary of answers to three of the qualitative questions (n=30)

	Yes		No	
	N	%	n	%
Have you learnt anything new by using telemedicine? If yes what?	25	83	5	17
Have you started to perform tasks yourself which you previously were seeking assistance for?	10	33	20	67
Can anything be done in telemedical work which promotes your own learning? [a]	20	67	9	30

[a] One (3 %) did not know

Appendix Q

The Role of Organizational Culture in the Management of Clinical e-health Systems

By

David Bangert and Robert Doktor

Abstract

The Problem

Modern health care organizations are confronted with a steady stream of new clinical e-health technologies. These technologies have taken giant strides in increasing functionality and restraining costs (Bashshur, 2002 and Ackerman, Craft, Ferrante, Krantz, Mandil and Sapci, 2002). Early evidence suggests great difficulty in the implementation of these new technological advances in the U.S.A. (Bangert and Doktor, 2000). Telemedicine is a good example of this problem. Bashshur (2002) discusses how the second generation of telemedicine has the requisite technology, but faces such uncertainties as lack of long-term sustainability plans, lack of mature programs that can be the basis of definitive cost-benefit analyses, and limited acceptance of telemedicine by health providers and health administrators. 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 in the U.S.A. (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 Health Care Providers (HCP) services is sometimes a barrier to utilization. Sometimes the technology does not perform as advertised.

While the issues listed above are real and relevant, they do not explain what we believe to be one of the primary causes of the problem: organizational dynamics (Aas, 2001). 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. In some nations, such an organizational approach is still appropriate. However, we contend that in many national cultures around the globe, a successful adoption of an e-health strategy requires a more organic and less mechanistic organizational culture and structure. For health care organizations of such national cultures, a more organic form will better match the cultural and knowledge/learning predispositions of the organization's members who are elementary to the strategic adoption of such a highly disruptive healthcare delivery system as e-health.

We assert that cultural analyses show that what works in one culture may not be appropriate in another. Specifically, we will discuss how the capacities of a successful health care organization depend upon the values of the society it serves, and, accordingly, that one solution to the e-health implementation problem does not fit all situations.

The Theory

Cross-Cultural Organization Literature

We find the work of Geert Hofstede (1980, 1991, 1994, 2000) insightful when considering the organizational designs for successful e-health implementation. Hofstede (1991) has argued that organizational systems 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 cultural values that differ from those held in the United States. Critics of Hofstede's work believe that he takes too simplistic a view of the multifaceted, complex dimensions which comprise the notion of culture. However, for our purposes Hofstede's (2000) defined basic dimensions are exceedingly useful hypothetical constructs. Hofstede's (2000) five dimensions of cultural variability are: 1) power distance, 2) uncertainty avoidance, 3) individualism-collectivism, 4) masculinity-femininity, and 5) Confucian dynamism (long versus short-term orientation). Each of these dimensions is rather complex; we refer the reader to Hofstede (2000) for a complete analysis. However, it is the second and third basic dimensions, uncertainty avoidance and individualism-collectivism, which seem most relevant to our analysis of the relationship of organizational design to successful e-health implementation.

Uncertainty avoidance refers to how comfortable people feel towards ambiguity. High uncertainty avoidance cultures value predictability, formal rules, and stability. They prefer fixed structures and clear interpretations. They like things black and white, not gray. They dislike experimenting with unknown outcomes.

We maintain that societies high in uncertainty avoidance create environments that strongly favor mechanistic organization in order to motivate successful implementations of disruptive technology – and we maintain that the obverse is true for low uncertainty avoidance cultures.

Countries which Hofstede (2000) has measured to be high uncertainty avoidance cultures include Japan, France, and South Korea. Examples of middle level uncertainty avoiding countries are Italy and Taiwan. Countries scoring low on uncertainty avoidance include Singapore, USA, and Great Britain. The complete ranking of countries is in table 1.

Individualism is a social pattern that consists of loosely linked individuals who are motivated by heir own preferences, needs rights, and contracts. Collectivism is a social pattern that consists of closely linked individuals who see themselves as belonging to one or more collectives and are motivated by norms, duties and obligations, which are imposed by the collectives (Bhagat, Kedia, Harveston and Triandis, 2002).

Bhagat at al. (2002) argue that organizations located in individualist cultures are better able to transfer and absorb knowledge that is more explicit and independent. In contrast, organizations located in collectivist cultures are better able to transfer and absorb knowledge that is more tacit and systemic.

Tacit knowledge is developed and internalized by the knower over a long period of time. It is almost impossible to reproduce in a document or database. Whereas explicit knowledge is fully articulable (Davenport and Prusak, 1998). Independent versus system knowledge addresses the extend that knowledge is embedded in the organizational context. Knowledge that is independent can be described by itself. Systemic knowledge must be described in relationship to a body of knowledge existing within the organization (Bhagat at al. 2002).

Hofstede (2000) found USA, Great Britain, and France to be individualistic and Korea and Singapore to be collective. Italy and Japan fell in the middle range.

TABLE 1
Scores on Five Cultural, National Dimensions for 53 Countries or Regions

{PRIVATE} Country	Power Distance		Individualism/ Collectivism		Masculinity/ Femininity		Uncertainty Avoidance		Confucian Dynamism	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Argentina	49	18-19	46	31-32	56	33-34	86	39-44	-	-
Australia	36	13	90	52	61	38	51	17	31	9-10
Austria	11	1	55	36	79	52	70	29-30	-	-
Belgium	65	34	75	46	54	32	94	48-49	-	-
Brazil	69	40	38	27-28	49	27	76	32-33	65	18
Canada	39	15	80	49-50	52	30	48	12-13	23	4
Chile	63	29-30	23	16	28	8	86	39-44	-	-
Colombia	67	37	13	5	64	42-43	80	34	-	-
Costa Rica	35	10-12	15	8	21	5-6	86	39-44	-	-
Denmark	18	3	74	45	16	4	23	3	-	-
Ecuador	78	45-46	8	2	63	40-41	67	26	-	-
Finland	33	8	63	37	26	7	59	22-23	-	-
France	68	38-39	71	43-44	43	18-19	86	39-44	-	-
Germany,F.R.	35	10-12	67	39	66	44-45	65	25	31	9-10
Great Britain	35	10-12	89	51	66	44-45	35	6-7	25	5-6
Greece	60	26-27	35	24	57	35-36	112	53	-	-
Guatemala	95	51-52	6	1	37	11	101	51	-	-
Hong Kong	68	38-39	25	17	57	35-36	29	4-5	96	22
Indonesia	78	45-46	14	6-7	46	23-24	48	12-13	-	-
India	77	43-44	48	33	56	33-34	40	9	61	17
Iran	58	24-25	41	30	43	18-19	59	22-23	-	-
Ireland	28	5	70	42	68	46-47	35	6-7	-	-
Israel	13	2	54	35	47	25	81	35	-	-
Italy	50	20	76	47	70	49-50	75	31	-	-
Jamaica	45	17	39	29	68	46-47	13	2	-	-
Japan	54	21	46	31-32	95	53	92	47	80	20
Korea, Rep. of	60	26-27	18	11	39	13	85	37-38	75	19
Malaysia	104	53	26	18	50	28-29	36	8	-	-
Mexico	81	48-49	30	22	69	48	82	36	-	-
Netherlands	38	14	80	49-50	14	3	53	19	44	14
Norway	31	6-7	69	41	8	2	50	16	-	-
New Zealand	22	4	79	48	58	37	49	14-15	30	8
Pakistan	55	22	14	6-7	50	28-29	70	29-30	0	1
Panama	95	51-52	11	3	44	20	86	39-44	-	-
Peru	64	31-33	16	9	42	16-17	87	45	-	-
Philippines	94	50	32	23	64	42-43	44	10	19	3
Portugal	63	29-30	27	19-21	31	9	104	52	-	-
South Africa	49	18-19	65	38	63	40-41	49	14-15	-	-
Salvador	66	35-36	19	12	40	14	94	48-49	-	-
Singapore	74	41	20	13-15	48	26	8	1	48	15
Spain	57	23	51	34	42	16-17	86	39-44	-	-
Sweden	31	6-7	71	43-44	5	1	29	4-5	33	12
Switzerland	34	9	68	40	70	49-50	58	21	-	-
Taiwan	58	24-25	17	10	45	21-22	69	28	87	21
Thailand	64	31-33	20	13-15	34	10	64	24	56	16
Turkey	66	35-36	37	26	45	21-22	85	37-38	-	-
Uruguay	61	28	36	25	38	12	100	50	-	-
USA	40	16	91	53	62	39	46	11	29	7
Venezuela	81	48-49	12	4	73	51	76	32-33	-	-
Yugoslavia	76	42	27	19-21	21	5-6	88	46	-	-
Regions:										
East Africa	64	31-33	27	19-21	41	15	52	18	25	5-6
West Africa	77	43-44	20	13-15	46	23-24	54	20	16	2
Arab Countries	80	47	38	27-28	53	31	68	27	-	-
Bangladesh	-	-	-	-	-	-	-	-	40	13
China	-	-	-	-	-	-	-	-	118	23
Poland	-	-	-	-	-	-	-	-	32	11

Organizational Design Literature

The appropriate design of an organization depends upon many factors. 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; McKelvey and Aldrich, 1983). Hofstede (1984) succinctly states "the culture of the human environment in which as organization operates affects the management process."

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 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). Balign (1994) argues that the performance of an organization is a product of its structure, the culture in which the structure is embedded and the technology of the organization.

Organizations with high formality are defined as having high division of labor (Weber, 1964; Rehder, 1992), maintaining strict rules (Drucker, 1987) and discouraging 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 formality and high centralization are often referred to as highly mechanistic in their structure. Organizations with the obverse structural characteristics are said to be more organic in their structural design. A strong parallel exists on the cultural side of organizational design. Organizations with cultures that value learning and that seek to encourage individual and organizational learning are often characterized as being more organic. They are usually more open about making mistakes, more encouraging of questioning and participation, highly supportive of learning new things, more willing to accept diversity, and tolerant of ambiguity (DiBella and Nevis, 1998). Organizations that fall into the mechanistic category do not tolerate ambiguity, are closed to admitting mistakes, punish mistakes, and avoid diversity. Organizational form thus spans the spectrum from organic to mechanistic, with each organization falling somewhere between these two ideal types and having shades of both organic and mechanistic dimensions. The issue is one of relativity: is the organization generally more organic in its structural and cultural dimensions, or is it more mechanistic?

Technology Diffusion Literature

The research literature on technology diffusion in organizations has shown low correlation between centralization and 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, and fiber optic endoscopy. 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 an adoption of technology often falters because the innovation fails to align with the 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 organizations points 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 dimension of uncertainty avoidance (Hofstede, 2000).

Resistance to Change Literature

Just as technology diffusion literature enriches our understanding of the role of organization design in the implementation problem, so too the literature on resistance to change and change-management adds insight. This literature has a long history (Lewin, 1951). A primary tenet of this school of thinking is the concept that attitude change requires a three phase phenomena: 1) unfreezing (ending), 2) transitioning (neutrality), and 3) refreezing (new beginning). In that most resistance to change in organizations is founded in rational decisions that are based on currently held attitudes of members relative to their position in the organization and the consequences of the change from the point of view of that position (Bridges, 1991), the organizational design then frames the capacity for attitude change.

In his book Leading Change, J.P. Kotter (1996) asserts that technological change needs a visionary leader who is capable of sharing the vision of using the new technology. The leader must also motivate its use and visibly reward those who first begin to adopt and use the new technology. Of greatest importance, according to Kotter (1996), the new technology must become part and parcel of the organization's culture -- as a part of the way that the organization does business.

Organizational Learning Literature

The conceptualization of organizational learning (DiBella and Nevis, 1998), at a more aggregate level, mirrors the dynamics of the resistance to change literature. Organizations with high learning cultures are keen to adopt new things, open to diversity and embrace change. At the aggregate level, a learning culture stimulates the unfreezing to refreezing phases noted in 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.

DeLong and Fahey (2000) argue that culture shapes the assumptions about which knowledge is important. Hence in individualistic cultures, task related knowledge that allows one to do his/her work would be valued whereas in collective cultures, knowledge that permits the organization to function smoothly would be more valued. DeLong and Fahey further state that culture embodies all the unspoken norms or rules about how knowledge is to be distributed between the organization and the individuals in it. Culture dictates what knowledge belongs to the organization and what knowledge remains in the control of individuals and subunits.

Technology Acceptance Model Literature

The Technology Acceptance Model (TAM) was developed by Davis, et. al. (1989) to understand the relationship between attitudes, intentions and behavior of potential IT users. Since its development, over 400 journal citations of the original Davis, et. al. (1989) article have been noted by the Social Science Citation Index. Therefore, the TAM is a well researched hypothetical construct. Most, but not all, TAM research indicated that if the potential user believes the IT system will help her accomplish her task, and to a lesser extent, will be easy to use, then the potential user will self-report that she will use the IT system.

However, Lucas and Spitler (1999) have shown that in real field settings, organizational variables, such as cultural norms and the nature of the job, were far more important in predicting use of technology than the potential user's perception of likely usefulness or ease of use. Further, Hu et. al. (1999) report that the TAM did not predict the use of telemedicine by physicians. Hu et. al (1999) suggest that cultural and professional/organization variables may be more explanatory of telemedicine use than perceived usefulness or perceived ease of use as measured by TAM.

Barki and Hartwick (1989) suggested that the higher the degree of the user's perceived participation in the development of the system, the more likely s/he would use the system. They posited that user involvement entails the execution of a set of activities as well as the psychological state of the user.

Drawing from the above review of the research literature, we propose the following:

I stopped here in my rewrite

Figure 1: Theoretical Construct

Introducing a new healthcare technology which fundamentally changes the organizational processes	Organizational Design Organic	Mechanistic
High Uncertainty Avoidance National Culture Low Uncertainty Avoidance	Healthcare providers resist experimenting with the new technology and create new processes that take advantage of its potential.	Clear policy and rules provide the necessary guidance for the providers to embrace the technology and its supporting processes.

	Healthcare providers see the new technology as a way to overcome problems that have hindered them in the past and embrace the new processes.	The healthcare providers do not "own" the technology and supporting processes. This low perceived involvement lowers their predilection to use the system.

Our Hypotheses

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?

References

Aas IHM. A Qualitative Study of the Organizational Consequences of Telemedicine. *Journal of Telemedicine and Telecare* **2001**;7:18-28.

Ackerman M, Craft R, Ferrante F, Kratz M, Mandil S, Sapci H. Telemedicine Technology. *Telemedicine Journal and e-Health* **2002**;8,1:71-78.

Bhagat, RS, Kedia, BL, Harveston, PD, Triandis, HC. Cultural Variations in the Cross-Border Transfer of Organizational Knowledge: An Integrative Framework. *Academy of Management Review* **2002**; 27,2, 204-221.

Baligh HH. Components of Culture: Nature, Interconnections, and Relevance to Decisions on the Organizational Structure. *Management Science* **1994**;40,1:14 – 28.

Bangert D, Doktor R. Implementing Store-and-Forward Telemedicine: Organizational issues. *Telemedicine Journal and e-Health* **2000**;6,3:355-360.

Barki H, Hartwick J. Rethinking the Concept of User Involvement. *MIS Quarterly* **1989**;13,1:53-63.

Bashshur RL. Telemedicine and Health Care. *Telemedicine Journal and e-Health* **2002;**8,1:5-12.

Bashshur RL, Gingsby J. Position paper: Telemedicine effects: cost, quality and access. *J. Medical Systems* **1995;**19,2:79-80.

Bashshur RL, Sanders JH, Shannon GW. *Telemedicine: Theory and Practice*. Springfield, IL: Charles C. Thomas Publisher, Ltd., **1997**.

Bridges W. *Managing Transitions*. Reading, MA: Addison-Wesley Publishing Co., **1991**.

Cyert RM, March JG. *A Behavioral Theory of the Firm.* NJ: Prentice Hall, **1963.**

Child. Strategies of control and organizational behavior. *Administrative Science Quarterly* **1973**;18:1-17.

Daft RL. Bureaucratic versus non-bureaucratic structure and the process of innovation and change. In: Bacharach SB, editor, *Research in the Sociology of Organizations*. Greenwich, CT: JAI Press **1982**:129-66.

Davenport TH, Prusak L. *Working Knowledge*. Boston, MA: Harvard Business School Press, **1998**.

Davis FD, Bagozzi RP, Warshaw PR. Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. *MIS Quarterly* **1989;**13,3:319-340.

Davis LJ, et al. The Pacific Teletumor Board: An innovation in cancer care. *Federal Practitioner* **2000**.

De Long DW, Fahely L. Diagnosing Cultural Barriers to Knowledge Management. *The Acadmy of Management Executive*. November **2000**.

DiBella AJ, Nevis EC. *How organizations learn: An integrated strategy for building learning capacity*. San Francisco, CA: Jossey Bass, **1998**.

Doz Y, Prahalad CK. Controlled variety: A challenge for human resource management in MNC. *Human Resource Management* **1986;**25,1:55-71.

Drucker PF. Workers' hands bound by tradition: *The Wall Street Journal* **1987**; August 2:18.

Eisenstadt SN. *Max Weber: On Charisma and Institution Building*. Chicago, Ill: University of Chicago Press, **1986**:46.

Galbraith JR. *Designing complex organizations*. Reading, MA: Addison-Wesley, **1972**.

Gerwin D. A Theory of Innovation Process for Computer-Aided Manufacturing Technology. *IEEE Transactions on Engineering Management* **1988;**35,2:90-100.

Hartwick J, Barki H. Explaining the role of user participation in information systems use. *Management Science* **1994;**40:440-465.

Hofstede G. *Culture's consequences*, 2nd ed. London, UK: Sage Publishing Co., **2000.**

Hofstede G. Management Scientists are Human. *Management Science* **1994;** 40,1:4–14.
Hofstede G. *Cultures and organizations: Software of the mind.* McGraw-Hill Publishing Co., **1991.**
Hofstede G. *Culture's consequences.* London, UK: Sage Publishing Co., **1980.**
Hu P, Chau P, Sheng O, Tam K. 1999. Examining the technology acceptance model using physician acceptance of telemedicine technology. *Journal of Management Information Systems* **1999;**16,2:91-112.
Kotter JP. *Leading Change.* Boston, MA: HBS Press, **1996.**
Lawrence PR, Lorsch JW. 1967. *Organization and environment: Managing differentiation and integration.* Boston, MA: Graduate School of Business Administration, Harvard University, **1976.**
Lewin K. *Field Theory in Social Science.* New York: Harper and Row, **1951.**
Lin Z, Hui C. Should lean replace mass organization systems? A comparative examination from a management coordination perspective. *Journal of International Business Studies* **1999**;30,1:45-80.
Lucas HC, Spitler VK. Technology Use and Performance: A Field Study of Broker Workstations. *Decisions Sciences* **1991;**30,2:291-311.
Mackenzie KD. *Organizational structures.* Arlington Heights, IL: AHM Publishing Corporation, **1978.**
Marchard D, Ketttinger W, Rollins J. *Information Orientation: The Link to Busienss Performance.* Oxford, UK: Oxford University Press, **2001.**
McKelvey B, Aldrich H. Populations, Natural Selection and Applied Organizational Science. *A.S.Q.* **1983;**28:101-128.
Meyer AD, Goes JB. Organizational Assimilation of Innovations: A Multi level Contextual Analysis. *Academy of Management Journal* **1988;**31,4: 899-923.
Mintzberg H. *Power in and around organizations.* Englewood Cliffs, NJ: Prentice Hall, **1983.**
Nevis EC, DiBella AJ, Gould JM. Understanding organizations as learning systems. *Sloan Management Review* **1995;**36,2:73-85.
Ouchi WG. The relationships between organizational structure and organizational control. *Administrative Science Quarterly* **1987;**22:95-113.
Perrow C. *Organizational Analysis: A sociological View.* Wadsworth Publishing Co., **1984.**
Pfeffer J. *Organizations and organizational theory.* Marshfield, MA: Pitman Publishing Inc., **1982.**
Porter M. *The competitive advantage of nations.* London, UK: Macmillan, **1990.**
Pugh DS, Hickson DT, Hinings CR, MacDonald KM, Turner C, Lupton T. A conceptual scheme for organizational analysis. *Administrative Science Quarterly* **1963;**8:289-315.
Pushkin DS, et. al. Patient and provider acceptance of telemedicine. *New Medicine* **1997:**55-59.
Rehder RR. Building cars as if people mattered: The Japanese lean system vs. Volvo's Uddevalla system. *Columbia Journal of World Business* **1992**;27,2:56-70.
Robbins SP. *Organizational behavior: Concepts, controversies, and applications.* Englewood Cliffs, NJ: Prentice Hall, **1993.**
Rogus EM. *Diffusion of Innovations*, 4th edition, Free Press, **1995.**
Shannon G, Nesbitt T, Bakalar R, Kratochwill E, Kvedar J, Vargas L. *Telemedicine Journal and e-Health* **2002;**8,1: 61-70.
Shortell SM, Morrison EM, Friedman B. *Strategic choices for America's hospitals: Managing change in turbulent times.* San Francisco, CA: Jossey-Bass, **1990.**
Van de Ven AH, Rogers GM. Innovations and Organizations: Critical Perspectives. *Communication Research* **1998;**15,5:632-651.

Venkatesh V, Davis FD. A theoretical extension of the technology acceptance model: Four Longitudinal Field Studies, *Management Science* **2000;**46:186-204.

Weick KE. Organization design: Organizations as self-designing systems. *Organizational Dynamics* **1977;**6:31-46.

Williamson JM. Future policy directions for quality assurance: Lessons from the health accounting experience. *Inquiry* **1988;**25:67-77.

Womack JP, Jones DT, Roos D. *The machine that changed the world: Based on the Massachusetts Institute of Technology 5-million dollar 5-year study of the future of the automobile.* New York, NY: Rawson Associates, **1990**.

Zetka Jr. JR. Mass-production automation and work-group solidarity in the post-World War II automobile industry. *Work and Occupations* **1992;**19,3: 255-71.