

MICROSOFT DIGITAL INCLUSION 2005 – PROPOSAL

Smartphone Health Information and Epidemiology Network (SHIEN) – Vietnam
Thayer School of Engineering, Dartmouth College, Hanover, NH

Contact Information

Joseph M. Rosen, MD
Norris Cotton Cancer Center
Dartmouth Hitchcock Medical Center
One Medical Center Drive
Lebanon, NH 03756
Tel: 603-650-5148
Fax: 603-650-5809
E-mail: Joseph.M.Rosen@Hitchcock.org

Abstract

As Vietnam’s health care system evolves it faces increasing health care disparities and emerging infectious diseases. We propose to build a wireless, electronic medical information system that leverages existing infrastructures to face these growing challenges. Because the local internet and PC infrastructure is still limited, we are designing a system based primarily on Windows Mobile smartphones. In doing so we will tackle the engineering hurdles inherent in making an intuitive, capable system based on low-bandwidth networks and small user-interfaces. Vietnam has shown remarkable ingenuity in response to challenges; without sophisticated medical technology, the health care system in Vietnam was able to tackle SARS more effectively than any other country in the region. In that same spirit, our priorities are simplicity, flexibility, and reliability. Our system – designed to connect doctors to vital medical information and each other – will be instrumental in ensuring greater access to quality care.

1. Problem Statement

Vietnam’s health care system is undergoing a transformation and decentralization, and while “Vietnam’s health indicators are better than would be expected for a country at its development level,...large disparities exist in many key health indicators by region, income and ethnicity. These disparities are further compounded by the advent of new health challenges, including SARS, avian flu and

resistant strains of other diseases.”¹ The major challenges to the Vietnamese health care system today include:

1. Lack of access to specialized care in remote regions
2. High transportation costs for patients – especially in the poorer, rural areas
3. Increasing fragmentation and a lack of continuity of care
4. Emerging infectious diseases – including SARS and Avian Flu

Health care is information whether it’s in the form of a patient history, a laboratory value, or a radiological study. Getting information from where it is to where it needs to be in a timely manner is the key to quality care. Information can also be used to substitute for transportation; a virtual patient can be transmitted instantly and inexpensively across long distances to be evaluated by remote specialists in tertiary care facilities.

Efforts to computerize electronic patients in the US have relied on a sophisticated internet backbone and a wide deployment of personal computers. At the moment Vietnam has neither of these. What it does have is an extensive cellular network, and use of and familiarity with cellular phones is widespread.

Doctors are conservative and practical by nature. The gravity of their decisions and the volume of their workload requires that they have complete confidence in their tools. Consequently, the adoption of new technology requires a proven benefit – particularly for the patient – over the old methods. Currently, medical information is stored and transferred on paper. Inherently secure and always reliable, paper has served the medical world well for hundreds of years, and paper will be the standard by which any new system is judged. Paper never runs out of batteries; it never crashes; it can be dropped on the floor. It is cheap, ubiquitous, and requires no training or tech support. By applying the “Paper Standard” our system will strive to be equally intuitive and unfailing. Rather than emphasize features and capabilities like some developers do, our paramount mission is simplicity, flexibility and reliability. In addition, limited bandwidth, unreliable networks and small user interfaces engender formidable engineering challenges.

2. Expected outcomes

¹ Susan J. Adams, Ph.D. Vietnam’s Health Care System: A Macroeconomic Perspective. International Monetary Fund, Hanoi, Vietnam. Paper Prepared for the International Symposium on Health Care Systems in Asia Hitotsubashi University, Tokyo, January 21-22, 2005.

Technology can make life easier, but it rarely makes life simpler. Our goal is to create a web-based, SQL database-driven, electronic medical record accessible via Windows Mobile 5.0 smartphones over a GSM/GPRS cellular network that comes as close to simplifying life as possible. Current solutions are ugly, unintuitive, needlessly inefficient and cannot operate effectively over a low-bandwidth cellular network.

Our solution will require an interface revolution. For simplicity we will strive to make all functions within 3 steps and customize interfaces to the individual and task at hand. The system will update itself automatically and wirelessly and will be location aware. For flexibility, the system will function on multiple platforms, leverage existing infrastructures, work anywhere in the country, and fulfill multiple applications. For reliability, we will commit more to stability than functionality and anticipate network failures with both networking technologies and system redundancy.

To increase access to health care we will connect hospitals through both their doctors and their medical records. To decrease the transportation burden we will facilitate remote consultations. To increase continuity of care, we will make medical information accessible anywhere and allow for better patient follow-up. The ability to data mine this large patient database will enable both studies to further medical knowledge and GIS-based epidemiological tools to track the progress of outbreaks. Finally, security and validation are always issues in any health care information setting.

Again, simplicity is the highest priority. Elegance is more important than elaborateness; connectivity is more important than features. Rather than trying to do too much, we will streamline processes and leverage as much as we can from a simple system to create a modular information framework that is open to future expansion. Thorough software documentation and training of local personnel will ensure sustainability in the long run.

Secondary issues that will not be formally addressed in this first round of funding but that will in the back of our minds as we design the system include a method for enabling physician reimbursement and long-term financial sustainability for the system.

3. Schedule

Conceptually the project will grow in stages moving through different units of the health care system. The system will first be implemented at the National Hospital of Pediatrics (NHP) in Hanoi which

will later be connecting to other pediatric facilities – beginning with the Thai Nguyen Medical University – before expanding into the entire hospital system. Along the way other elements of health care will be incorporated including epidemiological surveillance in public health.

The ultimate vision is grand, so to judge technical progress, the project is divided into four phases that emphasize connectivity over features [see Figure 1]. Phase 1 will involve creating the basic medical record, implementing the wireless platforms, and connecting doctors in rural areas to consulting doctors at major health care facilities. Phase 2 will add some of the other services within the hospital including nursing, the laboratory and radiology. In addition, Phase 2 will begin to connect the medical record to other hospitals in the region and public health outbreak monitoring. Phase 3 will move beyond direct patient care to incorporate access to research and some of the administrative functions within the hospital including reimbursement. The final Phase 4 will incorporate more sophisticated sensors and videoconferencing technology to allow remote physicians to directly evaluate patients from a distance. This last phase is years away, and this particular grant is only expected to allow us to complete a prototype of Phase 1 and begin to explore Phase 2 at the end of one year. Anticipated milestones are as follows:

Q1	Q2	Q3	Q4
Hardware Acquisition			
Database Design	Database Development	Database Development	Database Development
Handheld S/W Development	Handheld S/W Development	Handheld S/W Development	
GUI Design	GUI Design	GUI Design	
	Scouting in Vietnam	Phase 1 Testing in USA	Phase 1 Testing in Vietnam
		Addition of Ancillary Services	Public Health Integration
			Multiple Database Linking

4. Use of Funds

Personnel		Title
Joseph Rosen, MD	\$20,000	Principal Investigator
Eliot Grigg	\$10,000	System Designer
David Findlay	\$15,000	Software Engineer
Shunhui Zhu	\$10,000	Consultant
C. Everett Koop, MD	\$10,000	Consultant
Tom Hope	\$5,000	Software Engineer

Lily Hue, MD	-	Consultant
Matt Collins, MD	-	Consultant
Subtotal		\$70,000
Equipment	Qty	
Computer Server	1	\$4,000
Developing Computers	2	\$4,000
Smartphone/PDA TBD	1	\$600
Tom Tom Navigator 5 Bluetooth GPS	1	\$300
Socket Cordless Hand Scanner 7M	1	\$600
Webspace + Advertising + Admin	1	\$1,000
Phone Service Plans w/ Unlimited Data x 1year	6	\$5,500
Subtotal		\$16,000
Digital Inclusion RFP Technology Resource Kit	Qty	
i-mate K-JAM Smartphones	6	\$0
Visual Studio 2005 Professional Edition	3	\$0
SQL Server 2005 + Mobile Edition	2	\$0
.NET Compact Framework Rapid development platform	3	\$0
Windows Server 2003	2	\$0
Subtotal		\$0
Travel		
4 Trips to Vietnam (2 trips, 2 people)		\$10,000
Conference Travel (1 trip, 3 people)		\$3,500
Subtotal		\$13,500
GRAND TOTAL		\$99,500

5. Dissemination and Evaluation

The unpaid consultants will serve as independent evaluators, but the most important feedback is from the users (both doctors and patients), so we will create formal mechanisms for user feedback both here in the USA and in Vietnam. The system will also be evaluated by the Vietnamese Ministry of Health, and finally, the most telling source of feedback is how often the system is used once it is implemented, which we will monitor. Technical evaluation of the system will be based on clinical performance indicators and functional performance, including patient privacy, clinical efficacy, security, system usability, cost, quality and “End-to-End Performance Monitoring”.

We will exploit our team’s broad and deep technical experience to meet the objectives proposed for this effort using a spiral testbed development and evaluation cycle. Prototypes will be implemented and tested incrementally throughout the development cycle so that successive prototypes will incorporate

feedback from domain experts and performance analysis and the development cycle will move more quickly.

The team will publish one or two papers in telemedicine journals and present in at least one conference during the first year. To make it maximally accessible the code will be open source so that others can add to it in the future, and we will encourage all to preserve our philosophy of simplicity, flexibility and reliability. In addition, we will contribute any resulting curriculum material to the MSDN Academic Alliance Curriculum Repository.

6. Other Support

The team will be receiving consulting services from the following four individuals: C. Everett Koop, MD, ScD, former US Surgeon General, is currently the Director of the C. Everett Koop Institute at Dartmouth College. Shunhui Zhu is an independent contractor with extensive software engineering experience. Lily Hue, MD is the Director of Education, Research and Training at the National Hospital of Pediatrics, Hanoi, Vietnam. Matt Collins, MD is the Vice President of Medical Services the University of Massachusetts and has an ongoing relationship with the Thai Nguyen Medical University in Thai Nguyen, Vietnam.

7. Qualifications of Principal Investigator

Joseph Rosen, MD is a Professor of Surgery (Plastic and Reconstructive) at the Dartmouth-Hitchcock Medical Center and an Adjunct Professor at the Thayer School of Engineering, Dartmouth College. Dr. Rosen is a member of the American Telemedicine Society and has provided telemedicine technology and application consulting for both NASA and the Defense Advanced Research Projects Agency. He has helped to develop telemedicine systems in both India and Peru, and was instrumental in the design of ARTEMIS: A Vision for Remote Triage and Emergency Management Information Integration for the US Army. He teaches multiple courses in health care technology at the Thayer School of Engineering and has spent time in the last few years teaching and operating in Vietnam. Selected, relevant publications from the last few years include:

EB Grigg; JM Rosen, MD; CE Koop, MD. 2006. **The Biological Disaster Challenge: Why we are least prepared for the most devastating threat and what we need to do about it.** The Journal of Emergency Management. [Accepted for Publication]

C Swift, JM Rosen, GE Boezer, J Lanier, JV Henderson, A Li, RC Merrell, S Nguyen, A Demas, EB Grigg, MF McKnight, J Chang, CE Koop. 2005. **Homeland Security and Virtual Reality: Building a**

Strategic Adaptive Response System (STARS). Studies in Health Technology and Informatics 111: 549-555.

JM Rosen, EB Grigg, MF McKnight, CE Koop, S Lillibridge, BL Kindberg, L Hettinger, and R Hutchinson. 2004. **Transforming Medicine for Biodefense and Healthcare Delivery: Developing a Dual-Use Doctrine That Utilizes Information Superiority and Network-Based Organization.** IEEE Medicine in Engineering and Biology 23 (1): 89-101.

EB Grigg, CE Koop, J Lanier, JM Rosen. 2003. **Cybercare: Virtual Reality Technologies for Homeland Defense.** Studies in Health Technologies and Informatics 94: 96-9.

JM Rosen, MD; EB Grigg; SP McGrath; S Lillibridge, MD; CE Koop, MD. 2003. **Cybercare NDMS: An Improved Strategy for Biodefense Using Information Technologies.** Proceedings from the International Conference on Telemedicine. Regensburg, Germany. September 22-25th, 2002. Reprinted in Studies in Health Technologies and Informatics 97: 95-114.

JM Rosen, MD; EB Grigg; J Lanier; SP McGrath; S Lillibridge, MD; DS Sargent; CE Koop, MD. 2002. **Cybercare: The Future of Command and Control for Disaster Response.** IEEE Engineering in Medicine and Biology 21(5): 56-68.

JM Rosen, CE Koop, and EB Grigg. 2002. **Cybercare: A System for Confronting Bioterrorism.** The Bridge 32(1): 34-40.

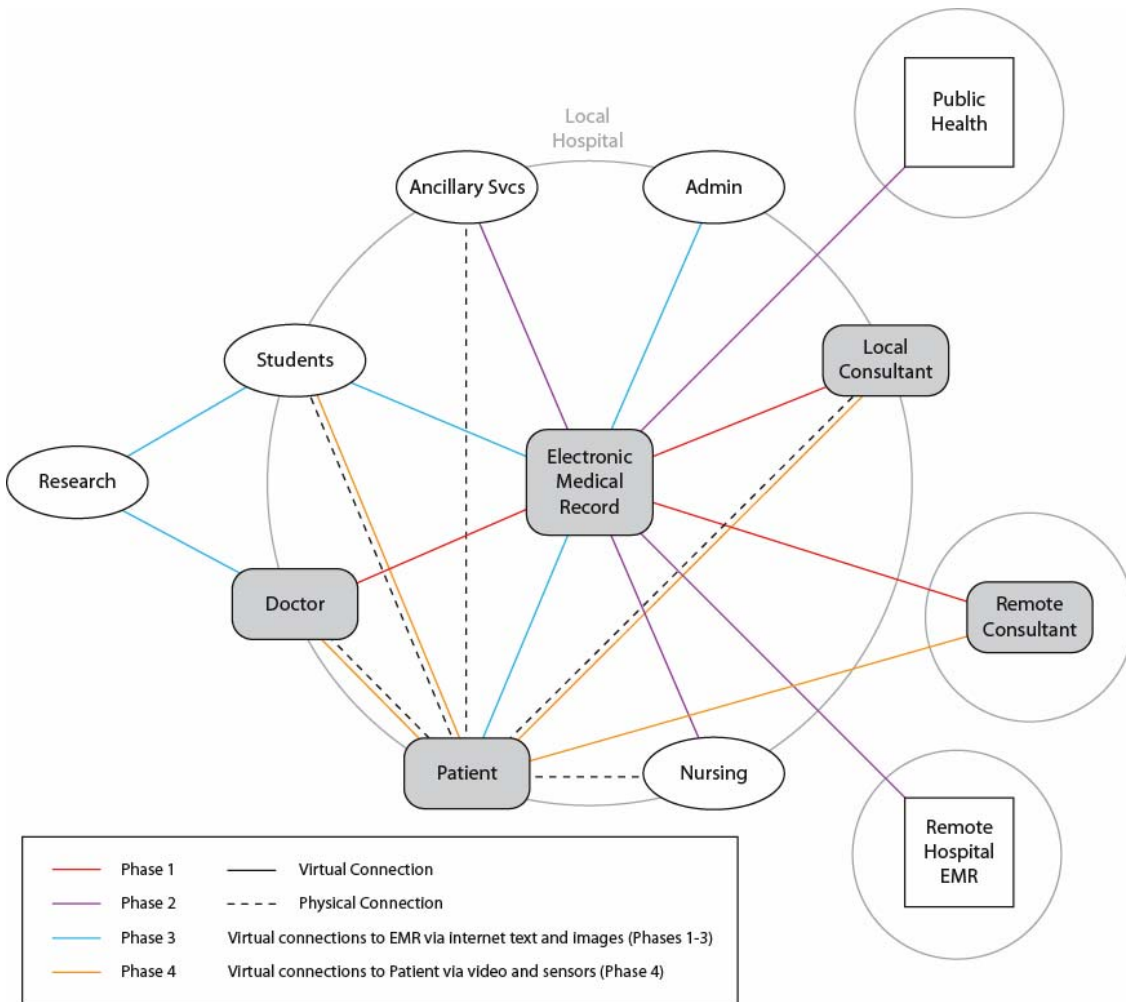


Figure 1. An overview of the system and its design phases. This grant would fund Phase 1 and the beginning of Phase 2.