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A Framework for Delivering M-health Excellence

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Abstract

Medical science has made revolutionary changes in the past decades. Contemporaneously however, healthcare has made incremental changes at best. The growing discrepancy between the revolutionary changes in medicine and the minimal changes in healthcare processes is leading to inefficient and ineffective healthcare deliver and one if not the significant contributor to the exponentially increasing costs plaguing healthcare globally.

Healthcare organizations can respond to these challenges by focusing on three key solution strategies; namely, 1. access - caring for anyone, anytime, anywhere; 2. quality – offering world class care and establishing integrated information repositories; and 3. value – providing effective and efficient healthcare delivery. These three components are interconnected such that they continually impact on the other and all are necessary to meet the key challenges facing healthcare organizations today.

The application of mobile commerce to healthcare; namely, m-health appears to offer a way for healthcare delivery to revolutionize itself. However, little if anything has been written regarding how to achieve excellence in m-health. This paper serves to address this major void.

Key Words: *healthcare, mobile/ wireless solutions, mobile architecture, healthcare portal*

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1. Introduction

Currently the healthcare industry in the US as well as globally is contending with relentless pressures to lower costs while maintaining and increasing the quality of service in a challenging environment (Pallarito, 1996; Wickramasinghe and Silvers, 2003). It is useful to think of the major challenges facing today's healthcare organizations in terms of the categories of demographics, technology, and finance. Demographic challenges are reflected by longer life expectancy and an aging population; technology challenges include incorporating advances that keep people younger and healthier; and finance challenges are exacerbated by the escalating costs of treating everyone with the latest technologies. Healthcare organizations can respond to these challenges by focusing on three key solution strategies; namely, 1. access - caring for anyone, anytime, anywhere; 2. quality – offering world class care and establishing integrated information repositories; and 3. value – providing effective and efficient healthcare delivery. These three components are interconnected such that they continually impact on the other and all are necessary to meet the key challenges facing healthcare organizations today.

In short then, the healthcare industry is finding itself in a state of turbulence and flux (Wickramasinghe and Mills, 2001). Such an environment, is definitely well suited for a paradigm shift with respect to healthcare delivery. Many experts within the healthcare field area agree that m-health appears to offer solutions for healthcare delivery and management that serve to maximize the value proposition for healthcare. However, to date, little if anything has been written regarding how to achieve excellence in m-health. This paper serves to address this apparent void.

2. Integrative Model for m-Health

Successful m-health projects require a consideration of many components. Figure 1 provides an integrative model for all key factors that we have identified through our research that are necessary in order to achieve m-health excellence.

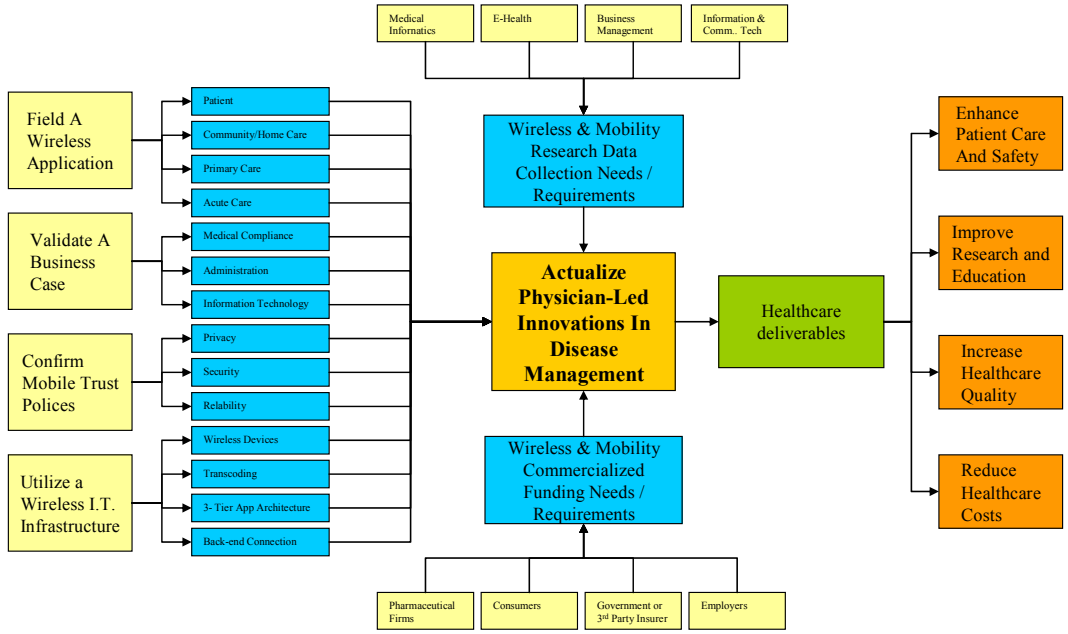

Figure 1 : A Mobile e-Health Project Delivery Model

2.1 Web of Players

Any healthcare initiative, be it wired or wireless, must first and foremost be aware of all key players that are required and involved in order to make a specific action, such as treating a patient, successfully. It is useful to think of these players as a web of players because they interact at different levels and degrees depending on the specific action or procedure. Figure 2 depicts the web of players that must be considered for healthcare in general and m-health in particular. From this figure, it is possible to see that m-health requires input and co-ordination between and within suppliers, payors, healthcare organizations, providers, regulators and the patient, if excellence is to truly ensue. Further, all these players are represented in figure 1, where their specific roles regarding any m-health project are also noted.

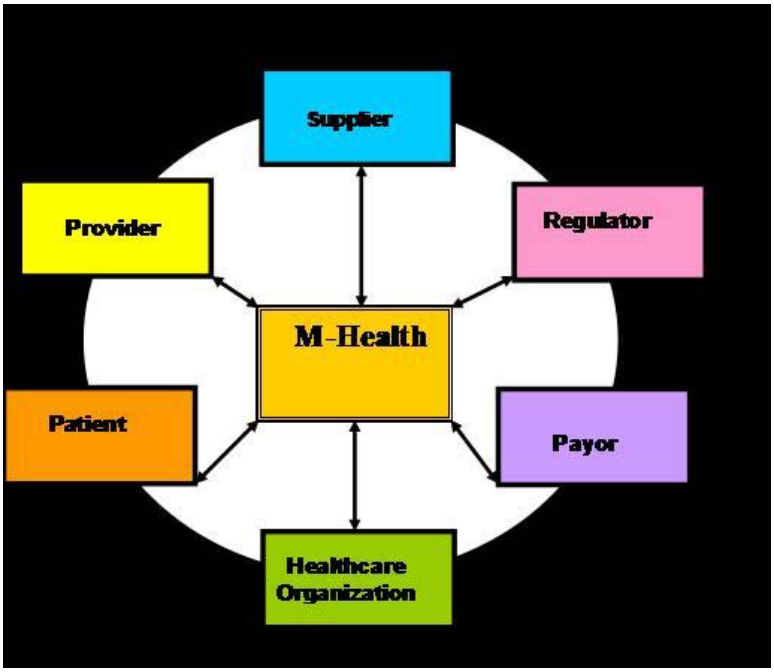

Figure 2 Web of healthcare players – adapted from (Wickramasinghe et al., 2004)

2.2 IT Architecture

The next important consideration is concerned with the existing IT infrastructure and architecture. Any m-health solution must leverage off existing IT architecture at the respective locations of the web of key players. Typically, in today's techno centric world this involves understanding the client-server computing paradigm as depicted in figure 3. To support such a client-server architecture special attention must be paid to the ICT infrastructure. The ICT infrastructure includes phone lines, fiber trunks and submarine cables, T1, T3 and OC-xx, ISDN, DSL and other high-speed services used by businesses as well as satellites, earth stations and teleports. A sound technical infrastructure is an essential ingredient to the undertaking of e-health and m-health initiatives. Such infrastructures should also include telecommunications, electricity, access to computers, number of Internet hosts, number of ISP's (Internet Service Providers) and available bandwidth and broadband access. Such IT infrastructure and architecture components form a key input into the designing and development of any m-health project as can be seen in figure 1.

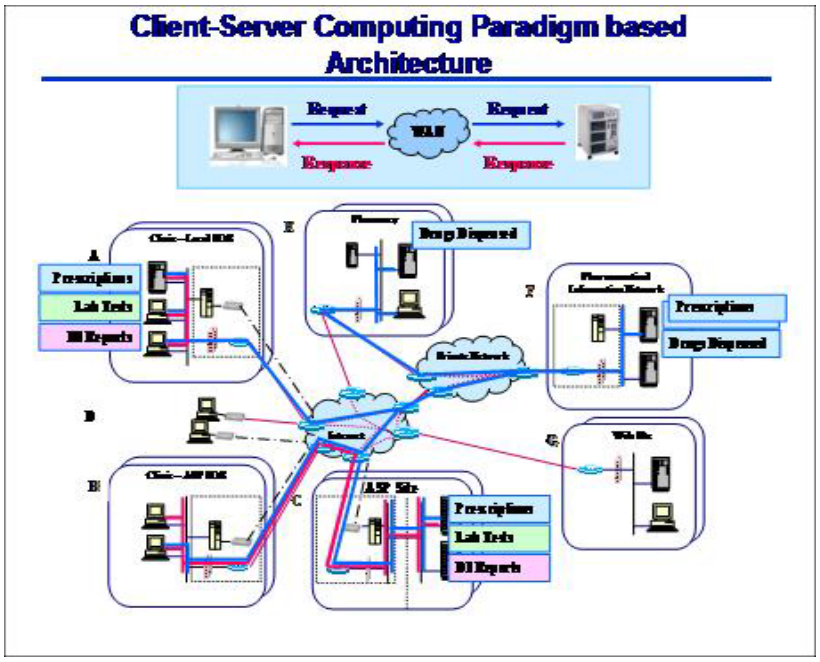

Figure 3 IT architecture - adapted from (Wickramasinghe et al., 2004)

2.3 Security And Regulatory Conformance

In the US, security, privacy and standards for electronic submissions and exchange of healthcare information are covered by HIPAA (the Health Insurance, Portability and Accountability Act) (HIPAA, 2001; Moore and Wesson, 2002). It is useful to conceptualize this as a HIPAA triangle (figure 4) which highlights the fundamental elements of the HIPAA regulation; namely, security, transaction standards and privacy.

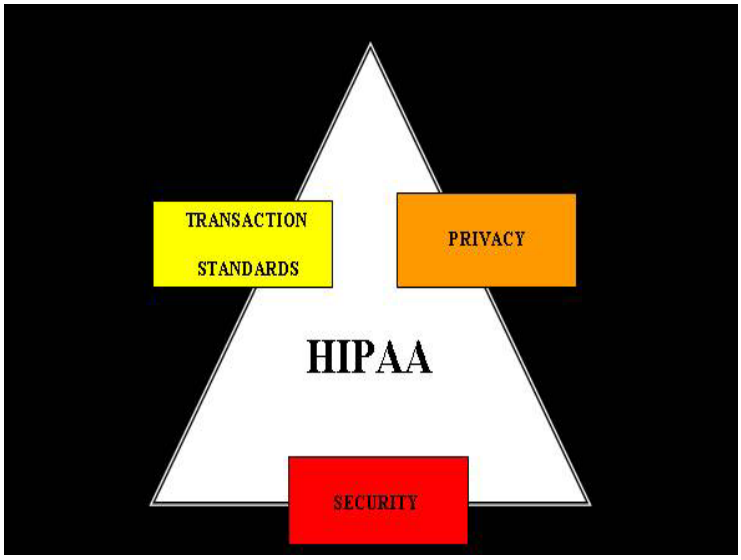

Figure 4 HIPAA Triangle - adapted from (Fadlalla and Wickramasinghe, 2004)

2.3.1 Security

According to HIPAA, a number of security criteria must be met by all electronic healthcare transactions. Some of these criteria directly affect how healthcare systems can be accessed as well as how the key players may interact with these systems. Table 1 details some extracts of the HIPAA security requirements (readers interested in the complete HIPPA security requirements are referred to (HIPAA, 2002)). Essentially, these security criteria fall into 3 main categories; namely administrative, physical and technical. Table 2 summarizes the major issues and levers under each of these categories as well as identifying which are required and optional.

Table 1 HIPAA Security Requirements adapted from (Fadlalla and Wickramasinghe, 2004)

Extracts from HIPAA Concerning Security Requirements
Establishment of trust partnership agreements with all business partners.
Formal mechanisms for accessing electronic health records.
Procedures and policies to control access of information.
Maintaining records of authorizing access to the system.
Assuring that system users receive security awareness training and the training procedures are periodically reviewed and updated.
Maintaining security configuration including complete documentation of security plans and procedures, security incident reporting procedures, and incident recovery procedures.
Communication and network control including maintaining message integrity, authenticity and privacy. Encryption of messages is also advocated for the open network transmission portion of the message.
Data authentication to ensure that data is not altered or destroyed in an unauthorized manner.

2.3.2 Transaction Standards

The Standards for electronic health information transactions cover such transactions, including claims, enrollment, eligibility, payment, and co-ordination of benefits. Succinctly stated the aspect of HIPAA referring to transaction standards can be thought of in terms of practice standards and technical standards as can be seen in Table 2 below.

Table 2 Practice and Technical Standards

STANDARD SETS
Practice Standards
Health Care Common Procedure Coding System (HCPCS) This standard contains the Level II alpha-numeric HCPCS procedure and modifier codes, their long and short descriptions. These codes, which are established by CMS's Alpha-Numeric Editorial Panel, primarily represent items and supplies and non-physician services not covered by the American Medical Association's CPT-4 codes. This standard does not contain the American Medical Association's CPT-4 codes.
ICD-9 – Diagnosis Codes International Classification of Diseases, 9th revision, Clinical Modification ICD-9-CM.
ICD-9 – Procedure Codes International Classification of Diseases, 9th revision, Clinical Modification ICD-9-CM.
Technical Standards
Technical Standards Adoption of electronic data interchange (EDI) using health care industry implementation guidelines and other standards such as XML and X12

2.3.3 Privacy

The final element of the HIPAA triangle deals with ensuring the privacy of healthcare information. Specifically, the Federal Register (Vol. 67, No. 157) details all the rules that must be adhered to with respect to privacy. The purpose of these rules is to maintain strong protections for the privacy of individually identifiable health information, addressing the unintended negative effects of the privacy requirements on healthcare quality or access to healthcare, and relieving unintended administrative burdens created by the privacy requirements. Thus, theses privacy requirements cover uses and disclosures of treatment and payment information and create national standards to protect individuals' medical records and other personal health information. Specifically, they

- give patients more control over their health information.
- set boundaries on the use and release of health records.
- establish appropriate safeguards that health care providers and others must achieve to protect the privacy of health information.
- hold violators accountable, with civil and criminal penalties that can be imposed if they violate patients' privacy rights.
- strike a balance when public responsibility requires disclosure of some forms of data - for example, to protect public health.

For patients - this means being able to make informed choices when seeking care and reimbursement for care based on how personal health information may be used. Specifically, privacy requirements

- enable patients to find out how their information may be used and what disclosures of their information have been made.
- generally limit release of information to the minimum reasonably needed for the purpose of the disclosure.
- give patients the right to examine and obtain a copy of their own health records and request corrections.

For the average health care provider or health plan, the privacy regulations require activities, such as:

- Providing information to patients about their privacy rights and how their information can be used.
- Adopting clear privacy procedures for its practice, hospital, or plan.
- Training employees so that they understand the privacy procedures.
- Designating an individual to be responsible for seeing that the privacy procedures are adopted and followed.
- Securing patient records containing individually identifiable health information so that they are not readily available to those who do not need them.

2.4 IT Architecture and Standard Mobile Environment

By adopting a mobile/wireless healthcare delivery solution it is possible to achieve rapid healthcare delivery improvements, which impact both the costs and the quality of healthcare delivery. This is achieved by using an e-business acceleration project which provides hospitals a way to achieve desired results within a standardized mobile Internet (wireless) environment. Integral to such an accelerated project is the ability to build on the existing infrastructure of the hospital. This then leads to what we call the 3-tier web-based architecture (figure 5).

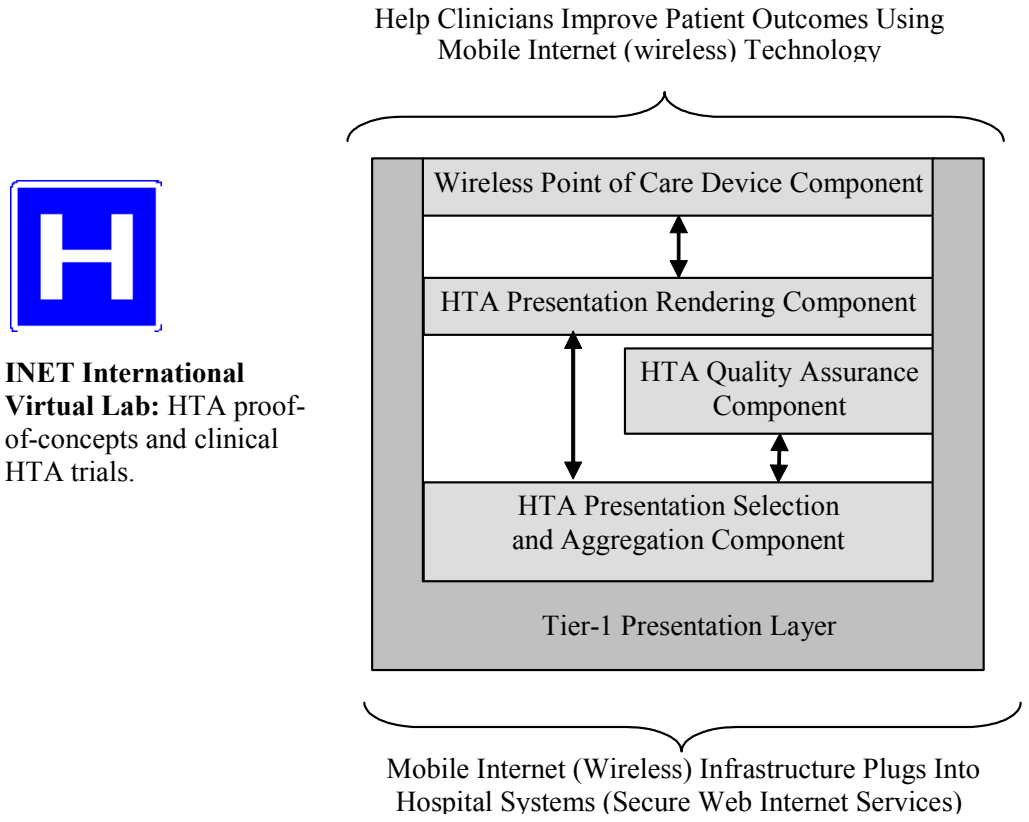

Figure 5: A Standardized Mobile Internet (wireless) Environment

In such an environment, Tier-1 is essentially the presentation layer; which contains the web browser but no patient data is stored within this layer, and thereby ensuring compliance with international security standards / policies like HIPAA. Tier-2 then, provides the business logic including but not limited to Lab, Radiology and clinical transcription applications, Messaging of HL7, XML, DICOM and other data protocols, and interface engines to a Hospital Information Systems (HIS,) Lab Information Systems (LIS), Radiology Information Systems (RIS) as well as external messaging systems such as Smart Systems for Health (an Ontario Healthcare I.T. infrastructure project). Finally there is the Tier-3 architecture which consists of the back-end databases like Oracle or Sybase.

3. Mapping Case Study to Model

During the past six years INET has used an eBusiness acceleration project to increase Information and Communication Technology (ICT) project successes. Today INET is repurposing the eBusiness Acceleration project into a mobile e-health project to apply, enhance and validate the mobile e-health project delivery model. Such a model provides a robust structure and in turn serves to ensure excellence in the m-health initiative. INETs data provides the perfect opportunity to examine the components of our model (figure 1) as it is both rich and longitudinal in nature. In Mapping the data and specific business case we have drawn upon many well

recognized qualitative techniques including conducting both structured and unstructured interviews, in depth archival analysis and numerous site visits (references Goldberg, et al, 2002a-2002e; Wickramasinghe and Goldberg, 2004) capture and substantiate the findings discussed while Kavale (1996), Boyatzis (1998) and Einhardt (1989)detail the importance and richness of the methodologies we have adopted in presenting the following findings) .

3.1 e-Businesses Acceleration Project Background

Understanding the need for an eBusiness acceleration project, starts with the core practice in ICT project delivery, the System Development Life Cycle (SDLC). Typically these are 1 to 5 year cycles that focus on reengineering large and complex business processes. When engaging in these projects major changes occur in the way people work, the way they are compensated, and the way they engage others in the delivery of goods or services. Once an organization engages in a SDLC project, they quickly formalize a change management team to prevent potential disruptions to delivery due to process, organizational and technology change. Unfortunately, even with this attention to rigor and taking into consideration the people issues, it is well documented that many of these SDLC projects fail. For instance, a major part of the SDLC is software; these projects have a high failure rate as presented in the in Figure 6.

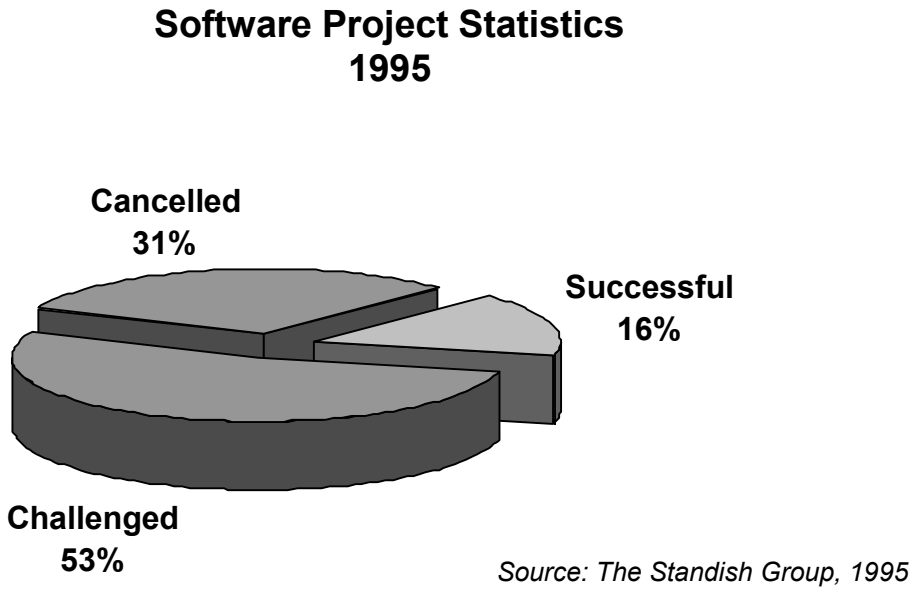

Figure 6: Software Project Delivery Success

A closer look at the reasons behind these failures can be found in papers, such as, the Chaos Report (1996). The scope and approach of this landmark survey provides expert comments on IT project failures. It was conducted among 365 IT managers from companies of various sizes and in various economic sectors.

Opinions about why projects are impaired and ultimately cancelled rank incomplete requirements and lack of user involvement at the top of the list. Please refer to Table 3 for a list of project impaired factors.

Table 3: Project Impaired Factors

Project Impaired Factors		% of the Responses
1.	Incomplete Requirements	13.1%
2.	Lack of User Involvement	12.4%
3.	Lack of Resources	10.6%
4.	Unrealistic Expectations	9.9%
5.	Lack of Executive Support	9.3%
6.	Changing Requirements & Specifications	8.7%
7.	Lack of Planning	8.1%
8.	Didn't Need It Any Longer	7.5%
9.	Lack of IT Management	6.2%
10.	Technology Illiteracy	4.3%
11.	Other	9.9%

To increase project success, INET created an e-Business acceleration project to narrow a SDLC project scope form meeting 100s or even 1,000s of requirements to just a few high impact requirements. As a result INET projects:

- Engage users very early in the project to identify, prioritize, and select the right set of requirements the first time and apply Internet and wireless technology to maximize user involvement.
- Minimize the need for resources in technology, process and people by developing an information and communication technology (ICT) application that can be developed, tested and QA (quality assured) within days.
- Demonstrate results early with a pilot project to set realistic expectations achieve executive sponsorship faster, and prevent changes to requirements once in field.
- Release low cost, simple-to-use, pervasive and commercialized ICT solutions to make planning much easier and significantly reduce technology educational costs and time cycles.

The purpose is to re-engineer a large and complex delivery process in small manageable chunks, in a much shorter time cycles, with a minimum impact on the way people work. Once a couple of projects are successfully accepted by the user community, many INET projects can happen concurrently to scale results and accelerate SDLC achievements. This is presented in figure 7: Refocusing the SDLC.

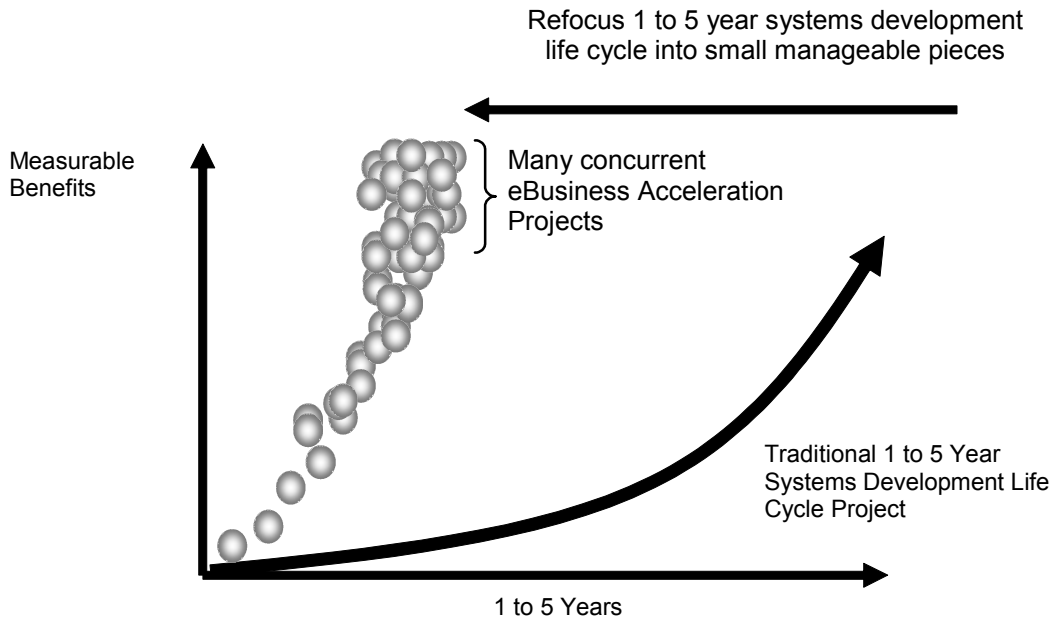

Figure 7: Refocusing the SDLC

The INET e-Business Acceleration project success has been documented in healthcare (Wickramasinghe and Goldberg, 2004). It meets the need to enhance healthcare delivery, under a medical model, in making small incremental changes and scale success with international peer review and acceptance.

3.2 A New ICT Infrastructure to Support eBusiness Acceleration Projects

INET's challenge was finding an ICT infrastructure to support the delivery of an accelerated e-business project. After five years of investigation and practical experience, INET has defined this new ICT Infrastructure as:

1. Simple and low cost technology: Internet applications, wireless technology, Cellphones, and/or Personal Digital Devices (PDAs)
2. The next generation ICT professional: Engage ICT players that have made the transition to a new cultural of meeting the highly responsive and evolutionary needs of end-users.
3. Demonstrable processes to accelerate ICT project delivery: Demonstrate a rigorous project delivery process that reduces time cycles by 75% with a 50% reduction in project costs.

For an in-depth look at INET findings let us begin with a definition of an Information and Communication Technology (ICT) infrastructure. It can be defined as a set of technologies, such as, computer hardware, devices, printers, applications, software, wired and wireless networks and other technology components. The infrastructure is supported by ICT players that research, develop, deliver, service and sell technologies to enhance information systems operations. These players also deliver new systems using a rigorous systems development life cycle methodology. In healthcare an ICT infrastructure can be referred to as e-Health, and typically contain configurations similar to that depicted in figure 3.

What is different today? In the past, many people resisted the use of technology to exchange and communicate information. It is well documented that they will not use technology if it is too complex or too costly. What is new today is the commercialization and acceptance of wireless technology. Wireless technology eliminates the costs and complexity in communicating and exchanging information at the point of need, regardless of location or time. This is evident by the widespread use of Personal Digital Assistances (PDA), and Cell-phones along with wireless data networks. Today, over 33% of the physicians use PDAs and by 2005 it is predicted to grow to 50%[2]. In 2003, PDA usage among medical residents is 85%[3]. Over 172 million American consumers use cell phones[4] with the potential to access healthcare ICT systems anywhere, anytime.

Even with wireless technology removing the cost and usability barriers to enhance communications and the exchange information; INET quickly discovered a new barrier when trying to engage the ICT industry in an e-Business Acceleration project. This is manifesting itself as a user frustration with the responsiveness of the ICT industry to meet their demands. INET believes this is the result of a project engagement gap between the ICT 1 to 5 year system development cycle practices and users demand for immediate and quick results. The e-Business Acceleration Project was design to bridge the gap between the ICT and the user. From INET's experience, ICT needs a cultural change, to meet the highly responsive and evolutionary needs of an e-business acceleration project. The INET experience clearly showed there was no consensus on an ICT infrastructure (people, process and technology) to support both benefits of wireless technology and rapid project delivery achievements. INET spent four years to research and develop a roadmap to help the ICT industry make this transition. To release a solution and build consensus, INET founded and chaired the first wireless I.T. committee for the Information Technology Association of Canada (ITAC). After the inaugural year, the group delivered the Wireless I.T. Infrastructure Procurement Guidelines in Healthcare5.

At the same time of the ITAC Wireless I.T. Committee, INET started to gather evidence on an ICT infrastructure that can support the rapid and concurrent delivery of INET e-business acceleration projects. After a surveillance of Internet usage, INET selected healthcare market research in 2003. This industry is quickly shifting traditional quantitative research methods, such as face to face or telephone interviewing to online surveys using the Internet. The use of the Internet has shorten field time cycles by as much as 75% with the added benefit of reducing costs upwards to 50% when compared with telephone studies. To confirm these findings INET completed over 20 market research engagements involving U.S., UK, Canada, Japan, Denmark, Italy, Spain, Australia, Germany, and France. To deliver these eBusiness Acceleration projects, INET assembled and used an ICT Infrastructure with the following key attributes:

- The heart of the INET ICT infrastructure is a form generation technology component(s) to create custom online surveys within 3 days. This an instrument with the programming capability to deliver custom surveys (forms) on demand, field multiple projects at the same time, integrate with many online panel methods; support, at a minimum, all standard survey question types including single and multi selects, grid and 3-dimensional grid questions,

[2] Source: Harris Poll.

[3] MercuryMD July 2003

[4] http://www.ctia.org : December 18, 2004 9:48 a.m. EST there were 172,984,768 Current US Wireless Subscribers

[5] This documents a consensus to begin the ICT industry's transition with a five step wireless IT infrastructure Deployment Roadmap. This document and other reference material is available at www.itacontario.com please select the wireless committee, wireless committee resources.

open text/verbatim, and numeric entry; and able to securely integrate video/audio clips and other embedded technology objects.

- The INET hosting environment employs a fully redundant technical platforms, hosted in a state-of-the-art data center and capable of handling over 50,000 surveys per hour. INET also assures these platforms are secure, and when required can conduct a HIPAA compliant audit.
- The technology hosting servers have redundant connectivity to the Internet and are managed on a 7 day/24 hour basis.
- When required connect to wireless networks and devices using transcoding technology components. Transcoding component sits on top of three-tier application architecture to redirect applications for use by a smaller screen, synchronize data, and supports many types of wireless devices from laptops to cell phones: Please refer to Figure 5.

Using the INET ICT infrastructure, an INET eBusiness acceleration project for market researchers begins with a questionnaire written in an MSWord document; it is then programmed and hosted for the Internet. When required the survey is translated into another language to field in a non-English speaking country. Then INET fields the study with an online panel of physicians, for instance INET sourced almost 200,000 physicians worldwide to participate in online research. An online panel process begins by e-mailing an invitation to the targeted respondent to participate in an Internet survey. With the use of an anonymous electronic ID, privacy is upheld and enhanced. There is no personnel information capture in the online survey. Once a panel member clicks on a unique URL, in the e-mail, they are immediately connected to a secure internet site and complete the survey. Typically, an online panel response rate is 23% and upwards to 40%. Total time to program and test a survey is 3 days. The timing in field is approximately five to seven days regardless if this is for N=100 or N=2000 completes, and delivery of the data file within 24 hours.

In summary, INET reuses the lessons learned from delivering market research data collection projects and using wireless technology to show how an ICT infrastructure can support INET e-business acceleration projects. The next step is to gain better acceptance of an e-Business acceleration project in healthcare.

3.3 Achieve ICT Project Success in Healthcare

To achieve ICT project success in healthcare INET is mapping the e-business acceleration project to the mobile e-health project delivery model and then vetting the model with a use case scenario. This paper is part of this process. INET sees this model, combined with use case scenarios and along with a peer review process as a rigorous mechanize in the delivery of local and international mobile e-health projects.

For the past 5 years, the primary sponsors for a mobile e-health project are organizations looking to conduct studies on the use of wireless or mobile technology in healthcare delivery. These projects are typically funded through government research grants, and the IT industry. In INET's case, eBusiness acceleration project was used to deliver mobile e-health project and was funded through the ICT industry sector. However, in 2003, INET began to quickly understand that it would be difficult for the ICT industry to continue the sponsorship of research originated projects without a much faster commercial payback period. INET clearly saw this as the need to rebalance funding from research to commercial sources. With this in mind, INET started working in collaboration with others, on a strategy to incorporate the eBusiness acceleration

project as an INET mobile e-health project and accelerate commercial successes. The INET Mobile e-Health project objectives include:

1. Accelerate consensus building with an e-Health solution that is focused on a disease state and driven by the medical model. With the primary objective to streamline communications and information exchange between patients, and providers of community / home care, primary care and acute care.
2. Acquire commercial funding early with a compelling business case. For instance, enhancing therapeutic compliance can improve patient quality of life with significant healthcare cost savings. It is well documented that in Diabetes this will have immediate and high impact benefits for healthcare consumers, pharmaceutical firms, governments, insurers, and employers.
3. Avoid risk by reengineering large-scale healthcare delivery processes in small manageable pieces. Today, organizations can harness a rigorous method to incrementally enhance a process one step at time. A way to achieve quick wins early and frequently.
4. Rapid development of simple-to-use, low cost, and private/secure information and communication technology (ICT) solutions. Achieve these benefits through a wireless Application Service Providers (ASPs). In addition to rapid development, a wireless ASP can easily connect and bring together many independent healthcare information systems, and technology projects.

To actualize the mobile e-health project, INET is looking to the mobile ehealth project delivery model as a framework. For INET, this will support a Mobile e-Health Project Management Office (PMO) to manage the costs, quality and ICT vendors, deliver many small projects and replicate projects for local and international distribution. As a first case scenario for the model, INET is proposing an INET Diabetes Mobile eHealth project with the leadership from a Family Physician. The INET PMO is provisioning a project manager to support this physician-led project to meet both research and commercial sponsor's interests and objectives in diabetes. A detailed description of the key attributes of INET Diabetes Mobile e-Health project includes:

- **Problem Statement:**

  There are many communication and information exchange bottlenecks between Patients and their Family Physicians that prevent the effective treatment of diabetes. As background, a fundamental problem today is the ability to have a private and secure way to manage, search and retrieve information at the point-of-care. In Diabetes, physicians cannot quickly and easily respond to patients with high glucose levels. They need to wait for people to: come to the office, respond to phone calls, reply using traditional mail delivery, or never receive the patient information.

- **Solution Mandate:**

  Implement a diabetes monitoring program to enhance therapeutic compliance, such as, release a program to enhance the usage of oral hypoglycemic agents (drugs), and/or the usage of blood sugar monitoring devices.

  As background, everyone wins when enhancing patients' ability to follow instructions in taking prescribed medication. The patient's health, safety and quality of life improve with significant healthcare cost savings. However, it is well documented that

many patients do not stay on treatments prescribed by physicians[6]. This is where wireless technology may have the greatest impact to enhance compliance.

One solution may be as simple as using a cell phone and installing a secure wireless application for patients to monitor glucose levels, and provisioning a physician to use a PDA (connected to a wireless network) to confidentially access, evaluate and act on the patient's data

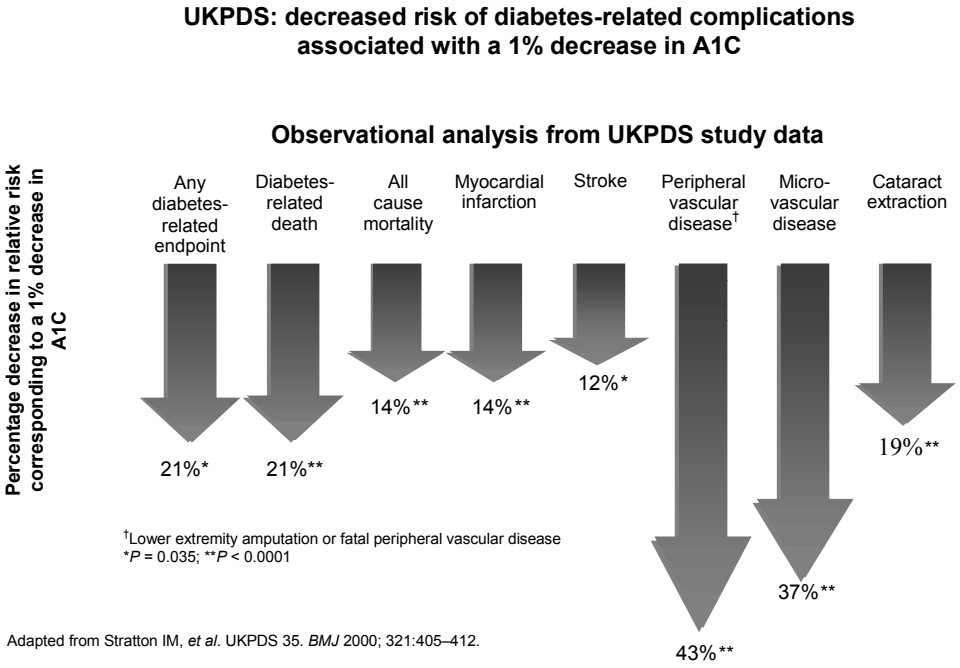

Figure 8: Impact form reducing AIC levels

- **Business Case:**

  In Ontario the cost savings may represent almost 1 billion dollars over three years.

  INET uses a simple calculation to determine the 1 billion dollar savings. This can be found at www.inet-international.com and please select the INET mobile e-health project section to review the calculations.

  The business case can be backed with additional data on how the cost of prevention (drugs) is far less than the cost savings associate of reducing the risk of complications associated with Diabetes. For instance, the impact of a 1% decrease in A1C is significant and evident in Figure 8.

6 Fourteen to 21% of patients never fill their original prescription and the thirty to 50% of patients ignore or otherwise compromise their medication instructions. Source: http://www.managedhealthcareexecutive.com/mhe/article/articleDetail.jsp?id=105388

The Canada healthcare costs savings is presented in Figure 9 and when matched with the impact of reduced complications in Figure 8 the cost savings are significant.

Economic Burden		
	direct medical costs*	mortality costs*
Diabetes	$573	$455
Chronic Complications	921	619
- Neurologic disease	148	63
- Peripheral vascular	63	N/A
- Cardiovascular	637	545
-Renal	49	11
-Ophthamologic	6	N/A
-Chronic complications	17	N/A
General Medical	1,133	N/A
Total	**2,627**	1,074

* in millions $

The economic cost of diabetes in Canada. 1998

University of B.C., Drs. Dawson, Gomes, Gerstein, Blanchard & Kahler

Figure 9: Economic Burden

More data is available to support the business case for the prevention of type 2 diabetes such as, lowering the incidence of End Stage Renal Disease (ESRD).

In summary, there is plenty of data today to quickly build consensus, fund and implement a national and international wireless diabetes program to enhance patients' quality of life with significant healthcare cost reductions.

- **Systems Development Life Cycle Project Delivery:**

  Use an INET Diabetes Mobile e-Health project to localize a wireless diabetes program led by a physician. Each project can easily and simply customize a program to quickly meet the unique needs of a rural and urban healthcare delivery setting, age, ethnicity, income, language, and culture. These are small manageable projects and may cost $100,000 to $250,000 with a per user operational cost of 1,200 to 1,500/year/consumer. Each project collects data on patient /healthcare provider relationships, wireless medical informatics, therapeutic compliance business case, and ICT usability to accelerate acceptance of a wireless diabetes program using wireless technology. The program may include cellular network and application usage, support, healthcare provider PDA, consulting fees for family physician and other healthcare providers. However it is expected that the costs may not include items, such as, consumer cell phone, medication or blood sugar monitoring devices/supplies. It is recommended that commercial and/or research sponsor(s) pay for an INET project, and help subsidize the user costs.

  In summary, INETs research data indicates that using the Mobile e-health project delivery model will increase ICT project success in healthcare. To realize and test this, INET plans to map the player's form an INET diabetes mobile e-health project (use case scenario) to the model. To show how this may work, please review the mapping exercise below. The bold text in black is a project player, and the color text in [] parenthesis relates to the sections of the model presented in Figure 1:

- **Physician Mobile eHealth Project Lead**: [Actualize Physician-led Innovations in Disease Management component in figure 1]. Physicians provide the linkage to the medical model to enhance disease management programs (wireless Diabetes Program) to enhance patient care and safety, improve research and education, increase healthcare quality and reduce healthcare costs. These are the project deliverables [Healthcare Deliverables component in figure 1]
- Commercial Sponsor(s) [Wireless & Mobility Commercialized Fund needs/Requirements component in figure 1] The project delivers information and communication solutions for:
  - Consumers wishing to improve their quality of life with an enhanced relationship with their healthcare provider's i.e. family physicians.
  - Pharmaceutical firms looking to increase revenues with e-Compliance programs.
  - Government/Insurers investigating ways to significantly reduce administration and healthcare costs, and shorten healthcare delivery time cycles (wait times.)
  - Employers wanting to increase productivity and avoid absenteeism with a healthier workforce.
- Research Sponsor(s) [Wireless & Mobility Research data collection Needs / requirements component in figure 1]: The project develops intellectual property for researchers in the fields of:
  - Patient and Healthcare Provider Relationships.
  - Wireless Medical Informatics.
  - Therapeutic Compliance Business Case.
  - Wireless Information Technology Usability.
- An INET Mobile eHealth Project Delivery Team:

- **Healthcare Delivery Team** [Field a Wireless Application component in figure 1] For a wireless diabetes program the players may include:
  - Healthcare Consumer: People with Diabetes
  - Community Care: Nurse Specializing in Diabetes
  - Primary Care: Family Physician
  - Acute Care: Endocrinologist
- **Business Process Analyst** [Validate A Business case component in figure 1]
- **Privacy and Security Consultant** [Confirm Mobile Trust Policies component in figure 1]:
- **Programmer using a wireless ASP** [Utilize a Wireless I.T. Infrastructure component in figure 1]:
  - Wireless Network and Devices
  - Device and Application Transcoding
  - Application Service Provider
  - Back-end connection

In conclusion, INET is looking forward to further advancements in the mobile e-health project delivery model to:

- Achieve rapid advancements in healthcare delivery.
- Improve diabetes management.
- Enhance therapeutic compliance.
- Realize significant healthcare care cost savings .

INET is planning to continue its role as a sources of use case scenarios for the model with the delivery Mobile eHealth Projects.

4. Critical Success Factors

The preceding has served to outline all the critical aspects that must be considered when trying to actualize a mobile health initiative. Clearly, Mobile e-health or m-health projects are complex and require much planning and co-ordination within and between the web of healthcare players. Success is never guaranteed in any large initiative however in order to realize the four major healthcare deliverables depicted in figure 1 (enhance patient care and safety, improve research and education, increase healthcare quality and reduce healthcare costs) it is vital that any m-health initiative to focus on the key success factors of people process and technology. Specifically, the technology must be correct and functioning as desired. Further, it must integrate seamlessly with existing ICT infrastructure and enable the processes. The processes must be well defined and at all times ensure that they are of a high quality and error free. The Institute of Medicine in America (2001) identified medical errors as the 4th leading cause of many deaths. In trying to prevent such errors it has identified six key quality aims; namely, 1) healthcare should be safe – avoiding injuries to patients from the care that is intended to help them, 2) effective - providing services based on scientific knowledge to all who could benefit and refraining from providing services to those who will not benefit (i.e. avoiding under use and overuse), 3) patient-

centered – providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions, 4) timely – reducing waiting and sometimes harmful delays for both those receiving care and those who give care, 5) efficient - avoiding waste and 6) equitable – providing care that doesn't vary in quality based on personal characteristics. Finally, and arguably the most critical key success factor is the web of healthcare players. Any m-health project must consider the impact and role on each of these players, the interactions of such an initiative both within one group of the web of players as well as between groups of players. As discussed, and based on the findings from INETs longitudinal studies it is critical to the ultimate success of these projects and the ability to in fact realize the healthcare deliverables that they are in deed physician led.

5. Discussion and Conclusions

Healthcare in the US and globally is at the cross roads. It is facing numerous challenges in terms of demographics, technology and finance. The healthcare industry is responding by trying to address the key areas of access, quality and value. M-health, or mobile e-health, provides a tremendous opportunity for healthcare to make the necessary evolutionary steps in order to realize its goals and truly achieve its value proposition. What is important is to ensure m-health excellence. By an in depth analysis of the rich and longitudinal data of INET we have developed a model to facilitate the achievement of m-health excellence. To the best of our knowledge it is the first such model and while it is certainly not a panacea it does help to set the stage and outline the key issues that must be addressed for a successful m-health initiative. We close by strongly urging for more research in this area that serves to test our model further.

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