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"Proposed Framework to Measure the ROI of Mobile Tele-Health Solutions in the Management of Chronic Diseases."

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# Proposed Framework to Measure the ROI of Mobile Tele-Health Solutions in the Management of Chronic Diseases

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**Abstract** - Significant changes in the distribution of healthcare costs (away from critical care and towards chronic diseases) pose major challenges to existing healthcare systems. Caring for a patient with a chronic disease lasts as long as a person is alive, and medical expenses accumulate unrelentingly. Therefore, new approaches to disease management of chronic diseases are urgently needed, especially in terms of increasing the (currently low) rate of adherence to the patient's prescribed treatment plan. A proposal is advanced to use Mobile Tele-Health systems to enhance the effectiveness of Disease Management programs. A framework to measure the ROI (Return On Investment) of these systems is also proposed.

***Index Terms*— Social ROI, Mobile Tele-Health, Chronic Disease, Mobile Disease Management, Medicare, Health Economics, Mobile Computing and Communication Devices.**

## I. INTRODUCTION

This paper looks at the potential to use Mobile Computing and Communication Devices ("MCCDs") as part of Mobile Tele-Health ("mTH") solutions to be used in the management of chronic diseases. [1] outlines some of the benefits of MCCDs that make them suitable for use in applications such as mTH. Even though some challenges have been identified in [2], MCCDs can help to alleviate some of the demographic and financial burdens imposed on the healthcare systems today [3]. According to a generally accepted definition of Tele-Health[1], it is a superset of the traditional Tele-Medicine systems currently in the market [4]. mTH is not just about providing remote access to a physician (the traditional version of tele-medicine). mTH is centered on the notion of the patient's body as the point of care.

Section II briefly covers some of the significant demographic shifts taking place in developed countries. Section III explains the radical change in healthcare usage patterns from critical care towards chronic care. Section IV presents a summary of the social costs chronic diseases impose in both the US and other countries. Section V highlights some of the reasons Disease Management programs have risen in visibility as a powerful cost-containment measure to bring escalating healthcare costs under control. Section VI addresses the challenge of adherence, or how to get patients to follow their prescribed treatment. Section VII advances the concept of mTH solutions as potential adherence-enhancing tools. Section VIII outlines a proposed framework to measure the Return on Investment ("ROI") of mTH solutions within the context of Disease Management programs for chronic diseases. The paper concludes with a call for companies developing mTH solutions to publish the results of their clinical trials in order to advance the level of knowledge and credibility in this area.

## II. IMPACT OF DEMOGRAPHIC SHIFT IN DEVELOPED COUNTRIES

As outlined in [2], developed countries face a demographic tsunami as significant percentages of their population will be over 60 by 2050: in Japan: 42.4%; Spain: 40.9%; and the US 25.5%. This demographic shift will put tremendous pressure on health care systems as follows

- Diminishing number of working adults contributing to the social health care pool
- Increasing number of older citizens demanding health care benefits for longer periods as life expectancy increases

A September 2003 report from the Cato Institute[2] has some sobering statistics on the financial impact of an aging America:

> "..Without reforms, the combined cost of Social Security and Medicare Part A is expected to rise from 13.8 percent of taxable wages today to 24.2 percent by 2040. Adding in projected spending on Part B of Medicare pushes up the total projected costs of the two programs to 30 percent of wages by 2040."

## III. EPIDEMIOLOGIC TRANSITION

All developed countries, and even some developing countries as well, are undergoing what's called an "Epidemiologic transition." This term describes the changing patterns of disease that accompanied overall improvements in health in the late 19th and early 20th Century. As mortality rates declined and life expectancy rose, these populations experienced a shift in the pattern of disease, from one dominated by infectious diseases to one dominated by chronic disorders such as heart disease and cancer. The shift to chronic diseases can be partly

[1] "Tele-Health" is the removal of time and distance barriers for the delivery of health care services or related health care activities. Some of the technologies used in telehealth include: telephones, computers, interactive video transmissions, direct links to health care instruments, transmission of images and teleconferencing by telephone or video. Telemedicine, as a telehealth subset…includes many medical specialties, such as teleradiology, teledermatology, telepsychiatry, etc.

[2] "War between the Generations: Federal Spending on the Elderly Set to Explode;" at http://www.cato.org/pubs/pas/pa488.pdf, last accessed on 04/27/2004.

explained by the fact that many more people were living to the age when chronic diseases strike. Even so, this transition represented not just a simple substitution of one set of problems for another but an overall improvement in health.

The World Health Organization ("WHO") in [5] defined Chronic Conditions as "The Health Care Challenge of the 21st Century." According to [5]:

> "..Chronic conditions share fundamental themes: they persist and they require some level of health care management across time. In addition, chronic conditions share some concerning features:
>
> - Chronic conditions are increasing throughout the world, and no country is immune to their impact.
> - Chronic conditions seriously challenge the efficiency and effectiveness of current health care systems and test our abilities to organize systems to meet the imminent demands.
> - Chronic conditions engender increasingly serious economic and social consequences in all regions and threaten health care resources in every country."

The management of chronic illnesses requires significant changes from the traditional healthcare model based on critical care. Chronic illnesses require:

- Higher frequency of patient interaction with provider
- Close analysis of patient's data over time
- Frequent intervention with individualized information
- Need to promote engagement with support groups
- Close collaboration and integration across multiple providers, and with others (relatives, care givers)

## IV. Social Costs of Chronic Diseases

In [5], the WHO estimates that currently, chronic conditions are responsible for 60% of the global disease burden. By the year 2020 developing countries can expect 80% of their disease burden to come from chronic problems. In the US alone, the Centers for Disease Control and Prevention ("CDC") indicates total cost estimates for diabetes range from $2.6 billion in 1969 to $98.2 billion in 1997, with the highest estimate being $137.7 billion in 1995. Although several of the reports consider only direct costs, most include both direct and indirect costs.[3] The health-related economic cost of obesity to U.S. business is substantial, representing approximately 5% of total medical care costs [9]. In the case of congestive heart failure (CHF), estimates are that it accounts for a million hospitalizations with an annual cost of $38.1 billion annually (5.4 percent of total healthcare costs in the U.S.)[4]. [13] indicates that Americans with chronic conditions account for 75% of health care costs.

## V. The Promise of Disease Management

Multiple published results, as well as empirical evidence, indicate that disease management is an effective way to both improve patient outcomes and reduce healthcare costs.

Staffers at the US Congressional Budget Office ("CBO") recently published a paper where they state that "..Disease management programs where technology is put in the service of identifying high-spending patients and coordinating their treatment may be a potent way to control Medicare spending."[5] The US Centers for Medicare & Medicaid Services ("CMS") has recently become a strong supporter of Disease Management programs as potential tools to reduce healthcare costs while improving patient outcomes. Specifically, CMS has launched two initiatives of interest:

- CMS is urging states to adopt Disease Management Programs to help those with chronic illnesses better manage their diseases. CMS will match state costs' in implementing such programs.[6]
- "Chronic Care Improvement Program".[7] In its pilot phase, the program will serve approximately 150,000 – 300,000 chronically ill beneficiaries. The program will offer self-care guidance and support to chronically ill beneficiaries to help them manage their health, adhere to their physicians' plans of care, and assure that they seek (or obtain) medical care that they need to reduce health risks.

In Germany, [11] reports a vivid example of the elevated costs of diabetic patients that do not properly control their disease:

> "..About half of the patients with diabetes type 2 had severe diabetes-related comorbidity, 56.2% showing more than one. For patients with macro- or microvascular complications, the costs increase 2.5 up to 4.1 times in comparison to the average health-insured patient. Costs for patients with ulcer of the lower extremities added to a mean total of EURO 7,537.- (DM 14,742.-) in the year of complication occurring. For patients undergoing amputation, mean annual costs of EURO 10,796.- (DM 21,115.-) arose. In diabetes patients suffering from a stroke, costs in the respective year summed up to EURO 7,147.- (DM 13,987.-). Amputations therefore led to a more than sixfold increase in costs, ulcer and stroke to a more than fourfold increase compared to diabetes patients without complications."

Given the heightened level of interest in Disease Management programs, what are the challenges towards broad implementation of such programs?

## VI. The Challenge of Adherence

One of the most significant challenges faced by Disease Management programs is the "adherence" issue. The WHO defines it as "The extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes- corresponds with agreed recommendations from a health care provider."[8]

[3] At http://www.cdc.gov/diabetes/pubs/costs/intro.htm, last accessed on 04/26/2004.

[4] At http://www.barnesjewish.org/groups/default.asp?NavID=767, last accessed on 04/26/2004.

[5] At http://content.healthaffairs.org/cgi/content/abstract/hlthaff.w3.603, last accessed on 04/26/2004.

[6] At http://www.cms.hhs.gov/media/press/release.asp?Counter=967, last accessed on 04/26/2004.

[7] At http://www.cms.hhs.gov/medicarereform/ccip/, last accessed on 04/26/2004.

[8] At http://www.who.int/chronic_conditions/en/Section1.pdf, last accessed on 04/26/2004.

The willful lack of compliance from individuals with Chronic Diseases creates enormous external costs ("Externalities"[9]) to other members of society. Seemingly private activities (such as the failure to measure one's glucose level in the case of a diabetic driver) can lead to increased fatality rates for drivers as well as for innocent by-standers, as outlined in [7].

In [8] the WHO clearly outlines the link between compliance and treatment success:

> "Adherence to therapies is a primary determinant of treatment success. Poor adherence attenuates optimum clinical benefits and therefore reduces the overall effectiveness of health systems. Medicines will not work if you do not take them — Medicines will not be effective if patients do not follow prescribed treatment, yet in developed countries only 50% of patients who suffer from chronic diseases adhere to treatment recommendations. In developing countries, when taken together with poor access to health care, lack of appropriate diagnosis and limited access to medicines, poor adherence is threatening to render futile any effort to tackle chronic conditions, such as diabetes, depression and HIV/AIDS."

For people who suffer from diabetes in the US, [10] reports that only 3% of insulin users and 1% of nonusers met all five of the American Diabetes Association standards in the previous year.

## VII. Mobile Tele-Health as a Potential Adherence-Enhancing Tool

The US Department of Commerce released a report on March 2004 ("Innovation, Demand and Investment in Telehealth")[10] suggesting that telehealth will be an increasingly important tool, and that the US government should do a better job of funding and coordinating. The report suggested that though the technology required to monitor patients from afar has matured, tele-health had not reached the "..critical mass needed to be fully included in national discussions of healthcare and homeland security."

In [12] and others we see the possibility of leveraging the always-on capabilities of MCCDs to deliver compliance reminders to patients. Also, these systems can be used to enhance patients' adherence to their Disease Management program.

According to [6] in Table 2.5, the hospital as the locus of care accounted for 36.4% of all US healthcare expenditures in 2000; and the physician's office, for 22.2%. Based on our prior analysis in Section IV above, the largest financial burden for current healthcare systems in the area of chronic diseases, and those can be treated effectively outside of institutional settings. Therefore, there is a tremendous mis-match between where the social need is (care to the individual) vs. where the healthcare expenditures are directed towards (institutions and physicians). MCCDs allow Disease Management service providers to use the patient's body as the point of care. That is, mTH has the potential to leverage "Mobile Disease Management Solutions" that bring disease management to the individual, wherever he/she is at during the day. mTH sees the body as the point of care; not the house, not the office. Look at this as building a "Disease Management cocoon" that goes with the individual throughout the day, as opposed to the traditional static, home-bound tele-medicine systems.

These are some of the areas where mTH systems can potentially bring value to patients as well as providers:

- increased accuracy: data collection takes place automatically off sensors (weight scale, heart rate monitor, etc.) into the MCCD
- increased efficiency: the automated data collection mechanism reduces the need for healthcare workers to perform those repetitive and low-value data collection tasks
- increased convenience: automated data collection eliminates burden to users, workers and administrators

mTH systems can help providers to meet the Institute of Medicine's ("IOM") six aims for improving quality: [11]

- safe: building a new kind of environment, one where learning from real-time measurements is encouraged
- effective: facilitating the use of "evidence-based medicine,"[12] following updated clinical guidelines
- timely: instead of sending the patient to the physician's office (and to wait there), mTH enables patient's data to be sent to the practitioner in real time for evaluation
- patient centered: care can be delivered to the patient's body directly, and fully personalized
- efficient: leverage limited physical facilities and practitioners by pushing care out of institutional boundaries and into the patient's community
- equitable: allows for wider deployment of healthcare services at lower costs than on institutional settings

The question might be asked as to what evidence is there of the receptivity of different demographic segments to mTH technologies. Large segments of the population between the ages of 18 and 60 is comfortable with and very used to the idea of carrying a MCCD with them at all times. As Baby Boomers age into this segment, it is reasonable to expect that the usage of MCCDs will explode as Boomers bring the technological tools they used during their working lives with them into retirement. There are some research papers available that address the issue of using MCCDs for peer group support, the creation of buddy lists, as well as some forms of group communications. [14] already shows some early promise in these fields.

## VIII. Proposed Framework to Measure ROI of Mobile Tele-Health Solutions in the Management of Chronic Diseases

One of the biggest challenges in measuring the ROI of mTH systems in the US is the fact that any such system that could potentially reduce healthcare costs will spread those cost savings across multiple financial "buckets." That is, multiple

[9] "Externalities:" external benefits and costs that arise when one person's actions create benefits for or impose costs on others, and when those benefits and costs are not privately accounted for in individual's decisions.

[10] www.technology.gov/reports/TechPolicy/Telehealth/2004Report.pdf, last accessed on 04/27/2004.

[11] Institute of Medicine report *"Crossing the Quality Chasm: A New Health System for the 21st Century."*

[12] Defined by the Institute of Medicine as "the integration of best research evidence with clinical expertise and patient values."

parties (practitioners; hospitals; insurance companies; etc.) might realize a portion of the cost savings from mTH systems, but no single party might realize enough savings to justify the initial investment in the mTH systems. The US healthcare system is generally designed around fee-for-services, and there are few reimbursement mechanisms that reward prevention. Two recent approaches to healthcare reimbursement in the US healthcare system provide a framework to build ROI models:

### A. *Capitation*

This is a method of payment to a provider of medical services where the payer defines a set per person per month fee to cover the costs of each patient. Under this model, providers have an incentive to keep costs low while minimizing potential future costs. mTH systems could allow providers to better manage their financial risks by using these systems to enhance the compliance of their enrollees with chronic diseases.

### B. *Pay for Performance*

These initiatives are designed to compensate providers based on documented performance (measured as patient outcome and cost).[13] This movement is gaining attention across the US, and an estimated 30 million covered lives are now touched by this approach to reward efficiency. Pay for Performance is expected to drive hospitals and health care organizations to look past the immediate acute episode of care to the total life cycle of a disease process which for many chronic diseases means the life of the patient.

### C. *Beyond Economic ROI*

There are clear non-economic benefits to be derived from patients complying with their chronic disease programs. For example, from the patient perspective, mTH systems could reduce negative outcomes requiring hospitalization; allow for higher empowerment levels, and provide assistance to patients managing their chronic disease. From the payer perspective, mTH system could lead to a more productive, healthier staff. From the provider perspective, mTH systems could lead to reduced utilization of specialty care units / physicians by pushing a higher percentage of chronic disease patients down to primary care facilities.

### D. *Specific "Low-hanging Fruit"*

As per the CBO report, the top 05% of all Medicare recipients account for 47% of all Medicare expenditures, with a mean spending of US$53.5K per person per year. mTH systems that target the top 01% spenders of Medicare (those that consume 17% of all Medicare dollars, with a mean spending of US$98K per person per year) could have an opportunity to prove a solid ROI. Medicare's recent initiatives point in this direction.

## IX. Conclusions

This paper addressed the opportunities to leverage new reimbursement mechanisms to develop clearer ROI frameworks. Further research is needed in measuring the social ROI of mechanisms to reduce the impact of chronic diseases.


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The author dedicates this paper to his 03 young children.


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