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Implementing the Chronic Disease Self Management Model in Vulnerable Patient Populations: Bridging the Chasm through Telemedicine

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1. Introduction

Vulnerable patient populations include those with chronic diseases, disability, the elderly, minorities and persons with limited health literacy. According to Healthy People 2000, despite recent progress in health care, there is a stagnation or decline in health care outcomes in these vulnerable patient groups. With the world population aging and the number of those over the age of 60 expected to grow to almost 2 billion by 2050 the prevalence of Chronic Disease (CD) will rise. So will the economic cost which currently is substantial and accounts for 46% of the global disease burden. Specifically in the United States, Chronic Diseases (CD's) will be responsible for 78% of all medical expenses. Unfortunately, the demographic imperatives of an aging society with the concomitant rise in disease burden will coincide with a decreasing provider base (Wooten et al., 2006). This will necessitate the adoption of different patient management models, to ensure cost effective patient monitoring within a continuum of care. Chronic Disease Self Management Programs (CDSMP) based on the Bandura's self-efficacy theory (Bandura 2004) focuses on teaching patients coping skills to include disease monitoring and understanding, skills to continue with normal living and strategies to improve emotional well being. Based on the Chronic Care Model, optimal care is achieved when a prepared, proactive practice team interacts with an informed, activated patient (Bordenheimer et al.2002). In the new paradigm patients with CDs become their own care givers, with health care providers acting as consultants in a supporting role. The Institutes of Medicine Report "Crossing the Quality Chasm" (1998) advocated continuous healing relationships, customized care with the patient in control, and an information system that flows freely to facilitate evidence based decision making. To achieve this, Healthcare Systems will have to shift from a Provider Centered to a Patient Centered System within the concept of Advanced Patient Centered Medical Homes, where patients are empowered as partners. The question therefore is can Telemedicine (TM) bridge the chasm by empowering patients, improving and supporting equal access, enhancing capacity, improving quality and cost effectiveness, reducing disease burden and supporting decision making, especially in vulnerable patient populations who have the

greatest need and the highest disease burden. Within this context innovative use of technology (to include TM) has been adopted to facilitate seamless care, coordination of services and patient monitoring. The data to-date suggests that TM is a promising strategy with the potential to empower patients, change behaviors and attitudes, enhance knowledge and improve clinical outcomes. Moreover vulnerable populations such as older patients, those with limited health literacy, patients from rural areas and poor socio-economic status, appear to be willing to accept the use of technology to assist them in disease self management. This chapter will detail the history and the progress of TM and evaluate the current outcomes in Chronic Disease Management in vulnerable patients especially the elderly, those living in rural areas and minority populations especially those with low health literacy. We will also discuss the scope and potential of future novel TM advances which must emerge, as the challenge to tailor services to individual needs of the patients, the provision of continuous medical education to the patient and provider, within the complexities of the health care system become imperative.

2. History of telemedicine

The term "telemedicine" has a Greek origin from "tele" meaning at a distance and a Latin derivative for medicine "mederi" meaning "healing". A WHO definition of TM (1997) refers to "the delivery of healthcare services, where distance is a critical factor, by healthcare professionals using information and communications technologies for the exchange of valid information for diagnosis, treatment and prevention of diseases and injuries, research and evaluation, and for continuing education of healthcare providers, all in the interest of advancing health and their communities". Today TM refers to the use of communications and informational technologies for the purpose of providing clinical care, while the term "telehealth" includes the delivery of both clinical and non-clinical (medical education, research or administrative) services. While "e-health" is used as an umbrella term to cover telehealth, electronic medical records and other health informational technology. The relationship between the various terminologies associated with e-health is depicted in Figure 1.

The earliest form for communication at a distance was the use of smoke signals as a form of a communication system, a "preventive medicine" approach to warn people to stay away from a village afflicted with a serious disease. The history of present day TM dates to the early 1960's when the National Aeronautical and Space Agency (NASA) was able to measure astronaut physiological data in space, and successfully transmit it to earth. This galvanized NASA to support a project utilizing TM to deliver medical care (from 1972-75) to the Papago Indian Reservation in Arizona. NASA continued to fund TM projects in the late 1960's and early 1970,s and by 1975 there were 15 active TM projects. (Basher et al., 1975).

There are two different forms of technology used in TM, the first, also called "store and forward" which primarily transfers digital images and is used in tale-radiology (sending X-ray, MRI and CT scans), tale-pathology (pathology slides) and tale-dermatology (sending digital images of skin conditions for dermatologists to interpret). A second technology provides for a two-way interactive television when face to face consultation is needed. A number of subsequent variations have evolved to include video-conferencing, urban to rural links, capabilities to use an otoscope to examine the ear or use the electronic stethoscope to auscultate the heart from a distance and mobile TM systems termed mHealth.

The future vision as proposed by The Telemedicine Alliance formed under the European Commission is the development of a citizen-centered e-Health System (Figure 2).

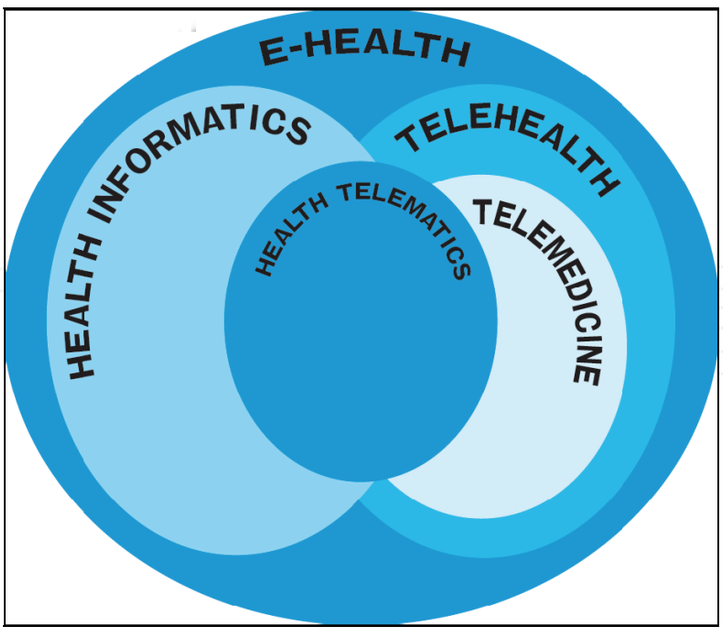

Fig. 1. The relationship between the various terminologies associated with e-Health.
Reproduced from: Telemedicine 2010: Visions For A Personal Medical
Medical Network-The Telemedicine Alliance-July 2004.

Fig. 2. The Vision For a Citizen-centered health care.
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3. Factors influencing the emerging growth of TM

3.1 The demographic imperative

The world population is ageing, tripling over the last 50 years and expected to rise to two billion by the year 2050, accounting for 21% of the total world population (Gavrilov & Heuveline 2003). In the US alone the population of those >65 will exceed 53 million by 2020 as the "baby-boomers swell the ranks. These baby boomers "will also accelerate the movement for greater awareness, self-care and wellness and will alter the traditional doctor patient relationship" (Institute for the Future, 2010). In Europe between 16 and 18% of the population is already over the age of 65, many with at least one CD and possibly more. Aging increases the prevalence of CDs currently responsible for 46% of the global disease burden and rapidly rising economic burden. As a result in most healthcare systems 5% of patients are responsible for 50% of costs (Berk et al, 2001). Unfortunately, as already stated the rising disease burden will coincide with a period when there is going to be a projected decline in the provider base (Wooten et al., 2006) and this will necessitate the development of novel approaches for patient management and access to care. In this context TM with its rapidly emerging technology appears to have both the capacity and the innovative potential to complement the growth and development of future healthcare delivery models.

3.2 Current healthcare system in need of change

The traditional system of healthcare delivery has focused on acute care where the patients admission is treated as a random event to be taken care of with the purpose of discharging the patient home when stable This may be appropriate for acute problems however with increasing longevity and rising prevalence of CD's the present model is distinctly unsuitable, it lacks a continuum and results in fragmentation of care leading to poor clinical outcomes and high cost. In addition a number of other factors are also driving the decision to consider alternative healthcare delivery modes; the culture and expectations of the baby boomers, the complexities of health care delivery, the need to monitor quality and the imperative to provide the tools to make seamless care a reality. As a result we are beginning to see a transition to the Chronic Care Disease Management Model practiced within a patient-centered health care delivery system, as the preferred option of care. This begins with a care transition program with a purpose to improve quality and safety during care hand offs. A recent position statement from the American Geriatrics Society defines transitional care as, " a set of actions designed to ensure the coordination and continuity of health care as patients transfer between different locations or different levels of care within the same location. Representative locations include (but are not limited to) hospitals, sub-acute and post-acute nursing facilities, the patient's home, primary and specialty care offices and long-term care facilities. Transitional care is based on a comprehensive plan of care and the availability of health care practitioners who are well trained in chronic care and have current information about the patient's goals, preferences and clinical status. It includes logistical arrangements, education of patient and family, and coordination among the health professionals involved in the transition. Transitional care, which encompasses both the sending and the receiving aspects of transfer, is essential for persons with complex care needs" (Coleman et al., 2003). TM can be the link to allow a seamless process from acute care through transitional care into a care continuum based on the Chronic Disease Care Model.

3.3 The increasing importance of the chronic care model

This is a system that empowers patients by allowing them to interact with providers, receive the necessary education to self-manage CDs and make decisions between the best options of care tailored to the patient's individual circumstance. The healthcare system has started to move from a physician-centered to a patient-centered system, wherein patients as knowledgeable partners interact with providers as mentors, to allow for disease self management with the aid of TM. The central tenet of the CDSMP is for the patient to be able to achieve the greatest possible physical ability and pleasure from life by "positively managing" illness (Lorig et al., 2006). According to the Chronic Care Model, optimal care is achieved in a proactive format wherein both patient and provider are well informed about the goals and care options (Bodenheimer et al., 2002). This is giving rise to a new paradigm in the management of CD with the patient acting as their own care-giver and the health care professional in the supporting role.

This partnership that emphasizes the concept of collaborative care and self-management requires an empowered patient with the necessary resources to solve their own problems with the aid of appropriate information (Holman et al., 2000). The success of the collaboration is based on the need of the patient having a high level of internal motivation and being less dependent on external (professional) motivation (Funnell et al., 1991).

The patient in turn as the manager has to decide what he/she wants to accomplish, examine alternate options as to how to achieve this, create a successful action plan and be able to make mid-course changes (problem solving) as necessary. Understanding and dealing with common disease symptoms and practicing different symptom management techniques while controlling the emotional overlay, is central to the process. Ultimately having the provider as mentor and the patient as manager is the basis for successful CDSMP.

The patient-physician partnership is becoming the new dyad, with the addition of patients as their own principal caregivers. To this effect Corbin and Strauss (1988) defined 3 sets of tasks patients with CDs have to learn: (1) medical management of the condition; (2) to create and maintaining new meaningful life roles and (3) to cope with the emotional fall out (anger, fear and frustration). A central tenant in self management is the development of self-efficacy it allows patients to solve patient identified problems. This requires a system with the capability of continuous patient education, disease monitoring and collaborative care where the provider can use TM as a resource. Current TM technology can bridge not only the chasm in the education continuum but also fill the gap between patient and provider. CDM programs are based on two pillars, a patient related and a professional directed intervention (Bodenheimer 1999; Kane et al., 2005).

The spectrum of self management extends from only providing written material to more extensive CDSMP designed to enhance self-efficacy.

Professional guidance requires an increased knowledge base and expertise necessary to support patient decision making skills. When an informed patient takes an active role in managing their health and providers feel prepared and supported with time and resources, the provider patient interaction can be more productive. It is becoming increasingly clear that patient education is a critical factor in disease management; it is an important determinant of treatment compliance and changes in behavior. There is evidence that programs teaching self management skills through TM are more effective than those that only provide patients with written disease information (Stromberg et al., 2006). For example, there is also evidence that TM Video education increases Congestive Heart Failure (CHF) self-care behaviors especially when symptoms are worsening (Albert et al., 2007). There are

a number of interventions to promote self-care, skill development, behavior change, family support and redesign of systems of care. In all these aspects especially the latter, telehealth has a role in disease management as the focus shifts to providing care across the continuum and bridging the chasm between acute and chronic care.

3.4 The growing need to bridge the chasm and develop a care continuum through telehealth networks

The growth of telehealth technologies specifically home telemonitoring is a method to link acute, transitional and chronic care needs. In this regard Meystre (2005) concluded that long-term disease monitoring at home through TM represents a promising application of telemonitoring technology for the delivery of cost effective quality healthcare. A recent review of home telemonitoring for CDs showed a good level of accuracy and reliability of transmitted data (Pare et al., 2007). It also demonstrated the ability of TM to identify early changes and improvement in quality of life indices. In addition patients had positive attitudes to TM they expressed high levels of satisfaction, acceptance and compliance. Direct involvement by patients in their care was also associated with increased knowledge and awareness of disease leading to greater patient empowerment in management. Most studies have shown a reduction in cost of care with lower re-admission rates, decreased visits to emergency rooms and lower hospital length of stay. Specifically the Weight monitoring in HeART (Goldberg et al., 2003) trial demonstrated that daily reporting of weight and symptoms in patients with advanced CHF reduced mortality by 56.2%. Other studies have demonstrated that technology using video-conferencing and telephone-line transmission of weight, blood pressure and electrocardiograms were even more effective at reducing hospitalization and inpatient length of stay (Dang et al., 2009). Similar results were noted with improvement in self-efficacy and glycemic control using TM in older ethnically diverse patients with diabetes (Trief et al., 2009). TM is rapidly becoming the go to tool to bridge the chasm and improve quality of care especially for those with chronic illness while controlling cost.

4. Update on the current status of TM in vulnerable patient populations

4.1 TM in geriatrics

The rising cost of Medicare suggests that there is a need to move from a high-tech to a high-value practice system. Prevalence of CD increases with age, increased longevity (at the turn of the last century life expectancy was 47 years today it is 77), an astounding rise of 64% that has resulted in a population of 35 million over the age of 65 today. There are an estimated 64.4 million with cardiovascular disease (with 50 million having Hypertension, 13.2 million with Coronary Heart Disease, 7.8 million have had Myocardial Infarction, 5 million with Heart Failure and there are 4.8 million Strokes/year. Cardiovascular diseases including Strokes accounted for 40% of all deaths in the US in 2001 (AHA, 2004). The direct and indirect costs are substantial. Almost a fifth (19.6%) of Medicare beneficiaries discharged from hospital were re-hospitalized within 30 days and 34% within 90 days in 2004, at a cost of 17.4 billion dollars (Jenks et al., 2009) while 10% of reimbursement codes account for 90% of Medicare spending. The question therefore is can TM improve quality of care, reduce cost of care and is this technology applicable to older populations?

As regards improvement in essential hypertension, in a randomized controlled trial, direct links through TM to patient homes to monitor blood pressure, resulted in improved control

(Rogers et al., 2001), A number of studies have evaluated cost, Noel et al (2004) were able to show that non-invasive monitoring of patients with CHF, Diabetes and Chronic Lung Disease (supervised by a nurse manager) not only resulted in better disease outcomes but also reduced cost of care and increased patient satisfaction. Evidence also suggests that the elderly are able to manage computer based programs despite the fact that they as a group have lower access to computers at home. Other barriers to the use of computers by older persons such as low self-esteem, visual, auditory and mobility problems also need to be addressed when creating programs for the elderly (Hendrix 2000). These programs should have the capacity to be individualized to allow for choice of areas of interest that can be repeated and accessed at their learning pace using synchronized multimedia text, photos, animation and speech (Stromberg et al., 2002; Lewis 2003; Hendrix 2000). Even a single computer-based educational session on heart failure delivered to a group of older persons showed an increase in knowledge compared to a randomized similar group that only received the standard program (Stromberg 2002). As regards consultation for geriatric hospital patients, TM from an off-site location (while uncommon), could be of value for institutions with no geriatricians or for patients in rural hospitals. This modality has the potential to offer a service at a marginally increased cost with the added advantage of lowering the cost for the patient and doctor, by eliminating travel (Persaud et al., 2005). TM is now being used in dementia monitoring to support family caregivers and link home to their workplace (Mahoney 2009). Studies have been done in a variety of practice environments, inpatient, nursing home, consultation, triage, ambulatory care and community care (home care and wellness centers). While the literature supports the overall reliability, acceptance and cost effectiveness of TM in older populations recent reviews agree that "good quality studies are still scarce" (Whitten et al., 2002; Hailey et al., 2004; Pare et al., 2007; Dang et al., 2009). However with the current shortage of geriatricians which is expected to get worse and the rising prevalence of chronic diseases the role of TM in providing the continuum of care for older patients has to be advanced.

4.2 In rural areas

"The doctor will see you now. Please log On" describes how a two way video consult was able to diagnose that a patient on an oil rig was having pain secondary to a kidney stone, provide emergency treatment and have the patient air lifted for definitive management (Freudenheim 2010). With rapidly improving technology the distance between doctor and patient can be dramatically reduced to resemble a virtual in-office encounter. With up to a fifth of Americans living in areas where primary care physicians are scarce TM can make significant contributions. A number of organizations use TM to provide physician services to patients on oil rigs, psychiatric institutions and to prisoner inmates, at lower costs. As an example the State of California spends more than $40/day per inmate for health care, this includes the cost of guards and transportation for visits to outside doctors, the latter expenses would not be necessary with TM as a result of which there was a savings of $ 13 million (Bloch 2010). In a recent publication Kroenke et. al (2010) describes the effects of Telecare management of pain and depression in cancer patients. The intervention consisted of telephonic care management delivered by a nurse care manager at periodic intervals over 3 months coupled with a system of automated symptom monitoring.

This telecare management intervention resulted in significant improvements in both pain and depression when compared to usual care. The roles of TM in electrocardiography and

echocardiography (Huffer et al., 2004), radiology and pathology, orthopedics (Couturier et al, 1998), psychiatry (Montani et al., 1997) and trauma care, in rural areas, are receiving greater attention (Latifi et al., 2009). There is also a role for TM in patient triage systems in a number of specialties. The benefit of these TM consultations is great especially if patient transfer poses a risk or the distance is great, a relevant factor given that a number of Americans (20%) live in places where primary care physicians are scarce or unavailable. A number of physician groups are addressing this need through TM and this mode of interactive TM is growing 10% annually in United States as Medicare, Medicaid and other agencies have begun to reimburse doctors and hospitals that provide care remotely to rural and underserved areas.

The combination of video-conferencing with TM has been reported to enhance the clinical interaction. In the ambulatory care TM requires the patient be introduced to the remote specialist, and the feasibility and efficacy of this process has been demonstrated in Neurology (Wiborg et el., 2003). While teleneurological examination via video conferencing in conjunction with tele-radiology (to examine brain scans) for stroke evaluation in pre-hospital triage and care is being increasingly utilized in rural areas (Audebert & Schwamm 2009). Another example of virtual outreach consultation is tele-psychiatry for rural nursing home residents which has been shown to be a cost-effective and is a medically acceptable alternative to face to face care (Rabinowitz et al., 2010).

Passive monitoring of indices for HTN, CHF, Diabetes and COPD have also shown positive clinical outcomes and savings in cost of care. In addition the technology (including video-conferencing) has been well accepted by patients. However, from the provider perspective the inability to elicit physical examination findings and/or only viewing images, leads to uncertainty and some dissatisfaction, a potential limitation to the use of TM.

4.3 In minority and low health literacy groups

Contrary to expectations patient populations deemed vulnerable to higher morbidity as a consequence of adverse psychosocial circumstances (the elderly, low socioeconomic status, minorities, underserved and disadvantaged) welcome collaborative care, they have the greatest potential benefit from information technology and are not as commonly believed disadvantaged by the "digital divide" (comScore study). While poor access to health care contributes to higher morbidity and mortality rates in minority populations, innovative solutions using technology have begun to show better outcomes and higher satisfaction rates. A case in point was demonstrated in the study in the Baby CareLink project (Safran 2003) in an Neonatal Intensive Care Unit (NICU). Here parents even remote from the NICU participated in decisions in the care of their premature infant, received customized education and information. The end result was better outcomes, lower cost, and greater patient and provider satisfaction rates. The cost effectiveness and feasibility of Telehealth was also shown in American Indians and Alaskan Native Subjects (Shore et al., 2007). This study compared direct costs of conducting structured clinical interventions via real-time interactive videoconferencing versus standard in-person methods, the latter proved to be more expensive.

Health literacy has been defined as "the degree to which the individuals have the basic capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions" (Selden et al., 2000). A US health literacy survey done in 2003 estimated that 36% of the adult population had basic or below basic health literacy

levels, which is defined as low literacy, this approximates to 87 million US adults (National Center for Education Statistics, 2006). Low health literacy plays a major role in determining the patient's outcome with maximal adverse impact on older people (Baker et al., 2007). To compound the problem numeracy skills (the ability to understand and use numbers in daily life, as in understanding and applying nutritional label information) are also low (Rothman et al., 2006). The high prevalence of low literacy in certain groups, those with limited education, certain racial and ethnic groups and the elderly may contribute to disparities in health care outcomes (Kirsch et al., 2002). Cardiovascular diseases constitutes the single largest entity of the chronic diseases afflicting 70 million Americans, with many of these patients above the age of sixty and prone to have low literacy levels. However a major barrier to improving patient education is that only 10% of the education material is written at the 8th grade level or below (Davis et al., 1990). One study found that more than 80% of the web site material on 37 non-prescription medicines was written at a grade 10th level (Wallace 2006).

The future challenge for TM is to develop material that is appropriate for this patient population. As stated in Healthy People 2010 adequate health literacy is necessary to provide individuals with the capacity to obtain, process and understand basic health information and services if they are to make individualized appropriate health decisions (Healthy People 2010). Currently the literature in this area specifically as it relates to the use of TM to overcome the barriers of health literacy remains sparse.

4.4 In chronic disease management

True disease management includes population identification processes, comprehensive needs assessment, pro-active health promotion, patient focused health management goals and education, self-care education, routine reporting and feedback with ongoing evaluation of outcomes (Disease Management). Studies have demonstrated the feasibility of group-based self-management processes among patients with congestive heart failure (Smeulders et al., 2009) and other chronic diseases (Lorig et al., 2003). Even limited heart failure self-care education by video can change patient behaviors (Albert et al., 2003), leading to fewer symptoms of volume overload. This study also showed that patients with better cognitive status benefited more from CDSMP as did those from lower education levels. Systems of care such as disease management and care-coordination can promote self-care because they facilitate transitions across care settings. A recent study (Maric et al., 2010) described the use of the Internet to remotely monitor patients with heart failure was described. Participants entered their weight and symptoms onto the Web for six months. Self-care, quality of life, 6-minute walk test and patient confidence showed sustained improvement.

In the Hypertension Intervention Nurse Telemedicine Study (HINTS) (Bosworth et al., 2007), the authors describe a novel multifactorial tailored behavioral and a medication management intervention control program, which was successful and feasible in the patient's home. More sophisticated technology such as video-conferencing and telephone line transmission of weight, BP and EKG's has been shown to be even more effective in reducing hospitalization rates, length of stay. (Woudend et al., 2008) and symptom reduction (Dawsky et al., 2008). Other workers (Dang et al, 2009) have evaluated the effects of the use of Home TM remote monitoring in the elderly with Heart Failure and concluded that the impact on healthcare utilization, mortality and cost appear to be positive in most cases. In their opinion the study by Clark et al (2007) had the strongest level of evidence in

the meta-analysis, supporting the use of TM in the community setting for heart failure patients. Seto (2008) evaluated 11 articles using 10 different Heart Failure telemonitoring systems, for their economic impact. They concluded that TM requires an initial investment but it substantially reduces cost in the long term through decreased re-hospitalizations and patient travel costs. In a recent review of randomized controlled trials of structured telephone support or telemonitoring programs for patients with chronic heart failure versus usual care (Inglis et al., 2010), the authors concluded that telemonitoring was effective in reducing the risk of all-cause mortality, CHF related hospitalizations and that there was improved quality of life, reduced costs and it led to evidence-based prescribing.

A systematic review of home telemonitoring in diabetes, asthma, heart failure and hypertension covering 62 empirical studies from 1966-2008 (Pare et al., 2010), the author concluded that TM was a promising approach with a trend to better glycemic controls, significant improvements in asthma and control of hypertension however the studies were equivocal on heart failure. In a Diabetes study at a veteran hospital (Dang et al., 2007) care coordination facilitated by telemedicine resulted in improved glycemic controls and reduced resource utilization. A literature review of asynchronous and synchronous teleconsultation for diabetes care (Verhoeven 2010) from 1994 to 2009 concluded that despite the diversity and lack of quality in many studies, TM was feasible, cost-effective and reliable.

4.5 In home healthcare settings

In a systematic review of home telemonitoring for CD (Pare et al., 2010) an analysis of home telemonitoring for four disease categories (Diabetes, Hypertension, Chronic Pulmonary conditions and CHF) was done. In these studies most researchers (in the US and Europe) focused on exploring the benefits of TM. The consensus was that; (a) the data collected was accurate and consistently transmitted from the patients home, (b) the data appeared as reliable as that which would have been obtained from patient face to face examination, (c) that the findings related to the patient's attitudes and behaviors were consistent across all studies in that TM was well received, improved awareness, quality of life, fostered a sense of security and led to greater patient empowerment; however there was evidence of a decrease in patient compliance seen over time, (d) that TM is able to detect early changes in the patient's condition and (e) that there was a significant decrease in hospital admissions, emergency department visits and length of hospital stay.

The decrease in cost in terms of decrease in emergency visits, hospital admissions and length of stay were more consistent for pulmonary and cardiac diseases than for diabetes and hypertension. It also supported the fact that these findings were noted regardless of patient nationality, socioeconomic status or age, in those who complied with the program. Home-based case management directed by a nurse in conjunction with TM-case managed telemedicine (CMTM) is an effective intervention for enhancing the continuum of care (Speedie et al., 2008).

It has been shown to improve outcomes in those patients classified as high risk, in elderly veterans (Schofield, 2005), patients with chronic atrial fibrillation (Inglis et al., 2004), and diabetics (Chumbler et al., 2005). CMTM has also shown reduce cost of care, improve compliance, self-efficacy and patient education. We were able to show in a large study (851 recently discharged elderly patients followed up by TM for 2 months) that the majority showed improved quality of health perception, better disease understanding and high

satisfaction rates. In addition we documented that treatment goals were met in 67%, patient compliance was 77%, and the average improvement in nine Quality of Care Measures (pain control, dyspnea, urinary incontinence, upper body dressing, bathing, toileting, transferring, ambulation/locomotion, medication management) was 66% (Cardozo & Steinberg, 2010)

5. Educational aspects of telemedicine

As mentioned previously, the WHO defines TM in the broad concept of "…delivery of healthcare services, where distance is a critical factor using information and communication technologies… for diagnosis, treatment, and prevention of diseases… and for continuing education…". In contemplating the application of TM for such an educational mission one could consider several logistical factors, including the choice of the specific technological platform or device used from the myriad of possibilities, the model of healthcare delivery in practice, the specific venues along the continuum of care (whether in the home, primary care clinic, non-institutional care setting, chronic long term care institutional care setting, hospital etc.) at which the educational event occurs, the educational content of the material, and the participants of the educational activity. Participants could include any members of the spectrum of individuals involved in the healthcare process, from patients (i.e. consumers) to healthcare professionals (i.e. providers), and may utilize the healthcare professional providers as a source of educational materials (i.e. teachers) directed at the targeted patient consumers (i.e. students).

While we may view the traditional educational landscape as populated by such patient consumer students taught by healthcare provider teachers, we must recognize the potential flexibility of these roles and the opportunities for reinforcing or recasting them through educational TM. In particular, the evolving models of CDSMP in the context of the Advanced Patient Centered Medical Home appear conducive to the anticipated goal of establishing TM as a potent educational tool to enhance outcomes, quality of care, and the healthcare experience for all participants. Virtual education, primarily in the various forms of online education gradually has established a presence in the conventional education process. Approximately 40% of public school districts in the United States offer at least one online class and some school districts instruct through virtual high schools, whose students exhibit high completion rates and performance on advance placement exams.

This integration of technology into the classroom spans the entire age range. A recent foundation sponsored symposium of public and private sector leading educators, innovators, researchers, and journalists, conclude that digital media provide a powerful learning tool especially at an elementary school level, and that the country, in an interdisciplinary manner should, " -build a coherent research and development effort, -use digital tools effectively and safely to help students read well, think critically, broaden geographical and cultural knowledge, and participate in collaborative learning communities, and to -advance digital equity to reach all children." (Shore 2008). Studies indicate that digital media can support social growth (more peer interaction around common interests; more collaborative projects); cognition (greater motivation to read, more opportunities for problem-solving); and health (through simulations and games, better understanding of the importance of healthy behaviors) (Bernholz 2006). Adult education also embraces virtual technology as reflected in the volume of online learning and matriculation opportunities.

As an early and committed proponent of the application of new technologies, the military recognizes the value of virtual reality simulations, creating the sophisticated virtual reality series titled Virtual Iraq, designed to provide soldiers with the skills necessary for deployment in regions of active conflict and also for therapeutic interventions such as treatment for Post Traumatic Stress Disorder (PTSD) (Rizzo et al., 2008).

The benefits of TM extend in to the realm of healthcare education. E-learning educational programs, in various electronic formats, directed toward patients, healthcare professionals, and healthcare professional trainees continue to gather acceptance and momentum. Many medical schools gradually present more material in an E-learning format, which may include simulated patient encounters, that encourages student self learning and facilitates self management of time and resources.

Healthcare professionals benefit from a growing repository of E-learning resources. In geriatrics education for example, some of these resources include the Portal of Online Geriatrics Education (Pogo-E), the Geriatric Web, The Online Geriatrics University (GeriU), Consortium of E-learning in Geriatrics (CELGI), and Geriatrics Resources on the Web (GROW). A few of the resources available in medical education include MedBiquitous, the International Virtual Medical School (IVIMEDS), Health Education Assets Library (HEAL), Competencies Across the Continuum of Health Education (CACHE), and the Multimedia Education Resource for Learning and On line Teaching (MERLOT). There are also exciting innovations in post-graduate health education and training where " surgical students geographically separated can collaboratively learn and interact with specialists, telemonitoring environments where trainees may be hand-held by geographically separated experts, and telesurgical planning environments where experts who are geographically separated may collaborate to plan surgery" (Conde et al., 2009).

As the concept, development, and implementation of TM emerges from the evolving economic and technology forces driving healthcare, patients will inevitably need to confront and contend with it. While TM will profoundly influence the practice of medicine, unavoidably impacting patients, innovative applications of TM may assist patients in successfully navigating our turbulent healthcare system. One TM application occurs in the form of computer based systems that attempt to allow patients to access and exchange health information, facilitate decision making, provide social and emotional support, and encourage behavior changes that promote health and well being (Calvin et al., 2009). This type of system integrates well into the CDSMP and Advanced Patient Centered Medical Home concepts. These types of systems allow patients to review their medical history, review information about diseases and their treatment, and communicate electronically with healthcare providers ultimately resulting in self management decisions. Health care delivery systems will need a change in format if it is to benefit from evolving telehealth applications. As an example the State of Arkansas has a telehealth program called "Antenatal and Neonatal Guidelines, Education and Learning System and Peds Place", an outreach program that has reduced cost and improved community health outcomes (Hall et al., 2008; Hall et al., 2009).

When used effectively these systems reduce hospital admission and mortality rates, and enhance patient health outcomes and quality of life for common chronic diseases such as congestive heart failure. Patients however may not accept TM applications. Barriers may prevent some patients from engaging these potentially empowering models of TM. User acceptance of technology depends on many factors including individual (demographic, health status, diagnostic/treatment intervention factors), human-technology interaction, organizational, social, task, and environmental factors (Karsh & Holden 2007).

While research has gathered abundant information about these factors outside of TM applications, much remains unknown about these in the patient user TM context. The limited patient acceptance data available, which mostly concerns only certain demographic factors, describes an inconsistent effect on age and no apparent effect on gender. Higher education and familiarity with computer technology appears to favor acceptance (Calvin et al., 2009). Sensory, motor, and cognitive functional limitations may interfere with acceptance (Lober et al., 2000). The few studies available concerning patient trust suggest it exerts a prominent influence (Song & Zahedi 2007). The inevitable presence of TM in the future of healthcare demands the need for a greater deal of further research to design successful patient empowering, user friendly, and medically outcome enhancing TM systems.

6. Future trends and Global issues in TM

During the last decade the pace of application in technology for diagnosis and management has been rapid, however the same needs to occur in the field of health information services to allow for effective collaborative care and participatory decision making process. The consumer (the patient) must be involved in the decisions about their health care by becoming an empowered partner (through shared information) for disease self management.

The European Union has developed a vision to convert traditional health strategies to e-health. With this in mind they have formed a TM-Alliance consortium in 2005 with the purpose to study the challenges and assess opportunities presented by e-health. The Alliance speaks to empowering patients, to improving and supporting equal access, building capacity, increasing quality and value, reducing travel burden and supporting decision making (Telemedicine 2010). In effect, to enhance the move towards citizen-centered healthcare. In the NIH Conference on the Future of Telehealth (NCRR's 2009-2013 Strategic Plan) a new model for collaborative efforts to harness information and communication technologies to expand the scope and reach of clinical and translational research, reduce health disparities and put science to work in the service of healthcare reform was proposed (Doarn et al., 2010).

It is also clear the while CD management is important Disease Prevention will become equally important. The WHO reports that "at least 80% of premature deaths from heart disease and stroke could be avoided through effective reduction of risk factors (WHO 1998). This needs to be viewed in the context that in 2005 over 861,826 deaths in the US were due to Cardiovascular Diseases, accounting for 32.5% of all deaths (Rosamond et al., 2008) while in Europe there were over 4.35 million deaths (49% of all deaths) each year (Peterson et al., 2005). Preventive approaches will require patients to take responsibility for self management and TM can both provide them with access to the education and the means to record and report data. In this regard the concept of a "virtual doctor's office" or a "virtual waiting rooms" to provide patients with 24 hour access to physicians for non-life-threatening consultations, is gaining momentum (Freudenheim 2010).

Home devices such as motion-detectors, medicine-cabinet and door opening monitors and event detectors (to record falls, blood pressure drops, heart rhythm changes) are available to create a "smart home", a virtual "assisted living" arrangement. These devices can identify risk factors, monitor health and onset of disease (Novak et el., 2004), or in cardiovascular disease to predict impending heart failure, arrhythmias or sudden death (Myerfeldt et al.,

2002), or in continuous electrocardiographic monitoring to diagnose unstable sleep patterns and sleep apnea (Kesek et al., 2009). Innovations such as the iBrain that uses a small probe to monitor electrical brain activity through a single electrode to measure neurological function has the potential to revolutionize the diagnosis and management of sleep disorders, seizures, drug effects, recovery from brain trauma and the course of neurodegenerative disorders including Alzheimer's disease. (Darce 2010). While a prototype device to monitor brainwaves and provide patients in-real time with warning of an impending seizure are in the testing phase (Hamblen 2010) and if found to be effective it would have a significant effect on the management of epilepsy. Other digital devices with the potential to diagnose early cancers, monitor cardiac markers, detect infectious diseases and other illnesses and transmit the data to physicians are in the offing. There are also telemonitoring devices embedded into belts, clothing or watches under investigation.

A variant of TM is the emerging mobile communications and network technologies for healthcare systems, termed mHealth. Currently 64% of mobile users are in emerging markets, it is estimated that by 2012, 50% of individuals in remote areas will have access to mobile phones. A mobile TM system can use attachments turning phones into microscopes to diagnose diseases such as tuberculosis and malaria. Major efforts in countries like India to enhance medical telecommunications via mHealth are underway though it will take time to reach a critical mass for a successful national TM network (Ganapathy et al., 2007).

The advent of Electronic Medical Records (EMR) does provide the opportunity to link with TM and provide a method to follow the dynamic changes between a patient's physiological responses and their interactions with the environment of care. Specifically, portable TM devices have been shown to have a positive role in monitoring patients with gait disturbances (Mudge et al., 2007), or in measuring the degree of patient social interaction through sociometric devices (Sung et al., 2005) an important TM advance given that increase social interaction and engagement is associated with slower cognitive decline (Barnes et al., 2004) and decreased fall risk (Baker et al., 2008).

It also provides the opportunity to establish mobility patterns (Gonzalez et al., 2008), aid in the management of Parkinson's disease by using accelerometer data (Patel et al., 2007) and to detect social isolation (Peel et al., 2005). Specific tools such as Asthmapolis are now available to help physicians and patients record, track and self manage their asthma in near-real-time through TM (Community Health Data Initiatives, 2010).

All these advances and the potential of TM has not gone un-noticed by the Federal Government in the United States. The Department of Health and Human Services (DHHS) has allocated funds towards the further development of rural TM. The State and Local Information Technology spending is expected to reach $ 10 billion by 2015. Of note," The New Wave Medicaid Management Information System" expects the Information Technology market to grow by 19% over the next 5 years, up from $ 8.3 billion in 2010 (The New Wave Medicaid Management System, 2010).

In April 2010 the DHHS announced the Open Government strategy to expand the availability to the public of health data to allow patients to make informed health care decisions when choosing their hospital (Conway & Van Lare 2010). While The Veteran's Health Administration which has the largest telehealth program in the world (with over 40,000 veterans enrolled) is well advanced in both the delivery of telehealth based treatment and researching the evidence based outcomes of TM (Darkins et al., 2008).

7. Conclusion

TM is coming of age. The rapid expansion seen in the last decade has followed the realization that increasing longevity with the concomitant rising prevalence of CDs necessitates the development of alternate models of health care access, delivery and management. I addition the need to change from a system that primarily focuses on acute care to one that facilitates the transition of care into a continuum is imperative for effective management of CDs. The process of developing a care continuum is further complicated by the impending decrease in the medical provider base and the unique culture that the baby boomers will bring as they enter the ranks of the elderly. A culture that expects health care to be individualized, one that encourages self care and self efficacy as practiced within a Chronic Disease Self Management System. Current advances in TM coupled with the increasing global access to the Internet, wider availability of mobile phones is setting the stage for TM to become the communication link to bridge the chasm between acute and chronic care and provider and patient even if geographically separated. We believe that TM will increasingly assume a major role in the practice of medicine in the 21st Century especially as it pertains to the care of vulnerable patient populations and the provision of continuous medical education to patients, to all level of medical trainees and providers in practice. The need to bring care to the patient in their home and other living environments in the "virtual" format will have increasing relevance. Governments, Health Care Systems and Corporations are looking at TM as a means to greater medical access to personalized health care, one that also improves quality, reduces cost and adds value to the service provided. The current positive outcomes seen with the incorporation of TM coupled with its general acceptance by patients bodes well for the future.

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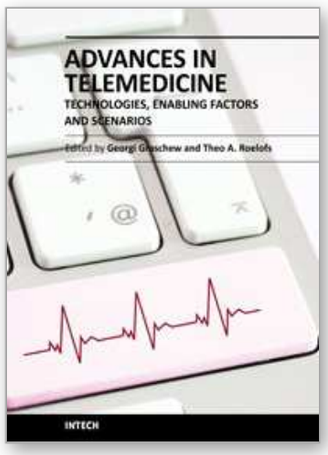

Advances in Telemedicine: Technologies, Enabling Factors and Scenarios

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Innovative developments in information and communication technologies (ICT) irrevocably change our lives and enable new possibilities for society. Telemedicine, which can be defined as novel ICT-enabled medical services that help to overcome classical barriers in space and time, definitely profits from this trend. Through Telemedicine patients can access medical expertise that may not be available at the patient's site. Telemedicine services can range from simply sending a fax message to a colleague to the use of broadband networks with multimodal video- and data streaming for second opinioning as well as medical telepresence. Telemedicine is more and more evolving into a multidisciplinary approach. This book project "Advances in Telemedicine" has been conceived to reflect this broad view and therefore has been split into two volumes, each covering specific themes: Volume 1: Technologies, Enabling Factors and Scenarios; Volume 2: Applications in Various Medical Disciplines and Geographical Regions. The current Volume 1 is structured into the following thematic sections: Fundamental Technologies; Applied Technologies; Enabling Factors; Scenarios.

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