White Paper Series on mHealth and Aging



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mHEALTH OPPORTUNITIES FOR NON-COMMUNICABLE DISEASES AMONG THE ELDERY

ADA KWAN
mHealth Alliance, UN Foundation
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mHealth Alliance

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Ada Kwan, mHealth Alliance, United Nations Foundation

ABSTRACT



THIS WHITE PAPER, WHICH HAS EVOLVED FROM PRIOR RESEARCH [1], IS ONE PART OF A THREE-PART SERIES DEVOTED TO EXPLORING THE USE OF MOBILE AND WIRELESS TECHNOLOGIES IN HEALTH (MHEALTH) and the opportunities for impacting and advancing healthy aging in low- and middle-income countries (LMICs). This specific paper focuses on the use of mHealth for the prevention and control of non-communicable diseases (NCDs) among elderly persons in LMICs.

In 2000, the number of people in the world over the age of 65 was just over 500 million, and this number is expected to triple by the year 2050 [2]. The largest growth will occur in LMICs, and this fact reflects many achievements in public health, such as higher immunization coverage, better disease prevention and control, and improved access to safe drinking water and basic sanitation. However, the growing size of an older world population foreshadows significant challenges ahead [3]. As individuals age, nearly half will develop at least one NCD, such as cardiovascular disease, cancer, diabetes, and chronic respiratory disease [4]. Despite NCDs being largely preventable, they are associated with 60% of deaths around the world. Three quarters of NCD-related deaths are among individuals over the age of 60, who comprise an age segment that is often neglected in policy and requires more specialized attention in health services, particularly for diagnostic, curative and rehabilitative care [5]. Existing health systems, especially those in LMICs, are not prepared for these challenges, especially as the aging population will increasingly demand more long-term care options and specialized attention in homes and communities [6].

The global disease burden from NCDs is predicted to progress over time, resulting in increased treatment costs and losses to productivity in the estimated amount of US $47 trillion over the next 20 years [7]. If action is not taken now to prevent and control NCDs in the context of aging, the burden and corresponding costs will grow substantially, which will place great stress on caregivers and health systems. If the world neglects these issues and chooses not to invest in the health of the elderly and capitalize on their life knowledge and experiences, the consequences could take a devastating human and economic toll around the world [7]. Failure to address the aging population could eventually become a larger and more costly threat to global economic development than fiscal crises, natural disasters or pandemic influenza [7].

The imminent global threat of NCDs, combined with an expanding older population, calls for urgent solutions that have wide reach, strong potential for scale-up and the ability to extend existing health systems into the community. In early 2013, the number of mobile phone subscriptions around the world reached 6.8 billion, and this figure is expected to grow and surpass the world population in the year 2014 [8, 9]. This recent explosion and near ubiquity of mobile phone uptake around the world may offer opportunities for NCD prevention, health promotion, treatment and disease management. mHealth efforts focused on NCDs are already being implemented [10, 11], and new evidence based on rigorous trials have begun reporting the benefits of text messaging, automated telephone monitoring, treatment reminders and self-care support for improving health outcomes related to chronic disease management [12]. This paper describes ways mHealth can reduce the burden of NCDs affecting the elderly in LMICs. It concludes with a call to action to bring together stakeholders from a variety of sectors to achieve this potential.

In 2012, the number of people in the world who were 60 years or older was approximately 810 million, which is more than the number of children over the age of 5.

INTRODUCTION

THE BURDEN OF CAREGIVING FOR OLDER PEOPLE IS QUICKLY INCREASING AROUND THE WORLD. In 2012, the number of people in the world who were 60 years or older was approximately 810 million, which is more than the number of children over the age of 5 [5]. Growing quickly, this number is expected to surpass one billion in ten more years and reach two billion by 2050 [5]. The largest growth will occur in low- and middle-income countries (LMICs), and these countries in particular will undergo epidemiologic transitions in which non-communicable diseases (NCDs) will replace infectious diseases as the leading causes of death [5]. Globally the leading causes of mortality, NCDs include cardiovascular diseases, cancer, chronic obstructive pulmonary disease, and diabetes mellitus. As individuals age, nearly half will develop at least one NCD, commonly with comorbidities [4]. In addition to the general burden of NCDs, older adults are at higher risk for long-term consequences of NCDs, which include retinopathy; nephropathy; auditory issues related to long-standing diabetes; greater chances of congestive heart failure, renal failure, and strokes related to hypertension; depression; anxiety; cognitive dysfunction; as well as reduced motor control [13-17]. Health systems in LMICs are not prepared to respond to these challenges [4, 7], and over time, it will become more difficult for the elderly to get appropriate help as the demand for specialized attention and care, especially long-term care, increases with a shrinking pool of available caregivers [6].

Despite NCDs being largely preventable, the prevalence and incidence of NCDs are expected to increase substantially alongside a world population growing older over the next two decades, with the majority of the increase occurring in LMICs [18]. Between 1990 and 2020, ischemic heart disease – the leading cause of death in the world [19] – is expected to increase by 120% for women and 137% for men in LMICs [18]. The next two decades will be witness to a tripling of ischemic heart disease and stroke mortality in Latin America, the Middle East, and sub-Saharan Africa [18]. Diabetes, which affected approximately 171 million individuals in 2000, will affect 366 million people by 2030 [18]. If more action is not undertaken to avert the growing burden of NCDs, the productivity losses and long-term costs of treatment will take a devastating toll on individuals, families, and societies and could become one of the most severe threats to global economic development in the future [20]. LMICs must develop comprehensive


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health policies to improve health service provision for older adults with NCDs by developing primary health care services and extending care to communities and homes [21].

Alongside the growing NCD burden and expanding aging population, the world is witnessing another global trend that could be part of the urgently needed solution. Mobile and wireless technologies and mHealth, which are increasingly prevalent across LMICs, are being used to support healthier aging in the prevention, treatment and management of NCDs by offering new ways to transmit information and easier ways to communicate. With the number of mobile phone subscriptions predicted to surpass the world population in 2014, mHealth provides a way to reach individuals in almost all corners of the world [8, 9]. *The objectives of this white paper are (i) to understand the implications of NCDs in the world's aging population and (ii) to understand how to capitalize on mobile and wireless technologies to improve the quality of life and access to health services for elderly people living with NCDs. The focus will be on LMICs while drawing on relevant information from high-income countries (HICs).*

With the number of mobile phone subscriptions predicted to surpass the world population in 2014, mHealth provides a way to reach individuals in almost all corners of the world.

BACKGROUND



AS PEOPLE AGE, STAYING IN GOOD HEALTH OFTEN BECOMES A CHALLENGE[12]

FOlder adults living in poverty are most vulnerable, as they cannot access quality health services or maintain proper nutrition, have poor literacy and low levels of education, and rarely have strong caregiver support [5]. Thus, this demographic will be the hardest hit by the growing NCD burden. In 2008, NCDs were responsible for 60% of the 57 million deaths that occurred globally [22]. NCDs are defined as "diseases of long duration, generally slow progression and they are the major cause of adult mortality and morbidity worldwide" [7, 23]. Although actual data on cause-specific mortality rates are difficult to achieve because of gaps in surveillance, individuals over the age of 60 account for three quarters of NCD-related deaths [24].

NCDs are associated with certain risk factors, which is why NCDs have been said to "originate early in life [and] develop insidiously" [25]. NCDs are largely preventable, given the amount of exposure to NCD-related risk factors; however, diseases are often symptomless, which makes them difficult to detect at preventable or curable stages, particularly in LMICs. Thus, early detection by screening is one strategy to mitigate the effects of advanced stages of illness. Risk factors for NCDs are categorized as modifiable or non-modifiable. Modifiable risk factors are characteristics that can be changed on the individual or environmental level. Non-modifiable risk factors are ones that cannot be changed, such as age, sex, and genetic tendencies. According to a report from the World Health Organization (WHO), a large proportion of deaths from NCDs are associated with six specific risk factors: high blood pressure, tobacco use, high blood glucose levels, physical inactivity, obesity or being overweight, and high cholesterol levels [20]. A United Nations High-Level meeting on NCDs held in September 2011 described tobacco control as the "most urgent and immediate priority" [21]. However, the non-modifiable risk factor that will require more attention is age.

On the population level, the growing burden of NCDs is "the result of complex interaction between health, economic growth and development, and … is strongly associated with universal trends such as aging of the global population, rapid unplanned urbanization and the globalization of unhealthy lifestyles" [7], and the NCD burden is only accelerating as the world grows older [3]. Effective population-level responses will have to combat not only universal shifting patterns in diets dominated by higher fat and sugar content intake, but also changing activity patterns at work and in leisure, which are associated with increasing rates of physical inactivity and tobacco consumption [26, 27].

The situation will be particularly challenging for LMICs where demographic transitions will place pressure on governments to work on strengthening health systems to control and respond to NCDs at the same time as responding to infectious diseases. On the policy level, NCDs are not prioritized, despite the fact there is strong awareness of the importance of addressing NCDs among decision-makers, donors, and governments [19]. Few developing countries have committed significant resources to disease control, nor have they

[1] The presence of two or more NCDs in an individual.

addressed aging [18]. More comprehensive policies and fiscal space will need to be developed for integrated prevention, surveillance, and control approaches that emphasize the role of aging and the growing population of older adults. Donors and development agencies also do not prioritize investment in aging issues or in interventions for the prevention and control of NCDs. In 2002, only 0.1% of the US$2.9 billion dollars spent by the Official Overseas Development Aid on health went to chronic diseases, including mental health [18]. Poor funding streams and lack of prioritization for NCDs affect national NGOs, which can play a large role in reducing risk factors and building in-country capacity for strong diet, nutrition and exercise habits [18]. The Millennium Development Goals (MDGs), which were established by the United Nations to reach eight health and development goals by 2015, helped focus global development efforts towards certain targets and have led to "significant and substantial" progress in reducing extreme poverty and increasing access to safe drinking water, but did not address the expanding aging population or age-related health conditions, such as NCDs [5, 28]. A great deal must be done quickly to place aging and NCDs on the international and policy agendas or else the consequences will be expensive, despite being preventable.

Regardless of the root cause at the individual or population level, there is a strong economic argument for taking action now. A recent report on NCDs estimates that NCDs will cost over US$47 trillion – approximately 75% of the 2010 global GDP – over the course of the next 20 years [7]. Existing knowledge and interventions can be implemented to mitigate these costs, but more solutions in reducing high healthcare costs, medical waste, inequality of care, and hospital readmissions are required [7]. The costs of treatment and productivity losses related to NCDs will be devastating to societies and global economic development [7]. Cost savings can begin to accrue with effective prevention strategies (e.g., behavior change interventions that can begin promoting more healthful habits, such as better diet and increased physical activity), as well as by adapting health system strengthening efforts for better access to higher quality primary health care and in-community disease management for older adults [29].

A recent report on NCDs estimates that NCDs will cost over US$47 trillion – approximately 75% of the 2010 global GDP – over the course of the next 20 years.

[2] Although the majority of countries are equipped with evidence-based guidelines, protocols, or standards for diabetes, hypertension, and dietary counseling, the WHO reports less than a third fully implement them (22).



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EXISTING SOLUTIONS: mHealth in NCD interventions

MOBILE AND WIRELESS TECHNOLOGIES HAVE CHANGED THE WAY PEOPLE COMMUNICATE AND ACCESS INFORMATION AROUND THE WORLD, and there is growing interest in using mobile to improve health outcomes. This section will describe the strategies in which mHealth is being applied in the context of NCDs and how mobile solutions can be considered for the aging population. This section will also include examples of projects that are capitalizing on mHealth to prevent, treat and manage NCDs to minimize the growing disease burdens attributed to NCDs. Several of these interventions address older adults specifically, such as the Chinese Aged Diabetic Assistant (CADA) Project in China and projects implemented by ClickMedix, which are described in more detail later in this section [11, 12, 30-37].

Rigorous trials have reported the benefits of text messaging, automated telephone monitoring, treatment reminders and self-care support for improving health outcomes related to chronic disease management [12]. For NCD prevention, mHealth behavior change interventions in the form of mobile phone applications or text messaging have been implemented for encouraging individuals to exercise, improve their diets, or reduce tobacco use [38-40]. For improving NCD treatment compliance, a systematic review of interventions demonstrated that adherence improved most in behavioral interventions that reduced the demands of dose schedules and that had monitoring and feedback [41]. For NCD monitoring, wireless sensors, such as accelerometers, are being developed with easy access to Internet for sending data to clinicians or with algorithms for recognizing abnormal signs [35]. Disease surveillance and home monitoring using wearable sensors, including wireless links between mobile phones and backend systems, will become more sophisticated with time, and particularly as aging interventions are delivered in the community. Using remote learning options, health workers can improve their education and training on age-related health conditions, as their access to learning modules, literature and the ability to call other health workers increases. Tracking medicines and supplies with mobile technologies also offers short-term benefits, as supplies can be monitored to improve limited access to and prevent stock-outs of essential hypertension, diabetes and cancer medicine. Long-term benefits include data generated by mobile technologies producing insights and facilitating discoveries in drug development and health care delivery.

For NCD prevention, mHealth behavior change interventions in the form of mobile phone applications or text messaging have been implemented for encouraging individuals to exercise, improve their diets, or reduce tobacco use.

The field of mHealth is fairly new and evolving rapidly, and the evidence base for the effectiveness of mHealth in disease management – even without considering the aging context – is small and often derived from high-income country (HIC) contexts [42]. Moreover, mHealth implementation in the context of aging is rarely discussed and, when it is addressed, it is almost never in detail. At the time of this report, the link to actual health outcomes is equivocal and requires closer scrutiny with rigorous evaluation methods. This will only happen as the periods of evaluation begin to last long enough to assess actual health outcomes and once studies can be conducted in a variety of settings. However, some feasibility studies suggest mHealth use in NCD-related interventions improves user satisfaction ([43]. One study found participants with a mean age of 72.93 years were satisfied with a telecare system that monitored their oxygen levels, pulse rates and respiration rates [43]. Although the study participants found the screen and buttons difficult to read and use, respectively, the findings suggested that improving the design was a better option than not using the technology, and the authors called for a rigorous evaluation to assess the telecare system's effectiveness in improving health outcomes [43]. Another study that assessed Internet access of electronic medical records for patients with chronic inflammatory bowel disease reported that technology considered to be useful for health providers and patients was "multifaceted, self-care promoting, and integrated into the patient's already existing health and psychosocial support infrastructure" [44]. These design characteristics of technology have also been demonstrated to be useful to other end users of mHealth interventions, and thus should be emphasized in the development of other mHealth solutions [31, 42, 44]. Additionally, the actual mechanisms by which mHealth solutions are able to motivate and encourage behavior change that reduces risk factors for NCDs are not well understood, but are expected to be better understood in the future [45].

In Table 1, there are several examples of mHealth being implemented for NCD-related interventions; however, not all of them are specifically targeted towards older adults. They are divided into cases from LMICs and HICs.

NCD-related mHealth Interventions in LMICs

APPLICATION OR IMPLEMENTING ORGANIZATIONS, LOCATION IMPLEMENTION	PROJECT DEFINITION
Be He@lthy, Be Mobile, Multiple Countries	The International Federation of Pharmaceutical Manufacturers and Associations (IFPMA), International Telecommunications Union (ITU) and WHO is working on the Be He@lthy, Be Mobile initiative, which aims to scale up mHealth in eight countries for NCD prevention, treatment, and policy (46). In the countries, mHealth interventions for NCDs are being implemented and standard mHealth operating procedures are being developed to integrate mobile solutions into existing NCD prevention and control activities. The first country in this initiative will be Costa Rica, where the government and local partners will employ mHealth for smoking cessation [47].
CADA Project, China	The CADA Project allows older adults with diabetes in rural and urban China to self-manage their condition through the use of smart phones [36]. The phones will send messages with recommendations related to physical activity, blood glucose monitoring, blood pressure monitoring, weight and waist measurement, and eating habits. To design the applications better for the elderly target population, the members of the project: conducted clinician interviews, focus groups and direct observation of diabetic elderly in rural and urban China; measured usability; and allowed for iterative design [48]. The user-centered approach was adopted to account for user needs, desires and limitations. The interface was initially offered in a prototype for its smartphone application CADA. The elderly were excited to use this application and found it to be simple and straightforward. The elderly expressed their desires for CADA to be connected to televisions.
ClickMedix, Multiple Countries	ClickMedix offers mHealth applications that allow healthcare professionals to conduct home-care and specialist telemedicine services, including cervical cancer screening, mobile teledermatology and mobile teleradiology services, as well as HIV clinical staging and mobile-based pre/post oral surgery from a distance. In China, home visit care for seniors is offered (49). Seniors can be visited at home several times, beginning with the initial assessment where a physician collects vitals and other body measurements. Nurses and caregivers pay subsequent visits to the seniors. These health workers use forms that have been digitized from the original paper-based forms by ClickMedix, as well as diagnostics whose information can be wirelessly transmitted with mobile data collection tools.
mDiabetes, India	A non-profit organization called Arogya World has teamed up with Nokia to generate awareness for diabetes and encourage healthier behaviors that can prevent a targeted 50,000 individuals in India [50]. In one year, the program enrolled over one million individuals and has sent over 45 million text messages for free. The content of the messages were developed for cultural relevancy and translated into 12 languages. The partnership is currently developing an evaluation that will help inform a model that can be adapted and replicated in other countries.
Text Messaging for Health, South Africa	First created for low-income women with type 2 diabetes to self-manage their conditions, a text messaging program leverages peer networks of women who support each other in managing NCDs [51]. The effort is a collaboration among DPS Health; the University of California, Los Angeles; and Women for Peace in South Africa.

NCD-related mHealth Interventions in HICs

APPLICATION OR IMPLEMENTING ORGANIZATIONS, LOCATION IMPLEMENTION	PROJECT DEFINITION
ADOPT Toolkit, United Statess	The Center for Technology and Aging at the Public Health Institute has designed a toolkit that supports planning, design and implementation stages of programs that leverage health technologies [52]. For the United States context, the toolkit consists of many resources including practical guidelines and lessons learned in remote patient monitoring, medication optimization, care transitions and mobile health – all designed to maintain independence for the elderly.
Care4Today Mobile Health Manager by Janssen, United States	Care4Today Mobile Adherence Manager is a combined two-way messaging platform, mobile application and website for clients to improve their medication adherence, refill their prescriptions and have communication with their health providers when necessary [53]. The mobile application and website offer opportunities for clients to track their progress.
BJohnson & Johnson Digital Health Scorecard, United States	The Digital Health Scorecard is a downloadable application that calculates an overall health score on a scale from 0 to 100, which can be tracked and sent to a provider [54]. The score, which reflects how likely one is to develop a chronic condition, is based on responses to seven questions related to lifestyle and health indicators (e.g., blood pressure, body mass index, physical activity, tobacco and alcohol use).
WellDoc, Inc., United States	A healthcare company, WellDoc, Inc. works to improve patient outcomes for heart disease, asthma, chronic obstructive pulmonary disease, and oncology by using mobile technologies to deliver a set of clinically validated disease management tools (55). Specifically, the WellDoc DiabetesManager System enables doctors and individuals with diabetes, including the elderly, to collaborate on capturing, storing and transferring in real time blood glucose data and other diabetes self-management information in a highly secure environment. On the back end, WellDoc's Automated Expert Analytics System identifies trends, which helps send educational and behavioral coaching to patients and decision support to providers.

TABLE 1. NCD-related mHealth interventions in LMICs and HICs.



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In 2008, Beaglehole et al. published in the Lancet series "Alma Ata: Rebirth and Revision" on primary health care a specific report on improving the prevention and management of chronic diseases in LMICs [56]. The authors reported that certain components of traditional health service delivery, if enhanced, could improve the prevention and control of NCDs in LMICs with respect to primary health care [41]. These components included community resources, health systems, self-management support, decision support, delivery-system redesign, and clinical information systems to avert NCDs, but lacked specific guidance on how to provide these more effectively for older adults [41]. Opportunities in mHealth, as seen in the above mHealth interventions, have demonstrated the capability of working in each of these components, can be tailored for caregivers who take care of older adults and can create an environment for more active aging. In fact, a more recently published mHealth framework by Labrique et al. (2013) maps out 12 common mHealth solutions that overlap greatly and support the logical application of mHealth in the prevention and control of NCDs [57]. This framework includes: client education and behavior change communication; sensors and point-of-care diagnostics; registries/ vital events tracking; data collection and reporting; electronic health records; electronic decision support (e.g., information, protocols, algorithms and checklists); provider-to-provider communication (e.g., user groups, consultation); provider work planning and scheduling; provider training and education; human resource management; supply chain management; and financial transactions and incentives.[3]

Opportunities in mHealth...can be tailored for caregivers who take care of older adults and can create an environment for more active aging.

[3] Financial transactions and incentives may not be an apparent solution for minimizing the NCD burden, but models that encourage healthier behavior changes in individuals or incentivize better health services in the health system through financial rewards have been implemented with success (58, 59). The ability to transfer money on mobile phones makes these efforts simple and holds strong potential for health; however, previous efforts have reported high set-up costs (60).

More knowledge will need to be generated, especially on how solutions can best be tailored for older adults.

CONSIDERATIONS FOR mHEALTH RELEVANT TO THE PREVENTION AND CONTROL OF NCDs AMONG THE ELDERLY



DESIGNING AND IMPLEMENTING mHEALTH SOLUTIONS FOR THE PREVENTION AND CONTROL OF NCDs, IN THE CONTEXT OF AGING, POSES MANY CHALLENGES. The most obvious is the lack of emphasis on older adults and aging in funding, research, implementation and policy. More knowledge will need to be generated, especially on how solutions can best be tailored for older adults. Below are other considerations to take into account.

Solutions that can be adapted for multiple diseases will match reality better than solutions that focus on single diseases. Nearly half of older adults will develop at least one NCD, and co-morbidities and complex treatments are common [61]. mHealth solutions offering the flexibility to tackle co-morbidities should be considered when designing solutions for single disease conditions. This does not only apply to NCDs, but efforts must plan for the coexistence of cancer, diabetes, and heart diseases with HIV, tuberculosis, and malaria.

Mobile is a tool that can help deliver effective interventions, rather than a stand-alone solution for managing NCDs among elderly. The potential for mobile and wireless technologies can be best met as part of a larger solution or as a vehicle to communicate or transmit information. Facilitated by an enabling donor and policy environment, partnerships implementing mHealth solutions for NCDs in the context of aging must find the best solution for the end user, which may involve combining mHealth with existing agents involved in providing treatment (e.g., traditional healers) or with technology already being used (e.g., radio or television, similar to what was suggested by participants in the CADA Project study).

Lessons from other mHealth projects, especially implemented in LMICs, are good initial sources of information. Much mHealth work has been done in LMICs; however, most of this work focuses on using mobile technologies for HIV/AIDS or maternal and child health. The experience and lessons learned from these efforts are still helpful with regard to tackling issues

related to design, training, connectivity, language and culture. General processes learned from other mHealth interventions can also be useful, such as how the Mobile Alliance for Maternal Action (MAMA) project tested different content for text messages with potential end users and then made final modifications, such as making sure the tone of the content worked with the language and the message was both supportive and easily understood for users with low literacy rates and education levels [62].

Existing theoretical and behavioral models can be applied to strategically leverage technology. Theoretical and behavioral models have been useful for integrating and applying technology into health interventions,[4] but are not commonly used and do not account for age-related concepts [63]. Findings from a review conducted by Cole-Lewis and Kershaw (2010) on behavior change in mHealth suggest that mobile content developed from theoretical and behavioral models was more successful at achieving intended results [45]. However, there is debate on the adequacy of existing health behavior models to explain the effect of mHealth on behavior change. Other theoretical models may be applicable, such as the Technology Acceptance Model and the Use of Technology Model [64-66].

mHealth solutions for NCDs in aging will need to overcome structural barriers. The barriers that will have to be addressed to prevent and reduce the NCD burden include regulatory- and policy-related barriers, socio-cultural barriers, as well as intergenerational patterns and dynamics of mobile phone use within families [29].

Gaps in knowledge exist for the effects of mHealth on NCDs, but will be filled with coordination and sharing of lessons learned. The field is expected to move quickly and, thus, monitoring and evaluation and sharing knowledge will be critical for efforts to maximize their impact. Studies with rigorous evaluation methods are needed, particularly in low-income settings [34]. At this time, data reflecting a study period of more than 12 months have not been collected to understand the effects of text messaging on self-managing chronic conditions [34].

More evidence is needed for how the elderly interact with technologies to make a measurable impact on reducing NCD burden. There is no replacement for formative research and usability testing for understanding how end users will respond to the content and technology of an mHealth solution. However, usability research for mobile technologies focuses on younger populations and "considerably fewer" studies have considered the way older adults interact with technology [67]. Blaschke et al. (2009) summarize some concerns for older adults using technology, which include age-related issues (e.g., impaired vision, issues with manual dexterity and mobility, memory and cognition issues), characteristics of current technology (e.g., small text on screens, small keypads, poorly built technology), issues related to attitudes (e.g., not feeling perceived benefits, perception that technology is expensive), training and support issues (e.g., lack of training opportunities or adequate support to learn how to use the technology), and cost (e.g., technology is not considered affordable for everyone) [68]. The authors conclude that, despite these barriers, there are enough indications that point towards the value of developing more capacity for information and communication technologies, including mobile technologies, in long-term care, within health care and among family members who act as caregivers [68]. Additionally, as more of the world's population enters old age, this segment will attribute more value to and also adapt more quickly to technology. Blaschke et al. (2009) states, "the situation is thus very fluid, and the evolving research agendas will have to adjust to this dynamic process" [68].

[4] A published article by Riley et al. (2011) discusses how smoking and weight loss mHealth studies often had a theoretical basis, but most studies on mHealth in medication adherence and disease management did not (63).

CALL TO ACTION: REALIZING THE mHEALTH POTENTIAL

PRIORITIZING AGING AND NCDS IN POLICY AND BUDGETS, COMBINED WITH ESTABLISHING EFFECTIVE PARTNERSHIPS, WILL BE CRITICAL IN ADVANCING mHEALTH EFFORTS FOR NCDS IN AGING POPULATIONS. Recommendations from a recent report written by Lemaire (2013) and commissioned by the Advanced Development for Africa on scaling up mHealth describe how to build, implement and sustain partnerships, as well as how to ensure that partnerships are able to achieve mHealth scale-up [50]. One of the characteristics of a good partnership for mHealth includes clear roles and an understood vision. Developers and implementers, health care professionals, organizations, researchers, governments, mobile phone and network operators, and donors and development agencies are all called to action with their roles below in this effort to leverage the full potential of mHealth in NCD prevention and control.

Developers and Implementers – Create, design, and implement mHealth solutions centered on the context and be mindful of accounting for older adults as a user group if they are not the main target population. The technology alone can't minimize NCD-related risk factors or fix medication adherence issues, but can be a strong vehicle to carry effective strategies. For this, it will also be important to consider the absence or presence of caregiver.

Health care professionals – Participate in the design and help support the link of high-quality mHealth strategies for the elderly and their caregivers to community-based health workers, professional health workers, formal care support, the health system, as well as other individuals patients seek when they are not feeling well, such as traditional and faith healers.

Organizations – Join networks or alliances with other organizations involved in aging- and NCD-related work to coordinate program and advocacy networks and tap into knowledge resources that are in line with international recommendations. For example, the NCD Alliance offers a global monitoring framework, additional resources, and access to regional and national NCD alliances.

Researchers – Develop the evidence surrounding mHealth and NCDs among the elderly, especially in low-resource settings. In addition to measuring health outcomes from mHealth and satisfaction levels of using mHealth, it will be important to share challenges, successes and other lessons learned during design and implementation to expand the knowledge base. This will also help investment and policy decisions in the rapidly evolving field of mHealth.

Governments – Prioritize NCD programs in the context of aging, beginning with the implementation of existing NCD guidelines and protocols and integrating the WHO STEPwise approach[5] to NCD surveillance [70], and begin capacity building for NCD health services for elderly by encouraging institutions to incorporate NCD material in health professional training and curricula [68]. In health systems, NCD services should be integrated alongside infectious disease services, particularly at the primary health care level, while considering mHealth options to extend service delivery from facilities into homes, as well as creating new services at the community or household level.

Mobile phone and network operators – Participate in this growing need by joining in partnerships that support NCDs and the aging population. Handsets, products, and networks should be developed to accommodate seamless interaction among older adults, caregivers, and health professionals while considering privacy and data security issues.

Donors and development agencies – Be active in developing appropriate fiscal space for NCD policies and programs for older adults. Funding should be earmarked not only for projects that aim to improve quality of life and access to appropriate NCD care for the elderly, especially in LMICs, but also for training health workers to respond properly to NCDs. Developing incremental funding for existing efforts and earmarking funding for building capacity and supporting partnerships to scale effective projects can encourage sustainability.

[5] The WHO STEPwise approach is an approach to obtain "core data on the established risk factors that determine the major disease burden" and allows "each country to expand on the core variables and risk factors" (69). The approach offers optional modules related to local or regional interests" and uses three steps: questionnaires, physical measurements, and biochemical measurements.

CONCLUSION

This paper has described the ways mHealth can help avert risk factors associated with NCDs in the context of aging. These include:

- Enabling and creating new resources in the community such as in-community or home monitoring systems with access to providers
- Strengthening the health system response to NCDs by offering flexible ways for health professionals to reach patients remotely, which can also help alleviate the human resource crisis in health
- Allowing the elderly and their caregivers to take more control of managing their health conditions by sending informational messages and encouraging self-management with telecare options
- Improving decision support by offering guidelines and protocols on the mobile phones of health providers or community-based health workers
- Formalizing linkages between patients and primary health centers through patient networks, helplines, appointment reminders, or simple phone calls from providers to their patients
- Digitizing monitoring systems for treatment, health records, and disease surveillance information that can assist decision making on the policy, patient-provider relationship, or individual levels.

Available resources, such as mobile technologies, can help societies invest in the health of the elderly and start to capitalize on their life knowledge and experiences without the fear of NCDs taking a devastating human and economic toll. Action must be taken immediately to prevent and control the growing disease burden of NCDs among older adults. As the deadline for the MDGs arrives in 2015, there is an urgent need on the international level to place aging and NCDs in the post-2015 agenda and to set explicit goals and prioritize strategies for aging and reducing risk factors associated with NCDs [5, 71].

Significant challenges in public health, such as pandemics, infectious diseases, and poor sanitation, have been overcome with the invention of certain technologies that were accessed, delivered, and scaled up rapidly. This paper describes the imminent challenges societies will need to confront as the NCD disease burden grows and weighs heavily on the world's aging population and existing health systems. With mobile phone subscriptions set to surpass the world population in 2014, mobile and wireless options hold strong potential for providing wider access to better health for individuals who may develop or already have developed NCDs.

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