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13 Conclusion

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Introduction

In the introduction to this volume on the *State of Behavior Change Initiatives and How Mobile Phones are Transforming It*, Kwan, Mechael, and Kaonga highlight the growing role of mobile communications technologies in public health interventions. Changing human behaviors and attitudes requires time, considerable effort, and motivation; yet for those implementing programs, both the underlying determinants of behavior and the practices supporting the application of strategic communications theory to change campaigns are often not top-of-mind. A recent review by (Riley, Rivera, Atienza, Nilsen, Allison, and Mermelstein, 2011). of the published clinical outcome studies on mobile behavior change initiatives found that explicit linkages to behavioral change theory were more common among antismoking and weight/diet interventions than among treatment adherence and disease management interventions. Indeed, of twenty studies on mobile disease management interventions (in diabetes, asthma, and hypertension), Riley *et al.* found only one with a specific link to behavior change theory. This gap between theory and practice came up repeatedly in the conversations we had with workshop participants in the London sessions, and in the chapters of this volume that grew out of those discussions.

Mobile technologies are unlocking a new mechanism for promoting behavior change. Mobile phones are being used for every stage of disease – from health knowledge and promotion to disease prevention, diagnosis, and treatment, including appointment reminders and medication compliance. Although mobile phones have been the focus of considerable public health research in developed countries (Fogg and Eckles, 2007; Fogg and Adler, 2009), the strengths and limitations of mobile phones in behavior change campaigns in developing countries are less well-understood. This lack of documentation and sharing was reinforced by the projects and research in this volume. While there is a broad range of mHealth behavior change initiatives in low- and middle-income countries from gaming for HIV/AIDS awareness to self-management of diabetes to video support for frontline

health workers, there is limited research to evaluate their impact. This edited book provides a snapshot of mobile-mediated behavior change projects emphasizing health promotion and disease prevention as well as disease management, treatment compliance, and appointment reminders and explores the theoretical frameworks that underpin them in a way that examines what 'mobile' brings to the behavior change world and what more there is to understand. This conclusion chapter provides a review and reflection on the projects and research described in the book as well as some insights into where we might want to go from here.

Moving beyond the pilots and hype toward systematic integration of mHealth

Over the last decade, the mobile technology landscape has changed dramatically across the developing world. Mobile phones are enabling higher levels of human capacity and productivity in a range of 'development' domains, from agriculture and education to governance and health (Donner, 2008; Aker, 2010). One theme that emerged from the discussions is how during this initial boom in mobile use, early innovators had been working across a wide set of national contexts and organizational settings, but with little initial awareness of other contemporary efforts. Through the lens of over ten years of mHealth experience in using mobile for HIV and AIDS prevention, care, and support, Peter Benjamin from Cell-Life in South Africa explored the need for communication and how it is this need that has driven the uptake of mobile phones beyond what anyone could have anticipated. For example, van Beijma and Hoefman were quick to recognize the potential to communicate health information to people in low-resource settings via a mobile phone. By 2007, they had proposed and designed a solution implemented by Text to Change (TTC), using short message service (SMS) as an easy, cost-effective and interactive way to communicate information, collect data, and create awareness on health issues, including HIV and AIDS, family planning, and malaria. In the meantime, thousands of miles to the west, Ilta Lange applied a thirty-plus year career in health service delivery and worked in tele-health in Chile to the strategic integration of mobile telephony for diabetes management.

How quickly things change: these pockets of initial innovations and experimentations have been replaced with a global web of interconnected initiatives. Full of workshops, conferences, startups, and RFPs, the mHealth community is burgeoning, so much so that there is the risk of an unhealthy 'hype cycle' surrounding mHealth that needs to be tempered with research, methodical approaches, and the sharing of real stories of success and failure (Fenn and Raskino, 2008). Mobile technologies are only as good as the systems and the

programs that they support. With the onslaught of rapid mass communication and mass interaction, almost anyone anywhere can communicate with nearly anyone else, immediately and for a relatively low cost.

Cell-Life has spent nearly ten years developing, testing, and implementing health applications through basic phones and increasingly moving toward the creation of ‘smart apps for dumb phones’. These health applications range from basic lifestyle services through general health information to condition-specific services – where much of their work began in the use of mobiles for HIV and AIDS, health administration, to medical consultations and counseling. Modestly, Benjamin comments that they have just started to learn how to use this new technology, where mobile technology provides an opportunity to increase equity in the provision of quality health services. They are now working with the government of South Africa to advise on and develop strategies for more effective integration of mobile technology at a national scale.

Like many countries, Chile is experiencing a dramatic increase in rates of diabetes as well as of diabetes risk factors, such as obesity and a sedentary lifestyle. The government of Chile has committed itself to providing primary care services to the entire population at need – requiring more innovative approaches to service delivery. This led to Lange’s early work in tele-health and more recent foray into mHealth. When her work began, the project did not consider mobiles to provide tele-self-management support to patients with Type 2 diabetes, as the cost of communication was three times higher than calling fixed phones. This decision changed very rapidly, as they encountered the continuous interruption of telephone traffic because copper landlines were stolen, which obliged the project to contact patients through their cellphones. Mobile phone contacts, although more expensive, were more convenient because the program could contact patients at the first instance at home, at work or in other places outside their home. In the long run, the process demanded less professional time, which is scarce and of high cost.

As illustrated by Benjamin, we are just learning how to find effective and proven ways to turn these electronic-connected devices in the pockets of billions of youths and adults into means of accessing a range of health and medical services and sources of information that could transform health systems. Different from other forms of telemedicine or electronic health (eHealth), mHealth can address aspects of healthcare beyond the curative. Lange learned through her work in tele-health that mobile phones have become part and parcel of daily life; such as, mobile tools can be used to address chronic illness as well as build health awareness, enhance preventative healthcare, and support well-being and overall wellness as highlighted by Benjamin. This is a much wider agenda for technology in healthcare than ICT and medicine usually cover. However, while cellphones provide a means of reaching

a very large number of people, it must be remembered that there are a significant number of people who do not have access to this technology.

Van Beijma and Hoefman take this a step further and provide some concrete recommendations for how to better ground mHealth as it evolves beyond pilots and hype into more systematic integration within health systems. Governments and organizations enthusiastic to implement mHealth should ask themselves: *What problem is mobile going to solve for us? And what has already been done by other organizations?* It cannot just focus on adding an mHealth component to an existing program or campaign; but needs to be fully integrated into the health system and/or program from conception with both scale and sustainability in mind. The future of mobile phone deployment in health is encouraging and growing steadily; however, it cannot be substituted for a weak health system – a good quality and fully equipped health sector is vital to its success. It should be understood that ICTs/mobile phones are just a tool or an enabler to economic development with the biggest opportunities in improving access to quality and timely health information and knowledge. Government should not be mandated to implement mHealth, but act as the overseer, giving support and guidance as much as possible. They should also create an auspicious environment to deploy mHealth by putting policy frameworks and making available essential information and knowledge as often as they can. Approximately four years ago, TTC gave an eye-opening presentation about the potential of using mobile phones in health communication to senior management at Ministry of Health in Uganda and from this it was decided that mHealth be used in their programs.

Development of a strong regulatory framework involving a range of stakeholders with emphasis on end-user involvement is needed and slowly emerging in a number of countries, including Uganda. A national ICT policy is in place and a health sector ICT policy (eHealth) is already operational. The Uganda Ministry of Health is taking steps to coordinate ICT development and has allocated resources to support implementation of its ICT strategy. Nationwide deployment of an mHealth application program could only be successful with the inclusion of government having a dedicated budget. MHealth applications have the potential to improve and strengthen the current health system if integrated into an existing ‘well-functioning’ structure. As a compliment to emerging regulatory frameworks and policies, new business models and more effective public-private partnerships are needed to solidify the growth and stability of mHealth for behavior change.

The state of mHealth for behavior change research

In early 2010, Heather Cole-Lewis’s article entitled ‘Text messaging as a tool for behavior change in disease prevention and management’ was published in the peer-reviewed journal, *Epidemiologic Reviews* (Cole-Lewis and Kershaw, 2010).

This systematic review of the peer-reviewed literature on behavior change interventions for disease management and prevention delivered through mobile text messaging identified nine out of twelve studies that were sufficiently powered to detect a difference in the intervention conditions. Of those nine, eight studies suggested that text messaging was a useful tool for behavior change. The utility of text messaging was supported for users of different ages, nationalities, and minority status. Only one of the nine countries represented in this study is considered a developing country. The review recorded characteristics of each intervention and attempted to identify the gaps and issues in the literature as well as the best practices for researchers and practitioners. Issues identified include lack of scientific rigor, little representation of developing countries, and lack of use of behavioral theory.

In order to understand why mHealth interventions have an impact, it is important to conceptualize the mechanisms by which we expect change to happen for each specific aspect of the intervention. Using an overall model of change during the design, implementation, and evaluation stages can both inform how a program is positioned and identify how to approach measuring the outcomes one aims to achieve.

There is an ecosystem of health that already exists; the overlay of mobile phones has only made this ecosystem more fluid and is allowing it to progress rapidly. Each mHealth intervention will take a different approach depending on circumstances and the resources available. As summarized by Cole-Lewis, no one project will answer all the questions on mHealth, but if we are able to build upon theoretical models, lessons learned from other ICT and/or health-related research, develop sound and systematic documentation of methods, and apply rigor in evaluations, we will eventually be able to piece it all together.

Mobile messaging: Methods to the madness

A critical challenge often cited in mHealth programs is how best to approach messaging. What is the optimal tone, frequency, and mode of interaction, and what methods are available for evaluating whether they have generated the desired behaviors? Can what has been done in one environment be effectively adapted for use in another? The work of Caroline Free to leverage messaging for smoking cessation in the United Kingdom, Jessica Osborn for maternal and newborn health in Ghana, and Divya Ramachandran for ASHAs promoting health pregnancies in India explores answers to these questions. The work of Free and Ramachandran highlights critical dimensions of a systematic process as applied to mHealth for behavior change, while the work of Osborn provides some critical lessons learned through doing mHealth messaging.

As illustrated by Free, existing effective behavior change smoking cessation support interventions include group, one-on-one, and telephone counseling. However, many smokers cannot or do not want to use existing services. Motivational messages and behavior change tools used in face-to-face smoking cessation support have been modified for delivery via mobile phones with the content tailored to the age, sex, and ethnic group of the quitter (Rodgers, Corbett, Bramley, Riddell, Wills, Lin, and Jones, 2005; Free, Whittaker, Knight, Abramsky, Rodgers, and Roberts, 2009). In this way, support is delivered wherever the person is located, without them having to attend services and can be interactive, allowing quitters to obtain extra help when needed. Because of the widespread ownership of mobile phones, fully automated smoking cessation support can be delivered to large numbers of people at low cost.

The STOMP (Stop smoking with mobile phones) trial, conducted among 1,700 young smokers (at least sixteen years of age, with a mean age of twenty-five years) throughout New Zealand, assessed the effectiveness of a text message-based smoking cessation intervention (Rodgers *et al.*, 2005). It showed considerable promise, with over a twofold increase in self-reported quit rates at six weeks (28 per cent versus 13 per cent, relative risk 2.2, a 95 per cent confidence interval of 1.79 to 2.70, *p* value of less than 0.0001). The results were consistent and separately significant across all major subgroups including those defined by age, sex, ethnicity, income level, and geographical location. The txt2stop intervention in the United Kingdom was modified and developed from the STOMP intervention and was evaluated in a randomized controlled trial with 5,800 participants (Free, Cairns, Whittaker, and Edwards, 2008; Free *et al.*, 2009), perhaps the largest study of its kind.

Ramachandran used ethnographic research, iterative design, and experimentation with a range of audio-visual aids to help ASHAs communicate with their pregnant clients during house visits and counseling sessions in the poorest state in India, Orissa, which struggles to achieve targeted health outcomes for women and children. The final version of the videos followed a dialogue-based structure, drawing from theories of persuasion, influence, and rhetoric. These videos directly addressed the prevalent myths and barriers that hindered the acceptance and utilization of information and services that ASHAs provided. The videos followed a scripted dialogue, with built-in pauses and questions which ASHAs quickly learned to follow and emulate that led to a significant increase in the ASHAs' ability to provide effective and high-quality counseling, and considerable engagement from clients and their family members.

Through a focus on persuasion during the iterative design process, Ramachandran developed a change model that was pieced together and adapted according to qualitative interviews, lessons from local stakeholders, and iterative

field-testing. Six guiding principles for designers of persuasive messages emerged: (1) focus the message on action items, not on broad topics of information, (2) address local myths and barriers, and provide convincing corrections and solutions, respectively, (3) create opportunities for structured, persuasive dialogue between humans, keeping in mind that persuasion is a largely social phenomenon in rural communities, (4) include reminders about the positive rewards for changing behavior, paying close attention to local values, (5) capture the most persuasive local language and prosody style, even if it is counterintuitive, and (6) do not assume reactions are honest – persuasion takes time.

Similar to other authors in this volume, Ramachandran studied a number of different theoretical frameworks, but found that no single one perfectly fitted in the context in which she was working. What she calls a mosaic model emerged through a mix of theory, practice, and intuition is necessary to accommodate factors that can influence the persuasive power of any interaction whether it is human-to-human or human-to-machine.

With a similar focus on pregnant women and their children, the Mobile Technology for Community Health (MOTech) Initiative as described by Osborn uses two interrelated mobile phone applications to increase the quantity and quality of antenatal and neonatal care in rural Ghana with a specific goal of improving health outcomes for mothers and their newborns. Access to basic health information in rural areas of Ghana is limited, resulting in lack of knowledge about maternal and child health, low uptake of health services, and adherence to often-damaging local myths and cultural practices, contributing to high maternal and child morbidity and mortality. The ‘Mobile Midwife’ application enables pregnant women and their families to receive SMS or pre-recorded voice messages on personal mobile phones that provide time-specific information about their pregnancy each week. Information is provided in the client’s local language and is localized to address issues faced in various regions of the country. The messages continue through the first year of life of the newborn and reinforce well-child care practices and vaccination schedules. The ‘Nurse Application’ enables Community Health Nurses to electronically record care given to patients and identify women and newborns in their area that are due for care. MOTech has linked its two mobile applications so that if a patient has missed treatment that is part of the defined care schedule, the Mobile Midwife service sends an appointment reminder to the patient and nurse.

Existing guidance for the development and evaluation of complex interventions suggests that key elements of the process include development, feasibility and piloting, evaluation, and implementation phases (Craig, Dieppe, Macintyre, Michie, Nazareth, and Petticrew, 2008). Unlike many other mHealth projects and evaluations (as illustrated by Cole-Lewis and Riley (Cole-Lewis and Kershaw, 2010; Riley *et al.*, 2011)), the

work of Free *et al.* was approached systematically beginning with theory, the existing evidence base and the existing STOMP program to generate text messages which were evaluated and modified using feedback from smoking cessation counselors and potential participants in focus groups. The messages were subsequently tested in a pilot trial. Feasibility of the trial process (recruitment, follow up) and delivery of the intervention were assessed in a pilot trial. Findings from the process evaluation for the pilot trial were used to further develop the intervention. The intervention was subsequently evaluated in a main trial. The movement between development, piloting, and evaluation phases provided necessary and critical insights to finalize the txt2stop intervention evaluated in the main trial. Plans for implementation have been initiated. A similar methodology is highly recommended for the development of other texting messaging interventions.

Similar to the work of Free, Osborn identifies common themes to designing applications for specific types of users – those who are consumers of health information and services – in this case pregnant women and their families and those working to provide health services in organizational settings. When designing for consumers, the recognized lack of information drives demand for service which is seen as something with potential for personal benefit (being more informed, having better health). In order to deliver messages to this population, it is critical to use a technology and functionality familiar to the user to enable uptake. In this case, the program expended its plan to use SMS only to provide the same content by voice. The intervention works because it slots into the everyday routines of the user. One debate that often arises in mHealth is whether or not to distribute mobile phones as part of the intervention. There is no apparent business model that makes the provision of mobile phones a viable option, forcing dependency on common channels – voice and SMS. The information service has credibility through its association with respected partners, such as the Ghana Health Service, whom people trust to provide accurate information and is delivered as a standalone effort but one that complements other parallel behavior change initiatives and provides a link to appropriate services.

In the case of delivering mHealth services to health workers, a critical lesson is to begin with a demand for the proposed service that comes from within the organization. This does not always translate into recognition of the need for a technology intervention by individuals within the system, who may not see the personal benefit or gain personal satisfaction from doing a thorough job. This presents a challenge to uptake and compliance, and can limit the success of efforts to encourage that. Related to this is the allowance of the need for changes to existing workflows, which makes it more difficult to integrate the service into the routines of health workers than for their clients. In relation to nurses, the total cost of ownership is reduced by providing phones, enabling the use of data and more sophisticated apps. Credibility

has been gained only through demonstrating the Ghana Health Service ownership of the intervention, and ensuring that it is situated in an existing ecosystem. For instance, phones cannot have an impact unless they are implemented alongside efforts to improve service delivery and the appropriate levels of training are provided.

Innovations to inform the next phase of mHealthy behavior change

The works of Sultan and Moran, Quraishi and Quraishi, and Gomez-Marquez illustrate many of the new possibilities emerging within mHealth for behavior change in developing countries, including the use of smartphone applications for self-management of chronic illness in the Caribbean; gaming for health; and treatment compliance for TB treatment through the use of at home mobile phone supported urinalysis. These initiatives represent the engagement of the technology field in helping to introduce innovation within the health sector, raising some recommendations for how to better engage with the health sector and end-users as part of the design process.

Mohan and Sultan's MediNet Project began in 2007 as a response to a Microsoft External Research Request for Proposals, whose theme was 'Cell phone as a Platform for Health Care'. The main objective of the project was to develop a Caribbean-wide healthcare management system that would pool the healthcare resources of the Caribbean Islands, including a mobile phone-based remote patient monitoring and self-management system for chronic illnesses such as diabetes and cardiovascular disease. Sultan and Mohan's main advice to software programmers entering this domain: that while the health sector provides enormous potential and scope for the development of software technology, the intended users of the software must always be considered in the development process and user interfaces should be designed as simply as possible. Systems should concentrate on the value that intended users will gain from using the system rather than having impressive hard-to-use features which are seldom used. It is also important to become familiar with healthcare standards and government regulations and understand the implications they have on the software being developed. A broad range of software development skills are required depending on the target delivery platform and programmers need to develop expertise in many of them. Engaging with a multidisciplinary team is very important, given the many facets of software development associated with a healthcare system and the different stakeholders involved.

For Quraishi and Quraishi, Freedom HIV/AIDS began as a mobile games-based social venture designed to create information and awareness and behavior change among youths on issues related to sexual interaction, myths, and misconceptions surrounding the disease, combating discrimination, and testing and treatment

behaviors. With HIV and AIDS, many behavioral practices exist due to lack of information, social-economic conditions, and personal attitudes among the youths contributing to nonconforming behaviors to the facts. Before launching the initiative, a systematic study of types of games popular with the youths, the level of information on the subject and basic general risk behavior trends among the youth was conducted. As the initiative was designed to leverage mobile networks and their reach, games were developed to address these issues based on the highest common factors (HCF) approach as against lowest common multiples to cover a large audience group (gamers both casual and serious).

The initiative was launched on December 1, 2005, on the World AIDS Day, as a gift to Indian youths. Highlighting the benefits of public-private partnerships, ZMQ partnered with the state of Delhi, the Delhi State AIDS Control Society, and Reliance Infocomm – one of the largest mobile operators in India. Over the period, many more partners from all sectors joined the initiative to make it a success. Later, the initiative was scaled to different parts of Africa under the Africa Reach program of ZMQ to address other communicable diseases such as tuberculosis and malaria and other lifestyle diseases such as diabetes, and cancer. While overall, gaming is proving to be a popular approach to create effective learning outcomes, there is much to learn about behavior change pathways, that it is stimulating.

Adhere.IO is a technology invented at the MIT that introduces a new class of medical devices called behavioral diagnostics. Behavioral diagnostics combine emerging trends in applied behavioral economics and diagnostic design at the micro-scale wrapped in a telemedical application. Adhere.IO's application of behavioral diagnostics is a home-based test aimed at improving poor adherence of complex drug regimens such as HIV and tuberculosis. Originally developed with resource-constrained regions (such as Nicaragua) in mind, Adhere.IO's initial deployments may end up in the US domestic market.

Looking across these initiatives, it is already evident that 'behavior change' does not begin and end with reminders, information; nor must it rely on ubiquitous text messaging and USSD channels to be relevant in emerging markets. In the developed world, land of smartphones and copious bandwidth, the mHealth community is witnessing an explosion of innovation in different platforms and programs, coupled with a deeper – albeit still not universal – understanding of the psychological process for behavioral support (from peer groups to behavioral reinforcement) (Fogg and Adler, 2007; Fogg and Eckles, 2009; Riley *et al.*, 2011). The work of Adhere.IO, ZMQ, and MediNet illustrate how similar processes can take root in resource-constrained communities, as well. Data-enabled feature phones and smartphones are becoming more affordable, putting them reach of many more (but still not all) users throughout the developing world.

But this explosion in capabilities presents as great a challenge as it does an opportunity; just because technical functionalities are increasing, there is no guarantee that they will be accompanied by the links to behavioral theory and best practice necessary to get the most out of them; if anything, the new technologies may obscure how many more elements of psychology, sociology, and economics are at play in the design of multimedia, interactive, wireless digital behavior change initiatives. As voice, image, and video join the humble SMS, and as interactivity, presence, and context-aware computation replace one-way ‘message blasting’, the set of options and genres is expanding. Riley *et al.* described the evolving challenge this way: ‘The development of time-intensive, interactive, and adaptive health behavior interventions via mobile technologies demands more intra-individual dynamic regulatory processes than represented in our current health behavior theories’ (Riley *et al.*, 2011). Continued knowledge sharing, theoretical linkage and evaluation, critical reflection, and exchange will help the next wave of mHealth innovators deploy and scale more quickly and to great effect.

Conclusion

mHealth for behavior change innovations has become a new buzz word in the public health field throughout the world. In low- and middle-income countries, efforts to leverage mobile phones to provide health information, improve knowledge, and engage individuals in healthier behaviors that generate improved health outcomes are rapidly growing along with more and better research to enhance the impact it is having. This volume is a timely attempt to glean wisdom and learning from early pioneers to better inform decisions related to funding, designing, implementing, and evaluating such programs, and to minimize the reinvention of the wheel and learning the hard way. While it was challenging for many of the practitioners represented in this book to step back and reflect on their experiences, their contributions throughout the process have been tremendous. It is their voices and on-the-ground insights that will help us all become more thoughtful in our approaches to this work and ultimately generate programs that are more fully integrated in a meaningful way into the everyday lives of those who *are* well to *stay* well, and those who fall ill to better manage their health.

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