Kwan, Ada. "State of Behavior Change Initiatives and How Mobile Phones Are Transforming It." *mHealth in Practice: Mobile technology for health promotion in the developing world*. Ed. Jonathan Donner and Patricia Mechael. London: Bloomsbury Academic, 2013. 15–31. *Bloomsbury Collections*. Web. 26 Apr. 2023. <<http://dx.doi.org/10.5040/9781780932798.ch-002>>.

Downloaded from Bloomsbury Collections, www.bloomsburycollections.com, 26 April 2023, 09:16 UTC.

Copyright © Jonathan Donner and Patricia Mechael 2013. You may share this work for non-commercial purposes only, provided you give attribution to the copyright holder and the publisher, and provide a link to the Creative Commons licence.

2 State of Behavior Change Initiatives and How Mobile Phones Are Transforming It

Ada Kwan, Mexican National Institute of Public Health,
Patricia Mechael, mHealth Alliance at the UN
Foundation and Earth Institute at Columbia
University and Nadi Nina Kaonga, Earth Institute
at Columbia University

Introduction

For many decades, public health interventions worldwide have utilized various strategies that can predict and modify the adoption and maintenance of healthier behaviors. At a time when the world's deadliest diseases are largely preventable and treatable, disease prevention is becoming increasingly emphasized, and behavior change has naturally become a central focus in public health. However, changing human behaviors and attitudes requires time, considerable effort, and motivation, and for those implementing programs, understanding the determinants of behavior can become ever more challenging.

In the past and present, different strategies have been employed to change behaviors or for persuasion. Successful interventions have used the following as vehicles to encourage people to be healthier: role models as examples of how to change, narratives with specific cultural and social links, personalized messages, and testimonials (Galavotti, Pappas-DeLuca and Lansky, 2001; Macintyre, Brown and Sosler, 2001). Knowing someone who is affected or has died of a related disease has also been a factor in changing behaviors. Reminders, cues, prompts, and incentives are additional ways to modify behavior, and they have been spread through mediums such as radio, television, and other forms of mass media (Elder, 2001).

More recently, mobile technologies have exploded in popularity, unlocking a unique vehicle for eliciting behavior change. With nearly 5.3 billion mobile phone subscriptions worldwide at the end of 2010, the ubiquity of mobile phones and networks is providing countless opportunities for health behavior change initiatives in

high-, middle-, and low-income countries (ITU, 2010). Within these initiatives, 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. However, the application of mobile phones in health behavior change interventions does not stop there, as their abilities to link to software applications and back-end systems can make data collection possible, medical records more electronic and up to date, and patient–provider relationships stronger (Mechael *et al.* 2010). On an organizational level, mobile technologies are offering an opportunity for individuals to communicate comfortably without being in the same physical space (Kegler and Glanz, 2008).

Although mobile phones have been the focus of thorough and advanced research in developed countries (Fogg and Eckles, 2007; Fogg and Adler, 2009), what we know about mobile phones and behavior change mechanisms is less known among less-developed countries. Additionally, not only do we need to further understand existing factors and processes that can elicit behavior change, we need to more importantly and pragmatically understand strategies that should exist. In five parts, this introduction will describe the state of mHealth, or the use of mobile phones for health, in behavior change initiatives and research in low- and middle-income countries: (1) a snapshot of mobile-mediated behavior change projects; (2) health promotion and disease prevention; (3) disease management, treatment compliance, and appointment reminders; (4) theory in mHealth behavior change initiatives; and (5) a reflection on what ‘mobile’ brings to the behavior change world and what more there is to understand.

Snapshot of mHealth behavior change interventions

In general, mHealth behavior change initiatives focus on the spectrum of disease and illness with different target populations. In this section, we paint the landscape of mHealth behavior change through brief responses to the following questions:

- What kinds of mHealth behavior change projects exist in LMICs?
- How do social, cultural, and political contexts play a role?
- What can mobile phones provide?
- How are mobile phones utilized to change behavior?
- How do these projects begin and to whom do they target?

Figure 2.1 displays a variety of mobile-mediated behavior change projects in LMICs. The figure and the descriptions that follow (and more examples will be introduced throughout this book) are by no means intended to be representative

Figure 2.1 mHealth behavior change projects

Source: Highlights of mHealth behavior change interventions on a world map displaying 2008 mobile phone subscriptions per 100 people by country (permission granted to use and alter map entitled 'Map of per-capita mobile phone subscriptions' by Mark Graham, PhD. (Graham, 2011)).

but should instead reflect projects that collectively demonstrate several approaches for mobile-led behavior change.

What kinds of mHealth behavior change projects exist in LMICs?

Below is a brief description for each of the projects included in Figure 2.1.

Adhere.IO Nicaragua – Individuals in a tuberculosis program are incentivized to achieve high treatment compliance rates with mobile minutes or credit. Program participants are given urinalysis test strips dispensed every twenty-four hours. These strips contain four numbers and embedded chemicals, which react with urine from patients who have properly taken their TB medication. Patients then send a text message reporting the numbers on the strip, and those with high compliance rates are rewarded.

Project Zumbido, Mexico – Project Zumbido created a mobile phone support group for patients taking antiretroviral medications. Within three months of the pilot, 25,000 text messages were sent among the forty participants, who also sent voice messages and participated in conference calls. Support and information were exchanged, which encouraged the patients to better monitor their disease.

Cell-PREVEN, Wawared, CEL-POS, Peru – Cell-PREVEN is a computer system set up for real-time data collection and surveillance of adverse events among female sex workers. Other linked programs within Peru involve the use of mobile phones for community care, maternal care, and antiretroviral treatment adherence.

ATAS, Chile – ATAS provides telecare, self-management support for patients with Type 2 diabetes. The ATAS model has four components: a training program for face-to-face and telecare teams; tele-counseling services; self-management tele-support guide; and software for self-care information, management, and follow-up. Using ATAS, nurses are able to utilize both mobile and electronic technologies (i.e. phone and the internet) to provide behavioral and motivational support and counseling to Type 2 diabetes patients, in coordination with the patients' primary healthcare teams.

MoTECH, Ghana – MoTECH, or Mobile Technology for Community Health, is an initiative that determines how best to increase the quantity and quality of maternal, antenatal, and neonatal care in rural areas. Health information is sent both to pregnant women to encourage them to seek care and to new mothers to address issues on newborn care. Pregnant women can register their numbers along with descriptive information, and then they will receive both text and voice messages regarding pregnancy, health facilities, and treatments.

Text Me! Flash Me!, Ghana – Connecting individuals to a helpline for HIV/AIDS information, referrals, and counseling services, Text Me! Flash Me! also sends text messages containing information collected from ongoing quality assurance and monitoring and evaluation information. Text Me! posters are created to inform the public of the service and that texting specific HIV-related words to a number allows users to receive more information about the texted topic. The Flash Me! component offers a strategy for individuals to flash a helpline counselor, who can then return the call within twenty-four hours, making the call free for the inquirer.

La Ligne Verte, DR Congo – To respond to a lack of knowledge in family planning products and services, the toll-free family planning hotline La Ligne Verte was created in 2005. Mobile phone operators Vodacom and Zain set up the hotline, which was paid by Population Services International and its local affiliate Association de Santé Familiale. The hotline operated between the hours of 8:00 a.m. to 4:30 p.m., and in its first four years, the hotline received 80,000 calls from across the country. Interestingly, the hotline was originally targeted to women of reproductive age; however, approximately 80 percent of the callers were male. This may suggest a strong unmet demand for family-planning-related knowledge for men.

Project Masiluleke, South Africa – 'Project M' is encouraging the general public to get tested for HIV, alerting patients to take their antiretroviral medications,

and providing support for self-testing all by leveraging the features of mobile phones. The launch of the project included the daily delivery of approximately one million ‘Please Call Me’ text messages for one year. A free form of text messaging, these messages linked users to HIV call centers, and the campaign tripled average call volumes to the National AIDS Helpline in Johannesburg.

Cell-Life, South Africa – Cell-Life is using text message reminders for improving treatment adherence and providing information to empower individuals to choose risk-reducing behavior among its long list of activities that involve communicating many HIV topics with mobile phones. Topics include mass messaging for prevention, mass information for positive living, linking patients and clinics, peer-to-peer support and counseling, building organizational capacity of HIV-related organizations, and monitoring and evaluation.

SIMpill, South Africa – SIMpill is a medication adherence system that alerts patients and caregivers through text messages when medication has not been taken. The technology has been used to remind TB patients to take their medication. The bottle is outfitted with a SIM card and transmitter. Each time the bottle is opened, an SMS is sent to a server. If the bottle is not opened when it should be, a notification is sent to the patient and/or their caregiver.

loveLife’s MYMsta, South Africa – loveLife’s MYMsta is a social network that harnesses the features of mobile phones to spread HIV prevention information, in addition to bursary information and employment opportunities to South African youths.

m4RH, East Africa – A service that sends family planning information via text messages, m4RH can be accessed after individuals send a text message containing ‘m4RH’ to a specific number. The individuals then receive a list of topics, such as contraceptive information or family planning clinic locations. The different options can be entered as a reply, and the individual is then able to access these different options.

Text to Change, Uganda – Although initiated in Uganda, Text to Change’s SMS campaigns for health, education, and economic development can now be found across Africa, as well as other countries in the world. The organization’s health education programs, aimed to be interactive and incentive-based, encourage testing and drug compliance and inform people of options of which they may or may not be aware regarding health services.

WelTel Kenya1, Kenya – Implemented by an organization that uses evidence to improve strategic planning of health interventions, WelTel Kenya1 was a randomized controlled trial (RCT) evaluating the use of SMS for antiretroviral treatment adherence.

ZMQ Software, India – ZMQ Software considers mobile phone games as a method to learn about health topics. In India, one of the projects provides information

through SMS to women about prenatal care. As of 2009, nearly 18,000 women had participated in this program by enrolling their numbers at hospitals; however, ZMQ is trying to offer women the opportunity to enroll directly by sending an SMS.

PRIDE, Pakistan – The PRIDE project has been using mobile technologies to increase access to maternal and child health information and services. Initiatives include interactive voice response (IVR) services and text message reminders for antenatal care, immunizations, and post-natal care.

BabyCenter, Worldwide – In addition to being a source of information for expecting mothers, BabyCenter offers two services on mobile phones. BabyCenter's Booty Caller offers a series of eighteen text message ovulation alerts, and BabyCenter Mobile provides expecting mothers advice on pregnancies. Recently, in collaboration with the Grameen Foundation, BabyCenter has been working on a mobile-phone-based fundraising and education campaign for pregnant women to learn more about their pregnancies, in addition to advice on avoiding malaria and managing pregnancy-related costs.

How do social, cultural, and political contexts play a role?

In these projects, social, cultural, and political contexts play a large role not only in the feasibility and perceptions of using mobile phones or other information and communication technologies, but also in each stage of the project. Thus, getting to know the target audience is of great importance. Considerations must also be made for resource-limited contexts. For example, populations in which illiteracy rates are high are likely to not benefit from a text messaging program. For the populations where a text messaging program is feasible, specific words and phrases may be of much more influence than others, and it is up to program implementers and all stakeholders to determine what combination of words will be the most successful in inducing healthier behaviors.

Exploring the acceptability and perceptions among individuals to use mobile phones and their features as a medium to deliver health promotion or treatment reminders in a useful and culturally specific way has seen increasing efforts in recent years, resulting in growing evidence. It was found that among HIV-positive individuals in Peru, just under one quarter were already informally using alarms on their mobile phones as reminders to take their medications, and others found alarm reminders to be necessary (Curioso and Kurth, 2007). Individuals also expressed a desire to receive information via their mobile phones on their personal sexual health, general information on sexually transmitted infections (STIs), general HIV information, recent advances in HIV treatment, and up-to-date research. Compared with in-person interactions, individuals also found mobile phones to offer greater confidentiality. At a community-based clinic in Lima, Peru, patients expressed the importance of

messages to be confidential and private (e.g. by using ‘coded’ words, such as *‘Remember, it is the time of your life’*), as well as be written in simple and concise words (Curioso, Quistberg, Cabello, Gozzer, Garcia, Holmes, and Kurth, 2009).

What can mobile phones provide?

In addition to differing in social, cultural, and political contexts, projects differ by the particular mobile phone features utilized to elicit behavior change. Varying across mobile phone models, features include voice, text, multimedia messaging service (for example picture and video messaging), and applications, such as camera, calendar, and the internet. One of the most used features across phones, as well as for behavior change, is text messaging, also known as short message service (SMS). In a review of twenty-five studies selected solely to demonstrate the use of voice and text features on mobile phones conducted in 2009, eight projects used voice and SMS; another eight projects combined the internet with SMS; and the remaining nine utilized SMS only (Krishna, Boren and Balas, 2009).

How are mobile phones utilized to change behavior?

In mobile-mediated behavior change projects, attempts to elicit desired behavior changes can be simply from created to either directly or indirectly target a desired change, which can be a reduction of a behavior related to poor health or an increase of a behavior related to better health. Examples of these forms of behavior change include:

- Direct way to reduce behavior related to poor health:
 - Text messages to encourage an individual to stop smoking
- Indirect way to reduce behavior related to poor health:
 - Information about how to effectively stop smoking
 - Information about lung cancer statistics to encourage smoking cessation
- Direct way to increase behavior related to better health:
 - Text messages to remind HIV/AIDS patients to take antiretroviral medication
 - Text messages to encourage exercise
- Indirect way to increase behavior related to better health:
 - Information about available HIV and STI hotlines
 - Information for pregnant women regarding mother and newborn care from pregnancy to after birth

When categorizing the mHealth projects in Figure 2.1 in this fashion, the majority of the projects focus on increasing behavior related to better health in both direct and indirect ways. Additionally, we see that mHealth efforts distinctly increase behaviors that prevent or mitigate infectious diseases, primarily HIV/AIDS and other STIs, or promote behaviors to improve maternal and child health. In higher income countries HICs, where chronic diseases are the main killers, mHealth efforts focus more often than not on increasing or reducing behaviors linked to the development of chronic diseases, such as exercise to prevent or mitigate heart disease, and smoking cessation to prevent or mitigate lung disease, respectively. Although the primary purpose of this book is to introduce behavior change efforts in the mobile phone era of LMICs, it is important to draw some lessons learned from HICs as the epidemiological profiles of LMICs reflect shifting disease burdens from infectious diseases to chronic diseases. From the review of the twenty-five studies, which happened to draw from studies in high and upper-middle income countries, described above, ten were related to evaluating behavior change outcomes, such as smoking cessation (reducing smoking behaviors) and antiretroviral (ARV) treatment adherence (increasing proper medication intake behaviors), and the majority of studies concluded that information and knowledge delivered through mobile phones could result in clinical health and health process improvements.

How do these projects begin and to whom do they target?

mHealth behavior change projects generally spawn from supply or demand. In 2009, Fjeldsoe, Marshall and Miller *et al.* performed a review of fourteen studies on health behavior change interventions delivered by text messaging. Out of these fourteen studies, 29 percent ($n = 4$) targeted health behavior change in prevention, and the remaining 71 percent ($n = 10$) targeted health behavior change in clinical care. Text messages in each of the prevention interventions were 'research-initiated'; those in most of the clinical care interventions were 'participant-initiated', where initiation refers to the body that initiated the dialogue via text messages. Very few of the interventions were theory-based, and the authors suggest that behavior change theory should be described more explicitly in future studies (more detail on theory later on). Twelve of the studies sent patients tailored messages, which incorporated the participant's name or nickname, nominated support person's name, age, gender, behavioral history, behavioral preferences, behavioral goals, behavioral barriers, previous text message responses, and medical status (Fjeldsoe *et al.*, 2009). Interestingly, the two studies using untailored messages were in the top three for highest participant attrition. Eight of the studies the authors reviewed reported significant and positive behavioral change, and an additional five had positive behavior trends that were not significantly significant. The authors mention

that there is a strong attempt in research to measure outcomes objectively; however, the effects of targeted behavior are lacking in the literature. Additionally, because most studies reflected pilots or feasibility tests, sample sizes were relatively small to provide sufficient statistical power. The authors suggest future studies should use larger sample sizes.

Health promotion and disease prevention

Regarding health promotion and disease prevention, mobile phones are delivering interventions to promote and disseminate information for sex, family planning, and STIs, particularly HIV, and to encourage individuals to stop smoking and lose weight, respectively. Aimed at improving health behaviors and psychological and physical symptoms, interventions using palm computers or mobile phones can be successfully delivered, are accepted by patients, and are efficacious for treating a wide variety of health behaviors and physical and psychological symptoms (Heron and Smyth, 2010).

For encouraging and reinforcing health behaviors, text messages are frequently employed as an effective strategy; however, they should not be considered stand-alone for behavior change, but as a tool by which behavior change methods can be administered (Cole-Lewis and Kershaw, 2010). Whether or not these projects are effective can only be deduced from robust evaluations, which require sufficient time and support for implementation and monitoring and evaluation. In their review of literature for text messaging in disease prevention and management, Cole-Lewis and Kershaw assessed seventeen articles that reported on twelve studies (one conducted in a developing country) where interventions ranged from three to twelve months (Cole-Lewis and Kershaw, 2010). Three of the twelve studies were inconclusive, and eight of nine powered studies found evidence that text messaging for disease prevention and management was effective. A review was also conducted for mHealth text messaging interventions for sexual health education and management (Lim, Hocking, Hellard, and Aitken, 2008). Evidence appeared to be lacking on the effectiveness of these programs (the authors provided the goals, context, and potential of these programs); however, only one RCT was known among these programs.

Demonstrating how physical activity can be increased through text messaging, an RCT was conducted on the physical activity intervention called MobileMums. Eighty-eight postnatal women were randomized into a control or intervention group (Fjeldsoe, Miller and Marshall, 2010). The control group did not receive any contact or resources aside from a telephone reminder to confirm their week six and week thirteen assessments, whereas the intervention group received two physical activity goal setting consultations with a behavioral counselor (one in-person and

one over the telephone), a refrigerator magnet for planning weekly activities and monitoring physical activity goals and rewards, forty-two (three to five SMSes a week) text messages with personally tailored messages with behavioral and cognitive approaches, eleven weekly text messages sufficing as 'goal checks', and instructions for selecting someone to assist the participant in reaching activity goals. On average, the intervention group increased physical activity by 1.82 days/week and walking for exercise by 1.08 days/week. The participants described the magnet to be the 'most helpful component' for changing their behavior.

The growth of health hotlines has also been observed with the potential of mobile phones to spread information on conditions of interest for individuals. In the Democratic Republic of Congo, the program *La Ligne Verte* ('hotline' in French) offers individuals an opportunity to speak with those trained in high-quality family planning and contraceptive information and in making referrals to clinics if needed (PSI DR Congo and Toth, 2008). Most interestingly, although women were the target population for the family planning information, 80 per cent of callers have been men of reproductive age, perhaps reflecting an unmet demand for such information (PSI DR Congo and Toth, 2008). Additionally, Ivatury and colleagues looked at different health hotlines in Bangladesh, Pakistan, India, and Mexico that together provided information to over ten million individuals, mostly women in rural areas (Mechael, Batavia, Kaonga, Searle, Kwan, Fu, and Ossman, 2010). Not only are hotlines a 'reliable and supportive source of help', but they offer an opportunity to overcome barriers such as limited numbers of healthcare workers to meet with patients and costs in time and money for unnecessary transportation to clinics (Mechael *et al.*, 2010).

Disease management, treatment compliance, and appointment reminders

For individuals who are living with diseases, mobile phones are being utilized in behavior change interventions for disease management, drug adherence, and appointment reminders. As mentioned earlier, projects in HICs heavily focus on the management of chronic diseases, and projects in LMICs heavily focus on the management of infectious diseases, particularly HIV/AIDS. Interventions are primarily delivered through text messages, followed by voice, web browsers, and health hotlines (Mechael *et al.*, 2010).

Users of a clinic in both urban and rural south India were asked about their mobile phone usage behaviors and other topics considered to be important for designing a mobile phone based intervention for ARV treatment adherence (Shet, Arumugam, Rodrigues, Rajagopalan, Shubha, Raj, D'souza, and De Costa, 2010). Ownership was lower in rural settings, but still a majority of users (60 percent) mentioned that

the ‘most acceptable intervention’ would be automated voice calls, opposed to text messages, at a weekly frequency, opposed to a daily frequency. One caveat to this is that the users of the clinic may actually respond much differently to the way they mentioned when asked. In other words, ‘perceived responses do not automatically translate to actual behaviors’ (Shet *et al.*, 2010).

For improving appointment attendance, SMS reminders have been shown to be successful; however, a handful of other studies found mixed results, and others with small samples were inconclusive (Mechael *et al.*, 2010). One RCT in Cote d’Ivoire evaluated text messages for improving malaria chemoprophylaxis adherence among French soldiers ($n = 424$) (Ollivier, Romand, Marimoutou, Michel, Pognant, Todesco, Migliani, Baudon, and Boutin, 2009). Although cited as being useful by the treatment group, the text messages did not significantly improve adherence, but overall treatment adherence was higher than expected. One possible explanation and limitation of the study was that soldiers in treatment and control groups were in close enough contact to remind each other when to take the medications, which could have caused a weakened measured effect between the two groups.

Within the literature, many RCTs on the use of mobile phones for ARV treatment are emerging from LMICs – providing more clues to what may be effective in certain contexts. In an RCT with 538 participants randomized into a treatment group receiving text messages and a control group receiving standard care in Kenya, HIV patients who received text messages had ARV treatment adherence rates that were significantly higher than those in the control group (Lester, Rivot, Mills, Kariri, Karanja, Chung, Jack, Habyarimana, Sadatsafavi, Najafzadeh, Marra, Estambale, Ngugi, Ball, Thabane, Gelmon, Kimani, Ackers, and Plummer 2010). These increases in adherence rates among patients in the treatment group were confirmed by significant increases in rates of viral suppression. Also in Kenya, 431 adult patients who had recently begun ARV treatment for HIV were randomized into a control group or one of four intervention groups, which received either short or long text messages sent at a daily or weekly frequency. Short messages were designed to determine whether a simple reminder was sufficient to change behavior; long messages, whether additional support was more effective. Daily messages were sent at a frequency close to proper treatment usage, and weekly messages sent to avoid the possibility of too frequent messages becoming habituating. Weekly reminders improved the amount of patients having achieved 90 percent ARV treatment adherence.

Theory in mHealth behavior change initiatives

As the uptake of mobile phones strongly offers a new strategy for the field of behavior change, it will be important to attentively assess the integration of this new strategy

within existing and/or new theories. This is extremely important because behavior change is hard to do for different reasons, such as varying levels of motivation in individuals who are targeted for behavior change interventions, in combination with the difficulty in reducing an unhealthy behavior that makes an individual feel good, such as smoking, or increasing a behavior that an individual already has begun to an extent versus an individual who has not begun that behavior. Messaging interventions that are designed and evaluated based on theory have been found to be more successful, and theory is being applied more frequently in some disease interventions than in others (Cole-Lewis and Kershaw, 2010; Riley, Rivera, Atienza, Nilsen, Allison, and Mermelstein, 2011). When reviewing fourteen studies on text messaging health behavior change interventions, Fjeldsoe et al. found four studies that were implemented through a theoretical basis (Fjeldsoe and Kershaw 2009). Theories applied included social cognitive theory, behavioral self-regulation theory, relapse prevention, and a combination of social psychological theories. The authors suggest that the stronger focus on behavior change in clinical care compared with preventive care may be a reason for fewer studies providing a theoretical basis. In another systematic review of literature on mobile health interventions, Riley *et al.* found that most smoking and weight loss studies reported a theoretical basis and that most of the adherence and chronic disease (for example, diabetes, asthma, and hypertension) management studies did not (Riley *et al.*, 2011). Among the seven smoking prevention, twelve weight-loss, ten treatment adherence, and twenty chronic disease management mHealth interventions, the authors found that those interventions based on theory drew most frequently from, in decreasing order, health belief model, theory of planned behavior, social cognitive theory, transtheoretical theory, self-determination theory, self-efficacy theory, and contingent theory. It appears as though deeper applications of theory across mobile health behavior interventions will have strong benefits, but existing theories lack the qualities or constructs that can fully inform development. In this regard, it is likely that mobile phone integration into health behavior interventions will push theory development, particularly as these systems become more dynamic, adaptive, and interactive (Riley *et al.*, 2011).

Reflection on what ‘Mobile’ brings to the behavior change world – reach, access, and mobility

Mobile phones have become attractive vehicles for delivering behavior change interventions (Mechael *et al.*, 2010). We are currently seeing mobile phones relay information, send encouragement, and provide reminders, as well as make available contact information for hotlines, counseling, and educators along the cascade of

health services provided in LMICs. In this section, we reflect on what mobile phones have brought to the behavior change world.

Mobile phones have become so ubiquitous in recent years, particularly because of flexible payment plans, that they provide an unmet opportunity for reaching and accessing neglected populations (Mechael *et al.*, 2010). From a public health perspective, behavior change interventions ought to be delivered with equitable access, and mobile phones, having reached all corners of the world and all socioeconomic and education levels, offer a huge advantage over traditional health behavior change techniques (for example radio, landline telephones, and the internet) to reach more disadvantaged groups of the population who are less likely to have access to health interventions while being the ones who may need it the most (Fjeldsoe *et al.*, 2010).

The fact that mobile phones are cheap, small, and can be personal offers individuals communication flexibility with features, namely voice calls and text messaging, through which health professionals can create a more interactive way to promote health, prevent disease or illness, and manage disease and treatments (Cole-Lewis and Kershaw, 2010). For promoting health, text messages are quick and immediate vehicles for tasks such as carrying information about family planning (PSI DR Congo and Toth, 2008) and quizzes about HIV/AIDS knowledge and beliefs (Henriquez, 2009). For preventing disease, health professionals are primarily using voice call strategies and text messaging for encouraging individuals to exercise more and stop smoking (Krishna *et al.*, 2009). For disease management and treatment, simple text messages are being utilized as reminders for patients to take their medications (Lester *et al.*, 2010; Pop-Eleches, Thirumurthy, Habyarimana, Zivin, Goldstein, de Walque, MacKeen, Haberer, Kimaiyo, Sidle, Ngare, and Bangsberg, 2011). Low start-up costs of these interventions, the ability to use existing infrastructure (mobile networks), and, as previously mentioned, the potential of mobile phones to run software applications and link to back-end systems offer additional advantages (Lester *et al.*, 2010; Mechael *et al.*, 2010). To summarize, many of these strategies exhibit opportunities for individuals to self-manage their health and to take ownership of their health while receiving real-time or close-to-real-time responses or feedback (Suter, Suter and Johnston, 2011). In many ways, interaction through mobile phones is affording new possibilities in behavior change: for some interventions, existing communication channels are being strengthened, and for others, new communication channels are being created to induce healthier behavior.

More specifically, as a promising vehicle for health behavior change intervention delivery, the ability of text messaging to offer reminders or bits of encouragement may tap important constructs central to many behavioral theories, such as cues to action, reinforcement, and social support (Cole-Lewis and Kershaw, 2010). Other

features of text messaging that allow it to be a strong tool for healthcare improvement include its availability on almost every model of mobile phones, relatively low cost, widespread use, no requirements for great technological expertise, asynchronous (for example, if the phone is turned off, messages can be delivered when the phone is turned back on, or if the battery dies or the power is lost, messages can be received when the battery is recharged or when the power returns), and access of messages at any time. These features allow mobile phones to be widely applicable to a variety of health behaviors and conditions, as well as in-the-moment, personally tailored health communication reinforcement (Cole-Lewis and Kershaw, 2010).

There is more to understand on what ‘Mobile’ can bring to behavior change

Among the aforementioned, there is more to understand on what mobile phones can bring to behavior change. First, rigorous evaluations of mHealth behavior change interventions are the exception and not the rule. Much of the existing research findings are from pilot or feasibility studies, which have small sample sizes or not enough power to identify significance across intervention and nonintervention groups. This makes it even more difficult to conclude what particular behavior mechanisms are in play when an individual finds, for example, encouragement from text messages to exercise more or to go get tested for STIs at the nearest clinic. To further understand the determinants of behavior change, scale up is necessary for some of these programs, which could benefit very much from strong private–public partnerships among donors, program managers, ministries of health, evaluation teams, mobile phone companies, healthcare professionals, and those targeted to receive the interventions (Lester *et al.*, 2010; Mechael *et al.*, 2010). Second, most of the health behavior change interventions are delivered via SMS, which presents the issue that illiterate members of a population cannot be included in a text messaging intervention, perhaps a reason why interventions that target populations with higher rates of illiteracy are known to use voice features, such as interactive voice response systems. This has previously been suggested as the ‘rate-limiting step on use of text messaging’ (Kaplan, 2006). Third, the mobile phone will be a channel for triggering many behaviors (Fogg and Adler, 2009), but it is important to consider the inability to send tailored messages to an individual in a context where mobile phones are often shared, usually among household members. In the case where someone is borrowing another person’s phone, calls and texts can be sent but perhaps not received, whereas the person who owns the phone can both send and receive phone calls and text messages (James and Versteeg, 2007). Fourth, generalizability across different populations, across different times, or across different diseases or illnesses can be fallacious. Similarly, as exhibited by the evolution of behavior

change models and their applications in different settings, a model created and meant for use in an HIC may not be suitable for use in a low-income country, or vice versa (Bertrand, 2004; Kaplan, 2006). Similarly, existing research conducted in HICs corresponds to chronic diseases, and research conducted in LMIC settings generally correspond to infectious diseases, mostly HIV/AIDS-related. This brings up two issues: (1) Findings from these studies may not be generalizable to other diseases or illnesses or from one setting to the next, so reapplying findings from one study to a new context is cautioned, and (2) As LMICs are currently facing epidemiologic transitions, the application of health behavior change interventions, especially those for prevention, targeting chronic diseases are just as important as those targeting infectious diseases. However, successful mHealth behavior interventions can provide invaluable knowledge, as well as a skeleton and platform upon which additional behavioral interventions for other diseases or illnesses can be introduced. Although the list of what mobile phones can provide to the field of behavior change is extensive, it is matched with an even more extensive list of what there is to learn. In order to reach the full potential of mHealth behavior change, it will be crucial to understand these.

Closing

We hope that this introduction has provided sufficient background information on behavior change interventions in the context of nearly saturated global mobile phone uptake. Through a snapshot of mHealth behavior change projects, we briefly touched upon a handful of projects taking place in LMICs, which reflect mobile phone strategies in health promotion and disease prevention to disease management, treatment compliance, and appointment reminders. We have touched on theory in these initiatives, and how interventions designed and evaluated based on theory have been found to be more successful. All in all, mobile phones provide reach, access, and mobility to the field of behavior change, but there is a lot more to learn before full potential can be possible. In the next chapters, this book will provide a deeper look into several of these interventions across the world.

Bibliography

- Bertrand, J. (2004), 'Diffusion of Innovations and HIV/AIDS', *Journal of Health Communication* 9: 113–21.
- Cole-Lewis, H. and Kershaw, T. (2010), 'Text Messaging as a Tool for Behavior Change in Disease Prevention and Management', *Epidemiologic Reviews* 32(1): 56–69.
- Curioso, W. and Kurth, A. (2007), 'Access, Use and Perceptions Regarding Internet, Cell Phones and PDAs as a Means for Health Promotion for People Living with HIV in Peru', *BMC Medical Informatics and Decision Making* 7(24).
- Curioso, W., Quistberg, D., Cabello, R., Gozzer, E., Garcia, P., Holmes, K. and Kurth, A. (2009), '“It's Time for Your Life”: How Should We Remind Patients to Take Medicine Using Short Text Messages?', *AMIA Annual Symposium Proceedings*: 129–33.

- Elder, J. (2001), *Behavior Change and Public Health in the Developing World*, Thousand Oaks: Sage Publications.
- Fjeldsoe, B., Marshall, A. and Miller, Y. (2009), 'Behavior Change Interventions Delivered by Mobile Telephone Short-Message Service', *American Journal of Preventive Medicine* 36(2): 165–73.
- Fjeldsoe, B., Miller, Y. and Marshall, A. (2010), 'MobileMums: A Randomized Controlled Trial of an SMS-Based Physical Activity Intervention', *Annals of Behavioral Medicine* 39: 101–11.
- Fogg, B. and Adler, R. (2009), *Texting 4 Health: A Simple, Powerful Way to Change Lives*, Stanford: Captology Media.
- Fogg, B. and Eckles, D. (2007), *Mobile Persuasion: 20 Perspectives of the Future of Behavior Change*, Stanford: Captology Media.
- Galavotti, C., Pappas-DeLuca, K. and Lansky, A. (2001), 'Modeling and Reinforcement to Combat HIV: The March Approach to Behavior Change', *American Journal of Public Health* 91(10): 1602–7.
- Graham, M. (2011), 'Map of Per-Capita Mobile Phone Subscriptions', <http://www.floatingsheep.org/2011/01/map-of-per-capita-mobile-phone.html> [Accessed 15 February 2012].
- Henriquez, K. (2009), 'Text to Change: Spreading the Message to Stop the Virus', <http://ict4uganda.wordpress.com/2009/03/31/text-to-change-spreading-the-message-to-stop-the-virus/> [Accessed 15 February 2012].
- Heron, K. and Smyth, J. (2010), 'Ecological Momentary Interventions: Incorporating Mobile Technology into Psychosocial and Health Behavior Treatments', *British Journal of Health Psychology* 15(Part 1): 1–39.
- ITU. (2010), 'Measuring the Information Society', <http://www.itu.int/pub/D-IND-ICTOI-2010/en> [Accessed 15 February 2012].
- Ivatury, G., Moore, J. and Bloch, A. (2009), 'A Doctor in Your Pocket: Health Hotlines in Developing Countries', *Innovations: Technology, Governance, Globalization* 4(1): 119–53.
- James, J. and Versteeg, M. (2007), 'Mobile Phones in Africa: How Much Do We Really Know?', *Social Indicators Research* 84: 117–26.
- Kaplan, W. (2006), 'Can the Ubiquitous Power of Mobile Phones Be Used to Improve Health Outcomes in Developing Countries?', *Globalization and Health* 2: 9.
- Kegler, M. and Glanz, K. (2008), 'Perspectives on Group, Organization, and Community Interventions', in K. Glanz, B. Rimer and K. Viswanath (eds), *Health Behavior and Health Education: Theory, Research, and Practice*, San Francisco: Jossey-Bass: 389–404.
- Krishna, S., Boren, S. and Balas, E. (2009), 'Healthcare Via Cell Phones: A Systematic Review', *Telemedicine and e-Health* 15(3): 231–41.
- Lester, R., Rivito, P., Mills, E., Kariri, A., Karanja, S., Chung, M., Jack, W., Habyarimana, J., Sadatsafavi, M., Najafzadeh, M., Marra, C., Estambale, B., Ngugi, E., Ball, T., Thabane, L., Gelmon, L., Kimani, J., Ackers, M. and Plummer, F. (2010), 'Effects of a Mobile Phone Short Message Service on Antiretroviral Treatment Adherence in Kenya (Weltel Kenya1): A Randomised Trial', *Lancet* 376(9755): 1838–45.
- Lim, M., Hocking, J., Hellard, M. and Aitken, C. (2008), 'SMS STI: A Review of the Uses of Mobile Phone Text Messaging in Sexual Health', *International Journal of STD & AIDS* 19: 287–90.
- Macintyre, K., Brown, L. and Sosler, S. (2001), "'It's Not What You Know, but Who You Know': Examining the Relationship between Behavior Change and AIDS Mortality in Africa', *AIDS Education and Prevention* 13(2): 160–74.
- Mechael, P., Batavia, H., Kaonga, N., Searle, S., Kwan, A., Fu, L. and Ossman, J. (2010), *Barriers and Gaps Affecting mHealth in Low and Middle Income Countries: Policy White Paper*. New York, Center for Global Health and Economic Development, Earth Institute, Columbia University.
- Ollivier, L., Romand, O., Marimoutou, C., Michel, R., Pognant, C., Todesco, A., Migliani, R., Baudon, D. and Boutin, J. (2009), 'Use of Short Message Service (SMS) to Improve Malaria Chemoprophylaxis Compliance after Returning from a Malaria Endemic Area', *Malaria Journal* 8(236).
- Pop-Eleches, C., Thirumurthy, H., Habyarimana, J., Zivin, J., Goldstein, M., de Walque, D., MacKeen, L., Haberer, J., Kimaiyo, S., Sidle, J., Ngare, D. and Bangsberg, D. (2011), 'Mobile

- Phone Technologies Improve Adherence to Antiretroviral Treatment in a Resource-Limited Setting: A Randomized Controlled Trial of Text Message Reminders', *AIDS* 25(6): 825–34.
- PSI DR Congo and Toth, C. (2008), 'Cell Phone Hotline Spreads Family Planning Information in DR Congo', Washington, DC: USAID. www.flexfund.org/resources/technical_updates/psi_drc_case_study.pdf [Accessed 15 February 2012].
- Riley, W., Rivera, D., Atienza, A., Nilsen, W., Allison, S. and Mermelstein, R. (2011), 'Health Behavior Models in the Age of Mobile Interventions: Are Our Theories up to the Task?', *Translational Behavioral Medicine* 1(1): 53–71.
- Shet, A., Arumugam, K., Rodrigues, R., Rajagopalan, N., Shubha, K., Raj, T., D'souza, G. and De Costa, A. (2010), 'Designing a Mobile Phone-Based Intervention to Promote Adherence to Antiretroviral Therapy in South India', *AIDS and Behavior* 14(3): 716–20.
- Suter, P., Suter, W. and Johnston, D. (2011), 'Theory-Based Telehealth and Patient Empowerment', *Population Health Management* 14(2): 1–8.