Effectiveness of mHealth Behavior Change Communication Interventions in Developing Countries: A Systematic Review of the Literature

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Effectiveness of mHealth Behavior Change Communication Interventions in Developing Countries: A Systematic Review of the Literature

TILLY A. GURMAN, SARA E. RUBIN, AND AMIRA A. ROESS

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Mobile health (mHealth) technologies and telecommunication have rapidly been integrated into the health care delivery system, particularly in developing countries. Resources have been allocated to developing mHealth interventions, including those that use mobile technology for behavior change communication (BCC). Although the majority of mobile phone users worldwide live in the developing world, most research evaluating BCC mHealth interventions has taken place in developed countries. The purpose of this study was to conduct a systematic review of the literature to determine how much evidence currently exists for mHealth BCC interventions. In addition to analyzing available research for methodological rigor and strength of evidence, the authors assessed interventions for quality, applying a set of 9 standards recommended by mHealth experts. The authors reviewed 44 articles; 16 (36%) reported evaluation data from BCC mHealth interventions in a developing country. The majority of BCC mHealth interventions were implemented in Africa (n=10) and Asia (n=4). HIV/AIDS (n=10) and family planning/pregnancy (n=4) were the health topics most frequently addressed by interventions. Studies did not consistently demonstrate significant effects of exposure to BCC mHealth interventions on the intended audience. The majority of publications (n=12) described interventions that used two-way communication in their message delivery design. Although most publications described interventions that conducted formative research about the intended audience (n=10), less than half (n=6) described targeting or tailoring the content. Although mHealth is viewed as a promising tool with the ability to foster behavior change, more evaluations of current interventions need to be conducted to establish stronger evidence.

Estimates indicate that half of all people living in remote areas of the world will have access to a mobile phone by 2012 (United Nations Foundation/Vodafone Foundation, 2009), with the greatest growth for mobile phones being primarily in low- and middle-income countries (Mechael, 2009). As a result, mobile phone technology is increasingly viewed as a promising communication channel that offers the potential to improve health care delivery and promote behavior change among vulnerable populations. Some of the more attractive features of mobile phones include the pay-as-you-go
and the short message service (SMS) capacities. SMS is the most widely used form of communication globally and is a simple transfer of data usually from person-to-person in the form of 160 characters, but the message can also be sent in bulk and from computer to person or vice versa (Atun et al., 2006). Proponents suggest that advantages of using SMS to communicate with others include its ability to disseminate information immediately, assure a certain level of confidentiality, confirmation of delivery, and cost little (Atun et al., 2006).

This integration of mobile telecommunication technologies into the health arena is also known as mobile health (mHealth; Mechael, 2009). No systematic literature review to date has focused exclusively on the effectiveness of behavior change communication (BCC) mHealth interventions in developing countries. The current systematic review fills this gap and identifies recommendations for future BCC interventions and research using mHealth.

Experts in mHealth have outlined recommendations about how to use mHealth technologies strategically and effectively for BCC (GSMA Development Fund, 2010; K4Health, 2011; McNamara, 2007; Mechael, 2009; Mechael & Sloninsky, 2007). These recommendations address the technology specifications, the intended audience, the design of BCC messages, and the evaluation. The current systematic review analyzes available literature with these recommendations in mind in order to offer insight about the overall quality of the interventions themselves.

Method

Search Strategy

This systematic review consisted of several data collection steps. Publications were identified through four separate mechanisms. First, an Internet keyword search via Scopus, PubMed, MEDLINE, LexisNexis, and GoogleScholar identified potential peer-review publications. Keywords used in these searches included the following: text, text message, short message service, SMS, cell phone, phone, mobile phone, mobile health, mHealth, eHealth, health communication, health education, behavior, behavior change, prevention, and intervention. Second, we manually searched specific journals that had recently published articles on mHealth (The Lancet, the Journal of Health Communication, and Health Affairs). Third, gray literature was identified by searching the websites of organizations and agencies that are currently engaged in international mHealth BCC efforts (e.g., Population Services International, Academy for Educational Development, The Johns Hopkins University Center for Communication Programs, United States Agency for International Development, The World Bank, CORE Group, and the World Health Organization) and by querying the CORE Group mHealth listserv. Last, we reviewed reference lists within individual publications to ensure an exhaustive search.

Once a possible publication was identified, its title and abstract were reviewed to assess whether it might meet the inclusion criteria for this systematic review. Publications that were not excluded at the title/abstract stage underwent a full-text review. After the various levels of review, the result was the sample of publications that met all the eligibility criteria. (See Figure 1 for a decision tree describing the inclusion/exclusion process.) Eligibility criteria for inclusion were as follows: study used mHealth technology in its interventions for BCC in low- and middle-income countries; study included formative, process, or summative/outcome evaluation.
that assessed the mHealth intervention; and study was a peer-reviewed article, gray literature, internal organization report, or conference paper/PowerPoint presentation. Given the lack of research available in the field, limiting solely to peer-reviewed literature was not feasible.

The initial search for abstracts resulted in 44 articles that were reviewed for relevance to the research question. The main factors for ultimately excluding many articles included the following: study was conducted in a high-income country; study provided descriptive summaries of mHealth programs but failed to provide an evaluation of the program; study provided a short description of multiple mHealth programs without providing specific details on the BCC mHealth intervention; and study focused on mHealth informatics, health worker training, or other subsets of mHealth outside the realm of BCC.

**Quality Assessment**

In addition to evaluating publications for their methodological rigor and quality of evidence, the interventions were assessed for quality based on mHealth BCC intervention components recommended by experts (GSMA Development Fund, 2010; K4Health, 2011; McNamara, 2007; Mechael, 2009; Mechael & Sloninsky, 2007).

Technology-related components considered critical to the success of BCC mHealth interventions include selecting the appropriate technology for the intended audience, location, and context. Because BCC mHealth interventions may deal with sensitive health issues and phone sharing commonly practiced in developing countries, the ability to ensure privacy is also key (Atun et al., 2006; McNamara, 2007). In addition, a goal of BCC mHealth interventions in low- and middle-income countries should be to minimize costs while maximizing the benefits (Mechael et al., 2010).
Creating interventions with the intended audience’s level of comprehension—including not only language and literacy competency but also the ability to understand and use technology—will help to foster greater behavior change. Message design considerations include creating targeted and tailored content which engages the user in two-way communication, allowing users to interact and ask questions instead of simply receiving information (Atun et al., 2006; Mechael et al., 2010). In addition, despite the anytime/anywhere nature of mobile phones, the timing of communication messages (i.e., time of day, frequency, and sequencing) should be considered in order to communicate at a convenient time in a way in which the end user is receptive to the information (Atun et al., 2006).

Last, quality components related to the evaluation include conducting formative research in order to design culturally sensitive interventions which truly understand the audience, in terms of health needs and telephone usage. In addition, to obtain the strongest evidence and entice donors to continue funding, experts have suggested the need for long-term evaluation of mHealth BCC interventions (Mechael et al., 2010).

Results

Although a total of 44 articles received full-text review, only 16 (36% of the 44 articles) met the inclusion criteria for the systematic review. (See Table 1 for a summary of the 16 articles.) The majority of publications reported findings from summative evaluations (n=10), followed by formative (n=5) and then process (n=1) evaluation. For three of the publications, the same organization, Text To Change, was involved in the intervention (“Using an interactive,” 2010; Danis et al., 2010; Hoefman & Apunyo, 2010). Quantitative research methodologies were most often represented, with nine publications that were solely quantitative and four that were mixed-methods.

The majority of studies were located in Africa (n=10), Asia (n=4), and multicountries (n=2) consisting of Sub-Saharan Africa, South America, and South Asia. Studies most commonly occurred in Uganda (n=3), South Africa (n=3), and India (n=3). The topical focus of the articles included HIV/AIDS (n=10), family planning/pregnancy (n=4), self-breast exam (n=1), general health appointments at a clinic (n=1), and tuberculosis (n=1). No existing literature offers an explanation as to why more than two thirds of the existing literature focuses on HIV/AIDS.

Five publications focused on interventions for reminder to do a certain behavior. However, as discussed later only some required a response indicating that the behavior had been completed, and most of them that do require responses are entirely based on self-reported data. This ranged from several different kinds of behaviors such as taking a drug treatment, conducting a self-breast examination, and keeping track of the menstrual cycle for a traditional family planning method. Four publications specifically focused on quiz-based SMS in which a server would send out knowledge questions to participants, they would be encouraged to reply and receive the correct answer if wrong or congratulated if correct.

Quality Assessment

For the application of mHealth recommendations, the following areas were used the most in the reviewed studies: two-way communication (n=12), technology platform selection (n=10), and understanding the audience (n=10). Lesser used recommendations include the following: comparison studies (n=2), long-term evaluation (n=2), and timing of communication (n=3).
Table 1. Summary of literature review

<table>
<thead>
<tr>
<th>Region and country (or organization)</th>
<th>Author</th>
<th>Summary</th>
<th>Relevant findings</th>
<th>Application of mHealth recommendations</th>
<th>Evaluation</th>
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<tbody>
<tr>
<td><strong>Sub-Saharan Africa</strong></td>
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</table>
| Democratic Republic of Congo         | Ligne Verte (Corker, 2010) | • Toll-free family-planning hotline  
• Lessons learned from 3 years of the hotline | • More than 80,000 calls made to hotline over 3 years; men are the primary users of the hotline—80% annually  
• Call time of 2 min is insufficient to answer all questions (part of the deal with VODACOM limited to 2 min)  
• Concept of a hotline not well understood in the Democratic Republic of Congo—20% of calls on a topic unrelated to family planning  
• Cost of program: annual operating costs about $8,000 on the basis of per-call rate of $0.36 and salary for the educators | • Select appropriate technology  
• Ensure privacy  
• Minimize costs  
• Consider comprehension  
• Use two-way communication  
• Target and tailor content  
• Understand audience  
• Conduct long-term evaluation | • Type of evaluation: outcome  
• Methodology: mixed methods  
• Design: lessons learned document, unclear on the design |
| Ghana                                | Mobile Midwife (Grameen Foundation, 2011) | • “Mobile midwife” allows pregnant women and their families to receive weekly messages  
• 42% who listen to the primary message also opt to listen to a second message and 36% opt to listen to a third message  
• Content translated into several Ghanaian languages and targeted toward mothers, fathers, and extended family | • Select appropriate technology  
• Minimize costs  
• Consider comprehension  
• Target and tailor content | • Type of evaluation: formative  
• Methodology: mixed methods  
• Design: lessons learned document |
messages (99% choose voice over text message)

- Pregnancy question box set up before voice program to hear what questions were on the minds of mothers and family members
- Cost of recording and translating 177 messages was $22,000 per language
- People preferred to hear a softer “auntie” voice to deliver the message

- Understand audience

Ghana

Text Me!
Flash Me!
(Clemmons, 2009)

- Helpline for MSM to answer questions and encourage them to seek care
- MSM call and hang up or text their number to “flash” it, and then counselor calls them back

- In the first month, five helpline counselors spoke with 439 MSM, for an average of 20 min; 1,000 texts were missed in the first month because there were not enough counselors to meet demand
- Average of 88 MSM counseled per month versus 50 MSM compared to in-person counseling.

- Select appropriate technology
- Ensure privacy
- Use two-way communication
- Target and tailor content
- Know audience

- Before the survey, 98% of MSM no uptaking HIV/AIDS services, but after the program there was a 54% uptake of services
- Sixfold increase of uptake at Centre for Popular Education and Human Rights, Ghana Drop-In Center one month after launch of hotline

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<table>
<thead>
<tr>
<th>Region and country</th>
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</table>
| Kenya | WelTel Kenya 1 (Lester, 2010) | Reminder program comparing antiretroviral adherence after receiving text messages to those who received no reminders | • Self-reported adherence of 62% (viral suppression 57%) in intervention group; 50% adherence (viral suppression 48%) in control group  
• Self-reported adherence significantly better in control group; odds ratio = .57, \( p = .0028 \)  
• No secondary outcomes showed significance such as male sex, urban residence, mobile phone ownership  
• Cost: Intervention costs about $0.05 per text message and a total of $20 per 100 patients per month, and follow-up voice calls averaged $3.75 per nurse per month  
• 98% of intervention group would recommend it to a friend; 191 out of 194 wanted to continue the program | • Minimize costs  
• Use two-way communication  
• Conduct long-term evaluation | • Type of evaluation: outcome  
• Methodology: quantitative  
• Design: randomized clinical trial; \( n = 538 \); SMS intervention group (\( n = 273 \)), control group with no reminder (\( n = 265 \)); the intervention group received weekly text message reminders to take antiretrovirals from nurses and were asked to respond |
within 48 hr; the control group consisted of 265 who received no reminders; self-reported antiretroviral adherence was monitored for 30 days and then at 6- and 12 month follow-up.

Nigeria Learning about Living (Mobile4Good, no date)

- Clients ask questions about sexual and reproductive health via call, text message, or web through the “My Question” service; questions are stored on a mobile
- By the end of pilot phase, almost 9,000 young people had been reached
- 14 months after launch of the initiative, “My Question” had received more than 60,000 questions via text message; “My Answer” participation increased month to month throughout the pilot
- 76% of users felt questions were answered properly; 24% said use service because it’s free. Of 24% who were not satisfied, more than 50% did not receive reply to text messages because of “network fluctuations”
- Select appropriate technology
- Ensure privacy
- Use two-way communication
- Target and tailor content
- Understand the audience

- Type of evaluation: outcome
- Methodology: mixed methods
- Design: quasi-experimental (n = 9,000), unclear whether that number signed up voluntarily and unclear how many participated in survey

(Continued)
### South Africa

**Cell-Life (Skinner, n.d.)**

- Process research to determine the best way to better distribute information through mobile phones
- Importance of two-way text messages; tailor text messages so people can select to receive a small number or bulk; privacy on HIV status was a concern
- When asked what health information they wanted to receive on cell phone: 61.4%, HIV-related information; 58.6%, TB treatment; 51.9%, avoid

- Select appropriate technology
- Ensure privacy
- Consider comprehension
- Target and tailor content

**Application of mHealth recommendations**
- Type of evaluation: process
- Methodology: qualitative
- Design: 10 in-depth interviews and 5 focus groups

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**Table 1. Continued**

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<tbody>
<tr>
<td>South Africa</td>
<td>Cell-Life (Skinner, n.d.)</td>
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<tr>
<td>South Africa</td>
<td>Project Masiluleke</td>
<td>• Bulk text messaging service sent 1 million texts per day for 365 days to South Africans</td>
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<td></td>
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<td>• Message is call to action to visit HIV/TB call centers to obtain information or get tested</td>
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<td>• 1.2 million calls to hotline attributed to SMS program (300% increase in overall calls to hotline)</td>
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<td>• English and Zulu offered, but Zulu messages outperformed</td>
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<td>• Time the communication appropriately</td>
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<td>• Consider comprehension</td>
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<td>• Target and tailor content</td>
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<td>• Type of evaluation: outcome</td>
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<td>• Methodology: quantitative</td>
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<td></td>
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<td>• Design: none listed</td>
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<tr>
<td>Uganda</td>
<td>Health Child and Text to Change</td>
<td>• Bulk text messages delivered to 3,000 people in areas of Uganda</td>
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<td>• 58.4% answered correctly (multiple choice) how babies can acquire HIV.</td>
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<td>• Conclude adding voice segment would help reach the illiterate (48% of target)</td>
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<td>• Consider comprehension</td>
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<td>• Use two-way communication</td>
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<td>• Type of evaluation: outcome</td>
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<td>• Methodology: quantitative</td>
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### Table 1. Continued

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</table>
| Uganda             | Text to Change (Danis, 2010) | where Health Child has programming  
  - Goal of quiz to build knowledge on antenatal care/pregnancy, HIV/AIDS, and malaria prevention  
  - Average response rate to the survey was 33% (700 participants)  
  - Quiz-based bulk SMS program to increase knowledge of HIV/AIDS  
  - SMS quiz questions answered correctly ranged from three groups ranged between from 84.6% to 91.9%  
  - Technical error in responding to text messages ranged from 3.16 to 9.70% because text message in conversational format that computer cannot process |  
  - 264 people showed up at health clinics mentioning this SMS program  
  - Of the 700 participants, they attribute knowing about health services through the following: 38% community health workers, 28% radio, 25% mobile phones |  
  - Select appropriate technology  
  - Consider comprehension  
  - Use two-way communication |  
  - Design: quasi-experimental |  
  - Type of evaluation: outcome  
  - Methodology: quantitative  
  - Design: quasi-experimental; three samples |
• Intervention conducted in three studies:
  One group targeted a regional area of 10,000 cell phone users in Uganda, the other targeted two separate groups of 5,000 factory workers in Southeastern Uganda.

• Health centers at factory quiz towns received threefold increase in HIV test requests from workers (no statistics on this provided)

• Bulk text messages delivered to 8,000 users and several opted in;

• The week after the program, 398 HIV tests were carried out, double the 185 in the previous week
  • 96% stated that the survey helped them gain HIV knowledge
  • On average, 74% correct answers
  • 19% of participants were female

• Consider comprehension
• Use two-way communication

96% stated that the survey helped them gain HIV knowledge
• On average, 74% correct answers
• 19% of participants were female

Type of evaluation: outcome
Methodology: quantitative

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| Asia               | [No program name] (Chen, 2007) | overall, 8,272 subscribed for the survey, but 1,222 did not respond to any questions  
- Goal of quiz to build knowledge on HIV and family planning in addition encouraging free HIV/AIDS testing the following week  
- Reminder program for general health upcoming | The rates of attendance were 80.5% in control group, 87.5% in the SMS group and 88.3% in the voice group. The intervention groups significantly higher than | • Understand the audience  
• Select appropriate technology  
• Minimize costs  
• Understand the audience | Design: quasi-experimental  
Type of evaluation: outcome  
Methodology: quantitative |
appointments; one group received text message reminders, one group received voice reminders, another received no reminders control \((p = .001)\).

- No statistical difference between the SMS and voice group \((p = .670)\)
- Cost effectiveness: SMS group cost .31 Yuan and voice group was .48 Yuan per participant; text message reminders were more cost-effective.

- Design: randomized control trial; 1,859 had appointment at a health clinic and were randomly selected to participate, of which 619 were placed in control group, 620 in the SMS group, and 620 in the voice group; the intervention groups received reminders about their upcoming meeting at the clinic.

- Men and women interested in service but lack knowledge of “fertile day”
- Message should say “safe/unsafe day,” participants viewed

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India CycleTel (Lavoie, 2009)

- Focus groups to discuss preference for a text message
- Consider comprehension
- Understand the audience

- Type of evaluation: formative
<table>
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<th>Relevant findings</th>
<th>Application of mHealth recommendations</th>
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</table>
| India              | [No program name] (Khokhar, 2009) | Office women receive monthly reminders via text message to conduct monthly self-breast exam; they must reply if they completed it, and if not, why | “fertile day” as degrading to women  
• Message should be Hindi words spelled out in English letters: Hinglish  
• Keep frequency of messages low and content short | • Select appropriate technology  
• Use two-way communication  
• Time the communication appropriately  
• Understand the audience | • Methodology: qualitative  
• Design: Four groups consisted of women, two groups consisted of men, and one group of couples, for a total of 54 participants who are aged 18 to 28 years with a family-planning need  
• Type of evaluation: outcome  
• Methodology: quantitative  
• Design: quasi-experimental; 106 female employees to voice call |
between the ages of 22 to 54 years in a private sector office in Delhi volunteered to participate in the study; all women received text message reminders to conduct breast self-exam and self-reported if they conducted exam.

India Project Pragati (Sambasivan, 2011)

- Prerecorded voice messaging system to reach urban sex workers in Bangalore and offer

- Inauguration invitation: Of 35 called, 93.10% listened to entire message, and 10 of the 29 people who answered the calls attended the event

- Microfinance call: Of 23 called, 22 were reachable and 20 listened to the full message; no difference was

- Select appropriate technology
- Ensure privacy
- Consider comprehension
- Time the communication appropriately

- Type of evaluation: outcome
- Methodology: mixed methods
- Design: Four intervention events occurred urban sex

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Table 1. Continued

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<tr>
<td>Multicountry</td>
<td>SimPill, SimMed, XoutTB</td>
<td>• An overview article that provides findings on three major TB regimen reminder</td>
<td>• SimPill: After patients received texts for 10 months, drug adherence stabilized between 86% and 92% and treatment success rate of 94%; SimPill nurse could keep tabs on 50–60 patients instead of just 10</td>
<td>• Minimize costs • Use two-way communication</td>
<td>• Type of evaluation: outcome</td>
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</table>

<p>| South Africa, Nicaragua, Pakistan | Barclay, 2009 | invitations to programs or reminders to visit health clinic/pay bills | found in those who got the call and paid on time and those who did not • Medical testing reminders: 90% of those contacted connected and 59% listened to the whole message • Computer training: Of total number dialed, 63 people (19%) attended the training | • Understand the audience | workers: 35 called for the Swati Manne Inauguration event, 38 called for microfinance reminders, 230 calls for medical testing reminders, 627 invited to a computer training class; completed 21 structured interviews with urban sex workers |</p>
<table>
<thead>
<tr>
<th>Program</th>
<th>Methodology</th>
<th>Design</th>
<th>Key Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>SimPill</td>
<td>Quantitative</td>
<td>Largely unclear</td>
<td>SimPill had a pilot study with 155 TB patients at three clinics in Cape Town; the other two programs offer results, but not information on population studied.</td>
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<tr>
<td>SimMed</td>
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<td>Cheaper competitor to SimPill that asks respondents to press speed dial button after taking medication, which records their adherence in a database.</td>
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<tr>
<td>XoutTB</td>
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<td>Patients urinate on filter paper after taking medication which reveals a code, and patient must send code via text message; economic incentive for those who participate; program has been tested in Nicaragua and now Pakistan (no results listed).</td>
</tr>
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**Tanzania, Kenya m4RH (L’Engle, 2009)**

- Interviews to provide insight on how to design a mobile phone program for reproductive health in Dar es Salaam, Tanzania and Nairobi, Kenya were interviewed.
- Almost all respondents said they would share information with family and friends.
- Respondents would trust family planning information received via phone.
- Respondents said they wanted to learn about contraceptive methods through text message.
- Respondents said they read all text messages and would not delete assuming a message is spam before reading.

- Select appropriate technology
- Ensure privacy

**Type of evaluation:** Formative

- Methodology: mixed methods
- Design: interviewed 40 clients at two family-planning clinics.
Selecting the appropriate technology \((n=10)\) includes studies that weighed the pros and cons of various technologies or explained the reasoning for choosing one technology over another. The two articles from Ghana use the “flashing” method of encouraging users to call or text a hotline, hang up, and then they were either called back for counseling (Clemmons, 2009) or added to a weekly voice health message program (Grameen Foundation, 2011). The pricing structure for phone use in Ghana makes this technique a practical choice, and one article cited SMS was an option, but 99% of users chose to receive voice calls (Grameen Foundation, 2011).

Ensuring privacy \((n=5)\) is a particular concern for vulnerable populations such as men who have sex with men. An intervention from Ghana discussed men who have sex with men flashing their number to a hotline and a counselor calling them back within 24 hours (Clemmons, 2009). While phone sharing can be an issue in terms of privacy, voice calls provide a greater buffer of privacy for those sharing phones than SMS.

Although five publications mention the ability of mobile technology to minimize cost, in comparison with other health care option, few articles document this effectively. The randomized clinical trial in China effectively demonstrated the statistical significant improvement in attendance of appointments when given SMS/voice reminders over no reminder, and the study showed no statistical difference between SMS or voice \((p=.670\); Chen, Fang, Chen, & Dai, 2008\). This led the study to the conclusion that because SMS is cheaper than voice, 0.31 Yuan versus 0.48 Yuan, respectively, SMS is the more cost-effective option (Chen et al., 2008).

Considering comprehension \((n=10)\) refers to the linguistic and literacy competency of the audience as well as their ability to understand and use the technology. In one study in the Democratic Republic of the Congo, the concept of a hotline was not well understood (Corker, 2010). The study found that 20% of calls to the hotline were to ask for money, free phone credit or ask questions and discuss issues entirely unrelated to family planning (Corker, 2010). An article from Uganda that sent SMS quizzes to participants noted a 3.16 to 9.70% errors caused by people responding to SMS in conversational format instead of a quiz answer the computer database could read and convert.

The majority of publications \((n=12)\) used two-way communication in their communication message design. For example, a randomized clinical trial of 538 HIV-infected adults in Kenya taking antiretroviral treatments had an intervention group who received SMS reminders and a control group with no reminder (Lester et al., 2010). Every Monday, nurses would send a message to the patients asking how they were doing and request the reply of sawa (“doing well”) or shida (indicating a problem). Patients who did not respond in a 48-hour time frame would receive a call from a nurse (Lester et al., 2010). This example of two-way communication allowed users to indicate a problem or ask questions to a nurse instead of simply receiving a reminder (one-way).

Less than half \((n=6)\) of publications described targeting and tailoring the content for the intended audience. An article from Ghana discusses “mobile midwife,” which allows women or family members to sign up to receive voice messages once a week (Grameen Foundation, 2011). The messages are tailored specifically to her week of pregnancy, offered in several Ghanaian languages, and each message received she can choose to listen to a second or third message. The study found those who listen to the first message, 42% opt to listen to a second, and 36% opt to listen to a third message in a row (Grameen Foundation, 2011).
Timing of communication (n=3) requires studies to narrow down technology use from anytime/anywhere to an allotted time of day, frequency, or sequence of messages that is agreeable to the user. One article that dealt with urban sex workers in India considered time of day and length of message that would be least invasive to these individuals. The study found that 93.1% of urban sex workers listened to the entirety of a 19 second message, only 59% listened to a 30 second message (Sambasivan, Weber, & Cutrell, 2011).

Understanding the audience (n=10) requires studies to discuss the population’s health needs and phone usage needs to best design an intervention. Articles varied in description of ethnographic research into cultural background and preferences regarding health interventions and technological communication. One article in particular described research to capture technology used, time of date contact, length of contact, frequency of contact, two- or one-way communication, and the types of messages offered to them (Sambasivan et al., 2011). This article used 21 in-depth interviews that described the phone use and demographic of urban sex workers. This group of individuals had high uptake of cell phones, 97% compared with women in India (Sambasivan et al., 2011). The formative research informed the decision to use voice messages instead of text for this population.

Long-term Evaluation (n=2) requires long-term follow-up on a specific study or monitoring and reporting results of a program over a period of at least 1 year. The aforementioned SMS reminder program for antiretroviral treatment required self-reporting antiretroviral adherence to be monitored for 30 days with a follow-up at 6 and 12 months (Lester et al., 2010). Since many of the studies involve interventions of only a couple of weeks and no follow-up, this study offers a good example of long-term evaluation.

Discussion

This review of literature provided a full survey of evaluations for mHealth behavior change programs in low- and middle-income countries. The quality assessment in this review used several characteristics that should be incorporated into mHealth BCC interventions in such countries. The current literature offers a broad spectrum of quality regarding methodology and content, but most articles provided comprehensive information on the effectiveness of mHealth interventions.

The review began with 44 articles and was ultimately narrowed down to 16 articles of which 5 were peer-reviewed and 11 were gray literature. The majority of publications failed to meet the criteria of this study primarily because so much mHealth research is ongoing within the United States and other developed countries. Studies conducted in low- and middle-income countries that were excluded either were purely descriptive in nature or entirely lacked evaluation components. This finding provides a major gap in the literature and more attention should be directed toward programs with evaluation components.

The field of mHealth research is still in the infancy stage and there is a need for more thorough evaluation, follow-up from programs, and greater availability of research results publicly accessible on the Internet. Some articles had methodological flaws or lacked adequate sample sizes to draw statistically significant results, and three of the 16 articles did not provide methodological procedures of any kind; however, several articles provided adequate description of methods. As information and research become available, a more comprehensive
review will be able to draw conclusions on the effectiveness of mHealth interventions on BCC.

The quality assessment for this review points to successes and limitations within the existing literature. Specific areas in the quality assessment that were used extensively among a broad range of articles included two-way communication \((n=12)\), technology platform selection \((n=10)\), and understanding the audience \((n=10)\), while those elements demonstrated to a lesser extent in the literature included long-term evaluation \((n=2)\) and timing of communication \((n=3)\).

Two-way communication, technology platform selection, and understanding the audience are all factors that deal with the target audience’s usage and preferences for technology. As noted above, these three areas were particularly well represented in the reviewed articles. However, timing of communication was one of the worst represented elements, but topically it should fit into understanding the technological needs of a population. This gap might exist because timing of communication requires pretesting of messages and more formative research than was undergone in the existing studies (Lavoie, Puleio, & Jha, 2009). Pretesting messages should be a priority to understand and learn about the specific audience’s preferences in technology use, language, and health needs.

While understanding the audience was one of the better addressed elements, rigorous methods should continue to be used that take into account cultural factors and population specific issues and needs. Although comprehension was discussed in terms of people understanding how to use technology, programs that use wide-scale mass text messaging services should better troubleshoot the systems to avoid system fluctuations and glitches in replying to participants. In addition, where hotlines are unknown concepts, mass media campaign or other techniques should be used to better educate the population about the service (Clemmons, 2009).

The lack of long-term evaluation could be a result of an emerging field that has yet to conduct this type of research, or a lack of resources being directed toward an important area. Future interventions should focus on incorporating long-term evaluation to show the lasting effects of mHealth interventions. Similarly, although some articles mentioned cost \((n=5)\), more should conduct cost-benefit analyses similar to (Chen et al., 2008) to demonstrate which technologies are most effective and cost efficient. Greater follow-up with study participants in the long-term should become a priority. Because the studies are so new, it is unknown if further follow-up or development of formative research will lead to more conclusive results. The evaluation process should continue even after the immediate project ends to understand the long-term effects of the program.

A possible limitation of this literature review is that three of the 16 articles were sponsored by the same organization, Text To Change; however, the articles studied different populations in different locations (Danis et al., 2010; Hoefman & Apunyo, 2010; “Using an interactive,” 2010). Because the field is still emerging, recent research could be under review for peer-reviewed journals, but the data are yet to be publicly available for review. In addition, the articles focused on Sub-Saharan Africa and Asia (India and China) but left many other regions of the world unaccounted for in the field of mHealth BCC.

Another limitation of this review is that the studies targeted several different populations. For instance, in some articles at-risk populations such as urban sex workers/female sex workers (Sambasivan et al., 2011) and men who have sex with men (Clemmons, 2009) were the targeted population, while other studies targeted higher
income populations like educated women doing breast self-exams in India (Khokhar, 2009) and higher income populations for general health appointment reminders in China (Chen et al., 2008). As more research becomes available higher and lower income populations should be considered separately regarding their needs in mHealth studies. Likewise, issues such as privacy and gender are much greater concerns in vulnerable populations compared with high-income populations and should be considered separately in future reviews.

mHealth is a promising field of study that may improve the effect of BCC programs, but more studies need to be conducted with a greater emphasis on formative research and long-term evaluation. This review offers 10 main recommendations to incorporate into mHealth interventions in low- and middle-income countries and provides a status update on the areas of success and limitations. As the field continues to develop, mHealth reviews of BCC should further segment studies by income level or topic area, which was not possible in this review due to lack of available information.

References


