M-health for health behaviour change in resource-limited settings: applications to HIV care and beyond

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Background

Of the new advanced information and communication technologies, cellular telecommunication networks and mobile phones have reached far more people than any other, especially in developing countries. Although internet use has also increased substantially in recent years, in 2011 26% of the people in developing countries had internet access, whereas 79% had mobile or cellular phone subscriptions.[1]

This landscape of expanded access to modern communication technologies has given rise to the concept of "mobile health" (or m-health, a part of what is commonly referred to as "electronic health" or e-health), which is the use of mobile phones for improving health outcomes. Mobile phones can benefit patients and providers by helping overcome resource limitations on the supply side of health care as well as structural barriers and behavioural limitations on the demand side. However, the burgeoning interest in m-health creates the need to carefully assess how effectively m-health interventions can induce behaviour change and to objectively compare their cost-effectiveness with that of other behaviour change strategies. Unless the presumed benefits of m-health can be empirically demonstrated, donors and m-health programme implementers run the risk of spending resources on interventions of questionable benefit.

This paper draws on the results of three m-health interventions recently evaluated in Kenya to illustrate health behaviours that are particularly amenable to change through m-health interventions. It also underscores the need for controlled trials and points out those aspects of m-health that require further research.

Improving medication adherence

Access to life-saving antiretroviral therapy (ART) for people with human immunodeficiency virus (HIV) infection has increased in parallel with the closing of the divide between developed and developing countries in the use of mobile phones. By 2010, more than 6.5 million people in low- and middle-income countries were receiving ART, which is 5.5 million more than just five years earlier.[2] ART has also been proven highly effective for preventing HIV transmission and is therefore essential for controlling the pandemic of HIV infection.[3] On the other hand, incomplete adherence to ART is a leading cause of treatment failure.[4] As more patients receive ART, health systems are compelled to find ways to improve treatment adherence through cost-effective, supportive interventions.

Two randomized controlled trials of m-health interventions recently conducted in Kenya with our participation showed that text messages can improve adherence to ART, and, by doing so, prolong viral suppression.[5,6] In both studies, patients in the intervention arm received messages delivered via the short message service (SMS), but the studies differed in important ways in the manner in which the messages were deployed. The first study featured weekly two-way interactive communication. In other words, once a week patients would receive a text message enquiring about their health and could reply and seek advice from health-care providers. In the end, patients in the intervention group had adhered to treatment better than those in the control group, who did not receive any messages. The second study featured one-way communication; a text message reminding the patient to take the medi-cation was received weekly in one group and daily in the other. Surprisingly, ART adherence was significantly higher among patients who received a weekly message than among those who received a daily message. This finding suggests that adherence was influenced by supportive factors in the messages that were more intrinsic to the communication than simple daily reminders. These studies, which show that text messages can improve treatment adherence, suggest that such messages can be applied to evoke any behaviour that is amenable to the influence of encouragement and periodic reminders.

Text messages in Kenya had a marginal cost of about 0.02 United States dollars (US$) per message and minimal fixed costs. This suggests that interventions of this type can be highly cost-effective. A weekly one-way SMS intervention would cost approximately US$ 1 per patient per year, and a two-way intervention such as the one implemented in Kenya would cost about US$ 8 per patient per year.[7] These amounts represent a fraction of the estimated cost of ART (US$ 880 per patient per year).[8]

Unanswered questions

Despite promising evidence from the aforementioned trials, several aspects of m-health interventions warrant further research, preferably through controlled trials. One might investigate, for instance, how text-messaging interventions compare with other interventions designed to encourage better adherence, such as directly observed therapy, feeding programmes or home visits by community workers. In a recent systematic review of ART adherence interventions in sub-Saharan Africa, text messages were among a handful of interventions

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that proved effective.[9] There is a need for effectiveness research that compares these different interventions, when used separately or in combination.

It is becoming increasingly important to quantify the cost-effectiveness of m-health interventions and devise ways to improve them. Cost-effectiveness studies should take into account not just the interventions' low marginal costs, but other costs as well, including the cost of any necessary equipment and of the time devoted by staff to training and implementation. These, in turn, must be weighed against the gains obtained in terms of fewer clinic visits, averted drug resistance and improved health outcomes.

The cost-effectiveness of m-health interventions would be enhanced by identifying the types of patients who would benefit from them the most. This would make it possible to deploy interventions selectively. M-health cannot overcome all of the factors that can hinder adherence to treatment: medication side-effects, high pill burdens, high dosing frequency, lack of trust in the health-care provider, lack of time and lack of money, to name a few. However, by applying m-health interventions to as many individuals as possible and reserving more resource-intensive interventions for the patients most in need of them, we could increase the overall cost-effectiveness of adherence interventions. Even if m-health interventions are cost-effective, who will pay for them remains unclear. In settings with a complex mix of public and private health-care providers, everyone has different priorities, funding mechanisms and funding cycles, and such differences can affect the uptake of innovative interventions. Implementation science is an emerging field whose purpose is to address these issues. Patients' willingness to pay for inexpensive periodic text messages is also worth exploring.

M-health interventions have various characteristics that can influence how effectively they promote behaviour change. More extensive research on the content, frequency and type of telephone communication (e.g. text or voice; one-way or two-way) can increase the benefits derived from m-health applications. Finally, more research is needed to determine if m-health interventions can produce enduring behavioural changes that do not wane over time, and whether their effectiveness depends on the populations and medical conditions targeted. To shed light on these issues, longer-term studies in many different settings are required.

Other applications in developing countries

Targeting other health behaviours

ART adherence is only one of many modifiable health behaviours that can be targeted through the use of mobile phones. The list includes, among others, adherence to treatment regimens for malaria, tuberculosis and non-communicable diseases, and the uptake of preventive interventions, such as childhood vaccinations. Numerous organizations have begun to pilot the use of voice communications or mobile phones to convey text messages.[10] The software platforms needed to run these devices, such as those offered by the non-profit organization Medic Mobile, are becoming widely available. Effectiveness studies can help to identify the strategies that will be most suitable for various programmes, and, just as importantly, the strategies that should not be scaled up.

Targeting the supply side of health care

Checklists and other simple interventions have been implemented in medical settings to deter harmful practices. Similarly, mobile phones can be used to help health-care providers offer better care. In a recent study in Kenya, text-messages improved case-management among government health workers.[11] The messages sent to the workers summarized national guidelines for malaria case-management and were designed to be motivating and attention-getting, and thereby more likely to influence providers' behaviour. The correct use of artemisinin-based combination therapy in children saw a greater increase in intervention facilities than in control facilities (where text messaging was not used), which suggests that health workers' behaviour can be modified by means of m-health interventions.

Application to maternal and child health

In low-income countries, mother-to-child transmission is a major source of HIV infection, largely because strategies for the prevention of mother-to-child-transmission (PMTCT) have low coverage in those settings. In fact, to fully halt vertical HIV transmission, a series of interventions must be implemented along an entire pathway of events (the PMTCT cascade). The PEARL (PMTCT effectiveness in Africa: research and linkages to care and treatment) study has shown a failure in coverage at various points along the cascade during which mother-, provider- and facility-specific factors that facilitate infection come into play.[12] Mobile phones could be used to address several of these factors. Text messages could remind pregnant women to seek antenatal care and encourage those who test positive for HIV to link to care and adhere to treatment guidelines. At the same time, providers could also benefit from the innovative use of mobile phones to receive information about guidelines to be followed or send timely warnings of medication stock-outs. Rigorous evaluation of phone-based interventions in the context of maternal and child health should thus be prioritized.

Way forward

Emerging evidence suggests that m-health can enable behaviour change and improve health outcomes in resource-limited settings. Because of market competition, the cost of mobile phone use has decreased dramatically, to the point that people almost everywhere have now integrated mobile phone communication in their daily lives. Easy-to-use software programmes that facilitate automated communication with many people at once have also been developed. Thus, m-health interventions can be viewed as a means of supporting patients and their health-care providers in a convenient and cost-effective way.

M-health interventions could be applied to a very broad range of health-related behaviours. However, what works in one context does not necessarily work in another. For example, text message reminders may readily help patients to adhere to ART or get health-care providers to follow a malaria treatment protocol, but they may be of no benefit in connection with other health-related behaviours. Rigorous evaluations of small- and large-scale interventions could reveal the extent to which m-

health can provide cost-effective solutions to public health challenges. Since m-health presents an extraordinary opportunity to reach out to patients and health-care providers, it may offer just enough engagement to nudge them towards positive behaviours. ∎

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