mHealth Interventions to Counter Noncommunicable Diseases in Developing Countries
Still an Uncertain Promise

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KEYWORDS

- Low- and middle-income countries • mHealth • Chronic disease

KEY POINTS

- High population coverage by the mobile telephone network increased the possibilities of mHealth interventions in LMICs.
- Short text messages are the most common type of mHealth intervention used in LMICs.
- Results from randomized controlled trials showed a positive but modest effect of mHealth on NCDs outcomes.

THE PROMISE OF mHEALTH

Low- and middle-income countries (LMICs) carry a disproportionate burden of chronic diseases.[1] Health systems in these countries are facing a critical shortage of health professionals and resources making health services for persons with chronic diseases unavailable or low quality, which results in decreased life expectancy and quality of life.[2]

Mobile health (mHealth) interventions constitute a promise for health care delivery especially in resource-constrained settings in developing countries where mobile technology has a high penetration. In fact, cell phones and plans are lowering their cost, and cell devices are getting easier to use and are offering now more functionalities (eg, multimedia messaging service, bluetooth, Internet access, applications, GPS, camera and video) allowing the implementation of low-cost interventions.

In many places in LMICs, people have better access to mobile phones services than to basic services, such as water, electricity, sewerage, and sanitation.[3] In recent years, mHealth has yielded positive health outcomes because of improvements in the supply side of health care systems.[4] In terms of effectiveness, extensive reviews and meta-analyses in high-income countries have shown that mHealth increased access to medical services for vulnerable and hard-to-reach populations, enhanced communication flows and coordination among health care organizations, allowed timely data collection, improved education and training of health care workers, spread information

among the community, and improved health care delivery.[5–12]

Mobile technologies represent a potential tool for improving health care services and clinical outcomes for chronic diseases, especially in the developing world. High population coverage by the mobile phone network, with 91.8% penetration, was reported in LMICs by the International Telecommunications Union in 2015; however, Internet coverage is still low and only 34.1% of the population is online, compared with 81.3% in the developed world.[13] In this regard, affordable smartphones and a growth of mobile broadband will increase access and the possibilities of mHealth interventions in LMICs.

However, there is still limited evidence of the effectiveness of mHealth in relation to its impact and long-term effects on prevention and control of chronic diseases in the developing world.[14] This article assesses the impact of mHealth on noncommunicable diseases (NCDs) in adults in LMICs. It differs from a previous published systematic review[14] because it includes other mHealth interventions, such as mobile applications and e-health registries, in addition to voice communication and text messages. The period covered is between 2012 and 2016.

EVIDENCE OF MHEALTH TO COUNTER NONCOMMUNICABLE DISEASES IN LOW- AND MIDDLE-INCOME COUNTRIES
Method

Search strategy
Systematic literature searches were performed from February to May 2016 using the following electronic bibliographic databases: Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, and the Latin American and Caribbean Health Science Literature Database according to MOOSE and PRISMA guidelines. Key words used in these searches included the following: telecommunication, cellular phone, cell phone, mobile phone, short text message, multimedia message, mobile applications, e-health registries, lifestyle, reminder system, risk reduction, patient education, self-management, patient compliance, primary prevention, outcome assessment, developing countries, underserved areas, and the specific LMIC.

Studies were included if they (1) were randomized controlled trials (RCTs) or systematic reviews and meta-analyses of RCTs with original data, conducted in an LMIC as defined by the World Bank published between January 2012 and April 2016[15]; (2) included subjects older than 18 years of age; (3) addressed the impact of mobile interventions on a chronic disease (asthma, diabetes, hypertension, tobacco use, cardiovascular disease, chronic respiratory disease, and cancer); and (4) measured outcomes including morbidity, mortality, hospitalization rates, behavioral or lifestyle changes, process of care improvements, clinical outcomes, costs, and self-reported outcomes, such as patient, compliance, knowledge, self-efficacy and health-related quality of life. Only articles published in English language were included. Data were limited to published studies from the aforementioned databases.

Randomly assigned pairs of reviewers independently evaluated selected abstracts. Articles whose abstracts met the inclusion criteria were reviewed by a separate, randomly assigned pair of reviewers. If the article met the inclusion criteria, these reviewers extracted pertinent data and assessed methodologic quality using the Cochrane Risk of Bias Assessment Tool.[16] Discrepancies in article inclusion, data extraction, and bias assessment were solved by team consensus. Early Reviewer Organizer Software version 2.0 was used by reviewers' for full text evaluations of articles, data abstraction, and quality assessment.[17]

Results

We retrieved 1274 abstracts using the search terms and 108 articles were selected for full review, 36 of which were excluded because they were conducted in upper-income countries; did not address mHealth (n = 11); were not RCTs, systematic reviews, or meta-analyses (n = 24); did not focus on chronic disease (n = 2); were not published in English (n = 1); and (n = 14) were provisional abstracts (**Fig. 1**). Included studies (n = 20) came from 14 LMICs: Malaysia (n = 1); India (n = 5); China (n = 2); Iran (n = 3); Pakistan (n = 2); Philippines (n = 1); Thailand (n = 1); South Africa (n = 2); Mexico (n = 2); Honduras (n = 1); Argentina, Guatemala, and Peru (n = 1); and Bolivia (n = 1). We finally included 20 studies (see **Fig. 1**).

Most of the studies evaluated more than one outcome and included chronic diseases, such as asthma (n = 1), diabetes (n = 11), hypertension (n = 4), prehypertension (n = 1), and cardiovascular disease (n = 4) (**Table 1**).

Fifteen studies addressed clinical outcomes, which included intermediate outcomes or markers of disease severity, such as forced expiratory volume, blood pressure, body mass index, cholesterol, glycosylated hemoglobin, hospitalization, and adherence to medication.[18–32] Only one study addressed process of care measures, such as