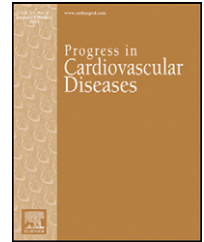


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Mobile Phone Interventions for the Secondary Prevention of Cardiovascular Disease

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ABSTRACT

Mobile health in the form of text messaging and mobile applications provides an innovative and effective approach to promote prevention and management of cardiovascular disease (CVD); however, the magnitude of these effects is unclear. Through a comprehensive search of databases from 2002–2016, we conducted a quantitative systematic review. The selected studies were critically evaluated to extract and summarize pertinent characteristics and outcomes. A large majority of studies (22 of 28, 79%) demonstrated text messaging, mobile applications, and telemonitoring via mobile phones were effective in improving outcomes. Some key factors associated with successful interventions included personalized messages with tailored advice, greater engagement (2-way text messaging, higher frequency of messages), and use of multiple modalities. Overall, text messaging appears more effective than smartphone-based interventions. Incorporating principles of behavioral activation will help promote and sustain healthy lifestyle behaviors in patients with CVD that result in improved clinical outcomes.

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As the leading cause of death globally, cardiovascular (CV) disease (CVD) claims more lives than all forms of cancer combined.^{1,2} Global deaths from CVD increased by 41% between 1990 and 2013 as a result of population growth and aging as well as epidemiologic changes in disease.³ CVDs are disorders of the heart and blood vessels including coronary heart disease (CHD), cerebrovascular disease, hypertension (HTN), heart failure (HF), valvular heart disease (VHD), congenital heart disease, and peripheral artery disease (PAD).^{2,4} In patients with established CVD, secondary preven-

tion includes comprehensive risk factor management that can be assessed by different outcomes such as improved survival, reduced recurrent events, reduced need for revascularization procedures, and improved quality of life.⁵ Compelling evidence has described the importance of secondary prevention interventions in our growing problem of CVD worldwide. However, self-management is often challenging because of the complexity of medication regimens; the importance of self-monitoring for signs and symptoms of disease complications; and difficulty in making lifestyle

Statement of Conflict of Interest: see page 648.

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Abbreviations and Acronyms

App = application
BP = blood pressure
CHD = coronary heart disease
CR = cardiac rehabilitation
CV = cardiovascular
CVD = cardiovascular disease
HF = heart failure
HTN = hypertension
mHealth = mobile health
PA = physical activity
PAD = peripheral artery disease
RCT = randomized controlled trial
SMS = short-messaging service
VHD = valvular heart disease

behavior changes i.e. physical activity [PA], diet, smoking cessation, and weight loss.⁶

Unlike traditional approaches of behavioral change interventions,⁷ we can now leverage advancements in mobile technology to examine their efficacy in improving behavioral and clinical outcomes. In this new era of near-ubiquitous mobile phone ownership worldwide,^{8,9} mobile health (mHealth) technologies offer unprecedented potential in disease prevention and self-management of chronic disease.

In the recent decade, mobile phones have been introduced as a potentially effective mechanism to promote behavior change in the secondary prevention of chronic disease. Mobile phone technology offers a personalized and inexpensive venue for patient communication, engagement, personal health data tracking, up-to-date information, and reminders for health behaviors. While the best way to promote self-management of chronic disease among patients has continued to elude health care providers, the use of technology may provide an

innovative and effective approach to promote prevention and management of CVD.

Text messaging (or short-messaging service [SMS]) and mobile applications (apps) are two popular forms of mHealth that can be used to communicate with patients. Text messaging is more widely used by all age groups; however, mobile apps offer many more features than SMS and can harness the full sensing and computational capacity to collect and analyze health-related data in real time to deliver health and behavioral interventions.^{10,11} In comparison to text messaging, mobile apps can offer interactivity, gaming, and feedback. In the past decade, there has been great interest in using mobile apps for promoting health and fitness. A majority of mobile phone users are interested in using mHealth apps.¹² There are now over 165,000 mobile health apps available to consumers.¹³ However, most commercially available mobile apps are not rooted in evidence-based practices,^{13–16} and there have been few studies on the use of mobile apps for prevention and management of CVD.¹⁷

The purpose of this paper is to review studies that have used mobile phone interventions to promote self-management of existing CVD (secondary prevention of CVD). In particular, we will explore the use of text messaging and mobile apps as single or combined technologies (mobile phones, tablets, Internet) for all CV conditions. Our aim is to identify the potential of mobile phones features to be used as effective interventions in the secondary prevention of CVD.

Methods

A comprehensive search was conducted to identify all studies related to the use of mobile phone interventions for CV health –

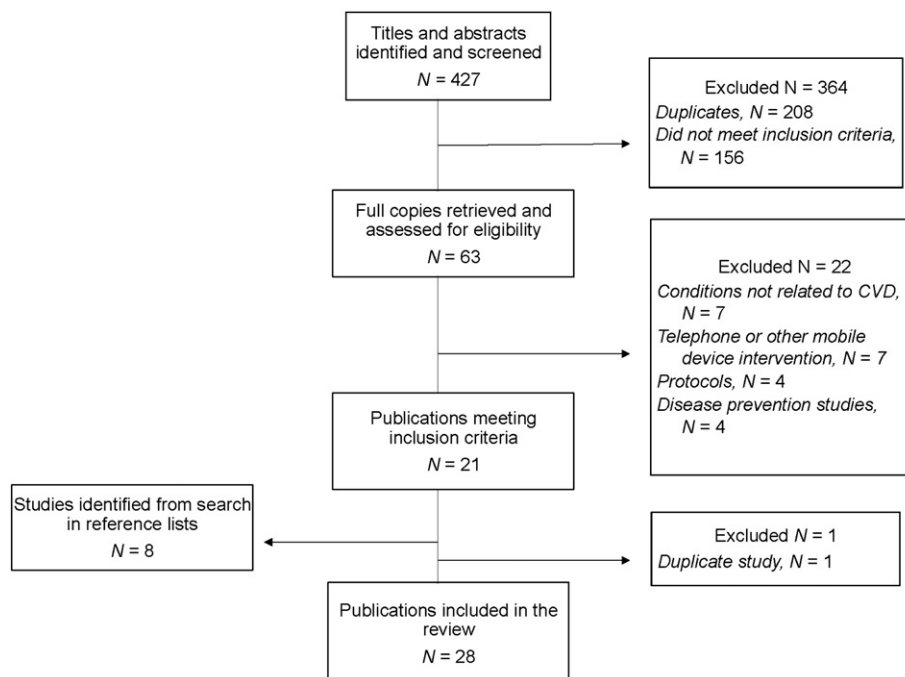


Fig 1 – Flow chart of study selection process.

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