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REVIEW

mHealth in Cardiovascular Health Care☆

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Mobile health (mHealth) has been defined as medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices and personal digital assistants.

Cardiovascular mHealth is, arguably, leading the mHealth space, through innovation, research and implementation, and especially in the areas of prevention, cardiac rehabilitation and education. mHealth includes simple strategies, such as the use of short message service (SMS) or text messages in successful short-term smoking-cessation, weight loss and diabetes management programs. The recent Australian Tobacco, Exercise and Diet Messages (TEXT ME) randomised clinical trial addressed multiple cardiovascular risk factors.

mHealth can also involve more complex strategies, such as smart phone applications (apps), global positioning systems (GPS) and Bluetooth technologies. Although many apps could be considered suitable for primary prevention, they are largely unregulated and most are not evidence-based. Some have been well-developed, such as the Food Switch app and an iPhone electrocardiogram (ECG) system. The ''explosion'' of apps has driven initiatives such as the Mobile Applications Rating Scale (MARS).

More recently, the use of sensors to monitor and provide feedback to patients and healthcare providers is being explored.

With almost two billion people currently owning a Smartphone, and 50% of adults (globally) predicted to own one by 2018, mHealth provides the prospect of delivering efficient, affordable healthcare services to widespread populations both locally and globally. In particular, it has the potential to reduce socioeconomic disparity and alleviate the burden of cardiovascular disease. There is now a need to rethink traditional health service structures and bioengineering capacity, to ensure mHealth systems are also safe, secure and robust.

Keywords mHealth • Mobile health • Cardiovascular disease • Text message • App

Introduction

Mobile health (mHealth) is a relatively new area of healthcare. In their 2011 report the World Health Organisation states that, ''the use of mobile and wireless technologies to support the achievement of health objectives (mHealth) has the potential to transform the face of health service delivery across the globe'' [1]. Although mHealth has no standard definition, it has been defined as medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants and other wireless devices [1]. Therefore, mHealth

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capitalises on the use of mobile devices and their functionality and includes simple strategies such as the use of short message service (SMS or text message) as well as more complex strategies using smart phone applications (apps), 3G/4G telecommunications systems, general packet radio service (GPRS), global positioning system and Bluetooth technologies [1]. More recently the use of sensors to monitor and transmit feedback to providers and patients regarding biological parameters is providing new areas of research and development.

The availability of mHealth is opening up enormous opportunities for the delivery of healthcare. In particular, mHealth provides the prospect of delivering efficient, affordable healthcare services to widespread populations. In particular, delivery of prevention and education is important given that these areas have traditionally been expensive to deliver direct to large numbers of patients. Almost two billion people currently own and use smartphones, which represents a 25% increase from 2013 [2]. Rapid growth in technology has led to the prediction that more than 50% of adults globally will own a smartphone by 2018 [3]. This growth provides opportunities for communication that have previously been unavailable. There is still, however, a gap between concept, delivery and translation into real healthcare with the barriers including the uncertainty around effectiveness, the need to rethink traditional health service structures and the bioengineering capacity to make these safe, secure and robust systems. Cardiovascular mHealth is arguably leading the mHealth space, through innovation, research and implementation. The aim of this paper is to provide an overview of some examples that illustrate current issues and successes.

Text-Message Based Interventions and Cardiovascular Disease

Two of the most common modes of mHealth delivery for cardiovascular disease (CVD) include text message and apps requiring the use of a 'tablet' or smart phone.

Text messaging is a technology that has been around for many years and is therefore a basic feature of most mobile phones. The first trials that examined their utility in cardiovascular heath, and amongst the first major mHealth trials were conducted in New Zealand and aimed at supporting smoking cessation. A meta-analysis of 9100 smokers showed that those receiving text-message interventions were almost twice (relative risk [RR] 1.71, 95%CI 1.47 – 1.99) as likely to quit smoking at six months follow-up [4]. These trials have led to the adoption of text-message smoking cessation programs by national programs in the UK, New Zealand and elsewhere [5,6].

The effectiveness of mobile phone text messaging has also been reported in relation to weight loss [7], physical activity [8], blood pressure lowering [9] and management of diabetes [10]. Most of these studies have focussed on individual risk factors despite the need for multifactorial risk factor management and modification for people with CVD. A systematic review summarising some of the evidence on behaviour change interventions delivered by mobile phone text messages identified 14 relevant studies that demonstrated positive short-term behavioural outcomes, but noted that many studies were of short duration, small sample size (and hence limited statistical power) and lacked quality with respect to standard indicators [11]. Findings of other systematic reviews are consistent with this, showing small but heterogeneous effects on weight loss [12], HbA1c values in diabetic patients and medical adherence [13,14].

The recent Australian Tobacco, Exercise and Diet Messages (TEXT ME) randomised clinical trial of 710 patients with coronary heart disease (CHD) from a tertiary hospital in Sydney, was unique in that it addressed multiple cardiovascular risk factors. (Figure 1) [15] The justification for targeting multiple cardiovascular risk factors concurrently, rather than targeting single factors, was the alignment with secondary prevention guidelines and the likelihood of such an approach to deliver greater reduction in cardiovascular events [16]. Patients in TEXT ME received four messages per week for six months that provided advice, motivation and support. For the intervention, the messages were customised according to baseline parameters, were personalised with the patient's name and content areas covered included smoking (if relevant), physical activity, diet and general heart health. The intervention program was developed using a multi-stage process involving researchers, health providers and consumers [15]. At six-month follow-up, patients allocated to the TEXT ME intervention program had lower LDL-cholesterol, systolic blood pressure, body mass index (BMI) and a greater proportion were physically active and had quit smoking compared to controls [15].

While TEXT ME represented a step forward in the literature in that it measured objective (and not only self-reported) clinical measures as outcomes, utilised a robust randomised design and demonstrated benefits in patients with known CHD, it also provided opportunities for future research. For example, it remains unclear whether the change in risk factors achieved can be sustained beyond six months, whether the program can be successfully delivered in languages other than English, whether the program was of benefit across other medical populations and those in high-risk sub-groups and whether findings can be translated into real improvements in clinical outcomes across populations.

Future research regarding text message interventions and CVD management requires further analysis of program delivery including the optimal level of customisation and/or personalisation [8,17,18], message frequency and potential for provision for interaction with the healthcare provider. The increasing complexity of the programs entails increased costs - such as the increased cost for utilising more complex software programs to manage customisation algorithms and the cost of providing personnel of the appropriate skill to manage and respond if two-way communication is sought.