The use of mHealth technology for chronic disease management: the challenges and opportunities for practical application


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The rising burden of chronic disease calls for innovative, cost-effective and patient-centred chronic disease prevention and management approaches. Despite the considerable progress made, chronic disease prevention and management require global attention. The global chronic disease prevention and management is mainly challenged by lack of policy attention, shortage of clinicians and inadequate self-management support. One promising solution to overcome the existing challenges of chronic care is the integration of mobile technologies into chronic disease services. The authors propose five potential areas for discussion; the objectives are to (1) advance patient engagement and education (2) inculcate a culture of shared decision making and evidence-based practice (3) improve system performance and efficiency (4) promote citizen engagement and (5) redress health inequality.

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Non-Communicable Diseases (NCDs) are a growing pandemic worldwide and posing a considerable public health problem that undermines social and economic development across the world (World Health Organization [WHO], 2013). It is estimated that over 41 million people die from NCDs, accounting for 73% of all deaths worldwide (The Lancet, 2018). In the coming decades, NCDs are expected to affect millions more and it is estimated that the four major NCDs: cardiovascular diseases, chronic lung disease, cancer and diabetes will cost the global economy nearly US$47trn by 2030 and push millions of people below the poverty line (Bertram et al, 2019). Despite efforts to combat the growing prevalence, mortality and morbidity associated with NCDs, reports indicate that chronic diseases are projected to rise and will remain the leading cause of death and disability in the world (Cao et al, 2018).

The burden of NCDs is especially impactful in developing countries where chronic disease prevention and management programmes are inefficient and poorly established (Richards et al, 2016). A report by the WHO (2018) indicated that more than 85% of "premature" deaths associated with NCDs occur in low- and middle-income countries (LMICs). This high prevalence and alarming upsurge of chronic illness in developing countries are partly due to urbanisation, a change in cultural norms related to globalisation, such as cigarette smoking and other unhealthy lifestyles, the obesity epidemic, ageing populations and a reduction of physical activity (WHO, 2014).

As such, no country is on track to achieve the global goal of reducing premature mortality from NCDs by a third between 2015 and 2030 (The Lancet, 2018). This disparity is particularly glaring in developing countries, where chronic disease care is given little policy attention and the healthcare system lacks the required infrastructures to tackle the growing burden (Shiferaw et al, 2018). A promising solution to overcome the existing challenges of chronic care is the utilisation of mobile technologies (mHealth) in chronic disease services. However, to explore the full potential of mHealth technologies, it is fundamental to analyse the challenges of chronic disease management and examine the practice and policy implications and the benefits and limitations of mHealth technologies.

Literature review

Search strategy

A literature search was conducted to identify

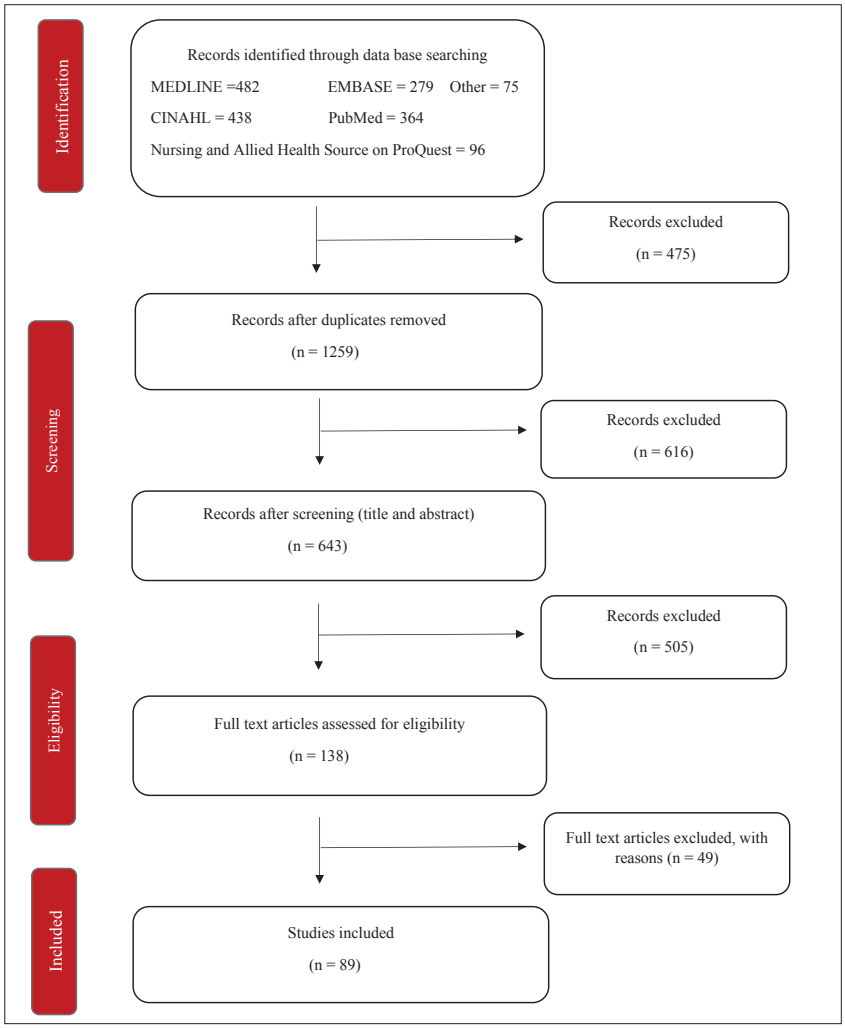

Figure 1. Search flow diagram.

the available articles addressing chronic illness, chronic illness self-management and mHealth technology. The search was performed on the following databases: MEDLINE, CINAHL, Nursing and Allied Health Source on ProQuest, EMBASE, PubMed, the first eight pages of Google Scholar. Furthermore, grey literature was searched to identify unpublished resources from international and national organisations, associations and agencies, including the WHO database and International Diabetes Federation using the key terms and phrases. A total of 1,734 documents were found, and after analysis, 89 documents were selected for the final review *[Figure 1]*.

The challenges of chronic diseases management

Due to limited emphasis on NCDs, the prevalence and impact of NCDs continues to affect millions and it is projected to rise unless an integrated, comprehensive and innovative patient-centred chronic illness management policies and strategies are put in place (WHO, 2015). However, the current global approach to tackle the growing threats of NCDs lacks cogent evidence, consistent delivery mechanisms, measurable and sustainable goals, robust public policy and leadership (Atun et al, 2013). Adding to the complexity are emerging issues, including the widening gap of inquities and inequalities, shifting demographics towards an aging, frail population, multimorbidity, accelerating shortage of trained clinicians, rising healthcare costs, evolving patient expectations and disenfranchised global health diplomacy.

Lack of policy attention and poor service organisation

Despite scientific advancement, quality improvement initiatives and increases in political commitment in the past decades, chronic disease services organisation and availability are inadequate (Atun et al, 2013; Shiferaw et al, 2018). In spite of the significant chronic diseases burden, healthcare systems have been primarily geared to address maternal and child health and infectious diseases (Bennett et al, 2018). For instance, a large proportion of global healthcare expenditure was allocated to HIV/AIDS, TB and malaria and only US$503mn (2.3%) were allocated to NCDs out of US$22bn-worth of international donor assistance (Kishore and Reddy, 2014; Bennett et al, 2018).

Shortage of clinicians and evidence-based guidelines

There is a critical shortage of trained staff and evidence-based guidelines for the prevention and management of NCDs. To reduce premature mortality due to non-communicable diseases, it is indicated that additional 17.4 million healthcare workers were needed worldwide, with the highest shortage in Southeast Asia and Africa (WHO, 2016b). For instance, only 10% and 7% of health facilities had trained diabetes and cardiovascular staff, respectively (Federal Democratic Republic of Ethiopia Ministry of Health [FDRMOH], 2018).

Along with the shortage of trained clinicians, the critical lack of NCDs treatment protocols and evidence-based guidelines also pose a considerable challenge. According to Wendimagegn and Bezuidenhout (2019), 95% of clinicians surveyed reported the absence of NCDs preventive and curative guidelines in their working area. Inadequate staffing further contributes to low chronic disease service utilisation (Bavoria et al, 2019).

Limited self-management knowledge and practice

As a central component of chronic disease

control and management, patients with chronic diseases should acquire the knowledge and skills of self-management, engage themselves in self-care and assume the responsibility of their health conditions (Ko et al, 2018). However, limited self-management knowledge and skill is a pressing challenge for chronic disease management (Dedefo et al, 2019). Available evidence demonstrate that self-management is the most neglected part of chronic disease management. For instance, a study conducted by Mariye et al (2018) identified that nearly 63% of study participants had poor diabetic self-care practices. Limited self-management knowledge may further lower the health-seeking behaviour of patients with chronic diseases (Abuduxike et al, 2019).

To overcome these barriers and provide more cost-effective and efficient chronic disease services, innovative and more accessible chronic disease management strategies should be implemented. One proven and highly recommended approach to tackle the present burden and trajectory of NCDs is adopting and integrating mHealth technologies into chronic disease prevention and management programmes.

Mobile health technology: the future of chronic disease management

The present organisation of the healthcare systems and the contemporary socioeconomic realities, as well as the complex nature of chronic diseases, demand redesigning of chronic disease management programmes and the introduction of innovative approaches to the existing healthcare delivery (Brunner-La Rocca et al, 2016). One promising solution to provide efficient, cost-effective and patient-centred chronic care is the integration of mobile technologies into chronic disease services (Hill, 2018).

Mobile Health or mHealth is defined as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices" (WHO, 2011). Mobile health (mHealth) encompasses a broad range of technologies. mHealth includes technology that is wireless, mobile, or wearable (e.g. sensors, medication pumps, or wristbands that monitor physical activity) (Gee et al, 2015), the use of information communication technologies in health facilities, such as Electronic Health Records (EHRs) or Personal Health Records (PHRs) (Silva et al, 2015). mHealth also includes thousands of health apps designed for mobile devices (Park, 2016).

There is a growing number and interest for mHealth technology in the healthcare system. A recent study revealed that more than 100,000 health-related mHealth applications are available in the Apple App Store and Google Play Store (Hood et al, 2016). The mHealth market is also expected to rise 25% per year, with no anticipated end in sight (Gee et al, 2015). According to Ramachandran et al (2015), 60% of patients attending chronic disease follow-up showed interest in receiving chronic disease care through their phone. This sharp growth of interest in recent years demonstrates the growing need for mHealth-based health services (Fiordelli et al, 2013; Hood et al, 2016).

Chronic disease management is expensive to individual patients, families and the healthcare system. Thus, significant healthcare service improvement can be achieved through mHealth-based chronic disease management, and there is excellent potential for the integration and utilization of mHealth technology in the healthcare systems (Hunt, 2015; Matthew-Maich et al, 2016).

mHealth chronic disease management

Due to its complexity, a wide range of chronic disease prevention and management models exist in the literature. Different models consider different elements. Most include self-management; some consider a community participation approach; while others have a health systems approach. Integrating the appropriate model into a healthcare industry requires a thorough understanding of the socio-cultural and political reality of the existing system (Davy et al, 2015). It is especially intricate when it is a new and innovative approach, such as mHealth technology. The authors propose an mHealth Chronic Disease Management (mCDM) Model *[Figure 2]* to raise awareness on the global chronic care agenda and advocate an approach that leverage on mobile technology to optimize and re-align health services at an acceptable cost.

Chronic disease and mHealth management: integration and utilisation

mHealth technologies can be adopted and utilised in a wide range of long-term conditions. There are several chronic disease management components and strategies that could potentially be delivered using mHealth technologies. Considering the existing healthcare systems, the authors propose five potential areas for deliberation; the objectives are to (1) advance patient education and engagement (2) inculcate a culture of shared decision making and evidence-based practice (3) improve system performance and efficiency (4) promote citizen engagement and (5) redress health inequality.

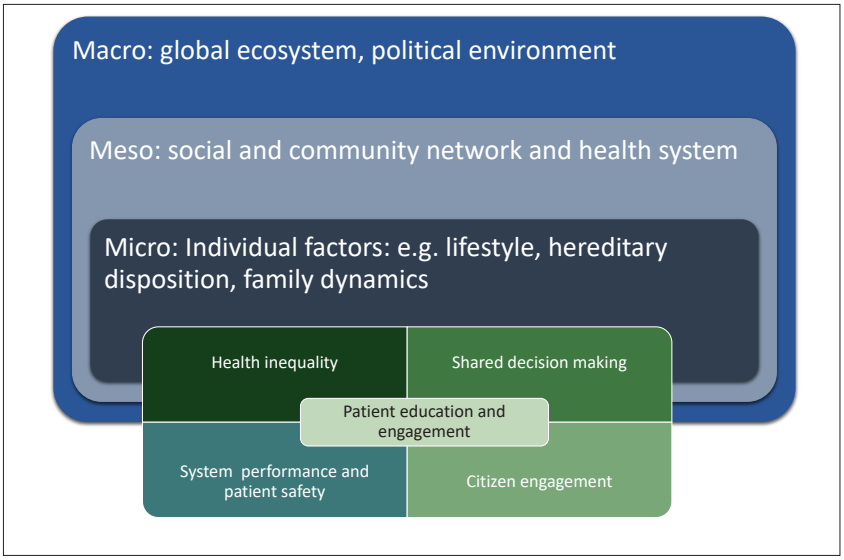

Figure 2. The mHealth Chronic Disease Management (mCDM) Model.

Patient engagement and education

Self-management and patient engagement are the cornerstone of chronic disease management. Self-management support refers to deliberate and often ongoing provision of education and supportive interventions to enhance individual's performance and confidence in managing their health problems. Poor adherence is one of the determining factors contributing to the meandering course the chronic disease trajectory.

Although traditional educational interventions to improve knowledge are necessary, they are rarely sufficient to change behaviours. mHealth technologies are widely used for patient education and information provision across the world for a wide variety of chronic diseases (Fiordelli et al, 2013). Patients and families can be prepared, motivated and informed via mHealth technology (Free et al, 2013; Moyano et al, 2019). Web-based structured health education can be delivered either through the internet or mobile phone and are easily accessible, reliable and most effective (Hunt, 2015). There is strong evidence that mHealth based self-management programmes are more effective and efficient (Bashi et al, 2018) For instance, web-based diabetes education demonstrated a significant improvement in blood pressure and blood glucose level, physical activity, and diet (Cotter et al, 2014; Gee et al, 2015).

Patient activation and empowerment can also be supported through a person-centred and contextually designed mHealth technologies. mHealth technologies can assist in designing and delivering self-management programmes and creating a platform for social support (Gee et al, 2015). The innovative use of social media has the potential to widen access of health information and make contact with populations that are hard to reach or isolated because of their geographical location, cultural dispositions, and socioeconomic status (Woo, 2014).

Shared decision making and evidence-based practice

As a crucial component of chronic disease management, effective communication between patients and healthcare providers can be established through mHealth technology. A fragmented communication system has been reported as a significant challenge of chronic disease management and the adoption of mHealth technology can narrow the gap and, thus, improve patients' chronic care experience (Kruk et al, 2015; Shiferaw et al, 2018). Studies demonstrated that mHealth technology could improve patient-care provider relationships and allow patients and healthcare providers to establish a more effective communication channel (Lu et al, 2018).

Patients can also remotely access personal records, request a medication refill, request a consultation and make appointments using mHealth technologies (Ball et al, 2007). Clinicians can monitor patients' clinical data, communicate and collaborate with other clinicians and search medical literature, as well as other information sources for clinical decision-making. For instance, clinicians could remotely monitor and consult their patients using smartphone apps (Mosa et al, 2012). It could also target patient groups/population to promote appointment reminders, consultations, and result notification (Gee et al, 2015). Easy access to clinical guidelines and drug references through mHealth devices will support clinicians' clinical decision-making (Ventola, 2014) and safeguard patient safety. mHealth technologies can be used to support healthcare providers, including education and training (Agarwal et al, 2015b). Overall, mobile technologies improve task performance, foster communication and teamwork, which subsequently enhances patient outcomes (Ventola, 2014; Lu et al, 2018; Martin et al, 2019).

System performance and efficiency

There is a compelling need to modernise healthcare infrastructure integrating mHealth technologies to reduce costs and facilitate the delivery of integrated, people-centred care. Mobile technologies are helping health institutions to reduce the average length of patients' hospital stays. Wearable devices, as well as mobile apps, enable clinicians to discharge patients and track their conditions with remote monitoring, which ultimately reduces hospitalisation costs (Ventola,

2014). mHealth technologies can reduce the burden of hospitals by minimising the rate of hospital visits and readmission rates (Fox and Felkey, 2013). Hospital information systems are often in place to enable communication and improve workflow. Electronic Medical Records are designed to allow healthcare professionals to access and review patients' medical records (medical history, vitals, prescriptions, lab results, X-rays, scans, consultations and discharge notes) through a secure record system (Ventola, 2014; Gee et al, 2015).

Citizen engagement

Citizen engagement connotes a conscious effort to recognise the active role that individual citizen plays in policy or programme development and their capacity to define issues, consider solutions, and identify resources or priorities for action. There is considerable enthusiasm for mHealth-based health service delivery, and it has been argued that mHealth interventions could enable intersectoral dialogue that is fundamental to strengthen the capacity for effective public policy stewardship and transform healthcare services, especially in developing countries where healthcare access is limited (Fiordelli et al, 2013; Kruk et al, 2015). For example, a recent systematic review demonstrated that mHealth intervention empowers patients and families, reduces frequent hospitalisation and decreases staff workload (Bassi et al, 2018).

Health equality

Improving access to care and narrowing health disparity is a key concern. International health organisations, including the WHO, highly recommend the use of mHealth technologies as one strategy to overcome the current challenge of the global healthcare system (WHO, 2011; Gee et al, 2015; Clarke et al, 2017).

As the burden of chronic disease rises and further pressurising the already insufficient healthcare systems, adopting mHealth technologies is an excellent opportunity to advance the Sustainable Development Goals (SDG), including increasing access to healthcare, reducing premature mortality from NCDs and promoting universal health coverage (Kruk et al, 2015; Harding et al, 2018). Moreover, mHealth can narrow the healthcare disparity between rural and urban communities, reach the underserved with timely and tailored messages, overcome the chronic care fragmentation and strengthen healthcare data through data collection and reporting for better decision making (Gee et al, 2015; Shiferaw et al, 2018).

According to the WHO, the projected shortage of health workers by 2030 is as high as 18 million, concentrated in low- and lower middle-income countries. The impact of qualified health care workers shortage is concerning but potentially mitigated via mHealth technologies (Lori et al, 2012). For instance, clinicians can tackle similar concerns from many patients at the same time as using mHealth technologies. Chronic disease management requires empowered healthcare providers; thus, capacity building training and resources, including evidence-based guidelines and textbooks can be de delivered through mHealth technologies (O'Donovan et al, 2015; Guo et al, 2015). As a new and innovative healthcare delivery approach, mHealth technologies will significantly transform the global NCD prevention and management initiatives.

mHealth limitations

While mHealth technologies have great potential in the prevention and management of chronic diseases, there are limitations attached to it. Policymakers, healthcare leaders, researchers and experts in the area of information technology advise a thorough evaluation of the technology before integrating into a system (WHO, 2016a).

Curriculum development

Technology literacy and savvy both for the user, as well as healthcare provider, is the drawback of mHealth technologies (Lori et al, 2012; Andualem, 2015). Competency based curricula should be refurbished to ensure that learners acquire a minimum level of digital health literacy and chronic disease management within an interprofessional context as part of their education.

Usability

Enhancing interoperability of digital platforms can be frustrating. Some mHealth technologies may require additional infrastructures, such as internet access, dedicated secure computer hardware and patient devices (Harding et al, 2018). The effectiveness of internet-dependent technologies may be decreased when internet connectivity is limited (Agarwal et al, 2015a; Andualem, 2015).

Information accuracy and reliability

Another disadvantage associated with mHealth technologies is the presence of unverified and inaccurate information. Some mobile apps and web-based mHealth technologies may contain wrong information that may jeopardise the health of patients (Ventola, 2014; Gutierrez et al, 2017). To overcome this challenge, a strong support system (approval by experts and authorities) should be established to monitor mHealth technologies, including mobile apps, e-records and social platforms (Gurupur and Wan, 2017).

Privacy and security

There are growing security and privacy concerns towards mHealth technologies. Despite its promising potential to store and retrieve patients' information, pertinent healthcare data may be lost due to cybersecurity issues (Steinhubl et al, 2015; Vayena et al, 2018).

Conclusion

The rising burden of chronic disease, especially in developing countries, calls for innovative, cost-effective and people-centred chronic disease prevention and management approaches. However, little policy attention and poor service organisation, inadequate self-management support and low service utilisation challenge the efficiency of chronic disease prevention and management initiatives. One promising solution to overcome the existing challenges of chronic care is the integration of mobile technologies into chronic disease services.

Chronic Care Model, as a comprehensive framework, can be utilised to guide the integration and utilisation of mHealth technologies for patient empowerment, healthcare service delivery, education and communication. Thus, it can help to narrow the healthcare disparity and reach the underserved, overcome care fragmentation and strengthen healthcare data.

mHealth technologies are beneficial in terms of quality and accessible care provision and reduction of chronic care costs. On the other hand, usability challenges, such as the need for additional infrastructure, privacy and security concerns, and the potential presence of unreliable information, are the limitations of mHealth technologies. Overall, mHealth technologies are a potential solution and carefully planned, and executed mHealth interventions could improve patient outcomes and address the burden of NCDs. WINT

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