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Scoping review and evaluation of SMS/text messaging platforms for mHealth projects or clinical interventions

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ABSTRACT

Objectives: Mobile technology supporting text messaging interventions (TMIs) continues to evolve, presenting challenges for researchers and healthcare professionals who need to choose software solutions to best meet their program needs. The objective of this review was to systematically identify and compare text messaging platforms and to summarize their advantages and disadvantages as described in peer-reviewed literature.
Methods: A scoping review was conducted using four steps: 1) identify currently available platforms through online searches and in mHealth repositories; 2) expand evaluation criteria of an mHealth mobile messaging toolkit and integrate prior user experiences as researchers; 3) evaluate each platform's functions and features based on the expanded criteria and a vendor survey; and 4) assess the documentation of platform use in the peer-review literature. Platforms meeting inclusion criteria were assessed independently by three reviewers and discussed until consensus was reached. The PRISMA guidelines were followed to report findings.
Results: Of the 1041 potentially relevant search results, 27 platforms met inclusion criteria. Most were excluded because they were not platforms (e.g., guides, toolkits, reports, or SMS gateways). Of the 27 platforms, only 12 were identified in existing mHealth repositories, 10 from Google searches, while five were found in both. The expanded evaluation criteria included 22 items. Results indicate no uniform presentation of platform features and functions, often making these difficult to discern. Fourteen of the platforms were reported as open source, 10 focused on health care and 16 were tailored to meet needs of low resource settings (not mutually exclusive). Fifteen platforms had do-it-yourself setup (programming not required) while the remainder required coding/programming skills or setups could be built to specification by the vendor. Frequently described features included data security and access to the platform via cloud-based systems. Pay structures and reported targeted end-users varied. Peer-reviewed publications listed only 6 of the 27 platforms across 21 publications. The majority of these articles reported the name of the platform used but did not describe advantages or disadvantages.
Conclusions: Searching for and comparing mHealth platforms for TMIs remains a challenge. The results of this review can serve as a resource for researchers and healthcare professionals wanting to integrate TMIs into health interventions. Steps to identify, compare and assess advantages and disadvantages are outlined for consideration. Expanded evaluation criteria can be used by future researchers. Continued and

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more comprehensive platform tools should be integrated into mHealth repositories. Detailed descriptions of platform advantages and disadvantages are needed when mHealth researchers publish findings to expand the body of research on TMI tools for healthcare. Standardized descriptions and features are recommended for vendor sites.

1. Introduction

1.1. Scientific background

Seven billion people, or 95% of the global population, live in an area covered by a mobile-cellular network [1–3]. Due to ubiquitous mobile phone availability and the capacity for interactive and real-time communication, rapid expansion of mobile health (mHealth) interventions occurred over the past decade to help address disparities in healthcare service access and improve health outcomes [4]. Text messaging or short messages service (SMS), an alphanumeric message of 160 or fewer characters, is among the most frequently used tool for mHealth interventions. Text-messaging interventions (TMIs) are popular because they can be sent, stored, answered and retrieved at the user's convenience; they are relatively inexpensive; and they are available for any type of phone [5–8]. In the US alone, an average of 169.3 billion text messages per month were sent in 2015, an increase from 110.4 billion in 2008 [3]. While the rate of smartphone ownership is rapidly growing, only about a third of the world's population (about 2.6 billion) will own one by 2017 compared to over 7 billion mobile phone subscribers. Therefore, simple text messaging will remain an important tool to reach any mobile phone user for some time to come [9].

TMIs can be used in various types of mHealth interventions. These have been categorized in multiple ways including, for example, behavior change communication (e.g., appointment and medication reminders, health promotion such as smoking cessation, community mobilization); data or information collection (e.g., collection and reporting of health information and service provision, vital event tracking, such as outbreaks); and logistics or supply chain management (e.g., ensuring basic supplies and medications are in stock throughout disparate health facilities) [5–8,10–13]. Evidence from systematic reviews and meta-analyses indicate that TMIs significantly improved antiretroviral medication adherence, attendance at medical appointments and behavior change outcomes [5,7], adherence in chronic disease [8] including diabetes self-management, weight loss, increase in physical activity, and smoking cessation [6]. However, authors of these reviews highlighted the need for further research to determine long-term intervention effects, identify features of TMIs that improve success, and evaluate outcome measures other than self-reported adherence [5–8,14]. TMIs are a promising avenue of research. Thus, many researchers and healthcare professionals are interested in TMIs and their technical platforms as a means to improve global health.

The mobile technology marketplace supporting TMIs is dynamic and diverse; therefore, deciding which TMI platform to use can be a challenge. A text messaging platform is defined as a combination of one or more executable programs with SMS capability that can perform several text messaging and basic computational tasks [15]. It can typically facilitate two-way SMS communication, send messages or reminders at pre-defined times or days, and respond to established keywords to trigger surveys or questionnaires. The software on these platforms can be open source (free-of-charge with modifiable source code) or purchased software-as-a-service with capabilities for customization for a specific project by a vendor. The platforms can also be web-based or downloadable. Program attributes usually depend on the complexity of features needed and the number or types of messages planned for a project. Fig. 1 shows how a text message platform interacts with service providers and wireless networks to facilitate tasks and communication between the interventionist and the participant. As depicted in the figure, a platform is often hosted on a computer and uses various communication protocols (e.g., Internet, modem) to communicate with one or more messaging services through multiple channels, antennas, and networks to deliver text messages to an end user (e.g., participants, patients, or field workers).

1.2. Rationale for the study

The driver for this review was the authors' first-hand experiences using TMI platforms for data collection and participant interactions in the US and in low-resource countries [16–18]. The authors wanted to determine what mHealth platform other researchers used, explore what options were available to mitigate some of the challenges they experienced and determine platform advantages and disadvantages.

One step in selecting a tool is deciding which functions are necessary for one's intervention and soliciting detailed services from the product vendor, as well as, understanding existing systems, standards and policies [19]. Selecting a TMI platform solution is just one component of project planning. Like any intervention, a mHealth project is complex and there are many considerations for planning and implementing. Currently, a number of guides and toolkits are available for steps and key considerations to plan an mHealth intervention [15,19–21]. These guides help outline the larger mHealth framework of, for example, developing and defining the concepts and outcomes, forming a team, planning for implementation, and estimating implementation costs. The mHealth mobile messaging toolkit provides a list of 19 questions to consider when selecting a vendor, such as "Does the vendor need to have prior experience with the project?," "Do you need to send messages in multiple languages?," "Does your project intend to use short code?"[15]. This toolkit provides a list of ten vendor platforms for low-resource countries and each of their hosting options, platform offerings, and geographic locations of implementation. However, no peer-reviewed evaluation was available outlining the platform selection process, identifying the larger set of platforms currently available and applying principles to evaluate platforms and summarize advantages and challenges. To date, researchers and health professionals all conducted separate, time-consuming evaluations to find suitable platforms for their projects. A more refined selection and evaluation process is needed for researchers and healthcare professionals to better meet research and clinical needs more efficiently. Without such a resource, a search for an optimal platform can be costly and time consuming particularly if the selection results in a sub-optimal match for the project. mHealth is a field that will continue to grow and evolve. This review adds to literature by creating a current list of available SMS platforms, providing a set of expanded evaluation criteria and applying them to current mHealth platforms beyond only those available for low-resource settings.

The purpose of this scoping review was to systematically identify and compare text messaging platforms and to summarize advantages and disadvantages of identified platforms as described