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Text Message Behavioral Interventions: From Here to Where?

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Abstract

Text messaging is an efficient and personal electronic form of communication, making it an ideal modality for remote delivery of behavioral interventions. The ubiquity of cell phones and short message service (SMS) worldwide allow the possibility of SMS behavioral interventions to impact global health. Studies to date suggest that SMS interventions can effectively support health behaviors and may offer advantages compared to other forms of computerized interventions. Program features optimizing user engagement and persuasiveness are suggested to mediate SMS intervention effect. Future research is tasked with identifying what SMS features are useful to which individuals at what times to best help them initiate and maintain health behaviors.

Introduction

Although remote communication between individuals has occurred since antiquity, through such means as smoke signals and mail couriers, and more recently through wire and radio, it was the rapid growth of cellular phones in the 1990s that allowed widespread transmission of messages to be possible. The first and still most popular form of messaging using cellular phones is short message service (SMS). SMS was invented in the late 1980s, the first text message sent in 1992, the first phone keyboard allowing efficient text typing developed in 1997, and the first internet network text exchange being made possible in 1999 [1]. Currently, there are more than 7 billion cell phone subscribers worldwide and over 6 trillion SMS sent each year [2]. In a survey of 21 countries, around 75% of cell phone owners reported regularly sending and receiving text messages [3]. Although SMS took time to enter the US, by 2008 the number of SMS sent in the US surpassed phone calls [4] and currently an estimated three-quarters of all mobile phone owners in the US use SMS. 99% of received text messages are opened and 90% are read within three minutes of being received [5].

What is SMS?

The technical answer is that SMS is a packet of data up to 160 letters, numbers or symbols in the Latin alphabet sent to another cell phone through a control channel that provides “store-and forward” service, where messages are sent only when the receiving phone is turned on or within range of a tower. This allows for the asynchronous receipt of and

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response to messages from one individual to another across most geographic boundaries. The sociologic answer is more complex, and still evolving. Text messaging seems to be a unique hybrid of writing and talking, recently being described as “fingered speech” [6]. Although it is textual in form, it has evolved with comparatively loosened rules of grammar, with users routinely employing shorthand and other forms of semantic experimentation. Text messaging gives the impression of extemporaneous thoughts while allowing the sender the liberty of premeditation and editing. It has been suggested that texting can even induce primitive craving pathways, where the anticipation of receiving a text causes a dopamine surge, which combined with the visual and audible alert individuals receive when a new message has arrived, further amplifies future craving [7]. SMS in social settings is so pervasive that it sometimes even replaces face-to-face verbal communication. It is not uncommon to see people sitting directly across from each other, together yet silent, their eyes trained to the screen of their cell phones.

Is there a role for SMS in health promotion?

The demand for tools and resources to help individuals adopt behaviors that promote health and avoid behaviors that harm health has rapidly and drastically increased in the last decade. Traditional venues of health care delivery, such as primary care, are not able to meet these demands. The average person spends only an hour per year in direct medical contact, whereas they spend thousands of hours making decisions about their health [8]. Computerized health promotion interventions through modalities such as internet (web), email, and SMS offer an enticing alternative way to help individuals with health behaviors. Several advantages of computerized compared to in-person interventions include the ability to standardize materials and protocols, deliver programs asynchronously when it is most convenient, in a person’s natural environment where they face threats to behaviors, remove perceived stigma associated with in-person disclosures of sensitive behaviors, and cost-effectively interact over time to geographically remote locations.

Text messaging may offer advantages compared to other computerized interventions. Given the near-universal presence of SMS worldwide, as well as high use among ethnic minorities in the US [9], SMS can reach populations most vulnerable to detrimental health behaviors. Given that cell phones are carried around with us throughout our waking (and sleeping) lives, SMS make it easy for individuals to periodically report health behaviors and to conduct real-time dialoguing to identify cues, trouble shoot barriers, and explore strategies to reinforce task performance [10]. Given that SMS does not require logging in, tunneling through web pages, or time-consuming data entry fields, it is more “light-touch” than other computerized modalities, thus reducing perceived barriers to engagement.

The first peer-reviewed study of text messaging for health promotion was published in 2002 [11] and the first RCT in 2005 [12]. Since then, there have been hundreds of individual studies and more than 20 systematic reviews, with two notable reviews published in the last year [13*, 14*]. Almost universally, published reviews have found that SMS can have a small, positive effect on health behaviors, but numerous limitations preclude definitive judgment about effectiveness. SMS behavioral interventions supporting *disease self-management* showed no effect on diabetes [15*] and hypertension [16*] outcomes. SMS

behavioral intervention focused on improving *medication adherence* showed no improved adherence or health outcomes to antiretroviral therapy for HIV [17*] or naltrexone for alcohol use disorder [18*], but did show improved adherence for anti-platelet therapy in heart disease [19] and intra-nasal corticosteroids for allergic rhinitis [20]. For SMS behavioral intervention focused on improving *disease prevention*, recent studies have shown positive effects for smoking [21*], alcohol use [22*], and infant breastfeeding [23*], and physical activity [24*]. As well, a recent systematic review of eHealth interventions focused on cardiovascular disease prevention (reducing obesity, encouraging regular physical activity, smoking cessation, control of hypertension, dyslipidemia reduction, and treating diabetes mellitus) found that most existing evidence supports SMS-based interventions [25*]. Still, variability in SMS intervention and study designs as well as limited long-term engagement and outcome data preclude definitive judgement about SMS behavioral intervention effects on meaningful health outcomes.

What features are important in an SMS behavioral intervention?

Even though SMS seems like a very simple interface, especially when compared with other computerized platforms, studies to date suggest that SMS design considerations can substantially effect program potency. Orr et al. [13*] found that more frequent messaging maximized effects and Head et al. [26] reported that SMS interventions using tailored and personalized messages, and those with customized and variable frequency of contact over time mediated effect sizes. Interestingly, Head et al. did not find a differential effect if the intervention was theory-based or if the intervention used other communication modalities concurrently. In another recent review of SMS interventions for a diverse sampling health behaviors, Hall et al. [14*] reported that two-way versus one-way SMS was not found by to be an important mediator, but a recent meta-analysis focused on medication adherence proves evidence to the contrary [27]. There is also the question of whether SMS interventions Clearly, much remains unknown, but insights can be gleaned from related literature.

Regardless of the communication medium, any well-designed behavioral intervention should be both engaging and persuasive. We consider engagement a measure of how well a person attends to the content of a program over time. Persuasiveness here refers to how well a program can influence someone to initiate and maintain a health behavior over time. Although the two goals are linked, they are each unique. Engagement with SMS programs can be influenced at various levels, from the individual message (language, tone, semantics, personalization) to the pattern of messaging (frequency, duration, adaptability) to the interactivity of program components. In a recent review using a diversity sample of 52 internet eHealth interventions, Morrison et al. [28] found that automated dialogue, proactive contact to repeatedly engage or prompt users, tailoring on multiple levels, and self-monitoring with activity planning were features associated with effective behavior change. Optimizing engagement with SMS programs can also be guided by such concepts as interactivity and presence [29].

Persuasiveness of SMS programs can be guided by the choice and application of behaviour change techniques [30]. An often cited review of 85 studies examining eHealth interventions

found that the use of behavioral theory was associated with larger effect size and interventions that incorporated more behavior change techniques also tended to have larger effects compared to interventions that incorporated fewer techniques [31]. The authors noted that the most commonly used behavior change techniques included provision of information on the consequences of behavior, prompting self-monitoring, and identifying barriers and/or problem solving. Also, behavioral modeling, relapse prevention/coping planning, facilitating social comparison, goal setting, action planning, and provision of feedback on performance all had effects on behavior.

Recently, there has been expressed concern that existing behavioral theories may be inadequate for application to mobile communication platforms, with concurrent development of new models. For example, Riley et al. [32] propose dynamic feedback system theories of health behavior informed by control systems engineering models. One recent example of an SMS behavioral intervention that utilizes dynamic feedback loops was designed and tested by Adams et al. [33*]. Specifically, their SMS intervention used adaptive goal setting and behavioral shaping to increase physical activity, which they demonstrated can outperform a static SMS intervention.

How does one design an SMS behavioral intervention?

Although there exists no established “best practices” for designing SMS behavioral interventions, there are a few useful published resources to help guide the design process. Intervention mapping is useful as a starting point to develop a framework to match behavioral goals with specific program features [34]. It describes the development process in six steps: (1) needs assessment, (2) specifying performance and change objectives, (3) selecting theory-based intervention methods and practical applications, (4) designing and organizing the intervention, (5) specifying adoption and implementation plans, and (6) generating an evaluation plan. The Multiphase Optimization Strategy developed by Collins et al. [35] offers a guide to more efficient behavioral program development. It consists of a screening phase, in which intervention components are efficiently identified for selection for inclusion, a refining phase, in which the selected components are fine-tuned, and a confirming phase, in which the optimized intervention is evaluated in a standard randomized confirmatory trial. Finally, Mohr et al. [36**] published an integrated conceptual and technological framework for eHealth interventions that maps an intervention behavioral aims to technological strategies.

What limitations exist when using SMS for behavioral interventions?

The foremost question pertaining to all computerized behavioral interventions is whether they can ever be comparable to in-person interventions. Computerized interventions lack many of the physical and non-verbal cues made available in face-to-face communication, including facial expressions and body language as well as tone and prosody of speech. Whereas some have suggested that these are essential components of the therapeutic relationship [37], others believe that computer-mediated textual communication can facilitate relationship-building in different ways [38]. Compared to other computer-mediated forms of communication, SMS may be closer to being able to foster personal relationships in

that it most closely mimics in-person speech, and has developed alternate strategies for indicating emotion, one example being the emoticon [39].

That being said, there are numerous other potential limitations in using SMS to deliver behavioral interventions that should be kept in mind. First, older adults and particularly those with disabilities still do not use SMS at high rates [40], limiting application of SMS interventions to elder health issues. Second, SMS may not be well suited to address multiple behaviors simultaneously or complex concepts that require visual or extensive textual content. The serial nature of the dialogue precludes parallel feedback loops occurring simultaneously. Third, SMS is not a secure form of communicating protected health information, influencing many US health systems to not use them in clinical care. Risks can, however, be reduced if a person sets a password on their phones and/or erases messages after reading them that they would not want someone to see. As well, information can be broken apart between messages, such that if a message happens to be intercepted, they cannot be interpreted in isolation. Fourth is the “Goldilocks” problem: SMS program engagement likely suffer as an individual receives too many texts in a day or does not text enough to make real-time feedback useful.

Why not just make an App?

Many believe that most of the limitations of SMS can be overcome through the use of phone applications (“apps”) to deliver effective behavioral interventions. There is no question that Apps have the capacity to offer a more comprehensive user experience, including features such as graphical and video content and social networking. There are several issues to consider, however. First, apps require a user to proactively engage with the program. Given that most people either prefer not to change their behavior, or have fluctuating motivations over time, they may not use the app when they most need it. SMS provides a proactive engagement, where a user must actively choose not to engage with it. Second, apps require more time to use. Whereas an SMS can be read in line at checkout or while waiting for an elevator, most apps require sustained effort to tunnel through their interface options, limiting use throughout the active day. Third, although most apps have messaging features, they lack comparable engagement to SMS. This is likely due to the fact that they are predominantly sent from entities such as companies rather than people, limiting the anticipation or stimulus one gets from receipt. Fourth, and related, is the fact that when a user interacts with an app, they are not conceptualizing this correspondence as being with a human. Even when an SMS program uses automation, it is likely that the user imagines the message as originating from a person. Finally, apps do not have usability cross platform and require a download, whereas SMS is usable across all current phone platforms and is programmed into every phone currently manufactured. Still, to our knowledge, controlled trials examining the comparative effectiveness of SMS versus apps have not yet been reported.

What is the future of SMS behavioral interventions?

The pessimistic prognostication would be that more efficient forms of computerized communication would supplant SMS. Researchers are already projecting this dire future and hedging efforts by influencing scientists to focus more on behavioral principles than on

communication modality [41]. A more optimistic view is that SMS is here to stay, will continue to be protected from advertisement and junk-SMS, and will become free to users due to the pressure on telecommunications companies. Although it would be foolish to predict which of these futures is more likely, it is certain that many developments in SMS behavioral intervention will occur along the way that can inform future computerized communication-based interventions aimed at health promotion. Scientists will learn how to better (1) leverage advances in natural language processing to allow branching off of open dialogue, (2) tailor intervention materials to time-varying factors, (3) utilize both intrinsic and extrinsic sensors to inform SMS programs, including provision of just-in-time support during periods of behavioral vulnerability, (4) identify language and communication theories to optimize salience and influence of messages, (5) apply engineering control principles to build more advanced communication architecture, (7) choose novel trial designs to rapidly iterate design features and (8) explore how SMS can best be used as a piece of a multi-platform behavioral program, leveraging the best of in-person and computer-mediated modalities. These advances will allow behavioral scientists to deliver the right support at the right time to optimize engagement and effects on target behaviors.

Conclusions

SMS is a ubiquitous and frequently used communication modality that has shown promise in delivering behavioral interventions. Existing evidence suggests SMS programs should aim to optimize user engagement and persuasiveness. Future research will continue to inform what SMS features are useful to which individuals at what times for what conditions.

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Highlights

- This review explores the role of text messaging, i.e. short message service (SMS), as a modern communication modality, and how it can be leveraged for delivery of behavioral interventions.
- Studies to date suggest that SMS behavioral interventions can effectively support health behaviors, and certain features optimizing user engagement and persuasiveness are suggested to mediate this effect.
- Although the role of SMS as a cheap, ubiquitous, and frequently used communication modality remains unknown, we can be sure that sophistication of SMS behavioral health interventions, including adaptability and tailoring, will increase to efficiently provide the right textual support at the right time to the right person.