



Using Digital Technologies to Improve Treatment Adherence

PAULA M. CASTAÑO, MD, MPH*,
MELISSA S. STOCKWELL, MD, MPH† ‡ § and
KATHERINE M. MALBON, MBChB, MD||

*Departments of *Obstetrics and Gynecology, Division of Family Planning, †Pediatrics, Division of Child and Adolescent Health, ‡Population and Family Health, Mailman School of Public Health, Columbia University, §New York-Presbyterian Hospital; and ||Department of Pediatrics, Division of Adolescent Medicine, Mount Sinai Hospital, New York, New York*

Abstract: Although health care recommendations should be agreed upon by a patient and her provider, patients cannot always follow these recommendations. Adherence remains low despite decades of research, highlighting the need for innovative approaches to tackle this problem. Interventions to improve adherence can capitalize on our reliance on technology. Digital technology interventions show promise in aiding patients attain and maintain their health care goals, including adherence to medication regimens and vaccination recommendations, receiving necessary treatment, attending appointments, and maintaining healthy behaviors. We present suggestions for clinicians who want to incorporate technologies to help their patients better engage in their health care.

Correspondence: Paula M. Castaño, MD, MPH, Department of Obstetrics and Gynecology, Division of Family Planning, Columbia University, New York, NY. E-mail: pc2137@columbia.edu

P.M.C. serves on an Advisory Board for Bayer Health-Care Pharmaceuticals Inc., as a Preceptor for Conceptus Inc., and as an Instructor for Merck Inc. The remaining authors declare that they have nothing to disclose.

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Introduction

Adherence can broadly be defined as the extent to which a patient's behavior corresponds with agreed-upon health care provider recommendations. Although traditionally thought to encompass mainly continuation of a medication regimen, a more broad definition of adherence can include seeking medical care appropriately, keeping follow-up appointments, and modifying unhealthy behaviors (eg, smoking cessation).¹ Interventions that have been tested to affect adherence, often in combination, have focused on the patient's desire or understanding of need for adherence such as with instructions, counseling,

telephone follow-up, self-monitoring, reinforcement or rewards, and psychological or group therapy. Others have focused on making it easier to remember to take or refill medications like simplified dosing, medication reminders by programmed devices or specialized packaging, medication charts, appointment and refill reminders, or increasing convenience of care. Still others focused on family or caregiver interventions or involvement in treatment. A recent systematic review of such studies found few of these interventions were effective and most were complex.² Thus, simpler solutions are needed that can be used in a real-world setting with little or no additional burden on health care costs.

Digital technologies, especially those utilizing cell phones, are increasing in popularity and use. They are nearly ubiquitous, portable, mostly private, and ever evolving. Patients and clinicians are increasingly finding a role for digital technology in the health care setting. We will review health care topics of particular interest to obstetricians and gynecologists in which mobile health (mHealth) technologies show promise in improving adherence to treatment regimens and provide recommendations for their use.

The Rise of Digital Technologies

A 2012 nationwide survey of over 3000 adults revealed that 85% own a cell phone.³ Text messaging, also known as Short Message Service or SMS, is a technology that has existed only since the 1990s but 80% of cell phone owners now send or receive text messages. Cell phone owners of all ages, races, incomes, and education levels use text messaging.⁴ Accompanying the rise in reliance on cell phones for communication is a decline in landline use. Thus traditional ways of reaching patients need to change to match the trends. Some cell phone users (9%)

already subscribe to health-related text message alerts. This is more common in women and in individuals aged 30 to 64 years.³ The national text messaging service for pregnant women and new parents, Text4Baby has enrolled almost 500,000 users in 3 years, showing the widespread interest in text messaging by the obstetric population.⁵

Over half (53%) of cell phone owners have cell phones with computer-like functionalities, or smartphones.³ This allows for other uses for cell phones, including accessing the internet (56% of users) and downloading mobile applications (apps) (43%).⁴ One in 5 (19%) smartphone users have downloaded a health app, and more women than men have health apps. The most popular apps are exercise, diet, and weight apps, followed by menstrual cycle, pregnancy, and medication management apps.³ Almost a third (31%) of cell phone users use their phones to look up health information on the internet.⁴ Looking online for health information is up from 17% 2 years ago and is most common among smartphone users (53% of whom have done so), minorities, and those aged 18 to 49 years.³

Treatment Adherence

MEDICATION REGIMENS

Given that adherence to a medication regimen averages 50%,¹ and has remained low despite decades of research, innovative approaches to improve continuation are needed. Fortunately, adherence to prescribed treatment is an area of health care where much research has been completed assessing the role of mobile technologies. As mobile technologies are portable and almost always accessible to the patient, they are ideal for customized interventions. The results of the limited randomized trials of mobile technology interventions to improve adherence to medication regimens

are promising both for chronic health conditions and preventive care.

Contraception

Contraceptive adherence is critical to optimal pregnancy spacing and helps prevent unintended pregnancies and all of their consequences. Castaño et al tested a text message intervention to affect oral contraceptive continuation in 962 young women seeking contraceptive care in New York City in 2008 to 2009. Women were randomized to either routine care or routine care plus a daily text message. The text messages were educational in content, adapted from the literature provided by the clinical site. They were sent daily at the time specified by the participant. After 6 months continuation was increased from 54% in the routine care group to 64% in the text message group ($P = 0.005$). Participants were satisfied ($\geq 90\%$) with the number, length, and content of the text messages.⁶

Although the intervention tested in this trial is not yet available on a large scale, there are existing Web sites offering free contraceptive reminders (eg, <http://www.missmint.com/users>, <http://bedsider.org/reminders/new>). Pharmaceutical Web sites may offer drug-specific reminder systems. With increasing use of mobile apps, providers can also suggest these to their interested patients.

Human Immunodeficiency Virus (HIV)

Adherence to recommended medication regimens is particularly important for patients with HIV infection. Antiretroviral therapy (ART) has reduced mortality and transmission but regimens often include multiple medications that must be taken at different times; drug resistance is a concern when regimens are not adhered to. Thus, it is not surprising that improving ART adherence with text messages has been the subject of studies in the young field of mHealth. A 2012 Cochrane systematic review by Horvath et al of 2

randomized trials in Kenya found greater self-reported ART adherence after 48 to 52 weeks of weekly text messages. On the basis of their evidence, the review authors recommend funding and implementation of similar programs.⁷

These findings indicate that text message reminders may play a positive role in improving medication adherence for a chronic medical condition with complex medication regimens, although improvements in clinical outcomes need to be further evaluated. Although the services used in the clinical trials are not yet available for widespread use, there are sites where patients can set up free general medication reminders, such as <https://secure.medactionplan.com/mymedschedule/index.htm>, and, again, mobile apps.

Supplements

Despite national recommendations for prenatal vitamin intake by all women of reproductive age who may become pregnant, self-reported adherence is low. In addition, patients are sometimes advised to take a vitamin supplement because of dietary restrictions or nutritional deficiencies. If a patient is not feeling ill and does not have an immediate objective measurement to improve by being compliant (eg, blood pressure readings or blood glucose levels) there may be less incentive to be compliant.

Cocosila et al randomized 102 healthy volunteers (54% women) in Canada to either a text message reminder to take vitamin C or to no text messages. After 1 month, more participants in the intervention group were taking vitamin C and fewer had missed pills in the last week by self-report, although both were nonsignificant differences. Although this was an exploratory study and enrolled a convenience sample,⁸ the results suggests that text messages may also play a role in improving adherence to preventive interventions. The existing mobile technology resources detailed above for medication

reminders can also be recommended for complying with preventive medications.

VACCINATIONS

Vaccination against vaccine-preventable diseases is important both for women and their families. Three of the most needed vaccines for women are those against influenza, pertussis, and human papillomavirus (HPV). Despite recommendations, coverage is low.⁹

Influenza causes significant morbidity and mortality as well as financial costs including both direct medical costs, and indirect costs from days missed from school and work. Although all adults should receive the influenza vaccine⁹ (including those seeking gynecologic care), pregnant women are a particularly important group to vaccinate. Pregnant women are at highest risk for influenza morbidity and mortality. Pregnant women will also, once they deliver, likely be the primary caretaker of an infant who will be at significant risk for influenza morbidity and mortality, but too young to be vaccinated. The most effective way to prevent influenza is through vaccination, which must occur yearly as the previous year's vaccine often does not offer protection against the current season. Vaccination should occur as early in the fall as possible. Therefore, routine influenza vaccination is recommended for all people over 6 months of age,⁹ unless a contraindication is present. In particular, it is recommended for all women who either are or will be pregnant during influenza season⁹; they can be vaccinated in any trimester.

Pertussis is a highly contagious infection, often causing outbreaks and morbidity and mortality in infants. Therefore, it is now recommended that women receive a Tdap (Tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis) booster with each pregnancy, optimally between 27 and 36 weeks of gestation.⁹ If Tdap was not administered during

pregnancy, it should be administered immediately postpartum to reduce the risk for transmitting pertussis to the infant. It is also recommended to vaccinate, with a single dose, all adults who have not previously received Tdap.⁹

HPV is the most prevalent sexually transmitted virus in the United States. Although most HPV infections resolve, HPV can lead to genital warts, cervical dysplasia, and cervical, vulvar, and vaginal cancer. The vaccine series is highly effective. It is recommended for girls and women aged 11 to 26 years.⁹

Two technological methodologies with particular potential for this population are text messaging and clinical decision support (CDS). Text message vaccine reminders notify a patient that they are in need of vaccination. Stockwell and Kharbanda et al successfully utilized text message vaccination reminders in the adolescent population to increase receipt of influenza,¹⁰ Tdap,¹¹ and HPV vaccination.¹² Text messages have also been used successfully in an adult travel clinic in Spain to improve return for needed doses of hepatitis vaccine.¹³ Kharbanda et al¹⁴ demonstrated that pregnant women are interested in vaccine-related text messages, including ones that contain vaccine-specific education that can target common influenza vaccine misperceptions. Stockwell et al¹⁰ successfully utilized text messages with this type of embedded influenza vaccine education to improve vaccination in an adolescent population. The evidence for the role of text messages in improving vaccination rates to prevent vaccine-preventable diseases is strong. Some companies that have offered other forms of reminders, such as automated phone calls, now support text messaging which makes these reminders more feasible for providers to implement.

CDS provides alerts to health care providers at the time they are seeing a patient for a visit; for example, they can notify a clinician by an electronic health record (EHR) that their patient is in need

of an influenza vaccination or that their patient needs a second dose of HPV vaccine. Provider recommendation is a key factor in acceptance of vaccination, therefore it is important to not miss opportunities to both discuss vaccination and vaccinate. Vaccination CDS may be particularly useful in the outpatient setting for providers who may not be thinking about vaccination with every visit. This is particularly important as the focus for vaccination has moved from the postpartum to the antepartum period. The use of CDS in the outpatient setting has been demonstrated to increase both influenza vaccination coverage in pregnant women and documented discussion regarding vaccination.¹⁵ CDS has also been successfully used for vaccination in the adolescent and general adult population.^{16,17} As the use of EHRs becomes more widespread, providers should seek implementation of these vaccination prompts.

RESULTS NOTIFICATION

Patients

Recalling patients for notification of results whether by phone call or mail is resource and time intensive. Current protocol in many clinical practices is a phone call either directly giving results or asking the patient to return for results. Patients, however, may prefer other modalities for contact. In a survey of young women enrolling in a text message intervention for oral contraceptive continuation, 76% were interested in the idea of a text message service that provided test results. Another possible innovative clinical use for mobile technology, therefore, is in notifying patients (and their partners) of laboratory results. This has been tested, albeit in limited well-designed studies to date, in notification of results of tests for sexually transmitted diseases and prenatal screening for Down syndrome.^{18,19}

A survey in a London-based genitourinary clinic identified an average of 120 hours per month spent providing results of sexual health screening over the telephone. Almost all (98%) of their patients had a cell phone. These discoveries as well as the acknowledgment that reducing the time to treatment of sexually transmitted infections (STIs) reduces complication rates and onward transmission, led the investigators to introduce text messaging for communicating STI results to patients. For a 6-month period in 2004, patients attending the clinic for STI screening and who were deemed at low risk for HIV were offered the opportunity to receive their results by text message, instead of a phone call or in person. The text message contained no personal identifying information and stated either that all results were negative or that the patient should call or visit the clinic. Participants were mostly female (>95%). Those with a diagnosis of *Chlamydia trachomatis* infection who were sent a text message received treatment sooner than the standard group (9 vs. 15 d, $P = 0.005$). The time to provide the results by consult at the clinic was estimated to be 12 minutes, by phone 4 minutes, and by text message 1.5 minutes. In the final month of the study, decreased staff time and money resulted in a cost saving of 40% and a desire to make text messaging the default results service.¹⁸

Understandably, concern surrounds confidentiality and the use of technology for communication of results, particularly of sensitive tests. Although text messaging has been shown to be cost and time effective for the health care system, patient opinion can be less favorable. Focus groups carried out in an inner city adolescent health center during the summer of 2010, demonstrated that adolescents, 22% of which had previously been diagnosed with Chlamydia, were concerned about receiving results of their STI screening by text message. The content of the text message seemed to be their biggest

concern. They did not want the result to appear in text, but if the message were coded they worried that they might not understand it properly and this would induce anxiety. Instead, they preferred a message notifying them of the need to attend clinic.²⁰

Cheng et al explored this concept of anxiety and time to receive results in a randomized controlled trial of 2782 women. In a prenatal clinic in Taiwan, pregnant women were experiencing high anxiety while awaiting the results of their Down syndrome serum screening. The investigators wanted to shorten this period of anxiety by delivering results in a quicker way with text messaging. In 2005 to 2006, pregnant women undergoing serum screening were recruited and randomized to be in the intervention group (results by text message) or control group (results given at follow-up). When compared with women not receiving a text message, those with negative results in the text message group had reduced anxiety before the clinic appointment. Anxiety did not differ by group for women with a positive screening result.¹⁹

Preliminary findings for results notification by text message are promising. More studies are needed to assess not just efficacy and cost effectiveness but patient acceptance and possible risks and harms associated with use of text message results notification. Before this technology can be used in a more meaningful and generalized way, systems need to be streamlined to allow for seamless electronic ordering of tests, results verification by a clinician, and initiation of a results text message.

Partners

One of the reasons why the incidence of STIs is so high in the United States is the lack of, or delay in, partner notification. This allows for onward transmission or retransmission. Typically partner notification is reliant on the patient, sometimes with the assistance of a public health

investigator or clinician, contacting partners in person or by phone, mail, or email. This is fraught with complications; partners may not be reachable or may have moved, or are unknown or forgotten. As informing partners can, at times, be an inflammatory discussion, having an online or anonymous method of notification may be preferable. This section provides information on existing online partner notification systems that can be recommended to patients immediately as a complement to traditional partner notification.

inSPOT (<http://www.inspot.org/>) is an online partner notification system that uses electronic postcards (e-cards) to inform up to 6 partners at the time of an STI diagnosis. The program was developed as a joint effort between the San Francisco Department of Public Health and Internet Sexuality Information Services in 2004. The program was designed to be replicable and to suit all sexually active adolescents and adults. Messages can currently be sent in French, Spanish, and English, and are available in British Columbia, Peru, and the United States. There is a pull-down menu of 12 STIs from which to choose. The user chooses an e-card to send to a partner and has the choice to remain anonymous. On receipt of the e-card, the recipient is linked to a page with disease-specific information. In San Francisco, the contacts can receive electronic prescriptions (expedited partner therapy). The use of inSpot is impressive with over 750 people visiting the portal daily in 2008.²¹

Additional electronic notification systems include 2 that provide helpful tips and scripts for notifying partners in person, or by phone, text message, or email—<https://www.sotheycanknow.org/inform> and <http://www.letthemknow.org.au/default.html>—and one that emails or texts partners anonymously about 14 STIs: <http://dontspreadit.com/start.php>. Limitations of these systems are that they require the patient to know a partner's contact information; this is not too

different from limitations of usual forms of partner notification. Obviously confidentiality and privacy are both concerns as is up-to-date referral information. inSPOT reports <10 complaints from recipients receiving an e-card in error. Furthermore, inSPOT does not store information on senders or recipients; they collect and report only usage data such as number of visitors, diseases selected, regional variations, and use of links embedded in the e-cards.²¹ Thus, full-scale evaluation of the effect of these systems is difficult. Future enhancements to such notification systems could include increased availability of electronic expedited partner therapy and the addition of anonymous notification by private messaging on social networking sites. The latter might be useful if a partner's contact information is otherwise unknown.

APPOINTMENT REMINDERS

Routine Appointments

For health care providers, missed appointments affect schedules and workday efficiency, resulting in financial loss. For patients, missed appointments can lead to a worsening of individual health and resultant financial costs. Within the reproductive health care arena, missing appointments can have serious health implications, such as unplanned pregnancy (no initiation or prematurely discontinued contraceptive use), undiagnosed cancers (missed opportunities for recommended screening), as well as late attainment of prenatal care; the latter can lead to multiple health consequences for both the woman and her child.

Reasons for missed appointments are multiple and may differ across demographic subgroups, but a major reason seems to be forgetfulness. Current attempts to increase appointment attendance include reminder cards, reminder phone calls (automated and personal),

aid with transportation (financial or logistical), and more convenient clinical hours (evenings and weekends).

In the study of a text messaging intervention to affect oral contraceptive continuation, 96% of young women expressed interest in a service that would provide text message appointment reminders. Text messaging lends itself as an ideal cost-effective mechanism for reminding patients about upcoming appointments. It allows customizable messages to be sent to multiple cell phones using minimal resources. It also allows information regarding appointments to stay readily accessible for easy reference as patients often keep their phones with them at all times. Yet knowledge regarding its efficacy and acceptance as a tool to improve appointment attendance is limited by few well-designed studies.

Three systematic reviews published since 2011 have analyzed studies testing interventions to improve appointment attendance, including telephone or text message reminders^{22,23} or only text message reminders.²⁴ Almost all (97%) of the studies in the Hasvold and Wootton²² review reported an increase in appointment attendance; personal calls seemed more effective than automated calls (39% vs. 29% improvement). Both the Car et al²⁴ and Free et al²³ reviews showed that text message appointment reminders increase attendance compared with no reminders. Text message reminders were similar in efficacy to telephone call reminders²⁴ and postal reminders.²³ Although reminders occurred between 1 and 3 days before the appointment, timing of reminders did not seem to affect attendance rates.²² In studies providing cost information, the most economic means of reminders were automated calls and text messages.^{22,24}

Although using text messaging is resource efficient it is not guaranteed that the text message reaches the correct recipient. Adding the ability to send a response of receipt (2-way messaging) can add

complexity and cost. The use of email for sending appointment reminders allows read receipts. In addition, email can be more secure than text message by being encrypted, and can include more information than a text message which is limited by character count. However, email also comes with its problems such as an increased workload for clinic staff, technical difficulties (full mailboxes), and lack of access to email in certain populations (low income). Atherton et al conducted a systematic review of email for appointment reminders. They found no studies that fulfilled their criteria. They concluded that there is a glaring need for rigorous, high-quality studies to evaluate the effects of email used for coordinating health care appointments and attendance reminders. They highlighted the widespread opinion that the use of email by health care professional is seen as risky in terms of security and patient confidentiality.²⁵ Future studies on email appointment reminders need to address usability, security, and impact on the health professional's workload.

Very little is known regarding content of text message appointment reminders as well as timing of when best to send the reminders in terms of patient satisfaction. Furthermore, no studies focus on older populations who generally have more medical appointments to attend and are less savvy using cell phones. For practices that do not have a system for appointment reminders, patients can be directed to online services (eg, http://bedsider.org/appointment_reminders/new) or countless mobile phone apps.

Test of Reinfection Appointments

To a patient, a routine appointment may be different than one for a very specific reason. A visit for test of reinfection after a Chlamydia infection is recommended 3 months after treatment. It may decrease untreated infections and their sequelae, such as chronic pelvic pain and infertility. A patient may forget the recommendation

for this appointment as time passes and symptoms resolve, placing the burden of reminders in the hands of the providers. Current clinical practice may involve scheduling the repeat appointment at the time of initial diagnosis, reminder cards, and phone calls. Once again, text messaging may have a role in improving appointment show rates in this specific clinical scenario, as demonstrated in 1 small randomized trial. In 2010 to 2011, Australian investigators randomized 94 participants to standard advice to return in 3 to 4 months, standard advice plus a text message reminder, or standard advice plus a text message and \$10 incentive. Half (51%) of participants were female and 63% were under the age of 25 years. For 21% messages were undelivered after a week of attempts. Visits for test of reinfection were higher for both groups receiving text messages when compared with the standard advice group ($P = 0.04$). Reinfection was present in 16%,²⁶ reinforcing the importance of returning for a repeat test. Again, online reminders and mobile phone apps can be used by patients to remember these and other important clinical appointments.

SMOKING CESSATION

Adopting healthy behaviors can result in positive long-term health outcomes. Nowhere is this more evident than in smoking cessation. Tobacco-related morbidity and mortality tax our health care system. Given the limited time during medical appointments, it is difficult to provide adequate counseling and ongoing support for smoking cessation. A recent Cochrane review of cell phone interventions for smoking cessation found 5 quality randomized trials that collectively enrolled over 9000 participants in Australia, the United Kingdom, and New Zealand. All trials enrolled women and had some text messaging component. Quit rates were by self-report in all trials, and confirmed by biochemical markers in

one. Pooled data revealed that 6-month quit rates were higher in the intervention group than in the control group (RR, 1.71; 95% CI, 1.47-1.99; $P = 0.001$).²⁷ These findings suggest that mobile interventions for smoking cessation should be offered to patients. An example of a similar text message system for smoking cessation available in the United States is <http://smokefree.gov/smokefreetxt/>. It is an initiative from the Department of Health and Human Services. Smoking cessation apps are also available.

Challenges

Clinicians may often encounter patients who were frightened or misinformed by health information they obtained online. Similarly, patients may be overwhelmed by the sheer volume of digital technology intervention options that market themselves as beneficial for their health. Clinicians should be ready to offer their patients trusted recommendations for helpful, low-cost digital technology interventions to allow them to optimize their health care. The recommendations for digital technologies presented in this review are meant to support and complement existing clinical practice, not to substitute for high-quality personalized care.

LIMITED DATA

The field of digital technology in health care, particularly that related to cell phone interventions, is relatively new. Given how long it takes to carry out a high-quality clinical trial, the data supporting its use are limited. Data on the use of apps or social networking for treatment adherence are forthcoming. There is a disconnect between technologies that have been used in the studies to date and the technologies that are available to consumers. New digital technologies in the form of apps are released daily, a pace that is difficult to match with quality

clinical trials. In many cases the recommendation in this review are not the necessarily of the same technologies studied in clinical trials. They are, however, close approximations.

Additional studies will need to investigate whether the existing results can be extrapolated to all health care areas. For example, if text messages increase continuation of complex HIV medication regimens, will they do the same for patients with other chronic health conditions? Or, as patients sometimes take medications for multiple conditions,⁶ how does a reminder for 1 medication affect adherence to the rest? As digital technologies are relatively low risk, it seems feasible to suggest that results might apply more broadly. We also need data beyond adherence, to know whether improved adherence ultimately affects clinical outcomes. More studies are needed that assess patients' desires and satisfaction with digital technology interventions. And even though many technologies are low cost or free to the patient, we need more studies of their cost effectiveness.

GENERALIZABILITY

A clear advantage of digital technologies to improve patient adherence is that they are designed to be used on platforms available to almost all of our patients, namely cell phones. Cell phones, in particular smartphones, are widely adopted by men and women of all ages, races, incomes, education levels, and geographic locations.³ In addition, they allow tailored information to be sent to patients in a scalable manner with little additional cost per patient.

CONCERNS

Reasons for nonadherence to medical recommendations may be multifactorial. As with many successful health care interventions, no 1 solution works equally for all patients. Instead, mobile

technologies allow us to increase our menu of options that may best fit an individual patient. They also make it easier for patients to access and engage in their own health care. Despite all of the advantages of incorporating digital technologies into our current health care arsenal, there are some caveats. First of all, these technologies do require some level of literacy, including health literacy. They also require good vision. Privacy and confidentiality are concerns. These may not be ensured if cell phones are shared or used in a public setting. Phone sharing, however, may be rare; only 2% of participants in the oral contraceptive text messaging trial reported sharing cell phones.⁶ Privacy might be increased by recommending that patients protect their cell phones with a password.

Patients may misinterpret the information they receive from digital technologies used or recommended by their providers. Text messages are limited to 160 characters and thus subtleties of spoken language may be lost. In addition, a patient receiving text message communication from a provider's office, for example, in an appointment reminder, might misinterpret that as an invitation to engage in a dialog with their provider through text messages. If providers choose to send text messages from their practice, they need to consider whether or not to accept replies; 1-way text messaging systems may be preferable. For 2-way text messaging systems, patients need to know if replies or unsolicited text messages will not be monitored and be advised on alternate or preferred ways to contact their health care providers. There is little published literature to guide how to document communication with patients by text messaging or, more broadly, social media. The most recent Ethics Manual by the American College of Physicians addresses the use of social media and states that physicians should (1) be aware that social media can blur social and professional

boundaries and (2) should extend their professional and confidentiality standards from the clinical setting to their use of social media.²⁸ For additional guidance, providers should check with their institutional policies regarding the use of digital technologies to communicate with patients or, if not available, regarding patient communication in general. Electronic interaction must comply with privacy and data security policies and may require written authorization by the patient. If no institutional guidance exists, we suggest that providers document as they currently do for other forms of communication with patients (eg, document as a telephone encounter in the EHR).

Interventions that rely on digital technologies are susceptible to service disruptions such as temporary loss of service, loss of phone, change in service provider, or change in cell phone number. In the trial of a text message intervention to improve contraceptive continuation, 28% of participants reported a service interruption or change during the 6 months. Interestingly, this did not weaken the effect of the intervention.⁶ Studies are needed to further evaluate the effect of service interruptions on interventions delivered by cell phone. Physical safety is rarely mentioned in trials of digital technology interventions. One can imagine an increase in repetitive motion injuries and accidents in users of digital technology that involves a cell phone. Future studies should report on any physical safety data they assess.

Lastly, despite the widespread use of cell phones, costs of ownership are not decreasing. Most of the digital technologies to improve adherence to recommended treatments included in this review are free or low cost. Text messaging programs can be set up that are free to the patient with the cost being absorbed by the sender of the text message. Should costs become prohibitive, providers may need to advocate for insurance coverage of digital medical interventions for their patients.

Conclusions

Digital technologies have a unique ability to bridge the 2 key players necessary to affect adherence—the health care system and the patient. Reliance on digital technology is increasing and health care providers should take advantage of its benefits. Although research into the efficacy of digital technology as an adherence aid is just emerging, results are promising. Digital technology, mainly in the form of text messaging, or SMS, increases adherence to medication regimens and recommendations for vaccinations, receipt of test results, attendance at appointments, and adoption of healthy behaviors. Existing digital technology interventions in the form of text messages are affordable and widely available; they should thus be recommended to patients. Mobile phone app health care interventions may be the wave of the future; although yet unstudied, they may serve as a proxy to text messaging systems. Overall, digital technology offers promising ways to improve medication adherence and its use should be strongly considered by health care providers.

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