Perspectives Piece: Realizing the Potential for Digital Health Technology in Behavioral Medicine

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The development and application of new technology has long been an integral part of healthcare. The desire to improve quality of care while lowering cost leads to a constant search for new devices and methods that can leverage recent technological advances to assess more accurately, study more informatively, and treat more effectively. Behavioral health interventions that leverage digital health technology have been lauded as a means to help remedy patient burden, treatment expense, and variable adherence found in traditional interventions (Pagoto & Bennett, 2013). The so-called "digital revolution" has produced powerful devices with unprecedented portability and, in the process, opened a new world of opportunities for the use of technology in healthcare. This "revolution" has resulted in a multi-billion dollar market that parallels the increasing global demand for fast and readily accessible health information to facilitate clinical care (Chakrabarti, 2012). However, despite these seemingly parallel movements, there is an ongoing disconnect between the commercial enterprise and clinical evidence-base of digital health technology.

Behavioral scientists may be particularly well-positioned to capitalize on recent health technology developments given the tremendous capacity of mobile devices and other technology to track key health behaviors, provide psychoeducation, and deliver timely interventions to promote health (Cushing & Steele, 2010; Palermo & Wilson, 2009). As a result, the development and testing of mobile health technology has been a "hot topic" in behavioral medicine. Leaders in the field have noted the potential of new technology to improve both research and practice by facilitating measurement of health-related symptoms, remotely examining adherence and self-management behaviors,

assessing functioning and outcomes, and delivering therapeutic interventions (Palermo, 2008). Despite this enthusiasm, the use of innovative health technology in daily practice is still in its infancy, and paradigm-shifting developments remain a hope for the future rather than a current reality. Furthermore, we contend that some of the traditional methods used in behavioral medicine may have real limitations when applied to digital health technology. Consequently, new approaches may be needed to realize the potential of this area. In this commentary, we discuss some of the most formidable challenges in the development and dissemination of digital health technologies, and recommendations for overcoming these obstacles using newer approaches. Our commentary focuses specifically on digital health technology, which encompasses the broader landscape of health technology and includes, but is not limited to, patient internet portals, wearable mobile sensors, smartphone and other handheld applications, electronic event monitors, health information technology (IT), telemedicine, and healthcare software.

The first unique challenge of digital health technology development comes in terms of the expertise needed to develop clinically useful applications. Although behavioral scientists bring expertise in behavior change, we may lack sufficient technical and design expertise necessary to bring functional technologies to full fruition. Indeed, the development health technology has, understandably, focused on the hardware and software design and engineering requirements. Yet, many have failed commercially in part due to poorly defined target behaviors and the lack of validity of the data they provide. Rather than individuals working in isolation, a team science

approach is needed, (Pagoto & Bennett, 2013), involving the collaboration of many stakeholders (e.g., clinicians, designers, health IT, engineers, insurance payers, families, marketers) all focused on a single goal: effective health care delivery and management for an individual. This team science approach is essential to ensure that the digital health technology is designed to maximize ease of use, minimize glitches, increase user engagement, and make data available in ways that inform clinical care. Behavioral scientists have employed team science for decades – working closely with medical and other health professionals to address psychosocial issues affecting health. However, the teams needed for developing and disseminating mobile health technologies necessitate a different look than the traditional behavioral scientist team. The incorporation of graphic designers, programmers, engineers, and industry partners may be essential, but also unfamiliar for behavioral scientists. This will require becoming familiar with the nomenclature of design and development (e.g., programming language and features, operating systems, principles of user-centered design) to ensure optimal team communication and a product that effectively integrates the expertise of various professionals. Behavioral scientists, with experience in facilitating interdisciplinary dialogue and collaboration, are well-positioned to lead the new teams needed for success in the digital health technology arena. Our involvement with these teams can occur across the spectrum of development—from the outset of new design and development, helping to improve already existing products by incorporating appropriate developmental behavioral strategies to increase patient engagement, or testing "mature" products for clinical efficacy (Pagoto & Bennet, 2013).

A second challenge of mobile health technology for psychologists is that traditional funding mechanisms (e.g., NIH R- or K-awards) may be ill-suited and incompatible with the fast-paced technology environment. Technology changes so rapidly that in some cases, the devices used in clinical research studies may be obsolete by the time the study findings are published. Moreover, this duration precedes the research-to-practice translation gap, which underscores the challenge of testing and implementing effective technologies in clinical care. To put this into perspective, the procession of a typical NIH R01 grant from initiation to completion of the study would mirror the industry-based iteration of the first iPhone device to the iPhone 5s. Thus, the typical NIH R01 mechanism, requiring substantial pilot work before a five-year evaluation period, may not

be realistic for the development and dissemination of new clinically-validated health technologies. Instead, alternative sources of funding, such as SBIR/STTR, foundation grants, and investment from industry partners may be needed to develop and validate various health technologies for widespread dissemination. Relatedly, the evaluation of digital health technologies presents new challenges that may not be well-addressed in traditional randomized controlled trial (RCT) designs. Because of constant changes in devices and operating systems, a more flexible and iterative approach to development and evaluation is needed (i.e., agile development process, see Abrahammson, Salo, Ronkainen, & Warsta, 2002). For example, in order to maximize clinical relevance and patient engagement, digital health technology must be able to evolve over time (e.g., including updated software versions), involve input from both the developer and user, and be adaptive (i.e., allow for frequent changes). Issues of ongoing development and modification are not unknown to existing behavioral medicine interventions, but the dramatically accelerated pace of change with mobile health technologies demands a particularly flexible approach. Validated versions of the technology can then be scaled-up for widespread dissemination, clinical integration, and commercialization.

Unfortunately, the proliferation of health technology applications as a whole in recent years has far outpaced the evaluation of these applications, resulting in an abundance of technology-based options, but a dearth of data supporting their efficacy. This has resulted in some questioning whether there is more hype than hope for digital health technology (Labrique, Vasudevan, Chang, & Mehl, 2013). Moreover, very few mobile applications include psychosocial principles or behavioral theory methods employed in traditional face-to-face interventions, and thus may limit their impact on health behavior change (e.g., Brannon & Cushing, in press; Pagoto, Schneider, Jojic, DeBiasse & Mann, 2013; Schoffman, Turner-McGrievy, Jones, & Wilcox, 2013). For behavioral scientists, untested applications represent a conundrum as the principles of evidence-based practice require that our services be based on "best available research evidence," and the promise of a technology may be offset by the lack of rigorous evidence to support its use. Ultimately, this will likely impede the integration of digital health technology into clinical practice and thus undermine its potential health impact (Pagoto & Bennet, 2013).

Finally, the landscape of mobile health technology poses a challenge in terms of informing clinicians of new technologies and keeping up-to-date on emerging evidence for effectiveness. Such evidence has a major impact on treatment selection, and clinicians will be rightfully hesitant to adopt new technologies without knowledge of their effectiveness. However, the volume of applications likely to be developed in the coming years makes it extremely challenging for any professional to keep abreast of the latest developments. The issue is exacerbated by the typical lag between evaluation research and publication of results, necessitating new mechanisms for disseminating findings quickly and in a format that is accessible to busy clinicians. In addition to maintaining up-to-date lists of new technologies and available evidence, opportunities to demonstrate new products and provide support for clinician implementation will be needed. Partnerships between behavioral scientists/clinicians and industry are necessary and mutually beneficial. Given the importance of clinician adoption of new technologies, it is crucial to involve these professionals from the beginning and then disseminate strategically to maximize impact.

Digital health technologies in behavioral medicine represent a confluence of staggering opportunities and formidable challenges. Realizing the potential of this area will require a combination of well-established behavioral medicine principles (i.e., rigorous evaluation, interdisciplinary team work) and new strategies that meet the unique challenges of a rapidly changing technology landscape. While there may be a general distrust or slow adoption into practice by some, increasing the evidence base of digital health technology has the potential to shift these views and unearth the true potential for improving health outcomes. Behavioral scientists/clinicians will be forced out of their comfort zone – working with previously unfamiliar partners in an environment that requires agile development and creativity in seeking funding. The potential rewards for this work are considerable and adopting a broader team science approach and adding some of these "new" experts (e.g., commercial developers and designers, engineers) to the table will dramatically enhance our ability to promote the health and psychological well-being of individuals.

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