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Adoption of Technology-Enhanced Treatments: Conceptual and Practical Considerations

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Abstract

As the efficacy of technology-enhanced mental health service delivery models (i.e., supportive or adjunctive technological tools) are examined, we must inform and guide clinician decision-making regarding acceptance and, in turn, uptake. Accordingly, this review aims to move beyond traditional discussions of geographic barriers by integrating, reconciling, and extending literatures on dissemination and implementation, as well as technology uptake, in order to anticipate and address organizational and clinician barriers to adoption of technology-enhancements. Specifically, a five-stage model is proposed to address organizational readiness for and clinician acceptance of technology-enhancements to evidence-based treatments, as well as the relevance of current adoption strategies for technology-enhanced services. Our aim is to provide a guiding framework for future research and practice.

Keywords

Technology; Evidence-Based Treatments; Barriers; Adoption

Less than half (40%) of individuals with mental health issues receive services, with the minority of those receiving evidence-based treatment and only a third receiving services from mental health providers (Gaudiano & Miller, 2013; Kessler et al., 2005; Wang et al., 2005; Weisz, Sandler, Durlak, & Anton, 2005). Due to a number of systematic barriers, including workforce shortages, failed dissemination efforts, and lack of services for the neediest groups (e.g., low-income and rural population; Glasziou & Haynes, 2005; Kazdin & Blasé, 2011; Khanna, Kerns, & Carper, 2014), it takes on average 15 to 20 years to fully integrate evidence-based treatment into practice (Balas et al., 2000), a lag that is even longer for psychological treatments (Karlin & Cross, 2014). In order to expand accessibility, acceptability, and availability, the field has turned to expanding the range of treatment delivery modalities, including capitalizing on the portability and ubiquity of technology (e.g., computers, mobile phones, wearables; Jones, 2014; Kazdin & Blasé, 2011; Ritterband et al., 2003). Despite enthusiasm in the field for technology to improve the implementation and dissemination of evidence-based treatments, little is known about barriers to incorporating technological tools into more traditional mental health services.

The incorporation of technology into mental health has been referred to by various names in the literature, including m-health, e-health, behavioral intervention technologies, adjunctive or supportive technologies, and technology-assisted interventions (e.g., Becker & Jensen-Doss, 2013; Eysenbach et al., 2011; Mohr, Burns, Schueller, Clarke, & Klinkman, 2013). Various and distinct methods of integrating technology into treatment exist, but these can essentially be divided into two broad categories (Khanna et al., 2014; Muñoz, 2010; Tate & Zabinski, 2004): standalone and technology-enhanced interventions. Standalone technology interventions can be defined as those that do not require any clinician involvement or intervention (e.g., computer-based treatments, web-guided interventions, self-guided mobile applications). Technology-enhanced interventions, in contrast, depend on at least some level of clinician involvement in coordination with the use of technology, ranging from roles such as providing telephone support to remote face-to-face videoconference to standard face-to-face sessions that are enhanced by between-session technology (e.g., videos, text messages, reminders; Andersson, Rozental, Rück, & Carlbring, 2015; Jones et al., 2013; Musiat & Tarrier, 2014). Of note, the current review will focus on these technology-enhanced, rather than standalone technology, interventions in particular for the following reasons: 1) technology-enhanced treatments are among the fastest growing behavioral health technology trends (Comer, 2015); 2) preliminary findings suggest that technology-enhancements may be more efficacious than standalone technologies, particularly for populations with clinically significant symptomatology (Jones, 2014; Mohr et al., 2013; Tate & Zabinski, 2004); 3) technology-enhancements have relatively low dropout rates compared to standalone technologies, with some work suggesting that they may actually increase engagement and decrease dropout (Jones, 2014; Mohr et al., 2013; Tate & Zabinski, 2004); and 4) the adoption barriers for technology-enhancements may differ in type and complexity compared to standalone approaches, due to the need for broader stakeholder involvement (i.e., clinicians, organizations, & client involvement versus only client involvement).

Of note, meta-analyses suggest that outcomes (i.e., effect sizes) for a range of technology-enhanced mental health approaches (e.g., internet-based, smartphone-enhanced, text messaging) are either comparable to or better than traditional face-to-face treatments (e.g., Gros et al., 2013; Lindhiem et al., 2015; Musiat & Tarrier, 2014). For example, technology enhancements to evidence-based treatments for depression (e.g., Mohr et al., 2013), anxiety (e.g., Khanna & Kendall, 2010), addiction (e.g., Marsch, Carroll, & Kiluk, 2014), and disruptive behavior disorders (e.g. Jones et al., 2014) boost treatment outcomes over traditional treatment. After accounting for development costs (Tate, Finkelstein & Khavjou, 2009; Muñoz, 2010), technology-enhanced services may also be more cost-effective than traditional approaches due to greater efficiency, with treatment taking an average of six times less time relative to standard interventions. Importantly, neither reduced delivery-time nor variability in level of therapist involvement across a range of technology-enhanced interventions appears to compromise outcomes, rapport, or client satisfaction (Musiat & Tarrier, 2014; Tate & Fabinski, 2004). Preliminary research also suggests that the type of support (e.g., providing support over the phone versus providing concurrent therapy) does not affect treatment outcome or client adherence to and satisfaction with the intervention (Musiat & Tarrier, 2014).

The empirical promise of technology-enhancements, however, does not necessarily increase the translation of evidence-based practice into clinical care (Lord, 2015). Indeed, technology-enhancements may pose unique attitudinal and organizational barriers to clinical adoption, which are imperative to consider if technology is to fulfill its promise. For example, many clinicians are integrating technology into their service provision; however, these technology-enhancements are not necessarily those with even preliminary evidence (Torous, Chan, Yellowlees, & Boland, 2016). Accordingly, as researchers continue to examine the efficacy of technology-enhancements, it is imperative that concurrent work is conducted to inform and guide clinician decision-making regarding acceptance and, in turn, the likely utility of uptake (Andersson et al., 2015; Lindhiem et al., 2015). To this end, this article draws on dissemination and implementation, technology uptake, and other related literatures to address organizational readiness for and clinician acceptance of technology-enhancements to evidence-based treatments, as well as the relevance of current adoption strategies for technology-enhanced services. Importantly, this review is not systematic or exhaustive; rather, we aim to survey and summarize the literature in order to inform a multi-stage framework intended to guide a more informed understanding of technology-enhanced services adoption and use.

Potential Clinician and Organizational Barriers to Technology-Enhanced Services

Clinicians raise a number of practical concerns regarding the adoption of technology-enhancements and a representative selection of these will be highlighted here as examples. Perhaps most fundamental to concerns regarding technology-enhancements, clinicians worry about variability in access (e.g., Becker & Jensen-Doss, 2013; Ramsey et al., 2014; Salloum et al., 2013). Preliminary findings suggest that clinicians have relatively high rates of standard technologies, including desktop computers (70%) and internet (76%) access (Becker & Jensen-Doss, 2013); however, even computer access is not evenly distributed. For example, Becker and Jensen-Doss (2013) found limited computer access among clinicians working in private practice compared to their counterparts working in hospitals, schools, and mental health agencies. Clinicians, however, have much less access to other platforms, such as tablet computers (19%), videoconferencing equipment (17%), and virtual reality equipment (0.8%) (Becker & Jensen-Doss, 2013), and rates of access to smartphones, and wearable sensors, which are increasingly being considered to increase the range of functionality and support within and between sessions (see Jones et al., 2013 for a review) remains unknown.

Despite the rising ubiquity of technology among consumers generally (Fox & Duggan, 2012; Smith, 2011), clinicians also have lingering concerns about their clients' technology access (Ramsey et al., 2014). Additionally, concerns exist about the availability and consistency of mobile service providers, and if and how variability in access shapes the fairness and justice of their service provision (Ramsey et al., 2014). In fact, clinicians' concern about client accessibility (or lack of it) is critical, given data to suggest that working with clients who generally have more accessibility predicted clinician openness to technology-enhancements (Becker & Jensen-Doss, 2013; Ramsey et al., 2013; Salloum et

al., 2014). For example, clinicians working in settings primarily serving youth, a client population for who access to and use of technology is increasingly normative, reported more positive attitudes towards technology-enhancements (Becker & Jensen-Doss, 2013; Rideout et al., 2010).

In addition to access, clinicians and service settings also cite funding, including for third-party reimbursement of services, as major barriers to the adoption of technology-enhancements (Gershkovich et al., 2016; Mora, Nevid, & Chaplin, 2008; Perle et al., 2013; Salloum et al., 2013). Yet, relatively few studies actually report cost data and those that do often fail to report costs in a systematic, translatable, or digestible way (see Hilty, Yellowlees, Sonik, Derlet, & Hendren, 2009; Jones, 2014, for reviews). Similarly, clinicians indicate that the sustainability of technology-enhancements depends on funding, as well as time, for comprehensive training and ongoing, consistent supervision and support (e.g., Glisson, 2002; Schoenwald & Hoagwood, 2001; Southam-Gerow et al., 2012). Only 38% of clinicians, have technical support (Becker & Jensen-Doss, 2013), however, and behavioral health organizations spend a minimum (1.8%) of their annual budgets on technology support (Druss & Dimitropoulos, 2013), with even smaller budgets in those service settings with the smallest caseloads (Becker & Jensen-Doss, 2013; Ramsey et al., 2014).

Beyond the practical aspects of access, funding, and technical support, clinicians report process concerns as well, including concerns about therapeutic alliance and privacy. Although empirical data suggest that technology does not compromise alliance (Richards & Simpson, 2015; Stiles-Shields, Kwasny, Cai, & Mohr, 2014), clinicians remained worried that technology will weaken therapeutic boundaries, challenge the flexibility of treatment planning, and dampen the dynamic interpersonal nature of therapy (Gershkovich et al., 2016; Mora et al., 2008; Ramsey et al., 2014). Inherent in concerns about alliance is apprehension regarding privacy and confidentiality (Mottl, 2015; Ramsey et al., 2014; Kazdin, 2015; Wu et al., 2014), which clinicians report as their second greatest concern after funding (Perle et al., 2013; Ramsey et al., 2014). Many everyday applications (e.g., SMS text messaging, Skype, email) do not meet Health Insurance Portability Protection Act of 1996 (HIPPA) standards, the primary federal law protecting the privacy and security of health information. Once clients share protected healthcare information with a clinician via technology, however, the clinician is mandated to adhere to HIPPA (Luxton, McCann, Bush, Mishkind, & Reger, 2011).

Finally, the adoption of technology-enhancements in various settings (e.g., community clinics, hospitals) appears to be linked with organizational goals and needs (Buti et al., 2013; Murray et al., 2011). Organizations that were undergoing significant and pressing change (e.g., staff changes, growth, restructuring), for example, were less likely to adopt technology-enhancements and more likely to perceive that technology would interfere with organizational goals and needs (Murray et al., 2011). Research on both the adoption of new mental health treatments in general and technology uptake in particular, in turn, highlights the importance of addressing organizational barriers as a means to improve clinicians' attitudes and, in turn, increase the likelihood and sustainability of adoption (Aarons et al., 2009; Fixsen et al., 2005; Proctor, 2004). Accordingly, as calls from leaders in the field to capitalize on the promise on technology-enhancements continue, concurrent consideration of

adoption models is necessary in order to inform and guide the most cost-effective transition into policy and practice (e.g., Mohr et al., 2013; Nelson et al., 2011; Ritterband et al., 2006).

Adoption of Technology-Enhanced Services: A Conceptual Framework

With growth in the dissemination and implementation field, the number of theories and frameworks to inform the integration of new treatments into practice continues to expand (Tabak, Khoong, Chambers, & Brownson, 2012). Many adoption frameworks stem from common theoretical underpinnings focused on behavior change (e.g., diffusion of innovation and the theories of planned behavior/reasoned action). A review of adoption models designed for treatment uptake in general emphasize the relevance of both clinicians' attitudes, knowledge and skill, organizational support and readiness, and system level factors, such as policy (Aarons et al., 2009; Addis, Wade, & Hatgis, 1999; Fixsen et al., 2005; Glisson & Schoenwald, 2005; Lewis & Simons, 2011; Schoenwald & Hoagwood, 2001, Southam-Gerow et al., 2012); however, the applicability of these models for technology-enhanced services remains untested. Moreover, theoretical and conceptual frameworks in the technology literature, including both Technology Acceptance Model (TAM; Davis, 1989) and Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh, Morris, Davis, & Davis, 2003), instead de-emphasize the connection between intentions to use, social norms, and adoption, and rather emphasize perceived usefulness and ease of use of the innovation. As such, this review aims to integrate, reconcile, and extend these literatures in order to anticipate and address organizational and clinician barriers to adoption of technology-enhancements and, in turn, inform subsequent research, policy and practice. Specifically, a top-down, five-stage conceptual and developmental framework is proposed.

Stage 1: Optimize Technology-Enhanced Services for Adoption and Use

Although comprehensive resources exist to inform the development of technology-enhancements (e.g., Mohr et al., 2013; Ritterband et al., 2003; Wu et al., 2014), this review highlights those aspects of development that will increase adoptability and use in practice in particular. That is, for technology-enhancements to be successful, it is essential to address factors that influence acceptance (Dabbs et al., 2011). Developers, therefore, must consider practical constraints, such as potential constraints of technology competency, resources, and organizational infrastructure, as well as ways to mitigate these factors (van Gemert-Pijnen et al., 2011).

Mental health technology-enhancement development to date focuses almost exclusively on the client as the end-user (van Gemert-Pijnen et al., 2011). Yet, clinicians will more likely serve as the gatekeepers who determine the extent to which and how these interventions are used, as well as with whom; thus, clinicians should therefore be involved in all aspects of design and development. Development guidelines, in turn, would benefit from reliance on commercial software industry standards, which require clinician engagement as key stakeholders. In particular, involving clinician stakeholders from diverse backgrounds, including a range of service settings, educational backgrounds, and areas of expertise, in the iterative design and development process will allow developers to account for the realities of

different adoption settings, and enhance the widespread feasibility of adoption and use (e.g., Druss & Dimitropoulos, 2013; Lord, 2015; van Gemert-Pijnen et al., 2011).

Specifically, developers should seek clinicians' feedback related to technology access and literacy, funding, and organizational needs. Although enhancements are constantly evolving in light of new technologies, care should be taken to ensure access by using platforms most readily available to both clinicians and clients (Mohr et al., 2013; Ritterband et al., 2003; Wu et al., 2014). For example, mobile phone and smartphone enhanced interventions may be the most readily adopted given that 90% of the adults in the United States own a mobile phone, with about 58% of those owning a smartphone (Pew Research, 2014). Wearable technology, however, is currently substantially less prevalent (i.e., 3–11% ownership depending on the device; Adweek, 2015). These considerations, in turn, will reduce the high startup costs associated with adoption and minimize burden on organizations and clinicians (Druss & Dimitropoulos, 2013; Mohr et al., 2013; Wu et al., 2014).

In addition to technology access, design should take into consideration clinicians' technology skill and competency, in order to develop services that are perceived to be easier to use and less complex (Becker & Jensen-Doss, 2013; Druss & Dimitropoulos, 2013; van Gemert-Pijnen et al., 2011). Related to funding, the affordability of technology-enhancements should be measured on multiple levels, including time and cost for training, delivery, and ongoing supervision and support (Lord, 2015). Researchers should calculate and report cost-effectiveness when testing the efficacy of technology-enhancements, including an estimate of the cost of delivery per client, in order for service settings and clinicians to make informed decisions about when and which interventions to adopt (Tate et al., 2009).

Although many technology-enhanced services were developed without stakeholder involvement and formal consideration for practical barriers to use, regulatory guidelines are one strategy to promote standardization and quality (e.g., Comer, 2015; Musiat & Tarrier, 2014; Ramsey et al., 2014). Given the relative ease of disseminating technology-enhanced services (i.e., via the internet and the App Store/Android Marketplace), prior to public release, these interventions should be evaluated to ensure quality, safety, and compliance with existing legal and ethical guidelines (e.g., Maheu, 2015; Mohr et al., 2013; Onken & Shoham, 2015). These regulations may include criteria for testing intervention effectiveness, including standardized treatment adherence measurement, satisfaction, and outcomes to allow for comparison across platforms and interventions (Eysenbach, 2011; Mohr et al., 2013; Musiat & Tarrier, 2014). Additionally, clinicians should have access to information about the potential risks associated with technology-enhanced service use. Regulation around tracking and reporting adverse events will provide clinicians and organizations with information about potential deleterious effects of technology-enhanced service use (Maheu, 2015). Overall, regulation around proof of benefit holds the potential to demystify the process of using technology-enhanced services and allow clinicians and organizations to make informed decisions about when and for whom to invest in adoption.

Of course, the gatekeeper for the efforts described in Stage 1 is yet to be determined. On one hand, clinicians express frustrations with regulation that makes the use of technology in the

provision of mental health services cost and time prohibitive (Hughes & Goldstein, 2015; Ramsey et al., 2014). As such, efforts should be made to minimize the impact of regulations if the goal is to encourage continued innovation and use (Gruessen, 2015; Hughes & Goldstein, 2015). That said, the American Psychological Association's (2013, p.1) established "Guidelines for the Practice of Telepsychology," defined broadly as the provision of psychological services via telecommunication devices, which would include technology-enhanced services; however, they clarify that these are "aspirational" with the intent to guide and educate, but do not include an "enforcement mechanism." Additionally, 22 professional guidelines for technology use in practice were published in 2014 alone and 18 states adopted statutes and/or rules for technology use (Pope, 2014); however, the APA Telepsychology 50 State Review (2013) suggests that the vast majority of states have no and/or minimal "telehealth and/or telepsychology statutes and/or regulations" and those that do exist vary greatly from state to state. As such, as more and more states consider and roll out guidelines, we recommend guidance and education that includes the development, as well as use of technology-enhanced services. For example, collective agreement and recommendations regarding minimal standardization of development will improve the ease of use and quality of technology-enhanced services. For example, the American Society for Testing and Materials (ASTM), who provide consensus technical standards, have released minimal standards for both the structure and content of Electronic Health Records to promote standardization, while allowing providers flexibility in the systems developed and used (Watzlaf, Zeng, Jarymowycz, & Firouzan, 2004). With such guidelines, technology-enhanced services can be designed and developed to maximize fit with organizational goals and clinicians' needs, decrease the complexity of technology-enhanced treatments, and possibly demonstrate the relative advantage of these services for certain client populations over traditional treatment modalities (Lord, 2015; Wu et al., 2014). Based on prior theories and implementation efforts (e.g., Davis, 1989; Rogers, 1995; 2002; Venkatesh et al., 2003), this should, in turn, improve attitudes towards technology adoption by improving clinicians' feelings of self-efficacy, decreasing training demands, and removing financial barriers to adoption (Druss & Dimitropolous, 2013; van Gemert-Pijnen et al., 2011).

Stage 2: Devise and Augment Regulations and Guidelines for Use of Technology-Enhancements

This second stage aims to create comprehensive practice guidelines, in order to further minimize systematic barriers. To date, much of the regulation described in Stage 1 centers on ensuring privacy in the context of heightened risk (e.g., need for protection against cyber-attacks, HIPPA compliance, data breaches; Hughes & Goldstein, 2015; Maheu, 2015). Despite these efforts, however, only 30% of clinicians believe that such privacy policies adequately protect clients' confidential information (Gruessner, 2015). To begin to ameliorate these concerns, intervention developers can place safeguards within the technology, such as password protecting the intervention, storing all data on a cloud rather than the physical technology, and adding encryption at rest and during transfer (Zamosky, 2015). Although these considerations can help protect clients' confidential information (Lord, 2015; Ritterband et al., 2003), regulation for use is also needed to ensure client security. Although guidelines exist for ensuring client privacy and security, the changing landscape of the type of data collected via technology-enhanced services makes regulation

difficult and often costly for developers (Kazdin, 2015; Comer et al., 2015; Wu et al., 2014). As such, in order to instill trust, national, state, and agency guidelines need to agree on standards for best practices in regard to protecting client privacy and security and effectively communicate these standards to developers, clinicians, and clients.

Of note, the Federal Drug Administration (FDA) already regulates those mobile applications considered to be medical devices (e.g., any mobile application with sensors that measure electrical signal produced by the heart). These applications must meet regulatory standards before being allowed on the market (U.S. Health and Human Services, 2015). Although the FDA indicated that they would not regulate mobile technologies that are not considered medical devices, several other organizations, including the UK National Health Services, have attempted to evaluate and regulate mental health smartphone applications; however, many of these efforts have failed (Wicks & Chaiuzzi, 2015). The American Psychiatric Association workgroup on smartphone application is currently in the process of developing an evaluation system for mental healthcare software applications. In the meantime, Torous and colleagues (2016) provide a framework to help clinicians evaluate mobile technologies, including ensuring the privacy and utility of the technology. This framework advises the examination of six aspects of mobile technology: 1) usefulness, 2) security, 3) compliance with professional standards, 4) evidence-base, 5) ability to customize, and 6) transparency of the data collection mechanism and functionality. There have also been calls for international organizations, such as the World Health Organization, to create clearinghouses to vet and disseminate information about evidence-based technology-enhancements (Munoz, 2010).

In addition, reimbursement and funding policies are needed to encourage sustainable adoption of technology-enhanced approaches. Clinicians will not adopt novel interventions, including those that include technology-enhancements, without incentives (van Gemert-Pijnen et al., 2011). Although reimbursement for technology use in the provision of mental health services is rapidly expanding, most of the reimbursement policies focus on remote therapy (e.g., telepsychology; Comer & Barlow, 2014); yet, many questions remain about third party payment for technology-enhancements to face-to-face therapy. Funding for frontline settings predominately stems from third-party payers, which generally only recognize traditional face-to-face interventions (i.e., direct contact), but not care provided indirectly via technology (Campbell, Muench, & Nunes, 2015; Comer et al., 2015). In turn, successful rollout of technology-enhancements depends on consideration by third party payers regarding if and how to incentivize clinicians to adopt technology-enhanced services and offset startup costs. One example of a third-party payer that has such a model is Medicaid, which reimburses for telepsychology services in 47 states. Although the reimbursement rate varies by state, many states include Medicaid reimbursement, as well as a separate code for a facility fee that offsets technology costs.

Once the issue of third-party reimbursement is resolved, marketing to clinicians must be considered (Gallo, Comer, & Barlow, 2013; Wu et al., 2014). Several business models for the deployment of technology-enhanced services have been proposed (see Ritterband et al., 2003; van Gemert-Pijnen et al., 2011 for reviews); however, the realization or effectiveness of these models is unknown. For example, van Gemert-Pijnen and colleagues (2011) suggest that technology development and implementation should be value-driven, including ensuring

that the product serves the practical and financial needs of the organization and also works as it is intended to in the real-world setting. Additionally, concerns remain about the maintenance of the technology after research funding has ended and clinicians have adopted a particular technology-enhanced approach (Ramsey et al., 2014).

As such, the field needs to consider and test the effectiveness of different payment models, in order to enhance the likelihood of ethical funding of technology-enhanced service use and maintenance. Given extant theory and research on adoption frameworks suggesting that relative advantage (e.g., decreased cost, less time to deliver) over existing interventions promotes innovation adoption (e.g., Damschroder et al., 2009; Rogers, 2002; Schoenwald & Hoagwood, 2001), promotion and demonstration of the monetary value of technology-enhanced services relative to face-to-face therapy may help to motivate adoption and use. For example, future research on technology use in mental health services should track outcomes of interest to both third-party payers and businesses, including the socioeconomic impact of changes to practice (e.g., potentially decreased service delivery time, increased caseloads), potential changes in client hospitalization rates due to increased monitoring between sessions, and long-term outcomes, such as rate of relapse.

Stage 3: Widely Disseminate Information about Technology-Enhanced Services

Technology optimization and regulations set the stage for adoption of technology-enhancements; however, these services are unlikely to make an impact without increased awareness of the options and potential benefits. In order to increase awareness, it is essential to continue to conduct research and disseminate findings that explicate when and for whom technology may be the most helpful (Onken & Shohma, 2015; Ritterband et al., 2006). First, technology-enhanced services are referred to by various names in the literature, including behavioral intervention technologies, adjunctive or supportive technologies, and technology-assisted interventions (e.g., Becker & Jensen-Doss, 2013; Eysenbach, 2011; Mohr et al., 2013). Lack of consensus terminology may hinder successful information dissemination and subsequent adoption, making consistent language necessary (Eysenbach, 2011). As such, professional organizations and regulatory boards should agree on terminology and encourage the sole use of this terminology to decrease confusion and facilitate information spread.

In addition, the proliferation and dissemination of technological tools for mental health treatment that lack sufficient testing and scientific support create uncertainty and wariness (Klein et al., 2010; Tate & Fabinski, 2004; Richards, 2015). Although quality control (see Stage 1) should begin to combat these concerns, the field must develop methods to increase knowledge of technology-enhanced services based in scientific research. Specifically, information about the efficacy and effectiveness of the technology-enhancements, cost-effectiveness, feasibility, and collateral effects should be provided to end-users (Lord, 2015; Musiat & Tarrier, 2014; Tate et al., 2009). This information will help clinicians select the most effective technology-enhanced services, as well as determine when these tools should be prescribed in the place of the standard version of the treatment (Campbell et al., 2015).

Third, there is much discussion in intervention research broadly regarding the extent to which randomized controlled trials (RCTs) may inadequately address some of the more

nuanced challenges in translational science (see Brown et al., 2009; Howe, Beach, & Brody, 2010 for reviews). In research on intervention technologies in particular, the primary concern regarding RCTs is that the rapid evolution in technology and consumer expectations is fundamentally inconsistent with the rigidity (i.e., a static intervention protocol), timeline (i.e., average 5.5 years), inordinate development and testing costs, and reliance on peer-reviewed publications as the primary dissemination pipeline, characteristic of the science of RCTs (see Jones, 2014; Kumar et al., 2013; Mohr et al., 2015, for reviews).

Because private sector development may be informed by knowledge regarding technology trends but not innovations in intervention science, faster paced research on and development of technology-enhanced services is needed. Suggestions to date include a range of strategies, including returning to basic behavioral paradigms, while also considering advances in study designs and quantitative methods (e.g., single case designs, iterative designs, intensive longitudinal data analyses (e.g., Dallery, Riley, & Nahum-Shani, 2015; Kumar et al., 2013); innovation champions (i.e., inform clinicians and organizations about treatment options and the research findings related to the benefits of use of technology-enhanced services, such as quantitative data on effectiveness, service offset, and acceptability; Glisson, 2002; Karlin & Cross, 2014; Lord, 2015; Rogers, 1995; 2002); and more direct-to-consumer marketing (e.g., blogs, podcasts, websites, and other social media; Dingfelder, 2010; Gallo et al., 2013; Luxton et al., 2011). For evidence-based treatments more broadly, solely targeting clinician education and training has historically not promoted sustainable adoption of evidence-based treatments (Gallo et al., 2013; Karlin & Cross, 2014). As such, Gallo and colleagues (2013) proposed direct-to-consumer marketing strategies to promote evidence-based practice adoption, including using the internet, local information sessions, and increasing media coverage to disseminate information about evidence-based interventions to consumers. Dissemination and implementation literature in general also highlights the need for both push and pull strategies (Karlin & Cross, 2014); therefore, direct-to-consumer marketing (a pull strategy) should work to create a demand and further incentivize clinicians and organizations to adopt these strategies.

With regard to marketing to clinicians and potential clients in particular, building awareness and knowledge of new interventions is an essential early step that helps to initiate the spread of new treatments (Glisson, 2002; Lord, 2015; Rogers, 1995; 2002). Specifically, framing messages about technology-enhanced services in ways that challenge beliefs about the potential detrimental effects of adoption is essential. As such, information about technology-enhanced services should highlight flexible use, the importance of clinicians' skill in delivering, and the relative advantages of technology-enhanced services (e.g., decreased training time, cost-effectiveness, and allowing clinicians to focus on more challenging aspects of cases; Becker & Jensen-Doss, 2013; Karlin & Cross, 2014; Salloum et al., 2013; Tate & Fabinski, 2004). One example of such an approach is the success of England's National Health Service's Improving Access to Psychological Therapies (IAPT), which aims to increase the availability of psychosocial services using a least restrictive or stepped care approach, including technology-delivered services when relevant (Fonagy & Clark, 2015). Of note, services are now available in the majority (60%) of areas, with 60,000 individuals accessing services to date, suggesting a promising model for technology-enhanced services in the U.S. and other areas as well.

Stage 4: Improve Organizational Readiness to Adopt Technology-Enhanced Services

Breaking down barriers in development and/or increasing awareness for technology-enhancements, however, is not enough to ensure adoption and use. Similar to evidence-based treatments more broadly, lack of resources, as well as other organizational factors, may continue to hinder technology adoption (Aarons et al., 2011; Bickman et al., 2016; Glisson et al., 2008; Karlin & Cross, 2014). Organizational readiness is defined by the extent to which organizations are both able and willing to adopt new innovations (Aarons et al., 2009; Damschroder et al., 2009; Scaccia et al., 2015). Intervening on three factors should improve readiness: 1) motivation, 2) organizational capacity to incorporate the innovation, and 3) innovation specific demands (Scaccia et al., 2015).

Several factors, which can be addressed via the top-down approach of diffusion of innovation theory (Rogers, 1995; 2002), such as relative advantage (i.e., perceptions of usefulness/need), compatibility (i.e., congruence with values and perceived needs), complexity (i.e., perceptions of difficulty of use), trialability (i.e., ability to test prior to investing), observability (i.e., visibility of the adoption outcomes), and priority (i.e., extent to which adoption is regarded important relative to other entities), influence motivation (Scaccia et al., 2015). For example, including stakeholders in design and development and creating appropriate guidelines and regulations for use (Stages 1 and 2) should improve relative advantage, complexity, and compatibility. Similarly, information dissemination about technology-enhancements (Stage 3), especially through the use of an innovation champion, should allow clinicians to use these innovations and provide organizations with information about outcomes (i.e., observability). Therefore, earlier stages should begin to improve motivation and, in turn, intent to adopt technology-enhanced services.

Motivation, however, is still not enough for successful adoption. Rather, organizations must have the tools needed to support adoption (Bickman et al., 2016; Karlin & Cross, 2014). For example, Salloum and colleagues (2013) demonstrate that even when clinicians are willing to use technology-enhanced approaches, organizational barriers, such as funding, create apprehension about the ability to use these in clinical practice. Therefore, this stage will mainly target factors associated with general and innovation-specific capacities. In regard to general capacity (i.e., attributes of a functioning organization; Wandersman et al., 2008), developers should consider factors related to an organizations' ability to sustain adoption and subsequent use. Organizations with high staff turnover, small budgets, fewer clients served, low levels of openness to innovation, and those not already using evidence-based treatments may not be well suited for technology-enhanced service adoption (Becker & Jensen-Doss, 2013; Ramsey et al., 2014; Murray et al., 2011). In turn, implementers should assess organizational readiness when deciding which service settings to target for adoption in order to capitalize on the general capacity of these settings for adoption (Bickman et al., 2016; Karlin & Cross, 2014).

Innovation champions (Glisson, 2002; Rogers, 1995; 2002) can also work with organizations to foster openness and promote climates more amenable to adoption. In particular, they can work with organization leadership to build social contexts in which use of technology-enhanced services is supported and encouraged (e.g., providing compensation for training time, pay increases for clinicians using technology). The innovation champion can and

should work to build internal support by training select clinicians to be “master users” who can then provide ongoing support to other staff and clinicians on site (Bickman et al., 2016). Additionally, an integral part of the innovation champion’s role is to link researchers and service settings by communicating information to researchers and developers about the fit of technology-enhanced services with organizational goals and needs and changes can be made to the intervention to increase fit (Karlin & Cross, 2014). For example, for evidence-based practice more broadly, in the Veterans Health Administration’s attempt at integrating evidence-based care into practice, each medical center was provided a local evidence-based practice coordinator to serve as an “internal facilitator.” These individuals provided education, information on the benefits of using these interventions, and worked with support staff (e.g., schedules, informatics) to build infrastructure to support evidence-based practice implementation (Karlin & Cross, 2014).

Innovation-specific capacities include the human, technical, and funding resources available to support adoption. Innovation-specific capacities are important to address due to the additional technological and staff resources needed to support technology-enhanced services (Bickman et al., 2016; Fixsen et al., 2005). Although several technology development recommendations presented in Stage 1 should minimize practical barriers (e.g., technology access, literacy, funding), existing interventions often cannot be adapted to the needs of organizations. Also, even when technology is optimized, organizations will likely need to continue to address practical constraints. Specifically, developers should work with adopting organizations to ensure that technical support staff is available. Support staff availability will mitigate concerns about needed support, training time, and lack of technological skill. Organizations should also allocate available technology to the provision of services, and clinicians trained in technology-enhanced approaches should have priority within organizations with limited technology access. This will not only increase the ease of delivering technology-enhanced services, but also incentivize and communicate organizational support of technology-enhanced service use (Venkatesh et al., 2003). Finally, organizations should allocate administrative support staff time to helping clinicians stay up-to-date with, understand, and comply with complex privacy and reimbursement regulations. Although some of these practical barriers should naturally diminish as technology ubiquity increases (e.g., increased technology access and skill; Blumenthal, 2010; Zambosky, 2015), enhancing organizational readiness for adoption should improve clinicians’ attitudes and intentions by creating perception that adoption is feasible, supported, and encouraged (e.g., Damschroder et al., 2009; Bickman et al., 2016; Lord, 2015; Ventakesh et al., 2003).

Stage 5: Ongoing Training and Technical Support for Technology-Enhanced Services

Policy, information dissemination, and enhanced organizational readiness are necessary, but not sufficient for technology-enhanced service adoption. These factors will be relatively ineffective at promoting deployment into service settings if clinicians are not properly trained and supported (Bickman et al., 2016; Fixsen et al., 2005). Although clinicians require training, ongoing support, and supervision to successfully adopt evidence-based treatments (e.g., Beidas & Kendall, 2010; Schoenwald & Hoagwood, 2001; Southam-Gerow et al., 2012), training may be especially important for technology-enhanced services (Bickman et al., 2016). For example, Bickman and colleagues (2016) highlight that

unforeseen challenges, including user error, pose additional implementation barriers, including decreased clinician and staff confidence in the intervention and increased frustration. Moreover, service settings may have fewer resources available to support technology training. The final stage of this framework provides recommendations for training and ongoing support.

As noted earlier, technology-enhanced approaches are one of the fastest growing trends in behavioral health technology interventions (Comer, 2015) and also appear to offer the greatest promise of efficacy (Mohr et al., 2013; Musiat & Tarrier, 2014). Therefore, clinicians may or may not already be trained to deliver the standard intervention components upon which the technological tools are designed to enhance. Similar to evidence-based interventions more broadly, organizations could select staff to be included in training based on their previous qualifications (e.g., knowledge of evidence-based treatments, skill level; Karlin & Cross, 2014). However, if a clinician is not trained to deliver the established or standard treatment and/or the technology-enhanced version deviates substantively from existing treatment models, clinicians will need to be trained to deliver the specific therapeutic components. Because successful intervention adoption depends on effective training, many models exist for training clinicians in evidence-based treatments (see Becker & Stirman, 2011; Beidas & Kendall, 2010 for reviews). The gold standard for training includes manuals, workshops, and clinical supervision, as well as active learning components and criteria-based evaluation of skill acquisition and fidelity (Becker & Stirman, 2011; Beidas & Kendall, 2010; Karlin & Cross, 2014; McHugh & Barlow, 2010). Developers and researchers should rely on the established knowledge of the dissemination and implementation literature to guide training for the intervention aspects.

Emerging training methods capitalizing on technological advancements also provide exciting possibilities for supporting both the therapeutic and technological aspects of technology-enhanced services. Increasingly, researchers integrate technology into the evidence-based treatment training process with the hope of expanding training opportunities (see Khanna & Kendall, 2015, for a review). For example, web-based training and consultation and remote supervision and consultation via videoconferencing demonstrate preliminary efficacy for a range of evidence-based treatments, including Cognitive Behavioral Therapy for anxiety (Kobak, Craske, Rose, & Wolitsky-Taylor, 2013), Dialectical Behavior Therapy (Dimeff et al., 2009), and Parent Child Interaction Therapy (Funderburk et al., 2008). Additionally, web-based trainings are being developed to provide pre-training (i.e., prior to in-person training workshops) or to provide ongoing support to help serve as a reminder of core skills (Bickman et al., 2016; Karlin & Cross, 2014). Despite these exciting opportunities, it is important to note that many of the same barriers to technology-enhanced service delivery models (e.g., organizational fit, technology access, funding) may hinder the training and more research will be helpful in optimizing the utility of such methods.

Although there is also a dearth of empirical data about the effectiveness of training and support for technology-enhancements via technology itself, this is a common practice in commercial products, and, therefore, may be less problematic than anticipated. For example, technical support for everyday technologies (e.g., mobile phones, computers, email) is often embedded within the technology (e.g., live chat support, video tutorials; Elmorshidy, 2013)

and, in turn, may be particularly useful, given financial constraints, lack of in-house technical support, and research revealing preferences for the burden of support to fall on developers and researchers (Becker & Jensen-Doss, 2013; Salloum et al., 2013). For example, built-in tutorials may be accessed through the technology-enhancements (e.g., videos describing use of the technology) or links may be provided to online troubleshooting manuals (Wu et al., 2014).

If development of technology-enhancements occurs without considerations for technical support, in-person or on call technical support may be needed. Developers and researchers may consider providing adopting organizations with support staff, particularly during the initial adoption stages. Similar to providing onsite supervision or a treatment champion for evidence-based treatment adoption (Beidas & Kendall, 2010; Bickman et al., 2016; Glisson, 2002; Karlin & Cross, 2014), support staff can assist in training and troubleshoot problems. When onsite technical support provision is not possible, or during later phases of adoption, remote technical support can assist with troubleshooting and ongoing support. For example, developers can establish support call centers or on-call IT support to remediate and troubleshoot (Lord, 2015; Karlin & Cross, 2014). Finally, like treatment manuals for evidence-based treatments, electronic manuals for technology-enhanced services can supplement training, provide information about technology use, and address frequently asked questions (Wu et al., 2014). Technological training outcomes should be evaluated to determine, similar to evidence-based practice in general, which training techniques are the most effective in changing therapists' competencies, self-efficacy, and attitudes towards technology use (Karlin & Cross, 2014).

Comprehensive training and ongoing support/monitoring of implementation for both the therapeutic and technological components of technology-enhanced services should improve clinicians' perceptions of efficacy and ease of use, as well as increase facilitative supports for adoption (Fixsen et al., 2005; Karlin & Cross, 2014). All of these factors not only predict clinicians' attitudes, but also technology uptake (e.g., Becker & Jensen-Doss, 2013; Davis, 1989; Venkatesh et al., 2003). Therefore, in combination with the previous stages, training and ongoing support should promote the transportability of technology-enhanced services.

Summary and Considerations for Future Research

Successful adoption of technology-enhanced services is a function of both technology research and development as well as the attitudes and infrastructure of the clinicians and organizations responsible for delivering them (Druss & Dimitropoulos, 2013). In past dissemination and implementation work, models have been retrospectively applied to treatments or models are prospectively applied in the development of future treatments (Tabak et al., 2012). In order for the field to capitalize on technology-enhanced services' full potential, the adoption framework presented must be supplemented and supported with continued research on development and use in frontline service settings. As such, considerations and future directions for technology development and adoption are explored.

The literature on innovation uptake often distinguishes between adoption (i.e., the decision to use an innovation) and implementation (i.e., acquiring skill in, consistency with, and

commitment to delivering the innovation). Importantly, adoption often occurs in the absence of successful implementation (Klein & Knight, 2005). Although the conceptual framework presented attempts to promote not only adoption, but also sustainable use, of technology-enhanced services, successful implementation will require additional considerations (Dabbs et al., 2011). Large-scale adoption efforts are needed to establish the effectiveness of the proposed framework for adoption and implementation. First, future research is needed to determine if one comprehensive framework, such as the one proposed here, is sufficient or if different frameworks reflecting specific treatment types, technology enhancements, service settings, and clinician characteristics are needed. Second, research should seek to further understand the barriers to technology-enhanced services adoption and use. To date, the majority of research on barriers to adoption of technology-enhanced approaches investigates perceived barriers. As technology-enhanced services are adopted and tested in frontline service settings, real-time assessment of barriers is needed, as well as the investigation of moderators of successful adoption and use. Investigating the moderating effects of factors, such as service setting type and size, clients served, and technology access and literacy, on successful adoption and use can guide adoption efforts and enhance our understanding of acceptability and feasibility of technology-enhanced services.

Although much of this review focuses on the potential of technology-enhanced services, the field is still at a relatively nascent stage. As such, possible disadvantages, moderators, and mechanisms of these interventions should be considered (Ritterband et al., 2006). Future research should investigate the effectiveness of different technological platforms for enhancing treatment outcomes and promoting cost-effectiveness. For example, preliminary research reveals that smartphone application enhanced interventions are more effective than text messaging and personal digital assistants (PDAs) interventions (Lindhiem et al., 2015). Such research on new and evolving technologies is imperative, given the fast-paced rollout of increasingly sophisticated platforms available to consumers (see Jones, 2014, for a review). The past decade alone has seen a virtual “cut” of landlines in favor of mobile phones, an integration of the functionality of phones, desktop computers, and the internet into single handheld devices, and more attention to the potential to move from a reliance on handheld to hands-free technology in the form of wearables (e.g., glasses, bracelets). As such, ongoing research is needed to prevent costly investment in eventually obsolete technologies. Developers of technology-enhanced services should also consider how technology will change the nature of the therapeutic relationship, and develop platforms and applications that support and enhance the relationship rather than interfere with it. Finally, both in this review and the literature more broadly, many recommendations have been proposed for future technology-enhanced service development, payment structures, and training models. These recommendations should be subjected to empirical inquiry to confirm their usefulness. Collectively, this research will help guide clinicians in determining when technology use is indicated, for whom technology use may be helpful, and what technologies may be the most effective at supporting the therapeutic process. Of course, technology should only be used when it is deemed to be helpful, and, particularly in the early stages of the field, care should be taken to consider possible challenges and unintended negative consequences of technology use (Onken & Shoham, 2015).

In summary, technology holds promise for increasing mental health service options and delivery flexibility with the potential to reduce the burden of mental illness (Kazdin, 2015; Richards, 2015). Technology-enhanced services are not meant to replace traditional face-to-face therapy or even compete with it, but rather to offer innovative tools that can provide additional or alternative service options (Kazdin, 2015; Ritterband et al., 2003). The true potential of these treatments, however, remains unknown until strategies to successfully integrate technology-enhanced services into practice are developed and tested in large-scale implementation studies. As such, a five-stage conceptual framework synthesizing common factors from adoption models across disciplines and recommendations in the technology-enhanced service literature was proposed. Although this is an important first step, continued development of and research on new technology-enhanced services is necessary. Emerging technology-enhanced service models should not only be developed as adaptations to existing treatments, but also capitalize on technological innovation to develop new treatment methods.

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