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EDITORIAL

# Technology-based interventions for psychiatric illnesses: improving care, one patient at a time

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Worldwide, individuals with severe psychiatric illnesses struggle to receive evidence-based care. While science has made remarkably slow progress in the development and implementation of effective psychiatric treatments, we have witnessed enormous progress in the emergence and global penetration of personal computing technology. The present paper examines how digital resources that are already widespread (e.g., smartphones, laptop computers), can be leveraged to support psychiatric care. These instruments and implementation strategies can increase patient access to evidenced-based care, help individuals overcome the barriers associated with the stigma of mental illness, and facilitate new treatment paradigms that harness wireless communication, sensors and the Internet, to enhance treatment potency. Innovative digital treatment programmes that have been used successfully with a range of conditions (i.e., schizophrenia, posttraumatic stress disorder and borderline personality disorder) are presented in the paper to demonstrate the utility and potential impact of technology-based interventions in the years ahead.

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**Key words:** eHealth, mental health services, mHealth, patient-centred care.

## Introduction

As a community of psychiatry researchers and practitioners, we have accomplished too little, too slowly and for too few. Worldwide, individuals with psychiatric illnesses still struggle to receive effective care. In developed countries, mental health care typically lags far behind other branches of medicine in terms of accessibility, quality and patient outcomes. In many developing countries, diagnostic and treatment capabilities for mental health care range from inadequate to absent.

Unlike the stymied progress in the development and dissemination of high-quality mental health treatments, we have witnessed enormous leaps and bounds in the evolution and penetration of personal computing devices that are available to the general public (i.e., mobile phones, laptops and tablets). People across the world are rapidly gaining access to the Internet, mobile–cellular network infrastructure has spread to cover 90% of the world's geography and widely available contemporary technologies now offer individuals more computational power than NASA had when it landed the first humans on the moon (ITU, 2011, 2013; Smith, 2013). We have exciting opportunities to move the science and practice of mental health care forward by harnessing these technologies as instruments to support novel treatments for people with psychiatric illnesses.

Technology-based interventions for mental health conditions have begun to appear. These include Internet-based psychotherapeutic interventions (e.g., Proudfoot *et al.* 2007; Rotondi *et al.* 2010; Alvarez-Jimenez *et al.* 2013) short-message service (SMS) paradigms in support of psychiatric care (e.g., Bauer *et al.* 2003; Granholm *et al.* 2012; Sims *et al.* 2012), remote patient/provider treatments using two-way telephone or videoconferencing (e.g., Nelson *et al.* 2003; Mohr *et al.* 2012; Choi *et al.* in press) electronic decision support systems (e.g., Brunette *et al.* 2011), virtual reality paradigms to support skills training and functional rehabilitation (e.g., Freeman, 2008; McLay *et al.* 2011; Tsang & Man, 2013), and smartphone programmes to treat and promote the recovery of individuals with psychiatric illnesses (e.g., Burns *et al.* 2011; Rizvi *et al.* 2011; Ben-Zeev *et al.* 2014). Overall, the emerging evidence from this work is promising, with rigorously developed interventions demonstrating efficacy that is equal to, or better than, traditional treatment models (Barak *et al.* 2008; Mohr *et al.* 2012). Importantly, technology-based interventions may help overcome barriers that block patients from getting effective care (Ben-Zeev *et al.* 2012*b*). We now describe three important advantages technology-based interventions hold for patients.

## Access to evidence-based care

Clinical research has produced a host of evidence-based pharmacological and psychosocial interventions

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for psychiatric illnesses. But even in resource-rich countries like the USA, a large proportion of individuals do not actually benefit from them (Mojtabai *et al.* 2002; Boyd *et al.* 2011). This is particularly true for severe psychiatric disorders such as schizophrenia; many practitioners who prescribe antipsychotic medications do not stay abreast of guidelines for optimal pharmacotherapy, and do not adhere to evidence-based guidelines for dosing and monitoring of side effects. Evidence-based psychosocial interventions for schizophrenia are scarce in most outpatient treatment settings, where there are not enough providers trained in these approaches to provide care, and there is insufficient funding to sustain services for all those in need (e.g., Mojtabai *et al.* 2009). In low- and middle-income countries, conditions are worse; mental health care is often non-existent. Where psychiatric services are available, they are grossly underdeveloped in relation to the population's needs (Lora *et al.* 2012).

Technology-based interventions can dramatically improve accessibility to evidence-based care. Intervention software that is developed to be compatible with existing commercial technologies can be made available to clinicians and patients. For example, in the USA, the majority of the adult population uses smartphones (i.e., mobile phones with computational capacities) that run one of two operating systems (i.e., Android or iPhone). Clinical applications compatible with these operating systems can be deployed as handheld algorithm-driven clinical decision support tools that provide concrete guidance for stepwise patient assessment, diagnosis and selection of appropriate interventions (e.g., motivational interviewing, pharmacotherapy, psychotherapy and supported employment). Moreover, smartphone applications can deliver evidence-based care and support directly to patients. For instance, FOCUS is a smartphone system designed to help individuals with schizophrenia self-manage their illness (Ben-Zeev *et al.* 2013). The system provides adapted evidence-based interventions targeting distress from psychotic symptoms, social impairment, mood problems, sleep difficulties and correct medication use. FOCUS is comprised of several applications that can be downloaded onto Android smartphones from any location, so long as the user has one-time access to the Internet. Once downloaded, a patient can use FOCUS tools (e.g., relaxation strategies, social skills training and mnemonics for medication adherence) wherever and whenever they choose. Recently, Ben-Zeev *et al.* (2014) showed that even patients with significant cognitive impairments, negative symptoms and low literacy levels were able to use this system with ease, and found the intervention helpful in independently managing psychotic symptoms and depression.

When deployed in parallel with available face-to-face services, patients can use technology-based interventions to enhance the therapeutic work they are already doing with providers, increasing their exposure to clinical content beyond their scheduled sessions (e.g., continued skills training and coping strategies). For example, in dialectical behaviour therapy (DBT), patients are trained to use techniques for emotion regulation in face-to-face sessions (Linehan, 1993). Adapting DBT strategies to a mobile phone platform, Rizvi *et al.* (2011) demonstrated that when individuals with borderline personality disorder and substance use who were receiving standard DBT care were also given an adjunctive mobile support technology, they used daily emotion regulation skills significantly more times than when they did not have the device, and experienced reductions in depression and urges to use substances (Rizvi *et al.* 2011).

With a global penetration rate of close to 7 billion (approximately three quarters of that in developing countries) (ITU, 2013), mobile phones may be a particularly important equaliser in terms of access to information and resources, and a powerful new instrument for delivery of care worldwide (United Nations Foundation, 2009; WHO, 2011; Brian & Ben-Zeev, in press). In regions that have no mental health care, mobile-phone delivered intervention programmes could have a very significant role as the first or only line of treatment.

## Overcoming stigma

Some progress has been made in increasing public awareness and knowledge about mental health, but psychiatric illnesses remain highly stigmatised (Phelan *et al.* 2000; Corrigan *et al.* 2003; Ozmen *et al.* 2004). Between a quarter and a third of the population experiences mental illness over the course of their lifetime and could benefit from treatment, yet the majority of people with mental health problems do not seek out care (e.g., Kessler *et al.* 2001; Mojtabai *et al.* 2011). Part of the underutilisation of services is linked to concerns about being labelled 'mentally ill' (Sirey *et al.* 2001; Corrigan, 2004). In many cultures, psychiatric problems are still broadly considered signs of moral weakness or a spiritual crisis. Continued efforts are needed to eradicate the stigma associated with mental illness. But until this vision is fully actualised, delivering interventions via technological platforms may help people get care with minimal stigmatisation.

Treatments that can be accessed remotely (e.g., downloadable software or online) allow people to seek services without having to disclose their problems to others, if they choose not to. This approach may be particularly relevant to cultures where an identified mental health condition might have significant negative impact on one's social standing, professional advancement and responsibilities (e.g., military

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context) (Ben-Zeev *et al.* 2012*a*). For example, PTSD coach is a mobile application that was developed by the US Department of Veterans Affairs to help individuals struggling with symptoms of Posttraumatic Stress Disorder. It can be downloaded by anyone freely from a webpage, the iTunes store or Android Marketplace and used with complete anonymity. As a result of this easy access, the application has been downloaded over 100 000 times in 74 countries around the world (U.S. Department of Veteran's Affairs, 2014).

For some, going to a mental health clinic may be especially daunting – individuals may be concerned about identifying themselves with others whom they view as dangerous, incompetent or weak (i.e., they hold stigmatising beliefs themselves). If the intervention is delivered via widely available technologies (e.g., smartphone and laptop), people can engage in treatment in their own environments without ever having to set foot in a mental health clinic. For younger individuals who already use digital technologies for a range of functions that historically required a physical presence (e.g., shopping, dating and banking), technology-based psychiatric interventions delivered at home might be ideal.

Contending with mental health problems may activate individuals' self-stigmatising beliefs (e.g., 'I am incompetent'; 'I should be able to work through this on my own'), interfering with treatment seeking and engagement. Technology-based interventions that enable users to learn about their condition while exploring treatment options at their own pace (rather than the dictates of a provider, clinic or insurance company) may give patients better opportunities to gradually come to terms with their problems without feeling overwhelmed or disempowered. For example, 'Coping with Voices' is a web-based intervention programme that allows individuals who are experiencing auditory hallucinations to access psychoeducation and cognitive behavioural coping strategies in a self-directed manner (Gottlieb *et al.* 2013). Patients can review online treatment modules whenever they want and revisit content as needed. Moreover, the programme uses language that focuses on 'the experience of hearing voices' and normalisation of false sensory experience, rather than extensive use of pathologising terms (e.g., schizophrenia and mental illness) that may be off-putting to individuals who do not want to be associated with a stigmatised group.

## New models of care

Technological tools can serve as delivery systems for existing evidence-based interventions, but they can also facilitate the development of novel treatment approaches. Unlike in-person psychiatric services, technology-based interventions are not constrained by clinic hours, provider availability or environmental contingencies (e.g., weather and transportation to the treatment centre). They can be deployed at a much higher frequency or on-demand. Thus, instead of requiring a pre-scheduled 50-min psychotherapeutic session, technology-based interventions can be structured as much briefer interactions, skills training or real-time coping tools. They can be formatted to suit patients' cognitive capacities and to be consistent with how they prefer to use their technological resources (e.g., before they go to sleep, high frequency throughout the day and at work) (Schueller *et al.* 2013). Audio and visual elements can be leveraged to improve treatments; video clips demonstrating illness management strategies or peers describing their recovery in the context of similar conditions can help normalise and empower users. Patients can select music or other audio cues that can be assigned to particular exercises (e.g., diaphragmatic breathing), or used as motivation or reward for engaging in healthy behaviour (e.g., a favourite song is played every time a patient remembers to take their medication). Computational resources can be leveraged to enhance treatment engagement or compensate for patients functional vulnerabilities; automated reminders can help individuals remember appointments or medication use, and software can be programmed to send automated prescription refill requests to one's pharmacy, ensuring patients never run out of their medications.

Finally, technology-based interventions can be used to collect new forms of data that may prove clinically meaningful to patients and providers. For example, smartphone sensors (e.g., accelerometers and GPS) can be harnessed to unobtrusively record patient kinesthetic activity (e.g., proportion of the day spent sedentary and calories expended) or geospatial activity (e.g., number of times a patient left their home and duration of time spent at a high-risk location). The manner in which an individual uses the device for other purposes (e.g., spending time engaged in social media and talking on the phone) may also be an important indicator of their mental wellbeing (Burns *et al.* 2011). Patients may directly benefit from seeing summary reports of these behaviours. They may elect to have the same data made available to their clinicians on digital dashboards, so that providers have close to real-time information about how their patients are functioning. Future research will be essential in elucidating whether these new forms of data can be leveraged to improve the scope and quality of patient care (Ben-Zeev *et al.* 2012*b*)

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## Conflict of Interest

None.

## References

**Alvarez-Jimenez M, Bendall S, Lederman R, Wadley G, Chinnery G, Vargas S, Larkin M, Killackey E, McGorry PD, Gleeson JF** (2013). On the HORYZON: moderated online social therapy for long-term recovery in first episode psychosis. *Schizophrenia Research* **143**, 143–149.

**Barak A, Hen L, Boniel-Nissim M, Shapira N** (2008). A comprehensive review and a meta-analysis of the effectiveness of internet-based psychotherapeutic interventions. *Journal of Technology in Human Services* **26**, 109–160.

**Bauer S, Percevic R, Okon E, Meermann R, Kordy H** (2003). Use of text messaging in the aftercare of patients with bulimia nervosa. *European Eating Disorders Review* **11**, 279–290.

**Ben-Zeev D, Corrigan PW, Britt TW, Langford L** (2012*a*). Stigma of mental illness and service use in the military. *Journal of Mental Health* **21**, 264–273.

**Ben-Zeev D, Drake RE, Corrigan PW, Rotondi AJ, Nilsen W, Depp C** (2012*b*). Using contemporary technologies in the assessment and treatment of serious mental illness. *American Journal of Psychiatric Rehabilitation* **15**, 357–376.

**Ben-Zeev D, Kaiser SM, Brenner CJ, Begale M, Duffecy J, Mohr DC** (2013). Development and usability testing of FOCUS: a smartphone system for self-management of schizophrenia. *Psychiatric Rehabilitation Journal* **36**, 289–296.

**Ben-Zeev D, Brenner CJ, Begale M, Duffecy J, Mohr DC, Mueser KT** (2014). Feasibility, acceptability, and preliminary efficacy of a smartphone intervention for schizophrenia. *Schizophrenia Bulletin*. DOI: 10.1093/schbul/sbu033

**Boyd RC, Joe S, Michalopoulos L, Davis E, Jackson JS** (2011). Prevalence of mood disorders and service use among US mothers by race and ethnicity: results from the National Survey of American Life. *Journal of Clinical Psychiatry* **72**, 1538–1545.

**Brian RM, Ben-Zeev D** (in press). Mobile health (mHealth) for mental health in Asia: objectives, strategies, and limitations. *Asian Journal of Psychiatry*.

**Brunette MF, Ferron JC, McHugo GJ, Davis KE, Devitt TS, Wilkness SM, Drake RE** (2011). An electronic decision support system to motivate people with severe mental illnesses to quit smoking. *Psychiatric Services* **62**, 360–366.

**Burns MN, Begale M, Duffecy J, Gergle D, Karr CJ, Giangrande E, Mohr DC** (2011). Harnessing context sensing to develop a mobile intervention for depression. *Journal of Medical Internet Research* **13**, e55.

**Choi NG, Marti CN, Bruce ML, Hegel MT, Wilson NL, Kunik ME** (in press). Six-month postintervention depression and disability outcomes of in-home telehealth problem-solving therapy for depressed, low-income homebound older adults. *Depression and Anxiety*.

**Corrigan PW** (2004). How stigma interferes with mental health care. *American Psychologist* **59**, 614–625.

**Corrigan PW, Thompson V, Lambert D, Sangster Y, Noel JG, Campbell J** (2003). Perceptions of discrimination among persons with serious mental illness. *Psychiatric Services* **54**, 1105–1109.

**Freeman D** (2008). Studying and treating schizophrenia using virtual reality: a new paradigm. *Schizophrenia Bulletin* **34**, 605–610.

**Gottlieb JD, Romeo KH, Penn DL, Mueser KT, Chiko BP** (2013). Web-based cognitive-behavioral therapy for auditory hallucinations in persons with psychosis: a pilot study. *Schizophrenia Research* **145**, 82–87.

**Granholm E, Ben-Zeev D, Link PC, Bradshaw K, Holden J** (2012). Mobile assessment and treatment for schizophrenia (MATS): a pilot trial of an interactive text-messaging intervention for medication adherence, socialization, and auditory hallucinations. *Schizophrenia Bulletin* **38**, 414–425.

**International Telecommunication Union (ITU)** (2011). The world in 2011: ICT facts and figures. Accessed 19 February 2014 from http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2011.pdf.

**International Telecommunication Union (ITU)** (2013). The world in 2013: ICT facts and figures. Accessed 19 February 2014 from http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2013-e.pdf.

**Kessler RC, Berglund PA, Bruce ML, Koch R, Laska EM, Leaf PJ, Manderscheid RW, Rosenheck RA, Walters EE, Wang PS** (2001). The prevalence and correlates of untreated serious mental illness. *Health Services Research* **36**, 987–1007.

**Linehan M** (1993). *Cognitive-Behavioral Treatment of Borderline Personality Disorder*. Guilford Press: New York.

**Lora A, Kohn R, Levav I, McBain R, Morris J, Saxena S** (2012). Service availability and utilization and treatment gap for schizophrenic disorders: a survey in 50 low- and middle-income countries. *Bulletin of the World Health Organization* **90**, 47–54.

**McLay RN, Wood DP, Webb-Murphy JA, Spira JL, Wiederhold MD, Pyne JM, Wiederhold BK** (2011). A randomized, controlled trial of virtual reality-graded exposure therapy for post-traumatic stress disorder in active duty service members with combat-related post-traumatic stress disorder. *Cyberpsychology, Behavior, and Social Networking* **14**, 223–229.

**Mohr DC, Ho J, Duffecy J, Reifler D, Sokol L, Burns MN, Jin L, Siddique J** (2012). Effect of telephone-administered *vs* face-to-face cognitive behavioral therapy on adherence to therapy and depression outcomes among primary care patients: a randomized trial. *Journal of the American Medical Association* **307**, 2278–2285.

**Mojtabai R, Olfson M, Mechanic D** (2002). Perceived need and help-seeking in adults with mood, anxiety, or substance use disorders. *Archives of General Psychiatry* **59**, 77–84.

**Mojtabai R, Fochtmann L, Chang SW, Kotov R, Craig TJ, Bromet E** (2009). Unmet need for mental health care in schizophrenia: an overview of literature and new data from a first-admission study. *Schizophrenia Bulletin* **35**, 679–695.

**Mojtabai R, Olfson M, Sampson NA, Jin R, Druss B, Wang PS, Wells KB, Pincus HA, Kessler RC** (2011). Barriers to mental health treatment: results from the National Comorbidity Survey Replication. *Psychological Medicine* **41**, 1751–1761.

**Nelson EL, Barnard M, Cain S** (2003). Treating childhood depression over videoconferencing. *Telemedicine Journal and E-Health* **9**, 49–55.

**Ozmen E, Ogel K, Aker T, Sagduyu A, Tamar D, Boratav C** (2004). Public attitudes to depression in urban Turkey – the influence of perceptions and causal attributions on social distance towards individuals suffering from depression. *Social Psychiatry and Psychiatric Epidemiology* **39**, 1010–1016.

**Phelan JC, Link BG, Stueve A, Pescosolido BA** (2000). Public conceptions of mental illness in 1950 and 1996: what is mental illness and is it to be feared? *Journal of Health and Social Behavior* **41**, 188–207.

**Proudfoot J, Parker G, Hyett M, Manicavasagar V, Smith M, Grdovic S, Greenfield L** (2007). Next generation of self-management education: web-based bipolar disorder program. *Australian and New Zealand Journal of Psychiatry* **41**, 903–909.

**Rizvi SL, Dimeff LA, Skutch J, Carroll D, Linehan MM** (2011). A pilot study of the DBT coach: an interactive mobile phone application for individuals with borderline personality disorder and substance use disorder. *Behavior Therapy* **42**, 589–600.

**Rotondi A, Anderson C, Haas G, Eack S, Spring M, Ganguli R, Newhill C, Rosenstock J** (2010). Web-based psychoeducational intervention for persons with schizophrenia and their supporters: one-year outcomes. *Psychiatric Services* **61**, 1099–1105.

**Schueller SM, Muñoz RF, Mohr DC** (2013). Realizing the potential of behavioral intervention technologies. *Current Directions in Psychological Science* **22**, 478–483.

**Sims H, Sanghara H, Hayes D, Wandiembe S, Finch M, Jakobsen H, Tsakanikos E, Okocha CI, Kravariti E** (2012). Text message reminders of appointments: a pilot intervention at four community mental health clinics in London. *Psychiatric Services* **63**, 161–168.

**Sirey JA, Bruce ML, Alexopoulos GS, Perlick DA, Raue P, Friedman SJ, Meyers BS** (2001). Perceived stigma as a predictor of treatment discontinuation in young and older outpatients with depression. *American Journal of Psychiatry* **158**, 479–481.

**Smith A** (2013). Pew internet and American life project: smartphone ownership 2013. Accessed 19 February 2014 from http://pewinternet.org/Reports/2013/Smartphone-Ownership-2013.aspx.

**Tsang MMY, Man DWK** (2013). A virtual reality-based vocational training system (VRVTS) for people with schizophrenia in vocational rehabilitation. *Schizophrenia Research* **144**, 51–62.

**United Nations Foundation/Vodafone Foundation** (2009). *mHealth for Development: the Opportunity of Mobile Technology for Healthcare in the Developing World*. UN Foundation-Vodafone Foundation Partnership: Washington, DC and Berkshire, UK.

**US Department of Veteran's Affairs** (2014). Mobile App: PTSD Coach. Accessed 21 February 2014 from http://www.ptsd.va.gov/public/materials/apps/PTSDCoach.asp.

**World Health Organization** (2011). *Global Observatory for eHealth series – Volume 3: mHealth: New Horizons for Health Through Mobile Technologies*. World Health Organization: Geneva, Switzerland.

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