Harnessing Technology to Address the Global Mental Health Crisis:

An Introductory Brief

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MENA MDTF

May 2019

Contents

Acknowledgements

This document has been prepared by Amirali Batada and Rene Leon Solano from the World Bank. The authors gratefully acknowledge the inputs and comments provided by those inside and outside the World Bank including Dr. Ernest E. Massiah, Zeina Afif, Renos Vakis, James Walsh, Francarlo Roberto Valcarcel Benitez, Athena Robinson, Alison Darcy and Amira Nazarali. The authors are grateful for the guidance and support received from Saroj Kumar Jha and Hana Brixi. The Multi-Donor Trust Fund for the Middle East and North Africa Region financed the study.

I. Introduction

The mounting challenges of global mental health are affecting millions of individuals throughout industrialized and developing regions of the world. Though the underlying driving forces may vary across contexts, the consequences of mental illnesses are experienced globally, resulting in rising social and economic costs for governments, communities, and families attempting to manage the growing challenge.[1] Global estimates illustrate that mental illness contributes to 32.4% of years lived with disability (YLDs) and 13% of disability-adjusted life years (DALYs).[2] Presently, in excess of 300 million people globally experience depression, while an estimated 800,000 deaths from suicide are linked to the disease, annually.[3] "Depression is the leading cause of disability globally"[4], coupled with anxiety disorders, contributes to an estimated US$1.15 trillion of lost economic output and 12 billion days of lost work each year, resulting from diminished productivity.[5] Mental, neurological and substance use disorders impact annual economic output, with losses contributing to US$2.5-8.5 trillion globally; this figure is projected to nearly double by 2030.[6] For individual households, out of pocket expenditures constitute the primary method of payment for mental health care in 40% of low income countries.[7] Aside from having a significant economic impact, mental illness is a cross-cutting issue that affects a breadth of development objectives, including eight of the Millennium Development Goals (MDGs).[8] The disease's prevalence and impact on global development contributed to the inclusion of mental illness in the UN Sustainable Development Goals (SDGs) in 2015.[9]

One key factor hindering the progress of addressing mental illness lies in the structural imbalance between inadequate capacity to extend support, and the high growth rate of individuals requiring treatment.[10] On average, nearly half the global population resides in countries where there is one psychiatrist per 200,000 people.[11] This reality is reflected primarily in low and middle income countries (LMICs) where, for example, 76-85% of individuals with a severe mental disorder do not receive treatment for their illness.[12] Addressing this gap in a timely and effective manner will warrant innovative approaches that operate in parallel with traditional strategies. This approach will assist in resolving the key challenges and barriers associated with the planning, design and deployment of effective mental health services, and reducing the risk factors associated with mental illness. The application of emerging technologies holds promise in potentially addressing different dimensions of the global mental health challenge. This brief explores how select technologies and tools could potentially garner new insights, build efficiencies, and scale support in responding to the mental health challenges unfolding in a wide array of communities and contexts.

II. Rise in Global Mental Disorders: Exploring Contributing Factors

Defining Mental Health, the Spectrum of Mental Disorders and Psychosocial Support

1. Mental Health and Well-Being

According to the World Health Organization (WHO), mental health is defined as "a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community."[13] As such, mental health is not just the absence of mental disorders, but rather a state of being that enables individuals to live active and productive lives. The state of mental health is not only determined by individual attributes including "the ability to manage one's thoughts, emotions and behaviors"[14], but is also linked with socioeconomic, biological, environmental, cultural and political factors. Mental health may be promoted and protected through a range of actions including quality and constructive early childhood experiences, effective education and skill building opportunities, socio-economic empowerment, and psychosocial tools and community networks to manage stress and difficult contexts.[15] This publication will outline a series of challenges associated with maintaining mental health across broad contexts and explore how the application of various technologies can promote mental well-being and facilitate access to strong protective factors against mental illness.

2. Mental Disorders

A series of definitions and descriptions have been developed on the spectrum of mental and behavioral disorders. Two leading sources often referenced are the International Statistical Classification of Diseases and Related Health Problems (ICD-10)[16] developed by the WHO, and the Diagnostic and Statistical Manual of Mental Disorders (DSM-5)[17] published by the American Psychiatric Association (APA). For the purposes of this brief, a broad definition of mental disorders is used, aligning with the guidelines of the WHO. In this regard, mental disorders are "generally characterized by a combination of abnormal thoughts, perceptions, emotions, behavior and relationships with others"; they include "depression, bipolar affective disorder, schizophrenia and other psychoses, dementia, intellectual disabilities and developmental disorders including autism."[18] Common mental disorders, including anxiety and depression, are more prevalent across broad population segments and are often addressed through standard treatments such as cognitive behavioral therapy (CBT). Severe mental illnesses, including schizophrenia and dementia, may require more complex and intensive interventions, though these illnesses have a lower rate of incidence. This brief will focus on the challenges and treatment barriers associated with common mental disorders, and propose solutions that leverage technology to strengthen treatment capacity and introduce new approaches to alleviate suffering. For severe mental disorders, the proposed technological interventions may have mechanisms embedded to alert trained specialists of high risk cases and enable users to identify appropriate treatment options through referral services.

3. Psychosocial Illness and Support

The concept of psychosocial illness or support is defined and utilized in different forms, often depending on the domain of research and practice. Within the context of international development and humanitarian relief, psychosocial illness may be interpreted as "the result of a disturbed relationship between psychological and social effects" and as such, understood that "social problems can easily affect the psychological status of the individual" and the corollary, where "psychological problems can affect the individual's social wellbeing"[19], illustrating the interplay and co-dependence between the two elements. Some of the interventions that support psychosocial well-being in humanitarian settings, often termed as Mental Health and Psychosocial Support (MHPSS), may include providing counselling for individuals, groups and families; establishing child-friendly spaces and support for schoolchildren; and extending assistance to cope with and manage mental disorders through nonpharmacological support provided by general healthcare experts and community volunteers.[20] For the most part, this research brief will examine broad themes associated with mental health and well-being, and explore several technology-enabled interventions that intend to address common mental disorders, including through the application of psychosocial support. The review will take a global perspective, covering both developed and developing regions, and discuss considerations pertinent to international development and humanitarian relief practitioners.

Determining Who is Affected

The emphasis of this brief is to explore the external forces that either initiate or exacerbate mental illness, rather than examine internal factors such as genetic or other biological contributors to mental illness. There are numerous segments of the global population that experience mental illness and endure varying degrees of its effects on their daily lives. Some factors, illustrated in the following section, increase the likelihood of developing a mental disorder, while others which may seem banal, can also give rise to mental illnesses for those living even in the most prosperous and stable settings.

In more developed environments, mental illnesses are affecting almost every segment of the population from its youngest members such as children and adolescents, to seniors and the elderly. Among the adult population, there are a spectrum of individuals experiencing mental illnesses, these include: women who have experienced violence;[21] veterans returning from war or those exposed to hostile environments;[22] employees in highly dynamic and demanding work settings;[23] caregivers and frontline health workers providing continuous support whilst facing capacity constraints;[24] young and middle aged adults facing social and financial stressors;[25, 26] individuals who are poor or unemployed - facing hardship and uncertainty;[27, 28, 29] others battling addiction and substance abuse issues;[30,31] people living in isolation and experiencing loneliness;[32] and many other population segments considered as vulnerable groups comprising of high risk factors.

At the other end of the spectrum, within contexts rife with instability and inadequate resources, environments that may be defined as fragile, conflict affected or having a prevalence of violence, there are a multitude of individuals affected by mental illness, often proportionally higher than those living in more stable and developed settings. In these contexts, the individuals who may be suffering include victims of armed conflicts

and violence; survivors of sexual and gender-based violence (SGBV); children and adolescents who have experienced trauma through exposure to extreme violence and conflict; individuals wounded in conflict or those with disabilities; others directly affected by pandemics and emergencies; frontline workers or volunteers responding to emergencies and providing support; and internally displaced populations (IDPs) and refugees.[33]

Among the population segments affected by mental illness, each require thoughtful, suitable and effective interventions, which in some instances, may warrant tailored solutions that are adapted for the respective context and individual/group circumstances. Arguably, the statistics associated with the respective population segments may not accurately reflect the precise incident levels of mental illness sufferers within the wider population (due to numerous factors including stigma, culture, education, etc.). As such, inaccuracies or exclusions may not reveal important population differences relating to access, labelling or treatment among the different groups affected. The different population groups identified in this brief may be considered a subset of a larger cohort of individuals or groups experiencing mental illnesses across different regions and contexts.

Exploring Contributing Factors

It is evident, perhaps more so than ever, that mental disorders are having a detrimental impact on broad segments of societies globally.[34] Findings from the Global Burden of Disease study undertaken in 2010, illustrate that mental and substance use disorders are the primary cause of years lived with disability (YLDs) worldwide, amounting to 175.3 million YLDs.[35] The forces contributing to mental illnesses often vary within and between societies; these can be driven by biological, psychological, social or environmental factors. The emergence of these illnesses may occur through traumatic experiences or sustained exposure to more common risk factors, including poverty or work related stress. Extensive studies on the subject illustrate the importance of social determinants as key risk factors among those affected by mental disorders; this may include groups encountering low socioeconomic conditions, violence, low levels of education attainment, chronic physical ill-health, or conflict.[36] For the purposes of this brief, the research and recommendations focus primarily on social and environmental forces that contribute to mental disorders. The following are select examples of social and environmental factors that are contributing to a rise of mental disorders in varied geographic, economic and social contexts.

1. Poverty, Inequality and Exclusion

In developing countries, linkages between poverty and mental illness are not often found associated solely with income, [37] but rather through factors such as insecurity, hopelessness, swift and disruptive social changes, and incidents and risks of violence and physical ill-health.[38] In developed country contexts, those from lower or marginalized socio-economic segments are more likely to experience higher levels of common mental disorders. [39] The frequency of mental disorders is increased with low education attainment, material disadvantage and unemployment. [40] Though more common in wealthier societies, higher levels of income inequality are associated with greater prevalence of mental illness.[41] Other areas of socioeconomic disadvantage, including low education attainment, unemployment and deprivation, are also found to be linked with

mental illness. Some population segments, such as those experiencing extreme poverty, homelessness or displacement, may encounter structural exclusion in their respective societies. Other groups including minorities, migrants, or those with disabilities may also experience different forms of discrimination. Despite the circumstances, groups encountering exclusion are more likely to experience broader health challenges, including a range of mental illnesses.[42] If not addressed, systemic and prolonged forms of exclusion could engender sentiments of unfairness or injustice, further exacerbating mental disabilities.

2. Economic Insecurity

Globalization and rapid technological developments, including increased automation and applications of artificial intelligence, will continue to drive economic growth and productivity in the years ahead. The impact of artificial intelligence is projected to increase global GDP by US$3.5-15.7 trillion, with some forecasting attainment by 2030.[43, 44] This transformation towards higher productivity will inevitably require a modification and retraining of existing work practices. Some researchers estimate that by 2030, 400 to 800 million individuals may be displaced by automation, and 60 percent of occupations may have at least one-third of work activities automated.[45] As such, investments in human capital and a commitment to lifelong learning will be essential for individuals and countries to remain competitive and reap the economic and social benefits of the transformations.[46] The impact of these changes also has and continues to shift many societies towards building a knowledge and innovation based economy to remain competitive. As these developments progress, it is anticipated that more individuals will endure higher levels of economic insecurity [47] and precarious employment,[48] which may potentially exacerbate mental illness stemming from rising anxiety and stress levels, already taking form in many societies globally.[49]

As the pace, complexity and scale of economic transformations accelerate, societies may continue to observe rising anxiety levels[50] contributing to a growing sense of frustration and fear of what may lie ahead.[51] In some contexts, these changes have contributed to growth in temporary or part-time employment,[52] which is becoming more prevalent in many large global cities.[53] In other regions, historical and structural economic factors have contributed to persistent unemployment or underemployment, especially for large youth populations.[54] Unemployment is often cited as a strong risk factor for developing mental disorders; [55] initiatives to develop relevant skills that support employment warrant consideration and integration into strategies intending to address mental illness.

3. Violence, War and Mass Displacement

In recent years, pockets of regions and countries have encountered increased violence, wars and displacement of citizens at unprecedented levels – in some cases, unobserved since the second World War.[56] The economic impact of violence globally amounts to US$14.3 trillion, nearly 12.6% of the world's economic activity. [57] Deteriorations in the Global Peace Index were observed in 68 countries, stemming from factors including declining societal safety and security, increased domestic and international conflict, and the degree of militarization. Regions affected by higher instability and conflict include the Middle East and North Africa (MENA) and sub-Saharan Africa. The consequences of violence and conflict, along with other social and economic factors, have contributed to the forced displacement of 65.6 million people globally by the end of 2016, the highest

point in several decades.[58] Another prevalent issue of concern is domestic violence, where it is estimated that 35% of women globally have experienced physical or sexual violence during their lifetime. [59] Catastrophic circumstances or events, at times underpinning these tragic outcomes, are producing conditions and environments conducive to forming mental disorders. Some of these situations stem from observances of armed violence, loss of family and friends, untreated trauma, sexual and gender based violence, discrimination and exclusion, extreme poverty, fear and insecurity, isolation and loss of community, unemployment, and harsh living conditions.[60] The underlying factors are often prolonged, while the interventions to improve the conditions sometimes provide only temporary relief across different dimensions of the challenge. This is concerning as prolonged cases of untreated post-traumatic stress disorder (PTSD), severe depression as well as other related mental disorders risk marginalizing and destabilizing families, communities and countries, leading to further social, economic and political consequences.

4. Ubiquitous and Addictive Technology

The authors of this brief recognize that technology is both an enabler, capable of accelerating and scaling initiatives to achieve positive outcomes, but also holds potential to produce unanticipated or undesired consequences for some. The appropriate use of technology could potentially support different facets of the mental health challenge;[61] though its misuse or overuse may be linked to mental disorders such as depression and addiction.[62]

There are now over 2.6 billion social media users globally; this figure is expected to grow to 3.02 billion by 2021.[63] Globally, the average daily time spent on social media has increased by 50% over the past five years, rising from 90 to 135 minutes each day.[64] The shift online has initiated wider discussion and research on the notion of smartphone, screen or social media addiction, though only a minority of users have been formally diagnosed with having psychological issues including anxiety, depression, loneliness and attention deficit hyperactivity disorder, stemming from overuse of social media. [65] Despite the small number of confirmed cases of related mental disorders, broader population segments continue to express the perceived negative impact of excessive technology and social media use on their lives.[66,67,68]

Some potential consequences associated with the overuse of technology have compelled several global institutions and companies, including the WHO and Apple, to employ new measures to raise awareness of the challenge and extend users more control over their usage. Earlier this year, the WHO introduced 'gaming disorder' into the revision of its International Classification of Diseases (ICD-11),[69] while Apple deployed new anti-addiction control features in the latest release of its mobile operating system, iOS 12, for iPhones.[70] One primary challenge is that this field is relatively nascent and that evidence continues to emerge, supporting both sides of the equation. More work and research is required to improve the understanding of linkages between digital technological applications and how their use could potentially affect (or not) the mental health and well-being of its users.

In the domain of work, as industries shift towards digital or knowledge-based production (or incorporate elements of related technologies and practices), more work activities are taking place outside the confines of office environments and beyond traditional work hours. As such, individuals are facing growing pressures to always be online – accessible

and connected to their work.[71] As professional responsibilities occupy more time and become ever-present, societies may experience rising stress levels, [72] potentially contributing to mental disorders and disabilities for some, culminating in a loss of global economic productivity.[73] For example, the economic impact of work-related stress in the United States may cost businesses up to US$300 billion annually.[74] The evolving role of technology in the workplace, both as an enabler of productive work but also a contributing factor to new forms of stress, makes it difficult to quantify the adverse impact on personal mental health and well-being, as well as the net economic costs to business and society.

As for leisure and lifestyle uses of technology, some studies illustrate linkages between the use of digital technology and increased levels of anxiety, depression, loneliness and addiction.[75] Other studies have generated differing conclusions, illustrating minimal impact on the mental well-being of users.[76] Despite some of the evidence based or perceived drawbacks of technology that are emerging, similar technologies have also brought new benefits, knowledge and opportunities to vast population segments. This includes previously 'unconnected' groups whom traditionally have had lower social capital or encountered access barriers to essential information and services.[77] One example, perhaps non-intuitive at first, illustrates the dual aspects of technology within the bourgeoning field of digital gaming. The growing prevalence of digital games has been found to increase isolation and addiction levels of some users, while in other instances, the concept of 'games for good' has been known to offer vast social benefits contributing to better health, economic and educational outcomes.[78] Essentially, technology has and continues to offer a double-edge sword to health, progress and development. The domain of digital technology, its intersection with society, and their collective impact on individual and societal mental health and well-being is a rapidly evolving field that continues to be explored. New research will continue to emerge as technology develops and its implications on society are explored and understood by a wide body of stakeholders and researchers. As such, the advances and applications of technology should be navigated carefully, along with effective measures to mitigate related risks.

5. Diagnostic Capacity and Mental Literacy

Aside from a breadth of external forces that are contributing to a rise of mental disorders worldwide, there are also some practical factors that have supported a rise in the estimated number of individuals affected by mental illness. As more countries adopt legislation on mental health, increase the frequency and scale of related public surveys, enhance the sophistication of diagnostic tools, and strengthen support services and treatment capacities for mental illness,[79] it is inevitable that these efforts would contribute to more individuals self-identifying their challenges of mental illness and coming forward to seek treatment. Additionally, particularly in high income countries (HICs), an emphasis on fostering increased mental health literacy and employing creative strategies to reduce the stigma associated with the disease,[80] would likely contribute to a rise in the number of individuals disclosing and/or seeking treatments for mental illnesses. These efforts have likely contributed to a broader awareness of mental disorders, and as such, have likely increased the documented prevalence of mental illness globally.

III. Challenges and Barriers in the Provision of Scalable Mental Health Services

The growth of mental disorders is a shared global challenge affecting a vast array of populations, while mechanisms to address the issue vary across countries and contexts. Findings from the WHO World Mental Health Survey Initiative illustrate varying utilization levels of mental health services across 17 countries; at the low end is Nigeria at 1.6%, and the top end is the United States with 17.9%.[81] The treatment gap for individuals suffering from mental disorders is in excess of 50% for all countries of the world, and nearly 90% in some of the least resourced countries.[82] There are numerous factors distinguishing response levels, accessibility of support services, and efficacy of treatments; these may include adequate and relevant mental health policies and laws; sufficient financial resources allocated in health budgets for mental illness treatments; organization and planning of mental health service delivery including robust infrastructure and systems; and capacity for evidence-based interventions and training.[83] Additional factors may include treatment coverage guidelines, access to quality treatment centers, social and cultural perceptions of mental illness, level of country development, and other relevant factors. The following are select examples illustrating pertinent challenges and barriers for providing accessible and effective treatments of mental disorders.

Cultural Norms, Social Perceptions and the Stigma of Mental Illness

Throughout the history of many industrialized and developing countries, the dominant perceptions and cultural understandings of mental illness has and continues to evolve.[84,85] The degree of societal-level understanding and acceptance, of both the contributing factors and treatments of mental illness, has been slowly shifting towards scientific and biomedical explanations, rather than cultural or religious reasoning more commonly held in the past.[86] Though, inevitably, there remain differences among population groups within and between countries as healthcare and other development objectives, knowledge, policies, systems and practices take root and improve the quality of life for millions of people. As such, varying historical factors and present day perceptions of mental illness continue to influence the public health response, the extent by which mental health services are included within the broader set of offerings extended by government health ministries, and the service utilization levels by different population segments, where available, across many countries.[87,88]

Despite efforts in select countries to boost mental health literacy and treatment capacity, some societies have not observed the expected uptake of individuals seeking treatment services. In these cases, the barriers to mental health treatments involve a low perceived need; limited awareness or understanding of treatment services; and transportation or financial barriers that preclude access to essential support.[89] In other

instances, there are significant cultural or social factors that prevent individuals from acknowledging they are coping with mental illnesses, let alone desiring to seek treatment.[90,91] Stigma is considered a key deterrent to seeking professional assistance for coping with and resolving mental health problems. Two specific forms of stigma, internalized stigma (e.g., shame or embarrassment) and treatment stigma (e.g., using mental health services or receiving mental health treatment), are identified as being most frequently associated with reduced help-seeking.[92]

Depending on cultural norms or other contextual factors, some individuals may feel that their struggles are not necessarily mental illnesses, but rather affiliated with their faith or beliefs,[93] while others view it as a test or personal struggle that must be surmounted on their own.[94,95] The stigma of mental illness in some societies is acute and widespread, bringing with it shame and discrimination for those openly disclosing or seeking treatment for their illness.[96] For others, they may be compelled to live in silence or seek alternate coping mechanisms, which at times can be destructive or even self-harming.[97] As such, the cultural, social and attitudinal dimensions of mental illness should be addressed in tandem with treatment capacity building efforts. This approach could optimize impact and ensure that more individuals feel comfortable disclosing illnesses and seeking treatment.

Recognition of Mental Illness and Funding of Support Services

The provision of mental health services, particularly through public resources and institutions, is often predicated on whether and how governments formally recognize and classify mental disorders. In contexts where mental illness is considered a primary health issue, funds may be allocated as part of annual public health budgets. In some instances, publicly funded mental health services may be identified in budgets and channeled through programs that take place outside the Ministry of Health, and as such, may not explicitly appear on the health ministry's budgets.[98,99] These services may take place in the form of school counselling, social support for the elderly, social work support programs and other related offerings. In these cases, the support being extended may not be formally recognized and associated with broader mental health programs or strategies. The following analysis explores the present state, where governments have formally recognized, allocated resources, and put forward laws and policy interventions in support of mental health care.

In 2017, 72% of all WHO Member States confirmed their countries had a stand-alone policy or plan for mental health in place, 57% reported to have a stand-alone law for mental health, and 49% had a functioning dedicated authority "to assess compliance of mental health legislation with international human rights."[100] In wealthier countries such as those of the OECD, expenditures for mental disorders are estimated to be 5% to 18% of all health expenditure in select countries.[101] In LMICs, the figures are starkly lower where often less than 1% of health budgets may be allocated for mental health.[102] Globally, average annual spending on mental health is less than US$ 2 per capita; HICs allocate the most funding at US$ 50,[103] while low income countries spend US$ 0.25 per capita.[104] The majority of budget allocations, in excess of 80%, are used to fund mental hospitals. Expenditures for mental health treatments may comprise of counselling, hospitalization, medication and other psychosocial support services.

In contexts where timely and effective mental health treatments are unavailable through public health services, individuals turn to private providers.[105] In this instance, out-of-pocket costs for mental health treatments can serve as an additional barrier to accessing quality services, often the primary source of mental health financing in LMICs.[106] In countries where there is no formal recognition or prioritization of mental disorders, there may be nominal, if any, allocations made in health budgets for the provision of treatments. As such, many individuals in developing countries must rely on private or civil society sectors for receiving mental health treatment, when affordable or available. The ensuing gap in accessing quality treatment contributes to millions of individuals living with mental illnesses globally, unable to access the essential support and services needed.[107]

Infrastructure and Capacity for Treatment

In many LMICs and contexts, mental health infrastructure and capacity constraints contribute to reduced access and delays in obtaining quality treatment. A broad set of infrastructure challenges impact the organization and planning of mental health services; these may include gaps in referral systems, evidence-based treatment guidelines, mental health information systems, and integrated offerings with other relevant sectors in the areas of policy and operational plans.[108] Effective research capabilities and a focus on data quality could be underpinned by robust mental health information systems. A lack of data and evidence-based research practices, primarily in LMICs, compounds the issue determining the scale and complexity of the mental health challenge, and presents impediments to accessing quality treatments and innovative, contextually relevant interventions.[109] This may entail outdated or absent information systems, coupled with inadequate data collection, analysis and research practices on critical variables pertinent to the identification of needs and delivery of mental health treatments for those coping with related illnesses.[110] The impact of these challenges may contribute to operational inefficiencies, longer waiting times, and gaps in accessing quality and tailored support services.

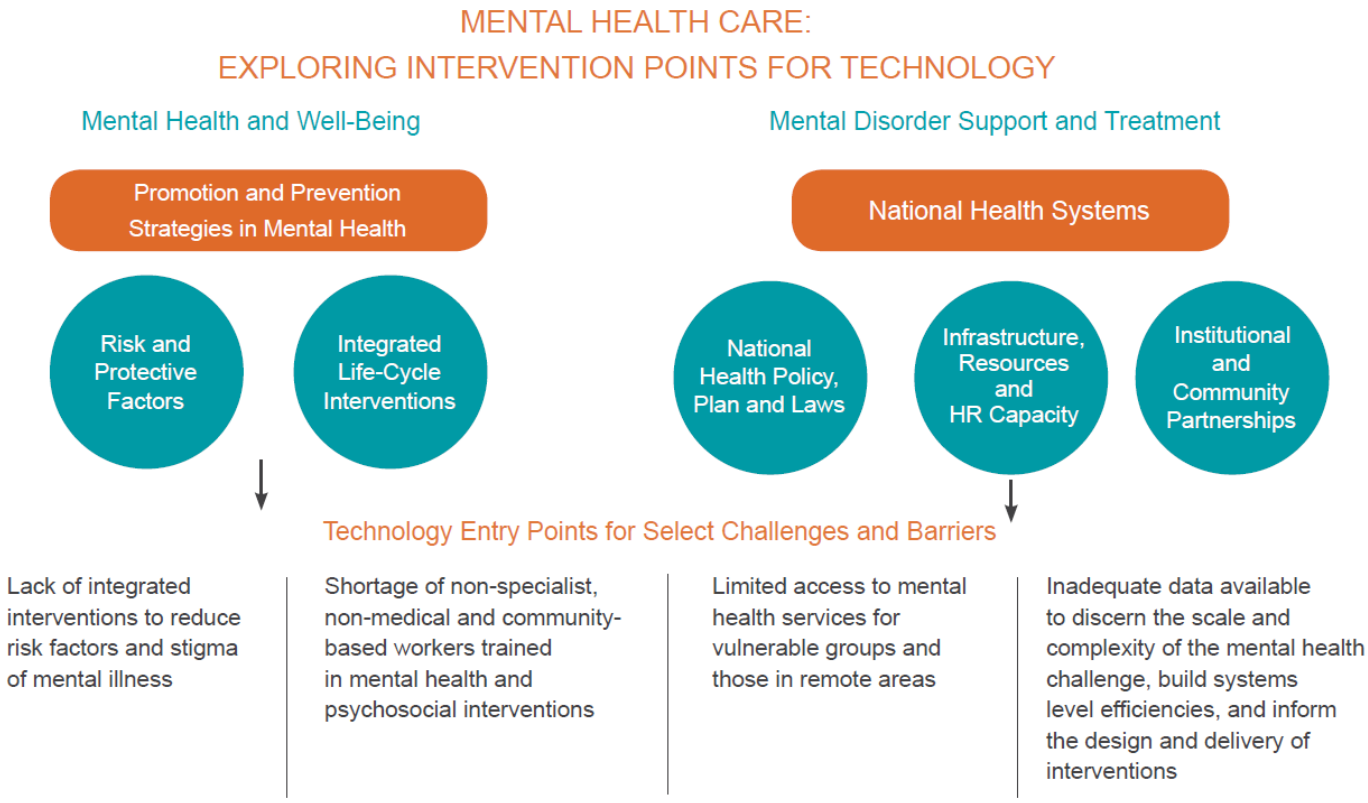
Aside from data and research which inform critical decisions, there are numerous examples of capacity shortages leading to diagnostic and treatment gaps, and access delays for those suffering from mental illness. It is estimated that less than 10% of individuals from LMICs who suffer from mental disorders, end up receiving quality treatment.[111] Globally, there are 9 mental health workers per 100,000 population (median), with a wide spectrum consisting of 72 in HICs and below 1 in LICs.[112] There is a significant shortage of specialized mental health practitioners including psychiatrists and psychiatric nurses; in HICs these constitute 8.59 and 29.15 per 100,000 population respectively, while in LICs they account for .05 psychiatrists and .42 psychiatric nurses per 100,000 population. This constitutes a ratio of 1 psychiatrist per 200,000 individuals for nearly half the global population.[113] These stark figures were one of the contributing factors compelling the WHO to establish its Mental Health Gap Action Programme (mhGAP), which focuses on "scaling up" services for mental, neurological and substance use disorders, by empowering "non-specialist healthcare providers in resource-poor settings."[114]

Harnessing the potential of non-specialist healthcare providers to deliver mental health support to the millions of individuals suffering from common mental disorders may serve as one of the most effective methods today for addressing the magnitude of the global mental health challenge.[115] This concept has been in practice for many years whereby the trust, accessibility and capabilities of key stakeholders including those involved in task-shifting, community based programs, and members of the general population are leveraged to swiftly build capacity and support the organization and delivery of mental health services. This approach may not necessarily be the most effective in treating individual cases, however under the present circumstances, particularly in LMICs which encounter significant capacity shortages of trained mental health specialists and limited publicly funded treatment options, the method is promising.[116] Successful examples of this approach have been documented in many countries, select examples include: engaging faith and traditional healers in Ethiopia to reduce stigmatization, facilitate the inclusion of sufferers, and increase access to mental health support; [117] training volunteers as community support officers who provided referrals and case management assistance to mental health sufferers following the 2004 tsunami in Sri Lanka;[118] and leveraging the mhGAP behavioral disorders module to train primary school teachers in North West Nigeria on understanding and supporting children suffering from attention deficit hyperactivity disorder (ADHD).[119]

Other capacity constraints include inaccessible service providers and institutions due to geographic, linguistic, cultural or financial barriers;[120] disproportionately low number of graduates from relevant training programs (e.g., psychiatry, psychology, etc.) to extend treatment in comparison to the size and growth rate of the population requiring mental health services; [121] limited capacity of hospitalization rooms for those requiring specialized treatment; inconsistent availability and limited supply of relevant medications; and a lack of integrated psychotherapeutic interventions and nonpharmacological treatment options and providers among the primary health institutions extending frontline mental health treatment (e.g., for extending PSS services).[122] The presence of such constraints may also contribute to increased waiting times for quality support or lead to cases of ineffective or unavailable treatment options.

Intervention Points for Technology

A subset of challenges and barriers associated with the prevention and treatment of mental disorders could potentially be reduced through the application of select technologies across different elements of the mental health care ecosystem. One set of challenges are associated with the promotion of mental health and prevention strategies against mental illness, while another involves support with treatment and related services for those suffering from mental disorders. The following figure illustrates potential intervention points for technology across a spectrum of relevant challenges and barriers in mental health care.



IV. Technology for Mental Health Care: No Panacea, but a Partner to Adapt and Scale Response

Defining Emerging and Applicable Technologies

Artificial Intelligence (AI)

There are a broad set of definitions that address different dimensions of AI, two prominent being *thought processes* and *reasoning*, and the other involving *behavior*. The field of AI attempts to *build* and *understand* intelligent entities using machines.[123] Some common definitions of AI include: "1: a branch of computer science dealing with the simulation of intelligent behavior in computers; 2: the capability of a machine to imitate intelligent human behavior"[124]

Machine Learning

A prominent figure specializing in the domain of 'deep learning', Yoshua Bengio, defines machine learning as "a way to try and make machines intelligent by allowing computers to learn from examples about the world around us or about some specific aspect of it."[125]

Predictive Analytics

The topic of predictive analytics is closely tied to the field of data science; data science is understood as "the application of quantitative and qualitative methods to solve relevant problems and predict outcomes."[126] Predictive analytics could be defined as "the use of data, statistical algorithms and machine learning techniques to identify the likelihood of future outcomes based on historical data."[127]

Exploring the Role of Technology in the Promotion of Mental Health Care

As noted in this brief, technology has the potential to support positive outcomes and scale different elements of the mental health challenge, but it may also be a damaging force that initiates or exacerbates mental disorders, based on the manner that technology is used. If leveraged thoughtfully, some types of technologies hold potential to enhance access to mental health treatments;[128] provide insights on understanding and addressing related issues;[129] and extend targeted and personalized support to essential mental health promoting factors. The impact of these efforts and innovations may contribute to new insights and efficiencies, wider reach and efficacy of services, lower treatment and operating costs, and overall improvements to societal mental health and well-being.[130]

The following cases illustrate potential applications of varied technology to address different facets of the global mental health challenge. The applicability of these proposed interventions is predicated on numerous factors pertaining to the design, development and deployment of these solutions in different countries and contexts.

Some factors for consideration may include, adequate financial resources for prototyping, testing and deploying technological solutions at scale; specialized talent from a range of disciplines to develop and manage solutions; sophistication of mobile technology infrastructure, accessibility and adoption in a specific context; education levels, language and digital literacy of target populations; social and cultural norms associated with mental illness; and government investments, priorities and commitments for mental health. For example, if a specific context has a high smartphone penetration rate, wide access to mobile broadband and low data usage costs, these factors may enhance the applicability of some interventions and increase their likelihood of a successful outcome versus other contexts where similar conditions are not present. As such, the proposed interventions outlined below will be applicable and feasible in contexts based on the respective requirements and implementation criteria. Finally, many of the solutions outlined in this section have been developed and deployed in HIC contexts; more research and prototyping is required to assess the applicability and effectiveness in LMICs.

Addressing Challenges and Barriers of Scalable Mental Health Care

1. Lack of Integrated Interventions to Reduce Risk Factors and Stigma of Mental Illness

Proposed Solution: Scale Access to Mental Health Promoting and Risk Mitigating Interventions

It is important to note that the identification of one single causal factor that reduces the risk of developing a mental illness is difficult to determine, and research in this area is still emerging. Additionally, interventions that support the social determinants of mental health, have often not been evaluated against mental health outcomes following the implementation of an intervention. As such, the focus of this section is to illustrate how technology may be leveraged to deploy a range of interventions that reduce the risk factors associated with mental illness, rather than treating the illness directly.

Integrated interventions that promote mental health or reduce the risk of mental illness can be deployed across the life-cycle, potentially enabling partnerships with numerous public ministries, private sector or civil society organizations. As such, solutions may be implemented in many areas including, supporting healthy and constructive early development and relationships between young children and their parents, to ensuring that seniors can age gracefully while maintaining their dignity and having access to essential services that support their mental health and well-being.

An emerging set of research illustrates that a series of mental health promoting factors could support resilience building and assist those coping with common mental disorders. [131] In some cases, researchers have found that nonpharmacological interventions can be as effective in treating mental illness as those receiving prescribed medication,[132] while the demand for nonmedicinal based treatments is also on the rise, particularly among younger patients. [133] For example, there is a growing movement towards addressing the social determinants of mental health through nonpharmacological interventions, such as exercise, volunteering or skills development. [134] Given the magnitude of the mental health challenge, some governments and civil society organizations have sought to strengthen support for these

services through increased resource allocation, integrated offerings with public health services, and raising societal awareness of the benefits of these approaches through public campaigns.[135] Depending on the context, some countries have made progress while others have not yet started to formally coordinate and integrate these elements into their current mental health strategy.

As communication technology becomes more prevalent, even for the most marginalized populations, an integrated digital strategy that promotes and facilitates access to mental health promoting factors may serve instrumental in enhancing mental well-being. This could also involve forging partnerships with public, private and civil society organizations to raise broader awareness of the opportunities and services available, especially for those who may not be connected or lack social capital.[136] An integrated digital strategy could take on many forms, based on the requirements of the context being considered. One intervention could take the form of an engaging and informative platform, which centralizes, maintains and disseminates essential information contributing to mental well-being. The collective features of the platform may be tailored according to contextual needs; below are some examples of potential elements that could be incorporated into such a platform.

i) Employment

The ability to earn a living and engage in purposeful work can be a positive contributor to mental well-being. Though the corollary also holds true where unemployment is often cited as a strong risk factor associated with common mental disorders.[137] To support the acquisition of employment, a digital platform can facilitate broader awareness and uptake of skills development programs that hold potential in increasing wages or providing access to new employment. Additionally, the platform could also enable the identification and pursuit of new employment opportunities in real-time, including virtual or microwork where applicable (i.e., contexts where segments of the population are not permitted to engage in formal work such as displaced individuals living in temporary settings).

ii) Education

Low education attainment is associated with common mental disorders, while the acquisition of education can be a strong protective factor, contributing to the building of emotional resilience and supporting relevant life outcomes that reduce the risk of mental disorders.[138] A trusted platform can be useful in navigating through the expansive landscape of educational offerings to find relevant and effective resources that contribute to the desired outcomes. This may entail identifying and enrolling in formal or informal learning programs, exploring career pathways and relevant course offerings, or accessing convenient and self-paced digital learning resources and tools. Aside from professional development, the educational content can also strengthen personal development which may impart training on resilience, stress management and other coping skills to manage common mental disorders.

iii) Public Services

The inability to access essential services or obtain basic material needs including food/nutrition, water, sanitation or housing may influence or risk the onset of mental disorders.[139,140] In some cases, those who are 'connected' or have access to social capital may have insights on how to obtain these services more readily than those without the advantage. [141, 142] Technology may be a potential equalizer in democratizing this information, such that more individuals could identify public and private support services, thereby alleviating some of the burden facing households. Emerging technology can improve public service delivery by either facilitating increased access or in certain cases, providing services directly through digital channels.

iv) Social Prescribing

Aside from identifying and accessing essential services, the emerging area of 'social prescribing' [143] and its potential benefits to enhancing mental well-being could be another service supported by technology. [144] Though still considered to be an experimental approach with limited data supporting outcomes, social prescribing involves referrals, made by health professionals or a link-worker, to a breadth of non-clinical, local and personalized activities intended to improve health and well-being.[145] Components of the approach include a focus on physical health, psychological well-being, perceived social isolation and financial stressors. Recommended 'prescriptions' involve a spectrum of activities undertaken by community organizations; these may include "volunteering, arts activities, group learning, gardening and cookery."[146] Similar to public services, technology could also facilitate simpler identification and participation of social prescribing programs through an integrated network of patients, health professionals (or link-workers) and civil society organizations, collaborating to achieve common objectives.

v) Positive Psychology

Technology has fundamentally altered how, when and where people consume content. Undoubtedly, it has enabled society to amplify the amount of information generated and consumed daily. For example, the following occurs in just *one minute* online each day: 4 million search queries on Google; 2.4 million pieces of content shared on Facebook; 72 hours of new video uploaded on to YouTube; 216,000 photos uploaded on to Instagram; and much more.[147] Though, not all of this content is constructive to our mental health and well-being. The sheer volume and varied nature of information encountered holds potential to increase an individual's anxiety, stress and depression levels.[148,149] There are several measures that can potentially be taken to reduce the risk; one approach could be to intentionally disconnect or find quiet offline time to engage in other activities. An alternate approach could be to leverage aspects of positive psychology by prioritizing online content that relays constructive messages, thereby restoring balance in the types of content consumed and contributing to positive mental health and well-being.[150,151] In this instance, technology can facilitate the creation and dissemination of positive messages at scale – leveraging literature and other types of narratives and media that promote hope and resilience. The intent would be to enhance the frequency, proportion and depth of positive messaging and engagement, thereby shifting mindsets towards constructive pursuits and pathways. Additionally, complex topics such as stigma

associated with mental health may also be addressed through this vehicle, serving to educate users and provide insights to alleviate concerns. In this regard, technology may support the reduction of treatment stigma through privacy, autonomy and community education opportunities offered by many technology leveraged solutions. Many online mechanisms intended to enable these objectives are functioning at the early stage of development. Further research on best practice and evidenced based outcomes associated with these interventions will be required to enhance wider adoption and endorsement from public health institutions.[152] In the interim, preliminary findings suggest this form of intervention is promising and warrants further exploration and innovation, particularly given the magnitude of the challenge and persistent resource constraints.

2. Shortage of Non-Specialist, Non-Medical and Community Based Workers Trained in Mental Health and Psychosocial Interventions

Proposed Solution: Enhance Access to Mental Health Treatments by Scaling Capacity Building Efforts

Build Capacity of Treatment Providers through Digital and Mobile Learning

In numerous countries, there is an insufficient supply of mental health professionals to meet the increasing demand for mental health treatment.[153] The issue is compounded further by a disproportionately lower rate of trained professionals graduating from quality educational institutions and training programs, when compared to the growing base of individuals requiring mental health treatment. Both factors warrant a new approach to rapidly building the capacity of organizations and large cohorts of individuals (e.g., NGOs, community counsellors, etc.) to offer quality mental health support. In this instance, technology could be leveraged to train and certify community advisors to dispense quality mental health support, while referring priority cases to specialized treatment providers. To facilitate swift and scaled capacity building of community advisors, as well as those already working in the health field, digital or mobile learning platforms could be leveraged to disseminate content widely and strengthen learner/user engagement. The technology could also guide learners, track progress, and award certification for completing relevant training modules.[154] High quality content, including the World Health Organization's Mental Health Gap Action Programme (mhGAP), [155] could be leveraged and delivered through these tools. Additionally, partnerships to facilitate digital learning and accreditation (e.g., micro-credentials such as micro or nano degrees) with quality degree granting academic institutions in the field of mental health, could be another pathway to quickly build local capacity in meeting the growing demand for treatment. For example, in 2017, a mobile-based blended learning initiative was deployed in rural Afghanistan to improve the knowledge of health providers across four primary mental health illnesses; these include depression, psychosis, PTSD and drug abuse. The results of the initiative were promising, where marked gains in the treatment group were observed; this entailed an increase in the overall knowledge scores from 45% to 63%, evaluated through the pre-and post-intervention tests.[156] Another key intervention is underway, led by the World Health Organization (WHO) through the development of its Program Management Plus (PM+) initiative. The program trains non-specialists in helping to address common mental disorders; a study of its efficacy and cost-effectiveness is presently being examined through a trial in Pakistan.[157] These types of approaches could potentially address

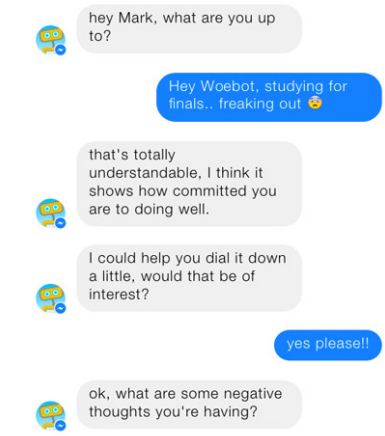
present capacity constraints, thereby contributing to lower wait times, reduced costs per treatment, and wider access to services, particularly in remote or rural areas.

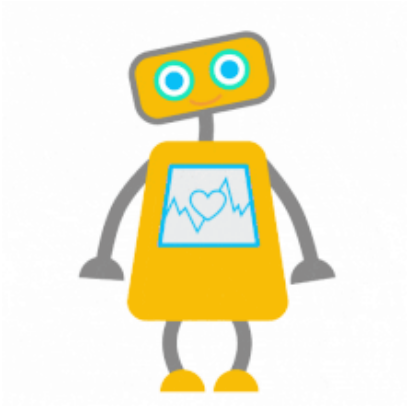
3. Limited Access to Mental Health Services for Vulnerable Groups and those Living in Remote Areas

Proposed Solution: Explore Digital Mental Health Support Tools

Despite efforts to allocate more financial resources, improve accessibility and quality of services, and build the capacity of providers to increase mental health treatments, there is a likelihood that some societies, particularly those in developing regions, will fall short in meeting the growing demand for quality and cost-effective mental health services. As such, numerous governments and private providers are exploring investments in technology-based mental health interventions that extend high efficacy while lowering costs, shortening wait times, and widening access, particularly to lower income and remote communities. These approaches not only hold potential in addressing key structural challenges, but also indirectly resolve a notable social issue, the stigma associated with disclosing or seeking treatment for mental disorders, often identified as a key barrier in accessing mental health support in many developing countries.[158] Since most of the technology based treatments are inherently virtual, individuals can obtain support discretely without being concerned about the social consequences that may arise from seeking in-person mental health support. Undoubtedly, as with any technology intended to operate in a traditionally human-centric domain, there may need to be a cultural shift to overcome potential barriers that inhibit human-machine interaction. This may begin with technology facilitating more efficient human-to-human interaction, and then gradually shifting to more human-to-machine interaction for more predictable and algorithmic use cases.

The following are some examples of new technological approaches that hold promise to enhancing access to quality mental health treatments across broad contexts, in both developed and developing societies, based on the availability of underlying infrastructure and resources required to deploy the services.[159] At the present time, not all of these technologies may be accessible to developing and remote regions, or would necessarily be suitable for vulnerable groups as more research into their effectiveness across different population segments may still be required. Additionally, smartphone ownership, technological infrastructure and network reliability, data costs, illiteracy, and cultural norms are some of the added barriers[160] that may preclude poor and rural communities, as well as other population segments from accessing and benefiting from these emerging technologies and mental health services.[161,162] However, observing the continuous trend and benefits of increased computing power, declining data and hardware costs including more entry level smartphones,[163] and the growth of local startups and software engineers in developing countries, it can be confidently expected that some of these barriers will be transcended in the near future. For now, the technology-based examples below provide a glimpse of how mental health services are evolving and could be delivered in the years ahead, globally.





The Woebot is ready for you.

Image credit: Woebot Labs Inc.

Therapeutic / Coaching Bots

As mobile infrastructure and technology become ubiquitous coupled with low cost smartphones, access to essential information and connected services through applications (or apps) and other platforms will grow. Additionally, as artificial intelligence is leveraged more widely and integrated into consumer apps, individuals will have more powerful tools in their hands capable of performing high-level computations across a spectrum of domains. Bots, essentially applications that can perform automated tasks via the internet (or provide pre-programmed responses),[164] are being utilized more readily to undertake both simple and complex tasks.

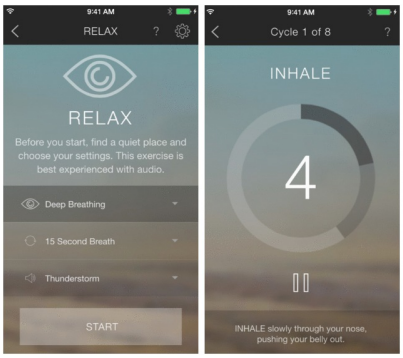
One category of application that has been steadily growing is the use of chatbots, also commonly referred to as conversational agents, to provide mental health support.[165] These technologies provide a virtual outlet for individuals to express their feelings and concerns about their mental well-being, and then are recommended tools and techniques that could improve their mental health. Some of these applications leverage and integrate common therapies through a virtual format – such as internet based cognitive behavioral therapy (ICBT). ICBT has been found to work well through an online, self-guided format with results comparable to in-person treatments, especially when integrated with in-person therapist support.[166]

Some applications have been designed with safety measures to ensure that high risk cases are alerted to human professionals that can provide more extensive support. In other instances, users may be able to consult a human specialist by requesting support from a list of partnering mental health professionals. Both features still require further testing and improvements as gaps have been identified among varying user issues, segments and contexts.

Though many of these applications are in their infancy, some have demonstrated promise in providing timely and accessible support, as well as positive outcomes in dealing with different forms of mental illness. Woebot, a conversational agent developed by Stanford researchers, that combines CBT, a guided self-help infrastructure, and natural language processing, holds promise in providing effective digital mental health support at scale.[167] An initial study, based on a randomized control trial, illustrated that participants who conversed with Woebot via the text message interface "experienced a significant reduction in symptoms of depression" after two weeks, while those in the control group did not. [168]

Meet Ellie, a virtual therapist

Image credit: Teresa Dey/The Guardian/USC institute for Creative Technologies



Leveraging CBT for Mobile Therapy Apps

Image credit: Pacifica Labs

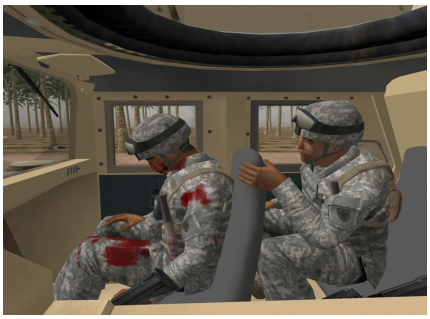
Virtual Therapists

Similar to bots, the growth of virtual reality fused with artificial intelligence has enabled shifts beyond automated text-based support (conversational agents) to a new class of engaging, empathetic and life-like virtual therapists. Though smaller in number given the extent of resources required and technological complexity involved, this new category of therapist is demonstrating positive results in helping mental health sufferers access quality, effective treatments in a resource constrained environment.[169] In some cases, user sentiments suggest preference for virtual therapists over their human counterparts, as some patients have expressed feeling more comfortable disclosing their issues without having concerns of judgement that may stem from human therapists.[170] This discovery has been observed through a virtual therapist named, *Ellie*, designed by the University of Southern California's Institute for Creative Technologies.[171] *Ellie* has been demonstrating astonishing results by detecting symptoms of depression and supporting veterans coping with PTSD.[172]

Self-Guided Therapy

Another form of digital therapy, slightly different from guided sessions facilitated by bots or digital therapists, are self-guided individually paced therapy tools. These approaches provide individuals with added control and permit users to undertake a structured and observable path of healing. This occurs through a sequenced set of guidance and insights, tools and techniques, and recommended interventions that are provided along a user's individualized journey. Some individuals who may be reluctant to utilize traditional treatments due to their length or limited visibility of a healing pathway, may find this option appealing.

In many instances, cognitive behavioral therapy (CBT) is often leveraged, as it lends itself well to this type of digital treatment format, consistent with face to face treatments.[173] Self-guided therapies, underpinned on the principles of CBT and delivered through digital formats are gaining momentum among young people coping with common mental illnesses (e.g., stress, anxiety, etc.).[174,175] Some examples of popular apps leveraging CBT include, Pacifica, Moodnotes, and Happify. The incentives driving uptake in enrollment include individualized control versus offline sessions driven by therapists; anonymity, particularly in contexts where stigma persists; ease of use and the convenience of seeking treatment from home; and the low cost of enrollment or subscription fees, in comparison to private therapists or counsellors.[176]

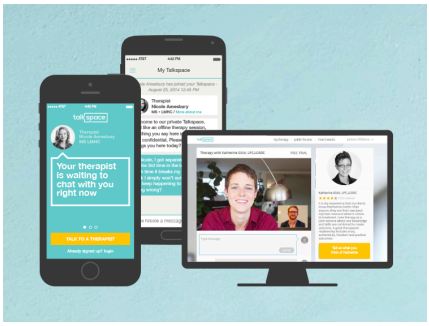


VR based immersive Therapy.

Image credit: USC institute for Creative Technologies

Virtual Reality (VR) Based Exposure Therapy

As technology advances, individuals could explore new forms of therapy outside of traditional physical environments or even hybrid physical-virtual contexts, and shift towards more immersive spaces in virtual worlds. For individuals dealing with mental illnesses relating to trauma or various phobia, virtual reality is demonstrating progress in extending support by affording patients with new forms of exposure therapy that provide a safe and controlled space to seek treatment.[177] [178] A virtual world can be reconstructed, enabling patients to heal from a challenging situation or environment that was encountered in the past. Gradually, patients find comfort and a constructive way forward to resolve anxieties, develop coping mechanisms, and obtain greater mental well-being as they move past the experience and manage their lives more effectively. There are excellent examples of this work, including the *Bravemind* project at the University of Southern California's Institute for Creative Technologies, which designs therapy tools to help veterans recover from PTSD using VR based exposure therapy tools.[179]

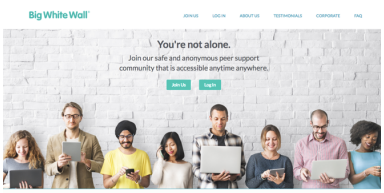


Delivering real-time, video-based therapy.

Image credit: Talkspace

Telepsychiatry / Video Based Therapy

Developments in the quality and accessibility of video technology are prompting some therapists to offer telepsychiatry or video-based therapy sessions. Although the format is not significantly different from in-person sessions, the accessibility, convenience, cost savings and discretion extended to patients has made this new approach grow in popularity.[180] Additionally, in countries where there is a shortage of qualified mental health therapists, this new format facilitates increased access and balanced distribution of global resources (i.e., globally trained professionals that can reach more patients, in cases where there are limited language or cultural barriers). As with other digital therapies, there are some concerns pertaining to patient privacy and quality of service delivered through this channel; though these are likely to be addressed as the technology evolves and digital therapies become more prevalent. Some notable providers of video-based therapy in the United States and Western Europe include BetterHelp, Talkspace, Babylon and PlusGuidance. The growth and popularity of this delivery format for mental health therapy has prompted the UK government to allocate further resources in building the digital infrastructure and pilot models for expanding this form of treatment.[181]



Virtual Peer Support for Mental Health

Image credit: Big White Wall

Digital Peer Support Communities

Aside from connecting with mental health professionals, individuals coping with mental illnesses are also opting to engage with each other to share experiences and foster meaningful connections through utilizing different online platforms. The digital spaces that are created in response to this need permit mental health sufferers to express their feelings and concerns anonymously and safely, while also seeking comfort and support from those that can understand and empathize with their situation. Emerging platforms, such as *Big White Wall* and *PatientsLikeMe*, are examples of the type of support and potential benefits that may be offered through this service. Alternatively, traditional social media platforms such as Facebook, also have dedicated groups for mental health sufferers, though these environments may be more challenging to maintain patient safety, anonymity and trust.

Other platforms focus on different segments of the population coping with mental illness, such as young adults. A study undertaken in the UK involved the review of a sizeable dataset from a popular youth focused online mental health peer support forum, *Kooth*. The findings illustrated that youth are benefitting both from informational and emotional support delivered through these digital spaces and communities.[182] Though, more research needs to be undertaken, particularly on how to mitigate risks associated with users extending directive support, and ensuring that global experiences shared can be contextualized to local health care systems and practices.[183]

4. Inadequate Data Available to Discern the Scale and Complexity of the Mental Health Challenge, Build Systems Level Efficiencies, and Inform the Design and Delivery of Interventions

Proposed Solution: Harness Data to Derive Insights

i. Strengthening Data Systems Infrastructure to Generate Efficiencies and Service Improvements

Investments made by mental health promoting institutions in the areas of data systems, processes and specialists, hold potential in offering insights to enhance the accessibility and quality of mental health treatments. If essential mental health related data is captured consistently, maintained securely, and harnessed responsibly, mental health providers may be able to make more informed decisions and investments, leading to quality treatments and improved outcomes for more patients.[184]

Demand Side

Though this varies by context, some accessibility barriers noted by patients deterring their access or pursuit of treatments involve the following information gaps: location and proximity of services; timing and availability of providers and services; service fees (if applicable); background of providers (e.g., gender and language fluency for cultural and comprehension purposes); wait times and duration of service; knowledge gaps pertaining to treatment process, expected outcomes and the types of mental health issues that can be supported or treated; and how discretion is maintained to avoid stigma or manage social perceptions.[185] These are just some examples that individuals coping with mental illnesses identify as impediments for either accessing or pursuing mental health treatments.[186] If relevant data on each of these points was regularly captured and presented in a manner that is easily accessible, interpretable and trusted by those requiring treatment, there is strong likelihood that more individuals would become aware and possibly seek mental health services, thereby enhancing the accessibility and demand for treatments.

Supply Side

The example above illustrates data improvements to enhance the awareness and uptake of mental health treatments – focusing on the demand side of the equation. In some contexts, the demand for mental health treatment is already high, though capacity constraints impede individuals from obtaining treatment in a timely manner, resulting in increased waiting times. In this instance, supply side improvements could potentially enhance service quality and efficiency by better understanding and anticipating the demand, delivery and coordination of treatments. Some of the challenges treatment providers identify as impediments to providing quality service include, inadequate tools for patient demand forecasting; limited data capture, management and accessibility of patient records (i.e., history, tracking, services, outcomes, etc.); unavailability of essential resources when needed (e.g., medicines); misallocation of provider capacity (i.e., mismatch between patient demand and treatment supply across different

geographical areas); performance targets and tracking systems to measure the impact of treatments; unstructured and inefficient diagnostic and referral systems for mental disorders; and limited integration between mental health providers and institutions providing psychosocial support – when social prescribing is recommended (e.g., volunteering, group learning, employment programs, etc.).[187] Addressing some of these challenges through enhanced data capture and utilization could bring about operational improvements leading to new efficiencies and insights, thereby contributing to the overall enhancement in the quality and delivery of treatment services. In some ways, this is an optimization challenge that requires providers to leverage data more effectively. The resulting outcome would potentially enable treatment providers to better anticipate, plan and respond to patient demand, thereby offering quality services more efficiently, despite having capacity constraints (i.e., shorter waiting times, increased number of patients served, improved outcomes, etc.).

ii. Leveraging Big Data and AI for Mental Health

As the acquisition, management and utilization of data becomes more entrenched in the planning and delivery of mental health services, more sophisticated uses of data can be pursued to garner new insights, enhance treatment services, and improve patient outcomes, such as those promised in the emerging field of Computational Psychiatry.[188] This may entail leveraging and bridging large datasets across multiple domains (e.g., medical, census, social media, economic, etc.), and then harnessing supercomputing and analytical technology - including artificial intelligence, machine learning and predictive analytics, to extract useful patterns and insights that can inform different dimensions of the mental health challenge.[189]

Predictive Psychiatry

An emerging field operating at the intersection of psychiatry and big data analytics, is 'predictive psychiatry' or 'predictive analytics in mental health'.[190] The objectives and aspirations tied to this field are, in some ways, aligned to the emerging arena of personalized and precision medicine. The intent is to utilize vast amounts of aggregated data, pertaining to patient backgrounds, mental health issues, preferences, treatments, outcomes and numerous other factors, to determine the most suitable therapy option that may likely produce a positive outcome for patients.[191] The technology would incorporate large sets of variables to determine the types of compositional and correlating factors that best align to different treatment options, thereby producing desired results for different patients.[192] The success of this approach is predicated on numerous factors, one particularly essential, is having access to very large data sets (i.e., patients, variables, etc.) to perform deep analytics. The field is in its infancy and clouded with many unknowns, yet holds promise along with broader areas of precision medicine to provide individualized diagnosis and treatments for addressing mental health issues.

Social Media Mining

Though often crowded with noise, social media platforms house vast amounts of data that could provide insights on user sentiments and issues relating to mental health and well-being.[193,194] This information could be tremendously useful in anticipating the onset of potential mental health issues amongst certain user segments (i.e., based on socioeconomic, ethnic, gender, geographical or other factors), and then thoughtfully formulating strategies and responses, both online and offline, to extend support and treatment services.[195] For example, an online intervention may be to develop and deploy a targeted marketing campaign promoting volunteering, skills building and vocational employment training programs for certain segments of high-risk or vulnerable youth. This type of intervention can be supported through stronger partnerships with private sector companies managing social media platforms and other digital tools and environments.

Data Analytics and Visualizations

Many public institutions today are facing resource constraints and thus require more targeted and efficient interventions to address issues such as mental health. The effective allocation of limited resources can be enabled through harnessing vast amounts of data which can be analyzed and visualized to generate and communicate insights more effectively.[196, 197] For example, a geographical visualization may provide new perspectives on how different regions or municipalities may be faring on important mental health indicators (predictive and responsive). The visualized map can also draw in other data sets, such as those associated with the social determinants of mental health, to provide a more nuanced understanding of contributing factors and inform regional intervention strategies accordingly.[198] If relevant data is captured regularly, accurately and comprehensively, visualizations can be constructed to better understand specific mental health pain-points and priority areas, enabling effective interventions and resource allocations to resolve issues immediately.

V. Exploring Pathways Forward

Governments across the globe, spanning industrialized and developing nations, are raising awareness on the importance of understanding and addressing mental disorders. Though progress is being made, the underlying forces associated with the growth of mental illnesses prevail, placing increased burdens on individuals, families and governments to resolve the formidable challenge.

Resources allotted to build the capacities of public health providers coupled with new regulations to enhance the accessibility of mental health services have been welcomed, yet in many countries, extensive waiting times for receiving treatments persist. Traditional approaches to building treatment capacity and delivering mental health services, in many cases, have not been able to keep pace with treatment demands and requirements. There is an essential need to provide quality interventions, particularly to the most vulnerable populations that require not only treatments, but support to address the social determinants that contribute to the onset and persistence of mental disorders.

Given the magnitude of the mental health challenge, innovative approaches to accelerate the deployment of feasible, effective and scalable solutions will be imperative to underwrite structural and sustainable transformation. A thoughtful and targeted approach that leverages emerging technology may be immensely useful in addressing different elements of the problem. As more countries and contexts increase their adoption of and reliance on mobile and broadband communication technology, many more individuals may benefit from enhanced access to mental health treatments through traditional and digitally enabled services.

Innovative technologies may also enable the development of new insights and operational efficiencies, leading to improvements in the quality and accessibility of treatment services. Exploring beyond treatments, technology also holds potential to enhance health promoting factors that address the underlying forces associated with common mental illnesses. Notwithstanding its potential risks and related factors concerning the applicability of interventions, technology may still be a powerful tool to drive and scale impact across different dimensions of the mental health challenge, and contribute to the improvement of societal mental health and well-being.

VI. Endnotes

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