

COVID-19 and mental health: A review and the role of telehealth and virtual reality

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ABSTRACT

On March 12, 2020, with more than 20,000 confirmed cases and almost 1000 deaths in the European Region, the World Health Organization classified the COVID-19 outbreak as a pandemic. As of August 15, 2020, there are 21.5 million confirmed cases of COVID-19 and over 766,000 deaths from the virus, worldwide. Most governments have imposed quarantine measures of varied degrees of strictness on their populations in attempts to stall the spread of the infection in their communities. However, the isolation may have inflicted long-term psychological injury to the general population and, in particular, to at-risk groups such as the elderly, the mentally ill, children, and frontline healthcare staff. In this article, we offer the most up-to-date review of the effects of COVID-19 confinement on all the disorders listed in the Diagnostic and Statistical Manual of Mental Disorders. We make data-driven predictions of the impact of COVID-19 confinement on mental health outcomes and discuss the potential role of telemedicine and virtual reality in mental health screening, diagnosis, treatment, and monitoring, thus improving the above outcomes in such a difficult time.

Keywords: COVID-19, Mental health, Telehealth, Virtual reality

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INTRODUCTION: THE COVID-19 PANDEMIC

The official name for the disease caused by the 2019 novel coronavirus outbreak, which was first identified in Wuhan (China), is COVID-19. Specifically, COVID-19 is caused by the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2), a beta-coronavirus, like Middle East respiratory syndrome-CoV and SARS-CoV, which had also caused a respiratory syndrome previously. The onset and duration of viral shedding and the period of infectiousness for COVID-19 remain to be established although its incubation period has been estimated to range from 2 to 14 days.^[1]

The highest risk groups are elderly people and those who live in a nursing home or long-term care facility. COVID-19 also impacts all age groups with underlying medical conditions such as chronic lung disease or asthma, serious heart condition, compromised immune systems, severe obesity, diabetes, and renal failure undergoing dialysis and those with liver diseases. Further, of concern, frontline staff including healthcare workers, emergency services personnel, and nursing homes staff have been highly affected.^[1]

As of September 1, 2020, there is no specific or effective, evidence-based treatment or vaccine for COVID-19; hence, acquired immunity cannot be assured. Moreover, there have been worrying reports of potential long-term neurodegenerative sequelae and neuro-immune dysregulation after recovery from COVID-19, and children appear to present with signs of autoimmune inflammatory reaction to the virus.^[1] According to the World Health Organization (WHO), the COVID-19 pandemic outbreak size and the subsequent negative impact on our society, including a significant economic disruption, have made this disease more catastrophic than any other that our generation has had to live through.^[2] Almost every country has been affected, and even the most resilient healthcare systems have struggled treating a large number of patients. It is estimated that around 20% of cases are severe or critical, with a crude clinical case-fatality rate of over 3%. This rate is higher in older age groups and in those with certain underlying medical conditions, which has also disproportionately affected healthcare workers and people living in residential care settings. Moreover, the widespread extent of home confinement and other contention/lockdown measures implemented in an attempt to stem the rate of infection have had broad and deep socioeconomic consequences.^[2] The

WHO has suggested that a global coordinated strategic response is needed.^[3]

LESSONS FROM THE PAST

Effective quarantine measures, including confinement, cannot be implemented without a cost, in terms of both financial and health outcomes. A 2004 Canadian study^[4] examined the psychological effects of quarantine due to SARS control measures on Toronto residents through a cross-sectional, web-based survey, which was completed by 129 persons who spend a median duration of 10 days in quarantine. A high prevalence of psychological distress was identified with 28.9% having symptoms of posttraumatic stress disorder (PTSD) and 31.2% having symptoms of depression. Longer durations of quarantine, acquaintance with or direct exposure to someone with a diagnosis of SARS were also associated with an increased prevalence of PTSD symptoms, which tended to worsen as the household income fell.^[4]

Sprang and Silman^[5] measured self-reported stress in confined families using the University of California at Los Angeles Posttraumatic Stress Disorder Reaction Index Parent Version and the PTSD Check List Civilian Version and found that criteria for PTSD were met by 25% of parents and 30% of children (based on parental reports).^[5]

Beaglehole *et al.*^[6] conducted a systematic review and meta-analysis to explore the effects of natural disasters on mental health. They identified 41 studies, 27 of which were meta-analyzed and found psychological distress and psychiatric disorders increased after natural disasters, especially rates of PTSD and depression, although changes in anxiety and alcohol misuse/dependence rates were not significant.

Brooks *et al.*,^[7] a review published in *the Lancet*, found that quarantine measures result in psychological distress, although this can be attenuated by some measures. They found consistent evidence of trauma following the quarantine measures in hospital staff immediately after the quarantine period (9 days), who were more likely to report a wide range of psychological distress symptoms, such as exhaustion, detachment from others, anxiety when dealing with febrile patients, irritability, insomnia, poor concentration and indecisiveness, deteriorating work performance, and reluctance to work or consideration of resignation. Being quarantined was also a predictor of long-term PTSD in hospital employees (at 3 years). Quarantined children were also found to be at risk of trauma, showing posttraumatic stress scores four times higher than those who had not

been quarantined, and 28% of the parents quarantined reported sufficient symptoms to warrant a diagnosis of a trauma-related mental health disorder, compared with 6% of parents who were not quarantined.^[7]

Interestingly, this review included a study examining symptoms of depression 3 years after quarantine involving hospital staff and found 9% of the sample to report severe depressive symptoms. In this group, nearly 60% had been quarantined, whereas only 15% of the mild depressive symptoms group had been quarantined.^[7] People quarantined also reported fear (>20%), nervousness (18%), sadness (18%), and guilt (10%), as well as a range of other psychological responses to quarantine, such as confusion, anger, grief, numbness, and insomnia. More worryingly, in healthcare workers, alcohol abuse or dependency symptoms were positively associated with having been quarantined 3 years after the end of the quarantine period. Quarantine was also significantly and positively associated with avoidance behaviors, such as minimizing direct contact with patients and not reporting to work.^[7]

These findings were replicated by a literature review on the effects of quarantine and isolation for infection prevention on mental health outcomes that revealed high levels of depression, anxiety, mood disorders, psychological distress, PTSD, insomnia, fear, stigmatization, low self-esteem, lack of self-control, and other adverse mental health outcomes among patients, informal caregivers, and healthcare providers who experienced quarantine or isolation. The authors suggested multipronged interventions, including policy measures for strengthening mental health services globally and promoting psychosocial well-being among high-risk populations, to mitigate the effects of containment measures on healthcare providers' mental health, thus lessening suboptimal performance in workplaces.^[8]

Given the impact of quarantine and isolation on mental health outcomes in the general population, concerns have been voiced regarding vulnerable groups. A recent position paper published in *the Lancet* is especially relevant.^[9] The authors suggest a number of potential measures to support the most vulnerable groups under pandemic conditions, frontline healthcare and social care staff, those with pre-existing mental health issues, young people (aged ≤18 years), and older adults (aged ≥65 years). These measures include, but are not limited to:

- Deploying interventions that can be delivered under pandemic conditions to reduce mental health issues and boost well-being

- Developing methods for promoting more successful adherence to behavioral advice about COVID-19 while enabling mental well-being and minimizing distress.^[9]

THE COVID-19 PANDEMIC EARLY LEARNING AND MENTAL HEALTH EFFECTS

Evidence of the impact of COVID-19 on mental health emerged initially in China, which was later replicated in other countries. Based on a sample of 7236 Chinese participants, Huang and Zhao^[10] designed a web-based, cross-sectional survey to collect the data from volunteers using validated instruments such as the Generalized Anxiety Disorder-7 (GAD-7), Center for Epidemiology Scale for Depression, and Pittsburgh Sleep Quality Index. Overall, the prevalence of GAD (35.1%), depressive symptoms (20.1%), and poor sleep quality (18.2%) was high. Specifically, two main findings emerged from the study. First, adults aged 35 years and younger reported having a higher prevalence of GAD and depressive symptoms than older people ($P < 0.001$). Second, compared with other occupational groups, healthcare workers showed the highest rate of poor sleep quality ($P < 0.001$).^[10]

Rosen *et al.*^[11] conducted a survey in the US among approximately 1250 quarantined New York city residents. Rosen *et al.* measured distress using the Subjective Units of Distress Scale and anxiety using the Beck Anxiety Inventory. The sample was comprised of 303 individuals and the mean levels of distress were shown to be heightened and sustained, with 69% of participants reporting moderate-to-severe distress and 25% indicating level of anxiety/distress that significantly impaired functioning. The authors suggested that access to professional mental healthcare as well as behavioral interventions should be prioritized.^[11]

In one multicenter survey involving $n = 1563$ medical staff in Guangzhou, China, Liu *et al.* found high prevalence of depression (50.7%), anxiety (44.7%), insomnia (36.1%), and stress-related symptoms (73.4%).^[12] The authors concluded that access to professional mental health care as well as behavioral interventions should be prioritized.^[11]

Consistent with this, Galea *et al.*^[13] warned that there would be substantial increases in mood disorders, substance use, loneliness, and domestic violence and high levels of child abuse in the context of the COVID-19 pandemic and they suggested that a plan was needed to

address the inevitable mental health crisis using digital technologies.

In a recent survey,^[14] 3550 Spanish adults' symptoms of anxiety, depression, and stress were analyzed using the 21-item version of the Depression Anxiety Stress Scale, and symptoms of PTSD were assessed with the Impact of Event Scale. A large percentage of respondents reported high levels of anxiety (32.4%), depression (44.1%), and stress (37.0%). Furthermore, symptomatic scores indicating psychological stress were found in 88.6% of respondents.

A systematic review and metaanalysis conducted by Rogers *et al.*^[15] advised clinicians to be mindful of the possibility of depression, anxiety, fatigue, post-traumatic stress disorder, and rarer neuropsychiatric syndromes in the longer term in a proportion of patients infected by SARS-CoV-2.

Taken together, these findings suggest significant increased risk for mental disorders in the general population and for those already suffering from mental health issues that are directly linked to the COVID-19 pandemic. Given the need for isolation and physical distancing due to the pandemic and the fact that this exacerbates mental health issues, it is clear that digital technologies should be considered to address this need.

THE IMPACT OF NATURAL DISASTERS AND CONFINEMENT ON PEOPLE WITH MENTAL ILLNESSES

As the review above suggests, quarantine strongly affects people with mental illness, healthcare workers in hospitals and laboratories, and volunteers and social service personnel.^[16] Psychiatrists should therefore educate people and encourage them to engage in health-promoting behaviors, assist in the integration of mental and healthcare, empower patients and families, and regularly monitor mental health of healthcare providers, including delivering care as appropriate.^[16]

Given the upcoming significant financial constraints as a result of the COVID-19 pandemic, it is envisaged that these interventions will have to be delivered remotely, using telehealth and other solutions such as virtual reality (VR). Therefore, guidelines on how to conduct online telepsychiatry consultations are needed. These have been published by The Royal College of Psychiatrists in the UK^[17] and by the American Psychiatry Association, in the US.^[18] The WHO^[19] and

Centers for Disease Control and Prevention (CDC)^[20] have issued the guidance and resources to support the population and ensure resilience in societies during this pandemic.

Before turning to a discussion of the role of telehealth and VR in addressing mental health concerns due to the COVID-19 pandemic, we generate a comprehensive set of predictions regarding the impact of COVID-19 on all Diagnostic and Statistical Manual of Mental Disorders (DSM) mental disorders and offer solutions for sustainability and treatment.

NEURODEVELOPMENTAL DISORDERS

Neurodevelopmental conditions include autism spectrum disorder, attention deficit hyperactivity disorder, and intellectual disability. These life-long conditions are associated with varying degrees of cognitive, emotional, behavioral, social, and functional impairment and share a number of diagnostic symptoms. As such, the effective treatment and management of such conditions may involve a number of different agencies and systems of support including familial, educational, mental healthcare, and social care services.

However, the COVID-19 pandemic has resulted in worldwide government-enforced lockdowns. This has caused considerable disruption to the systems of support and typical access to appropriate services for young people and adults with neurodevelopmental conditions. Despite services adapting their provisions to accommodate the changes brought about by COVID-19, such as using telephone or video technology, the face-to-face support, including therapy, education, medication reviews, and respite that are relied upon by many, has been dramatically reduced.

In response to these limitations, a number of management strategies have been identified by various groups across Europe for young people and their families to consider during this challenging period [detailed alleviation strategies can be found in Table 1].

Young people and adults diagnosed with neurodevelopmental disorders are at an increased risk of experiencing low mood and anxiety when routines are disrupted. Reducing uncertainty, such as introducing schedules and structure during this challenging time, can support their mood and unhelpful behavior. It is essential that all relevant services continue to engage with young people and families via the telephone and online

Table 1: Recommendations for young people and their families managing ASD, ADHD and ID during COVID-19 lockdown

	Autism spectrum disorder: Recommendations provided by the NAS - United Kingdom^[21]	ADHD: Recommendations provided by the EAGG - European Consensus^[22]	Intellectual disability: Recommendations provided by the challenging behavior foundation - United Kingdom^[23]
Young people and families	<p>1) Anxiety about unexpected changes or events</p> <p>a) Support your child to remember your family's plan has changed and might change again, but you can always make a new one.</p> <p>b) Even if you are self-isolating, structure each day and time. Build in points in the day for exercise, eating, and fun activities.</p> <p>2) Sensory Sensitivity.</p> <p>a) If you do not have a quiet, sensory area in your home already, make one, even if it is just the corner of one room. Fill it with homemade sensory toys and activities.</p> <p>3) Time to process information.</p> <p>a) Give your child time to absorb and process each piece of news and make sure they have a source to go back to and re-read when they need to</p> <p>b) Think about the minimum level of information that your child needs; do not overwhelm them with every single piece of news or information.</p> <p>c) Write down the important bits or use the social stories available to explain what is happening. Give them time to think about it and let them know they can come back to you later to ask questions.</p> <p>4) Social Anxiety.</p> <p>a) If you are stuck at home with people, you usually do not spend that much time with you might need to let them know that your child requires distance and their own time.</p> <p>b) If you are feeling socially isolated, connect to other parents on our online community or get support through our Parent to Parent service.</p> <p>5) Communication and interaction.</p> <p>a) Let people know that at times of stress your child might find communication, especially verbal communication, harder than usual.</p> <p>b) Agree with your child how you will communicate with them - via text, or in writing, or at specific times of the day.</p>	<p>1) Keep positive and motivated.</p> <p>a) Do not let things get you down - no parent is perfect - remember small changes in your parenting can really improve things.</p> <p>b) Everyday find time and space to do some small thing you enjoy.</p> <p>c) Share your experiences with other parents - get on-line or call your friends.</p> <p>2) Make sure all family members know what is expected of them.</p> <p>a) Agree house rules - then get the children's buy in to the rules.</p> <p>b) Keep rules simple - pick the ones that really matter.</p> <p>c) Put rules on a display, so everyone can see them.</p> <p>d) Parents must work together, so children do not play one parent off against another.</p> <p>3) Build your child's self-confidence and trust in you.</p> <p>a) Children act up if they are feeling uncertain or anxious - take time to listen to them.</p> <p>b) Give children lots of positive feedback - do tasks together where praise can be given.</p> <p>c) Do things you enjoy together as a family - it is an opportunity to praise and build confidence.</p> <p>4) Help your child to follow instructions.</p> <p>a) Move to the same room, remove distractions, and make eye contact before giving an instruction.</p> <p>b) Speak slowly in short simple sentences - one idea per sentence.</p> <p>c) Be polite, calm, but firm - do not plead. Respect breeds respect.</p> <p>d) Give warnings when asking your child to stop something they enjoy.</p> <p>5) Promote better behavior.</p> <p>a) Use rewards to encourage your child to follow rules.</p> <p>b) Only use sanctions, for instance, by taking something your child values, as a last resort to discourage really bad behavior.</p> <p>c) Make it clear what you are rewarding or sanctioning - do not get into debates. Do not use corporal punishment.</p> <p>d) Always follow through on what you promise.</p> <p>e) Record rewards on a chart as soon as possible after the reward has been given.</p>	<p>1) Development of physical health difficulties.</p> <p>a) Monitor the young person's physical health difficulties which may increase challenging behavior.</p> <p>b) Seek support from medical health professionals to address these concerns.</p> <p>2) Environment.</p> <p>a) Consider if environmental changes are having an impact and how you might be able to alter these. For example, is it noisier, hotter, are there more people than usual in the house?</p> <p>3) Triggers.</p> <p>a) Control or reduce setting events (or triggers), i.e., things that happen in the environment or in their body that might make behavior that challenges more likely to happen?</p> <p>4) Communication.</p> <p>a) Communication systems need to be in place - e.g., if a communications system is used at school, then try to ensure that it continues now. People should have maximum support with their communication.</p> <p>5) Routines.</p> <p>a) Think about activities that can replace the usual daily activities.</p> <p>b) What can you include from other routines that will be familiar to the person?</p> <p>c) Choose an activity that you can continue on a daily basis, so you can build a new everyday program together (e.g., if you start cooking, you may not be able to cook everyday).</p> <p>d) It is important that a new routine is followed through in the same way each time.</p> <p>6) Reduce demands.</p> <p>a) At this time of change and increased anxiety, consider reducing demands and expectations. e.g., usually your son/daughter may be able to do XX independently, but currently may need more support because the circumstances are different.</p> <p>b) Provide more access to things the person enjoys, increase their access to preferred activities. These are short-term changes to accommodate a crisis.</p> <p>7) Specific Strategies</p> <p>Provide choice where possible</p> <p>Praise and reward positive behavior</p> <p>Keep language simple and positive</p> <p>Divert or distract</p>

Contd...

Table 1: Contd...

Autism spectrum disorder: Recommendations provided by the NAS - United Kingdom ^[21]	ADHD: Recommendations provided by the EAGG - European Consensus ^[22]	Intellectual disability: Recommendations provided by the challenging behavior foundation - United Kingdom ^[23]
<p>Parents and primary caregivers</p> <ol style="list-style-type: none"> 1) As well as thinking about the children or young people under your care, it is important to take care of your own mental health and well-being. Parents and carers can be more supportive to others around them, especially children, when they are better prepared. 2) Keeping up to date and informed about developments in local service provisions will support timely access. 3) Neurodevelopmental conditions are known to frequently co-occur with each other and a number of mental and physical health conditions. As such, some young people and adults with neurodevelopmental conditions may be considered within high-risk populations. Therefore, parents and primary caregivers should follow governmental guidelines as to appropriate behavior in regard to social distancing, social isolation, and protective equipment, for example, wearing masks. When protective equipment may cause the young person distress, alternative methods of protection or distancing should be considered. 	<p>6) Limit conflicts.</p> <ol style="list-style-type: none"> a) Keep your child occupied and work to routines - plan each day. b) Avoid situations which provoke you or your child. c) Distract your child if they start getting upset - talk about something they enjoy or find funny. d) If you are starting to over-react step back, take a breath, and collect your thoughts before continuing. e) Make a quiet and safe space at home where you or your child can go to calm down. 	<p>Involve them in everyday activities Use body gestures/signs Give reminders of rules and routines Plan activities Withdraw from a situation if safe to do so Give what is wanted at the start to avoid escalation (short-term option) Stay as calm as possible in a low arousal approach</p>

NAS: National Autistic Society, ADHD: Attention-deficit hyperactivity disorder, EAGG: European ADHD Guidelines Group

technologies to ensure continued support.^[24] In regard to ensuring continued access and compliance to medication, effective communication channels between caregivers, pharmacists, and prescribers and implementing solutions for remote monitoring should be developed.^[22]

Furthermore, for parents of young people and adults with neurodevelopmental conditions, timely and accessible information is essential to ensure that they are up to date with changes in the lockdown restrictions. This may include information and guidance around changes in personal protective equipment, restrictions around visiting others or receiving visitors, both social and professional, changing roles of professionals or professional services, such as social care or clinical support, including mental health support and medication prescriptions. Inconsistency in information or obstacles accessing relevant information may further increase uncertainty and anxiety for families and adults with neurodevelopmental conditions. Systems involved in their care such as neurodevelopmental or mental health services, general practitioners, social care, educational providers, or employers should ensure that they are informed with the most up-to-date information. In the absence of typical face-to-face appointments, technological strategies should be employed where appropriate.

SCHIZOPHRENIA SPECTRUM AND OTHER PSYCHOTIC DISORDERS

Patients suffering from psychotic disorders are at higher risk of infectious diseases and tend to have worse medical outcomes than the general population. In particular, most of these patients are affected by clinical comorbidities in the cardiovascular system and metabolic disorders.^[25] These individuals often have a heightened sense of fear, stress, and boredom associated with the lack of stimulation brought by compulsory isolation, poor compliance, and loss to follow-up by their healthcare services. In addition, lack of judgment and poor self-care (self-neglect) seem to hinder compliance with health recommendations which put patients, families, and health professionals at higher risk.^[25]

The authors suggest a series of recommendations for patients, health professionals, and families of people with schizophrenia.

1. Schizophrenia patients should follow the same health instructions and receive the same treatment as clinical high-risk groups for COVID-19, i.e., equality and justice.
2. General practitioners' screening COVID-19 patients should pay special attention to those with schizophrenia who may struggle to report respiratory symptoms.

3. Mental health professionals should remotely monitor unstable outpatients, for which telehealth (internet-based) technologies may be useful.
4. Mental health services should inform patients and families of all procedures to be followed during this period and should provide clear remote contact channels to minimize overcrowding and exposure to potential sources of infection in hospital settings. However, families should also monitor for signs of relapse and contact mental health services as soon as possible.
5. Professionals and families should promote and monitor adherence to antipsychotic medication, ensuring access to prescriptions, and organizing a delivery system, including clozapine.
6. To reduce emotional distress – and possibly psychotic relapse – families and patients should be advised to:
 - a. Anticipate stress reactions and be informed about them by professionals.
 - b. Prepare for quarantine, which can be better adhered to if patients and families receive more information about COVID-19, about the benefits of quarantine (both personally and in terms of public health), and about quarantine procedures (such as adequate supplies of food and medication).
 - c. Limit media exposure, since overexposure to broadcasts of stressful situations has been linked to negative mental health outcomes, and avoid misinformation.

In a rapid review of the evidence of contemporary epidemic and pandemic research to evaluate the potential impact of COVID-19 on psychosis, Brown *et al.* indicated that there is moderate (albeit of low quality) evidence suggesting an increased risk of coronavirus related to psychosis in people exposed to a virus during the pandemics as previous research showed that between 0.9% and 4.0% of people exposed developed psychosis compared with a median incidence rate of 15.2 in 100,000. This is likely to be associated with steroids or viral exposure, pre-existing vulnerability, and/or psychosocial stress and should be treated with low doses of antipsychotic medication, particularly aripiprazole, which seems to have been effective in patients with emerging infectious disease.^[26]

No evidence of changes in the form and content of psychotic symptoms, impact on the physical health of people with psychosis, rates of suicide or attempted suicide, incidence of homelessness, unemployment, and domestic violence was found. Recommendations to policymakers and service managers were to consider

providing some forms of community support using telehealth technology to protect their staff.^[26]

BIPOLAR AND RELATED DISORDERS

Patients with bipolar disorders are likely to suffer from the disruption of medical and health services, increased strain, disrupted sleep and routines, and stigma.^[27] These patients are also more likely to suffer from infections, metabolic disorders, and medical comorbidities than the general population. Medical treatment for COVID-19 is multifaceted (containment and hygiene measures, confinement, physical distancing, and use of antibiotics). As a result, some patients with bipolar disorder may find it difficult to follow and to adhere to while maintaining their specific mental health pharmacological and behavioral treatment. Treatment plans will require active monitoring to prevent adverse side effects and/or lack of response.^[28] Finally, these subjects are likely to face a double stigma stemming from their mental and health problems.^[27]

We need to reconsider novel ways to facilitate access to therapeutic interventions for this patient population. Face-to-face visits could be replaced by telehealth solutions that facilitate assessment, monitoring, diagnosis, and treatment, including issuing prescriptions. In addition, psychoeducation programs, mindfulness sessions, sleep hygiene recommendations, and online support resources specific for bipolar patients could help ameliorate the effects of the pandemic and its forced confinement measures.^[29]

Organizations such as the International Bipolar Foundation^[30] and Bipolar UK^[31] have published practical recommendations on their websites that include:

1. Having adequate supply of medication.
2. Keeping track of manic and depressive episodes.
3. Looking after physical health: Eat well, stay hydrated, get enough sleep, and exercise.
4. Being mindful of lithium toxicity and virus infection.

DEPRESSIVE AND ANXIETY DISORDERS

Social containment measures implemented to control the COVID-19 pandemic are linked with an increased risk of depression and anxiety disorders,^[6,7] and those with established mood disorders are more likely to relapse as a result. Of major concern for these patients are the social containment measures implemented in an attempt to control the pandemic. These patients have demonstrated 21% higher pooled population attributable risk of suicide than their counterparts from the general population.^[32]

According to the WHO, suicide accounts for approximately 800,000 deaths/year. The COVID-19 pandemic has resulted in unprecedented increases in unemployment and social isolation, both of which are well-established risk factors for suicide, nationally and globally.

In a recent paper, Weems *et al.* estimated the increased rate of suicide worldwide to be close to 50,000 individuals as a result of increased unemployment and social isolation brought by containment measures and recommended to weigh the efforts to stop the spread of COVID-19 against these potential collateral mental health effects.^[33] This increase in suicide risk is likely to affect the elderly particularly as pointed out by Yip *et al.* in previous research conducted in SARS-related older adult suicide victims.^[34] The suicide motives were mainly associated with stress over fears of being a burden to their families, social disengagement, mental stress and anxiety related to fear of getting sick and dying, fear of losing people, fear of unpredictable shortages, and economic disaster at the time of the SARS epidemic. Hence, tackling stigma, which requires an integrative approach involving different elements of society, may significantly reduce suicide risk associated with the COVID-19 pandemic.

OBSESSIVE–COMPULSIVE AND RELATED DISORDERS

Patients with obsessive–compulsive disorder (OCD) symptoms related to cleanliness and fear of infection are among the top affected patient population in times of pandemics. COVID-19-related anxiety is likely to exacerbate existing obsessive fears of contamination, which may lead to potentially harmful compulsive acts^[35] or justification of their symptoms, thereby challenging their therapeutic program.

A working group of clinical experts from the International College of Obsessive Compulsive Spectrum Disorders and the Obsessive–Compulsive Research Network of the European College of Neuropsychopharmacology has produced a pragmatic guidance for clinicians to help them manage this patient population.^[35] A summary is presented below with strong encouragement to review the full guidance on the original paper:

1. Take a compassionate calming approach. Use telemedicine, including telephone or video calls.
2. Careful history-taking. Confirm the diagnosis of OCD, paying particular attention to other related disorders such as hypochondriasis, which are likely to be most affected by COVID-19.

3. Suicide risk assessment. Although OCD has not been associated with a high risk for suicide, the presence of with severe obsessions, comorbid depression, bipolar disorder, impulse control disorders, substance use disorders, personality, and eating disorders should be properly evaluated, which may increase the risk.
4. Provide psychoeducation with balanced information about known risk factors and impact of COVID-19 on physical and mental health.
5. Enquire about internet usage and news consumption. Suggest trusted sources to avoid myths, rumors, and misinformation:
 - a. Health education websites:
 - i. WHO (https://www.who.int/health-topics/coronavirus#tab=tab_1)
 - ii. CDC (<https://www.cdc.gov/coronavirus/2019-ncov/infection-control/hcp-hand-sanitizer.html>)
 - iii. Center for Health Security, Johns Hopkins University (<http://www.centerforhealthsecurity.org/resources/COVID-19/index.html>).
 - b. Handwashing videos:
 - i. National Health Service (<https://www.nhs.uk/video/pages/how-to-wash-hands.aspx>)
 - ii. CDC videos (<https://www.youtube.com/watch?v=3EoAyQu3LI8>).
1. If OCD symptoms are the main problems:
 - a. Review medication status as a priority: Pharmacotherapy should be the first option for adults and children with OCD with contamination, washing or cleaning symptoms during the COVID-19 pandemic.
 - b. Review and risk: Assess the cognitive-behavioral therapy (CBT) plan, including considerations around feasibility and compliance with the government safety guidance. We suggest therapists to regularly check, e.g., by phone or digitally, those OCD patients more likely to engage in particularly harmful decontamination rituals or behaviors. Video calls should be recommended, where possible.
 - c. Deep brain stimulation (DBS): Delaying the implantation of electrodes in OCD patients waiting for DBS until the outbreak is over, although it is worth noting that these subjects suffer from highly disabling treatment-resistant OCD symptoms.
 - d. Social and occupational care: Patients under quarantine or staying at home under national restrictions are at great risk of circadian rhythm disruption which could increase anxiety and worsen OCD symptoms. Offer guidance

regarding a rational amount of time spent listening to news may help the isolated patient to overcome loneliness. Regular communication with friends, family members, and loved ones regardless of distance, for instance, via online platforms, such as Facetime, Skype, and Zoom, is essential. Patients and family members should also be encouraged to keep weight under control.

- e. Carer support: Family members and carers are at increased risk of stress-related disorders and may therefore need additional support.

TRAUMA- AND STRESSOR-RELATED DISORDERS AND DISSOCIATIVE DISORDERS

The profound loss, stress, and fear associated with COVID-19 are likely to exacerbate previous mental health disorders and contribute to the onset of new stress-related disorders.^[36] This pandemic is exerting unusual pressure on our collective healthcare, political, economic, and social-welfare systems given the profound loss, stress, and fear associated with COVID-19 will likely exacerbate existing mental health disorders and contribute to the onset of new stress-related disorders for many.^[36] Patients suffering from trauma and/or those developing *de novo* symptoms might benefit from concerted efforts targeting diagnostic process, prevention, public outreach, and communication by liaising with mental and physical healthcare services and designing “COVID-19 and Trauma” research projects.^[36]

SOMATIC SYMPTOM AND RELATED DISORDERS

Little is known about the effects of COVID-19 on patients suffering from somatic symptoms/disorders. A Chinese large-scale survey of psychological distress in the general population during the COVID-19 pandemic showed that almost 35% of respondents had experience psychological distress (described as experiencing either anxiety, depression, specific phobias, cognitive change, avoidance and compulsive behavior, physical symptoms, and loss of social functioning) during 7 days before the survey being conducted.^[37] Another study revealed that patients who experienced COVID-19 were more likely to have depressed mood and somatic symptoms in the subitems of the PHQ-9, compared to individuals under quarantine.^[38]

FEEDING AND EATING DISORDERS

In brief, eating disorders are characterized by food restriction. Food insecurity and panic buying both have

occurred during the COVID-19 pandemic and may have a detrimental effect on patients with eating disorders.^[39] In keeping with this, Touyz *et al.*, writing in *the Journal of Eating disorders*, warned us that these patients have a complex and difficult relationship with food and that food insecurity and panic buying will worsen it. Exceptionally, low-weight people with anorexia nervosa may be particularly vulnerable to COVID-19 because of their compromised physical health. People with bulimia nervosa and binge eating disorder, however, might encounter increased family conflict, higher risk of depression and anxiety, self-harm behaviors, or even suicidality when their bingeing behavior impacts on the family’s food at a time when restocking is problematic.^[39] Healthcare systems should address the special needs of eating disorder patients. In the short term, standard treatment approaches should be re-considered and CBT group programs through video conferencing delivered, which have proven effective under similar circumstances.^[39,40]

SLEEP-WAKE DISORDERS

The prevalence of insomnia diagnoses according to the DSM-IV Classification is at 6%.^[41] Mental disorders and organic diseases can increase the risk of insomnia. On the other hand, individuals with insomnia are more likely to have a major depressive illness and longitudinal studies have shown that the persistence of insomnia is associated with the appearance of a new depressive episode.^[41] We now know that over a third of the frontline medical staff who first attended patients in China suffered insomnia symptoms during the COVID-19 outbreak^[42] and that the disruption brought by changes in social mobility, exercise, and work patterns resulted in increased risk of anxiety-, depression-, and trauma-related symptomatology;^[10] and hence, it is likely that those patients with existing sleep-wake disorders will see their symptoms worsened by the physical and mental health impact of the pandemic.^[43]

SUBSTANCE-RELATED AND ADDICTIVE DISORDERS

COVID-19 could be an especially serious threat to those who smoke tobacco or marijuana or who vape. People with opioid use disorder and methamphetamine use disorder are also high-risk COVID-19 groups due to the respiratory effects of these drugs.^[44] In addition, people with substance use disorders tend to have limited access to healthcare services and high levels of housing and employment insecurity and incarceration, all of which are well-known risk factors of suicide. As alluded to above, access to mental healthcare and substance use disorders

treatment is likely to be hindered by the COVID-19 pandemic. The use of telemedicine might mitigate this, however, which is particularly relevant in such a vulnerable population.^[45]

NEUROCOGNITIVE DISORDERS

Individuals with Alzheimer's disease and related dementia (ADRD) are a very high-risk group for COVID-19 infection in terms of morbidity and mortality because of their age, frequent medical comorbidities and difficulties in understanding and complying with public health recommendations due to cognitive impairment or comorbid mood or psychotic symptoms.^[46] Of concern, nonurgent clinical management of these patients may be postponed, while healthcare systems struggle to cope with the unusual demand in emergency services. Communities will find it harder to support individuals with ADRD, both informally through relatives and formally through professional caregivers, because of confinement and containment measures. In addition, financial adversity will hit harder those with limited resources and families should be supported and provided with essential services. Mitigation strategies, such as telehealth solutions, might be necessary to support ADRD patients, carers, and clinicians.^[46] Support for people living with dementia and caregivers should be delivered collaboratively by multidisciplinary health and social care teams which meet patient physical, mental health, and psychosocial needs. Self-help interventions such as relaxation and meditation exercises should be encouraged. Behavioral management and support could be delivered through telephone and psychological interventions could be provided online as these emerging technologies can be harnessed to secure social support networks and a sense of belonging.^[47] In summary, the impact of COVID-19 on these patients will depend on a variety of factors, such as the severity of cognitive impairment, whether there is associated agitation, type of residential placement, existence of informal and formal care support networks, availability of resources, and how strict public health measures deployed to control the pandemic are. Therefore, making simple generic recommendations appears to be impractical.^[46]

SUMMARY

We are living through the worst global natural disaster of our generation. The likely adverse effects of the pandemic on population mental health will be exacerbated by fear, self-isolation, and the physical distancing imposed by public health organizations until a vaccine or specific treatment is found. In other words, COVID-19 core

prevention measures, namely physical distancing and confinement, may succeed at the price of worsening mental health outcomes. These mental health problems will be experienced by the general population, and more acutely so, by those with high levels of exposure to COVID-19 such as frontline healthcare workers, those who eventually develop severe symptoms of the infection by SARS-COV-2, and those with previous mental health problems.

The COVID-19 pandemic will cause untold psychological distress and lead many people to develop mental health problems which are likely to become chronic in some cases and might even peak much later than the actual pandemic, which is known as the post-COVID fourth wave. Those with premorbid mental disorders might experience worsening of symptoms, while others might develop new-onset mental health problems, especially depression, anxiety, and posttraumatic stress.^[48]

Strategies should be therefore prioritized, including a concerted effort between public and private institutions providing evidence-based online resources and free of cost scalable interventions.

These therapeutic interventions should target specific at-risk populations such as healthcare staff, particularly those working in intensive care units, those with physical and mental comorbidities and chronic conditions, children and parents, and those with low levels of education or who suffer from bereavement, perceive themselves at risk, or live in outbreak hotspots.^[49] Stepped care (i.e., delivering the most effective, yet least resource-heavy treatment to patients in need and then stepping up to more resource-heavy treatment based on patients' needs) may thus be a useful approach to meeting mental health needs during the COVID-19 pandemic.^[13]

THE ROLE OF TELEHEALTH AND VIRTUAL REALITY IN REDUCING COVID-19 MENTAL HEALTH BURDEN

As the comprehensive review above suggests, the COVID-19 pandemic is having a huge negative impact on the general population, especially frontline workers and those with mental health issues. Isolation, fear, and uncertainty are leading to mental health issues in the general public and are exacerbating problems for those suffering from mental health issues. Digital therapeutic technologies offer a cost-effective, scalable solution to address these mental health problems as part of a multipronged approach.

For example, video-based telemedicine in which a patient uses a flat-screen video service to “meet” with their mental health professional can serve as a stopgap and in some cases a replacement for in person visits. Although physical contact is precluded, with video, the mental health professional can still read verbal and nonverbal cues and can undertake a synchronous interaction. If wearable sensors are incorporated, physiological measures can be shared with the mental health professional in real time.

There is a growing body of evidence supporting the effectiveness of video-based mental health solutions, especially in the context of depression, anxiety, and PTSD. This digital technology can be used for diagnostic screening, treatment, and monitoring as well as to deliver psychoeducation, support, and relevant trustworthy information.^[50]

VIRTUAL REALITY FOR BEHAVIORAL AND MENTAL HEALTH

VR-based behavioral and mental health solutions offer an innovative complement to video-based solutions or in person mental health solutions. VR, unlike any other digital therapeutic technology, broadly engages multiple systems in the brain, including cognitive, emotional, behavioral, and experiential learning systems.^[51] VR leads to a sense of immersion and presence that can only be matched by real-world experience. Thus, VR can transport a patient into any virtual, realistic environment to address multiple mental health issues with consistency, scalability, and 24/7 availability. No other digital therapeutic technology has this power and potential.

Innovative approaches to the use of VR for several treatments have been developed. These include approaches to reduce stress and promote relaxation,^[52] to treat PTSD^[53] and anxiety disorders,^[54] to facilitate pain management,^[55] treat addiction^[56] or psychosis,^[57] and as assessment tools.^[58] There are hundreds of other solutions currently in the development.

VR has been used extensively to complement in person therapy for anxiety, including public speaking, phobias, fear of flying, and panic attacks, to name a few. Patients are immersed in VR while physically present with the mental health professional. The mental health professional can track physiological and subjective metrics and can increase or decrease the anxiety-provoking exposure. With the recent COVID-19 pandemic, mental health

professionals and VR mental health solution providers are exploring remote applications of these same anxiety reducing solutions. Patients can be provided with VR headsets (or the inexpensive Google Cardboard) and can be immersed in mental health relevant environments from the comfort of their own home while connected via some telemedicine platform with their therapist. Patients can be assigned “homework” as well, to speed progress on the therapeutic journey.

Another fascinating application of VR is in social and interpersonal skills and eating disorders. The ability to “walk a mile in someone else’s shoes” in VR is especially important for interpersonal and social skills development to allow the patient to “experience” how they are perceived by others. Analogously, the ability to “walk a mile in your own shoes” in VR can provide insights to a patient suffering from an eating disorder. Patients can gain direct experience with their distorted of body image and can help them correct these distortions in the interest of developing a more realistic perception.

Across all of these applications, one primary strength of VR is the consistency of experience, the scalability of the application, and the 24/7 availability. All of these behavioral and mental health issues are issues in “learning.” It is well established from over a century of basic science research on learning^[59] that learning and the relevant behavior change require hundreds if not thousands of repetitions. VR provides the opportunity to meet this need.

EMBODIED VIRTUAL REALITY

The future of VR in mental health (and many other applications) is in the full embodiment in VR. The majority of VR applications use visual and auditory cues to create the sense of immersion and presence. This is highly effective in behavioral and mental health; however, as haptic, tactile, and olfactory senses are incorporated, the feeling of embodiment will increase. The potential here is huge. Embodied VR has the potential to facilitate remote therapies that can be more consistent, scalable, and available. Embodied VR can more directly address body image disorders and facilitate the development of appropriate eating behaviors. Embodied VR can directly address the foundational problems associated with isolation and loneliness brought on by the pandemic. Embodied VR is still relatively novel, and more empirical and technical work is in order. Even so, the value is clear and the evidence is growing.

The need for these digital therapeutic technologies and their growing value is not going unnoticed by the medical community. The *Journal of the American Medical Association* recently published an opinion piece arguing for the creation of a new medical specialty focused on virtual care called “medical virtualist.”^[60] Nowadays, the information and communication technology (ICT) has evolved to provide enough resources (software and hardware) to make it possible. The success to technology-based services is not determined by ICT access alone but also by ease of use, perceived value, and workflow optimization.^[59] The coordination of virtual care with home visits, remote monitoring, and simultaneous family engagement is changing the perception and reality of virtual healthcare. These services need the collaboration of stakeholders across healthcare.

The use of VR for physicians should include certificated training to improve skills and competences in the use of new technology. The “medical virtualist” specialist will cover the aspects of nonphysical examination therapies. Furthermore, new therapies derived from quarantine isolation will consider new approaches for the relationship between physicians and patients.

SUMMARY AND CONCLUSIONS

The COVID-19 pandemic represents the worst global natural disaster of our generation. As this article suggests, the COVID-19 pandemic is negatively impacting the general population, especially frontline workers, isolated older adults, and those with mental health issues. It is leading to mental health issues in the general public and is exacerbating problems for those already suffering from mental health issues. In this article, we offer the most up-to-date review of the effects of COVID-19 confinement on all the disorders listed in the DSM and make data-driven predictions of the impact of COVID-19 confinement on each. We discuss the potential of digital therapeutic technologies, such as video-based telehealth and immersive VR that offer cost-effective, scalable, on-demand solution to address these mental health problems as part of a multipronged approach. The time to act is now. We need to act decisively and collaboratively. We are all vulnerable to suffer from mental illness and health problems. We can all benefit from establishing and improving access to new ways to tackle these problems, and digital therapeutic technologies are available to help.

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Conflicts of interest

Psious and IKONA are privately owned digital health companies.

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