

# The Mental Health of Frontline Health Care Providers During Pandemics: A Rapid Review of the Literature

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**Objective:** This rapid review addresses two key questions posed by the COVID-19 pandemic: What are the anticipated mental health sequelae for frontline health workers? and What are best practices during health emergencies to address the mental health needs of these workers?

**Methods:** This review synthesized the literature on the mental health sequelae for health workers during major pandemics and epidemics that occurred in the 21st century (severe acute respiratory syndrome, Middle East respiratory syndrome, Ebola virus disease, and swine flu) and interventions used to address related mental health sequelae. PubMed, MEDLINE, and PsycINFO were searched with terms related to these epidemics/pandemics.

**Results:** Of 3,876 articles retrieved, 94 were included in this review. Across these studies, most health workers exhibited some adverse psychological experiences during outbreaks, with stress and anxiety being most common.

Psychological distress decreased over time. Some studies reported insomnia, burnout, and posttraumatic stress for a subset of individuals up to 3 years after the disease outbreak. Few interventions have been implemented to address providers' mental health needs, and these strategies have not been evaluated systematically.

**Conclusions:** Systems-level interventions may alleviate distress for most providers without the need for specialized mental health intervention. Psychotherapeutic support and referral to specialty care should be available to health workers with severe and intense adverse psychological outcomes during and beyond the COVID-19 pandemic. Evidence-based interventions are urgently needed to better serve health workers both during and following epidemics/pandemics.

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The COVID-19 pandemic has abruptly triggered extreme changes and challenges in the delivery of health services. Frontline health workers responding to this pandemic are encountering many sources of stress, and emerging evidence indicates that the COVID-19 outbreak has already taken a toll on these workers' mental health. In China, health care workers who directly cared for patients with COVID-19 had higher rates of depression, insomnia, and distress than health care workers who were not on the front lines (1). In Wuhan specifically, health care workers were twice as likely as administrative staff to experience anxiety and depression (2). Irrespective of the source, psychological distress of health workers is associated with poor-quality care and reduced safety for patients (3). Health crises are associated with health care provider burnout and an increased likelihood of providers leaving the health care profession (4). Together, these observations underscore that addressing the mental health needs of COVID-19 health care workers is of high priority.

Despite an abundance of general research on provider mental health during health and other emergencies,

research specific to epidemics and pandemics is limited. Pandemics and epidemics uniquely threaten public health because an effective treatment or a cure often is not available. Unlike other types of emergencies, these health threats can

## HIGHLIGHTS

- Most, if not all, health care providers responding to the COVID-19 pandemic will experience some adverse psychological outcomes, but a significantly smaller subset will require referral to specialized mental health services.
- The evidence indicates that a stepped-care mental health response—proactive health care leadership, psychotherapeutic intervention, and referral to specialized care—will properly allocate mental health resources and treatment to best support health care workers experiencing adverse psychological outcomes during and beyond the COVID-19 pandemic.
- Evidence-based mental health interventions need to be developed and assessed to better serve health care workers both during and after pandemics.

run a protracted course, with a high degree of uncertainty about the progression or suppression of the illness.

To date, no systematic literature review has provided summary information about the specific factors affecting the mental health of health care workers and the needs of these workers during major pandemic and epidemic outbreaks or about mental health interventions targeted to this specific context and population. To the best of our knowledge, this article represents the first such review of the literature. In response to a need to quickly inform policy makers and mental health practitioners during the COVID-19 pandemic, we used a rapid review process to assess health workers' mental health during four past pandemics and epidemics: severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), Ebola virus disease (EBVD), and swine flu. These viral diseases, several of which contributed to major outbreaks in the 21st century, were chosen because the mental health implications of these events have the potential to inform the mental health burden of the current COVID-19 pandemic.

## METHODS

The World Health Organization recommends conducting rapid reviews when developing health threats require a quick synthesis of the evidence to produce guidance for the public (5). The advancing COVID-19 pandemic prompted this review. Our goal was to create a short but in-depth synthesis of the current state of science on the topic of mental health of health care workers during and after epidemics or pandemics. We included both quantitative and qualitative studies in this analysis to provide the most comprehensive overview of the literature. Two study authors (E.M. and Z.S.) screened all titles and abstracts, extracted and synthesized study data, and reviewed the findings. The senior author (K.M.P.) assisted in question development as well as synthesis and review of study data.

The overarching questions guiding this review were the following. What are the anticipated mental health sequelae for COVID-19 frontline health care workers? What evidence do we have about best practices to address these expected mental health care needs?

We developed and refined several secondary questions as the review progressed. What factors may lead to adverse psychological outcomes among frontline health care workers? Which health workers are at higher risk for experiencing heightened adverse psychological outcomes or adverse psychological outcomes requiring specialized support? Are there changes in the anticipated mental health sequelae for health workers beyond the pandemic?

The rapid review method we used is similar to Khangura and colleagues' (6) seven-step process. The present rapid review used data from four major global pandemics and epidemics since 2000 (SARS, MERS, EBVD, and swine flu). Data from these outbreaks provide an overview of mental health risks associated with such events and have the

potential to inform mental health strategies in the context of COVID-19. Using PubMed, MEDLINE, and PsycINFO, we identified research articles published in the 2000–2020 period by using the MESH terms “pandemic” and “mental health” and the following non-MESH keywords: “severe acute respiratory syndrome,” “Middle East respiratory syndrome,” “swine flu,” “H1N1,” “Ebola,” “mental disorder,” “depressi\*,” “anxi\*,” “panic,” “fear,” “stress,” “suicide,” “psych\*,” and “psycholog\*.”

For studies to be included in this review, they had to report original research, be published in English in peer-reviewed journals, be reporting on one of the aforementioned four pandemics or epidemics, and include data on mental illness, psychological well-being, or closely related mental health indicators among health care workers. The selected studies provided descriptive data on mental health indicators and evaluated mental health interventions for health care workers during one of the designated outbreaks.

After removal of duplicates, the initial search (conducted on March 28, 2020) yielded 3,876 titles or abstracts. A full description of the search and review strategies and a PRISMA diagram of study flow is included in an online data supplement to this article. Although the research protocol used in this review adhered to PROSPERO guidelines, the requirement for timely publication did not allow for submission of this work for formal PROSPERO review.

Study-level data were extracted on key components addressing our research questions, including study setting (country, dates, related pandemic, time relation to the outbreak, and target population), study design (quantitative or qualitative and type of data analysis), mental health impact evaluated (impact tested, measurement tool, and results), factors related to mental health outcomes (factors identified and their association with these outcomes), and mental health intervention tested (name, related framework, measurement tool, and results). We also analyzed qualitative studies by using grounded theory analysis related to mental health impacts or interventions described in each study. We used convergent analysis to synthesize quantitative results and qualitative themes emerging from the search.

## RESULTS

### Overview of the Literature

Our screening process yielded 94 studies from which we extracted data for our analysis and review. Major foci and topics of these studies included qualitative reports on provider mental health (N=35), prevalence of mental health outcomes (N=29), correlations between sociodemographic and work-related factors and mental health outcomes (N=26), and the impact of interventions on provider mental health (N=4). The coverage of diseases included in these studies was as follows: SARS, 51% (N=48); EBVD, 25% (N=23); MERS, 18% (N=17); and swine flu, 6% (N=6).

The studies were done in 24 countries, with >10% conducted each in Taiwan (N=16), Canada (N=13), and Sierra

Leone (N=11). Of the 94 studies, 67% (N=63) included more than one type of health care worker, and 23% (N=22) focused exclusively on nurses. The remaining studies focused on doctors (N=3), hotline workers (N=1), medical students (N=1), midwives (N=1), social workers (N=1), Chinese medicine practitioners (N=1), and volunteers (N=1).

All studies reported evidence that outbreaks adversely affected mental health among health care providers. The mental health outcomes studied were stress (N=32), anxiety (N=26), posttraumatic stress disorder (PTSD; N=25), a general measure of mental health (N=18), depression (N=16), and sleep (N=4). Two studies also measured obsessive-compulsive behavior and paranoid ideation (7, 8), and one study measured substance abuse (9). Most studies assessed mental health symptoms, with only 18% (N=17) measuring criteria for full mental disorder diagnosis.

The results section provides summary information about the three types of mental health outcomes found across all studies: common adverse psychological outcomes, heightened adverse psychological outcomes, and adverse psychological outcomes requiring specialized support. Each of these subsections includes results related to the review's primary and secondary questions: prevalence of mental health symptoms, factors associated with these symptoms, and interventions conducted to relieve these symptoms. The last subsection describes studies that analyzed the mental health sequelae of frontline health workers up to 3 years after the outbreaks studied and that evaluated interventions conducted postoutbreak.

### Common Adverse Psychological Outcomes

Overall, several adverse psychological consequences during disease outbreaks were found to be common among health care workers. Across the 94 studies, between 18% and 89% of health workers were reported to exhibit general psychological distress while working during a widespread disease outbreak. The most commonly reported mental health symptoms included stress (ranging from 42% to 89% in studies that assessed stress) and anxiety (ranging from 56% to 100% in studies that assessed anxiety). Depressive symptoms were also noted, with a prevalence between 28% and 77% among nurses in the SARS outbreak (10).

Across the disease outbreaks, work-related stressors were reported as factors most directly leading to these adverse psychological consequences. The most common mental health-related factor among providers was fear of infection and spreading infection to family members (11–21). Up to 75% of health workers worried about spreading the infection to others, including their family, and felt that they were responsible for their family members' social isolation (14, 15, 21, 22). This fear led many health workers to isolate themselves after their work shifts; 15% of staff members reported not going home after work to avoid infecting their family with SARS (11, 23). Throughout multiple studies, health workers associated this isolation with increased loneliness and sadness (20, 24).

Workload stress—defined heterogeneously across studies as increased workload, changing work duties, shortage of medical supplies and personnel, lack of safety for infection prevention, unfamiliarity with correct infection protocols, lack of agreement on treatment protocols, and inconsistent organizational support—was directly associated with anxiety and generalized stress levels of health care workers (8, 10, 18, 22, 24–28). Significant or severe job-related stress was reported by 68% of health workers surveyed during the SARS outbreak (29). Health workers in four qualitative studies directly reported that inconsistent information or misinformation from hospital management led to mistrust of authority as well as anxiety and stress among health care staff (30–32). Moreover, four studies found that a lack of community support and network among health workers caused high levels of anxiety, fear, and stress (15, 33–35). A study of nurses in Taiwan found that 26% felt such intense stress due to the SARS outbreak that they reported looking for another job (36).

Across pandemics, an additional factor related to the mental health of health care providers was stigma. Five studies examined the prevalence of stigmatization among health workers during the SARS and EBVD pandemics and found that between 20% and 49% of workers felt socially stigmatized during these outbreaks (22, 30, 37–39). Workers reported feeling stigmatization by family and friends and the larger community. One example of community stigmatization was being avoided while wearing hospital uniforms on public transportation systems (40). Inaccurate media coverage was identified as a main cause of misinformation that led to stigmatization (41). Stigma was correlated with increased anxiety, depressive symptoms, and posttraumatic stress (PTS) symptoms (37, 42). Health care workers describing their experience during the SARS outbreak in Canada reported that they felt so much stigmatization that they would avoid identifying themselves as health workers (43).

It is important to note that not all mental health outcomes identified from pandemics were negative. Twelve studies noted positive psychological effects on health care workers, including a renewed appreciation for the meaning and importance of their profession, feelings of appreciation from society, courage, self-awareness, and emotional connectedness with other health care providers (12, 15, 29, 33–35, 44–48). Across all four studies that measured prevalence of positive mental health outcomes, >75% of health care workers reported these positive mental health outcomes in addition to adverse psychological outcomes noted in each study (12, 29, 44, 45).

Studies consistently reported that heightened mental distress diminished when health care workers were supported in the workplace and by communities. Evidence was found that hospital systems-level activities, even those not directly related to mental health care, limited and improved adverse psychological outcomes among providers across outbreaks by engendering confidence and enhancing the

positive psychological effects described above. For example, a SARS prevention program implemented in Taiwan resulted in decreased depression and anxiety for health workers (49). Health workers commonly cited effective institutional and organizational support and leadership as being critical to reducing mental distress and burnout, allaying anxiety and fear, and increasing confidence (13, 16, 26, 30, 31, 33, 45, 46, 50–57). Training, access to necessary equipment, clear communication, and outward praise from hospital leadership were all noted across studies as particularly supportive of health workers' mental health (46, 51, 52). In one study, the potential for additional compensation for exposure to MERS was mildly effective in reducing stress during the outbreak (57).

Beyond hospital-level interventions, five studies analyzed how individual health workers' coping behaviors affected their mental health (28, 38, 58–60). Coping measures assessed across these studies included religious practices, using emotional supports, taking sleep medication, reducing travel, venting, engaging in social isolation, self-distraction, denial, and substance use. Overall, no clear correlation was detected between individual coping behaviors and mental health status. Findings from one study suggest that two common coping strategies, behavioral disengagement from work and self-distraction, had the highest correlation with overall distress level (60).

### Heightened Adverse Psychological Outcomes

Beyond the common adverse psychological outcomes of stress, anxiety, and depressive symptoms during a pandemic, some health care workers will experience heightened levels of psychological distress that require more specific mental health supports and services. Evidence suggests that the presence of PTS symptoms is one adverse psychological outcome that may be particularly heightened among providers during pandemics and epidemics: 93.5% of health workers at a SARS-affected hospital in China considered the outbreak to be a traumatic event (53). Across studies, up to one-third of health workers reported moderate to severe PTS symptoms during the outbreaks (range 10%–33%). Up to 1 year after the outbreaks, these scores remained relatively consistent (range 1%–32%) (8, 9, 13, 21, 61, 62). Among South Korean nurses working at isolation hospitals during the MERS outbreak, 25% experienced all PTSD symptoms after the outbreak and another 32% experienced a moderate or low level of PTS symptoms (61).

Persistent anxiety and generalized stress symptoms led to panic attacks, insomnia, and burnout in some studies. One study reported sleep disturbances among 37% of nurses surveyed during the SARS outbreak (63). Among health workers from a Toronto hospital who treated SARS patients, 19% experienced panic attacks even up to 2 years after the outbreak (9). Between 19% and 50% of health workers experienced burnout 1 year later (52, 62).

It is important to anticipate which health care providers are at greater risk for higher levels of adverse psychological

outcomes during a pandemic. The overall trend across all pandemics and epidemics studied here is that workers who had direct contact with infected patients had a higher prevalence and severity of mental health symptoms than those who did not. One study that compared PTS symptoms among providers 1 to 2 years post-SARS outbreak in Canada found that 14% had high PTS symptoms at a high-contact hospital, compared with only 8% at a low-contact hospital (62).

Among providers who worked with infected patients, those in higher-risk wards (e.g., intensive care units or emergency departments) had higher rates of psychological distress. This was true during (53, 63), immediately after (8), and up to 2 years after (62) the outbreak. One study found that 22% of health workers who worked in the emergency unit at a Chinese hospital during the SARS pandemic met criteria for PTSD, compared with 13% of health workers who worked in the psychiatric ward (53).

Of interest, three studies found that health care workers who worked in hospitals treating patients affected by the outbreak but who did not directly work with the patients themselves had higher stress and anxiety than those who worked directly with these patients (43, 64, 65), and one study found that the distress of these workers was higher than that of other professionals even at 3 years postoutbreak (64). Significantly higher anxiety was also found among providers who worked only with one patient affected by the outbreak than among providers who worked with two or more infected patients (66). A suggested reason for this finding was that providers caring for numerous patients either have a high level of knowledge and training a priori or develop greater experience in the course of the pandemic than workers on other wards or those who are less involved in pandemic care (67).

Several studies indicated that having fewer years of health care experience correlates with increased anxiety (9, 36, 61, 67). Of note, health care workers in underresourced or inadequately resourced settings with less training also reported higher levels of mental distress (22, 25, 27, 30, 32, 40, 45, 56, 68–70).

From the studies surveyed, it remains unclear whether a health care worker's specific discipline influences adverse psychological outcomes. Four studies noted that nurses were more likely than other health workers to exhibit adverse mental health symptoms (52, 65, 71, 72); however, two studies found that doctors were most likely to show psychological distress (13, 14). One study suggested that this could be a function of varied professional responsibilities, rather than discipline, in diverse contexts resulting in differences in risk for disease exposure (14).

Limited data exist on the efficacy of psychotherapeutic interventions for health care workers. Three studies reported primary outcome data on specific mental health interventions, which were all forms of low-intensity psychotherapeutic support consisting of group workshops or one-on-one counseling sessions. The interventions evaluated

were brief cognitive-behavioral therapy (73); narrative medicine (74); and combined peer support, debriefing, and psychoeducation (55). Six studies assessed the effect on providers of any type of mental health support, including general psychological support workshops, mental health debriefing sessions, individual counseling sessions, sleep aids, and a social media platform targeted to mental health support (17, 26, 28, 35, 40, 75).

Respondents across all studies reported that specific interventions and general psychological support services were beneficial to their mental health; however, only one study quantitatively assessed a specific peer-led mental health intervention, finding that it significantly alleviated stress, depression, and anxiety (73). Across qualitative assessments, health workers reported improvements in stress, depression, and anxiety, as well as sleep (55, 74). One qualitative analysis found that health hotline workers who worked during an EBVD epidemic and participated in support groups most valued having the opportunity to meet in a safe space that sustained their emotional resilience by helping them to manage their stress (55). When nonspecific mental health supports were assessed, the vast majority of health care workers reported that these supports were beneficial for their well-being (17, 36, 40). These included, for example, establishing a communications platform for workers to support each other and training sessions that both increased provider confidence about safely delivering care and reduced stress by acknowledging the stressful work context and providing community connection and support. Nurses in one study who participated in mental health debriefing sessions suggested that these sessions could be more effective if they flexibly matched individuals' work shifts, had fewer participants per group session, and were shortened to  $\leq 50$  minutes (17). In addition, these nurses asked for continuing mental health services beyond the outbreak, reflecting the perceived success of the health debriefing intervention.

### **Adverse Mental Health Outcomes Requiring Specialized Support**

It is clear from the evidence reviewed that a limited percentage of health care providers develop adverse psychological outcomes that meet the full diagnostic criteria for mental disorders requiring specialized care in the context of these extreme working conditions. One study found that despite ubiquitous reports of stress symptoms among providers at a hospital during the SARS outbreak in Taiwan, only 11% of these providers exhibited full stress reaction syndrome (76). Another study found that 100% of providers reported minimal anxiety, but none reported severe anxiety, during the MERS outbreak in Saudi Arabia (67). After the SARS outbreak in Toronto, 5% of health care workers were diagnosed as having a new psychiatric disorder in the year after the pandemic (9); the authors noted that this incidence rate was lower than that reported for Toronto's general population. Across three studies, providers who had

preexisting mental health conditions were more likely to exhibit severe mental health outcomes during outbreaks (9, 68, 77). No further data were reported on risk factors for severe mental health outcomes related to the outbreaks, and no studies reported specifically on treatment for health workers with severe mental health outcomes during or after pandemics.

### **Mental Health Beyond the Pandemic**

Across the disease outbreaks covered in the studies, mental health consequences did not end after the outbreaks ceased. Several studies (N=19, 20%) assessed the mental health of health care providers following outbreaks. These studies were conducted immediately after the outbreak (7, 13, 21, 53, 58, 61, 78), up to 6 months after the outbreak ended (77), 1 year postoutbreak (9, 19, 62), 1 to 2 years postoutbreak (12, 18, 33, 72, 79, 80), and up to 3 years postoutbreak (10, 81).

Within this time frame, the providers continued to report adverse mental health outcomes; however, the number of symptomatic individuals and the severity of symptoms tended to decline over time. Immediately after an epidemic/pandemic had ended, most studies found that about half of the health care workers surveyed continued to experience psychological distress (range 14%–57%). At 1 year postoutbreak, the range of health workers reporting psychological distress symptoms remained between 17% and 45%.

During the acute onset of the disease outbreak, the percentage of health workers reporting distress ranged from 18% to 68% (29, 77), and about 20% of health workers exhibited PTS symptoms (13). Studies that assessed psychological outcomes at 1 year found that general psychological distress was still elevated but lower than the levels experienced during and immediately after the outbreaks; this was true for PTS symptoms (61), depression (10), anxiety (19, 58), and generalized stress (52). Two studies showed that after both SARS and MERS outbreaks, health care workers reported continuation of—and even an increase in—sleep disturbances, up to 1 year after the outbreak ended (79, 80). One study found that 4% of hospital employees reported high PTS symptoms 3 years post-SARS outbreak, compared with 10% during the outbreak itself (81).

Physical isolation during mandatory quarantines was reported to increase interpersonal stress (82), anxiety (67), and exhaustion (54). One study specifically studied health care worker stress levels on being quarantined after the SARS pandemic in Canada, finding that adverse mental health sequelae were expressed in both somatic symptoms, such as headaches, and psychological symptoms, such as stress (83). Time spent in quarantine predicted higher levels of emotional exhaustion (54). After returning from quarantine, the workers continued to experience community stigma, which was associated with continued stress (42).

Health care providers who had lost family members or coworkers to the viral epidemic/pandemic were among those who experienced continued psychological distress

**TABLE 1. Overview of the intervention types that may support provider mental health during and after the COVID-19 pandemic**

| Who needs support?   | What percentage of health workers? | What can be done?  | Who is responsible?                              |
|--|------------------------------------|--|--|
| All health care providers who report any adverse psychological outcomes  | Up to 100%                         | Hospital-level interventions: clear and consistent communication, public support for providers, training, and provision of necessary protective equipment                    | Hospital leadership                              |
| Health care providers exhibiting moderate psychological symptoms. Providers especially at risk include nurses, providers with extended contact with patients with COVID-19, and less-experienced providers.                                      | Around 50%                         | Psychotherapeutic support services: individual or group psychotherapy, narrative medicine, and peer-led support groups (all evidence-informed but lacking an empirical base) | Peer providers, community laypersons, counselors |
| Health care providers exhibiting severe psychological symptoms or prolonged psychological symptoms. Providers especially at risk include those with preexisting mental disorders and those who witness deaths from COVID-19 of people they know. | No more than 15%                   | Referral to specialty mental health services   | Specialized mental health practitioners          |

immediately after and beyond 6 months postoutbreak. This was particularly true in Sierra Leone after the EBVD outbreak, in which an estimated 21% of the overall health care workforce died from the disease (40). One qualitative study found that 87% of health care workers surveyed had depressive symptoms postoutbreak that they associated with witnessing colleagues die (37).

Many of the psychotherapeutic interventions described above were implemented or continued postoutbreak to support providers experiencing continued adverse psychological outcomes, including group therapies (74) and narrative writing workshops (73). Health care workers also leaned on their work community after the outbreak because of their unique experience of working together during the disease outbreak. One study found that 29% of health workers reported feeling isolated after the outbreak because of the challenges caring for infected patients, an experience they could not fully explain and process with family members and friends (41). Health care workers in three studies reported that supportive work environments extending beyond the outbreak's end, along with continued praise and acknowledgment of the hardships faced by health care professionals, significantly improved their well-being and transition back to normal work (16, 51, 84). In one study, supervisor support had a strong buffering effect that limited turnover intention among nurses after the MERS outbreak (61).

Table 1 provides an overview of the types of interventions that can be implemented to support the mental health of health care providers both during and after outbreaks according to the evidence presented in this review.

Several studies of the 94 we surveyed are not specifically mentioned in the foregoing but are included in the references (85–100) and in an online data supplement.

## DISCUSSION

The purpose of this rapid review was to synthesize and describe what is currently known on the topic of mental health of health care providers during pandemics and epidemics to inform the mental health response to the COVID-19 pandemic. The data from recent widespread disease outbreaks indicate that most, if not all, health care providers responding to COVID-19 will experience some level of adverse psychological outcomes. Up to 90% of health workers reported mental distress during the viral disease outbreaks covered in the studies included in this review. Much of this distress was associated with workload and workplace issues. This distress and these adverse psychological outcomes do not typically require high-intensity mental health interventions. Rather, they require a sensitivity to mental health issues that can be addressed by health care leadership. Leaders that act swiftly, communicate clearly and consistently, and deploy strategies that address these workplace stresses can reduce general anxiety, fear, and depressive symptoms among their workers. Further, to the extent that leadership works to provide enhanced support at these times of extreme stress, health care workers will report more positive and lasting mental health outcomes.

A smaller, but significant, subset of health care workers who experience higher or prolonged levels of adverse psychological outcomes during the COVID-19 pandemic are likely to benefit from low-intensity psychotherapeutic intervention. Few interventions have been rigorously tested in the context of health epidemics, and we found no randomized controlled trials of the effects of psychotherapeutic intervention for health workers experiencing adverse mental health outcomes. Descriptions of organizational peer groups and group therapy interventions suggest that such

efforts may reduce adverse psychological outcomes; however, the empirical evidence is sparse given the absence of randomized controlled trials. The current COVID-19 pandemic may be an opportune time to conduct rigorous studies of such treatment interventions to help develop improved guidance on the allocation of limited mental health resources after an epidemic or pandemic.

Our review of the mental health sequelae associated with epidemics and pandemics indicated that mental distress, anxiety, fear, and depressive symptoms are common among health care workers. These are expected human responses to crises as serious as the outbreaks studied. A smaller percentage of individuals, up to approximately 10% of the total health care provider population, including a large subset with preexisting mental health conditions, will develop more severe mental health disturbances and disorders that require more intensive and more specialized mental health services. Given that access to specialized mental health services is usually limited, it is essential that intensive, specialty care be reserved for such individuals. To this end, a stepped-care approach to serving mental health needs during and after a pandemic is essential to establishing an effective allocation of limited resources. Everyone will benefit from workplace systems-level efforts to support health care workers' mental health and well-being. To protect limited health care resources, it is critical to utilize mental health screening and assessment tools to identify the appropriate level of care for health care workers during and after a health crisis. Of note, the data suggest that sleep disturbance may be a persistent mental health issue requiring longer-term attention.

Compared with other pandemics, the COVID-19 pandemic is unique in its impact on health care workers because of its high prevalence and burden for inpatient medical settings (101). Moreover, a lack of personal protective equipment has led to significantly increased widespread risk for infection for health care workers (102). Previous outbreaks likely had more limited impact on health providers' mental health than the global burden of COVID-19. Thus, any extrapolation of findings or recommendations to other settings must recognize this potential underestimation of the anticipated mental health burden, especially that arising from PTS symptoms resulting from death or illness of loved ones.

The body of literature reviewed here had limited scientific rigor because most of the research was conducted in response to disaster and crisis events. However, quality metrics were available to evaluate research rigor, and these were used in many of the studies we included in this review: appropriate sample description (10, 17, 36, 60), standardized measures (7, 43, 61, 80), careful data collection management (9, 23, 63, 79), and evidence-based data analysis methods (21, 62, 68, 91). We found that data examining the efficacy of interventions are particularly limited. The impact on psychological outcomes was quantitatively assessed for only two interventions (49, 73), only one of which was a mental

health intervention (73), and none used a randomized controlled design. Therefore, we are unable to recommend an evidence-based psychotherapeutic intervention for health care workers during the COVID-19 pandemic.

On the basis of the findings in this review, we propose that research is urgently needed to inform organizational strategies and clinical interventions to better address the mental health needs of health care workers exposed to increased stress and trauma. The COVID-19 pandemic provides an opportunity for researchers to develop innovative research methods that are appropriate for the particular constraints of postdisaster and pandemic contexts. Innovative alternatives that take us beyond the randomized controlled trial may enable filling the wide gap in knowledge about appropriate evidence-based mental health interventions in these contexts (103).

We acknowledge several limits of this rapid review. It included both qualitative and quantitative studies investigating any mental health impact, which complicates generalizations across these studies. Studies defined mental health impacts heterogeneously, even within disorder groupings; for example, some studies measured rates of anxiety disorders, whereas others measured only anxiety symptoms, a difference that precluded a meta-analysis. Quantitative and qualitative studies could also not be fully compared, even not by mixed-methods analysis. Thus, our review focused on a breadth of understanding about this topic, but it lacked quantitative synthesis and analysis. Because of time constraints, we could not complete a full quality assessment of all included studies; instead, we non-systematically identified higher-quality studies according to quality research metrics. Last, the review focused solely on major pandemics and epidemics in the 21st century. Further research could include other disease outbreaks.

Health care leadership plays a crucial role in supporting the mental health needs of all health care workers by managing workplace regulations, workload, and infection control guidance in crisis situations. To protect the long-term health of their workforce, leaders must provide direction and clear, consistent communication throughout the pandemic and must remain engaged long beyond the pandemic's end. Appropriate assessment of need and allocation of specialty services for more severely affected health care workers will result in improved mental health outcomes and rational allocation of limited resources, reducing attrition and preserving the health care workforce.

## CONCLUSIONS

This rapid review identified and discussed the main impacts on the mental health of health care providers during several epidemics and pandemics in the 21st century and highlighted interventions and coping strategies that can address these mental health impacts. The evidence presented here indicates that a stepped-care mental health response includes properly allocating mental health resources and treatment to best

support health care providers experiencing adverse psychological outcomes during and after the COVID-19 pandemic.

## AUTHOR AND ARTICLE INFORMATION

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## REFERENCES

- Lai J, Ma S, Wang Y, et al: Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Netw Open* 2020; 3:e203976
- Lu W, Wang H, Lin Y, et al: Psychological status of medical workforce during the COVID-19 pandemic: a cross-sectional study. *Psychiatry Res* 2020; 288:112936
- Salyers MP, Bonfils KA, Luther L, et al: The relationship between professional burnout and quality and safety in healthcare: a meta-analysis. *J Gen Intern Med* 2017; 32:475–482
- Oyeleye O, Hanson P, O'Connor N, et al: Relationship of workplace incivility, stress, and burnout on nurses' turnover intentions and psychological empowerment. *J Nurs Adm* 2013; 43:536–542
- Tricco AC, Langlois EV (eds): *Rapid Reviews to Strengthen Health Policy and Systems: A Practical Guide*. Geneva, World Health Organization Alliance for Health Policy and Systems Research, 2017
- Khangura S, Konnyu K, Cushman R, et al: Evidence summaries: the evolution of a rapid review approach. *Syst Rev* 2012; 1:10
- Ji D, Ji YJ, Duan XZ, et al: Prevalence of psychological symptoms among Ebola survivors and healthcare workers during the 2014–2015 Ebola outbreak in Sierra Leone: a cross-sectional study. *Oncotarget* 2017; 8:12784–12791
- Li L, Wan C, Ding R, et al: Mental distress among Liberian medical staff working at the China Ebola Treatment Unit: a cross sectional study. *Health Qual Life Outcomes* 2015; 13:156
- Lancee WJ, Maunder RG, Goldbloom DS, et al: Prevalence of psychiatric disorders among Toronto hospital workers one to two years after the SARS outbreak. *Psychiatr Serv* 2008; 59:91–95
- Liu X, Kakade M, Fuller CJ, et al: Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. *Compr Psychiatry* 2012; 53:15–23
- Bai Y, Lin CC, Lin CY, et al: Survey of stress reactions among health care workers involved with the SARS outbreak. *Psychiatr Serv* 2004; 55:1055–1057
- Belfroid E, Mollers M, Smit PW, et al: Positive experiences of volunteers working in deployable laboratories in West Africa during the Ebola outbreak. *PLoS One* 2018; 13:e0196320
- Chan AO, Huak CY: Psychological impact of the 2003 severe acute respiratory syndrome outbreak on health care workers in a medium size regional general hospital in Singapore. *Occup Med* 2004; 54:190–196
- El Gaafary MM, Abd Elaziz KM, Abdel-Rahman AG, et al: Concerns, perceived impacts and preparedness of health care workers in a referral hospital in Egypt in facing influenza (H1N1) epidemic. *J Prev Med Hyg* 2010; 51:105–109
- Hewlett BL, Hewlett BS: Providing care and facing death: nursing during Ebola outbreaks in central Africa. *J Transcult Nurs* 2005; 16:289–297
- Kim CJ, Yoo HR, Yoo MS, et al: Attitude, beliefs, and intentions to care for SARS patients among Korean clinical nurses: an application of theory of planned behavior. *Taehan Kanho Hakhoe Chi* 2006; 36:596–603
- Lee SH, Juang YY, Su YJ, et al: Facing SARS: psychological impacts on SARS team nurses and psychiatric services in a Taiwan general hospital. *Gen Hosp Psychiatry* 2005; 27:352–358
- Li Y, Wang H, Jin XR, et al: Experiences and challenges in the health protection of medical teams in the Chinese Ebola treatment center, Liberia: a qualitative study. *Infect Dis Poverty* 2018; 7:92
- Lung FW, Lu YC, Chang YY, et al: Mental symptoms in different health professionals during the SARS attack: a follow-up study. *Psychiatr Q* 2009; 80:107–116
- McMahon SA, Ho LS, Brown H, et al: Healthcare providers on the frontlines: a qualitative investigation of the social and emotional impact of delivering health services during Sierra Leone's Ebola epidemic. *Health Policy Plan* 2016; 31:1232–1239
- Sim K, Chong PN, Chan YH, et al: Severe acute respiratory syndrome-related psychiatric and posttraumatic morbidities and coping responses in medical staff within a primary health care setting in Singapore. *J Clin Psychiatry* 2004; 65:1120–1127
- Bell SA, Munro-Kramer ML, Eisenberg MC, et al: "Ebola kills generations": qualitative discussions with Liberian healthcare providers. *Midwifery* 2017; 45:44–49
- Belfroid E, van Steenberg J, Timen A, et al: Preparedness and the importance of meeting the needs of healthcare workers: a qualitative study on Ebola. *J Hosp Infect* 2018; 98:212–218
- Wong EL, Wong SY, Lee N, et al: Healthcare workers' duty concerns of working in the isolation ward during the novel H1N1 pandemic. *J Clin Nurs* 2012; 21:1466–1475
- Carter SE, O'Reilly M, Frith-Powell J, et al: Treatment seeking and Ebola community care centers in Sierra Leone: a qualitative study. *J Health Commun* 2017; 22(suppl 1):66–71
- Liu C, Wang H, Zhou L, et al: Sources and symptoms of stress among nurses in the first Chinese anti-Ebola medical team during the Sierra Leone aid mission: a qualitative study. *Int J Nurs Sci* 2019; 6:187–191
- Bukhari EE, Tamsah MH, Aleyadhy AA, et al: Middle East respiratory syndrome coronavirus (MERS-CoV) outbreak perceptions of risk and stress evaluation in nurses. *J Infect Dev Ctries* 2016; 10:845–850
- Witter S, Wurie H, Chandiwana P, et al: How do health workers experience and cope with shocks? Learning from four fragile and conflict-affected health systems in Uganda, Sierra Leone, Zimbabwe and Cambodia. *Health Policy Plan* 2017; 32(suppl 3):iii3–iii13
- Tam CW, Pang EP, Lam LC, et al: Severe acute respiratory syndrome (SARS) in Hong Kong in 2003: stress and psychological impact among frontline healthcare workers. *Psychol Med* 2004; 34:1197–1204
- Gee S, Skovdal M: Public discourses of Ebola contagion and courtesy stigma: the real risk to international health care workers returning home from the West Africa Ebola outbreak? *Qual Health Res* 2018; 28:1499–1508
- Rambaldini G, Wilson K, Rath D, et al: The impact of severe acute respiratory syndrome on medical house staff: a qualitative study. *J Gen Intern Med* 2005; 20:381–385
- Broom J, Broom A, Bowden V: Ebola outbreak preparedness planning: a qualitative study of clinicians' experiences. *Public Health* 2017; 143:103–108
- Gershon RR, Magda LA, Canton AN, et al: Pandemic-related ability and willingness in home healthcare workers. *Am J Disaster Med* 2010; 5:15–26
- McCormack L, Bamforth S: Finding authenticity in an altruistic identity: the "lived" experience of health care humanitarians deployed to the 2014 Ebola crisis. *Traumatology* 2019; 25:289–296

35. Shih FJ, Gau ML, Kao CC, et al: Dying and caring on the edge: Taiwan's surviving nurses' reflections on taking care of patients with severe acute respiratory syndrome. *Appl Nurs Res* 2007; 20: 171–180
36. Shiao JS, Koh D, Lo LH, et al: Factors predicting nurses' consideration of leaving their job during the SARS outbreak. *Nurs Ethics* 2007; 14:5–17
37. Englert EG, Kiwanuka R, Neubauer LC: "When I die, let me be the last." Community health worker perspectives on past Ebola and Marburg outbreaks in Uganda. *Glob Public Health* 2019; 14: 1182–1192
38. Erland E, Dahl B: Midwives' experiences of caring for pregnant women admitted to Ebola centres in Sierra Leone. *Midwifery* 2017; 55:23–28
39. Verma S, Mythily S, Chan YH, et al: Post-SARS psychological morbidity and stigma among general practitioners and traditional Chinese medicine practitioners in Singapore. *Ann Acad Med Singapore* 2004; 33:743–748
40. Raven J, Wurie H, Witter S: Health workers' experiences of coping with the Ebola epidemic in Sierra Leone's health system: a qualitative study. *BMC Health Serv Res* 2018; 18:251
41. Son H, Lee WJ, Kim HS, et al: Examination of hospital workers' emotional responses to an infectious disease outbreak: lessons from the 2015 MERS Co-V outbreak in South Korea. *Disaster Med Public Health Prep* 2019; 13:504–510
42. Son H, Lee WJ, Kim HS, et al: Hospital workers' psychological resilience after the 2015 Middle East respiratory syndrome outbreak. *Soc Behav Personal* 2019; 47:1–13
43. Maunder R, Hunter J, Vincent L, et al: The immediate psychological and occupational impact of the 2003 SARS outbreak in a teaching hospital. *CMAJ* 2003; 168:1245–1251
44. Chua SE, Cheung V, Cheung C, et al: Psychological effects of the SARS outbreak in Hong Kong on high-risk health care workers. *Can J Psychiatry* 2004; 49:391–393
45. Koh D, Lim MK, Chia SE, et al: Risk perception and impact of Severe Acute Respiratory Syndrome (SARS) on work and personal lives of healthcare workers in Singapore: what can we learn? *Med Care* 2005; 43:676–682
46. Chiang HH, Chen MB, Sue IL: Self-state of nurses in caring for SARS survivors. *Nurs Ethics* 2007; 14:18–26
47. Holroyd E, McNaught C: The SARS crisis: reflections of Hong Kong nurses. *Int Nurs Rev* 2008; 55:27–33
48. Kim Y: Nurses' experiences of care for patients with Middle East respiratory syndrome-coronavirus in South Korea. *Am J Infect Control* 2018; 46:781–787
49. Chen R, Chou KR, Huang YJ, et al: Effects of a SARS prevention programme in Taiwan on nursing staff's anxiety, depression and sleep quality: a longitudinal survey. *Int J Nurs Stud* 2006; 43: 215–225
50. Chung BP, Wong TK, Suen ES, et al: SARS: caring for patients in Hong Kong. *J Clin Nurs* 2005; 14:510–517
51. Kang HS, Son YD, Chae SM, et al: Working experiences of nurses during the Middle East respiratory syndrome outbreak. *Int J Nurs Pract* 2018; 24:e12664
52. Kim JS, Choi JS: Factors influencing emergency nurses' burnout during an outbreak of Middle East respiratory syndrome coronavirus in Korea. *Asian Nurs Res* 2016; 10:295–299
53. Lin CY, Peng YC, Wu YH, et al: The psychological effect of severe acute respiratory syndrome on emergency department staff. *Emerg Med J* 2007; 24:12–17
54. Marjanovic Z, Greenglass ER, Coffey S: The relevance of psychosocial variables and working conditions in predicting nurses' coping strategies during the SARS crisis: an online questionnaire survey. *Int J Nurs Stud* 2007; 44:991–998
55. Mymin Kahn D, Bulanda JJ, Weissberger A, et al: Evaluation of a support group for Ebola hotline workers in Sierra Leone. *Int J Cult Ment Health* 2016; 9:164–171
56. Tolomiczenko GS, Kahan M, Ricci M, et al: SARS: coping with the impact at a community hospital. *J Adv Nurs* 2005; 50:101–110
57. Khalid I, Khalid TJ, Qabajah MR, et al: Healthcare workers emotions, perceived stressors and coping strategies during a MERS-CoV outbreak. *Clin Med Res* 2016; 14:7–14
58. Grace SL, Hershenfield K, Robertson E, et al: The occupational and psychosocial impact of SARS on academic physicians in three affected hospitals. *Psychosomatics* 2005; 46:385–391
59. Wong EL, Wong SY, Kung K, et al: Will the community nurse continue to function during H1N1 influenza pandemic: a cross-sectional study of Hong Kong community nurses? *BMC Health Serv Res* 2010; 10:107
60. Wong TW, Yau JK, Chan CL, et al: The psychological impact of severe acute respiratory syndrome outbreak on healthcare workers in emergency departments and how they cope. *Eur J Emerg Med* 2005; 12:13–18
61. Jung H, Jung SY, Lee MH, et al: Assessing the presence of post-traumatic stress and turnover intention among nurses Post-Middle East Respiratory Syndrome outbreak: the importance of supervisor support. *Workplace Health Saf* (Epub ahead of print, March 9, 2020)
62. Maunder RG, Lancee WJ, Balderson KE, et al: Long-term psychological and occupational effects of providing hospital health-care during SARS outbreak. *Emerg Infect Dis* 2006; 12:1924–1932
63. Su TP, Lien TC, Yang CY, et al: Prevalence of psychiatric morbidity and psychological adaptation of the nurses in a structured SARS caring unit during outbreak: a prospective and periodic assessment study in Taiwan. *J Psychiatr Res* 2007; 41:119–130
64. Alsubaie S, Hani Tamsah M, Al-Eyadhy AA, et al: Middle East respiratory syndrome coronavirus epidemic impact on healthcare workers' risk perceptions, work and personal lives. *J Infect Dev Ctries* 2019; 13:920–926
65. Matsuishi K, Kawazoe A, Imai H, et al: Psychological impact of the pandemic (H1N1) 2009 on general hospital workers in Kobe. *Psychiatry Clin Neurosci* 2012; 66:353–360
66. Styra R, Hawryluck L, Robinson S, et al: Impact on health care workers employed in high-risk areas during the Toronto SARS outbreak. *J Psychosom Res* 2008; 64:177–183
67. Al-Rabiaah A, Tamsah MH, Al-Eyadhy AA, et al: Middle East Respiratory Syndrome-Corona Virus (MERS-CoV) associated stress among medical students at a university teaching hospital in Saudi Arabia. *J Infect Public Health* 2020; 13:687–691
68. Al Knawy BA, Al-Kadri HMF, Elbarbary M, et al: Perceptions of postoutbreak management by management and healthcare workers of a Middle East respiratory syndrome outbreak in a tertiary care hospital: a qualitative study. *BMJ Open* 2019; 9: e017476
69. Alsahafi AJ, Cheng AC: Knowledge, attitudes and behaviours of healthcare workers in the Kingdom of Saudi Arabia to MERS coronavirus and other emerging infectious diseases. *Int J Environ Res Public Health* 2016; 13:1214
70. Andertun S, Hörnsten Å, Hajdarevic S: Ebola virus disease: caring for patients in Sierra Leone—a qualitative study. *J Adv Nurs* 2017; 73:643–652
71. Gouliou P, Mantas C, Dimitroula D, et al: General hospital staff worries, perceived sufficiency of information and associated psychological distress during the A/H1N1 influenza pandemic. *BMC Infect Dis* 2010; 10:322
72. Lu YC, Shu BC, Chang YY, et al: The mental health of hospital workers dealing with severe acute respiratory syndrome. *Psychother Psychosom* 2006; 75:370–375
73. Waterman S, Hunter ECM, Cole CL, et al: Training peers to treat Ebola centre workers with anxiety and depression in Sierra Leone. *Int J Soc Psychiatry* 2018; 64:156–165
74. Cunningham T, Rosenthal D, Catalozzi M: Narrative medicine practices as a potential therapeutic tool used by expatriate Ebola caregivers. *Intervention* 2017; 15:106–119

75. Rowlands A: Medical social work practice and SARS in Singapore. *Soc Work Health Care* 2007; 45:57–83
76. Chen WK, Cheng YC, Chung YT, et al: The impact of the SARS outbreak on an urban emergency department in Taiwan. *Med Care* 2005; 43:168–172
77. Tham KY, Tan YH, Loh OH, et al: Psychiatric morbidity among emergency department doctors and nurses after the SARS outbreak. *Ann Acad Med Singapore* 2004; 33(suppl):S78–S79
78. Maunder RG, Lancee WJ, Rourke S, et al: Factors associated with the psychological impact of severe acute respiratory syndrome on nurses and other hospital workers in Toronto. *Psychosom Med* 2004; 66:938–942
79. Lee SM, Kang WS, Cho AR, et al: Psychological impact of the 2015 MERS outbreak on hospital workers and quarantined hemodialysis patients. *Compr Psychiatry* 2018; 87:123–127
80. McAlonan GM, Lee AM, Cheung V, et al: Immediate and sustained psychological impact of an emerging infectious disease outbreak on health care workers. *Can J Psychiatry* 2007; 52: 241–247
81. Wu P, Fang Y, Guan Z, et al: The psychological impact of the SARS epidemic on hospital employees in China: exposure, risk perception, and altruistic acceptance of risk. *Can J Psychiatry* 2009; 54:302–311
82. Smith MW, Smith PW, Kratochvil CJ, et al: The psychosocial challenges of caring for patients with Ebola virus disease. *Health Secur* 2017; 15:104–109
83. Robertson E, Hershenfield K, Grace SL, et al: The psychosocial effects of being quarantined following exposure to SARS: a qualitative study of Toronto health care workers. *Can J Psychiatry* 2004; 49:403–407
84. Bergeron SM, Cameron S, Armstrong-Stassen M, et al: Diverse implications of a national health crisis: a qualitative exploration of community nurses' SARS experiences. *Can J Nurs Res* 2006; 38: 42–54
85. Abolfotouh MA, AlQarni AA, Al-Ghamdi SM, et al: An assessment of the level of concern among hospital-based health-care workers regarding MERS outbreaks in Saudi Arabia. *BMC Infect Dis* 2017; 17:4
86. Al Ghobain M, Aldrees T, Alenezi A, et al: Perception and attitude of emergency room resident physicians toward Middle East respiratory syndrome outbreak. *Emerg Med Int* 2017; 2017:6978256
87. Chen CS, Wu HY, Yang P, et al: Psychological distress of nurses in Taiwan who worked during the outbreak of SARS. *Psychiatr Serv* 2005; 56:76–79
88. Chen CS, Yang P, Yen CF, et al: Validation of Impact of Events Scale in nurses under threat of contagion by severe acute respiratory syndrome. *Psychiatry Clin Neurosci* 2005; 59:135–139
89. Chen NH, Wang PC, Hsieh MJ, et al: Impact of severe acute respiratory syndrome care on the general health status of healthcare workers in Taiwan. *Infect Control Hosp Epidemiol* 2007; 28:75–79
90. Chong MY, Wang WC, Hsieh WC, et al: Psychological impact of severe acute respiratory syndrome on health workers in a tertiary hospital. *Br J Psychiatry* 2004; 185:127–133
91. Ho SM, Kwong-Lo RS, Mak CW, et al: Fear of severe acute respiratory syndrome (SARS) among health care workers. *J Consult Clin Psychol* 2005; 73:344–349
92. Nickell LA, Crighton EJ, Tracy CS, et al: Psychosocial effects of SARS on hospital staff: survey of a large tertiary care institution. *CMAJ* 2004; 170:793–798
93. Oh N, Hong N, Ryu DH, et al: Exploring nursing intention, stress, and professionalism in response to infectious disease emergencies: the experience of local public hospital nurses during the 2015 MERS outbreak in South Korea. *Asian Nurs Res* 2017; 11: 230–236
94. Park JS, Lee EH, Park NR, et al: Mental health of nurses working at a government-designated hospital during a MERS-CoV outbreak: a cross-sectional study. *Arch Psychiatr Nurs* 2018; 32:2–6
95. Phua DH, Tang HK, Tham KY: Coping responses of emergency physicians and nurses to the 2003 severe acute respiratory syndrome outbreak. *Acad Emerg Med* 2005; 12:322–328
96. Poon E, Liu KS, Cheong DL, et al: Impact of severe respiratory syndrome on anxiety levels of front-line health care workers. *Hong Kong Med J* 2004; 10:325–330
97. Shih FJ, Turale S, Lin YS, et al: Surviving a life-threatening crisis: Taiwan's nurse leaders' reflections and difficulties fighting the SARS epidemic. *J Clin Nurs* 2009; 18:3391–3400
98. Tse MM, Pun SP, Benzie IF: Experiencing SARS: perspectives of the elderly residents and health care professionals in a Hong Kong nursing home. *Geriatr Nurs* 2003; 24:266–269
99. Vinck L, Isken L, Hooiveld M, et al: Impact of the 2009 influenza A(H1N1) pandemic on public health workers in the Netherlands. *Euro Surveill* 2011; 16:19793
100. Wong WC, Lee A, Tsang KK, et al: How did general practitioners protect themselves, their family, and staff during the SARS epidemic in Hong Kong? *J Epidemiol Community Health* 2004; 58: 180–185
101. Willan J, King AJ, Jeffery K, et al: Challenges for NHS hospitals during covid-19 epidemic. *BMJ* 2020; 368:m1117
102. Ranney ML, Griffeth V, Jha AK: Critical supply shortages—the need for ventilators and personal protective equipment during the Covid-19 pandemic. *N Engl J Med* 2020; 382:e41
103. Frieden TR: Evidence for health decision making—beyond randomized, controlled trials. *N Engl J Med* 2017; 377:465–475