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A SYSTEMATIC LITERATURE REVIEW OF THE EFFECT OF COVID-19 ON HEALTH WORKER DEMAND

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Abstract: The COVID-19 pandemic has been one of the most severe in recent history, significantly impacting various social, economic, environmental, and employment sectors, particularly health workers. During the COVID-19 pandemic, health workers were needed to help treat COVID-19 patients and therefore, were at a higher risk of infection. Healthcare workers faced the risk of contracting the disease and experienced several other implications. This study examines the existing literature on the effects of COVID-19 on health workers. A systematic review of the Scopus and Web of Science using the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) review technique yielded 27 relevant studies. Analysis of these articles revealed five main themes: Mental health, working conditions, providing medical property, cost production, and supply. A total of 17 sub-themes were created from these five themes. The findings of this study can contribute to providing support and identifying the requirements of health workers in all impacted countries, enabling them to work, and respond to any future pandemic with confidence. However, additional research is needed to uncover the impact on health workers on the frontlines to design better, prepare for and respond to future pandemics.

Keywords: COVID-19, Health worker, demand, all countries, higher risk.

Introduction

COVID-19 was declared a global pandemic by the World Health Organization (WHO) on 11 March 2020. During the news briefing, the Director-General of WHO, Dr. Tedros Adhanom Ghebreyesus, stated, 'In the days and weeks ahead, we expect to see the number of cases, deaths and the number of affected countries climb even higher. WHO has been assessing this outbreak around the clock and we are deeply concerned both by the alarming levels of spread and severity and the alarming levels of inaction. We have therefore assessed that COVID-19 can be characterised as a pandemic' (World Health Organization, 2020). The symptoms of coronavirus include sputum production, fatigue, cough, fever, breath shortness, vomiting, sore throat, diarrhea, headache, and pneumonia (Baj *et al*., 2020). In Europe, Italy and Spain were among the first to report high deaths and a rapid increase in admissions to Intensive Care Units (ICU) among patients with symptoms associated with the disease (Jimenez *et al*., 2020). Globally, the World Health Organization (WHO) recorded a drastic increase in confirmed cases of COVID-19, from 20,114 in March 2020 to 2,737,134 in March 2021 (World Health Organization, 2021).

Since then, the global infection rate has increased, putting further strain on health workers. Health workers are on the pandemic's front lines and face higher infection risks. According to WHO data, infection rates among healthcare workers are higher than among the general population (Muzyamba *et al*., 2021). The COVID-19 pandemic is putting healthcare workers under tremendous stress. Higher COVID-19 caseloads, frequent shifts to cover ill co-workers and the demanding nature of caring for many COVID-19 patients all contribute to the strain on healthcare workers (Olagunju *et*

al., 2021). Healthcare systems and healthcare workers (HCWs) are under significant pressure during the COVID-19 pandemic (Smallwood *et al*., 2021). During severe epidemic outbreaks, demand for healthcare workers (HCWs) rose and they indirectly faced extreme pressure (Schwartz *et al*., 2020).

During a pandemic, a health worker or a frontline worker is a person who provides direct or indirect care and services to the sick and afflicted. These include doctors or nurses, aides, aids, laboratory technicians, or even medical waste handlers. There are approximately 59 million healthcare workers worldwide. WHO designated 2006 to 2015 as 'the decade of the human resources for health', recognising the critical role performed by healthcare workers as 'the most precious resource for health.' Nursing personnel in hospitals are on the front lines, providing care while being in close contact with patients with COVID-19 and are in danger of contracting the coronavirus (Hyeonmi *et al*., 2021). Healthcare workers are psychologically resilient professionals trained and experienced in dealing with illness and death (Billings *et al*., 2021). Health workers such as doctors, nurses, and other frontline healthcare workers may quickly become infected with COVID-19 through work and job confrontation. Health workers are vital in any country, especially during a crisis such as COVID-19 (Zare *et al*., 2021).

Community health workers (CHWs) have been crucial to the healthcare workforce in several low-income and middle-income countries (LMICs) since the 1978 Declaration of Alma-Ata. Decades of research have shown their essential role in increasing community access to necessary care (Joshi *et al*., 2021). Employment in nursing fluctuates due to the development of new healthcare facilities, retirement rates of the overall workforce, changes in healthcare policy, and delivery models, funding decisions and economic conditions. COVID-19 has increased the demand for nurses but has yet to increase the likelihood of hiring internationally educated-applicants (Baumann *et al*., 2021). The COVID-19 pandemic has significantly changed the global context and nature of healthcare delivery. Healthcare systems have adapted care delivery to meet the needs of COVID-19 patients, expand capability and protect patients and staff from infection. Specific adaptations have included limiting patient and elective services; making COVID-19 and non-COVID-19 care pathways with connected safety protocols; expanding capacity by absorbing other hospitals; large-scale redisposition of health workforces; and a significant increase in the use of telemedicine (Byrne *et al*., 2021).

Health workers are not alone in facing the risk of infection. However, the pandemic has also led to high levels of psychological stress and mental health levels. They have been exposed to long working hours, constant fear of disease exposure, separation from family and in some instances, social stigmatisation, and physical violence. Several factors have been identified as affecting the health workers' demand during the pandemic, including working conditions, medical property, cost production, and supply. In many countries, they were struggling with an increasing number of cases requiring hospitalisation resulting in the extensive use of overtime. Several countries have imposed holiday limits on health professionals to ensure enough available staff.

Towards a Systematic Review Framework Effect of COVID-19 on Health Worker Demand

A systematic review is defined as 'a review of the proof on a developed question that uses systematic and specific methods to identify, select and critically appraise relevant primary analysis and to extract and analyse information from the studies enclosed within the review'. The methods used should be consistent and clear. A scientific review examines authors' claims of rigor in their research, identifying gaps and necessary directions for future studies.

This research aims to fill the gap in understanding by identifying and characterising the effect of COVID-19 on health workers' demand globally, including in European

countries, African countries, Oceania countries, Asia countries and North American countries. Therefore, our study's operational definition of health workers during the COVID-19 pandemic includes physicians and clinical medical trainees, dental practitioners, pharmaceutical officers, science officers, nurses, occupational/ physiotherapists, paramedics, X-ray technicians, medical laboratory technicians, healthcare treatment assistants, and public health assistants in governmental and private healthcare settings. While several studies have been on demand health workers, a systematic review of these studies is still lacking. To construct a relevant systematic review, the current article is guided by the main research question – how does COVID-19 affect health worker demand?

As COVID-19 spread worldwide, we repeatedly heard about the mental health challenges experienced by frontline healthcare workers across the globe as they treated people infected with the virus. Due to the increasing demand for health workers to treat COVID-19 patients, they have faced significant threats to their mental health, leading to calls to provide psychosocial support. Most health workers are psychologically resilient individuals who have been taught and experienced in dealing with disease and death. Despite that, this group's mental health and psychological well-being before the current COVID-19 pandemic was already being recognised as an essential healthcare issue, evidenced by the rising incidence of stress, burnout, depression, anxiety, and insomnia among all groups of health professionals in many countries. High-stress jobs, coupled with demands brought about by the COVID-19 crisis, have significantly heightened the risk of mental health problems among healthcare workers, with preliminary reports from around the world indicating increased rates of depression, anxiety, burnout, and insomnia (Billings *et al*., 2021). Therefore, this study is critical because it provides preliminary evidence of mental health among workers during the COVID-19 pandemic, which should interest policymakers, health facility administrators, and anyone involved in the COVID-19 response.

During COVID-19, the demand for health workers increased to treat patients, affecting their working conditions, such as workload, need for safety, higher risk, and wearing personal protective equipment (PPE). The working conditions of health workers are critical to ensure their safety and protection from occupational hazards and contagious risks associated with the COVID-19 virus. According to the Malaysian Ministry of Health (MOH), In the context of the COVID-19 pandemic, health workers are defined as 'individuals with high risks of contracting and transmitting COVID-19 infection, those who are directly exposed to an infected individual, an individual at high risk of being infected, a patient sample, or an environment that has the potential to be the source of the infection,' (Sahimi *et al*., 2021). Many health workers are currently facing increased workloads, extended working hours and a lack of sufficient rest due to the COVID-19 outbreak (Jiménez *et al*., 2021). Wearing PPE for a complete shift while treating COVID-19 patients, such as face masks, eye protection, gown, face shield, gloves and shoe covers which may cause pain due to heat, skin irritation, and breathing issues (Sinclair *et al*., 2020). This study is essential to ensure that health workers have safe working conditions without being overly exposed to infectious risks to effectively combat this pandemic.

This category includes clinicians directly involved in providing medical treatment to patients and healthcare workers working in healthcare facilities. Health workers provide medical emergency services, hospital equipment, and quarantine facilities to COVID-19 patients. In Italy, the medical emergency service comprises an operative network that includes each province's local health authorities, facilities, equipment, resources, and personnel who provide first aid to critical COVID-19 patients on the spot. Patients are then transferred to the most appropriate facility (Tussardi *et al*., 2021). In 'Taiwan's hospitals, patients who assess positive for COVID-19 are placed in individual isolation rooms for further treatment. Patients with unusual symptoms or inconclusive testing

are transferred to a quarantine ward, where they will remain for the incubation period. Patients transported to isolation or quarantine wards take a specific route to prevent contact with the clean zone. As a result, patients take routes other than those used by health workers (Schwartz *et al*., 2020). This study is critical because information about health workers is essential in providing various medical treatments for COVID-19 patients.

The cost of production is also influenced by the impact of COVID-19 on the demand for health workers. Governments must allocate funds for production costs, such as salaries and expenses related to digital technology, for health workers during a pandemic. In reality, the wages and productivity of the health workers will affect their demands. Fewer workers may be needed if they can maintain higher productivity levels to deliver the same quantity of services, resulting in higher salary expectations (Lin *et al*., 2021). In low-income and middle-income countries, digital technology has emerged as a potential solution for training and capacity-building community health workers during COVID-19. However, the high cost associated with developing digital training programs in these countries poses challenges in terms of adoption, implementation and scaling up within primary care settings (Joshi *et al*., 2021). This study is crucial as it assesses the salaries of healthcare workers and the costs involved in developing a digital program to train them to provide psychological treatment for depression during the pandemic.

Ensuring an adequate supply of PPE such as gloves, aprons, eye protection, masks, and gowns is available in sufficient quantities is essential to meet the increased demand for health workers during the COVID-19 pandemic and to protect themselves and their patients from being infected. According to Sun *et al*. (2020), the World Health Organization (WHO) has warned that the global supply of PPE is quickly decreasing. Despite these efforts, many hospitals have experienced chronic shortages of PPE. Due to a lack of PPE, healthcare professionals are facing significant challenges in providing care for COVID-19 patients. It is crucial to have access to PPE and training and to teach them how to use it properly. The healthcare workplace is particularly vulnerable to exposure to COVID-19, making the availability of PPE essential. This study is essential to ensure that critical PPE products are sourced and allocated to frontline health workers, especially those at risk of infectious coronavirus.

This study evaluates the literature on the impacts of COVID-19 on the demand of health workers. The objective of conducting a systematic review is explained in this section, while the methodology section describes the approach using the PRISMA Statement (Preferred Reporting Items Systematic Reviews and Meta-Analysis). The third component involves conducting a systematic review and syntheses of the scientific literature to find, select, and evaluate essential research effects of COVID-19 on health worker demand. The final section identifies future research goals.

Methodology

This section discusses the method used to retrieve articles related to the effect of COVID-19 on health worker demand. The reviewers used a technique known as PRISMA, which includes resources from Scopus and Web of Science to run the systematic review, eligibility, and exclusion criteria, steps of the review process (identification, screening, eligibility) and data abstraction and analysis.

Prisma

PRISMA served as a guide for the review (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). The PRISMA is also a published standard for conducting a systematic literature review. Generally, publication standards are required in this study because they can provide authors with relevant and essential information to evaluate the quality and rigour of an examination. It identifies inclusion and exclusion criteria and attempts to examine an extensive database of scientific literature within a predetermined period. The

PRISMA statements enable a thorough search for terms associated with the response health workers demand in COVID-19 and its effects. This methodology can monitor the effect of COVID-19 on health worker demand.

Resources

Scopus and Web of Science (WoS), two major journal databases, were used in the study. WoS is an extensive database with about 33,000 journals covering over 256 areas, including environmental studies, interdisciplinary social sciences, social concerns, and development and planning. It ranks them based on three independent measures: Citations, papers, and citations per paper and incorporates over 100 years of complete backfile and citation data developed by Clarivate Analytics. The second database included in the review is Scopus, the largest abstract and citation database of peer-reviewed literature, with 22,800 articles from 5,000 publishers worldwide. Scopus covers various topics, such as environmental, social, agricultural, and biological science.

Eligibility and Exclusion Criteria

Eligibility and exclusion criteria are determined as follows. Firstly, in terms of literature type, only article journals with empirical data were selected: review articles, book series, books, chapters in the book, and conference proceedings were all excluded. Second, to avoid any confusion and difficulty in translating, the search efforts excluded non-English publications. Third, a time period of 2 years was selected (between 2020 and 2021), which is deemed sufficient.

To assess the progression of research and related publications, the review process focused on the impact of COVID-19 on-demand health workers. Articles indexed in social science-based indexes were selected, while articles published in a brutal science index (Science Citation Indexed Expanded) were excluded.

Finally, aligning with the objective of studying health workers, only articles that concentrate on hospital staff were selected. This includes all clinical staff, doctors, nurses, paramedics, dental practitioners, pharmaceutical officers, science officers, nurses, occupational/physiotherapists, paramedics, X-ray technicians, medical laboratory technicians, healthcare treatment assistants, and public health assistants in government and private healthcare settings.

Systematic Review Process

The systematic review process consisted of four steps. The review was performed in November 2021. The first phase involved identifying keywords used for the search process. Subsequently, the identified keywords were diversified by searching for words with synonyms and terms related to those identified earlier. Utilising prior research and a thesaurus, similar or related keywords to COVID-19 and health workers were used in this research. During this stage, eight duplicate articles were identified and removed through a thorough screening.

The second phase was screening, a process where we determine some criteria to select the articles we want to review. At this point, 206 articles out of 292 eligible for review were removed. The third phase was eligibility, which is the second screening process, where we read the title and abstract of the article to determine whether or not the selected article is related to the Systematic Literature Review (SLR) we are forming. Fifty-nine articles were excluded after careful consideration because they did not focus on the effect of COVID-19. There were also not empirical studies and did not focus on health workers. The final phase of the review resulted in a total of 27 articles being used for the qualitative analysis (see Figure 1).

Data Abstraction and Analysis

The remaining articles were evaluated and analysed. Focused efforts on specific studies that answered the questions that had been posed were selected. The information was gathered by reading the abstracts first, then the whole articles (in-depth), to find relevant themes and sub-themes. For example, in a qualitative study,

content analysis was used to discover themes connected to the effect of COVID-19 on health worker demand. The writers then organised sub-themes around the typology-driven themes.

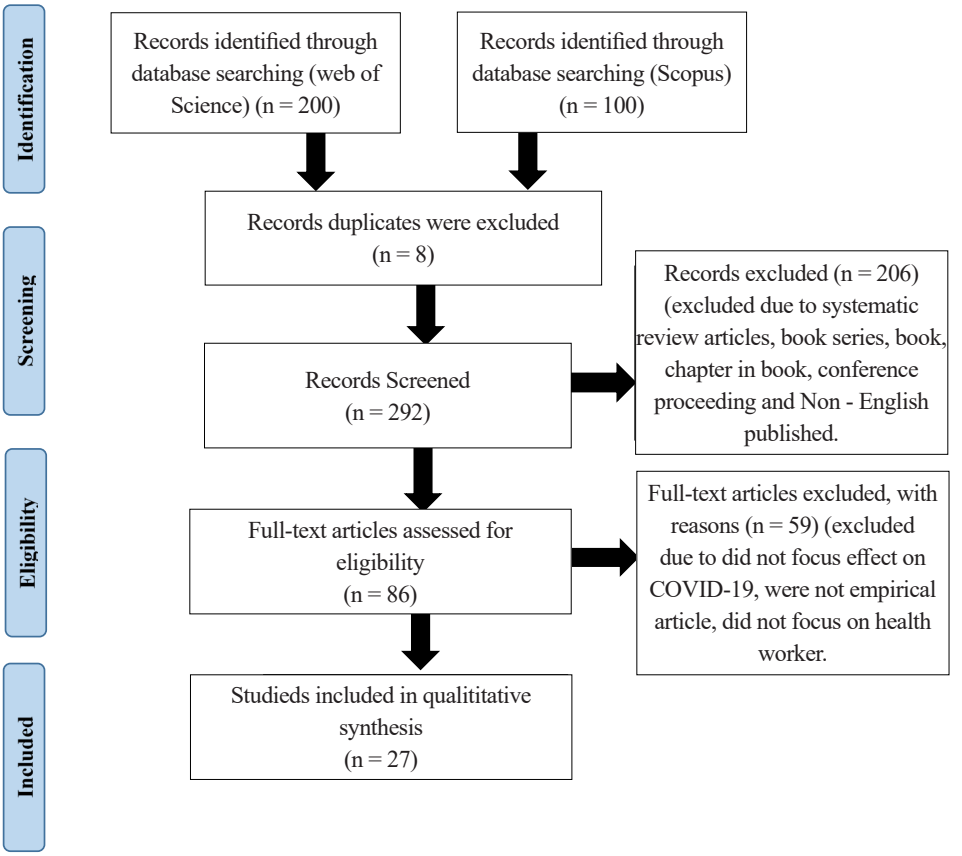

Figure 1: The flow diagram of the study

Table 1: The findings

Author / Countries	Main Study Design	Mental Health					Working Conditions				Provide Medical Property				Cost Production		Supply	
		D	A	B	S	I/SP	PPE	SN	HR	W	MES	HS	HE	QF	S	DT	PPE	ST
Jo Billings et al. (2021) - London	QL		√		√			√		√								
Choolwe Muzyamba et al. (2021) - Uganda	QL	√	√				√			√								
James Avoka Asamani et al. (2021) - Ghana	QL									√			√		√			
Tocco-Tussardi et al. (2021) - Italian	QL										√	√						
Natasha Smallwood et al. (2021) - Australia	QL	√	√	√											√			√
Andrew T.Olagunju et al. (2021) - Nigeria	QN				√	√												
Carrick Allison et al. (2021) - New Zealand	QL						√	√									√	
Tracy Kuo Lin et al. (2021) - Saudi Arabia	QL														√			
Jannis Barry (2021) - United States	QN														√			
Udita Joshi et al. (2021) - India	QL														√	√		
Moustafa Al Hariri et al. (2021) - Lebanon	QN	√	√	√			√											
John-Paul Byrne et al. (2021) - Ireland	QN		√	√					√	√								
Meeta Prasa Kerlin et al. (2021) - United States	QL										√	√	√					
Aws Khasawneh et al. (2021) - Poland	QL				√					√								
Sajad Zare et al. (2021) - Iran	QL				√				√									
Rosemberg MAS et al. (2021) - USA	QL		√		√													√
Jennifer E. Moreno-Jiménez et al. (2021) - Spain	QN			√	√		√			√								
Lourdes Luceno-Moreno et al. (2020) - Spain	QN	√	√	√	√													
Yinxiaohe Sun et al. (2020) - Singapore	QN						√	√									√	
Albert Nienhaus & Rozita Hod et al. (2020) -Malaysia	QL						√											
Robert R. Sinclair et al. (2020) - Switzerland	QL				√		√	√	√	√								
Liu Long et al. (2021) - Wuhan	QL		√		√			√										
Abdoli Nasrin et al. (2021) - Switzerland	QL	√	√		√	√												
Shayganfard et al. (2021) - Switzerland	QN	√	√		√													
Cho Hyeonmi et al. (2021) - USA	QL	√	√		√		√											
Jonathan Schwartz et al. (2020) - Taiwan	QL						√	√						√				
Sahimi et al. (2021) - Malaysia	QN	√	√		√													

Mental Health	Working Conditions	Provide Medical Property	Cost Production	Supply
D = Depression	PPE - Personal Protective Equiment	MES = Medical Emergency Service	S = Salary	PPE =Personal Protective
A = Anxiety	SN = Safety Need	HS = Hospital Service	DT = Digital Technology	ST = Safety Training
B = Burnout	HR = Higher Risk	HE = Hospital Equipment		
S = Stress	W = Workload	QF = Quarantine Facility		
I / SP = Insomnia / Sleep Problem				
QN = Quantitative, QL = Qualitative				

Results

The review results yielded a comprehensive analysis of the impact of COVID-19 on health worker demand. The review identified five main themes and 17 sub-themes relevant to the effect of COVID-19 on health worker demand. The five main themes include mental health, working conditions, providing medical property, cost production, and supply.

This study focused on the effects of COVID-19 on health workers' global demand in Europe, Africa, Oceania, Asia, and North American countries. A total of nine studies examined the impact of COVID-19 on health worker demand in European countries, including London (Billings *et al*., 2021), Italian (Tussardi *et al*., 2021), Ireland (Byrne *et al*., 2021), Poland (Khasawneh *et al*., 2021), Spain (Jimenez *et al*., 2021; Moreno *et al*., 2020), and Switzerland (Sinclair *et al*., 2020; Abdoli *et al*., 2021; Shayganfard *et al*., 2021). Additionally, three studies focused on the effects of COVID-19 on health worker demand in African countries, including Uganda (Muzyamba *et al*., 2021), Ghana (Asamani *et al*., 2021) and Nigeria (Olagunju *et al*., 2021). Furthermore, two studies examined the effect of COVID-19 on health worker demand in Oceania, encompassing Australia (Smallwood *et al*., 2021) and New Zealand (Allison *et al*., 2021).

Nine studies were conducted on the effect of COVID-19 on health worker demand in Asian countries, including Saudi Arabia (Lin *et al*., 2021), India (Joshi *et al*., 2021), Lebanon (Hariri *et al*., 2021), Iran (Zare *et al*., 2021), Singapore (Sun *et al*., 2020), Malaysia (Nienhaus & Hod, 2020; Sahimi *et al*., 2021), Wuhan (Liu *et al*., 2021), and Taiwan (Schwartz *et al*., 2020). Additionally, four studies focused on the effect of COVID-19 on health worker demand in the United States of America (Barry *et al*., 2021; Kerlin *et al*., 2021; Rosemberg *et al*., 2021; Hyeonmi *et al*., 2021). Out of the total studies, 18 studies applied a qualitative approach and the remaining nine studies utilised quantitative analytic methods. 22 articles were published in 2021 and five studies were published in 2020.

Mental Health

A total of 17 studies identified the mental effects of COVID-19 on health worker demand. Within this theme, five sub-themes were identified, namely, depression, anxiety, burnout, stress, and insomnia or sleep problems. Eight studies specifically focused on the impact of COVID-19 on depression and 12 studies explored the association with anxiety. Five studies mentioned burnout, while 13 studies mentioned stress. Two studies focused on insomnia. The COVID-19 outbreak is putting health workers under a lot of stress. Aside from the severe workload, they worry about getting sick and spreading it to their family and friends. Furthermore, the overall atmosphere of anxiety among the general population impacts health workers' mental health. Several risk factors have been identified as contributing to a higher number of mental health problems. These include existing comorbidities, such as asthma and diabetes; lack of protective equipment in health facilities; lack of adequate knowledge of prevention and care; working overtime; and concerns about exposing family members to COVID-19. (Moreno *et al.,* 2020; Schwartz *et al.,* 2020; Sinclair *et al.,* 2020; Abdoli *et al.,* 2021; Billings *et al.,* 2021; Byrne *et al.,* 2021; Hariri *et al.,* 2021; Hyeonmi *et al.,* 2021; Jimenez *et al.,* 2021; Khasawneh *et al.,* 2021; Long *et al.,* 2021; Muzyamba *et al.,* 2021; Olagunju *et al.,* 2021; Rosemberg *et al.,* 2021; Shayganfard *et al.,* 2021; Smallwood *et al.,* 2021; Zare *et al.,* 2021). In London, Uganda, Australia, Nigeria, Lebanon and Switzerland, the key findings of the present study were that among full-time frontline hospital staff members involved in the management of patients with COVID-19, higher scores of depression, anxiety, and stress were associated with higher insomnia and lower general health (Abdoli *et al.,* 2021; Billings *et al.,* 2021; Hariri *et al.,* 2021;Muzyamba *et al.,* 2021; Olagunju *et al.,* 2021; Smallwood *et al.,* 2021;) .

In Spain, one study showed that symptoms of depression are positively and significantly related to emotional exhaustion, depersonalisation, being a nurse and working

12 hour or 24 hour shifts or on-call hours. In addition, those who live with people at risk are very concerned about a possible infection by a family member they do not live with (Moreno *et al*., 2020). In Uganda, the three most common forms of mental health disorders include depression, anxiety, and post-traumatic disorder among health workers during their fight against COVID-19 (Muzyamba *et al*., 2021). Several frontline healthcare workers in Uganda highlighted various sources contributing to these mental health disorders. These include long working hours, lack of proper equipment, lack of sleep, exhaustion, and experiencing a high death rate under their care (Muzyamba *et al*., 2021). Before the pandemic, a third of healthcare workers in Australia (2389, or 30.4%) had a recognised mental health disorder. Since then, many more have reported mental health problems, mostly anxiety (4875, or 62.1%), burnout (4575, or 58.3%), and depression (2175, or 27.7%) (Smallwood *et al*., 2021).

Working Condition

A total of 15 studies have identified the impact of working conditions on health worker demand during the COVID-19 pandemic. Within this theme, four sub-themes have emerged: Personal protective equipment, safety needs, higher risk, and workload. Nine studies focused on personal protective equipment and six looked into safety needs. Three studies mentioned higher risk and seven studies mentioned workload.

COVID-19 has placed extreme pressure on healthcare personnel. They have faced threats to their physical safety and concerns about protecting their families. High mortality rates have forced them to oversee more patients in a high-stress environment. Strict infection control methods and inadequate personal protective equipment have not always been enough to deal with obstacles in providing care (PPE) (Nienhaus & Hod *et al.,* 2020; Schwartz *et al.,* 2020; Sinclair *et al.,* 2020; Alisson *et al.,* 2021; Asamani *et al.,* 2021; Billings *et al.,* 2021; Hyeonmi *et al.,* 2021; Jimenez *et al.,* 2021; Muzyamba *et al.,* 2021; Tussardi *et al.,* 2021).

In Ireland, frontline junior hospital doctors were identified as having a high risk of contracting COVID-19. Consequently, medical teams had to be frequently reconfigured due to doctors needing to self-isolate or quarantine after coming into contact with the virus (Byrne *et al*., 2021). As a result of COVID-19 protocols, additional staffing capacity was made available. As 'reserves' were employed to cover shifts at short and unpredictable schedule gaps, the increased medical staffing levels allowed teams to respond better to these situations (Byrne *et al*., 2021). In London, healthcare workers frequently reported experiencing high workloads, which significantly impacted their psychosocial well-being. They mentioned several factors that contributed to this stress, including increased hours and weekend shifts, additional time taken to wear/remove PPE and increased paperwork as frequent sources of stress. This situation was further compounded by staff shortages caused by inadequate staffing or staff absences due to ill health or caring responsibilities. As a result, the remaining staff members had to work overtime to meet the demands. This increased workload made the health workers feel fatigued and increased the risk of mistakes or errors (Billings *et al*., 2021). Next, each infected health worker meant a significant gap in the fight against the pandemic.

Therefore, ensuring health workers' safety and health is of high priority. Exposure to COVID-19 in the workplace is very high in the healthcare sector. This also increases the risk of contact transmission to support personnel, including those dealing with clinical disposal, cleaners, and laundry staff. Protecting health workers focuses on preventing contracting and spreading COVID-19 (Billings *et al*., 2021). Information on the transmission of disease must be disseminated clearly and promptly. PPE and proper training and instruction in its usage are equally important in ensuring the safety of workers. To keep healthcare personnel and patients safe from occupational respiratory infections, infection control techniques such as visual alerts, respiratory hygiene, cough etiquette, masking, and separation of people

with breathing problems and droplet precautions are important and helpful (Schwartz *et al.,* 2020; Sinclair *et al.,* 2020; Sun *et al.,* 2020; Allison *et al.,* 2021).

Provide Medical Property

Some studies have reported medical property as affecting COVID-19 health worker demand. Four sub-themes emerged under this theme, including medical emergency service (2 studies), hospital service (2 studies), hospital equipment (2 studies), and quarantine facility (1 study). In Italy, there is a comprehensive network of medical facilities, equipment, resources, and staff available for use in the event of a medical emergency on the island to manage the first aid on-site for critical patients and the subsequent transfer to the most appropriate facility (Tussardi *et al*., 2021). The alarm system Verona Emergency's Operations Center, open 24 hours a day, connects all requests for healthcare intervention emergencies with the most appropriate response and service through more than 80 dedicated lines (Tussardi *et al*., 2021). In Italy, Residents and Medical Direction also provided special support for the administration of a 'Self-assessment for COVID-19 infection risk sheet, based on a form developed by the Italian Society of Infectious and Tropical Diseases, to regulate outpatient access to 'essential' services, such as paediatrics (Tussardi *et al*., 2021).

Next, in Taiwan, hospitals provided a quarantine facility with implemented Traffic Control Bundling (TCB) (Schwartz *et al*., 2020). This tool effectively reduced infection rates among health workers in Taiwan during the SARS outbreak. Traffic Control Bundling (TCB) adjusted for COVID-19 begins with outdoor triage. Patients testing positive for COVID-19 are directed to an isolation ward (hot zone), where they are placed in individual isolation rooms for further care (Schwartz *et al*., 2020). Patients exhibiting a typical symptoms or whose tests remain inconclusive are directed to a quarantine ward (intermediate zone), where they stay for the duration of the incubation period (Schwartz *et al*., 2020). Patients who need to be transported to the isolation or quarantine wards follow a predetermined path that prevents them from coming into contact with the clean zone.

Consequently, patients walk along pathways separate from those taken previously by health workers, including nurses, physicians, and other hospital staff (Schwartz *et al*., 2020). In the majority of hospitals in the United States of America, Intensive Care Unit (ICU) providers experienced increased working hours (61.3%), and there are also newly created specialised procedure teams dedicated to patients with COVID-19 (59.5%). Most hospitals also either reassigned providers from other units and roles to ICUs (36.1%) or were prepared to do so (49.2%) (Kerlin *et al*., 2021).

Cost Production

Cost production is often a focal point of studies examining the impact of COVID-19. Seven articles have reported that cost production affects the demand of COVID-19 health workers. Under this theme, two sub-themes emerged, namely salary and digital technology. Five studies indicated that the impact of COVID-19 on health worker demand is salaries. In contrast, another study reported that digital technology affects COVID-19 health worker demand related to cost production. For example, in Australia, approximately 42.3% of healthcare workers reported increased paid (20.8%) or unpaid (21.5%) hours when treating patients infected with COVID-19 (Smallwood *et al*., 2021). In Ghana, from the perspective of the Ministry of Health (MOH) and Ghana Health Service (GHS), the estimated cost for health workers to meet the minimum staffing requirements (which included salaries, market premium, and other allowances paid from the consolidated fund), was estimated to be about GH¢2,358,346,472, which is equivalent to US$521,758,069 (using the December 2017 Interbank Exchange Rate of US$1: GH¢4.52), while the current cost of the staff at the post was estimated at GH¢1,424,331,400 (US$315,117,566) (Asamani *et al*., 2021). Therefore, the GHS required an additional

GH₵1,335,069,404 (US$295,369,337) to meet the minimum staffing requirement for the various levels of service delivery. This amount represented approximately 57% of the budgetary provision to fill vacant posts and meet the minimum nationally agreed staffing norms (Asamani *et al*., 2021).

In India, the study offers a comprehensive evaluation of the resources required and the associated costs of developing a digital program for training community health workers to deliver brief psychological treatment for depression (Joshi *et al*., 2021). The study revealed that the total development costs over approximately ten months was USD 208,814, with the most significant portion devoted to human resources (61%), suggesting that digital training development is highly labour-intensive (Joshi *et al*., 2021).

Supply for Personal Protective Equipment (PPE) and Safety Training

Three studies have identified that supply availability can affect COVID-19 health worker demand for personal protective equipment and safety training. Among the most common supply effects of COVID-19 on health worker demand is PPE. When dealing with aerosolised disease transmission, it is vital to have personal protective equipment to safeguard both healthcare staff and patients (Allison *et al*., 2021). Positive variables that impact healthcare workers and boost their desire to follow infection prevention and control standards include workplace culture, training, access to PPE, trust in the PPE and manager support. The COVID-19 pandemic presents significant challenges to healthcare systems worldwide, leading to shortages of PPE and leaving frontline healthcare workers (HCWs) at grave risk (Allison *et al*., 2021). In New Zealand, having appropriate PPE for staff in an environment with an ongoing risk of SARS-CoV-2 exposure necessitates a strategy that adapts to changing disease transmission risks, exposure to potential, and actual COVID-19 cases and logistical issues with national and international PPE supply chains. Changing demands due to variations in disease prevalence, hospital admissions, internal policies, and guidelines evaluate the demand side of this balance. In contrast, limitations in equipment storage, accessibility, and renewal of depleted stores try the supply side (Allison *et al*., 2021).

In Singapore, the potential for lengthy usage of N95s needs to be given serious thought. There could be an increase in the demand for respirators in response to the rising case counts, particularly among health workers and individuals with severe diseases who need intensive care and prolonged hospitalisation during the pandemic (Sun *et al*., 2020). Safety training is another effect of COVID-19 on health worker demand-supply. Safety training should be a major priority for health workers in COVID-19 because it saves lives, increases productivity, and reduces costs. Health workers are also particularly vulnerable to exposure to COVID-19. Safety training can protect health workers and prevent contracting and spreading COVID-19. In the United States, the study findings primarily focus on health workers in safety training with poor conditions, such as a lack of personal protective equipment for workplace hazards (Rosemberg *et al*., 2021).

Discussion

This study has attempted to systematically analyse the existing literature on the effects of COVID-19 on health worker demand. COVID-19 is a global challenge and adaptation measures must be practised to reduce its impact and capture possible opportunities. A rigorous review of two databases found 27 articles related to the effects of COVID-19 on health worker demand. Within the scope of this review, five themes and 17 sub-themes emerged. The five main effects of COVID-19 on health worker demand are mental health, working conditions, providing medical property, cost production and supply.

The first theme is mental health. Based on recent studies from all over the globe, a researcher found that anxiety, depression,

burnout, stress and insomnia were the most prevalent mental health issues among health workers during the COVID-19 pandemic. That means that healthcare workers are making critical decisions while experiencing significant distress. Hence, direct management support might help employees build positive work attitudes and better manage their mental health (Abdoli *et al*., 2021). Furthermore, the factors leading to a higher number of mental health issues among health workers identified in this study included lack of protective equipment in health facilities, lack of adequate knowledge of prevention, working overtime, lack of sleep and concern with regards to exposing family members to COVID-19. Several mental health factors in this study were reported from countries such as Spain, Uganda, London, Australia, Nigeria, Lebanon, Ireland, Poland, Iran, Wuhan and Taiwan. Further research is essential to determine the best way to support mental health among health workers during the pandemic.

Next, the theme is working conditions. This paper presented that the pandemic exposed health workers to difficult working conditions in different countries worldwide, such as workloads, higher risk, safety needs and wearing personal protective equipment (PPE). Research has shown that heavier workloads and longer working hours due to the pandemic can impact health workers' psychosocial well-being. In addition, the health workers at a higher risk of COVID-19 at the workplace were identified in this research because they treated patients infected by this virus. Safety and protective action must be practised at their workplace to reduce the risk and spread of COVID-19 among health workers. The review in New Zealand, Switzerland, Singapore and Taiwan reported that wearing personal protective equipment (PPE) and proper training are essential in ensuring the safety of health workers during COVID-19. A safe workplace and providing high-quality care required good resourcing among health workers during the pandemic were highly sought working conditions.

Then the next theme is providing medical property. This study showed that the effect of COVID-19 on health worker demand was affected by the difficulties in providing medical property such as emergency medical services, hospital services, hospital equipment and quarantine facilities to COVID-19 patients. During the pandemic, emergency medical services should be provided with a comprehensive and systematic protocol to provide hospital care per the standard set and prevent COVID-19 infection. In Italy, the research exposed the health workers in emergency departments responsible for providing treatment and first aid on-site for critical patients with COVID-19. The health worker also played an essential role in providing quarantine facilities during the pandemic for infection prevention and monitoring practices to reduce the risk of transmission of COVID-19. The study revealed that Taiwan's hospital provided a quarantine facility with implemented Traffic Control Bundling (TCB), and this tool proved effective in reducing infection rates among health workers in Taiwan during the pandemic.

After that, the next theme was cost production. This review identified that the production cost was also one of the effects of COVID-19 on health worker demand. During a pandemic, the government must invest in cost production, such as salaries and digital technologies for health workers. In Ghana, this study provides new insights into the fact that some 22% of the wage bill of Ghana Health Service is spent on health workers who are inequitably distributed in the health sector. The staffing norms of Ghana were used as the benchmark for distribution. Although the levels of health workforce budgetary deficits were as much as 57% on average, the cost of the inequitably distributed health workers could offset this budgetary deficit by almost 30%. Investing in hiring trained but unemployed health workers and employing evidence-based planning and policies for the health workforce is necessary for tackling the issues mentioned earlier. A comprehensive health labour market analysis is imperative for holistic insights (Asamani *et al*., 2021). Next, in India, the study showed it is important to recognise that the costs

described the one-time development costs, such as there would be recurring costs required for the implementation of the digital training programs such as server costs, technology support, web hosting, managing/supervising health workers, health workers time for completing the training, providing access to smart-phones for completing the training, and other data related costs while accessing the training program (Joshi *et al*., 2021). This study contributes to the existing body of research on the expenses involved in creating digital programs for training community health workers in low-income and middle-income countries (LMICs). It highlights that development costs are substantial, mainly driven by labour and technology expenditures. The findings suggest that due to the advancements in digital literacy, improved affordability and growing access to digital devices in most LMICs, digital technology has become a crucial tool for training the health workforce (Joshi *et al*., 2021).

Finally, we examined at the supply of PPE and safety training. This research reported that the effects of COVID-19 on health worker demand is the supply of PPE and safety training. The COVID-19 pandemic caused an interruption in supply chains and production of equipment at the global level, especially PPE. The World Health Organization (WHO) also issued a warning regarding the risks of the global supply of PPE rapidly depleting (Sun *et al*., 2020). In New Zealand, health workers faced a difficult situation with a lack of PPE at their workplace during the pandemic, which caused many health workers to be infected with COVID-19. There has been a substantial increase in the demand for respirators among health workers and patients due to the significant number of COVID-19 cases. This surge in demand highlights the critical need for respiratory protection in healthcare settings to ensure the safety of both healthcare professionals and patients. Next, the safety and well-being of healthcare professionals are a top priority. Due to the fact that the healthcare workplace is particularly susceptible to the possibility of being exposed to COVID-19, it is of utmost importance to have access to PPE, as well as training and instruction on how to use it in the correct manner (Rosemberg *et al*., 2021). The safety training of health workers focuses on preventing the contraction and spread of COVID-19 infection among health workers and patients in healthcare settings.

Conclusion

The systematic review has emphasised the significant impact of COVID-19 on global health worker demand. Through the review performed, the authors have identified five main themes that demonstrate the effects of COVID-19 on health worker demand: (1) Mental health; (2) working conditions; (3) medical property; (4) cost production; and (5) supply interruption. The impacts of COVID-19 on health worker demand were further extended to 17 sub-themes. The review presents several recommendations for future studies. Firstly, it suggests the need for more qualitative studies as it offers in-depth analysis and detailed explanations of health worker methods along with demand perspectives and decision-making about the effect of COVID-19. Secondly, it is important to have a specific systematic review method to guide research synthesis in the context of the effects of COVID-19 on health workers. Thirdly, practicing complementary searching techniques such as citation tracking, reference searching, snowballing, and contacting experts is essential.

The main finding of this research is that COVID-19 has significantly disrupted health workers' mental health and working conditions due to the increasing demand for health workers to treat COVID-19 patients. This research also presented that the pandemic affected medical property, cost production, and supply of personal protective equipment and safety training. The author believes that reviewing the effect of COVID-19 on health worker demand will help gain the insight required by authorities to implement a new policy to resolve this matter.

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References

Abdoli, Famia, Jahangiri, Radmehr, Alikhani, Pegah Abdoli, Davarinejad, Kenneth M. Dürsteler, Brühl, Bahmani, & Serge Brand. (2021). Sources of sleep disturbances and psychological strain for hospital staff working during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, *18*(12), 6289. https://doi.org/10.3390/ijerph18126289

Al Hariri, M., Hamade, B., Bizri, M., Salman, O., Tamim, H., & Al Jalbout, N. (2022). Psychological impact of COVID-19 on emergency department healthcare workers in a tertiary care center during a national economic crisis. *The American Journal of Emergency Medicine*, *51*, 342-347.

Allison, Tennant, Xiang, Stephens, Oliver Ball, & Wilton. (2021). Navigating the shifting sands of filtering facepiece respirator provision during the COVID-19 pandemic: a system response for maximizing staff safety. *BMJ Open Quality*, *10*(3), e001163. https://doi.org/10.1136/bmjoq-2020-001163

Asamani, Ismaila, Plange, Ekey, Ahmed, Chebere, Williams, & Orem. (2021). The cost of health workforce gaps and inequitable distribution in the Ghana Health Service: an analysis towards evidence-based health workforce planning and management. *Humans Resources for Health*, *19*(1), 43. https://doi.org/10.1186/s12960-021-00590-3

Baj J, Karakuła-Juchnowicz H, Teresiński G, Buszewicz G, Ciesielka M, Sitarz R, Forma A, Karakuła K, Flieger W, Portincasa P., & Maciejewski, R. (2020). COVID-19: Specific and non-specific clinical manifestations and symptoms: The current state of knowledge. *Journal of Clinical Medicine*, *9*(6), 1753. https://doi.org/10.3390/jcm9061753

Barry. (2021). Real wage growth in the U.S. health workforce and the narrowing of the gender pay gap. *Humans Resources for Health*, *19*, 105. https://doi.org/10.1186/s12960-021-00647-3

Baumann, C., Rousseau, H., Tarquinio, C., Batt, M., Tarquinio, P., Lebreuilly, R., Sorsana, C., Legrand, K., Guillemin, F., & Bourion-Bédès, S. (2021). Effect of the COVID-19 outbreak and lockdown on mental health among post-secondary students in the Grand Est region of France: results of the PIMS-CoV19 study. *Health and Quality of Life Outcomes*, *19*, 265. https://doi.org/10.1186/s12955-021-01903-9

Billings , Ching, Gkofa, Greene, & Bloomfield. (2021). Experiences of frontline healthcare workers and their views about support during COVID-19 and previous pandemics: A systematic review and qualitative. *BMC Health Services Research*, *21*(1), 923. https://doi.org/10.1186/s12913-021-06917-z

Byrne, Creese, Matthews, M., McDermott, Costello, & Humphries. (2021). '… the way it was staffed during COVID is the way it should be staffed in real life' : a qualitative study of the impact of COVID-19 on the working conditions of junior hospital doctors. *BMJ Journal*, *11*(8), e050358. https://doi.org/10.1136/bmjopen-2021-050358

Cho, H., Sagherian, K., & Steege, L. M. (2021). Hospital nursing staff perceptions of resources provided by their organizations during the COVID-19 pandemic. *Workplace Health & Safety*, *69*(4), 174-181. https://doi.org/10.1177/2165079920987543

Joshi, John A. Naslund, Anand, Tugnawat, Vishwakarma, Bhan, Patel, & Chunling Lu. (2021). Assessing costs of developing a digital program for training community health workers to deliver treatment for depression: A case study in rural India.

Psychiatry Research, *307*, 1-8. https://doi.org/10.1016/j.psychres.2021.114299

Kerlin, M. P., Costa, D. K., Davis, B. S., Admon, A. J., Vranas, K. C., & Kahn, J. M. (2021). Actions taken by US hospitals to prepare for increased demand for intensive care during the first wave of COVID-19: A national survey. *Critical Care Original Research*, *160*(2), 519-528. https://doi.org/10.1016/j.chest.2021.03.005

Khasawneh, Malkawi, Ababneh, Al-Araidah, & Kremer. (2021). Empirical study on mental stress among healthcare staffs and the influencing workplace stressors. *Engineering Management in Production and Services*, *13*(2), 54-67.

Lin, T. K., Bruckner, T. A., Alghaith, T. *et al*. (2021). Projecting health labor market dynamics for a health system in transition: Planning for a resilient health workforce in Saudi Arabia. *Globalization and Health, 17*, 1-9. https://doi.org/10.1186/s12992-021-00747-8

Liu, Shi, Fei, Wang, Wang, Li Li, Ding, & Yan. (2021). Stressors and coping strategies of medical staff in the COVID-19 pandemic in Wuhan. *International Journal of Mental Health Promotion*, *23*(3), 319-330. https://doi.org/10.32604/IJMHP.2021.015699

Luceño-Moreno, L., Talavera-Velasco, B., García-Albuerne, Y., & Martín-García, J. (2020). Symptoms of posttraumatic stress, anxiety, depression, levels of resilience and burnout in Spanish health personnel during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, *17*(15), 5514. https://doi.org/10.3390/ijerph17155514

Muzyamba, C., Makova, O. & Mushibi, G. S. (2021). Exploring health 'workers' experiences of mental health challenges during care of patients with COVID-19 in Uganda: A qualitative study. *BMC Research Notes*, *14*, 1-5. https://doi.org/10.1186/s13104-021-05707-4

Moreno-Jiménez, J. E., Blanco-Donoso, L. M., Demerouti, E., Belda Hofheinz, S., Chico-Fernández, M., Moreno-Jiménez, B., & Garrosa, E. (2021). The role of healthcare 'Professionals' passion in predicting secondary traumatic stress and posttraumatic growth in the face of COVID-19: A longitudinal approach. *International Journal of Environmental Research and Public Health*, *18*(9), 4453. https://doi.org/10.3390/ijerph18094453

Nienhaus, A., & Hod, R. (2020). COVID-19 among Health Workers in Germany and Malaysia. *International Journal of Environmental Research and Public Health*, *17*(3), 1-10. https://doi.org/10.3390/ijerph17134881

Olagunju, A. T., Bioku, A. A., Olagunju, T. O., Sarimiye, F. O., Onwuameze, O. E., & Halbreich, U. (2021). Psychological distress and sleep problems in healthcare workers in a developing context during COVID-19 pandemic: Implications for workplace wellbeing. *Progress in Neuropsychopharmacology & Biological Psychiatry*, *110*, 1-5. https://doi.org/10.1016/j.pnpbp.2021.110292

Rosemberg, M. S., Adams, M., Polick, C., Li, W. V., Dang, J., & Tsai, J. H. (2021). COVID-19 and mental health of food retail, food service, and hospitality workers. *Journal of Occupational and Emvironmental Hygiene*, *18*(4-5), 169–179. https://doi.org/10.1080/15459624.2021.1901905

Sahimi, H. M. S., Mohd Daud, T. I., Chan, L. F., Shah, S. A., Rahman, F. H. A., & Nik Jaafar, N. R. (2021). Depression and suicidal ideation in a sample of Malaysian healthcare workers: A preliminary study during the COVID-19 pandemic. *Frontiers in Psychiatry*, 12, 658174. https://doi.org/10.3389/fpsyt.2021.658174

Schwartz, J., King, C. C., & Yen, M. Y. (2020). Protecting healthcare workers during the coronavirus disease 2019 (COVID-19) outbreak: Lessons from taiwan's severe

acute respiratory syndrome response. *Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America, 71*(15), 858–860. https://doi.org/10.1093/cid/ciaa255.

Shayganfard, M., Mahdavi, F., Haghighi, M., Sadeghi-Bahmani, D., & Brand, S. (2021). Sources of health anxiety for hospital staff working during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, *18*(6), 3094. https://doi.org/10.3390/ijerph18063094

Sinclair, R. R., Allen, T., Barber, L., Bergman, M., Britt, T., Butler, A., Ford, M., Hammer, L., Kath, L., Probst, T., & Yuan, Z. (2020). Occupational health science in the time of COVID-19: Now more than ever. *Occupational Health Science*, *4*(1-2), 1–22. https://doi.org/10.1007/s41542-020-00064-3 1-22

Smallwood, N., Pascoe, A., Karimi, L., Bismark, M., & Willis, K. (2021). Occupational disruptions during the COVID-19 pandemic and their association with healthcare 'Workers' mental health. *International Journal of Environmental Research and Public Health*, *18*(17), 9263. https://doi.org/10.3390/ijerph18179263

Sun, Y., Otomaru, H., Quaye, S. E. D., Somani, J., Bagdasarian, N., Beh, D. L. L., Fisher, D. A., Cook, A. R., & Dickens, B. L. (2020). Scenarios to manage the demand for N95 respirators for healthcare workers during the COVID-19 pandemic. *Risk Management and Healthcare Policy*, *13*, 2489–2496. https://doi.org/10.2147/RMHP.S275496

Tocco-Tussardi, I., De Mattia, G., Gasabelli, V., Mazzer, M., Vanin, S., Ramaroli, D. A., Schiesaro, G., Salandini, G., Varalta, M. S., Benoni, R., Zanetel, E., Fagherazzi, J., & Tardivo, S. (2021). COVID-19 pandemic: An Italian single institution's experience and lessons learned by public health 'residents' workforce. *Annali di Igiene: Medicina Preventiva e di Comunita*, *33*(5), 410-425. https://doi.org/10.7416/ai.2021.2438

WHO. (2020). *WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020*. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

WHO. (2021). *WHO Coronavirus* (COVID-19) *Dashboard*. Retrieved from https://covid19.who.int/

Zare, S., Mohammadi Dameneh, M., Esmaeili, R., Kazemi, R., Naseri, S., & Panahi, D. (2021). Occupational stress assessment of health care workers (HCWs) facing COVID-19 patients in Kerman province hospitals in Iran. *Heliyon*, *7*(5), e07035.