

Prevention, Control and Safety of Health Care Providers during COVID-19: A Review Study

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Abstract

Background: Infection prevention, control, and health workers' safety in the face of biological agents are among the vital issues in healthcare systems across the world. Considering the high prevalence of COVID-19 infection in the world and its high mortality rate, this epidemic can be tackled to some extent through infection control in the general population and promoting the safety of health centers. This study aims to scrutinize the literature in terms of measures adopted for infection control and safety of healthcare workers in health centers during COVID-19.

Methods: We searched key words related to the study namely, "prevention and control", "safety", "coronavirus", "COVID-19", and "health personnel" in PubMed, Web of Science, ScienceDirect, Scopus databases, Google Scholar, and also in Persian data bases such as SID, Magiran, Irandoc, and Iran Medex using AND/OR functions. To select the documents, the titles of the retrieved studies were first evaluated for relevance; then, the abstracts and full texts of the papers with relevant titles were inspected.

Results: Out of 136 retrieved studies, 10 were relevant and their data were analyzed. Four of the articles highlighted the importance of prevention, three enunciated the importance control and three of them related to care providers' safety. The results showed that the COVID-19 epidemic has affected the healthcare providers' health; however, it is possible to prevent a catastrophe through strategic planning, prevention and control measures.

Conclusions: Considering the importance of the healthcare workers' health, it is necessary to implement COVID-19 prevention and control management principles according to scientific evidence.

Background

An outbreak of a new virus (SARS-CoV-2) started in Wuhan, China in December 2019 and spread to the rest of the world very quickly. The new coronavirus, which belongs to the betacoronavirus family, causes COVID-19 characterized by fever, coughs, and shortness of breath [1]. The spread of the coronavirus in China followed by its global spread has affected health systems, economy, and human societies across the world [2]. Although many people in different professions are exposed to coronavirus, healthcare workers that care for COVID-19 patients are at higher risk of infection due to their close contacts with the patients [3].

The world health organization (WHO) has recommended that healthcare workers adopt certain control and prevention measures to minimize the risk of infection transmission; however, many of them have been infected with COVID-19 [4], which is due to shortage of personal protection equipment and lack of training for infection prevention and control [3]. Moreover, it has been reported that nurses were infected with COVID-19 through respiratory droplets produced by coughs despite using protective equipment [5]. The situation even become worse with Coinfection of COVID-19 with other infections and lack of respiratory symptoms in many patients at the time of referring to health centers [6, 7]. Furthermore, lack of personal protection equipment, high workload, ineffective infection control systems, and even direct

verbal insults from patients like using offensive words or coughing deliberately on them, which may be due to high levels of stress, economic pressure, and the critical situation of the society, have increased the vulnerability of the healthcare providers. Therefore, it is necessary to provide extra support for healthcare personnel [8].

Considering the lack of a definitive treatment for COVID-19 and the risk of disease transmission in the incubation period, infection prevention and control are of utmost importance for global health. Since no study has comprehensively reviewed the safety of healthcare workers during this period, this study aims to sort out different preventive measures and proper management plans to achieve infection prevention and control in health centers.

Methods

This review was conducted according to the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) protocol. We reviewed the articles published in February to September 2020 about COVID-19 prevention, control, and healthcare workers' safety. No time filter was applied for the literature search. We searched key words related to the study namely, "prevention and control", "safety", "coronavirus", "COVID-19", and "health personnel" in PubMed, Web of Science, ScienceDirect, Scopus databases, Google Scholar, and also in Persian data bases such as SID, Magiran, Irandoc, and Iran Medex using AND/OR functions. Subsequently, we collected all articles relevant to control and safety of health workers and collected their full texts. Then, the full texts of the papers (excluding the authors' name to prevent any bias) were presented to two researchers that were experts in review studies. Both researchers independently reviewed each article and stated their reasons for accepting or rejecting the paper. Any disagreement was resolved through consultation with a third reviewer. The inclusion criteria were the articles that investigated prevention, control, and health workers' safety during COVID-19 and presented the required data for prevention, control, and health workers' safety. Finally, out of 136 retrieved studies, 10 matched the criteria and selected for analysis (see Fig. 1.)

Results

Four of the articles highlighted the importance of prevention [7–10–11–12], three enunciated the importance control [14–15–16], and three of them related to care providers' safety [17–18–20] (see Table 1).

Table 1
Characteristics of the studies included in the analysis

Study	Setting	Healthcare Workers	Outcomes
J.Tao 2020[7]	15 February 2020 China	Dermatology departments	Although their hospital is in an infected center, no infected patients have been detected in their departments, owing to heightened surveillance
Xiuqing Ma 2020[10]	West China Hospital, Wenjiang Hospital	all departments and personnel	The control of epidemic prevention in the subdivision area was effective and effective emergency plans should be formulated from the very beginning. Safety control measures should be taken decisively. Only in this way can the infection be controlled to the minimum.
Yang CJ 2020[11]	Kaohsiung Municipal Ta-Tung hospital (KMTTH) in Kaohsiung, Taiwan	all hospital staffs, included doctors, nurses, pharmacists, radiologists, cleaners etc	Community hospitals play an important role in the health system in Taiwan, which provide the basic medical needs for general population with limited human and equipment resources compared to medical centers.
WHO 2020[12]	Worldwide	This guidance is intended for health care workers (HCWs), health care managers	It has been adapted from WHO's Infection prevention and control during health care for probable or confirmed cases of Middle East respiratory syndrome
Kilic AU2020[14]	An operation center in Ankara within the General Directorate of Public Health.	Healthcare workers	Many factors may be contributed to the emergence and spread of previous outbreaks.
Zixing Huang2020[15]	people suspected or confirmed to be infected with COVID- 19	Radiology department	Strategic planning and adequate protections can help protect patients and staff against a highly infectious disease while maintaining function at a high-volume capacity.
Bloomer MJ2020[16]	Australian survey	Nurses working in the intensive care unit	ICU nurses play a key role in managing end-of-life care. This not only includes ongoing clinical care for the dying patient, but caring for and supporting families

Study	Setting	Healthcare Workers	Outcomes
Anup Agarwal2020 [17]	an evidence-based plan according to the needs and infrastructure	Infectious disease department, engineering and nursing department, and departments of microbiology and virology	High-quality clinical care not only helps in limiting the loss of lives from the onslaught of the contagions, but also interrupts the transmission by excluding the infective patients from the general population.
Yogesh G2020[18]	a cross-sectional hospital-based survey	40 healthcare workers	When infected, they need to be taken out of work force to prevent infection to colleagues and patients, which puts a severe strain on their teams.
Chekol W2020[20]	A systematic review	All personnel working in the operating room	All health care personnel should wear personal protective equipment based on the class of patients during surgery. Elective procedures should be postponed to save and mobilize resources for the protection and management of the pandemic disease.

Prevention

Epidemic diseases after the initial outbreak in hospitals may lead to outbreaks among patients and health care workers. It may even spread to the local community if visitors become infected, leading to increase patient mortality and medical costs in the community which could be prevented by protection measures [9].

The study by Tao et al. aimed to highlight the need for protective measures and recommend proper emergency management programs to prevent and control nosocomial infections (COVID-19) in China. They realized that at the Union Hospital, the amount of knowledge and information among healthcare providers about protective equipment in various medical departments, including dermatology, is very low. Therefore, management protocols were set up to prevent and control the disease, including the establishment of multilayer triage from the entrance of the hospital to the entrance of the wards. In addition, measures were taken for dermatologists and hair specialists to work with nurses at dermatology triage stations to evaluate patients if necessary. Moreover, the use of online counseling for patients with mild and non-emergency symptoms to prevent unnecessary referrals was prescribed [7].

Another prevention study was conducted in Wenjiang Hospital in China to ensure the effective implementation of new coronavirus prevention and control measures. A three-layer control and prevention system was implemented: (A) prevention and primary control at the main entrance of the hospital, (B) monitoring and evaluation at the emergency entrance and (C) supervision at the entrance of each ward.

At each entrance, professional nurses and security staff were responsible for closely monitoring the temperature, biographies of possible sources of the virus, identifying staff, and recording staff entry and exit. In other words, in each entrance, suspicious patients were carefully examined and in case of infection, the necessary isolation and treatment measures were performed. In addition, each unit was inspected at least three times a week for the effectiveness of the protective measures of different employees in the workplace [10].

In the same vein, the study by Chin et al. in Taiwan stressed the need for protection and preventive measures for healthcare workers during Coronavirus COVID-19. During the pandemic, health care workers demanded to receive more equipment, which means that it is important to protect health care workers. This is because of the fact that health care providers interact closely with vulnerable patients that may lead to anxiety and lack of willingness to work. The results of the study showed that psychological support of health care providers, availability of equipment, facilities to break the community-hospital infection cycle, and use of public health standards are of great importance [11].

Finally, the study by Muh et al., examined the consequences of prevention and control in 2020, concluded that protecting health care providers from patients in hospitals should be of prime importance. This is because many patients have unusual manifestations of the disease or are waiting for a definite diagnosis, which can be dangerous for health care providers. Therefore, the use of disinfectants and protection equipment to control the transfer cycle of the disease in hospitals are very important [12]

Control

To control epidemics, some priorities should be considered such as controlling an epidemic in its early stages, strengthening knowledge about prevention and control, and ensuring full attention to the implementation of prevention and control strategies [13].

In a study by Kilic et al. in Turkey, to control the coronavirus epidemic, measures were taken to control the infection. The most important of which is hand hygiene and proper use of personal protective equipment by healthcare providers. In so doing, relevant instructions, including the definition of suspected and definite cases and preventive and control measures for the transmission of the disease in all medical centers were immediately developed and notified to health care professionals [14].

In the same line, Huang et al., study in the radiology department of West Hospital in China, revealed more than 3,000 patients with suspected or definite COVID-19 were referred for imaging procedures in less than 50 days. In the end, none of the radiology staffs was infected with the virus following engineering measures (triage and zoning, low-dose chest CT protocol, and standard precautions in radiology). Therefore, strategic planning and adequate protection and control measures can help protect patients and staff against highly infectious disease while maintaining high performance [15]. The same results were also reported in Melissa et al. study of infection control in healthcare providers. They concluded that by providing infection prevention and control measures for emergency care workers, they can take care of

the patients as best as they can although the implementation of these guidelines require a unified approach [16]

Safety

Dealing with Coronavirus 2019 (COVID-19) and its outbreak require fully equipped and dedicated health facilities for patient management. Meanwhile, health and environmental care workers must have the necessary safety to provide services to patients [17].

Yogesh et al. conducted a cross-sectional and hospital-based survey from April 2020 to June 2020 to examine workplace safety and mental health of health care workers. They concluded that health care workers who are at the forefront of dealing with Coronavirus disease are at increased risk of developing COVID-19 infections.. When contaminated, health workers and patients need to rest to prevent infection, which puts pressure on their health systems. Thus, paying attention to the safety of the mental health workplace is very important for health care providers [18].

By the same token, Tongji at Wuhan Hospital in China conducted a study on effective safety management measures in the field of nursing during COVID-19 disease epidemic. They concluded by formulating solutions for nurses' safety: (A) forming an epidemic leadership team as a responsible system for designing emergency plans, (B) selecting experienced nurses as head nurses in different wards, (C) rotating nursing staff and observing the arrangement and composition of new and old staff in wards, (D) highlighting the role of nurse managers in the front line as a model and instructor to create a sense of responsibility and improve the nurses' morale and (E) providing adequate materials and equipment for nurses at the forefront of exposure to coronavirus.

Likewise, Chekol et al. study designed to assess the safety of operating room staff that are part of service personnel. They concluded that all health care personnel should use personal protective equipment based on the type of patients' surgery. Besides, selective operations should be delayed and emergency procedures like burns, cesarean operation, malignant neoplasia, and traumatic injury should be performed using personal protective equipment [20]

Discussion

COVID-19 manifests with a range of mild to severe symptoms; a major problem is that similar to common cold, patients with mild symptoms may not seek treatment, which may result in lack of diagnosis, increased chance of infection, and virus cycle expansion [2]. On the other hand, virus transmission is possible during the incubation period, which may last up to 14 days [7]. Tao et al showed that since the COVID-19 outbreak, the governments have implemented strict prevention and control measures; however, infected patients may still be missed in the asymptomatic incubation period. The study in China showed that 77.5% of the infected health professionals worked in general wards, indicating the high transmissibility of the disease even in general wards. Further, the coinfection of COVID-19 disease with other infections may even intensify the problem [8]. In the same line, Lotfinejad et al found that health

care providers is at the forefront of the fight against coronavirus. The growing rate of coronavirus transmission in hospitals has increased global demand for more effective prevention and control across healthcare settings. Experienced nurses can avoid infections with appropriate hand hygiene compliance and use of protective equipment. However, it is crucial to have adequate numbers of nursing staff and access to protective equipment to ensure the safety and quality of care [2]. To this end, experienced nurses can prevent infection by maintaining proper hygiene and using protective equipment. To ensure the safety and quality of care, it is essential to have a sufficient number of nursing staff and access to equipment [1]. In the study by Liu, they also mentioned that one of the most important challenges in responding to the coronavirus is human resource management and personal protective equipment [19].

A key step in controlling the corona virus is hand washing, which has been repeatedly recommended by the WHO. The WHO has also advised health workers to cover their noses and mouths with a cloth or elbow when coughing or sneezing, and to provide masks for patients with suspected infections [1]. The Centers for Disease Control and Prevention (CDC) and the WHO have also published lessons from China that protect health care providers and the proper use of masks according to protocols to protect health care providers from the coronavirus [21]. Thus, these studies are consistent with the present study emphasizing that during the epidemic of COVID-19, prevention and safety of employees who are the front line of service providers is of great importance.

Fascinatingly, a study by Gibson et al. in the United States found that the Pre-hospital emergency staff received no benefits in connection with COVID-19 disease. More importantly, 60 percent of mission staff does emergency work without an N95 mask, and 18 percent use only one N95 mask for a week or more on emergency missions. However, according to the WHO, it is important to maintain appropriate preventive measures not only when caring for patients but also in close contact with colleagues. The results of the study illustrated that the United States, as a leading country in the field of emergency medical services (EMS), is facing a serious problem and crisis. At present, treating coronavirus patients in the emergency centers are in accordance with the instructions of the CDC [3, 22].

Another important issue that should be mentioned is the use of experienced trained staff in COVID-19 to form a team to develop disease prevention and control programs, integrate processes, and continually improve management principles in disease prevention and control based on scientific evidence. Based on Huang et al. study, this group should provide a daily report on the updated status of suspected and definitively infected patients and analyze their condition and inform the specialists in the intensive care unit and radiology to assess whether the patient needs further examination and treatment. These medical communications can be web-based. Moreover, isolation, reporting and transfer of suspected patients should be done following policies and processes to control local infection and involve the general public. The above measures of the management group will stabilize the order in the wards and greatly reduce the duration of exposure to the patient and the risk of infection [7, 15].

Finally, the study conducted by Belingheri et al in 2020 with the aim of preventing and controlling health in unhealthy environments concluded that there is no recommendation and protective equipment for

personal protective equipment for people in unhygienic environments. Nevertheless, to prevent the spread of droplets, they should use masks, observe social distancing, clean and disinfect dirty surfaces, and prevent overcrowding at work [23].

Conclusions

Personal protective equipment for health care workers will improve services and improve the quality of staff care for patients. Thus, prominent protective measures and appropriate emergency management plans are recommended to prevent and control infection and the safety of health care workers.

It should be noted that most of the current studies investigated the prevention and emergency control of hospital pediatrics and the evaluation of patients with COVID-19 in the radiology department and unsanitary environments. Therefore, future studies should inclusively focus on the safety of health care providers in hospital environment.

List Of Abbreviations

WHO: World Health Organization, **CDC:** Centers for Disease Control and Prevention, **PPE:** personal protective equipment .

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

SM, and GM conceptualized and designed the study. FBS carried out the study, analyzed and interpreted the data, and wrote the first manuscript. MR gave intellectual feedback, redrafted and finalized the manuscript. All authors read and approved the final manuscript.

Availability of data and materials

Not applicable

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Figures

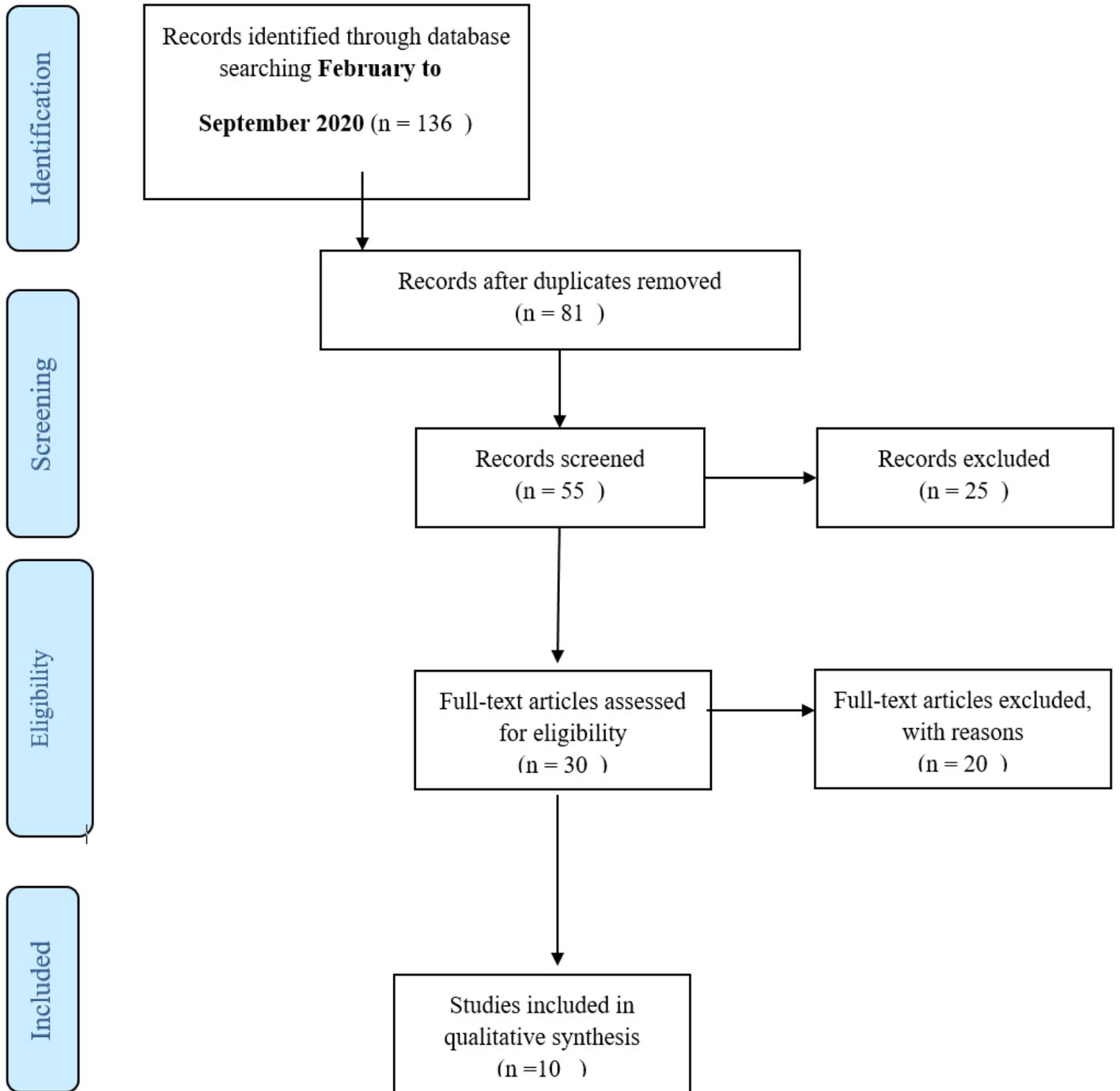


Figure 1

PRISMA study flow diagram

Supplementary Files

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- [PRISMA2009checklist.doc](#)