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## Global Perspective Article

## The impact of novel coronavirus SARS-CoV-2 among healthcare workers in hospitals: An aerial overview

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The ongoing outbreak of COVID-19, caused by the novel coronavirus SARS-CoV-2, places healthcare workers at an increased risk of infection as they are in close contact with patients. In this article, we report an overview of cases of infected healthcare workers in China and Italy during the early periods of the COVID-19 epidemic. China's coronavirus response highlights the importance of implementing effective public health strategies. The authorities worldwide therefore, need to be extremely cautious when they implement stringent protective measures that safeguard healthcare workers in hospitals and counteract the threats created by the pandemic

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Daily, the outbreak of the Coronavirus disease, COVID-19, seems to reach a new and tragic milestone. Current epidemiological data shows that person-to-person transmission of coronavirus SARS-CoV-2 is more likely to be occurring.<sup>1–4</sup> As of March 22, 2020, the World Health Organization (WHO) reported 267,013 confirmed cases, including 11,201 deaths, in 184 countries and regions. The virus spreads mainly between people who are in close contact (6 feet) with an infected person through respiratory pathways, though it can also be transmitted through contact with contaminated surfaces or objects. In this case, every individual is potentially susceptible to the virus as no vaccine is currently available. Data from the Chinese Center for Disease Control and Prevention indicates that leading up to February 11, 2020, a total of 1716 healthcare workers became infected and 5 had died (0.3%).<sup>5</sup> In addition, according to a more recent report from the Italian Institute of Higher Health and National Federation of surgeons and Dentists, from 1st to 23rd March 2020,

4826 healthcare workers were infected with COVID-19 (9% of confirmed cases) and 18 had died.

It is therefore, imperative to prevent further transmission of COVID-19 in medical facilities to protect healthcare workers. In this article, we report the findings of infected cases of healthcare workers in hospitals during the early outbreak period of COVID-19. The purpose of this paper is for readers to better understand the epidemiological characteristics and protective measures by which the coronavirus SARS-CoV-2 caused the COVID-19 disease in the thousands of infected medical staffs' patients in Wuhan and worldwide.

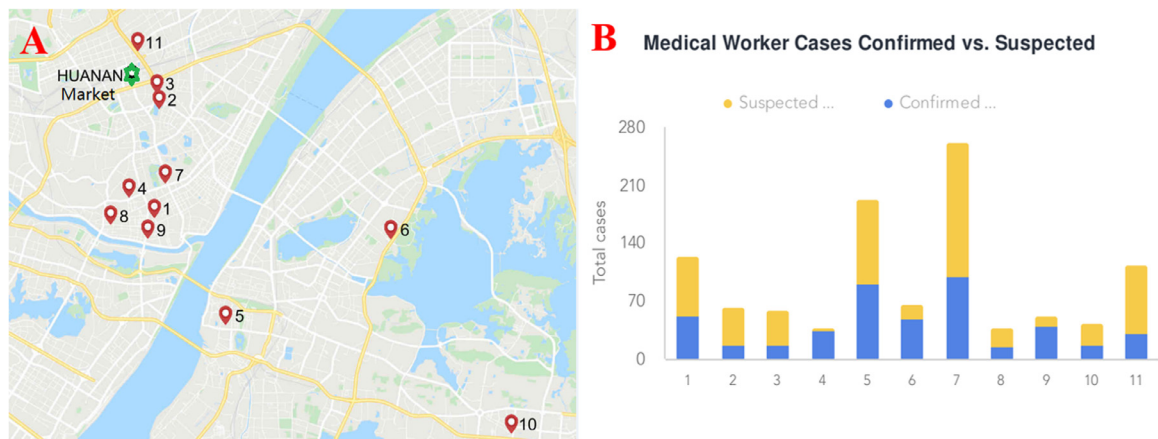
## METHODS

We collected publicly available data from the National Health Commission, Hubei Health Commission, Wuhan Health Commission National, China Center for Disease Control and Prevention, Italy, and the WHO. We also searched literature reporting healthcare workers infected with CoVID-19 in hospitals using the PubMed database and Cochrane Library from January 1, 2020 to March 24, 2020. Search terms included “healthcare workers” or “medical staff” and “novel coronavirus” or “COVID-19” or “2019-nCoV.”

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**Fig 1.** Geographical epidemiological characteristics of 11 hospitals with infected healthcare workers. (A) Geographical distribution of 11 hospitals. (B) According to the date of the first confirmed case with COVID-19 detected using viral nucleic acid testing, 11 hospitals were arranged in sequence from code 1 to 11. Confirmed and suspected cases of every hospital were identified by the end of January 2020.

## RESULTS

### *Geographical epidemiological characteristics of 11 hospitals with infected healthcare workers*

By the end of January 2020, 11 hospitals in Wuhan had reported over 15 confirmed cases among healthcare workers. Geographical distribution of these hospitals is shown in Figure 1A. According to the date of the first confirmed case with COVID-19 detected using viral nucleic acid testing, these hospitals were arranged in sequence and coded 1–11. Hospital-2, -3, and -11 are closer to Huanan Seafood Wholesale Market in comparison to the rest, and reported 63, 60, and 115 COVID-19-infected cases (including confirmed and suspected cases) of healthcare workers respectively (Fig 1B). Three hospitals farther from Huanan Seafood Wholesale Market are located in the southern region of the Yangtze River and reported 194, 66, and 44 COVID-19-infected cases, respectively (Fig 1B).

### *Characteristics of Chinese medical staff infected during the early period of the COVID-19 outbreak*

Data from hospital-6 showed that of the 138 patients with COVID-19, 40 (29%) were medical staff who were infected in the hospital setting. Moreover, over 10 healthcare workers in the surgical department were presumed to have been infected by a confirmed patient presenting with abdominal symptoms. Among those infected healthcare workers, 31 (77.5%) worked on general outpatient clinics and wards, 7 (17.5%) were in the emergency department, and 2 (5%) were in the intensive care unit (ICU; Fig 2). In addition, there were 230 diagnosed cases (130 inpatient cases and 100 home-quarantine cases) in hospital-11 by the end of February 2020.

The Chinese National Health Commission is the authoritative organization responsible for publishing data on medical staff infections. According to the National Health Commission, on 11th February 2020, among the 44672 confirmed cases, a total of 1716 cases were healthcare workers (3.8%). Specifically, 1502 were in Hubei province (87.5%) and 1102 in Wuhan city (64.2%; Fig 2). After implementing the clinical diagnostic criteria, the number of clinically diagnosed cases had surged by 13th February 2020. On 24th February 2020, the WHO-China Expert Group conference stated that a total of 3387 infected cases (2055 confirmed cases, 1070 diagnosed cases, and 157 suspected cases) were healthcare workers in 476 healthcare settings, of whom 3062 were in Hubei (90.4%). These results

suggest that the number of infected healthcare workers were mostly in Hubei province which is the epicenter of the outbreak in China.

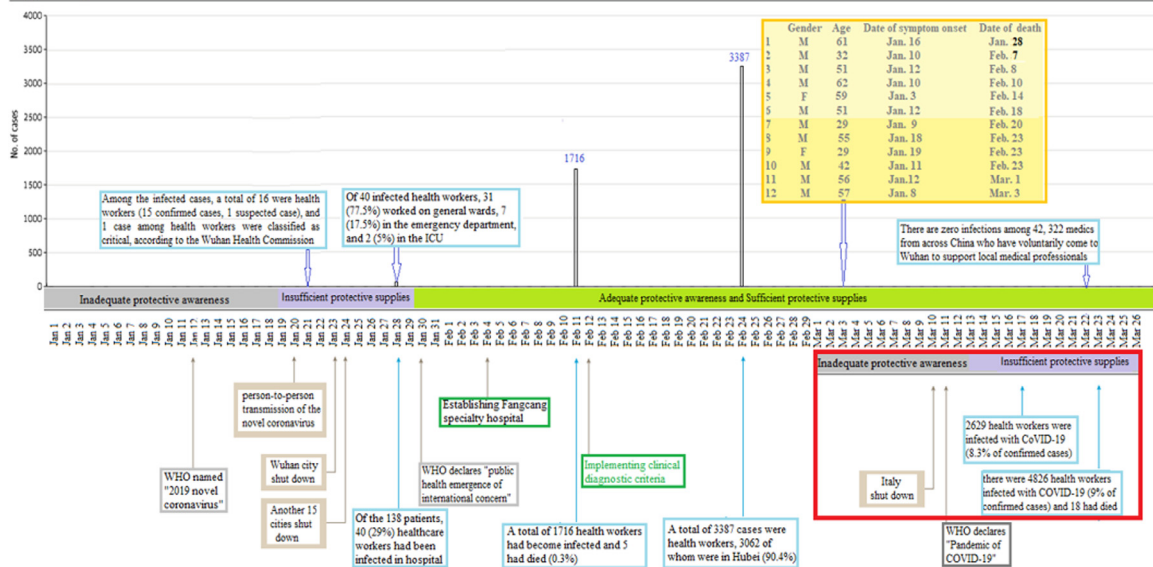
## DISCUSSION

Since COVID-19 is a novel disease with a high transmission rate,<sup>6–8</sup> it presents a greater risk of infection for healthcare workers who are in close contact with patients. Huang et al<sup>2</sup> first reported 41 COVID-19 cases known to have had a history of exposure to the Huanan Seafood Wholesale Market. Thus, we described geographical epidemiological characteristics of 11 hospitals with infected healthcare workers illustrated in Figure 1. To date (24th March 2020), there were 230 healthcare workers infected with COVID-19 in hospital-11 which is closer to Huanan Seafood Wholesale Market and had 4 deaths. The data suggest that several cases among the infected healthcare workers may be closely linked to the geographical proximity to the Market during the early phase of the COVID-19 outbreak, especially the beginning of January 2020.

We analyzed the data of 12 deceased healthcare workers and found that their dates of symptom onset were at the beginning and middle of January 2020 (Fig 2). Because of the 14-day latency, it was speculated that they were infected with the novel coronavirus SARS-CoV-2 between late December 2019 and early January 2020. Notably, at that time, many important questions involving the SARS-CoV-2 infections remained unanswered, including its ability and duration of transmission in humans and clinical consequences of human infections. Unfortunately, a substantial number of healthcare workers were infected in healthcare settings before the end of January 2020. Although SARS-CoV-2 itself is significantly infectious, it should not be held fully responsible for the extensive spread of the infection. In fact, the main reasons for earlier virus transmission to healthcare workers were due to lack of awareness of adequate protection of healthcare workers and leaders in health-care settings, and later transmissions were as a result of insufficient supply of protective devices (Fig 2). Moreover, to date, there is zero infection among the 42, 322 medical staff from across China who voluntarily came to Wuhan to support local medical healthcare professionals from 25th January to 26th March 2020. This suggests that high-grade protection and social distancing are crucial strategies to prevent transmission in hospitals.

In an article from *The Lancet* published online on January 24, 2020, Wang and colleagues<sup>3</sup> put forward a proposition that we have to be aware of the challenges SARS-CoV-2 poses to our world. Specifically, we need to be wary of the current COVID-19 outbreak turning into a

**Figure 2** Dynamic Profile of COVID-19-infected healthcare workers



**Fig 2.** The graph's x-axis (dates from 1st January to 26th March 2020) is used as a timeline of the key events and dynamic profile of infected healthcare workers in the different phases of the COVID-19 outbreak. The key events include the international public health emergency and the declaration of COVID-19 as a pandemic by the WHO. The profiles of infected healthcare workers are shown in blue boxes; the data of 12 deceased healthcare workers are shown in the yellow box. Italian information is shown in the red box.

sustained epidemic or even a pandemic associated with substantial morbidity and mortality. Though SARS-CoV-2 put all health organizations in China on high alert,<sup>9</sup> mounting evidence shows that the viral shedding of asymptomatic or mild cases of SARS-CoV-2 spread to infect others.<sup>10-13</sup> This may explain why the virus SARS-CoV-2 spread so quickly in Europe and is now swiftly circulating around the world. Before the WHO declared COVID-19 a pandemic on March 11, 2020, the Italian government did not implement strong measures through public health interventions, including case detection, wearing protective masks, closing public spaces, cancelling public gatherings, and self-isolation at home. Moreover, insufficient protective supplies fueled the infection of healthcare workers in hospitals. All these factors contributed to the current pandemic in Italy and other hardest hit countries such as Spain, France, Iran, United Kingdom and the United States of America.

**CONCLUSION**

The ongoing outbreak of COVID-19 worldwide highlights the importance of implementing effective public health strategies. What can China's coronavirus response teach the rest of the world? The answer is that authorities need to be extremely cautious and implement stringent protective measures to safeguard our healthcare workers in order to counteract the threats brought by the pandemic.

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