

## Severe Acute Respiratory Syndrome Coronavirus 2 Infection (SARS-CoV-2) among Healthcare Workers in Selected Governorates of Yemen

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### Abstract

**Introduction:** During Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) pandemic, health-care workers (HCWs) may experience an increased risk of infection due to their close contact with highly infectious patients, and also due to exposure to undiagnosed or subclinical infectious cases. This could be even more problematic, considering the poor access to personal protective equipment especially in countries with a complex humanitarian emergency like Yemen. This study describes clinical-epidemiological characteristic of HCWs affected by SARS-CoV-2 infection in Yemen.

**Methods:** The study is based on retrospective analysis of available data from 15 March to 27 December 2020, as compiled by the Disease Control and Surveillance Team in selected Governorates-Yemen.

**Results:** A total of 414 including 32 deaths of HCWs, with the onset of symptoms between 15 March and 27 December 2020 were reported through the surveillance system in Yemen. Of the total 414, 38.2% were laboratory confirmed and 61.8% clinically suspected. Most cases were recorded from Hadramout governorate. Three hundred and fifteen were males (76.1%), and 99 (23.9%) were females, (male to female Ratio being 3.18:1). The overall median age of the recorded cases was 37 years and the most affected HCWs were between 30-44 years. Hypertension (5.6%) and Diabetes Mellites (4.8%) were the most common comorbidities among those who died. No underlying conditions were reported in 83.8 % of the cases.

**Conclusion:** Yemeni HCW are at high risk for getting SARS-CoV-2. Thus, they should be given high priority for vaccine against SARS-CoV2 and the immediate implementation of infection prevention and control program at health care settings is highly recommended

**Keywords:** SARS-CoV2, Yemen, HCWs, Surveillance, Infection.

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## عدوى المتلازمة التنفسية الحادة الوخيمة فيروس كورونا 2 (SARS-CoV-2) بين العاملين في مجال الرعاية الصحية في محافظات مختارة من اليمن

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### ملخص الدراسة

**المقدمة:** خلال جائحة SARS-CoV-2، قد يواجه العاملون الصحيون خطرًا متزايدًا للإصابة بالعدوى بسبب اتصالهم الوثيق بالمرضى المصابين بشدة العدوى، وايضًا بسبب التعرض لحالات معدية غير مشخصة أو لم يكن التشخيص الإكلينيكي لها كافيًا. وقد يكون هذا أكثر إشكالية، بالنظر إلى ضعف الوصول إلى معدات الحماية الشخصية خاصة في البلدان التي تعاني من حالات طوارئ إنسانية معقدة مثل اليمن. لذلك، فإن هذه الدراسة تهدف لوصف الخصائص السريرية والوبائية لعدوى SARS-CoV-2 لدى العاملين الصحيين في اليمن.

**المنهجية:** تستند الدراسة إلى التحليل بأثر رجعي للبيانات المتاحة ما بين 15 مارس حتى 27 ديسمبر 2020، والتي جمعها فريق مكافحة الأمراض والترصد في عدد من المحافظات اليمنية. **النتائج:** بلغ إجمالي حالات الإصابة بين العاملين الصحيين 414 من بينهم 32 وفاة، وذلك خلال الفترة ما بين 15 مارس و27 ديسمبر 2020 حسب تقرير نظام الترصد في اليمن. من إجمالي 414 حالة مسجلة، كانت 38.2% كانت مؤكدة مخبريًا و61.8% مشتبه بها سريريًا. وقد تم تسجيل معظم الحالات من محافظة حضرموت. ثلاثمائة وخمسة عشر (315) كانوا من الذكور (76.1%)، و99 (23.9%) من الإناث، ونسبة الذكور إلى الإناث 1:3.18. وقد كان متوسط العمر الإجمالي للحالات المسجلة 37 عامًا وكان متوسط عمر العاملين الصحيين الأكثر تضررًا بين 30-44 عامًا. كما لوحظ إن ارتفاع ضغط الدم (5.6%) وداء السكري (4.8%) كانوا أكثر الأمراض المصاحبة لحالات الوفيات ولم يتم الإبلاغ عن أي أمراض مصاحبه في 83.8% من إجمالي الحالات.

**الاستنتاج:** يتعرض العاملون الصحيون في اليمن لخطر كبير للإصابة بـ SARS-CoV-2، وبالتالي يجب إعطاؤهم أولوية عالية للقاح ضد SARS-CoV2 كما يوصى بشدة القيام بالتنفيذ الفوري لبرنامج الوقاية من العدوى ومكافحتها في مواقع تقديم الخدمات الصحية. **الكلمات المفتاحية:** SARS-CoV2، اليمن، العاملون الصحيون، الترصد، العدوى.

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## Introduction

The outbreak of corona virus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first reported in Wuhan, China, in December 2019. In a short period, COVID-19 has spread fast worldwide, posing severe threats to global health. On 11 March 2020, the World Health Organization (WHO) declared the outbreak as a pandemic [1,2].

Yemen was one of the last countries in the world to declare the first case of the pandemic, on 10 April 2020 [1]. Fear and concerns of catastrophic outcomes of the epidemic in Yemen were immediately raised, as the country is facing a complex humanitarian crisis. About 50% of the population of Yemen is estimated to be in acute need of health care, with high rates of malnutrition, child and maternal mortality [1,2]. In addition, the limited availability of safe drinking water, people living in crowded houses, inadequate sanitation, and stigma constitute barriers for effective response and control of the epidemic in Yemen [2]. Due to the ongoing armed conflict, less than 50% of the health facilities in Yemen are fully functional [1,2] and more than 2 million children are malnourished [1].

Yemen has a population of 30 million people, and the armed conflict which started in 2015 led to a fragmentation of the healthcare system [1,2]. For early detection of SARS-CoV-2 in Yemen, as in other countries, a case

definition, active surveillance, and contact tracing were required and established according to the WHO guidelines [1,3].

During this pandemic, health-care workers (HCWs) may experience an increased risk of SARS-CoV-2 infection due to their close contact with highly infectious patients, and also due to exposure to undiagnosed or subclinical infectious cases [4,5]. This could be even more problematic, considering the poor access to personal protective equipment (PPE) especially in countries with a complex humanitarian emergency like Yemen [2]. Therefore, describing SARS-CoV-2 infection among HCWs is critical for achieving optimal control of the pandemic and to enhance the implementation of prevention and control programs and to contribute in increasing the evidence available to public health policymakers in the country. This study describes Clinical-epidemiological characteristic of HCWs affected by SARS-CoV-2 infection in Yemen.

## Methods

The study is based on retrospective analysis of available data from 15 March to 27 December 2020, as compiled by the Disease Control and Surveillance Team. We included in our analysis the data from 11 out of 23 governorates of Yemen, namely Aden, Abyan, Lahj, Al-Dhale'a, Taiz, Abyan, Shabwa, Hadramout (Mukalla and Sayoun), Al-Mahrah and Marib.

With the onset of the pandemic, an enhanced surveillance system for COVID-19 was set up in Yemen,

which included direct reporting to the General Directorate of the Diseases Control and Surveillance of each laboratory case of COVID-19. The following data were collected for each case, using a standardized form: demographics (age, sex, residence, nationality), clinical signs and symptoms, occupational status and place of treatment, laboratory findings and time course of illness (date of onset, date of admission, date of death) and underlying diseases. Trained health care workers extracted data from case notes.

Yemen adopted and updated the WHO case definition of suspected, probable, and confirmed cases in December 16, 2020 [1]. With the onset of the pandemic, nasopharyngeal swab specimens collected from each case “suspected case” and were sent to the 4 reference laboratories located in Aden, Hadramout Mukalla, Sayoun, and Taiz. The diagnosis was confirmed by Real-time reverse transcriptase polymerase chain reaction (RT-PCR) performed. The rapid response teams (RRTs) transported the specimens to the laboratories in viral transport medium. Only cases that were positive for SARS-CoV-2 using RT-PCR were classified as confirmed.

#### ***Statistical analysis***

Frequency tables were used for data presentation and the association between underlying disease and sexes

was considered statistically significant at  $p < 0.05$  by using chi-squared test. Data was analyzed using SPSS for windows, version 13.0.

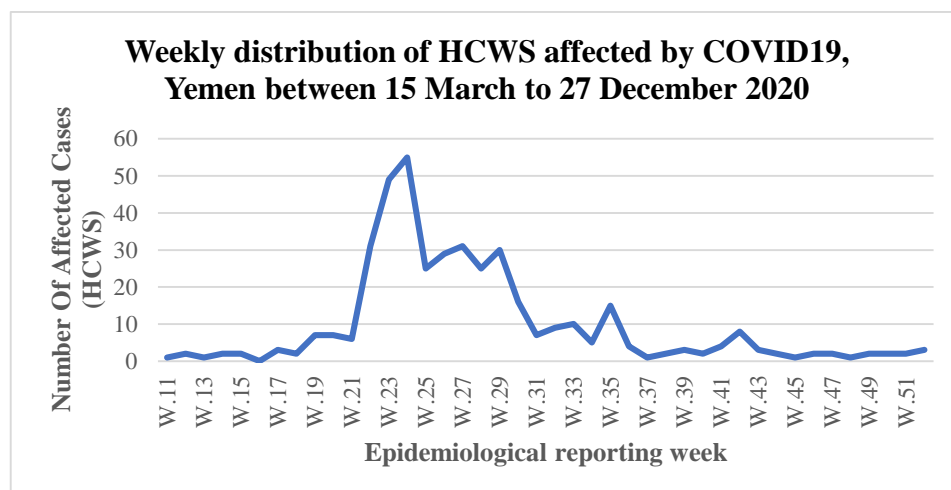
#### ***Ethical considerations***

Approval to conduct the study was taken from the Ministry of Public Health and Population in Yemen-Aden to data collection.

### **Results**

Between 15 March and 27 December 2020, a total of 414 including 32 deaths of HCWs were affected by SARS-CoV2, out of which 10 (2.4%) were held non-Yemeni citizenship and were reported to the Diseases Control and Surveillance in the Ministry of Public Health and Population, located in Aden “the temporary capital city of Yemen”. During this period, a total of 7153 cases were recoded, out of which 2093 laboratory confirmed and 607 deaths. With this denominator, the overall attack rate among HCWs was 5.8 % and the case fatality rate (CFR) for HCWs was 7.7%.

Between epidemiological weeks 11-18 and 36-52, (March-April) and September-December 2020), HCW cases were infrequently detected, including only 124; however, from epidemiological week 19 to 35 (May-August 2020), about 290 cases were reported as shown in Figure 1.



**Figure1:** Affected HCWs (Suspected and Confirmed) Cases of SARS-Cov-2 Infection in Yemen by Epidemiological Week, from 15 March to 27 December, 2020

Of the total 414 cases recorded, 158 (38.2%) were laboratory -PCR-confirmed and 256 (61.8%) clinically suspected. Most cases were recorded from Hadramout governorate (Mukalla, 37 & Sayoun, 32), Table 1.

**Table1:** Suspected and Confirmed Cases of HCWs Affected by SARS-CoV-2 Infection in Yemen According to Governorate, 15 March to 27 December 2020 (n=414)

Gov	Confirmed (n=158 (38.2%))	Suspected (n=256 (61.8%))
Abyan	7	11
Aden	10	34
Al-Baidha	2	14
Al-Dhale'a	10	53
Al-Mahara	5	2
Hadramout/ Mukalla	37	22
Hadramout/ Sayoun	32	17
Lahj	11	24
Mareb	4	20
Shabwa	3	5
Taiz	37	54

Three hundred and fifteen (315) were males (76.1%), and 99 (23.9%) were females (male to female Ratio being 3.18:1). The overall median age of the recorded cases was 37 years (range: 19-85 years) and the most affected HCWs were between 30-44 years. Hypertension (5.6%) and Diabetes Mellitus (4.8%) were the most common comorbidities reported among affected HCWs. No underlying conditions were reported in 83.8 % of the cases, as seen in Table 2.

**Table 2:** Demographic Characteristics of HCWs Affected with SARS-CoV-2 infection in Yemen from 15 March to 27 December 2020 (n=414)

Characteristics	Cases		Deaths		Recovered	
	No.	%*	No.	%**	No.	%**
	414	100	32	7.7	382	92.3
<b>Age (years)</b>						
19-29	77	19	1	1.3	76	98.7
30-44	200	48.3	6	3.0	194	97.0
45-59	105	25	11	10.5	94	89.5
≥60	32	7.7	14	43.8	18	56.3
<b>Gender</b>						
Male	315	76.1	27	8.6	288	91.4
Female	99	23.9	5	5.1	94	94.9
<b>Nationality</b>						
Yemeni	404	97.6	29	7.2	375	92.8
Non -Yemeni	10	2.4	3	30.0	7	70.0
<b>Comorbid Conditions</b>						
Cardiovascular Diseases	9	2.2	2	22.2	7	77.8
Hypertension	23	5.6	5	21.8	18	78.3
Asthma	3	0.7	1	33.3	2	66.7
Diabetes Mellites	20	4.8	3	15.0	17	85.0
Kidney Disease	12	2.9	1	8.3	11	91.7
No underlying conditions	347	83.8	20	5.8	327	94.3

\*Percentages were taken from column total

\*\* Percentages were taken from row total

The most common symptoms and signs among HCWs with confirmed SARS-CoV-2 infection were fever,

sore throat, cough and running nose. Difficulty of breathing was reported among 31.6% of cases, Figure 1.

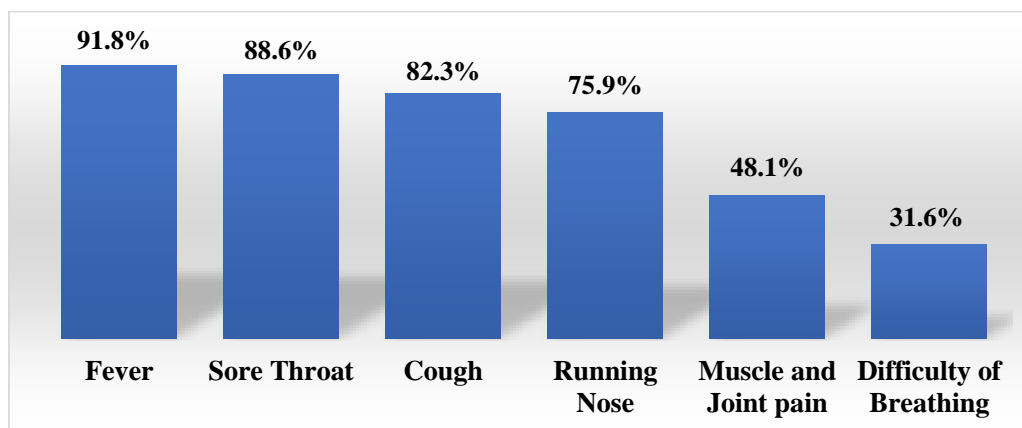
**Figure 1:** The Most Common Signs and Symptoms among HCWs with Confirmed SARS-CoV-2 Infection in Yemen from 15 March to 27 December 2020 (n = 158)

Table 3 shows that among the affected HCWs, medical doctors (37.9%) and nurses (31.1%) were the most frequently affected. Higher

percentage of deaths among each of HCWs categories was reported among laboratory technicians (40.0%) and pharmacist (33.3%).



**Table 3:** Status According to the HCWs Occupational Categories among those with Confirmed, Suspected and Death SARS-CoV-2 Infection in Yemen, 15 March to 27 December 2020, (n=414)

Occupation	Total		Confirmed (n=158)		Suspected (n=256)		Deaths (n=32)		Recovered (n=382)	
	No.	%*	No.	%**	No.	%**	No.	%**	No.	%**
Administrators	34	8.2	14	41.2	20	5.9	5	14.7	29	85.3
Physicians/Doctors	157	37.9	56	35.7	101	64.3	14	8.9	143	91.1
Nurses	129	31.2	38	29.5	91	70.5	6	4.6	123	95.3
Laboratory technicians	5	1.2	5	100	0	0.0	2	40.0	3	60.0
Pharmacist	3	0.7	3	100	0	0.0	1	33.3	2	66.7
Others (cleaners, registral, receptionist, drivers)	86	20.8	42	48.8	44	51.2	4	4.6	82	95.3

\*Percentages were taken from column total

\*\* Percentages were taken from row total

Most of the HCWs 257 (62%) were treated at home compared to only 157 (38%) of them who required hospitalization. Only 12% and 1.7 % of affected HCWs were admitted to intensive care unit admission and used ventilators respectively Table 4.

**Table 4:** Distribution Affected HCWs by SARS-CoV-2 According to Place of Treatment, Yemen, 15 March to 27 December 2020 (n=414)

Place of the treatment Center	No.	%
Home	257	62.0
Hospital admission	100	24.2
ICU admission	50	12.0
Use of ventilator	7	1.7
Overall Hospitalization rate	157	38.0

The median time from onset of symptoms to hospital admission was 8 days (range 1 - 17); while the median time from onset of the SARS-CoV-2 to the onset of deaths was 3 days.

## Discussion

HCWs are the first responders to any health problem in Yemen and worldwide and they may experience an increased risk with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection due to their close contact with highly infectious patients, but also due to exposure to undiagnosed or subclinical infectious cases. The epidemiology of HCWs has been summarized in several studies all over the world [3-12]. In this study, we described SARS-CoV2 infection among HCWs in Yemen with a complex emergency aiming to provide a scientific basis for prevention and control program for policy makers.

The authors analyzed the surveillance data of 414 including 32 deaths SARS-CoV-2 affected HCWs till 27 December 2020. During this period, a total of 7153 cases were recorded, out of which 2093 laboratory confirmed and 607 deaths. With this denominator, the overall attack rate among HCWs was 5.8 % and the CFR

for HCWs was 7.7%. The current evidence shows that approximately a tenth of the HCWs in the screened hospitals had a diagnosis of acute SARS-CoV-2 infection; half of these were nurses, thus our study finding almost was going with other studies reported globally [13-20]. The overall median age of the recorded cases was 37 years and the most affected HCWs were between 30-44 years (48.3%) followed by age group of 45-59 years (25%). Males were more affected (76.1%) than females (23.9%). In China, the median age of the patients was 47 years [3,4] against our findings because Yemen has younger population than China and other European countries. However, a higher proportion of males may be because of the male HCWs in Yemen had more chance for higher education and work due to local cultural effect and also, this finding were in disagreement with findings in China and other European countries [4-6].

According to what was reported by the WHO [21] and others [15,22], at least 50% of patients who died of COVID-19 were residents in hospitals or nursing homes, which highlights the need to control the spread of infection in a health-care setting. Our finding highlighted that, medical doctors and nurses were the most frequently affected and 38% of them required hospital admission, out of which 31(96.9%) died in the hospitals. We strongly agree with WHO recommendation and the need to control the spread of infection in a health-care setting is highly recommended. Clinically, the most common symptoms and signs among HCWs with confirmed SARS-CoV-2

infection were fever, sore throat, cough and difficulty of breathing, which are in agreement other studies worldwide [5, 9, 14-18]. Furthermore, most deaths were occurred among those with chronic underlying conditions and the overall median time from onset of symptoms to hospital admission was 8 days (range: 1-17); while the median time from onset of the SARS-CoV-2 to the onset of deaths was 3 days. The same findings have been reported elsewhere [14-23].

### **Limitations**

The major limitation of the study finding is that the analyzed data were from selected governorates under Internationally Recognized Government (IRG), which is home to 31% of the total population of Yemen, as the data from the northern part of the country was inaccessible for analysis. This makes our results not generalizable to the rest of the country, because besides the higher population, the northern part of Yemen has different characteristics including lower temperature and higher altitude [1].

### **Conclusion**

Yemeni health care workers are at high risk for getting SARS-CoV-2, thus they should be given high priority for vaccine against SARS-CoV2 and the immediate implementation of infection prevention and control program at health care sitting is highly recommended.



### Authors' Contributions

All authors attest to having contributed substantially to conception and design and acquisition of data and drafting the article and revising it critically for important intellectual content. All authors give approval of the final version to be published.

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### References

1. Al-Waleedi AA, Naiene JD, Thabet AA, Dandarawe A, Salem H, Mohammed N, *et al.* The first 2 months of the SARS-CoV-2 epidemic in Yemen: Analysis of the surveillance data. *PLoS ONE* 2020;15(10): e0241260. <https://doi.org/10.1371/journal.pone.0241260>.
2. Al-Awlaqi S, Dureab F, Annuzaili D. COVID-19 and conflict: The devastating impact of withdrawing humanitarian support on universal health coverage in Yemen. *Public Heal Pract* 2020; 1: 100015. <https://doi.org/10.1016/j.puhip.2020.100015>
3. Vannabouathong C, Devji T, Ekhtiari S, Chang Y, Phillips SA, Zhu M, *et al.* Novel coronavirus COVID19: Current evidence and evolving strategies. *J Bone Joint Surg Am* 2020; 102: 734–44. <https://doi.org/10.2106/JBJS.20.00396>
4. Amanat F, Krammer F. Perspective SARS-CoV-2 vaccines: Status report. *Immunity* 2020; 52: 583–9. <https://doi.org/10.1016/j.immuni.2020.03.007>.
5. Ao Y, Qiu Q, Kong X, Sun Y, Chen T, Zuo Y, *et al.* Clinical and epidemiological characteristics of COVID-19 patients in Chongqing China. *Frontiers Public Health* 2020; 8:244. doi: 10.3389/fpubh.2020.00244
6. Hewage SN, Cao LT, Jones RM., Fraser AM. Factors associated with environmental service worker cleaning practices in healthcare settings: A systematic review of the literature. *Am J Infect Control* 2021; 49(7):919–27. <https://doi.org/10.1016/j.ajic.2021.01.001>
7. Gómez-Ochoa SA, Franco OH, Rojas LZ, Raguindin PF, Roa-Díaz ZM, Wyssmann BM, *et al.* COVID-19 in Health-Care Workers: A living systematic review and meta-analysis of prevalence, risk factors, clinical characteristics, and outcomes. *Am J Epidemiol* 2020;00(00):1–15. 2021;190(1)161-75. doi:10.1093/aje/kwaa191
8. Progressive. The Coronavirus App [Internet].2020 [cited 2020 July 8]. Available from: <https://coronavirus.app/map>.
9. Mahase E. COVID-19 has killed more people than SARS and MERS combined, despite lower case fatality rate. *BMJ* 2020; 368:64.
10. CDC COVID-19 Response Team. Characteristics of health care personnel with COVID-19 - United States, February 12-April 9, 2020. *MMWR Morb Mortal Wkly Rep* 2020; 69(15):477–81.

11. The Lancet editors. COVID-19: protecting health-care workers. *Lancet* 2020;395(10228):922.
12. Barrett ES, Horton DB, Roy J. Prevalence of SARS-CoV-2 infection in previously undiagnosed health care workers at the onset of the U.S. COVID-19 epidemic Preprint. Posted online 2020; 14. (doi: 10.1101/2020.04.20.20072470).
13. Chu J, Yang N, Wei Y. Clinical characteristics of 54 medical staff with COVID-19: a retrospective study in a single center in Wuhan, China. *J Med Virol* 2020;92(7): 807–13.
14. Keeley AJ, Evans C, Colton H. Roll-out of SARS-CoV-2 testing for healthcare workers at a large NHS Foundation trust in the United Kingdom, March 2020. *Euro Surveil* 2020;25(14): 2000433.
15. Lai X, Wang M, Qin C, Tan L, Ran L, Chen D, *et al.* Coronavirus disease 2019 (COVID-2019) infection among health care workers and implications for prevention measures in a tertiary Hospital in Wuhan, China. *JAMA Netw Open* 2020; 3(5): e209666. doi: 10.1001/jamanetworkopen.2020.9666.
16. Baker MA, Rhee C, Fiumara K. COVID-19 infections among healthcare workers exposed to a patient with a delayed diagnosis of COVID-19. *Infect Control Hosp Epidemiol* 2020;1–2.
17. Chatterjee P, Anand T, Singh KJ. Healthcare workers & SARS-CoV-2 infection in India: a case-control investigation in the time of COVID-19. *Indian J Med Res* 2020;151(5):459–67.
18. Iqbal MR, Chaudhuri A. COVID-19: results of a national survey of United Kingdom healthcare professionals' perceptions of current management strategy – a cross-sectional questionnaire study. *Int J Surg* 2020;79: 156–61.
19. Chou R, Dana T, Buckley DI, Selph S, Fu R, Totten AM. Update Alert: Epidemiology of and Risk Factors for Coronavirus Infection in Health Care Workers. *Ann Intern Med* 2020;173: W46–W47.
20. Hsin DHC, Macer DRJ. Heroes of SARS: Professional roles and ethics of health care workers. *J Infect* 2004; 49: 210–5.
21. World Health Organization. Rolling updates on coronavirus disease (COVID-19) [Internet]. 2020 [cited 2020 Sep 29]. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>.
22. Bielicki JA, Duval X, Gobat N, Goossens H, Koopmans M, Tacconelli E, *et al.* Monitoring approaches for health-care workers during the COVID-19 pandemic. *The Lancet Infect Dis* 2020; 20: e261–7. [https://doi.org/10.1016/S1473-3099\(20\)30458-8](https://doi.org/10.1016/S1473-3099(20)30458-8).
23. Jia-Te W, Zhi-Dong L, Zheng-Wei F, Lin Z, Wu-Chun C. Epidemiology of and risk factors for COVID-19 infection among health care workers: A multi-centre comparative study. *Int J Environ Res Public Health* 2020; 17: 7149. doi:10.3390/ijerph17197149.