University of Louisville Journal of Respiratory Infections

ORIGINAL RESEARCH

Healthcare Workers Hospitalized with COVID-19: Outcomes from the Burden of COVID-19 study at the University of Louisville Center of Excellence for Research in Infectious Diseases [CERID]

Ruth L. Carrico[1], PhD; T'shura S. Ali[1], PhD; Maria C. Hill[1], MPH; Lucia B. Puga Sanchez[1], MD; Catherine M. Bryan[1], Dawn D. Balcom[1], DNP; Stephen P. Furmanek[1], MPH; Amr Aboelnasr[1], MD; Julio A. Ramirez[1], MD*

[1] Division of Infectious Diseases, Center of Excellence for Research in Infectious Diseases (CERID), Department of Medicine, University of Louisville School of Medicine, Louisville, KY, USA

*ruth.carrico@louisville.edu

Abstract

Introduction: On March 6, 2020, the current ongoing pandemic of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) also known as COVID-19 reached the commonwealth of Kentucky. Within days the first cases of infection and hospitalization were identified among healthcare workers (HCW) in Kentucky, other states in the U.S., and around the world. There is little information available regarding the impact of COVID-19 on the HCW population within this area. The objective of this study is to describe the baseline characteristics of hospitalized HCWs infected with COVID-19.

Methods: Data collection was performed as part of a retrospective study of patients hospitalized with COVID-19 in any of nine acute care hospitals in Louisville. COVID-19 infection was confirmed using Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR). Descriptive statistics were performed on clinical and epidemiological characteristics of hospitalized patients with COVID-19 who had indicated healthcare as their occupation.

Results: Of the 700 adults hospitalized with COVID-19 from March 7 through July 1, 2020, 23 were HCWs. The mean age was 51 years and 78% were female. The majority of hospitalized HCWs had comorbidities including obesity (70%), hypertension (57%), hyperlipidemia (35%) and diabetes (26%). Common symptoms reported were fever (70%), dyspnea (78%), cough (78%) and fatigue (57%). Nine HCWs (39%) were admitted to the intensive care unit (ICU) and 6 (26%) developed acute respiratory distress syndrome (ARDS). Two (9%) patients developed a new, serious arrhythmia, two sustained cardiac arrest (9%), and two (9%) died in-hospital.

Conclusions: Older adult HCWs with underlying health conditions such as obesity and hypertension were more likely to be hospitalized and have severe in-hospital complications. One HCW death due to COVID-19 was identified in this small population. These findings can help to identify and strengthen approaches to protect HCWs from SARS-CoV-2 infection and from long term effects of COVID-19.

Recommended Citation:
Carrico, Ruth L.; Ali, T'shura S.; Hill, Maria C.; Sanchez, Lucia B. Puga; Bryan, Catherine M.; Balcom, Dawn D.; Furmanek, Stephen P.; Aboelnasr, Amr; Ramirez, Julio A. (2020). "Healthcare Workers Hospitalized with COVID-19: Outcomes from the Burden of COVID-19 study at the University of Louisville Center of Excellence for Research in Infectious Diseases [CERID] ," *The University of Louisville Journal of Respiratory Infections*: Vol. 4, Iss. 1, Article 75.

Received Date: September 4, 2020

Accepted Date: December 9, 2020

Published Date: December 17, 2020

Funding Source: The author(s) received no specific funding for this work.

Conflict of Interest: All authors declared no conflict of interest in relation to the main objective of this work.

Introduction

As of August 29, 2020, the World Health Organization (WHO) has reported over 24.5 million cases of COVID-19 with close to 850,000 deaths. [1] Many initial studies have shown disproportionate rates of infection among healthcare workers (HCWs). [2-9] One early study in Wuhan, China described the clinical characteristics of cases of COVID-19 among HCWs who provided care for patients with known or suspected disease. They found that among 138 hospitalized patients, 40(29%) were HCWs that were suspected of hospital-associated transmission. [3]

A recent CDC study found that among COVID-19 cases reported between February 12 through April 9, 2020, 19% were identified as HCWs. The study also found that 38% of the cases reported at least one underlying health condition and the majority of infected HCWs were not hospitalized (90%); however, 184 (2%–5%) HCWs were admitted to the Intensive Care Unit (ICU) with 27 (0.3%–0.6%) deaths. Common symptoms recognized

among infected HCWs included fever, cough, shortness of breath, muscle aches and headaches. Among the cases who reported exposure information, 55% stated their only contact was in a healthcare setting within the 14 days before their illness onset. [10] As of August 29, CDC has reported close to 700 deaths among HCWs with a caveat recognizing that these data likely fail to capture the true rate of mortality due to COVID-19 in this group. [11]

Protecting HCWs from transmissible infection and recognizing when exposure may have occurred have long been recognized as vital components in routine infection prevention and control practice in all settings where healthcare is delivered. These factors stress the importance of studying HCWs as a means of determining effective local policy and strategies that protect this vital infrastructure. The objective of this paper is to describe the characteristics of hospitalized HCWs diagnosed with COVID-19 illness admitted to one of the nine adult hospitals in Louisville, Kentucky from March through July 2020.

Methods

Study design

The Center of Excellence for Research in Infectious Diseases (CERID) at the University of Louisville maintains an ongoing retrospective cohort study of hospitalized patients infected with SARS CoV-2 to determine the burden of COVID-19 in the Louisville, Kentucky area. The main objective of this study was to explore the incidence, epidemiology, demographics, clinical characteristics and outcomes of hospitalized patients diagnosed with COVID-19 admitted during the first four months of the pandemic (March-July 2020) in Louisville.

Human Subjects Protection

The University of Louisville Institutional Review Board approved the Burden of COVID-19 study (IRB #20.0257), as well as the research offices at each participating hospital. The study was exempt from informed consent. Study data were collected and managed using HIPAA-compliant electronic capture data tools hosted at the University of Louisville. REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support research studies. [12] All information is considered protected health information and standard data safety processes were followed.

Study Setting and Subjects

The Burden of COVID-19 study included nine acute care hospitals in Louisville, Kentucky. The inclusion criteria were to have either evidence of a positive Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) on the first or the repeat test and/or presentation of ground glass opacities on a chest computerized tomography (CT), including date of tests. Patients who were not hospitalized/admitted to the any of the nine hospitals were excluded (e.g., seen in an Emergency Department and discharged). A total of 700 adults were hospitalized between March 7-July 1, 2020 and captured for the Burden of COVID-19 study. A healthcare worker was defined in the Burden of COVID-19 study as having documentation of current occupation as a healthcare worker in their medical record.

Data Collection

The RT-PCR testing was performed either by the University of Louisville Division of Infectious Diseases reference laboratory or at each respective hospital's associated lab, with standard of care testing. Patients with a confirmed or suspected positive COVID-19 diagnosis were ascertained either through daily screenings of the hospital's Electronic Medical Record (EMR) by the CERID research team or from a daily report sent by the hospital. Information collected included COVID-19 test results, demographic and hospitalization data, past medical and social history, current medications, signs and symptoms, physical examination, laboratory, radiologic and microbiologic findings, management and therapies, in-hospital complications and clinical outcomes.

Statistical Analysis

Descriptive statistics were performed on relevant variables stratified by healthcare worker status, which was categorized dichotomously (yes/no). Continuous data are presented as mean ± standard deviation (SD), if normally distributed or as median (interquartile range (IQR), Q1-Q3), if not normally distributed. Categorical data are presented as percentage (%), when appropriate. All statistical analyses were performed using R version 3.6.3 and R Studio version 1.2.5033 (Boston, MA, USA).

Results

Among the 700 adults hospitalized with COVID-19, 23 (3%) met the healthcare worker definition and were hospitalized from March 9 through June 20, 2020. All 23 hospitalized HCWs were confirmed COVID-19 positive by RT-PCR with 10 also positive for ground glass opacities on CT exam. The mean age of hospitalized HCWs was 51 years (SD=

14.2) (**Figure 1**), mean body mass index (BMI) was 35 kg/m^2 (SD= 8.8), 18 (78%) were females and 13 (57%) were of Caucasian race (**Table 1**). The majority of HCWs reported having at least one symptom; 18 (78.0%) reported dyspnea, 18 (78%) reported cough, 16 (70%) reported a fever and 13 (57%) reported fatigue. Less common symptoms included myalgia, headache, cough with sputum, sore throat, dizziness and diarrhea (**Table 2**). The median duration from symptom onset to hospitalization was 4 days (IQR, 3.0-7.8). Physical examination findings within the first 24 hours of admission were within normal ranges except for minor deviations in heart rate and oxygen saturation levels (**Table 2**). Laboratory results were also within normal ranges (**Table 2**).

All 23 hospitalized HCWs had at least one underlying health condition. Obesity (16 [70%]), hypertension (13[57%]), hyperlipidemia (8[35%]), diabetes (6[26%]) and asthma (5[22%]) were the more common comorbidities (**Figure 2**). A total of nine HCWs were admitted to the ICU, with two of nine patients having two ICU admits. Most of the hospitalized HCWs received antibiotic therapy as a form of treatment (azithromycin; 15[65%] and hydroxychloroquine; 8[35%]). Of the 23 patients, 13 (57%) received high flow nasal cannula, 4 (17%) received vasopressors, 7 (30%) received inhaled pulmonary vasodilators (IPV) and 4 (17%) patients received noninvasive mechanical ventilation (NIMV) (**Table 3**). In the ICU, 6 (26%) required invasive mechanical ventilation (IMV) during the hospitalization (**Table 3**). The two most common in-hospital complications included acute respiratory distress syndrome (ARDS) (6[26%]) and septic shock (3[13%]). Two (9%) of the 9 ICU patients developed a new, serious arrhythmia, two sustained cardiac arrest (9%), and two (9%) died in-hospital.

Table 1. Demographic characteristics of healthcare workers hospitalized with COVID-19 (N=23)

Characteristics	
No.	23
Age (years), mean ± SD	51 ± 14.2
Age (years), %	
≤35	5(21.7)
36-55	9(39.1)
56-64	6(26.1)
≥65	3(13.0)
Body Mass Index (kg/m2), mean ± SD	35.0 ± 8.8
Body Mass Index (kg/m2),%	
Underweight (<18.50 kg/m2)	0(0.0)
Normal (18.50-24.99 kg/m2)	3(13.0)
Overweight (25.00-29.99 kg/m2)	4(17.4)
Obese (>30.00 kg/m2)	16(69.6)
Sex (%)	
Female	18(78.3)
Male	5(21.7)
Race (%)	
Black	8(34.8)
White	13(56.5)
Unknown	2(8.7)
Ethnicity (%)	
Hispanic	0(0.0)
Non-Hispanic	21(91.3)
Unknown	2(8.7)
Recent contact with another person with respiratory symptoms	12(52.2)

Percentages may not total 100 due to rounding.

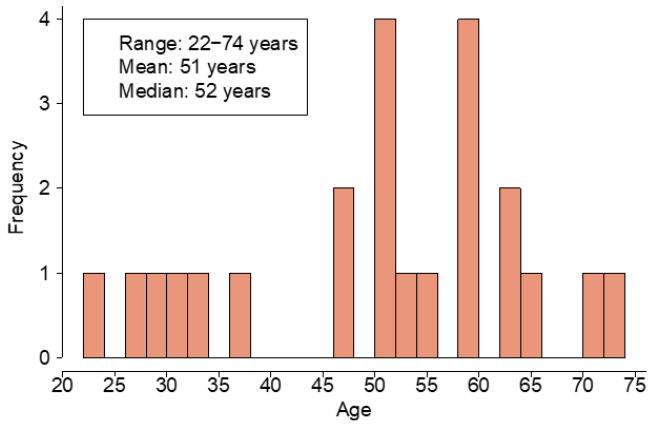

Figure 1. Distribution of ages among healthcare workers infected with COVID-19 hospitalized between March 9 – June 20, 2020 in Louisville, Kentucky (N=23)

Table 2. Signs, symptoms physical and laboratory findings of healthcare workers hospitalized with COVID-19 (N=23)

Signs and Symptoms	**N (%)**
Fever	16(69.6)
Dyspnea	18(78.3)
Cough	18(78.3)
Sputum	4(17.4)
Myalgia	10(43.5)
Fatigue	13(56.5)
Headache	2(8.7)
Time from illness onset to admission (days), median (Q1-Q3) N=22	4.0(3.0-7.8)
Physical Examination *(within first 24 hours of hospital admission)*	
Heart rate (beats/minute), mean ± SD	98.4 ± 18.7
Respiratory rate (breaths/minute), median(Q1-Q3)	20.0(18.0-23.5)
Systolic blood pressure (mmHg), mean ± SD	123.0 ± 20.3
Diastolic blood pressure (mmHg), mean ± SD	65.7 ± 10.8
Temperature (degrees Celsius), median(Q1-Q3)	38.1(37.1-39.3)
O2 saturation,(%) median(Q1-Q3) N=22	94.5(92.3-97.0)
FiO2, median(Q1-Q3) N=20	21.0(21.0-24.5)
Altered mental status (%)	1(4.4)
Laboratory Findings	
Hemoglobin (mg/dL), mean ± SD	13.1± 1.8
White Blood Count, (x 1000 per µL), median(Q1-Q3)	5.8(4.8-7.6)
Platelet count (x 1000 per µL), mean ± SD	195.1± 61.3
Neutrophil count (x 1000 per µL), median(Q1-Q3)	3.8(3.3-6.3)
Lymphocyte count (x 1000 per µL), median(Q1-Q3)	1.1(0.9-1.6)
C -reactive protein, (mg/L)), median(Q1-Q3), N=13	8.8(2.7-27.0)
Serum bicarbonate (mEq/L), median(Q1-Q3), N=22	24.0(22.0-27.4)
Procalcitonin (< 0.05 µg/L), median(Q1-Q3), N=16	0.05(0.05-0.09)

Percentages may not total 100 due to rounding.

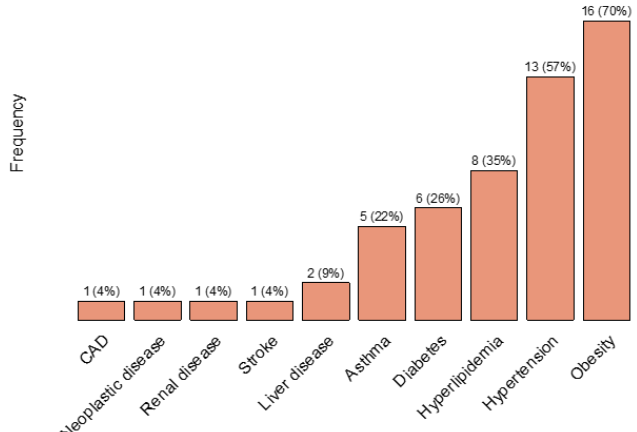

Figure 2. Comorbidities of healthcare workers hospitalized with COVID-19 (N=23)

Table 3. Treatments and complications of healhcare workers hospitalized with COVID-19 (N=23)

Treatment in Hospital	**N (%)**
Hydroxychloroquine	8(34.8)
Azithromycin	15(65.2)
Remdesivir	2(8.7)
High Flow Nasal Cannula	13(56.5)
Continuous Positive Airway Pressure (CPAP)	2(8.7)
Non-Invasive Mechanical Ventilation	4(17.4)
Invasive Mechanical Ventilation	6(26.1)
Proning Position	5(21.7)
Plasma Therapy	3(13.0)
Neuromuscular blockade/Artificial paralysis	5(21.7)
Inhaled pulmonary vasodilators	7(30.4)
Vasopressors	4(17.4)
Inotropes	1(4.4)
In-hospital complications	
Acute Respiratory Disease Syndrome	6(26.1)
Septic Shock	3(13.0)
Development of Heart Failure	0(0.0)
Sustained cardiac arrest	2(8.7)
Development of acute myocardial infarction	0(0.0)
Pulmonary edema	0(0.0)
Pulmonary embolism	0(0.0)
Development of new, serious arrhythmia	2(8.7)
Cerebrovascular accident	0(0.0)
Mortality	2(8.7)

Mortality Profile
There were two documented deaths among the 23 hospitalized HCWs. One patient was a 52-year-old, African American female, who tested positive for COVID-19 by RT-PCR on the day of admission. Her symptoms started 4 days before admission and included fever, productive cough, dyspnea, nausea and fatigue. She had a past medical history of diabetes and hypertension and was on ace inhibitors, angiotensin receptor blockers, metformin and prednisone at home. On admission, she was tachycardic, tachypneic, slightly hypoxic, documented as altered mental status and had diffuse bilateral infiltrates on both chest x-ray and CT. She was directly admitted to the ICU, where she was treated with azithromycin for 2 days, received high flow nasal cannula, CPAP, IPV and vasopressors. For one day, she was placed on NIMV but later required IMV. Over the 7-day ICU course, the patient went into septic shock, developed ARDS and a new, serious arrythmia and ultimately sustained cardiac arrest which led to her death.

The second patient was a 34-year-old, African American male HCW with an advanced directive. His symptoms started 2 days prior to hospitalization and included fatigue, cough and dyspnea. He was a current smoker, had a past medical history of alcohol abuse and asthma and was on a bronchodilator and anti-epileptic medications. On admission, he was slight tachypneic and hypoxic and had diffuse bilateral infiltrates on both chest x-ray and CT. Initial labs showed elevated white blood cell count, neutrophil count, bilirubin and liver function test. The patient was transferred to the ICU on the third day of admission, where he tested positive for COVID-19 by RT-PCR and was treated with azithromycin and cefepime. He also received plasma therapy, high flow nasal cannula, neuromuscular blockades, IPV, vasopressors and inotropes. Over his 18-day ICU stay, the patient was also diagnosed with Methicillin-resistant Staphylococcus Aureus and was placed on systemic steroids. He shortly after developed ARDS requiring IMV, which he was on for 16 days until his death.

Discussion

This study provides the first overview of the impact of COVID-19 on healthcare workers in the Louisville, Kentucky area. From March 6 through July 1, 2020, 23 HCWs were hospitalized with COVID-19 with two documented deaths from COVID-19 pneumonia.

Overall, this hospitalized HCW population was older with higher rates of comorbidities, unlike a recent CDC report analyzing national data of HCWs infected with COVID-19. The mean age in this study was 51 years (SD=14.2 years) compared to a median of 42 years (IQR = 32–54 years) in a recent CDC report. [10] All hospitalized HCWs with COVID-19 in this study had at least one underlying health condition compared to 38% and 35% in other studies. [10,13] One study showed significant increases in obesity prevalence among healthcare workers from 2004 through 2011. [14] However, the comorbidities among the HCWs in this study such as obesity, hypertension, diabetes and asthma were consistent with state-level rates. [10,13] Female HCWs (18 [78%]) were more likely to be hospitalized compared to males which was also consistent with several studies. [8-10,13,15] Common symptoms including fever, cough, dyspnea, fatigue and myalgia were seen in U.S. analyses of HCWs with COVID-19. [10,15,16,17] While there was a lower percentage of hospitalized HCWs in our study, there was a higher percentage of in-hospital complications and death compared to other studies. [9,10,15] There was also a higher percentage of hospitalized HCWs admitted to the ICU, as well as HCWs with ARDS and septic shock. [9,10,15] Treatments such as hydroxychloroquine and azithromycin given to the HCWs in this study reflected the state of knowledge at the time and are no longer standard of care. One randomized controlled trial showed that using hydroxychloroquine with or without azithromycin on patients hospitalized with COVID-19 did not improve their 15-day clinical status compared to standard care. [18] The standard care included the use of antibiotics, anti-viral agents, glucocorticoids and others, at the discretion of the physician. [18]

Kentucky's first COVID-19 case was confirmed on March 6, 2020 and a state of emergency was declared. Local testing through the University of Louisville was readily available and allowed for rapid testing. The baseline characteristics of HCWs hospitalized with COVID-19 can help to inform healthcare policies regarding infection control including personal protective equipment (PPE). One recent rapid review of eleven articles found that work overload, underlying comorbidities, lack of PPE, exposure to infected patients and poor infection control were the main risk factors of COVID-19 infection among HCWs. [19] These risk factors along with the atypical clinical manifestations of COVID-19 and asymptomatic but infectious cases may not have been recognized in the early phase of the pandemic leading to higher rates of severe COVID-19 cases among HCWs.

There are a few limitations to acknowledge. The results of this retrospective study may not be generalizable to all HCWs or the public as they may be significantly different from HCWs hospitalized with COVID-19. Due to the nature of this retrospective, observational study, we were not able to collect more detailed information on the classification of healthcare workers and exposures or causes of COVID-19 infection. The healthcare worker definition was self-reported and may not have included all personnel who work in a healthcare setting that have direct or indirect exposure to

COVID-19 patients limiting the sample size to 21. The small sample size of HCWs hospitalized with COVID-19 may reflect the availability of PPE and effective infection control processes or it may reflect more asymptomatic cases among HCWs. Future research should consider using prospective studies to follow healthy, uninfected HCWs to COVID-19 infection, so as to fully understand transmission modes, risk factors and biological mechanisms.

The current, ongoing COVID-19 pandemic remains a growing public health problem, putting frontline HCWs at the highest risk of infection. This retrospective analysis describes the characteristics of HCWs hospitalized with COVID-19 from March 9 through June 20, 2020 in Louisville, Kentucky. These findings suggest that older, obese HCWs with underlying comorbidities may be more likely to be hospitalized with severe COVID-19 infection. Further, the long-term impacts of COVID-19 and their relevance to the ability and willingness of the HCW to return to work should be part of ongoing research.

Author Contributions

RC and TA were responsible for primary writing of the manuscript. DB, MH, LP, CB, SF, AA and JR were responsible for critical review and editing of the manuscript. All authors have reviewed and approved the final version of this manuscript.

Acknowledgements

We greatly appreciate the role of the CERID Research Team at the University of Louisville. We would also like to recognize the dedication of healthcare workers, frontline employees and first responders during this COVID-19 pandemic.

References

1. World Health Organization. Coronavirus disease 2019 (COVID-19): situation report, 195. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200802-covid-19-sitrep-195.pdf?sfvrsn=5e5da0c5_2
2. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The lancet. 2020 Feb 15;395(10223):497-506.
3. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China [online ahead of print]. JAMA. 2020 Mar;323(11):1061–9. https://doi.org/10.1001/jama.2020.1585 PMID:32031570
4. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, Ren R, Leung KS, Lau EH, Wong JY, Xing X. Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. New England Journal of Medicine. 2020 Jan 29.
5. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, Yu T. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. The Lancet. 2020 Feb 15;395(10223):507-13.
6. Xu XW, Wu XX, Jiang XG, Xu KJ, Ying LJ, Ma CL, et al. Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-Cov-2) outside of Wuhan, China: retrospective case series [Erratum in: BMJ 2020;368:m792.]. BMJ. 2020 Feb;368:m606. https://doi.org/10.1136/bmj.m606 PMID:32075786
7. Chu J, Yang N, Wei Y, Yue H, Zhang F, Zhao J, et al. Clinical characteristics of 54 medical staff with COVID-19: A retrospective study in a single center in Wuhan, China. J Med Virol. 2020 Jul;92(7):807–13. https://doi.org/10.1002/jmv.25793 PMID:32222986
8. Liu J, Ouyang L, Guo P, Wu H, Fu P, Chen Y, Yang D, Han X, Cao Y, Alwalid O, Tao J. Epidemiological. Clinical Characteristics and Outcome of Medical Staff Infected with COVID-19 in Wuhan, China: A Retrospective Case Series Analysis. medRxiv. 2020 Jan;2020(09.20033118).
9. Wang X, Liu W, Zhao J, Lu Y, Wang X, Yu C, et al. Clinical characteristics of 80 hospitalized frontline medical workers infected with COVID-19 in Wuhan, China. J Hosp Infect. 2020 Apr;S0195-6701(20)30194-8. PMID:32302722
10. Burrer SL, de Perio MA, Hughes MM, Kuhar DT, Luckhaupt SE, McDaniel CJ, et al.; CDC COVID-19 Response Team. February 12–April 9, 2020. MMWR Morb Mortal Wkly Rep. 2020 Apr;69(15):477–81. https://doi.org/10.15585/mmwr.mm6915e6 PMID:32298247
11. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19): Cases & deaths among healthcare personnel [Internet]. Atlanta: CDC; 2020 [2020 Dec 15; 2020 November 21). Available from https://covid.cdc.gov/covid-data-tracker/?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fcases-updates%2Fcases-in-us.html#health-care-personnel
12. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009 Apr;42(2):377–81. https://doi.org/10.1016/j.jbi.2008.08.010 PMID:18929686

13. Barrett ES, Horton DB, Roy J, Gennaro ML, Brooks A, Tischfield J, Greenberg P, Andrews T, Jagpal S, Reilly N, Blaser MJ. Prevalence of SARS-CoV-2 infection in previously undiagnosed health care workers at the onset of the US COVID-19 epidemic. medRxiv. 2020 Jan 1.
14. Gu JK, Charles LE, Bang KM, Ma CC, Andrew ME, Violanti JM, et al. Prevalence of obesity by occupation among US workers: the National Health Interview Survey 2004-2011. J Occup Environ Med. 2014 May;56(5):516–28. https://doi.org/10.1097/JOM.0000000000000133 PMID:24682108
15. Mani NS, Budak JZ, Lan KF, Bryson-Cahn C, Zelikoff A, Barker GE, Grant CW, Hart K, Barbee CJ, Sandoval MD, Dostal CL. Prevalence of COVID-19 infection and outcomes among symptomatic healthcare workers in Seattle, Washington. Clinical Infectious Diseases. 2020 Jun 16.
16. Chow EJ, Schwartz NG, Tobolowsky FA, Zacks RL, Huntington-Frazier M, Reddy SC, et al. Symptom Screening at Illness Onset of Health Care Personnel With SARS-CoV-2 Infection in King County, Washington. JAMA. 2020 May;323(20):2087–9. https://doi.org/10.1001/jama.2020.6637; Advance online publication. PMID:32301962
17. Jary A, Flandre P, Chabouis A, Nguyen S, Marot S, Burrel S, et al. Clinical presentation of Covid-19 in health care workers from a French University Hospital. J Infect. 2020 Sep;81(3):e61–3. https://doi.org/10.1016/j.jinf.2020.06.048 PMID:32579992
18. Cavalcanti AB, Zampieri FG, Rosa RG, Azevedo LC, Veiga VC, Avezum A, et al.; Coalition Covid-19 Brazil I Investigators. Hydroxychloroquine with or without Azithromycin in Mild-to-Moderate Covid-19. N Engl J Med. 2020 Nov;383(21):2041–52. https://doi.org/10.1056/NEJMoa2019014 PMID:32706953
19. Mhango M, Dzobo M, Chitungo I, Dzinamarira T. COVID-19 risk factors among health workers: A rapid review. Saf Health Work. 2020 Sep;11(3):262–5. https://doi.org/10.1016/j.shaw.2020.06.001 PMID:32995051