

Investigation of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infections among Health Care Workers - Lusaka District, Zambia, April-June 2020

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ABSTRACT

Introduction: Zambia is experiencing an epidemic of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), that causes coronavirus disease 2019 (COVID-19). Infections initially sporadic, but community transmission began to occur widely in late June 2020. Over 100 health care workers (HCWs) reported infected with SARS-CoV-2 in Lusaka District. We investigated factors associated with SARS-CoV-2 infections among HCWs in four hospitals in Lusaka District during April to June 2020. **Methods:** Case control study among HCWs with confirmed SARS-CoV-2 infections at Levy Mwanawasa Hospital, Cancer Disease Hospital, Chilenje First level Hospital, and Women and Newborn Hospital in April to June 2020. Controls drawn from HCWs working in a department within 14 days before a positive test of cases. Standardized questionnaire assessing demographics, medical history, exposures, and infection prevention practices administered. Logistic regression conducted to assess associations with SARS-CoV-2 infection, with odds ratios (ORs) and 95% confidence intervals (CIs) reported. **Results:** Forty-three cases occurred in four facilities from April through June 2020. We interviewed 39 cases and 101 controls. Median age was 33 years (interquartile range: 28, 38). Twenty-nine (74%) cases self-reported being asymptomatic. Most (25(65.8%)) cases tested positive during HCW screening with no known HCW index case. Unknown exposure status in facilities had increased odds of acquiring SARS-CoV-2 compared to known exposure (OR = 4.5 (95% CI: 1.73, 11.9)). Low adherence to handwashing (OR=4.53 (95% CI: 1.74, 11.8)) and inadequate use of personal protective equipment (OR=2.87 (1.20, 6.87)) increased odds of having SARS-CoV-2. **Conclusion:** Low adherence to personal protective measures like hand washing, PPE use and absence of knowledge about potential SARS-CoV-2 exposures in health facilities suggest that transmission could have occurred in health facilities. Routine HCW screening for early identification and isolation of cases to minimise nosocomial transmission is recommended.

KEYWORDS: SARS-CoV-2, Covid-19, Health care worker infections, Zambia

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Introduction

Zambia reported the first two cases of infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the novel coronavirus that causes COVID-19, on 18th March 2020. These were followed by COVID-19 cases without epidemiological links to the initial cases which subsequently led to discovery of additional sporadic cases in Lusaka and other districts, signifying local transmission. Zambia as of 21st December 2020 reported a cumulative of 18,768 cases with 575 deaths. A significant proportion of cases have been reported among HCWs with more than 100 in Lusaka. In Lusaka district, the first two COVID-19 cases in HCW were reported at the Cancer Disease hospital. Chilenje First Level Hospital was the second to record infections among health care workers (HCWs) with nine cases recorded within a period of two weeks and later cases recorded in other provinces and districts.

COVID-19 infections in HCWs poses a risk to patients, other HCWs, and community members. Therefore, addressing infections among health care workers will contribute towards controlling the COVID-19 pandemic in Zambia as shown in some studies. The purpose of this study was to investigate COVID-19 infections in HCWs in Lusaka district from April to June 2020.

Methods

Study Design

We conducted a case control study in four hospitals, Levy Mwanawasa University Teaching Hospital, Chilenje First Level Hospital, Cancer Disease Hospital, Women and New-born Hospital in Lusaka district, where a COVID-19 case was reported in the facility.

Study site and study population

The study focused on four hospitals in Lusaka district which had recorded 43 confirmed COVID-19 cases from April to July 2020. Primary study population were all health care workers in the four

health institutions. A confirmed case was defined as a person with laboratory confirmation of COVID-19 infection, irrespective of clinical signs and symptoms [1].

Inclusion criteria

The study participants included HCWs confirmed with COVID-19 (cases) and HCWs who tested negative (controls) while working together within 14 days of a positive test reported in any department in each of the four hospitals. Age, sex, job title and religious affiliation were not considered when selecting participants.

Sampling and sample size

All HCWs who tested positive with COVID-19 between April and June 2020 were listed in the four health institutions; 43 were listed and 42 (98%) were recruited because one health worker was not available. Next, HCWs who worked during the same shifts within 14 days before a positive test in HCW cases were listed. From the list of these contacts, controls were randomly selected from each of the four hospitals using lottery sampling method. For every case, three controls were sampled, giving a total of 42 cases and 126 controls listed for this study.

Data collection and analysis

Demographic and clinical information, exposure history, and infection prevention and control (IPC) practices was collected using a structured questionnaire, according to WHO guidance [2]. Unknown exposure status was defined as when a participant did not know whether they were exposed to a potential risk.

Data analysis was done using Stata version 14. For descriptive statistics, frequencies and proportions were reported. Test for normality on age was done using Shapiro-Wilk W test and was not normally distributed; therefore, median age and interquartile range (IQR) was reported. To identify the factors associated with COVID-19 infection between the cases and the control group, odds ratios (ORs) were calculated using logistic regression and associated 95% confidence intervals (CIs) were reported.

Ethical consideration

Ethical clearance was sought from the ERES Converge institutional review board. All participants provided informed consent.

Results

A total of 140 HCWs (39 cases and 101 controls) were reached and interviewed in this study. Of this, 33 (84.6%) cases and 82 (81.2%) were females and there was no statistical difference. The median age in years for cases was 33 (IQR: 29, 38) and 33 (28, 38) in the control group with no statistical difference in the two groups [Table 1](#). Of the 140 participants, 64 (45.7%) were drawn from Levy Mwanawasa University Teaching Hospital of which 20 were cases and 44 controls, 33 (23.6%) were from Cancer Disease Hospital with 9 cases and 24 controls, 31 (22. %) from Chilenje Level One Hospital with 7 cases and 24 controls and 12 (8.6%) from Women and New-born Hospital with 3 cases and 9 controls. Nurses were the most common (50%) cadre followed by laboratory personnel (8.6%). Inpatient (25.6%) and outpatient department (23.1%) recorded the highest confirmed cases. Among the controls, 94 (93.1%) reported being tested at least once for COVID-19; the other seven indicated testing negative during listing but denied testing negative during interview. Overall, HCWs were tested as part of routine health care screening (58.4%), contact tracing (29.9%), sought out COVID-19 testing (8.0%) and exposure to fomites/equipment used on confirmed case (3.7%). There was no difference between cases and controls with respect to age, sex, and job type among the health care workers.

Overall, 13 (33.3%) of cases and 25 (24.8%) of controls reported having history of a co-morbidity (OR= 1.52 (95% CI: 0.68,3.40). Among those with a comorbidity, hypertension was most common (38.5% in cases and 28.0 % in controls).

Ten (25.6%) HCWs in confirmed cases reported experiencing symptoms, compared to two (2.0%) controls (OR = 17.07 (95% CI: 3.54,82.34) [Table 2](#). Dry cough was the most predominant symptom (80.0%), followed by runny nose (60.0%) and fever

(40.0%) in cases, while fever and runny nose were reported in controls. Of all the confirmed cases who reported symptoms, one (10.0%) had duration of illness ≤ 7 days, five (50.0%) between 8-14 days, and four (40.0%) ≥ 15 days.

Cases 26 (66.7) and controls 84 (83.2) reported taking at least one test and were less likely to stay away from work while awaiting results (OR=0.40 (95% CI: 0.17, 0.94)). Seventy-one percent of HCWs with confirmed cases and 89% of controls reported known contact with a person who tested positive for SARS Cov2 (OR = 0.3 (95% CI: 0.12, 0.77)). Sixty-six percent of HCWs with confirmed SARS Cov2 tested positive during routine health care worker screening. Among those with known contact with someone with COVID-19, HCWs with confirmed cases were more likely to report that the exposure was with a patient as opposed to another HCW (OR= 7.52 (95% CI: 2.01, 28.21)). Unknown exposure status for physical contact, exposure to body fluids/secretions, or percutaneous exposure was associated with higher odds of being infected with SARS-CoV-2 compared to those with known exposure status (OR= 4.5 (95% CI: 1.73, 11.9)).

Overall, 16 (41.0%) cases and 61 (60.4%) controls reported being trained in IPC practices (OR = 0.46 (95% CI: 0.21, 0.97)) [Table 3](#). Thirty (76.9%) HCWs with confirmed cases and 46 (45.5%) HCWs in the control group reported not always following hand hygiene practices (OR= 8.48 (95% CI: 2.78, 25.9)). Thirty-three (86.8%) HCWs with confirmed cases and 76 (75.2%) in the control group reported not always washing hands before touching patients, exposure to body fluids or before doing aseptic procedures (OR= 1.81 (95% CI: 0.85, 3.84)). HCWs who did not wash hands with water and soap or use alcohol-based hand rub after touching patients, exposure to body fluids or doing aseptic procedures had higher odds of COVID -19 compared to HCWs who always washed hands (OR=4.53 (95% CI: 1.74, 11.8)). HCWs who did not wash hands after touching patients' surroundings had 5.50 odds of being infected compared to those who always washed hands (OR = 5.50 (1.82, 16.7)). Not always using personal protective equipment (PPE) as recommended had higher odds of COVID-19 compared to those who always used PPE (OR= 2.87

(95% CI: 1.20, 6.87)). Twenty-six (66.7%) cases and 80 (79.2%) controls reported always using a face mask while at work (OR=0.52 (95% CI: 0.23, 1.19)).

Discussion

During an epidemic of COVID-19 in Zambia, HCWs in Lusaka were becoming infected with SARS-CoV-2. This investigation suggests that infections were occurring in health facilities. The consistent pattern of increased odds of COVID-19 for health care risk factors, including low adherence to personal protective measures like hand washing and PPE use and absence of knowledge about potential SARS-CoV-2 exposures in the health facilities suggest that transmission could have occurred in health facilities. Additionally, almost no HCWs reported known exposure to persons with confirmed COVID-19 in the community. Lastly, community transmission was not occurring in Lusaka for most of the period included in this study.

Overall, 74% of cases reported being asymptomatic. This asymptomatic rate is consistent with other studies demonstrating low rates of symptoms among HCWs [3]. Persons with asymptomatic infections could infect patients and other health workers in health facilities, which has been observed in other studies[4]. Cases with symptomatic infection were more likely to report any symptom than controls. Most cases with symptoms had them >7 days and cough was the main symptom which is consistent with other research [5]. Majority cases among HCWs tested positive during routine screening resulting in challenges identifying the index case. Routine health care worker screening could lead to earlier detection and isolation of those that are infected, reducing transmission. Given the high asymptomatic rate, testing among cases should be prioritized regardless of symptoms to prevent infections to other HCWs and patients. Policies directed at conducting periodic testing of HCW might help interrupt nosocomial transmission. This would be consistent with HCW testing approaches advocated in other countries, where HCW screening is seen as priority to reduce SARS-CoV-2 transmission in health care settings [6].

Most of the infections among cases took place in the inpatient and outpatient departments, which is consistent with a study from China where most infections occurred in general wards and emergency departments [7]. This could be due to HCWs attending to COVID-19 patients whose status is not known but later test positive while undergoing care, and prolonged contact periods with patients. Though most of the cases and controls took at least one COVID-19 test, the majority continued reporting for work until declared positive and most of them reported wearing face mask though they were only given one mask per shift. All HCWs reporting for work while awaiting test results should follow strict IPC practices to reduce the risk of transmission to other HCWs or patients and risk assessment must be adequately done to restrict those with high risk exposure from work [8]

Despite HCWs being at high risk of exposure to patients infected with SARS - COV 2, it was difficult to determine the index cases in various departments because most of health workers were tested through routine health care screening at the same time as other HCWs in respective facilities. Because exposure was both from patients and HCWs, cases necessarily did not know where they got infected. Further effort should be made to contact trace case among HCWs to isolate cases and quarantine contacts as quickly as possible to interrupt transmission.

Not knowing whether one was in contact with confirmed COVID-19 patient was associated with higher odds of infection. While paradoxical at first, exposures were self-reported, exposures may have been occurring unbeknownst to HCWs and therefore fewer precautions were taken to protect oneself. The findings on IPC training, handwashing and PPE use in this study support this possibility. Not always washing hands after touching a patient or their surroundings, and not always wearing PPE by cases as indicated were associated with SARS-CoV-2 infection, which is consistent with another study in Tanzania [9]. The World Health Organisation (WHO) guidance recommends among others, adequate training of HCWs, proper use of PPE hand hygiene[10] Taken together, it is paramount that

training and precautions be taken in health care facilities in Zambia.

Limitations

This study was subject to some limitations. Recall bias limited some participants' ability to remember certain information collected in retrospect. Responses, including exposures, were self-reported. Seven controls were not tested despite initially indicating so, meaning they could have been misclassified as controls. We could not reach our sample size because two cases and 25 controls were not available for the interview. Routine screening resulted in health care workers testing positive at the same time, making it difficult to establish the index case(s) within departments, so further transmission analysis was not possible. Because this was an observational study, causality between COVID-19 and risk factors cannot be established. Notwithstanding the above limitations, results for this study are from a representative sample of HCWs in Lusaka District and remain valid.

Conclusion

Low adherence to personal protective measures like hand washing and PPE use and absence of knowledge about potential SARS-CoV-2 exposures in the health facilities suggest that SARS-CoV-2 transmission may have occurred in health facilities in Lusaka. Routine HCW screening for early isolation and quarantine to minimise nosocomial transmission is recommended. PPEs must be used as per guidelines based on risk from where HCW is working from, and these must always be provided for by management in institutions.

What is known about this topic

- The COVID-19 pandemic has had a significant impact on global health systems. HCWs continue to be at high risk of occupational SARS-COV-2 infection, according to some studies conduct [11]. More prevalence studies and active surveillance are thus needed to determine the causes of the

infection and identify those who do not exhibit any symptoms. The implementation of evidence-based practice (EBP) science-specific perspective strategies for infection prevention and control (IPC) in Sub-Saharan Africa (SSA) necessitates additional research to promote IPC strategies appropriate for the context [12].

What this study adds

- This research will add to the body of evidence that already exists. The investigation of SARS-CoV-2 infections among health care workers will then aid in the development of protocols to improve the implementation of infection prevention and control in healthcare facilities.

Competing interests

The authors declare no competing interests.

Authors' contributions

MS, SN, NA wrote the protocol. MS, MC collected the data, MS, KE conducted data analysis, MS, SN, NA, KE, MK, EA wrote sections of the manuscript. All authors reviewed and approved the final version of the manuscript.

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Tables

Table 1: Demographic characteristics and medical history of health care workers with and without COVID-19 in four health institutions in Lusaka, Zambia, April-June 2020

Table 2: Clinical characteristics of health care workers with and without COVID-19 in four health institutions in Lusaka, Zambia, April-June 2020

Table 3: COVID-19 risk exposure history and infection prevention practices among health care workers with and without COVID-19 in four health institutions in Lusaka, Zambia, April-June 2020

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Table 1: Demographic characteristics and medical history of health care workers with and without COVID-19 in four health institutions in Lusaka, Zambia, April-June 2020

Characteristic	Cases n (%) (n=39)	Controls n (%) (n=101)	OR [95% C. I]
Age	33 (29, 38)	33 (28, 38)	1.0 (0.95, 1.05)
Sex			
Male	6 (15.4)	9 (18.8)	1
Female	33 (84.6)	82 (81.2)	1.27 (0.47, 3.47)
Job title			
Nurse	17 (43.6)	53 (52.5)	1
Clinician	3 (7.7)	5 (4.9)	1.87 (0.40, 8.66)
Laboratory personnel	4 (10.3)	8 (7.9)	1.55 (0.42, 5.83)
Radiology/x-ray technician	1 (2.6)	6 (5.9)	0.51 (0.06, 4.62)
Psychosocial counsellor	3 (7.7)	6 (5.9)	1.56 (0.35, 6.91)
Nutritionist	3 (7.7)	3 (3.0)	3.12 (0.57, 16.91)
Social worker	1 (2.6)	1 (1.0)	3.12 (0.18, 52.57)
Maid/porter	3 (7.7)	8 (7.9)	1.17 (0.28, 4.91)
Medical records	3 (7.7)	7 (6.9)	1.34 (0.31, 5.74)
Office orderly/secretary	1 (2.6)	4 (4.0)	0.78 (0.08, 7.46)
Hospital			
Chilenje level one	7 (17.9)	24 (23.8)	
Levy Mwanawasa - UTH	20 (51.3)	44 (43.5)	-
Cancer Disease Hospital-UTH	9 (23.1)	24 (23.8)	-
Women and New-born - UTH	3 (7.7)	9 (8.9)	-
Tested for COVID 19			
No	0	7 (6.9)	1 (empty)
Yes	39 (100.0)	94 (93.1)	omitted
What made you to test			
Health Care worker screening	25 (65.8)	55 (55.6)	1
Exposed to confirmed case	8 (21.1)	33 (33.3)	0.53 (0.22, 1.32)
Wanted to know status	4 (10.5)	7 (7.1)	1.26 (0.34, 4.69)
Exposed to fomites	1 (2.6)	4 (4.0)	0.55 (0.06, 5.17)
Number times tested			
0	0	7 (6.9)	-
1	3 (7.7)	52 (51.5)	-
2 - 3	25 (64.1)	41 (40.6)	-
≥ 4	11 (28.2)	1 (1.0)	-
Existing co-morbidities			
No	26 (66.7)	76 (75.2)	
Yes	13 (33.3)	25 (24.8)	1.52 (0.68, 3.40)
<i>Note: Seven controls who indicated that they were tested at recruitment reported that they were not tested during interview. Ninety-four controls were tested, 94 controls tested one or more times and 99 responses for reason for testing due to multiple reasons in some controls</i>			

Table 2: Clinical characteristics of health care workers with and without COVID-19 in four health institutions in Lusaka, Zambia, April-June 2020

Predictor	Cases n (%)	Controls n (%)	OR [95% C. I]
Did you have symptoms			
no	29 (74.4)	99 (98.0)	1
yes	10 (25.6)	2 (2.0)	17.07 (3.54, 82.34)
What symptoms			
Fever			
yes	4 (40.0)	1 (50.0)	0.67 (0.03, 14.03)
Dry cough			
yes	8 (80.0)	0	1 (omitted)
Loss of taste/smell			
yes	3 (30.0)	0	1 (omitted)
Diarrhoea			
yes	3 (30.0)	0	1 (omitted)
Runny nose			
yes	6 (60.0)	2 (100.0)	1 (omitted)
Chest pains			
yes	3 (30.0)	0	1 (omitted)
Shortness of breath			
yes	3 (30.0)	0	1 (omitted)
Headache			
yes	3 (30.0)	0	1 (omitted)
Fatigue			
yes	2 (20.0)	0	1 (omitted)
Duration of illness			
0 – 7 days	1 (10.0)	2 (100.0)	1
8 – 14 days	5 (50.0)	0	1 (empty)
≥ 15 days	4 (40.0)	0	1 (empty)
Existing co-morbidities			
no	26 (66.7)	76 (75.2)	
yes	13 (33.3)	25 (24.8)	1.52 (0.68, 3.40)
Type of existing co-morbidities			
HIV	3 (23.1)	4 (16.0)	1
Hypertension	5 (38.5)	7 (28.0)	0.95 (0.14, 6.28)
Hypotension	1 (7.7)	5 (20.0)	0.27 (0.02, 3.65)
Asthma	2 (15.4)	1 (4.0)	2.67 (0.16, 45.1)
Obesity	2 (15.4)	1 (4.0)	2.67 (0.16, 45.1)
Tuberculosis	0	1 (4.0)	1 (empty)
Pregnancy	0	5 (20.0)	1 (empty)
Diabetes	0	1 (4.0)	1 (empty)

*OR: Odds ratio

Table 3: COVID-19 risk exposure history and infection prevention practices among HCW with and without COVID-19 in four health institutions in Lusaka, Zambia, April-June 2020

Predictor	Cases n (%) n=39	Controls (%) n=101	OR [95% C. I]
Attend to patients			
no	2 (5.1)	7 (6.9)	1
yes	37 (94.9)	94 (93.1)	1.38 (0.27, 6.94)
Contact with case within H/Facility			
no	11 (29.0)	11 (10.9)	1
yes	27 (71.0)	90 (89.1)	0.3 (0.12, 0.77)
Contact with case outside H/Facility			
no	36 (97.3)	101 (100.0)	1
yes	1 (2.7)	0	omitted
Category contact with			
Health worker	20 (74.1)	86 (95.6)	1
patient	7 (25.9)	4 (4.4)	7.52 (2.01, 28.21)
Physical contact, exposure to body fluids, percutaneous exposure			
known	27 (69.2)	92 (91.1)	
unknown	12 (30.8)	9 (8.9)	4.5 (1.73, 11.9)
Report for work before receiving results			
no	13 (33.3)	17 (16.8)	1
yes	26 (66.7)	84 (83.2)	0.4 (0.17, 0.94)
Attended IPC training			
no	23 (59.0)	40 (39.6)	1
yes	16 (41.0)	61 (60.4)	0.46 (0.21, 0.97)
Recommended hand hygiene practices			
always as recommended	4 (10.3)	52 (51.5)	1
Not always as recommended	30 (76.9)	46 (45.5)	8.48 (2.78, 25.9)
Sanitize hands before touching patient, exposure to fluids, aseptic procedures			
always as recommended	5 (13.2)	25 (24.8)	1
Not always as recommended	33 (86.8)	76 (75.2)	1.81 (0.85, 3.84)
Sanitize hands after touching patient, exposure to fluids, aseptic procedures			
always as recommended	12 (31.6)	55 (54.5)	1
Not always as recommended	26 (68.4)	46 (45.5)	4.53 (1.74, 11.8)
Sanitize hands after touching patient surroundings			
always as recommended	4 (10.3)	39 (38.6)	
Not always as recommended	35 (89.7)	62 (61.4)	5.50 (1.82, 16.7)
Do you use PPE when indicated			
always as recommended	8 (20.5)	43 (42.6)	1
Not always as recommended	31 (79.5)	58 (57.4)	2.87 (1.20, 6.87)
Always wear mask when at work			
no	13 (33.3)	21 (21.8)	1
yes	26 (66.7)	80 (79.2)	0.52 (0.23, 1.19)
OR: Odds ratio			