



Research Article

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Observance of Standard Precautions for Infection Prevention in The Covid-19 Era: A Cross Sectional Study in Six District Hospitals in Yaounde, Cameroon

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Abstract

Introduction: Interest in infection prevention in healthcare facilities has been renewed with the advent of the COVID-19 pandemic. Accidental exposures to body fluids (AEB) occur under work environments that do not meet occupational safety standards. The aim of the present study was to assess the level of observance of standard precautions including adherence to required vaccinations to prevent healthcare related infections District Health facilities..

Methods: A cross sectional descriptive study was carried out from January to April 2022 in six District Hospitals in Yaounde. An auto-administered questionnaire was addressed to consenting healthcare workers (HCW). Data were analysed using R statistic version 4.2.3. A p-value <5% was considered significant.

Results: Out of a total of HCW who were enrolled, nearly a quarter (17%) claimed to wash the scalpel blades for reuse. More than half of the participants (53.5%) did not wash their hands after each care. Reasons for not washing hands after each procedure were the perception that the patient care for was risk free (36%), high workload (35.3%), distant washing point (20%). Almost half of HCW (46,5%) experienced a splash in the last 12 months. Personal protective equipment (PPE) were always available for only 43.56% of participants. Immunization coverage for COVID-19 was low 44.8%. Poor vaccine compliance was related to doubts on vaccine content (42%) and fear of adverse events (39.3%).

Conclusion: Strategies should be implemented to alleviate the burden of exposure to blood fluids and increase compliance with COVID-19 and other vaccine preventable infections among HCW.

Keywords: Standard precautions, Occupational exposure, Personal protective equipment, COVID-19, vaccination, body and fluids, District Hospital

Introduction

Up to three million Healthcare Workers are exposed to body fluid and resulting bloodborne pathogens each year, causing more than 170 000 HIV infections, two million viral hepatitis B (HBV) and 0,9 million viral hepatitis C (HCV) [1]. Some of these infections

result from poor compliance with standard precautions while providing health services [1,2]. The implementation of standard precautions within healthcare facilities aim to curve the transmission of infections. Standard precautions include administrative aspects



of infection control, use of PPE, engineering and environmental measures [3]. Insufficient adherence to standard precautions have been linked to poor supply of PPE and factors related to work environment [4,5], especially in resource limited settings [6]. Low compliance leads to high vulnerability of HCW. All health facilities are affected, including reference hospitals where a high prevalence of accidental exposure to body fluids and poor coverage with required vaccines have been reported [7]. Splashes on mucous membrane and skin breaches occur frequently among midwives and nurses [8,9]. Most exposures occur during childbirth and in surgical room [10,11]. Workers involved in cleaning activities, especially those involved in running the faucet and decontaminating medical devices are equally affected [12,13]. Interest in the control and prevention of infections in healthcare settings has been renewed with the advent of the Severe Acute Respiratory Syndrome due to Corona Virus (COVID - 19) and its inclusion in the list of diseases transmitted by contaminated expectorations [14,15]. Vaccination is the most efficient intervention for prevention of healthcare associated infections including influenza, hepatitis B, pertussis, measles, rubella, mumps, varicella, tetanus, diphtheria and COVID-19 [16]. Such vaccine administration aims to stimulate host immunity. Vaccines are typically whole virus, protein subunit, viral vector or pathogen nucleic acid [15-17]. However, reports indicated vaccine hesitancy as a barrier to its uptake [18].

The present study aimed to assess the level of implementation of infection control measures in district level reference health facilities, inclusive of compliance with vaccination during the COVID-19 epidemic.

Methods

Study Design & Period

We conducted an institution-based cross-sectional study in the six District Hospitals (DH) of Yaounde from January to April, 2022.

Setting

The Cameroonian health system is organised around health districts. The District Hospital is the first level of reference in the health pyramid. It is responsible for providing primary health care [19]. The Yaounde DHs (Biyem-Assi, Cite-Verte, Djoungolo, Efulan, Mvog-Ada and Nkolndongo) cover a population of 3.2 million residents, cumulate nearly 400 health personnel, 330 beds, provide 153 583 consultations and 19 092 admissions per annum [20,21].

Participant

The study population consisted of workers who get in contact with patients and are potentially exposed to body fluids. They were medical (physician and intern), paramedical (nurse, assistant nurse, midwife, laboratory and dental technician) and hygiene workers (cleaners, hygiene and sanitation engineer).

Sample Size

The study sample size was calculated using the single proportion formula ($n = [Z\alpha/2]^2 * [P(1-P)] / E^2$) at 95% confidence interval, where $Z\alpha / 2 = 1.96$ and $P = 36.7\%$ [22]. Using a standard error of $E = 5\%$, a 10% dropout rate [23], a minimum sample size of 198 was obtained. In each clinical department, all consenting personnel were included. Similarly, all services of medicine, surgery, obstetrics and gynaecology, paediatrics, stomatology and hygiene service were investigated.

Data Collection

The study instrument was an anonymous, structured and self-administered questionnaire consisting of 20 questions on demographics (age, gender, occupation, length of employment), compliance with standard precautions, exposure to blood and body fluids, perception of PPE availability and vaccination status. Observations on posting related to safety promotion, hand hygiene and respiratory etiquettes were documented.

Data Processing and Analysis

All filled questionnaires were entered and analysed using R statistics Version 4.2.3. The Chi-square (χ^2) or Fisher's exact test for proportions were used to compare proportions. Multivariate logistic regressions were used to assess the strength of the association between variables. A p-value < 0.05 was considered significant.

Results

Sociodemographic Characteristics

Out of the 279 healthcare workers who were contacted, 217 returned the completed questionnaire, for a response rate of 78%. Most study participants were female (81%). Participants aged 25-34 (38.2%) were the most represented. Almost half of the participants were married (54.8%). Participants were mainly nurses (32.3%) and laboratory technicians (21.2%). Half of the health personnel had professional experience of 3 to 7 years (Table 1).

Table 1: Selected practices related to universal precautions among healthcare workers in Yaounde District Hospitals, April 2022 (n=217).

Variable	Professional group n (%)			Total	p-value
	Medical(n = 34)	Paramedics(n = 163)	Hygiene(n = 20)		
Needle recapping	28(82.4)	107(65.6)	11(55)	146(67.3)	0.077(1)
Temporal staging of used needles on bench	12(35.3)	53(32.5)	0	65(30.0)	0.008(1)
Wash of scalpel for reuse	1(3.0)	15(9.2)	1(5)	17(8.5)	<0.0001(2)
Facilities used for sharps disposal					
Safety box	33(97.0)	159(97.5)	19(95)	211(97.3)	
Plastic bottle	0	4(2.5)	0	4(1.8)	0.213(2)
Trash can	1(3.0)	0	1(5)	2(0.9)	

Note*: (1): Chi² test; (2): Fisher exact test.

Reported Observance of Universal Precautions

A third of the participants (30%) stated that they placed used syringes temporarily on benches and trolleys. Nearly a quarter of

the participants (17%) reported washing the scalpel blades for reuse and the highest proportion was found among medical personnel (9.2%) (p -value<0.0001) (Table 2).

Table 2: Experience of training on infection prevention and splashes among healthcare workers in Yaounde District hospitals, April 2022 (n=217).

Health Facility	Training on IC	P - Value ⁽¹⁾	Splash ≤ 12 Months			P-Value ⁽¹⁾	
			n (%)	95 % CI Limit			Total
				Lower	Upper		
Biyem Assi	20 (51)		12 (33.3)	18.6	51	39	
Cite Verte	21 (49)		12 (30.8)	17	47.6	43	
Djoungolo	10 (26)	0.337	21 (48.8)	33.3	64.5	38	0.057
Efoulan	1 (3)		21 (55.3)	38.3	71.4	30	
Mvog Ada	13 (42)		18 (60)	40.6	77.3	31	
Nkolndongo	15 (42)		17 (54.8)	36	72.7	36	
Total	80 (37)		101 (46.5)	39.8	53.4	217	

Note*: (1): Chi² test. CI: Confidence Interval, IC: Infection Control.

Hand Washing

More than half of the participants (53.5%) reported not systematically washing their hand after each care. Such was attribut-

ed mainly to the perception that the patient cared for was risk free (36%), high workload (35%) and the distance from the point of care to the washing facility (20%) (Figure 1).

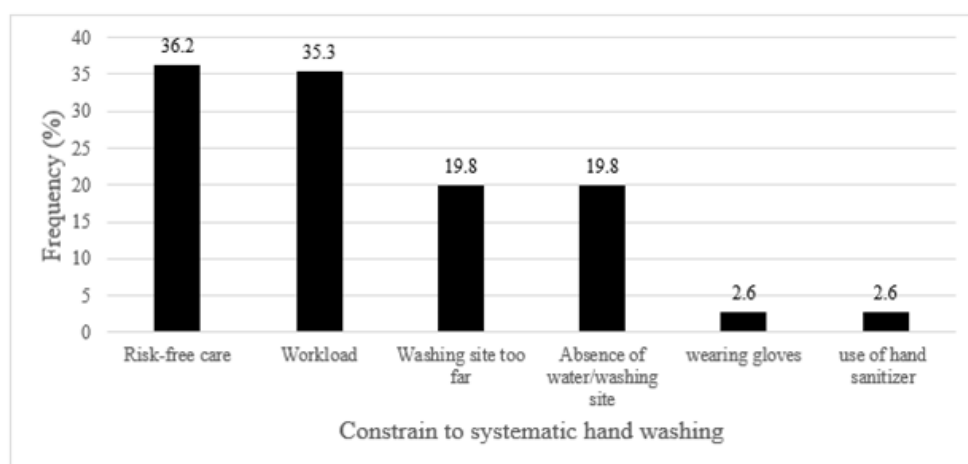


Figure 1: Constrains to systematic hand washing among healthcare workers in Yaounde District hospitals, April 2022 (n=116).

Accidental Exposure to Blood

Almost half of the HCW (46.5%; CI: 39.8-53.4%) experienced a splash to blood and body fluids in the year preceding the study and 29.5 % experience needlestick injuries [7]. There was a horizontal variation among District Hospitals. Mvog Ada DH having the highest prevalence of splash exposures (60%) (Table 2).

Participants that reported splashes were mostly midwives/ birth attendants (71.4%). Surface workers (5.6%) were the least exposed (p-value=0.002). Most projections occurred in the surgical (64.7%), obstetrics & gynaecology (64.5%) and stomatology (61.1%) departments (Table 3).

Table 3: Socio-professional characteristics of healthcare workers of Yaounde District hospitals, April 2022 (n=217).

Characteristic	Count (n)	Frequency (%)	Total (100 %)	p-value
Gender				
Female	87	49.4	176	0.055 ⁽¹⁾
Male	14	34.1	41	
Age				
18 - 24	5	29.4	17	0.122 ⁽²⁾
25 - 34	46	55.4	83	
35 - 44	33	42.9	77	
45 - 49	8	33.3	24	
50 +	9	56.2	16	
Professional Grade				
Assistant nurse	8	44.4	18	
Student	6	50	12	
Nurse	39	44.3	70	
Sanitary engineer	0	0	2	0.002 ⁽²⁾
Doctor	18	48.6	37	
Cleaner	1	5.6	18	
Midwife/Birth attendant	10	71.4	14	
Laboratory & dental technician	19	41.3	46	
Unit				
Surgery	22	64.7	34	
Hygiene and sanitation	1	5	20	
Laboratory	21	41.2	51	

Obstetrics & gynaecology	20	64.5	31	<0.0001 ⁽²⁾
Medicine	14	37.2	37	
Stomatology	11	61.1	18	
Paediatrics	12	46.2	26	

Note*: ⁽¹⁾: Chi² test; ⁽²⁾: Fisher exact test.

Personal Protective Equipment (PPE) and Hygiene

HCW reported that PPE was always available for use (43%). Goggles/visors/face shields, protective shoes and gowns were the least accessible PPE. Face masks and sterile gloves were inconsistently accessible. Most of disinfectants were frequently available in

all facilities. Chlorine was the most used disinfectants and reported available by 86 % of respondents (Figures 2,3).

Djoungolo, Mvog Ada and Nkoldongo District Hospitals reported deficiencies in infection control supplies. The obstetrics and stomatology departments reported the most effected.

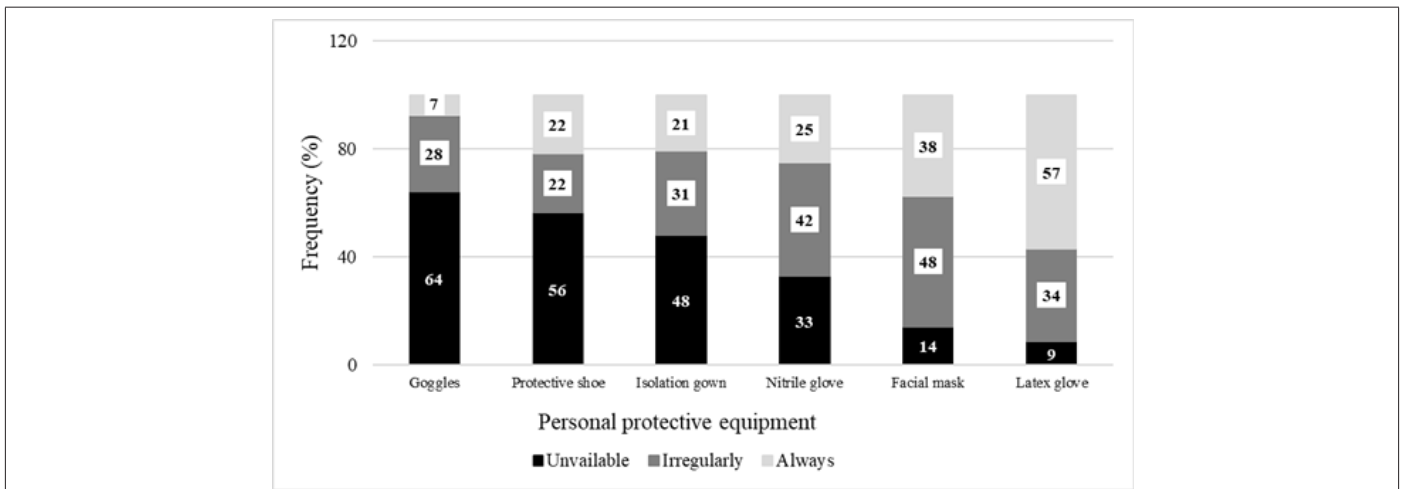


Figure 2: Reported availability of personal protective equipment among healthcare workers in Yaounde District Hospitals, April 2022 (n=217).

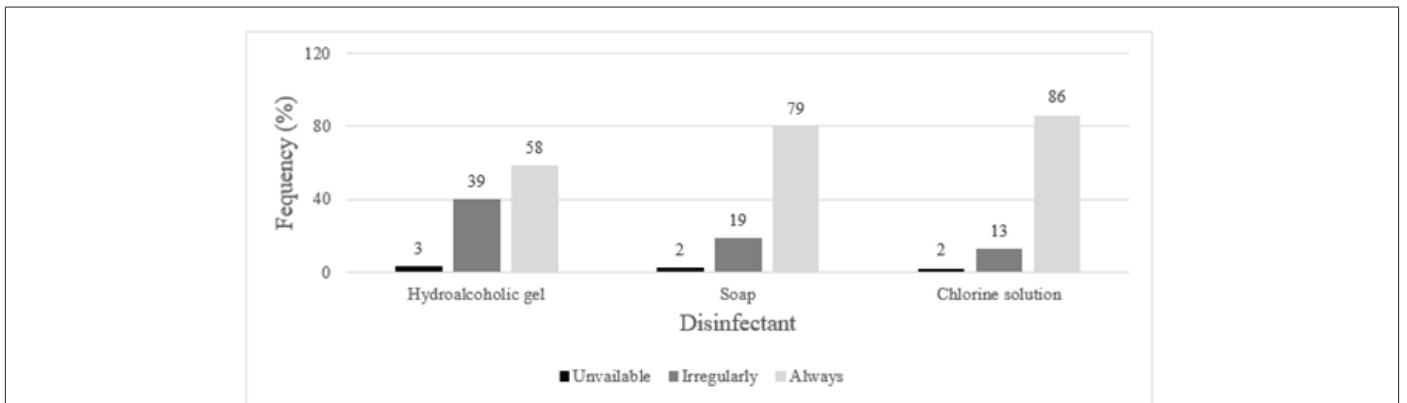


Figure 3: Reported availability of disinfectants among healthcare workers in Yaounde District Hospitals, April 2022 (n=217).

Occupational Safety Promotion Signs and Hospital Hygiene

All laboratory departments had posters on occupational safety, hand hygiene, guidelines for post-exposure management.

COVID-19 Vaccination Coverage

Less than half of participants had received COVID-19 vaccine (44.8%). Biyem-Assi (74.2%) and Mvog-Ada (66.7%) had the highest of fully immunized HCW (p-value <0.0001) (Figure 4). The vac-

cine most preferred by HWC were Janssen (61%) and Sinopharm (28%). Astra Zeneca and Pfizer were the least administered (Figure 5).

Non immunized healthcare workers were both medical (61.8%) and paramedical (52.1%) (Tables 4,5).

The main reasons of non-compliance with vaccination against COVID-19 were doubt on the content of the vaccines (42%) and fear of side effects (39.3%) (Figure 6).

Table 4: COVID-19 vaccination status and socio - professional status of healthcare workers in Yaounde District hospitals, April 2022 (n=217).

Professional Status	Vaccination Status n (%)			Total	p-Value ⁽¹⁾
	Unvaccinated	Partially	Fully		
Medical	21 (61.8)	0	13 (38.2)	34 (100)	
Paramedics	85 (52.1)	7 (4.3)	71 (43.6)	163 (100)	0.42
Hygiene	8 (40.0)	0	12 (60)	20 (100)	

Note*: ⁽¹⁾: Fisher exact test.

Table 5: Factors associated hindering compliance with COVID-19 vaccinations among health staff in Yaounde District hospitals, April 2022 (n=217).

Factor	aOR	95% CI	
		Lower	Upper
Male/Female	0.9	0.45	1.81
Single/Married	1.16	0.66	2.03
Educational level: < 12 years/≥ 12 years	1.5	0.68	3.34
Other working group/Doctors	0.65	0.3	1.43
Civil servant/Contractual	0.73	0.4	1.31
Infection control training: No/Yes	0.97	0.55	1.71

Note*: aOR: adjusted Odds Ratio.

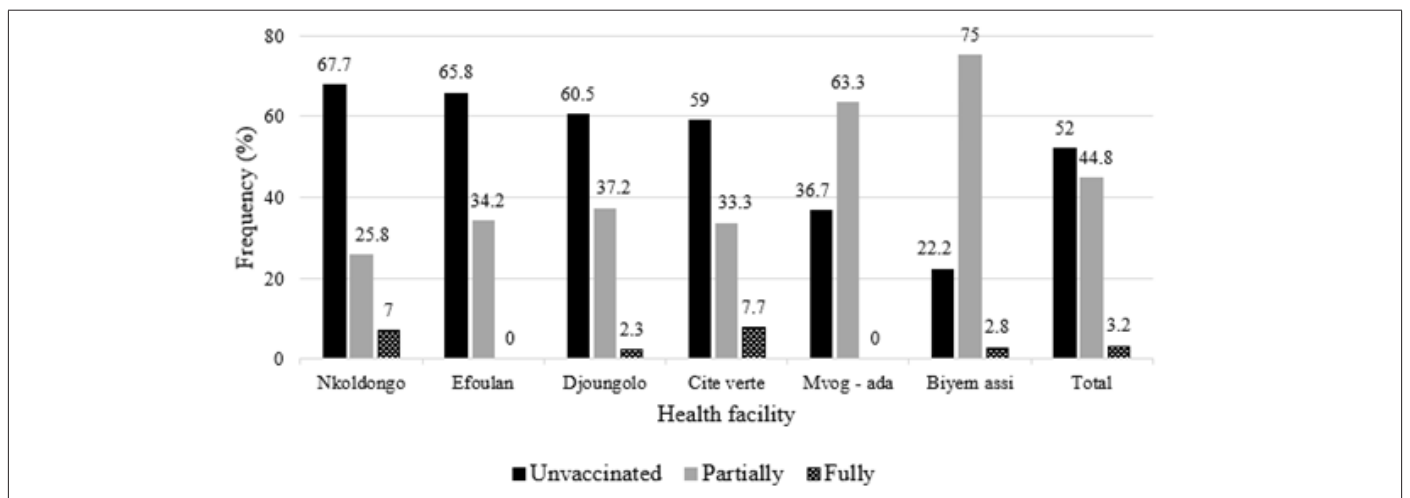


Figure 4: COVID-19 vaccinations coverage among healthcare workers in Yaounde District Hospitals, April 2022 (n=217).

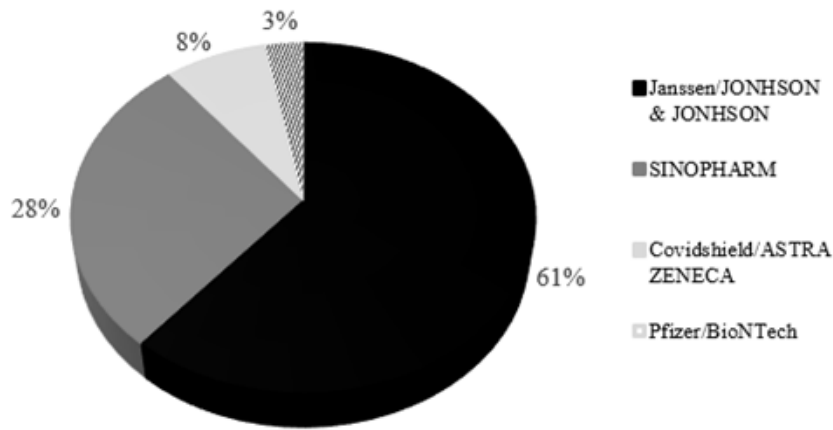


Figure 5: Source of COVID-19 vaccines received by healthcare workers in Yaounde District Hospitals, April 2022 (n=103).

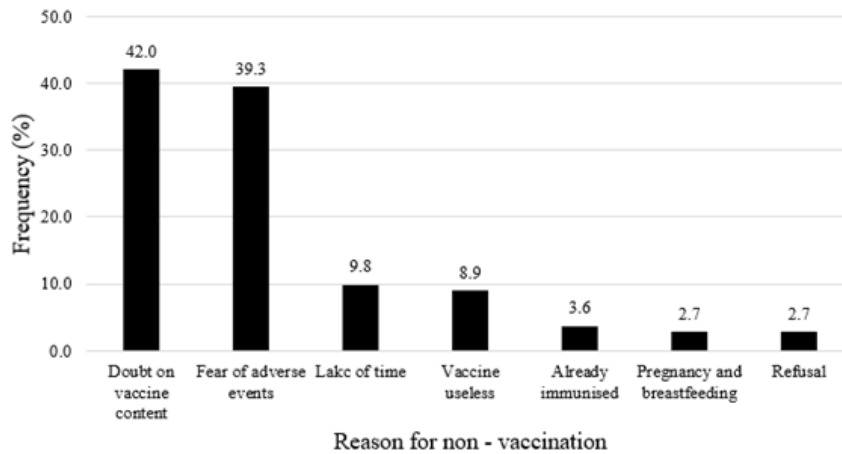


Figure 6: Reason for non-compliance with COVID-19 vaccination among healthcare workers in Yaounde District Hospitals, April 2022 (n=114).

Discussion

More than two third of respondents recaped needles during healthcare activities. This proportion is higher than that found in Congo and Morocco [22,23]. Nearly a third of respondents reported poor used needle disposal practices. Nearly 10% of respondent claimed to wash the scalpel blades for reuse, a practice that increases the risk of percutaneous exposure to blood.

The fact that half of HCW did not systematically wash their hands after health services is worrisome [24,25]. This poor performance were attributed to the high workload and unavailability of water or washing facilities that were far from the point of care. Elsewhere in Africa, the perceived sense of urgency was reported as key reason of non-compliance with mandatory hand washing between patients [24]. Sub - optimal adherence to universal precautions may reflect insufficient intermediate and central level supervisory activities of health facilities and their staff. Under such conditions the role of infection control committees, internal and external mon-

itoring guidelines are warranted to foster compliance [26].

Midwives and nurses were the most affected by splashes confirming observations in elsewhere, France and Ivory-coast [10,25].

PPE were inconsistently available (43,6%). Corroborating observations in Yemen (46.3%) [27,28]. Higher availability were documented in Nigeria (67.2%) [29].

Goggles/ facial shields, protective shoes and gowns were the least accessible PPE while face masks and sterile gloves were inconsistently accessible. Departments most affected were obstetrics & gynaecology and stomatology. The surgery department received the most PPE as it is involved in most invasive procedures

We did note that some of PPE (gloves) were supplied to the care provider by patients, explaining why most healthcare workers did not express shortage. Non-systematic use of these devices by exposes HCW to the risk of HIV, hepatitis B and C viruses contaminations [26,29].

Less than half of HCW (52%) were vaccinated for COVID-19. Vaccination against COVID-19 has been greatly influenced by social media coverage both nationally and internationally, raising fear and poor compliance with COVID-19 vaccination despite the implementation of specific immunization centres and its availability free of charge to HCW [31,32].

The Janssen vaccine was the most requested (61%), consistent with the national trend [18]. Its unique dose regimen has largely contributed to its acceptance by HCW.

The fact that medical and paramedical workers were more reluctant to vaccination is staggering. This could be due to doubts about the content of the vaccine and fear of vaccine-related side effects [33].

Controversies that aroused around COVID-19 vaccine in social media fuelled vaccine hesitancy among health workers just as was the case among HCW and community members [18].

Conclusion

Splashes are of common occurrence among healthcare workers. PPE availability remains a challenge for most health facilities despite the mobilisation surrounding the COVID-19 pandemic. Strategies should be implemented to tackle splashes and scale up observance of standard precautions and vaccination for infection prevention among HCW. Targeted communication for COVID-19 vaccine safety against counter hesitancy. There is a need to set up a national system for the design, implementation, monitoring and evaluation of infection control in healthcare settings.

Declaration

Author's Contribution

Drafting of the study protocol, data collection, analysis and interpretation, drafting and editing of manuscript: F.Z.L.C.; Critical revision of protocol, critical revision of manuscript: E.E.L., J.H.N., and M-K.F-X.; Conception, design and supervision of research protocol and implementation, data analysis plan, revision, editing and final validation of the manuscript: I.T.

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Ethical Approval Statement

The protocol was reviewed and approved by the Regional Human Health Committee of the Centre (CRERSH - Ce) and the ethical clearance: CE N° 2245/CRERSHC/2021 issued.

Declaration of Interests

All authors declare no conflict of interest and have approved the final article.

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References

- Westermann C, Peters C, Lisiak B, Lamberti M, Nienhaus A, et al. (2015) The prevalence of hepatitis C among healthcare workers: a systematic review and meta-analysis. *Occup Environ Med* 72(12): 880-888.
- (2003) World Health Organization. Aide-memoire for a strategy to protect health workers from infection with bloodborne viruses.
- Annette PU, Elisabetta R, Yvan H (2005) Estimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers. *Am J Ind Med* 48(6): 482-490.
- (2014) Infection Prevention and Control of Epidemic- and Pandemic-Prone Acute Respiratory Infections in Health Care [Internet]. Geneva: World Health Organization; (WHO Guidelines Approved by the Guidelines Review Committee).
- Motaarefi H, Mahmoudi H, Mohammadi E, Hasanpour Dehkordi A (2016) Factors Associated with Needlestick Injuries in Health Care Occupations: A Systematic Review. *J Clin Diagn Res JCDR* 10(8): IE01-IE04.
- Gumodoka B, Favot I, Berege ZA, Dolmans WM (1997) Occupational exposure to the risk of HIV infection among health care workers in Mwanza Region, United Republic of Tanzania. *Bull World Health Organ* 75(2): 133-140.
- Cheuyem FZL, Lyonga EE, Kamga HG, Mbopi Keou FX, Takougang I, et al. (2023) Needlestick and Sharp Injuries and Hepatitis B Vaccination among Healthcare Workers: A Cross Sectional Study in Six District Hospitals in Yaounde (Cameroon). *J Community Med Public Health* 7(3): 1-9.
- Beyene T, Tadesse S (2014) Predictors of occupational exposure to HIV infection among healthcare workers in southern Ethiopia. *Int J Infect Control* 10(3): 1-7.
- Em B, It W, Cn S, Me C (2000) Risk and management of blood-borne infections in health care workers. *Clin Microbiol Rev* 13(3): 385-407.
- Ward CL, Kozian L, Bartolacci J, Krupp JC, Karadsheh MJ, et al. (2023) A Novel Approach to Reducing Splash Exposure in Pulsatile Lavage. *Plast Reconstr Surg Glob Open* 11(6): e5016.
- Vincent A, Cohen M, Bernet C, Parneix P, L'Hériteau F, et al. (2006) Accidental exposure to blood by midwives in French maternity units: results of the national surveillance 2003. *J Gynecol Obstet Biol Reprod* 35(3): 247-256.
- Shitu S, Adugna G, Abebe H (2021) Occupational exposure to blood/body fluid splash and its predictors among midwives working in public health institutions at Addis Ababa city Ethiopia, 2020. Institution-based cross-sectional study. *PloS One* 16(6): e0251815.
- Ofstead CL, Hopkins KM, Daniels FE, Smart AG, Wetzler HP (2022) Splash generation and droplet dispersal in a well-designed, centralized high-level disinfection unit. *Am J Infect Control* 50(11): 1200-1207.
- Sagoe Moses C, Pearson RD, Perry J, Jagger J (2001) Risks to Health Care Workers in Developing Countries. *N Engl J Med* 345(7): 538-541.
- Ziraba AK, Bwogi J, Namale A, Wainaina CW, Mayanja Kizza H (2010) Sero-prevalence and risk factors for hepatitis B virus infection among health care workers in a tertiary hospital in Uganda. *BMC Infect Dis* 10(1): 191.
- Haviari S, Bénet T, Saadatian Elahi M, André P, Loulergue P, et al. (2015) Vaccination of healthcare workers: A review. *Hum Vaccines Immunother* 11(11): 2522-2537.
- (2023) There are four types of COVID-19 vaccines: here's how they work | Gavi, the Vaccine Alliance.

18. Amani A, Njoh AA, Mouangue C, Cheuyem Lekeumo FZL, Mossus T (2022) Vaccination Coverage and Safety in Cameroon; Descriptive Assessment of COVID-19 Infection in Vaccinated Individuals. *Health Sci Dis* 23(8): 1-8.
19. Bonny A, Tibazarwa K, Mbouh S, Wa J, Fonga R, et al. (2017) Epidemiology of sudden cardiac death in Cameroon: the first population-based cohort survey in sub-Saharan Africa. *Int J Epidemiol* 46(4): 1230-1238.
20. Kong SYJ, Wi DH, Ro YS, Shin SD, Jeong J, et al. (2019) Changes in the healthcare utilization after establishment of emergency centre in Yaoundé, Cameroon: A before and after cross-sectional survey analysis. *PLoS One* 14(2): e0211777.
21. (2022) Reports | DHIS2. Cameroon Ministry of Public Health.
22. Nouetchognou JS, Ateudjieu J, Jemea B, Mbanya D (2016) Accidental exposures to blood and body fluids among health care workers in a Referral Hospital of Cameroon. *BMC Res Notes* 9(1): 94.
23. Tshering K, Wangchuk K, Letho Z (2020) Assessment of knowledge, attitude and practice of post exposure prophylaxis for HIV among nurses at Jigme Dorji Wangchuck National Referral Hospital, Bhutan. *PLoS One* 15(8): e0238069.
24. Mandana BN, Likwela LJ (2013) Knowledge attitudes and practices of health professionals towards standard precautions in hospitals. *Public health* 25(5): 663-673.
25. Djeriri K, Charof R, Laurichesse H, Fontana L, El Aouad R, et al. (2005) Comportement et conditions de travail exposant au sang: analyse des pratiques dans trois établissements de soins du Maroc. *Médecine Mal Infect* 35(7-8): 396-401.
26. Laraqui O, Laraqui S, Tripodi D, Zahraoui M, Caubet A, et al. (2008) Évaluation des connaissances, attitudes et pratiques sur les accidents d'exposition au sang en milieu de soins au Maroc. *Médecine Mal Infect* 38(12): 658-666.
27. Gondo D, Effoh N, Adjoby R, Konan J, Koffi S, et al. (2016) Connaissances, attitudes et pratiques (CAP) du personnel soignant sur les accidents d'exposition au sang (AES) dans 4 maternités d'Abidjan. *Rev Afr Anesth Med Urgences* 21(1): 16-20.
28. Al Abhar N, Moghram GS, Al Gunaid EA, Al Serouri A, Khader Y (2020) Occupational Exposure to Needle Stick Injuries and Hepatitis B Vaccination Coverage Among Clinical Laboratory Staff in Sana'a, Yemen: Cross-Sectional Study. *JMIR Public Health Surveill* 6(1): e15812.
29. Akpuh N, Ajayi I, Adebawale A, Idris Suleiman H, Nguku P, et al. (2020) Occupational exposure to HIV among healthcare workers in PMTCT sites in Port Harcourt, Nigeria. *BMC Public Health* 20(1): 451.
30. Mbanya D, Ateudjieu J, Tagny CT, Moudourou S, Lobe MM, et al. (2010) Risk Factors for Transmission of HIV in a Hospital Environment of Yaoundé, Cameroon. *Int J Environ Res Public Health* 7(5): 2085-2100.
31. (2022) WHO. The World Health Organisation. Cameroon: WHO Coronavirus Disease (COVID-19) Dashboard with Vaccination Data.
32. Ritchie H, Mathieu E, Rodés Guirao L, Appel C, Giattino C, et al. (2020) Coronavirus Pandemic (COVID-19). *Our World Data*.
33. Amani A, Mossus T, Lekeumo Cheuyem FZ, Bilounga C, Mikamb P, et al. (2022) Gender and COVID-19 Vaccine Disparities in Cameroon. *COVID* 2(12): 1715-1730.