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Anita Anyimadu

anitaakuaaddowaa@gmail.com

University of Health and Allied Sciences

Peter Tettey Cheetham

Ghana Health Service

Elvis Enowbeyang Tarkang

University of Health and Allied Sciences

Research Article

Keywords:

Posted Date: November 9th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11620544/v1

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Additional Declarations: No competing interests reported.

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Author 1: Anita Anyimadu (Corresponding Author), University of Health and Allied Sciences and Ghana Health Service, Ho West District Health Directorate, anitaakuaaadowaa@gmail.com

Author 2: Peter Tettey Cheetham, Ghana Health Service, Ho West District Health Directorate, cheethampeter@yahoo.com

Author 3: Elvis Enowbeyang Tarkang, University of Health and Allied sciences, etarkang@uhas.edu.gh

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Abstract

Introduction: This study assessed occupational exposures, personal protective equipment (PPE) availability and utilisation, and factors associated with PPE utilisation among healthcare workers (HCWs) in Ho West District, Ghana.

Methods: A cross-sectional survey was conducted among 174 randomly selected HCWs from all 32 health facilities. Data collected using a structured, self-administered questionnaire in Kobo Collect were analysed in Stata 17. Descriptive statistics, chi-square tests and logistic regression were used, with statistical significance set at $p<0.05$ and a 95% confidence level.

Results: Overall, 79.3% of HCWs reported occupational exposure; 112 (64.4%) reported inadequate PPE availability, while 102 (58.6%) had poor PPE utilisation. Gloves were used by 75.3%, compared with gowns (5.8%) and eye protection (3.5%). Blood/body-fluid splashes were reported by 102 (58.6%) and needle-stick injuries by 73 (42.0%); 51.7% reported that exposures occurred rarely. PPE training was associated with higher odds of appropriate utilisation (AOR=2.75, 95% CI: 1.36–5.56; p=0.005), whereas economising on limited PPE supplies was associated with lower odds (AOR=0.34, 95% CI: 0.17–0.69; p=0.003).

Conclusion: HCWs in Ho West District experienced substantial occupational exposure alongside inadequate PPE availability and generally poor utilisation. Regular practical training and a reliable, uninterrupted PPE supply are needed to improve appropriate use and reduce occupational risks.

Keywords: Occupational Health Risks, Personal Protective Equipment, Personal Protective Equipment Utilisation, Occupational Exposures

Background

Healthcare workers (HCWs) are routinely exposed to occupational hazards that threaten their health and safety in healthcare settings. One of the most effective strategies for preventing occupational injuries and infections are the use of personal protective equipment (PPE). PPE refers to specialised clothing or equipment worn by workers to minimise exposure to hazards that may cause serious workplace injuries or illnesses. These include protective clothing, gloves, face masks, respirators, goggles, and face shields designed to serve as barriers against infectious agents and hazardous materials (1). The use of PPE is widely recommended and, in many settings, legally required to safeguard HCWs from occupational risks.

Despite established infection prevention guidelines, occupational exposures among HCWs remain a significant global public health concern. HCWs frequently encounter hazards such as bloodborne pathogens, needle-stick injuries, and exposure to airborne infections during routine clinical activities (2). A systematic review estimated that approximately 10% of HCWs worldwide experience sharps injuries each year, placing them at risk of infections such as Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), and Hepatitis C Virus (HCV) (3). Occupational exposures have been linked to thousands of infections globally and are projected to contribute to over one thousand premature deaths among HCWs between 2000 and 2030 if preventive measures are not effectively implemented (4).

The burden of occupational exposure is disproportionately higher in low- and middle-income countries (LMICs), where health systems often face resource constraints, weak occupational safety policies, and

limited infection prevention infrastructure (5). In sub-Saharan Africa (SSA), HCWs encounter additional challenges including shortages of PPE, heavy patient workloads, and inadequate training on infection prevention and control practices. Evidence suggests that approximately 65.7% of HCWs in the region experience exposure to bodily fluids, while 36.4% report percutaneous injuries such as needle-stick incidents (5). These occupational exposures contribute to a substantial proportion of blood-borne infections among HCWs. For instance, occupational exposure accounts for an estimated 11.8% of HBV infections, 2.8% of HCV infections, and 5.1% of HIV infections among HCWs in SSA, compared with considerably lower proportions reported in high- income countries (4). Furthermore, healthcare-associated infection rates in many low-resource settings are estimated to be two to three times higher than those observed in developed countries (6).

Ghana reflects many of these regional challenges. HCWs in high-risk clinical environments, such as emergency units and infectious disease wards, are particularly vulnerable to occupational exposures, especially during aerosol-generating procedures and while handling infectious materials (7).

Although studies conducted in Accra report high levels of knowledge regarding PPE protocols among HCWs exceeding 95% awareness for the use of gloves and masks actual adherence to recommended practices remain inconsistent (8). These discrepancies between knowledge and practice highlight ongoing challenges related to PPE availability, training, and institutional enforcement of infection prevention guidelines.

Additionally, most studies conducted in Ghana have focused on specific professional groups or isolated infection prevention practices, limiting a comprehensive understanding of occupational exposure risks among HCWs (9). Evidence from underserved regions, including the Volta Region, remains particularly scarce. The lack of context-specific data on occupational exposure and PPE utilisation constrains the ability of health authorities and policymakers to design targeted interventions that address the practical barriers faced by HCWs in resource-limited settings. The Ho West District represents a typical district-level health system where challenges such as inconsistent PPE supply, potential underreporting of occupational exposures, and limited training opportunities may compromise healthcare worker safety. However, empirical evidence documenting these challenges remains limited. This study therefore assesses the accessibility, availability, barriers and facilitators to the utilisation of PPE among HCWs in the Ho West District. By generating local evidence on occupational exposure risks and PPE utilisation practices, the study aims to inform context-specific occupational health policies and strengthen infection prevention and control strategies in healthcare facilities within the district and other similar resource constrained settings.

Materials and methods

Study site description

The aim of the study was to determine occupational health risks, PPE accessibility, utilisation and exposures among HCW in Ho West district (6). Ho West district is one of the 18 administrative districts in the Volta region in Ghana. The Ho West district is in the middle belt of Volta region in Ghana. The district shares boundaries with Adaklu to the South, Eastern Region to the South West,

Afadjato South to the North, Ho Municipality and the Republic of Togo to the East and South Dayi to the west. The district is made up of seven (7) Traditional areas namely: Kpedze, Dodome, Tsito, Hlefi, Avatime, Dzolo and Abutia. It has a population of about 88,219 people. The district is made up of two main ethnic groups, the Ewes and Avatimes. The district has 32 health facilities including 1 private hospital, 1 polyclinic, 13 health centres, 12 CHPs, 3 school clinics and 2 CHAG clinics. The Ho West District Assembly headed by the District Chief Executive constitutes the Local Government in the District. The District Health Directorate is a decentralised department under the District Assembly and represented on the Social Services Sub-committee of the District Assembly by the District Director of Health Services (10).

Study design

A cross-sectional quantitative survey was used for the study from the period of September 2025 to November 2025.

Strengths: It is relatively quick and inexpensive to conduct. Data on all variables are collected at one time point. Multiple outcomes and exposures can be studied.

To minimise the nonresponse bias, a 5% nonresponse rate was adjusted for to ensure that the minimum sample size was obtained. Also, clear, simple and concise questions were administered at convenient times of participants which increased participation rate. In addition, multiple follow-up attempts were made on participants to ensure questionnaires are administered to them. To minimise the recall bias, clearly defined questions were used. The questions were not vague. Also, standardised and validated questions adapted from WHO infection prevention and control guidelines (12) as well as Centre for Disease Control and Prevention "(CDC) occupational exposure assessment tools (13) were used.

Study population

The study targeted HWCs (those who come into contact with body fluids, blood and blood borne pathogens) in facilities across Ho West District. They are specifically Doctors, Physician Assistants, Midwives, Registered General Nurses, Enrolled nurses, Laboratory technicians, Public Health Nurses, Community Health Nurses and orderlies.

Inclusion and exclusion criteria

Inclusion criteria: The study included HCWs who are professionally active with at least one year of clinical work experience and directly come into contact with body fluids, blood and blood borne pathogens, who consented to participate.

Exclusion criteria: The study excluded those who qualify but were ill. Also, people who met the inclusion criteria but refused to consent to be part of the study were also excluded from the study.

Study variables

Dependent variable: The dependent variable was PPE utilisation.

Independent variables: The independent variables for the study were the socio-demographic characteristics (age, gender, professional role, department & years of work experience), PPE availability and common occupational exposures experienced by HCWs.

Sample size determination

Sample size was determined using Yamane's (1967) sample size calculation formula (14):

n= N/ $(1 + N(e)^2)$

Where n= estimated sample size, N=Population size, e=margin of error

N is 290, e =5% (0.05)

$n = 290/(1 + 290(0.05)^2)$

$n = 168$

The minimum sample size estimated for the study was 168.

Adjusting for 5% non-response rate: (5/100) x168=9.

The total adjusted sample size estimated for the study was 168 + 9 = 177.

However, 174 respondents at the time of data collection consented to participate (98.3% response rate).

Sampling method

A stratified type of random sampling method was used to select participants from each facility with each facility representing a stratum. This was to ensure that participants are selected across

all facilities (each facility in the district has at least one participant representing). This was achieved by cutting 290 (representing the number of study population) pieces of papers which were numbered from 1 to 177(total adjusted [+5%] sample size) with the remaining 83 pieces of papers left unnumbered. Both the numbered and unnumbered pieces of papers were folded and mixed thoroughly into a container. Upon reaching each of the facilities in the District, each HCWs who fell within the inclusion criteria was asked to pick at random a sheet of folded paper from the container without replacement. HCWs who picked numbered pieces of paper were included in the study. Those who picked unnumbered pieces of papers were excluded from the study. This was repeated in all facilities to obtain the required sample size for the study.

Data collection tool and procedure

A structured self-administered questionnaire which was mainly adapted from WHO infection prevention and control guidelines (12) as well as CDC occupational exposure assessment tools (13) was developed using kobo collect to determine occupational health risks, PPE utilisation and exposures among HWCs in Ho West District. Data collection took place in all facilities across the district. Standardised training was provided for data collectors to ensure accurate data collection and observational recording done on HCWs. The questionnaire contained six sections. Section A contained questions pertaining demographic characteristic, Section B included questions pertaining to availability and usage of PPE, and Section C included questions on the occupational health exposures and risks and Section D asked questions on PPE adherence

recommendations among HCWs. Section E, asked questions about barriers to the effective use of PPE and Section F, sought to know what facilitates compliance with the use of PPE.

To ensure validity of the questionnaire, the questionnaire items were compared with existing guidelines and standardised instruments (e.g., WHO, CDC). Also, responses to PPE use were compared to the observation checklist to see if they matched. In addition, a few HCWs and peers reviewed the questionnaire to confirm that questions were clear, relevant, and understandable. Consequently, adjustment of wording based on feedback was done to ensure it reflects real-world experiences. The questionnaire was pretested and revised to ensure reliability. Also, the observational PPE compliance checklist demonstrated good internal consistency (Cronbach's alpha = 0.81).

Also, a direct observational checklist was used where participants were observed closely while

performing their clinical activities and the average (mean) practice score was taken. Responses were coded " Observed; = 1, Not Observed; = 0 and Calculated for each HCW based on PPE practices observed. This was used to complement the utilisation of PPE by HCWs when performing procedures. Data were compiled in a excel spreadsheet, taking into consideration how many HCWs fall into each compliance category (Good//Poor). Results were presented in tables and bar charts. Trained research assistants performed the sampling procedure as described under sampling method in each facility to obtain the required study participants. A questionnaire was administered to each participant by the trained research assistants.

Pretesting

The questionnaire was pretested among 20 HCWs in Adaklu District to identify and address potential issues with data collection instruments before the full-scale study. Adaklu was chosen as a pretest District because of similar sociodemographic profile (age, sex, education, occupation), similar cultural, linguistic, and social context as well as similar health system. Pretest helps ensured the instrument is valid, reliable, and gathers accurate data. Consented participants were given a pretested structured questionnaire.

Data management and analysis

Data was entered into Kobo collect and downloaded from the database in Microsoft Excel format. Completeness was checked in the excel file and then exported to Stata version 17.0 for analysis. Descriptive statistical analysis including simple frequency and percentages was used. Bivariate analysis, chi-test was used to compare utilisation across roles. It was used to determine the correlation between dependent and independent variables. Logistic regression analysis was used to determine the strength of the association between the dependent and independent variables. This helped isolate key factors affecting PPE use for targeted interventions. A p-value less than 0.05 at

the 95% confidence interval was considered statistically significant. The participants were informed on how data would be stored, used, and protected.

Ethical consideration

Ethical approval for the study was obtained from the Research Ethics Committee of the University of Health and Allied Sciences (UHAS-REC) [UHAS/FNBSPH/PG/ {058}25-26]. Permission was sought from the District Director of health Service and Facility in Charges prior to the start of the study. The study posed little or no risk to the study participants. There was no direct or material benefit for participation in the study however, the study findings would contribute to better understanding of the impact of PPE non-utilisation and the health exposure experiences associated with it. Informed consent was sought from participants and they were allowed to voluntarily participate before commencement of the data collection. The study emphasised that participation is completely voluntary and that participants can withdraw at any time without penalty or loss of benefits. To ensure privacy, questionnaires were not administered in crowded spaces where responses could be overheard by others but rather in a private or quiet location away from supervisors, in-charges or colleagues. This will minimize desirability bias and peer or supervisor interference. In addition, participants were assured that their responses would be kept confidential (15). Data remained anonymous and findings generated would be disseminated publicly with permission.

RESULTS

Demographic characteristics of respondents

The demographic characteristics of the 174 HCWs involved in the study are presented in Table 1. The respondents had a mean age of 33.1 years (SD = 5.5), with ages ranging between 25 and 65 years. Most participants were aged 30–39 years, accounting for 112 (64.4%)**,** followed by those

aged below 30 years 43 (24.7%), and those aged 40 years and above 19 (10.9%). Females constituted 137 (78.7%) of the sample, while males represented 37 (21.3%). In terms of professional category, Community/Public Health Nurses formed the largest group with 50 (28.7%), followed closely by Enrolled Nurses 47 (27.0%). Midwives accounted for 31 (17.8%), Registered General Nurses 18 (10.3%), and other categories such as Physician Assistants, laboratory staff, orderlies and doctors collectively contributed the remainder. More than half of the participants had five or more years of work experience 92 (52.9%), while the rest had worked for less than five years 82 (47.1%). Facility distribution indicated that Health Centres were the most represented 71 (40.8%), followed by CHPS compounds 52 (29.9%), Clinics 28 (16.1%), Polyclinics 15 (8.6%), and Hospitals 8 (4.6%). Regarding educational level, Certificate holders formed the majority 85 (48.9%), followed by Diploma holders 59 (33.9%), First Degree holders 22 (12.6%), and those with Basic education 8 (4.6%). Ethnically, Ewes constituted 113 (64.9%), while Akans represented 35 (20.1%), with other ethnic groups forming the remaining proportion. Christianity was the dominant religion 162 (93.1%), with minority representation from Islam and African traditional beliefs.

Table 1: Demographic characteristics of respondents

Characteristics	Frequency (n=174)	Percentage (%)
Mean age (Range) SD in years	33.1 (25 - 65) 5.5	
Age (years)		
Below 30 years	43	24.7
30 – 39 years	112	64.4
40 years and above	19	10.9

Sex		
Female	137	78.7
Male	37	21.3
Cadre/ Profession		
Community Health Nurse/ Public Health Nurse	50	28.7
Doctor	1	0.5
Enrolled Nurse	47	27.0
Laboratory Technician	9	5.3
Midwife	31	17.8
Orderly	8	4.6
Physician assistant	6	3.5
Registered General Nurse	18	10.3
Others	4	2.3
Years of work experience (years)		
Below 5 years	82	47.1
5 years and above	92	52.9
Facility type		
CHPS compound	52	29.9
Clinic	28	16.1
Health Centre	71	40.8
Hospital	8	4.6
Polyclinic	15	8.6
Highest academic education attained		

Basic	8	4.6
Certificate	85	48.9
Diploma	59	33.9
First Degree	22	12.6
Ethnicity		
Akan	35	20.1
Ewe	113	64.9
Ga	3	1.7
Others	23	13.3
Religious affiliation		
African Traditional	1	0.6
Christianity	162	93.1
Islam	7	4.0
Others	4	2.3

Current state of Personal Protective Equipment availability among healthcare workers

Figure 1 illustrates PPE availability across health facilities. A total of 62 (35.6%) respondents reported adequate availability of PPEs in their facilities, whereas 112 (64.4%) indicated that PPEs were not adequately available. This demonstrates that nearly two-thirds of the healthcare workforce operated under consistent PPE shortages.

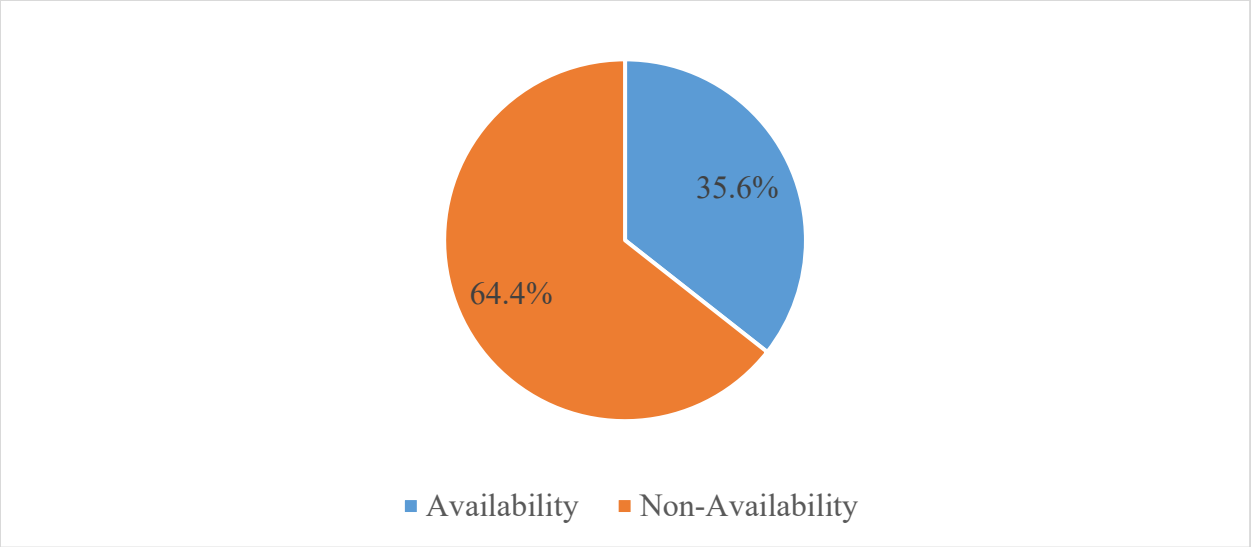


Figure 1: Personal Protective Equipment availability among healthcare workers in their facilities

Utilisation of personal protective equipment among healthcare workers

Table 2 outlines the PPE utilisation scoring across nine required PPE practices. Adherence varied widely, with 131 (75.3%) reporting correct glove use, while face mask use and eye protection were reported by 35 (20.1%) and 6 (3.5%), respectively. Proper disposal of used PPEs was practised by 146 (83.9%), whereas gown use was reported by 10 (5.8%), apron use by 29 (16.7%), safety boot use by 7 (4.0%), and head cover use by 9 (5.2%). Hand hygiene after PPE removal was practised by 143 (82.2%). PPE utilisation scores ranged from 3 (33.3%) to 9 (100%), with a mean of 7.1 (78.9%). Respondents scoring below the mean were classified as poor utilisers, while those scoring equal to or above the mean were classified as good utilisers.

Table 2: Personal protective equipment utilisation scoring table

S/N	PPE practice	Frequency of staff adhering (n=174)	Percentage (%)
1	Wearing gloves appropriately	131	75.3
2	Using face mask	35	20.1
3	Using eye protection	6	3.5
4	Proper disposal of used PPE	146	83.9
5	Wearing gowns	10	5.8
6	Wearing apron	29	16.7
7	Wearing safety boots	7	4.0
8	Wearing head covers	9	5.2
9	Hand hygiene after PPE removal	143	82.2

Compliance to each PPE usage for all required procedure attracted 1 point. Hence, the total points for usage of all the PPE for all the required procedure was 9 (PPE items). The minimum point attained was 3 points (33.3%) by 1 study participant and the maximum point attained was 9 points (100%) by 28 study participants. The mean score was 7.1 points (78.9%). Study participants who attained scores below the mean score were categorised under poor utilisation of PPE and study participants who attained scores more than or equal to the mean score were categorised under good utilisation of PPE. The result is presented in Figure 2 below.

Figure 2 displays the distribution of PPE utilisation categories. A total of 102 (58.6%) respondents demonstrated poor PPE utilisation, while 72 (41.4%) exhibited good PPE utilisation. This

highlights the fact that more than half of the HCWs in Ho West District did not meet the expected standards of PPE adherence.

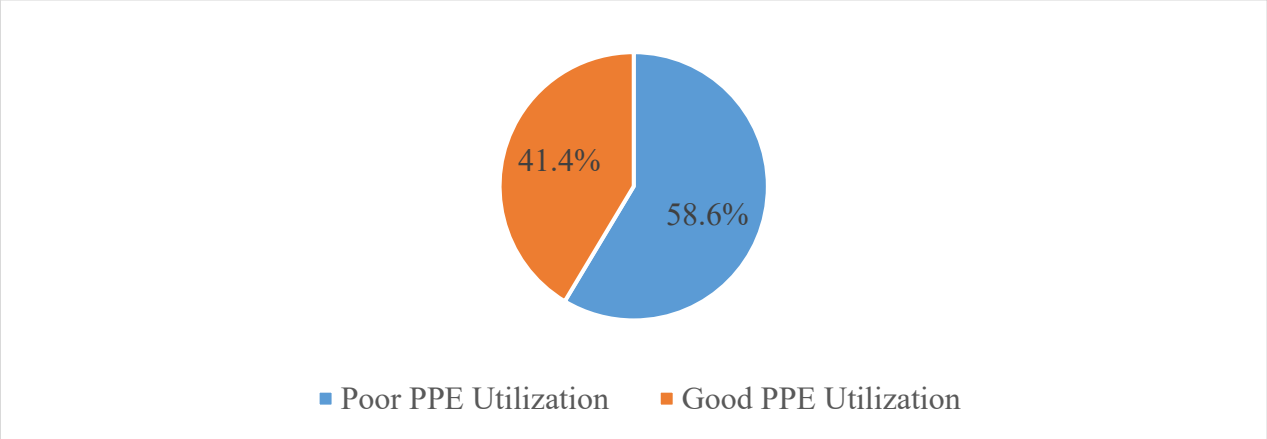


Figure 2: Personal protective equipment utilisation among healthcare workers in Ho West District

Common occupational exposures experienced by healthcare workers

Figure 3 portrays high level of occupational exposure among HCWs in Ho West District as 138 (79.3%) HCWs had ever been exposed in their line of duty in Ho West District.

Figure 4 displays the common occupational exposures experienced by HCWs in the Ho West District. The most frequently reported exposure was blood and body fluid splashes, affecting 102 (58.6%) of respondents. This was followed by needle-stick and sharp injuries, reported by 73 (42.0%) HCWs. Chemical exposures were experienced by 34 (19.5%) respondents, while infectious disease exposures (including TB, COVID-19, and HIV) were reported by 22 (12.6%) workers. An equal proportion of 22 (12.6%) also reported experiencing physical strain or injuries. These findings indicate that HCWs in the district experience multiple forms of occupational exposure, with blood and body fluid contacts being the most common.

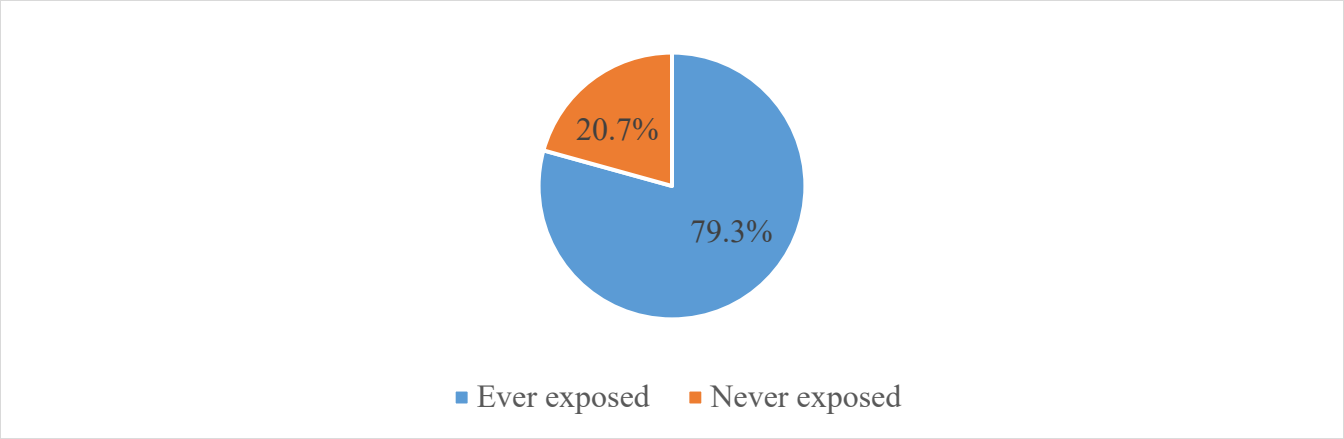


Figure 3: Overall occupational exposures experienced by healthcare workers in Ho West District

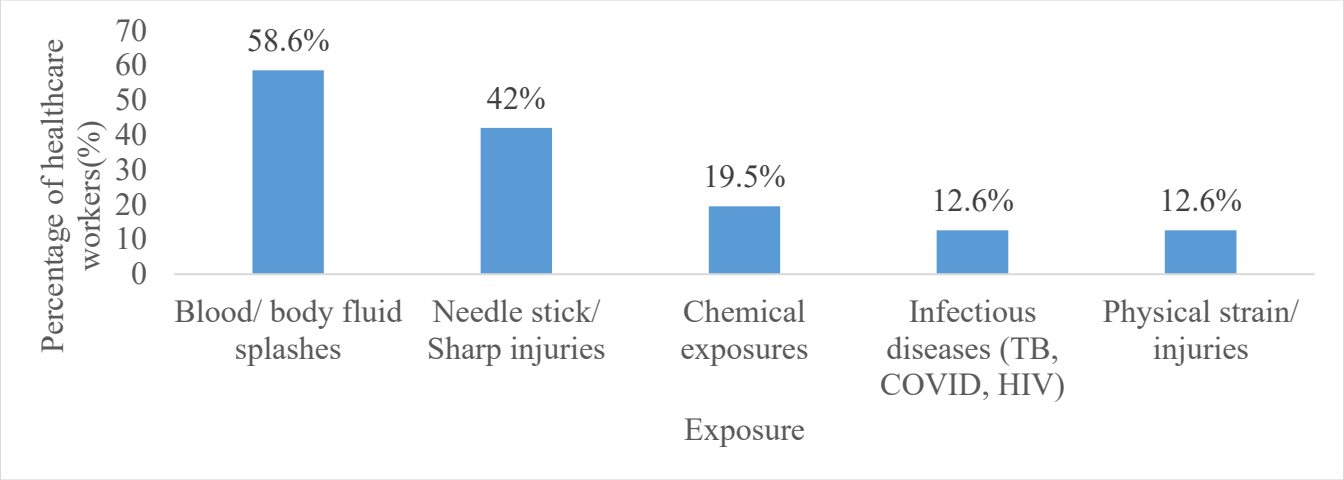


Figure 4: Common occupational exposures experienced by HCWs in Ho West District

Figure 5 presents the frequency of occupational exposures among HCWs in the Ho West District. The majority of respondents reported experiencing occupational exposures rarely, accounting for 90 (51.7%). This was followed by 36 (20.7%) who indicated that they had never experienced such exposures. Daily exposure was reported by 26 (14.9%), while 12 (6.9%) experienced occupational

exposures on a weekly basis. The least frequent category was monthly exposure, reported by 10 (5.8%) of respondents. These results indicate that although a significant proportion of HCWs encounter exposures infrequently, a notable minority experience them daily or weekly.

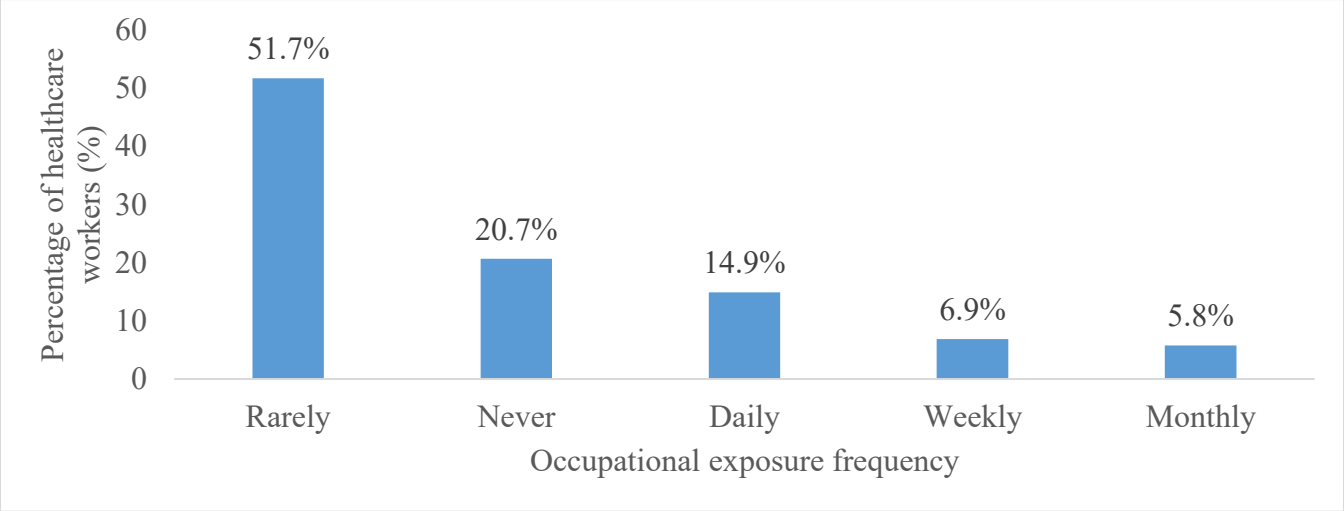


Figure 5: Occupational exposure frequency among healthcare workers in Ho West District

Factors influencing personal protective equipment utilisation among healthcare workers.

Table 3 presents the chi-square analysis of factors associated with PPE utilisation. Significant associations were observed for professional cadre, educational level, PPE training, PPE shortages, and management of limited PPE supplies. Professional cadre was significantly associated with PPE utilisation ($p = 0.015$), with some cadres such as Enrolled Nurses and Community Health Nurses being more represented among poor utilisers. Educational level showed a significant association ($p = 0.017$), as respondents with higher education levels were more likely to exhibit good PPE utilisation. Training on PPE use was strongly associated with adherence ($p = 0.008$), with 52 (73.2%) of good utilisers having received training compared to 46 (46.9%) of poor utilizers. PPE shortages were significantly more common among poor utilisers 56 (54.9%) than

good utilisers 24 (33.3%) (p = 0.005). Similarly, HCWs' management (economisation) of the limited PPE supplies was significantly associated with poor utilisation (p = 0.001).

Table 3: Factors influencing PPE utilisation among healthcare workers (n=174)

	PPE Utilisation			
Variables	**Poor PPE Utilisation Frequency (%)**	**Good PPE Utilisation Frequency (%)**	**χ2**	**p-value**
Age (years)				
Below 30 years	21(20.6)	22(30.6)	3.0292	0.220
30 – 39 years	71(69.6)	41(56.9)		
40 years and above	10(9.8)	9(12.5)		
Sex				
Female	83(81.4)	54(75.0)	1.0237	0.312
Male	19(18.6)	18(25.0)		
Cadre/ Profession				
Community Health Nurse/ Public Health Nurse	33(32.4)	17(23.6)	18.9903	***0.015**

Doctor	0(0.0)	1(1.4)		
Enrolled Nurse	26(25.5)	21(29.2)		
Laboratory Technician	5(5(4.9))	4(5.6)		
Midwife	20(19.6)	11(15.3)		
Orderly	8(7.8)	0(0.0)		
Physician assistant	0(0.0)	6(8.3)		
Registered General Nurse	8(7.8)	10(13.9)		
Others	2(2.0)	2(2.8)		
Years of work experience (years)				
Below 5 years	51(50.0)	31(43.1)	0.8169	0.366
5 years and above	51(50.0)	41(56.9)		
Facility type				
CHPS compound	36(35.3)	16(22.2)	6.5945	0.159
Clinic	13(12.8)	15(20.8)		
Health Centre	43(42.2)	28(38.9)		
Hospital	3(2.9)	5(6.9)		
Polyclinic	7(6.9)	8(11.1)		
Highest academic education attained				
Basic	8(7.8)	0(0.0)	10.2186	***0.017**
Certificate	51(50.0)	34(47.2)		
Diploma	35(34.3)	24(33.3)		

First Degree	8(7.8)	14(19.4)		
Ethnicity				
Akan	19(18.6)	16(22.2)	0.5058	0.918
Ewe	68(66.7)	45(62.5)		
Ga	2(2.0)	1(1.4)		
Others	13(12.8)	10(13.9)		
Religious affiliation				
African Traditional	1(1.0)	0(0.0)	0.8348	0.841
Christianity	95(93.1)	67(93.1)		
Islam	4(3.9)	3(4.2)		
Others	2(2.0)	2(2.8)		
Occupational Exposure frequency				
Never	22(21.6)	14(19.4)	8.5924	0.072
Rarely	53(52.0)	37(51.4)		
Monthly	4(3.9)	6(8.3)		
Weekly	11(10.8)	1(1.4)		
Daily	12(11.8)	14(19.4)		
Training on proper PPE use since start of work				
No training received	46(46.9)	19(26.8)	7.0826	***0.008**
Training received	52(53.1)	52(73.2)		

Availability of IPC committee in facility				
Unavailable	76(74.5)	50(69.4)	0.5421	0.462
Available	26(25.5)	22(30.6)		
PPE shortages				
No	46(45.1)	48(66.7)	7.9051	***0.005**
Yes	56(54.9)	24(33.3)		
Poor quality of PPE				
No	84(82.4)	59(81.9)	0.0048	0.945
Yes	18(17.7)	13(18.1)		
Discomfort while wearing PPE				
No	88(86.3)	65(90.3)	0.6374	0.425
Yes	14(13.7)	7(9.7)		
Availability of PPE protocols at facility				
Unavailable	50(49.0)	31(43.1)	0.6034	0.437
Available	52(51.0)	41(56.9)		
Management of limited PPE supplies (economizing)				
No	25(24.5)	36(50.0)	12.0454	***0.001**
Yes	77(75.5)	36(50.0)		

Influence of colleagues' non usage of PPEs				
No	91(89.2)	67(93.1)	0.7453	0.388
Yes	11(10.8)	5(6.9)		

***= Significant at 5% significance level**

Bivariate and multivariate analysis of factors influencing personal protective equipment utilisation among healthcare workers

The logistic regression results in Table 4 identify independent predictors of PPE utilisation. Training on PPE use emerged as a significant determinant. The crude odds ratio (COR) of 2.42 indicates that trained HCWs were 2.42 times more likely to have good PPE utilisation compared to those without training. After adjusting for confounders, the adjusted odds ratio (AOR) increased to 2.75, meaning trained respondents were 2.75 times more likely to adhere to proper PPE practices. PPE shortages demonstrated a COR of 0.41, indicating that respondents who experienced shortages were 0.41 times less likely to practice good PPE utilisation compared to their counterparts. Although the adjusted odds ratio of 0.57 suggests a 0.57 times reduction in likelihood, this association was not statistically significant after adjustment. HCWs management (economisation) of the limited PPE supplies was also a strong predictor, as respondents who try to manage the limited supply of PPEs had a COR of 0.32, indicating a 0.32 times reduced likelihood of good PPE utilisation. The adjusted model showed an AOR of 0.34, translating to a 0.34 times reduced likelihood of proper PPE use even after controlling for other variables. Other demographic

characteristics such as age, sex, ethnicity, years of experience, and type of facility did not show statistically significant associations with PPE utilisation.

Table 4: Bivariate and multivariate analysis of factors influencing PPE utilisation among healthcare workers (n=174)

Variable	COR (95% CI) p-value	AOR (95% CI) p-value
Cadre/ Profession		
Community Health Nurse/ Public Health Nurse	**Ref**	**Ref**
Doctor	-	
Enrolled Nurse	1.57(0.69 – 3.56) 0.283	-
Laboratory Technician	1.55(0.37 – 6.55)0.459	-
Midwife	1.07(0.42 – 2.73)0.891	-
Orderly	-	-
Physician assistant	-	-
Registered General Nurse	2.24(0.81 – 7.28)0.114	-
Others	1.94(0.25 – 15.01)0.525	-
Highest academic education attained		
Basic	**Ref**	**Ref**
Certificate	0.38(0.14 – 1.00)0.051	-
Diploma	0.39(0.14 – 1.08)0.070	-
First Degree	-	-
Training on proper PPE use since start of work		
No training received	**Ref**	**Ref**
Training received	2.42(1.25 – 4.68)**0.008***	2.75(1.36 – 5.56)**0.005***
PPE shortages		

No	**Ref**	**Ref**
Yes	0.41(0.22 – 0.77)**0.005***	0.57(0.29 – 1.12)0.103
Management (economisation) of limited PPE supplies		
No	**Ref**	**Ref**
Yes	0.32(0.17 – 0.62)**0.001***	0.34(0.17 – 0.69)**0.003***

***= Significant at 5% significance level**

Discussion

The findings of this study demonstrate that PPE availability in the Ho West District is inadequate for routine and high-risk clinical procedures. This aligns with extensive evidence from LMICs,

where PPE shortages have been consistently reported long before, during, and after the COVID-19 pandemic. Research from SSA shows that structural weaknesses in supply chain systems, procurement delays, and dependence on donor-driven supply make rural and district facilities particularly vulnerable to shortages (5, 16). Even pre-COVID studies in Ethiopia, Tanzania, Kenya, and Ghana documented chronic scarcity of essential PPE such as gloves, masks, face shields, aprons, and boots (17, 18).

Several systematic reviews published emphasise that PPE availability is often the weakest component of IPC programmes in LMICs (1, 19, 20). Limited facility-level budgets, bureaucratic procurement systems, irregular supply cycles, and uneven distribution to peripheral facilities create recurrent vulnerabilities. Studies in Ghana specifically report that PPE is often prioritised in teaching hospitals and regional centers, leaving district hospitals and CHPS compounds dependent on leftover stocks or emergency requests (21, 7).

Furthermore, global disruptions during COVID-19 exacerbated existing shortages. Several WHO reports (22, 23) affirmed that rural health facilities experienced disproportionately higher PPE scarcity due to weak supply chain resilience and the inability to compete with larger institutions in purchasing during global surges in demand. A 2023 LMIC multi-country assessment found that fewer than 25% of primary health facilities had complete PPE availability, especially eye protection, gowns, and N95 respirators (24).

From a systems perspective, PPE shortages reflect infrastructural and managerial challenges. Studies from Uganda, Malawi, and Ghana highlight the absence of real-time inventory systems, lack of minimum stock thresholds, and weak accountability for PPE distribution (6). Without formal forecasting systems, facilities tend to under-order PPE, creating cycles of perpetual stockouts. Thus, the inadequate PPE availability observed in Ho West District is consistent with

the broader African and global pattern, underscoring the need for supply chain strengthening, district-level surveillance of PPE stocks, and policy-level budget prioritisation.

Despite the essential role of PPE in preventing occupational infections, this study found that PPE utilization was poor among more than half of HCWs. This finding is consistent with a robust body of literature. Multiple studies across Africa report that even when PPE is available, utilisation remains suboptimal due to behavioural, structural, and contextual factors (17, 18, 25, 26).

Glove use is consistently high across most settings, as noted in this study and others (16, 27). Gloves are mostly inexpensive, readily available, and deeply embedded in clinical culture. However, utilisation of other PPE such as masks, goggles, gowns, and face shields is consistently low. Studies in Kenya and Malawi reported less than 10% utilization of eye protection, even during invasive procedures (6, 28). Ethiopian studies also show low uptake of gowns, aprons, and masks due to discomfort, heat, limited stock, and perceived minimal risk when dealing with familiar patients (17, 25).

The findings of this study, particularly the minimal use of eye protection (3.5%) and gowns (5.8%), align closely with results from Nigeria and Sierra Leone where HCWs frequently reported that eye protection was either unavailable, uncomfortable, or "not necessary" (29, 30). Behavioural models, including the Health Belief Model, explain such patterns: perceived susceptibility, perceived severity, and perceived benefits strongly influence PPE adherence. If HCWs perceive low risk or view PPE as an obstacle to quick service delivery, compliance declines (19, 31).

This study documented high levels of occupational exposure, particularly blood and body fluid splashes (58.6%) and needle-stick injuries (42%). This pattern is consistent with numerous studies across Africa, indicating that sharps injuries and mucocutaneous exposures remain the most

common occupational hazards for HCWs (5, 32, 33). More recent studies in Ghana, Ethiopia, Rwanda, and Cameroon confirm that exposures remain high due to high patient loads, limited engineering controls, and improper sharps disposal (8, 34).

The high incidence of splashes in this study parallels findings in surgical wards, maternity units, and emergency departments across LMICs, where rapid procedures, lack of eye protection, and inadequate distancing contribute to high mucocutaneous exposure rates (3, 28). Studies show that splash exposures are significantly higher when eye protection utilisation is low which is consistent with the low eye protection use found in this current study.

Chemical and infectious disease exposures, though less frequent, are also underrecognised.

Studies highlight that inadequate ventilation, laboratory spills, and improper handling of disinfectants contribute to chemical exposures (1, 35). The infectious disease risks remain high in settings where Tuberculosis (TB), Hepatitis B, and Lassa fever are endemic, elevating risk for frontline workers (29). Therefore, the burden of exposure observed in this study is consistent with regional evidence and highlights the urgent need for strong IPC systems, safe sharps disposal, availability of eye protection, and robust incident reporting structures.

The multivariate analysis identified that PPE training, adequate PPE supply, and management

(economisation) of limited supplies were the strongest predictors of PPE utilisation. This aligns with a large body of global literature documenting structural, organizational, and behavioural determinants of PPE use. Training is one of the most important determinants of PPE utilisation. Studies consistently demonstrate that HCWs who receive continuous, hands-on, scenario-based training are significantly more likely to comply with PPE protocols (17, 18, 29, 27). Training

improves knowledge, correct technique, risk perception, and confidence during high-risk procedures.

The strong association between PPE shortages and poor utilisation in this study supports the findings of multiple LMIC studies indicating that scarcity leads to rationing, selective use, or unsafe reuse (6, 16). When PPE is insufficient, HCWs prioritise immediate clinical efficiency over safety.

Another significant factor identified in this study was the "management of limited supplies," which, in practical terms, refers to how HCWs economise PPE when stocks are insufficient. In

contexts where PPE availability is unreliable, workers often adopt informal rationing strategies, that is prioritising PPE use only for what they perceive as "highest-risk" procedures, reusing single-use items, or avoiding PPE usage altogether to conserve limited stocks. This economising behaviour, althoughadaptive in resource-constrained settings, directly undermines consistent PPE adherence.

This finding is strongly supported by the literature. Studies across Ghana, Ethiopia, Malawi, and Nigeria show that when PPE supplies are limited, HCWs develop informal conservation practices such as skipping gowns, limiting mask use, or using gloves only when absolutely necessary (1, 6, 16). Similar behaviours were observed during the COVID-19 pandemic, where inconsistent supply forced frontline staff to ration PPE, leading to selective use and increased risk of occupational exposure (7, 20). Evidence shows that this "economising" is a structural response, not a personal preference. Inadequate and unpredictable supply chains force workers to act in self-preserving ways, often contrary to IPC guidelines. Research in Malawi and Ghana highlights that HCWs consciously "save" PPE for situations they perceive as emergencies, resulting in routine activities

like wound dressing or sample handling being performed without adequate protection (6, 8). In Ethiopia and Cameroon, workers described stretching PPE by reusing masks or limiting glove changes due to fear of total stock depletion (25, 36).

Thus, economising PPE is a predictable coping behaviour in under-resourced environments. The implication is that improving utilisation requires ensuring not just availability, but consistent and adequate supply. When HCWs have confidence that PPE will be replenished reliably, studies show that conservation behaviour declines and adherence improve (37, 24).

Beyond findings from this current study, numerous studies highlight additional influences: Safety climate and leadership commitment (19, 31); Workload, staffing levels, and time pressure (38); Comfort, heat, and PPE ergonomics (20); Peer modeling and supervision (39); Knowledge, attitudes, and perceived risk (1); Cultural and contextual norms around PPE (18). These factors collectively indicate that PPE utilisation is a multifactorial issue requiring interventions at the individual, organizational, and policy levels.

Limitations

Cross-sectional design cannot establish direct causal relationships over time. Self-reported data is susceptible to biases such as nonresponse bias and recall bias (11).

The study did not measure technical donning/doffing accuracy or task-specific/specialized PPE standards. Sample (N = 174) reflects Ho West District and may not apply to regional or teaching hospitals.

Conclusion

This study assessed the availability and utilisation of PPE, the prevalence of occupational exposures, and the factors influencing PPE use among HCWs in the Ho West District of the Volta Region. The findings provide important insights into the systemic and behavioural challenges that shape occupational safety in district-level healthcare settings. Overall, the study revealed that PPE availability remains inadequate, with a majority of HCWs reporting irregular or insufficient access to essential protective items.

Despite the recognised importance of PPE in preventing occupational hazards, PPE utilisation among HCWs was suboptimal. While gloves and hand hygiene practices showed relatively high compliance, the use of more protective PPE was markedly low. Poor utilisation was strongly linked to both insufficient availability and individual-level factors such as limited training. The study also found a high burden of occupational exposures, particularly blood and body fluid splashes and needle-stick injuries.

Importantly, the study identified key determinants of PPE utilisation, including PPE training, consistency of PPE supply, and the practice of economising limited PPE. HCWs who had received formal PPE training were significantly more likely to use PPE appropriately. Conversely, inadequate and unpredictable supply encouraged workers to ration or conserve PPE, leading to selective use and decreased compliance. It is therefore recommended that the District Health Directorate, facility managers, and the Ghana Health Service prioritise consistent PPE supply, strengthen routine PPE training, and implement structured facility-level systems to aid PPE usage.

Declarations

Ethics approval and consent to participate

Ethical approval for the study was obtained from the Research Ethics Committee of the University of Health and Allied Sciences (UHAS-REC) [UHAS/FNBSPH/PG/ {058}25-26].

Informed consent to participate in this evaluation was obtained from all participants. The study emphasised that participation is completely voluntary and that participants can withdraw at any time without penalty or loss of benefits.

Consent for publication

Not Applicable

Availability of data and materials

The Data that support the findings of this study are computationally generated and are available upon reasonable request.

Research Funding

This research did not receive funding.

Authors' contributions

A.A. came up with the core idea, identified the problem, led the research, data collection, analysis and writing. P.T.C. supported statistical analysis, prepared all the figures and assisted with writing. E.E.T. took an oversight role by supervising the work and assisted with a thorough review and corrections.

All authors read and approved the final manuscript.

Acknowledgement

The authors are grateful for the support of all health facilities and participants in the Ho West District and the University of Health and Allied Sciences, Ho.

Competing interests

The authors declare no competing interests.

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Appendices

Appendix I: Ethical Clearance Certificate

UNIVERSITY OF HEALTH AND ALLIED SCIENCES

Health for Development

FRED N. BINKA SCHOOL OF PUBLIC HEALTH
RESEARCH ETHICS COMMITTEE

My Ref. No: UHAS/FNBSPH/PG/00058/2025/26 Date: September 15, 2025

ETHICAL CLEARANCE CERTIFICATE

The University of Health and Allied Sciences Fred N. Binka School of Public Health Research Ethics Committee reviewed and unanimously approved your research proposal on the **agenda for Initial Submission** at its meeting held on September 15, 2025, subject to the conditions provided below:

Protocol Identification Number: **UHAS/FNBSPH/PG/ {058}25-26**

TITLE OF PROTOCOL:	**'Occupational Health Risks: Personal Protective Equipment (PPE) Utilization and Exposures among Healthcare Workers in Ho West District, Ghana'**
PRINCIPAL INVESTIGATOR REPORTING:	**Anita Aayimadu** This approval requires that you submit six-monthly review reports of the protocol to the Committee and a final full review to the Research Ethics Committee after the study. You must report all serious adverse events related to this study to the Committee within seven (7) days verbally fourteen (14) days in writing.
MONITORING:	The Committee may observe or cause to observe the procedures and records of the study during and after Implementation.
MODIFICATION:	Please note that any significant modification to this project must be submitted to the Committee for review and approval before it can be implemented.
PUBLICATION:	As part of the review process, Committee must, review the ethical aspects of any manuscript that may be produced from this study. You will therefore be required to furnish the Committee with any manuscript for publication.
NOTE:	You are required to provide updates to this Committee on any significant events that alter the objectives, design and Implementation of this research.

Please always quote the protocol identification number in all future correspondence concerning this protocol.

You are particularly asked to note and address the following as you commence your study. Hence, could the **Principal Investigator** address the following concerns:

Utilization should have been an observational instead, correct it.

Who is a health worker in the study. Describe who a health worker is clearly in the proposal.

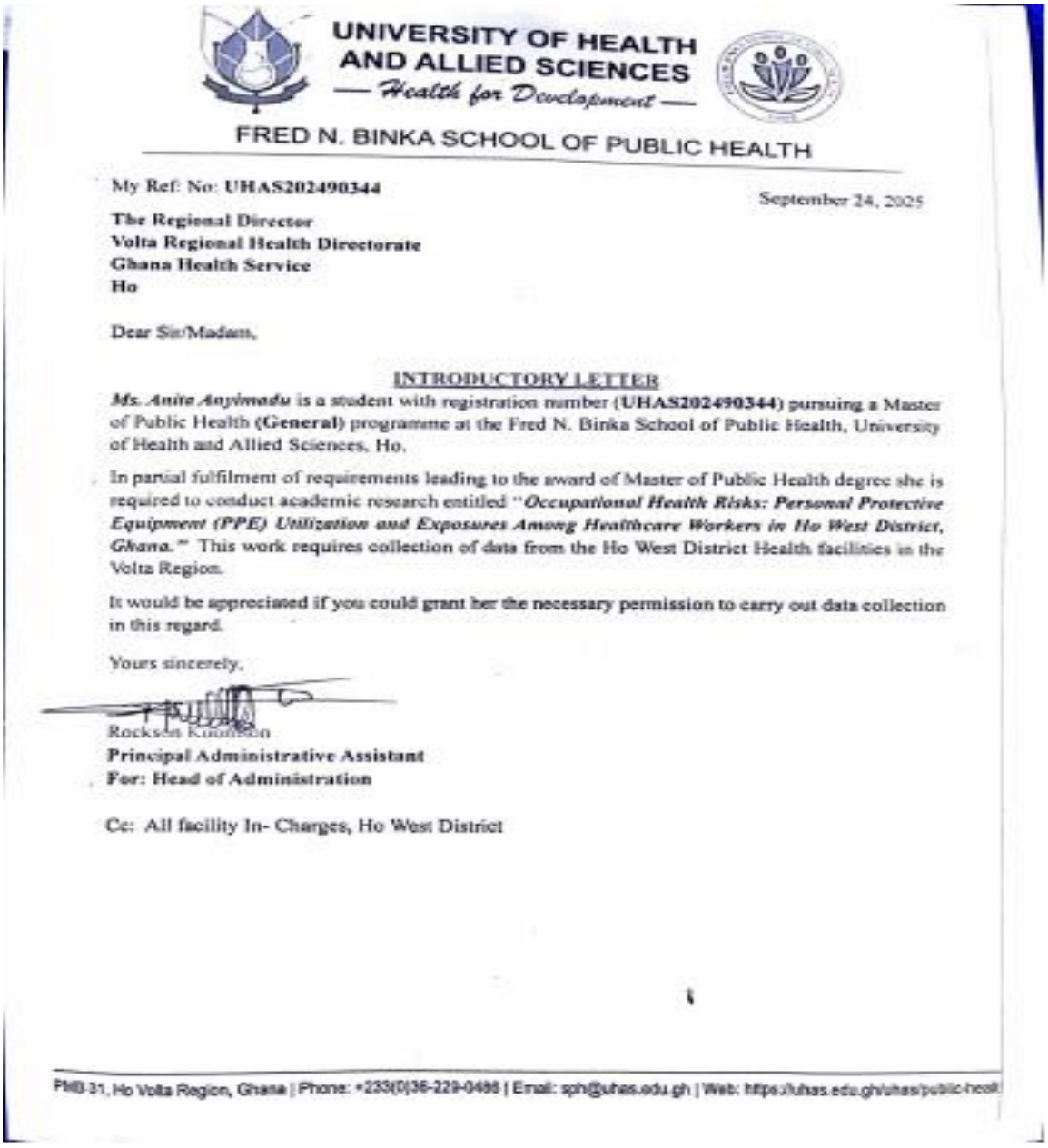
Per the health population of the study area, sample size of 189 health workers in Ho West is not feasible. Relook at it and correct the error.

Provide step-by-step approaches for protecting privacy of the participants.

.....

VICE-CHAIRMAN/UHAS-FNBSPH-REC

Appendix II: Introductory Letters



UNIVERSITY OF HEALTH AND ALLIED SCIENCES
— Health for Development —

FRED N. BINKA SCHOOL OF PUBLIC HEALTH

My Ref: No: **UHAS202490344**

September 24, 2025

The Regional Director
Volta Regional Health Directorate
Ghana Health Service
Ho

Dear Sir/Madam,

INTRODUCTORY LETTER

Ms. Anite Anyimadu is a student with registration number (**UHAS202490344**) pursuing a Master of Public Health (**General**) programme at the Fred N. Binka School of Public Health, University of Health and Allied Sciences, Ho.

In partial fulfilment of requirements leading to the award of Master of Public Health degree she is required to conduct academic research entitled "***Occupational Health Risks: Personal Protective Equipment (PPE) Utilization and Exposures Among Healthcare Workers in Ho West District, Ghana.***" This work requires collection of data from the Ho West District Health facilities in the Volta Region.

It would be appreciated if you could grant her the necessary permission to carry out data collection in this regard.

Yours sincerely,

Rockson Kuudaar

Principal Administrative Assistant
For: Head of Administration

Cc: All facility In- Charges, Ho West District

PMB 31, Ho Volta Region, Ghana | Phone: +233(0)36-229-0486 | Email: sph@uhas.edu.gh | Web: https://uhas.edu.gh/uhas/public-healt

LIST OF ABBREVIATIONS

CHAG: Christian Health Association of Ghana

GHS: Ghana Health Service

CHPs: Community-Based Health Planning and Service

Healthcare workers: Healthcare workers

HBV: Hepatitis B Virus

HCV: Hepatitis C Virus

HIV: Human Immunodeficiency Virus

LMICs: Low- and Middle-Income Countries

PPE: Personal Protective Equipment

SSA: Sub-Saharan Africa

WHO: World Health Organization