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Knowledge and Adherence to Individual Barrier Measures in Healthcare Settings: An Analytical Study in Healthcare Facilities in the City of Kisangani, DRC

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Abstract

This study was conducted to determine the factors associated with knowledge and compliance with barrier measures (BM) in healthcare facilities in the city of Kisangani.

Materials and methods: A cross-sectional analytical study was conducted with 240 healthcare providers from 20 healthcare facilities in the city of Kisangani, during the period from August 15 to October 22, 2025. Statistical inferences were made using Pearson's chi-square test and odds ratios with a 5% confidence interval for binary variables.

Results: The overall level of good knowledge of barrier measures was 73.7%, and the average rate of compliance was 60%. The professional categories of physicians, midwives, and nurses, as well as doctoral and graduate qualifications, were associated with both good knowledge and compliance with barrier measures. Continuing education increased knowledge of barrier measures sixfold (OR = 6.1; 95% CI: 3.2-11.5) and compliance fivefold (OR = 4.9; 95% CI: 2.6-9.6). Budget availability for purchasing supplies was significantly correlated with good knowledge of barrier measures (OR = 1.81; 95% CI: 1.01-3.3).

Conclusion: Knowledge and adherence to preventative measures are quite good among qualified and trained staff. Institutional policies encouraging on-the-job training, awareness campaigns, and the provision of personal protective equipment are recommended.

Keywords: Knowledge; Compliance; Barrier Measures; Healthcare Facilities; Kisangani

Introduction

The hospital environment is a prime location where the intense interaction between patients, healthcare staff, and visitors facilitates the transmission of infections. It is a major reservoir of microbes and includes multidrug-resistant bacteria that can cause infections in healthcare settings. Environmental contamination in acute care facilities is a major route of germ transmission between

patients, healthcare professionals, and visitors [1].

In 2022, the World Health Organization (WHO) highlighted the amplifying role of health facilities in epidemiological situations due to the convergence of sick and vulnerable people [2].

The past decade has been marked by outbreaks such as Ebola, MERS-CoV, and the COVID-19 pandemic, demonstrating the rapid spread of pathogens in healthcare settings [3]. These events have revealed gaps in infection control programs, regardless of a country's income level. At the same time, less visible health emergencies, such as nosocomial infections or healthcare-associated infections (HAS) and antimicrobial resistance (AMR), continue to endanger patients [3].

The protective measures for healthcare workers defined by the French Society of Hospital Hygiene include standard precautions [4] and additional precautions such as contact, droplet, and airborne precautions. Standard precautions are the first line of defense against the transmission of any microorganism. They must be followed when caring for any patient and their environment. Additional hygiene precautions apply in well-defined infectious situations to prevent the transmission of microorganisms, particularly those posing an epidemic risk but also those responsible for serious or difficult-to-treat infections [5].

In the absence of an effective medical treatment or vaccine, adherence to preventive measures and social distancing guidelines is the only way to control the spread of a virus. Systematic adherence to preventive measures and social distancing guidelines has evolved over time. The perceived effectiveness of the measures was associated (positively) with adherence only during epidemic waves, while the level of depression was associated (negatively) with adherence only during the first epidemic wave [6].

In developing countries, adherence to infection control measures is generally insufficient to control the transmission of infections in healthcare settings. A systematic review of the literature on factors influencing adherence to hand hygiene revealed that compliance rates are often below 50%, particularly among physicians [7]. Although the availability of sinks is important, having plenty of them does not guarantee satisfactory compliance ; motivation and evaluation play a more crucial role [7].

Several studies have demonstrated the positive impact of systematically implementing Standard Precautions (SP) or practices included in these precautions, particularly hand hygiene. In France, the Study Group on the Risk of Healthcare Workers' Exposure to Infectious Agents (SGRHW) demonstrated a 25% reduction over 10 years in blood exposure incidents (BEIs) among 1,506 nurses in medical and intensive care units thanks to improved application of SPs [8].

It should be noted that accidents preventable by the application of protective measures still represent more than a third of the needlestick injuries reported in the national needlestick injury surveillance conducted in France [9]. Similarly, another study showed that gloves reduced the amount of blood transmitted during a needlestick injury of a given volume [7, 9].

In the Democratic Republic of Congo (DRC), a study conducted at the ILEBO General Referral Hospital in the Kasai Province observed that, despite good knowledge among service providers about COVID-19 and the barrier measures enacted to curb the spread of the disease, handwashing facilities were absent, and mask-wearing and social distancing were not respected [10].

A study on hand hygiene compliance in hospital settings in Lubumbashi concluded that both private and public health facilities lacked adequate handwashing equipment and hand hygiene compliance in facilities differed statistically [11].

A previous study conducted in Tshopo Province on hand hygiene compliance in Kisangani general referral hospitals revealed an overall hand hygiene compliance rate of 39% (95% CI 37-41); washing with soap and water (34%) was predominant over rubbing with an alcohol-based hand rub (5%). Cleaning staff (49%) and physicians (44%) had higher compliance rates than nurses (33%), and 36% had a good understanding of the WHO hand hygiene guidelines [12].

Despite evidence of the level of infectious risk in healthcare facilities, the justified interest, the WHO recommendations in the field of patient safety and their contribution to improving the quality of care, PS often remain poorly understood and poorly respected.

The objective of this study was to determine the factors associated with knowledge and compliance with barrier measures in healthcare settings in the city of Kisangani.

Materials and Methods

This was a cross-sectional survey conducted during the period from August 15 to October 22, 2025, which covered twenty healthcare facilities in the health zones of the city of Kisangani, capital of the province of Tshopo.

The sample size was calculated using Schwartz's formula as follows: $n = Z^2*pq/d^2$. Comparing the 95% confidence level Z_{95} to 1.96; for a lower overall hand hygiene compliance rate of 19% used in a study conducted in Japan [13]; a margin of error of 5% and aWith an anticipated non-response rate of 5%, our sample size was 248 subjects.

Only healthcare facilities offering secondary-level care with a capacity of no more than 50 inpatient beds were included in the list. Within each facility, 10 to 15 providers were selected, encompassing all professional categories present at the time of the study. The total number of participants in the study was 240.

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Variables of interest

Knowledge of barrier measures (good or bad)

Knowledge was used by scoring one (1) point for each correct answer to the following parameters: Knowledge of 4 barrier measures (4 points), Knowledge of 5 indications for hand hygiene according to WHO (5 points), Knowledge of respiratory protocol (4 points), Knowledge of types of gloves (3 points), Knowledge of types of mask in healthcare settings (2 points) and Knowledge of routes of contamination in healthcare settings (3 points).

The overall score is greater than or equal to 15, equivalent to the top quartile (Q3) was considered to have "good knowledge".

Compliance with safety measures (Compliant or non-compliant)

The assessment of compliance focused on 22 items divided into four distinct categories as follows: hand washing or sanitizing (7), wearing disposable gloves (7), cough etiquette (4), and wearing disposable masks (4). Each item included an attitude scale with the following options: never, sometimes, and always. The practice was considered compliant when the "always" option was selected and non-compliant when only the "sometimes" or "never" options were selected. Overall compliance was determined by summing the number of items marked as "compliant" for all participants out of the total number of items submitted. A minimum threshold of 11—corresponding to the median—was used.

Data Collection

Data were collected using structured interviews and direct observation, with the aid of a survey questionnaire and an observation guide, both integrated into a smartphone using Kobo Collect tools.

Data Analysis

Inferences were made using Pearson's chi-square test for categorical variables and bivariate analysis for dichotomous variables, with odds ratios (ORs) and their 95% confidence intervals.

To control for potential confounding factors, a multiple logistic regression model was constructed using a stepwise forward selection procedure. Explanatory variables that showed a statistically significant association in bivariate analysis (p-value < 0.05) were included in the initial model. The results are presented as adjusted odds ratios (ORa) with their 95% confidence intervals and the p-value

from the Wald test. The overall goodness of fit of the final model was verified using the Hosmer-Lemeshow test. A p-value > 0.05 was considered an indicator of good fit, confirming that there is no significant difference between the observed and predicted frequencies.

Ethical considerations

The research protocol was submitted to the ethics committee of the University of Kisangani for approval. Participation in the study was voluntary, subject to verbal consent from each participant. Anonymity was guaranteed from data collection to dissemination.

Results

Variables N = 240	*Terms and conditions*	*Frequency*	*Percentage*
Age (Mean ± SD) years	38.1 ± 11.2		
Sex	Male	107	44.6
	Female	133	55.4
Professional category	Doctor	29	12.1
	Nurse	101	42.1
	Midwife	20	8.3
	Lab Technician	35	14.6
	Cleaning Technician	43	17.9
	Other	12	5.0
Qualification	Doctor	29	12.1
	Licensed	114	47.5
	Graduate	37	15
	Diploma	36	15
	Other	24	10
Seniority (Average ± SD) years	9.8 ± 8.7		

Table 1: Sample description.

The average age of the respondents was 38.1 ± 11.2 years; nurses, those with a bachelor's degree, and those affiliated with a network of contracted healthcare facilities were predominant. The average length of service was 9.8 ± 8.7 years.

Variables N = 240	*Terms and conditions*	*Frequency*	*Percentage*
Received training on barrier measures	Yes	162	67.5
	No	78	22.5
Overall level of knowledge	Good	163	73.7
	Weak	77	26.3
Overall level of compliance	Compliant	144	60.0
	Non-compliant	96	40.0

Table 2: Training, overall level of knowledge and compliance with barrier measures.

Nearly 2/3 of the participants had received training on barrier measures, about 3/4 had a good overall level of knowledge and 3/5 had compliant observance of barrier measures.

		Knowledge of barrier measures		*Odd ratio*	*IC 95%*	*P value*
Variables	***Terms and conditions***	***Good N = 163 (%)***	***Weak N = 77 (%)***			
Professional categories	Doctor	29 (100)	0 (0)	-	-	0.001*
	Nurse	72 (71)	29 (29)			
	Midwife	15 (75)	5 (25)			
	Lab technicians	21 (60)	14 (40)			
	Surface technicians	20 (47)	23 (53)			
	Others	6 (50)	6 (50)			
Qualification	Doctor	29 (100)	0 (0)	-	-	0.001*
	Licensed	77 (68)	37 (22)			
	Graduate	33 (89)	4 (11)			
	A2 Graduate	14 (39)	22 (61)			
	Others	10 (42)	14 (58)			
Training completed	Yes	131 (80.9)	31 (19.1)	6.1	3.2 - 11.5	0.001
	No	32 (41.0)	46 (59.0)			
Functional Hygiene Committee	Yes	83 (72.2)	32 (27.8)	1.45	0.81 - 2.62	0.175
	No	80 (64.0)	45 (36.0)			
Presence of a hygiene officer	Yes	117 (65.7)	61 (34.3)	0.67	0.33 - 1.32	0.219
	No	46 (74.2)	16 (25.8)			
Budget available for amenities	Yes	83 (74.8)	28 (25.2)	1.81	1.01 -3.3	0.035
	No	80 (62.0)	49 (38.0)			
**Pearson's squared chi*						

Table 3: Factors associated with knowledge of barrier measures.

The occupational categories of doctors, midwives, and nurses ($p<0.05$); the educational qualifications of doctor and graduate ($p<0.05$); on-the-job training (OR = 6.1; 95% CI: 3.2-11.5) and the availability of a budget for purchasing supplies (OR = 1.81; 95% CI: 1.01-3.3) were factors associated with good knowledge of preventive measures.

Analysis of the factors associated with adherence to preventive measures reveals a significant association with the occupational categories of physicians, midwives, and nurses ($p<0.05$); the educational levels of doctor and graduate ($p<0.05$); and on-the-job training (OR = 4.9; 95% CI: 2.6-9.6).

		Compliance with preventive measures		OR	95% CI	P value
Variables	**Terms and conditions**	**Good N = 163 (%)**	**Weak N = 77 (%)**			
Professional categories	Doctor	29 (100)	0 (0)	-	-	0.001*
	Nurse	71 (70)	30 (30)			
	Midwife	15 (75)	5 (25)			
	Lab technicians	35 (88)	5 (12)			
	Surface technicians	3 (7)	40 (93)			
	Others	6 (50)	6 (50)			
Qualification	Doctor	29 (100)	0 (0)	-	-	0.001*
	Licensed	77 (68)	37 (32)			
	Graduate	33 (89)	4 (11)			
	A2 Graduate	5 (14)	31 (86)			
	Others	0 (0)	24 (100)			
Training completed	Yes	117 (72.2)	45 (27.8)	4.9	2.6 - 9.6	0.001
	No	27 (34.6)	51 (65.4)			
Occupational Health Committee	Yes	72 (65.2)	43 (34.8)	1.23	0.81 - 2.62	0.42
	No	72 (57.6)	53 (42.4)			
Presence of a hygiene officer	Yes	104 (58.4)	74 (41.6)	0.77	0.40 - 1.46	0.39
	No	40 (65.5)	22 (34.5)			
Availability of funds for amenities	Yes	73 (65.8)	38 (34.2)	1.81	1.01 -3.3	0.09
	No	71 (55.0)	58 (45.0)			
Pearson's Chi-squared						

Table 4: Factors associated with adherence to preventive measures.

Variables Categories	*f (%)*	*aOR*	*IC 95%*	*valeur P*
Good knowledge				
Training completed				
Yes	131 (81)	2.51	1,66 - 3.37	0.001
Qualification				
Licensed	77 (68)	4.0	1,9 - 6,2	0.001
Graduate	33 (89)	5.1	2,8 - 7,5	0.001
Ensure Compliance				
Training completed				
Yes	117 (72)	2.7	1.7 - 3.6	0.001
Qualification				
Licensed	77 (68)	3.9	2.1 - 5.7	0.001
Graduate	33 (89)	5.1	3.0 - 7.1	0.001

Table 5: Multivariate analysis of factors associated with knowledge of and adherence to preventive measures.

The multivariate analysis shows that employees who received on-the-job training and those with a bachelor's degree or higher were more than two and a half times as likely to have a good understanding of and to follow preventive measures.

Discussion

Comprehensive training, knowledge, and adherence to preventive measures Formation

The study found that nearly two-thirds of the participants had received training on preventive measures, about three-quarters had a good overall level of knowledge, and three-fifths were adhering to the preventive measures as recommended.

The proportion of trained healthcare providers and the level of knowledge regarding preventive measures observed in our study are higher than those reported in some studies.

In Morocco, one study found that only 28.7% of healthcare workers had received training on preventive measures, and personal protective equipment was rarely mentioned in several high-risk situations [14].

In Burkina Faso, a low level of knowledge of standard precautions for the prevention of healthcare-associated infections (HAIs) was also recorded, highlighting the need to train healthcare professionals to reduce HAI-related morbidity and mortality [15].

The results obtained from a study during the COVID-19 epidemic showed a high level of knowledge, with all respondents stating that they knew about the existence of COVID-19 and the preventative measures put in place to curb the spread of the disease [10].

This good knowledge during the Covid-19 period was justified by a good overall level of knowledge of the disease (99.17%) and its perception in the community as a very serious disease (86.78%) and very contagious (97.52%) [16].

The overall high level of knowledge found in our study is justified, on the one hand, by a high proportion of the injected service providers who had already undergone on-the-job training on barrier measures, and on the other hand, by the COVID-19 epidemic period characterized by large-scale awareness campaigns through several channels.

Basic training is not sufficient to improve providers' knowledge of barrier measures; on-the-job training and ongoing awareness-raising actions are necessary to draw attention to the realities of the spread of infections in the workplace if barrier measures are relaxed.

In healthcare settings, the concept of protection and hygiene remains paramount today. The correct and effective application of barrier measures by healthcare staff, who have received on-the-job training, makes care even safer for both patients and hospital staff. Understanding standard precautions and their effectiveness leads to mastery of their application and should allow healthcare personnel to provide calm and confident care to patients, regardless of the infectious agent identified [4].

In Benin, the overall compliance rate was lower than that observed in our study (31.7%); adherence to the five critical moments of hand hygiene according to the WHO was found to be low. Compliance was 21.4% before contact with a patient, 28.8% before aseptic procedure, 26.8% after potential exposure to bodily fluids, 27.1% after contact with a patient, and 53.2% after contact with a patient's environment [17].

Observance of barrier measures "regular hand washing with soap and water" during the COVID-19 epidemic period was higher in Côte d'Ivoire (98%) than that found in our study [16].

Different results from ours were also observed in Likasi, DRC, with 76.5% compliance for hand hygiene, of which hydroalcoholic gel accounted for 71.1%. Other measures had lower compliance, notably greeting without shaking hands (51%), social distancing at least one meter (42%) and correct wearing of face coverings (31.1%) [18].

A similar compliance rate to ours was reported in a study conducted in Lubumbashi, which observed that the surveyed health facilities (private or public) lacked adequate handwashing equipment; 62.8% of public hospitals did not have water taps in the wards, compared to 29.5% in private hospitals. Public facilities (45.4%) lacked sinks near the point of care, compared to 13.9% in private facilities [11].

The systematic observance of barrier gestures and social distancing measures has evolved over time. The perceived effectiveness of the measures was associated (positively) with observance only during epidemic waves, the level of depression only in the 1st epidemic wave (negatively) [6].

The results of a study on the perception and compliance of protective measures in the context of the Covid-19 pandemic had shown that, despite good knowledge of the protective role of surgical masks, goggles and gloves, these Personal protective equipment (PPE) were only partially available, which could affect compliance with barrier measures [18].

Responsible institutional policies that take into account training, awareness, provision of PPE and consumables are needed to improve compliance with barrier measures.

Analysis of factors associated with good knowledge and proper adherence to barrier measures

Analysis of factors associated with knowledge and adherence to barrier measures showed a significant association with the professional categories of physicians, midwives, and nurses; doctoral and graduate qualifications; and on-the-job training (OR = 6.1, 95% CI: 3.2-11.5 and OR = 4.9, 95% CI: 2.6-9.6, respectively, for good knowledge and adherence). Budget availability for purchasing supplies was also significantly associated with good knowledge of barrier measures (OR = 1.81, 95% CI: 1.01-3.3).

Occupational categories and sectors of activity were reported in another study as factors associated with higher adherence rates among physicians and managers (78%) than among nursing assistants and hospital service workers. These results are consistent with ours [19].

In Cyprus, similar observations were reported where doctors had a better compliance rate, regardless of the type of contact with patients. The main obstacles identified were the heavy workload, the lack of infrastructure (e.g., lack of water, soap, hand sanitizer and clogged/leaking sinks) and the poor location of facilities [20].

The factors associated with adherence found in this study are consistent with the findings of some studies conducted elsewhere. However, some factors identified elsewhere, such as heavy workload, infrastructure deficit, and poor facility location, are also more common in developing countries [20].

Contrary to our findings, the results of a study conducted in the Democratic Republic of Congo's general hospitals in Kisangani showed higher adherence among cleaning staff (49%) and doctors (44%) than among nurses (33%). This discrepancy is somewhat contradictory to the results of that study. Other underlying factors could be investigated, including the level of training of cleaning staff, motivational factors, etc.

About one third of professionals knew the indications for hand hygiene according to the WHO, and 36% knew its importance, with no significant difference between professional categories [12].

Apart from the qualification, cleaning technicians are constantly exposed to handling soiled objects, which motivates them to observe barrier measures to protect themselves.

Similar results were obtained from a study conducted in the Republic of Korea, where the reported compliance rate was highest in the group of nurses, followed by other healthcare professionals and physicians. Scores relating to knowledge, attitudes, and behaviors regarding hand hygiene were highest in the group of nurses [21].

The level of knowledge and compliance with barrier measures were presented together with the same associated factors, which makes sense as these two variables go hand in hand, but knowledge precedes compliance.

More qualified staff (physicians, licensed or graduate) receive a significant amount of information on universal precautionary measures as part of their basic training, compared to less qualified or underqualified staff. On-the-job training and professional incentive

mechanisms (supervision, availability of PPE and appropriate resources) can address this deficiency.

Despite their justified value and contribution to improving the quality of care, Standard precautions (SP) often remain poorly understood and poorly implemented in hospitals. Their implementation, however, requires that resources be available, that indications and practical procedures be defined, and that staff be trained and made aware of the value and necessity of applying SP in healthcare settings. This approach can only succeed if valid information is available on the knowledge, attitudes, and practices of healthcare staff regarding Standard precautions [10].

Limitations of the Study

Assessing adherence to preventative measures through questionnaires is subject to classification bias, as some respondents may overestimate their compliance with these measures while others may be more critical of their practices. Levels of knowledge and intuition can influence responses to questions, without the possibility of verifying the accuracy of self-reported behavior.

Causal inference through cross-sectional studies is also a limitation.

Also, the exclusion of the commune of Lubunga for accessibility reasons may limit the generalization of data to the whole city of Kisangani.

Conclusion

Knowledge and adherence to barrier measures are fairly good in healthcare facilities in the city of Kisangani. The qualifications and training of healthcare providers are key to ensuring good knowledge and adherence to these measures. Institutional policies for continuous capacity building, awareness-raising, and the provision of Personal protective equipment (PPE) are needed to improve knowledge and practices of infection prevention through adherence to barrier measures.

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