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Risk Factors Associated with Nosocomial Infections in The City of Goma (Case of CBCA-Virunga and Maternal Charity in the DRC)

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ABSTRACT

Introduction: *The objective of this study was to identify the risk factors associated with nosocomial infections among healthcare personnel, the hospital environment and also determine the PCI Card score in each general reference hospital targeted by this survey: CBCA-Virunga and Charité maternelle.*

Materials and Methods: *We conducted an evaluative and analytical survey based on direct and participatory observation in two reference hospitals in the City of Goma, from July 27, 2024 to August 12, 2024. The study focused on a staff of 342 agents considered as a sampling frame from which we drew 148 respondents retained as a sample after using the Lynch formula to determine this size, (n = NZ2. P. Q / Nd2 + Z2. PQ). The subjects were selected by simple random sampling among the nursing staff and technical staff of different departments including surgery, gynecology-obstetrics, internal medicine, pediatrics, neonatology, resuscitation, laundry, laboratory, pharmacy and the administrative department.*

To collect the data, we formed a mixed team consisting of two delegates from the hospital concerned and two trainee doctors from the last year of medical studies (4th doctorate) in each hospital. As a tool, we used a survey questionnaire developed on the basis of the PCI score card covering the 8 multimodal components, namely: 1. the strategy for the prevention and control of infections in the Fosa; 2. Standard operating procedures on PCI (SOP), 3. Education and training of staff in PCI, 4. Surveillance of healthcare-associated infections (HAIs), 5. Multimodal strategies for the implementation of PCI interventions, 6. Monitoring and restitution of PCI audits, 7. Workload, staffing and occupancy of beds, 8. Built hospital environment and PCI equipment within the structure.

Results: *After investigation, 5 risk factors were identified in these two hospitals, namely: 3 factors linked to the hospital environment and 2 factors linked to the nursing and technical staff.*

a) Factors related to the hospital environment: 1. Absence or non-functionality of the triage department and the bacteriology department. 2. Insufficient drinking water not meeting the daily needs of patients/bed, i.e. an average consumption of 60 to 80 liters/bed/day, compared to 500 to 600 liters of water/bed/day recommended by WHO standards. 3. Absence of a wastewater management circuit from hospitalization services (no purification system or wastewater treatment), b). Factors related to the nursing staff: 4. Absence of a committee for the diagnosis and monitoring of NI (nosocomial infections). 5. Poor knowledge, attitudes and practices of healthcare staff and in PCI: lack of risk assessment, use of venous catheters beyond 72 hours, use of antibiotics beyond 7 days without antibiogram, irregularity of hand hygiene before and after administration of care. (The odds ratio of the assessment score: RE (Assessment Risk) = 1.7 [95% CI; [1.3-8.9].

After evaluating the infection prevention and control (IPC) score card, in these hospitals, the results were as follows: HGR CBCA-Virunga: 61.2% and HGR Maternal Charity: 65%. That is an average of 63.1%. This study identified overall; progress in terms of improving infrastructure, hospitalization conditions for patients and electrical energy. [Adjusted odds ratio=2.8, 95% CI: 1.6-4.2].

***Conclusion:** The absence of a committee for diagnosis and epidemiological surveillance of nosocomial infections in hospitals and the non-existence of provincial and national coordination for the fight against nosocomial infections in the health system in the DRC, favors the high prevalence of these infections in hospitals according to our study.*

Keywords
Risk factors, Nosocomial infection.

Introduction
Nosocomial or hospital infection constitutes a public health problem due to its frequency and its impact on the patient's health and economy. It is defined as an infection acquired in hospital whose clinical manifestations usually appear after the 48th hour of hospitalization and can even occur 30 days after discharge during a surgical procedure [1].

Advances in medicine, particularly the use of antibiotics and diagnostic or therapeutic techniques, have modified the microbiological and clinical expression of these infections. Unfortunately, multi-resistant bacterial strains and new types of microorganisms have appeared, especially in immunocompromised patients with significant risk factors requiring constant updating of preventive measures [2].

In recent years, the prophylaxis of hospital infections has been developed under the impetus of the Center of Disease Control (CDC) in Atlanta (USA). Prevention protocols have been proposed concerning patient care, isolation and sterilization techniques. The effectiveness of these protocols is only real if all the medical and paramedical staff have solid knowledge in PCI. Also, the fight against hospital infection cannot be dissociated from the problems of training and information of the medical and technical staff [3].

In the United States, the National Nosocomial Infection Study (NNIS) estimates that 3 to 5% of hospitalized patients acquire a nosocomial infection in intensive care units. In Canada in 2018, hospital-acquired infection affected 8% of patients. The overall incidence of infections in intensive care units was 9.2% [4].

In Africa, the study of Thaïs ADRENA ABEGHE shows that the high prevalence of nosocomial infections is often linked to several risk factors consisting of two origins: the origin **endogenous** comprising the saprophytic flora of the patient which undergoes qualitative changes during hospitalization. These changes are due to the hospital environment and certain practices of the nursing staff during treatment with antibiotics and immunosuppressants. The bacteria present in the normal flora cause infections if relocated to sites other than their natural habitat [5].

The exogenous origin:
Flora from another patient, staff member or companion: Contamination can occur through healthcare staff who transmit their germs to the patient or transmit the germs of another patient with their contaminated instruments or hands [5].

One of the main causes of hospital-related infection is the transmission of germs on the hands to patients: this is called cross-transmission. These infectious agents can be carried by healthcare workers and come from an initial contamination caused by caring for other patients or by any other person working in the hospital. All hospital staff are concerned, including visitors and family, and represent a population at risk for the patient. The quantity of germs present on the hands is greater at the level of the nails and the risk of transmission increases with the duration of care or diagnostic procedures [6].

The Flora Present in the Care Environment
Common use of air and water in hospitals is also the cause of many nosocomial infections. Air can indeed carry many microorganisms [7].

In the Democratic Republic of Congo, some studies have been conducted on the risk factors associated with nosocomial infections. This is the case of the study by Jean Christophe Bukassa, his study focused on the risk factors identified in the maternity ward in Mbujimayi. He showed 4 risk factors including: instrumental maneuvers, emergency caesarean section, the use of the same eye drops in all children and the raising of premature babies outside the incubator [8].

In North Kivu, in the city of Goma, our first study dealt with the prevalence of nosocomial infections and the factors that promote them among patients and placed particular emphasis on endogenous factors such as the patient's state of health, the patient's hand hygiene, the patient's nutritional status and the length of his hospitalization but did not mention the risk factors associated with nosocomial infections among healthcare personnel and the patient's hospital environment, while there is no other study in this area [8]. It is in this context that we initiated this study to complete the previous one by identifying the risk factors associated with NI in healthcare staff and the patient's hospital environment based on the 8 multimodal components of the PCI score card in these hospitals and the risk categorization.

Materials and Methods

Framework, type of Study and Period

This is an evaluative and analytical survey based on direct and participatory observation carried out from August 27, 2024 to September 12, 2024 in two general reference hospitals in Goma, in the province of North Kivu in the Democratic Republic of Congo.

Study Population and Sample Size

The study focused on the entire staff of two targeted hospitals estimated at 342 agents who were considered as a sampling frame, in which we drew a sample of 148 respondents after using the Lynch formula (n = NZ2. P. Q / Nd2 + Z2. PQ). of which n = sample size, p = supposed proportion of the target population, its value is 50% or 0.5. N = total population size or target population, Z = coefficient corresponding to the confidence interval 1.96 or 95%, Q = complementary probability or quotient = 1-P = 0.5, d = acceptable margin of error to confirm our study, it was 5% or 0.05.

Sampling

Subjects were selected by simple random sampling among nursing staff, cleaning technicians from different departments and administrative staff of these two hospitals.

Inclusion Criteria

-Be an agent of one of these two targeted hospitals CBCA – Virunga or Charité maternelle

-Freely consent to participate in the survey

Exclusion Criteria

Patients and hospital visitors were not considered in this study.

Limit of the Study

This study did not consider the consequences related to nosocomial infections in patients, nor did it develop an operational improvement plan (OIP) as they are part of the strategies implemented to reduce the prevalence of nosocomial infections in these hospitals. These two aspects are the subject of other studies in the following.

Data Collection

To collect the data, we formed, trained and led a mixed team of 2 delegates from each hospital and two trainee doctors from the final year of medical studies (4th doctorate).

We used as a tool a survey questionnaire developed on the basis of the 8 components of the PCI score card. (Prevention and control of infections) version 2022 validated by the Ministry of Public Health of the DRC in collaboration with the WHO. Tools used to assess the level of hygiene, prevention and control of infections in health facilities of the 1st and 2nd level (general reference hospitals and hospitals). The 8 multimodal components of the PCI considered are:

1. The strategy used by the Fosa for the prevention and control of infections: here we considered the following elements: the existence of a functional hygiene committee in the Fosa and an experienced PCI focal point dedicated solely to infection prevention and control activities.
2. PCI Standard Operating Procedures (SOPs): We have:
   - Verified the existence of a functional triage service for PCI in the fosa.
   - Checked the existence of PCI posters throughout the different departments of the hospital.
   - Verified the existence of regulatory texts and standard guidelines in PCI and their implementation in the Fosa
3. Staff education and training in PCI, we checked the knowledge, attitudes and practices of staff in relation to PCI. (Regular hand hygiene, correct use of personal equipment (in particular see if staff wear well-buttoned gowns, boots without holes and m asks in high-risk areas), management of venous catheters and waste management).
4. Surveillance of healthcare-associated infections (HAIs), we checked whether there is a diagnostic and epidemiological surveillance service for nosocomial infections in the Fosa, but also a functional bacteriology service to carry out the various bacteriological cultures with antibiogram.
5. Multimodal strategies for the implementation of PCI interventions, we checked whether the Fosa regularly reports the results and recommendations received in PCI to its staff and the way of communicating within the structure.
6. Monitoring and restitution of PCI audits, we verified the execution of different recommendations made by the supervisors of the DPS and the Health Zone in relation to the PCI and the recommendations of other researchers who carry out work in the Fosa.
7. Workload, staffing and bed occupancy. We checked: the professional ratio of staff to the population that the Fosa must serve. Also the occupancy rate of patients in relation to the number of beds. We were also interested in the spacing of beds from one patient to another (if the spacing between beds complies with WHO standards, at least 1 meter).
8. Built hospital environment and PCI equipment within the structure. We checked the amount of water served per bed per day against WHO standards. Permanent energy availability and the quantity of PCI inputs. But also the condition of the bed linen and mattresses.

Statistical Analysis

Data entry and processing were performed using STATA Version 16 software. Descriptive analysis was performed by calculating proportions and percentages for qualitative variables and calculating means and standard deviations for quantitative variables. We used the independent t-test or one-way analysis of variance ANOVA I, to compare card scores between the two hospitals. The correlation coefficient was used to assess the relationship between the EPKQ scores and certain variables found according to the different multimodal components of the score card evaluated. The confidence level was set at $p < 0.05$.

Ethical Consideration

This study was authorized by the Ethics Committee of the University of Goma No. UNIGOM / CEM / 12 / 2023 and the Provincial Health Division of North Kivu. Free and informed consent from the management committee of each hospital was obtained in writing and orally for each survey participant. During data collection, personal identifiers such as names and contacts were not recorded.

Results

In our study, 148 subjects were surveyed out of the 342 agents constituting the sampling base in these two hospitals. That is 40.8% of the agents who constituted the sample. By considering the 8 multimodal components of the PCI score card to determine the risk factors associated with nosocomial infections, we noted 4 strong points and 5 weak points considered as risk factors in these hospitals that we present in tables 2 and 3.

Description of the Sample

Table 1: Sociodemographic characteristics of respondents.

HGR	CBCA-Virunga	Maternal charity	Total	Raw gold	95% CI	p-value
Variable	**n= 82**	**n=66**	**148**			
Age (years)						
18 - 35 years old	32 (39%)	26 (39.1%)	58 (39.1%)	1, 16	0.99 – 1.35	0.095
36-50 years old	26 (31.7%)	21 (31.8%)	47 (31.7%)	2.18	1.84- 2.58	< 0.001
51-65 years old	21 (25.6%)	17 (25.6%)	38 (17.1%)	6.86	5.25- 8.97	< 0.001
66 and over	3 (3.6%)	2 (3%)	5 (3.3%)	1.00	-	-
Sex						
Female	31 (37.8%)	22(33.3)	53 (35.8%)	**1**,00	-	-
Male	51 (62.2%)	40 (60.6%)	97(65.5%)	**1.16**	0.98- 1.35	< 0.001
Marital status						
Bachelor	11 (13.4%)	14 (21.2%)	25 (16.8%)	1.86	1.57- 2.22	**< 0.001**
Bride)	63 (76.6%)	38 (57.5%)	101 (68.2%)	1.00	-	-
Divorce	0(0%)	0 (0 %)	0 (0%)	1.61	0.89- 2.87	**< 0.001**
Widower(s)	8 (9.7%)	10 (15.1%)	18 (12.1%)	4.55	2.12- 4.03	**< 0.001**
Level of education						
Primary	12(14.6%)	9 (13.6%)	21 (14.1%)	0.97	0.55- 1.11	**< 0.001**
Secondary	31(37.8%)	17 (20.7%)	48 (32.4%)	1.00	-	-
Higher/university	37(45.1%)	35 (53%)	72 (48.6%)	0.94	0.67- 1.24	**< 0.001**
Post university	2 (2.4%)	5 (7.5%)	7 (4.7%)	0.88	0.94- 1.57	**< 0.001**
Professional occupation						
Doctors	5 (6%)	3(4.5%)	8 (5.4%)	0.87	0.68- 1.34	**< 0.001**
Paramedical	37 (45.1%)	38(57.5%)	75 (50.6%)	1.00	-	-
Administrative	6 (7.3%)	4 (6%)	10 (6.7%)	1.87	2.46 – 3.77	**< 0.001**
Surface technicians	34 (41.4%)	17(25.7%)	51 (34.4%)			

Table 2: Strengths according to the multimodal components of the PCI Score card according to the respondents.

Variables / HGR	CBCA-Virunga n= 82	Maternity Charity. n= 66	Total n= 148	GOLD	95% CI	P-Value
1. Existence of a strategy used by the Fosa for the prevention and control of infections such as - a hygiene committee in the Fosa, a budget allocated to PCI activities and an experienced PCI focal point dedicated solely to infection prevention and control activities:						
Yes	64 (78%)	57 (86.3%)	121 (81.7%)	1, 17	0.96 – 1.34	< 0.001
No	18 (22%)	9 (13.7%)	27(19.3%)	1, 68	0.93- 1.49	< 0.001

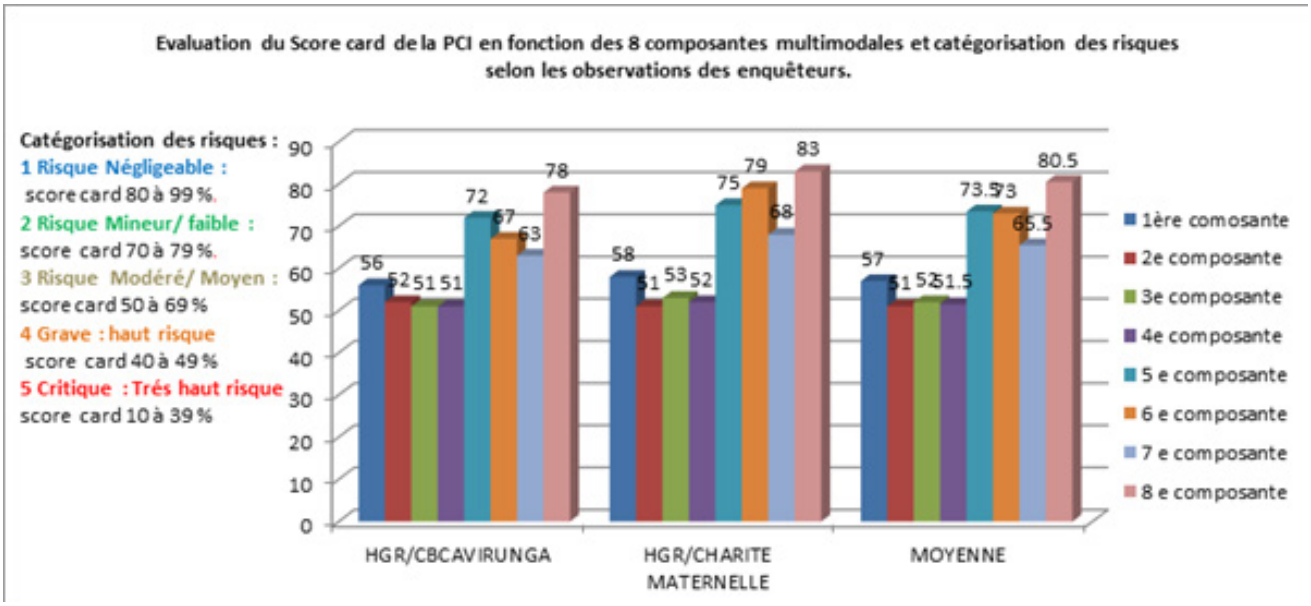
2. Existence of multimodal strategies for the implementation of infection prevention and control (IPC) interventions: Evaluation of the means put in place for IPC and IPC inputs (hand washing devices, soaps, personal protective equipment, etc.)						
Yes	78 (95.1%)	64 (96.9)	142 (95.9%)	1.98	0.87- 1.22	< 0.001
No	4 (4.9%)	2(3.1%)	6 (4.1%)	1.89	0.98- 2.03	< 0.001
3. Existence of monitoring and feedback to staff of PCI audits and recommendations for PCI supervisions organized by the Health Zone, the DPS. Or other researchers.						
Yes	80 (97.5%)	63 (95.4%)	143 (96.6%)	2.45	1.26 – 2.01	< 0.001
No	2 (2.5%)	3 (4.6%)	5 (3.4%)	2.76	3.65 – 4.01	< 0.001
4. Built hospital environment and PCI equipment within the structure: permanent availability of energy. But also the state of the bed linen, mattresses and the conditions of hospitalization of patients if appreciable: see the space occupied by the patient if compliance with WHO standards.						
Yes	67 (81.7%)	57 (69.5%)	124 (87.3%)	2.13	1.81- 2.65	< 0.001
No	15 (18.3%)	9 (30.5%)	24 (12.7%)	1.98	1.63- 2.05	< 0.001

Table 3: Risk factors observed according to the multimodal components of the PCI Score card according to the respondents.

Variables / HGR	CBCA-Virunga n= 82	Maternal Charity n= 66	Total or Average n= 148	GOLD	95% CI	P-value
1. absence and/or non-functional triage service (no agent assigned to triage for temperature screening of any person entering the hospital in order to detect a contagious disease in time and isolate the patient in a dedicated area for this purpose if necessary. no systematic hand hygiene for any person entering the hospital.)						
No	32(39.1%)	24 (36.3%)	56 (37.8%)	1.77	0.97- 1.21	< 0.001
Yes	50 (60.9%)	42(-63.7%)	92 (62.2%)	1.92	1.65- 2.01	< 0.001
2. low knowledge, attitudes and practices of healthcare staff in relation to PCI (: no regular hand hygiene respecting the 11 WHO steps in the case of using soap and water and the 8 steps, if hydroalcoholic hand friction before and after providing care to patients. Sometimes working without a gown or wearing unbuttoned gowns, wearing boots with holes, incorrect use of masks in areas at high risk of infection (chin-cash mask instead of nose-cash), incorrect removal of gloves with splashes, use of venous catheters for more than 72 hours, use of antibiotics for more than 8 days without a brief antibiogram, lack of mastery of standard precautions and additional precautions of the WHO and no risk assessment before and after care.						
No	34 (41.4%)	26 (39.3%)	60(40.5%)	1.09	1.13 – 1.89	< 0.001
Yes	48 (58.6%)	40 (60.7%)	88 (59.6%)	2, 7	1.97- 2.72	< 0.001
4. Absence of a nosocomial infection surveillance committee (NI), i.e. a diagnostic and epidemiological surveillance service for nosocomial infections, monitoring of antibiotic prescriptions with antibiogram, monitoring of invasive procedures performed by staff and their duration in the patient's body: case of central catheters and probes, etc.						
No	33 (40.2%)	24 (36.3%)	57(38.5%)	2.75	1;98- 2.34	< 0.001
Yes	49 (59.8%)	42 (63.7%)	91(61.5%)	1.89	0.75- 1.99	< 0.001
4. insufficient drinking water in the health center which does not adequately meet the daily needs per patient bed according to the WHO standard (500 to 600 liters/bed/day).	'40 to 60 liters/bed/ day	60 to 80 liters/bed/ day	50 to 70 liters per bed per day			
5. Absence of a wastewater management circuit from hospital services in the fosa, i.e. no wastewater pipeline, no treatment plants or treatment of this wastewater according to WHO standards.						
No	1(1.21%)	3 (4.6%)	4 (2.8)	1.37	1.87- 2.05	< 0.001
Yes	81(98.8%)	63(95.4%)	144(97.2%)	1.2	0.98- 1.99	< 0.001

Table 4: Evaluation of the PCI Scorecard based on the 8 multimodal components and risk categorization according to investigators' observations.

Variables / HGR	CBCA-Virunga / 100	Maternal Charity / 100	Total /200	Average / 100	Categorization of risk
1st component: In relation to the Standard Operating Procedures on PCI (PCI program operational in the fosa)	56	58	114	57	Medium risk
2nd component: Related to the existence of a functional triage service and the applicability of PCI guidelines	52	51	102	51	Medium risk
3rd component: Related to education and continuing training of staff in PCI	51	53	104	52	Medium risk
4th component: In relation to the monitoring of healthcare-associated infections (HAIs) in the structure, the existence of a functional bacteriology service and the prescription of antibiotics based on the antibiogram	51	52	103	51.5	Medium risk
5th component: Related to the application of multimodal strategies in the fosa	72	75	147	73.5	Low risk
6th component: In relation to the monitoring and restitution of audits on PCI practices	67	79	146	73	Low risk
7th component: Related to workload, staffing and bed occupancy	63	68	131	65.5	Medium risk
8th component: Concerning the built environment, material, and equipment for PCI in the fosa: sufficient presence of energy	78	83	161	80.5	Low risk
PCI Score Card Total / 800	490 (61.2%)	520 (65%)	1010 /1600	505 (63.1%)	Medium risk
Total score (range) and risk categorization			PCI Level		
0 – 200 (0 to 25%): very high risk			Poor		
201 – 400 (26 to 50%): high risk			Basic		
401 – 600 (51 to 75%): medium risk			Acceptable		
601 – 800 (76 to 100%): low risk			Advance		



Discussion

To assess the risk factors associated with nosocomial infections in the two targeted hospitals in the City of Goma, CBCA-Virunga and Charité maternelle, we used the PCI Version 2022 Card score. This tool helped us develop our survey questionnaire, which we submitted to a sample of 148 respondents randomly selected in the two hospitals after using the Lynch formula on a survey base of 342 agents constituting the entire staff of these two hospitals. In relation to the socio-demographic characteristics of the respondents: The mean age of the respondents was 41 years, standard deviation 22.4 and the median 42 years, the upper age was 66 years and the lower age was 18 years. The sex ratio M/F was 1.2. The mean duration of employment was 24 years and the maximum 48 years. The surface technicians were the agents most exposed to the risk factors associated with nosocomial infections than the other members of the staff.

During this assessment:

A) The identified strengths are:

1. The existence of a hygiene committee and a PCI focal point in these fosa affirmed by 121 out of 148 respondents or 81.7%, see table 2. This is a constituent element of a good strategy to promote hospital hygiene and the fight against nosocomial infections. WHO reports in the 1st multimodal component of the PCI score

cardthat a functional hygiene committee is the one that evaluates the progress of the PCI in the structure and holds regular weekly meetings with the staff of each department in the fosa. The hygiene committee includes: a sanitation technician, members of different departments and corporations (nurses, doctors, physiotherapists, pharmacists, laboratory technicians, administrators, incineration operators), advisory members: the medical director, the managing administrator and the director of nursing [9].

2. The implementation of PCI interventions requires dedicated and conscientious staff for the cause. Both HGRs have PCI focal points who take care of their tasks. However, we found that most of the staff in charge of PCI did not have the skills required to diagnose nosocomial infections, especially since they are surface technicians or rural development technicians trained in PCI/Wash (water, hygiene and sanitation) and are not doctors or nurses to make a diagnosis. According to the PCI Card score version WHO 2022, PCI personnel must be health personnel trained in epidemiology or infectiology, capable of diagnosing nosocomial infections, monitoring antibiotic prescriptions. They must also be able to train other PCI staff members on standard precautions, additional precautions and risk assessment [9].

3. For the Monitoring and restitution to staff of PCI audits, 143 out of 148 or 96.6% cfr. Table 2 affirmed that the fosa flawlessly execute the various recommendations made by the supervisors of the DPS and the Health Zone in relation to PCI. They have certain tools on the PCI guidelines. By comparing their tools with the Bundles, which the WHO speaks of in 2019: as a set of practices based on scientific evidence focused on the structured improvement of the care process. For example, improving catheter insertion. Bundles are tools that can be used to facilitate the implementation of PCI measures, ideally in the context of multimodal strategies which are a much more global approach. Our survey found that these statements are correct because we saw that the fosa hold texts from the Ministry of Health in line with those of the WHO [10].

4. Regarding the built hospital environment component and PCI equipment within the structure, 124 out of 148 or 87.3% accepted that their structure contains good patient reception infrastructure. Also in our observations, our study found that these hospitals contain hospitalization infrastructure of single rooms of 4m by 2.5m or 10 m square with hydro-sanitary installations of approximately 1.80 m by 1m for most hospitalization services. These infrastructures meet PCI standards, although slightly lower than the WHO standards which recommend that a single room should occupy a space of 4m long by 3m wide or 12 m square with hygienic installation of 2 m by 1.5m and common rooms 6m by 4 m for 2 beds. These dimensions ensure good spacing between beds and facilitate the movement of nursing staff, as well as access to medical equipment.

B) Identified risk factors. 5 risk factors have been identified, namely:

1) The absence or non-functionality of the sorting service: 92 out of 148 or 62.2% in Table 3, state that their triage service exists only in name and patients go immediately to the emergency department or reception. During our study, we found that the triage service is confused with the reception service. A non-functional triage is like a house without a door., the entry of a community infection into the hospital is very easy because it is not controlled. Functional triage plays a role in primary prevention as a sentinel. Compared to the PCI Card score, WHO recommends that each fosa have a functional triage service that must have at least one agent designated for this operation, with an isolation area adjacent to this triage station. This transitional isolation area is separated from other patient care areas. The walls and floor of the triage and the isolation area are easily cleanable and there is a device in the isolation area for collecting vomit, stools, urine and trash [10].
2) The 2nd risk factor identified was the insufficient quantity of drinking water not meeting the daily needs per patient bed. The results of the survey found that the quantity of water consumed per bed per day is as follows: '40 to 60 liters/bed/day for HGR Virunga and 80 to 100 liters/bed/day for Charité maternelle. The average being 60 to 80 liters/bed/day cfr table 3. However, this quantity remains insufficient compared to the daily needs of the patient bed recommended by the WHO standard, i.e. 500 liters to 600 liters/bed/day for a HGR and in an emergency situation, 60 to 100 liters of water/bed/day.

WHO and UNICEF, in a study of 129,557 health facilities carried out in 78 countries in 2021 on the consequences of the lack of water, hygiene and sanitation in health care structures: status and perspectives in low- and middle-income countries. This study showed that 1/5 of health facilities did not have improved water sanitation facilities. The study recommended that by 2030, each health facility should have reliable and well-managed facilities with sufficient safe access to drinking water, hygiene and sanitation to achieve universal coverage of drinking water in each health facility by 2030 in order to combat waterborne nosocomial infections. This survey further adds that 3 babies die every 5 minutes from preventable diseases such as diarrhea, septicemia, meningitis, or tetanus in sub-Saharan Africa in hospital due to lack of hygiene. 35% of health centers do not have soap for hand washing. Babies born in hospitals with low water resources are 20 times more likely to contract septicemia at birth [11].

The study by the Ministry of Public Health of Côte d'Ivoire in 2020 recommends the consumption of 750 to 1200 liters of water/bed/day to combat HIV [12]. Subject to judgment, we find that almost both studies show the importance of a fairly considerable quantity of drinking water in a care facility for the daily needs of patients and their companions.

3) Regarding the 3rd and 4th risk factors identified, our study found that these factors are related to the low knowledge, attitudes and practices of healthcare staff regarding the prevention and

control of nosocomial infection. 88 respondents out of 148 or 59.6% stated that healthcare staff have low knowledge about PCI. Our study found that healthcare staff washed their hands only at the beginning and end of care for all patients. This practice can easily promote cross-infection. Also, they wore unbuttoned blouses, bracelets, watches, and hung up the phones in the middle of care service, holey boots, removal of gloves without precautions against droplets and other agents entered high-risk contamination areas without protective masks. On the other hand, others wore cash-chin masks and not cash-nose masks. In short, there was no concept of risk assessment.

The use of venous catheters in the patient's body lasted more than 72 hours, the use of antibiotics more than 8 days without antibiogram. The WHO, in its survey of nosocomial infections in 40 African countries in 2022, reports that all hospital staff must respect, in addition to standard precautions, additional precautions and know how to assess the risks of contamination [13].

Our study is almost similar to that of Thaïs ADRENA ABEGHE, in BAMAKO 2020, which highlights that nosocomial infections have two origins: intrinsic and extrinsic and shows that extrinsic risk factors often take first place in triggering nosocomial infections [14].

4) Regarding the 5th risk factor: 144 out of 148 or 97.2% acknowledge that there is no wastewater management circuit in their hospitals. Also, our observation noted the alack of a wastewater management system in these fosa and found that in both fosa, there was no wastewater pipeline system or treatment plants and the discharge of wastewater into the environment without any prior treatment.

The study by López-Vélez R, & Zubizarreta I, in 2021, reports that wastewater from healthcare services contains microorganisms responsible for nosocomial infections such as:

1. Klebsiella pneumoniae, often associated with pneumonia and urinary tract infections.
2. Escherichia coli, responsible for urinary, gastrointestinal, and sometimes blood infections.
3. Pseudomonas aeruginosa, frequently involved in respiratory infections and wound infections.
4. Staphylococcus aureus, can cause skin and systemic infections, including methicillin-resistant Staphylococcus aureus (MRSA) infections.
5. Acinetobacter baumannii, linked to serious infections, particularly in intensive care units [15,16].

In view of the above, we found that the prevalence of IN is often higher in developing countries than in developed countries due to uncontrolled risk factors. This is the case in France with an average prevalence of 7% and in the United States 5% which have set up committees to combat nosocomial infections in each fosa. In the city of Goma, the prevalence is 16.2%. While in developing countries the prevalence is very high.

With all reservations of direct comparison between previous studies conducted by other researchers such as the Bukassa study in Mbujimayi on the prevalence and risk factors for nosocomial infections found in women who have given birth and newborns in maternity wards, but also the study by Khalladi R et al. which dealt with the risk factors and mortality associated with nosocomial infections in an intensive care unit at HELMI, also given the differences in methodological and temporal approaches, our results on risk factors deviate from theirs. These differences mainly concern the criteria, the method of data collection, the type of sample and the method used in drawing the sample but also our assessment tool which was developed on the basis of the PCI score card. standard precautions, additional precautions and risk assessment are the risk factors most associated with nosocomial infections. (95% CI) 2.3 [1.93-4.27].

On the other hand, the PCI score card evaluated in these hospitals shows that the level of control against nosocomial infection is average 62.3%), much effort remains to be made to fight against NI in these hospitals as in other hospitals in the country. The level of risk of contamination is still high. WHO reports in its institutional risk register that the assessment and categorization of risks in PCI is as follows:

1. Score card: 80 to 99%: negligible risk
2. Score card: 70 to 79%: minor/low risk
3. Score card: 50 to 69%: average/moderate
4. Score card: 40 to 49%: high risk/serious
5. Score card: 10 to 39%: very serious/Critical

Conclusion

To assess the risk factors associated with nosocomial infections in two general reference hospitals in the city of Goma, CBCA-Virunga and Charité maternelle, we developed a survey questionnaire based on the 8 multimodal components of the PCI score card. Thus, 5 risk factors were identified during our study, namely: insufficient drinking water in these fosa, poor knowledge, attitudes and practices of healthcare staff in PCI, poor wastewater management, the absence of a diagnostic and epidemiological surveillance service for nosocomial infections and the absence of functional triage.

Current State of Knowledge on the Subject

In the DRC, in Africa and in the world, the risk factors associated with nosocomial infections come essentially from two origins: endogenous (the patient himself) and exogenous (the healthcare staff, the hospital environment, visitors and those accompanying the patient).

Contribution of Our Study to Scientific Knowledge

Our study provides an evaluative approach to nosocomial infections in the fosa of North Kivu based on the 8 multimodal components of the PCI score card, the quantification of water needs per patient bed in accordance with the WHO standard, the assessment of risks related to wastewater and the categorization of risks in the fosa in terms of the fight against IN.

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