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Healthcare-Associated Bacteremia and Urinary Tract Infections in Wards A and B of Medicine Department, CNHU-HKM of Cotonou: Characteristics and Risk Factors

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Abstract

Introduction: Healthcare-associated infections are involved in hospital long-stay and in the increase in inherent costs to patients care. **Objectives**: Objective was to describe the characteristics of healthcare-associated bacteremia and urinary tract infections in medical wards of CNHU-HKM of Cotonou, describe the distribution of germs identified according to admission wards and identify factors associated with onset of healthcare-associated infections. **Materials and Methods**: It was a cohort study conducted from 4th April to 16th September 2016. The study population included patients admitted in wards A and B of CNHU-HKM Medicine department for at least the past 48 hours, or readmitted in one of the medical wards less than 14 days after their discharge from hospital. **Results**: The study included 825 patients in total. Prevalence of healthcare-associated infections was 9.8%. Bacteremia was the most represented group (65.4%). The most often identified germs regardless of the site were respectively: *K. pneumonia* (38.5%), *S. aureus* (23.1%) *and E. coli* (20.0%). HIV+ status, internal medicine department, nephrology and endocrinology, duration of admission and the use of urinary catheter represent factors statistically associated with the onset of healthcare-associated infections. **Conclusion**: Healthcare-associated infections are a real public health issue in CNHU-HKM Medicine Department. There is pressing need to conduct a study on clinical hygiene so as to assess healthcare staff in practice.

Keywords

Healthcare-Associated Infections, Bacteremia, Urinary Tract Infections,

Risk Factors

1. Introduction

Hospital-acquired infections or Healthcare-Associated Infections (HAI_s) are widespread in the world and affect both developed and low income countries [1]. They are responsible of 37,000 deaths per year [2], of the extension of hospital stay and increasing care-related expenses [3]. According to WHO in 2015, over 1.4 million people across the globe were affected by HAI [4]. According to European Center for Disease Prevention and Control (ECDC), the prevalence of HAI in Europe is 5.7% on average [5], whereas in France it was 5.3 in the year 2012 [6]. In India it was 26.1% in the year 2014 [7]. In Africa, according to WHO, HAI prevalence varies from 2.5% to 14.8% in 2011 [8]. Tunisia recorded 13.2% in 2010, Senegal 10.9% in 2008 and Mali 8.5% in 2011 [9] [10] [11].

In Benin, studies conducted at the National Teaching Hospital Hubert Koutoukou Maga (CNHU-HKM) estimated HAI prevalence at 6.3% in 2011 [12], and 9.8% in 2012 [13]. As these studies were primarily conducted in surgical units, emergency wards and neonatology department, they do not reflect the reality in medical wards and speciality services department. Another study conducted at the national level within 39 public and private hospitals with the exception of CNHU-HKM, revealed 19.1% prevalence in the year 2012.

In wards A and B of medicine department of CNHU-HKM, several cases of unexplained deaths in a context of fever occurred during admission were recorded in recent years. Strong suspicion of HAI led to bio cleaning of all admission wards. As this measure only had a provisional effect on the reduction of HAI cases, there was urgent need to develop an effective HAI prevention policy, the first step being an inventory of the situation. This study which is part of this quality approach, aims at the followings: Determine the characteristics of healthcare-associated bacteremia and urinary tract infections in wards A and B of CNHU-HKM Medicine department, describe the distribution of germs identified according to admission wards and identify factors associated with onset of healthcare-associated infections.

2. Material and Methods

It was a cohort study conducted from 4th April to 16th September 2016. The study population included patients admitted in wards A and B of CNHU-HKM. Medicine department during the study period. The respondents included patients admitted for at least the past 48 hours, or readmitted in one of the medical services less than 14 days after their discharge from hospital and who have given their informed consent. Patients who completed less than 48 hours of admission and those who received only outpatient care or had exclusively day hospital care (outpatient chemotherapy) were not included.

Wards A and B of Medicine department comprise six admission units including internal medicine, nephrology, neurology, endocrinology, rheumatology, and hepato-gastroenterology.

Healthcare-associated infection was defined as infections reported after 48 hours admission or within 14 days following discharge from hospital. Some terms related to HAI have been used as part of this study: Confirmed HAI (clinical sign(s) + microbiological confirmation); potential HAI (association of several clinical signs with no microbiological confirmation); less potential HAI (a single clinical sign with no microbiological confirmation); no potential HAI (no clinical signs).

Bacteremia was defined as germs presence in the vascular system confirmed through at least one positive hemoculture. However, hemoculture must be justified by clinical signs such as fever ($T \geq 38.5˚C$) or hypothermia ($t \leq 36.5˚C$), chills or hypotension.

Microbiological tests were carried out within the multi-purpose clinical biology laboratory of the national teaching hospital of pneumo-phtisiology.

In this study, we used as data sources: the medical records of patients for the collection of sociodemographic and clinical characteristics of the patients. Records and the database of bacteriology-virology laboratory have been used for the collection of the results of laboratory tests. Hospital records were used to calculate the number of patients in admission during the study period, and records of consultation to calculate the number of patients followed after leaving the hospital.

For the collection of data, a questionnaire was developed. It has two parts: A clinical part filled by ourselves or by the doctors in charge of the patients from the clinical assessment of patients, records of admission and consultation, and a biological part completed by ourselves to leave records and the database of the bacteriology-virology laboratory.

All patients who met the inclusion criteria were followed up during the admission and the post-hospital consultation, looking for signs that suspect a HAI. These signs were: hyperthermia (Temperature > 38˚C); Hypothermia (Temperature ≤ 36˚C); chills; urinary tract signs (or lumbar pain, suprapubic, dysuria, pollakiuria, IC-urgency, or urgent burns). When one or more of these signs was present, appropriate samples were taken. In case of urinary tract signs, the urines were collected for review urinalysis cytobacteriologique. In case of fever, chills, or hypothermia, samples of blood were taken. When the urinary tract signs were accompanied by fever, chills, or hypothermia, two samples (urine and blood for hemoculture) were jointly taken. The methodologyusedwassummarized in Figure 1.

The dependent variable was the occurrence of Healthcare-Associated Infections (urinary or bacteremia).

The independent variables were: socio-demographic (age, sex), duration of admission (duration of stay) calculated from the date of admission and the date

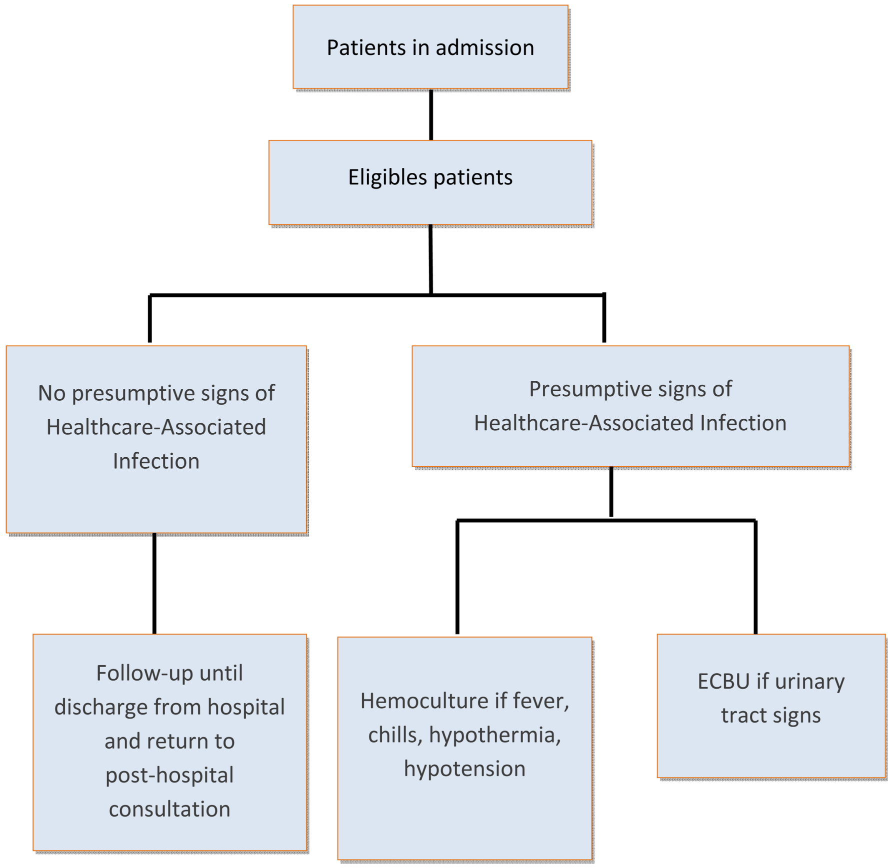

Figure 1. Diagram of the methodology used.

of release, the diagnosis made after admission (from theconclusions of the patient record), HIV status, antibiotics administered during admission, site of HAI, gateway germs, existence of invasive device (urinary catheter, venous catheter), sensitivity to antibiotics, the hospital where the patient is admitted, evolution of healthcare associated infection (death or healing).

Data entry was carried out through Epi-Data version 3.1. Data analysis was conducted through Epi-Data Analysis 2.2.2.182, R 3.2.2 and Open Epi (Open Source Epidemiologic Statistics for Public Health) 3.01. Continuous variables were expressed in form of mean values with their standard deviation, or medians with their interquartile ranges. Categorical variables were expressed in percentage. Inter-group unadjusted comparisons were carried out using chi^2 test, Exact Fisher test, and Wilcoxon and Kruskal-Wallis as the case may be. Significance threshold was 0.05.

3. Results

3.1. Patients General Characteristics

Globally, 825 patients were included in the study. Median age was 49 years with extreme values of 15 and 94 years. The most represented age group was 45 - 59 years (33.5%). Men were more represented: 422 men (53.6%) and 383 women

(46.4%), sex ratio was 1.1.

3.2. Prevalence of Healthcare-Associated Infections

Out of 825 patients included in the study, 208 (25.2%) presented one or several signs suggestive of HAI and they received microbiological tests. 9.8% ($IC_{95\%}$ 7.8% - 11.8%) were confirmed or potential HAI.

3.3. Patients Distribution According to Invasive Device

As part of patients care, invasive devices such as urinary catheters were sometimes used. Distribution of these invasive devices is highlighted in Table 1. Respondents had one or two invasive devices. Among them, 821 were using venous catheter and 109 bladder catheter.

825 patients who participated in the study had a catheter. Among them, 81 patients (9.9%) had a Healthcare-Associated Infections.

The second invasive device used was the urinary catheter and 19.3% of the patients with urinary catheter had a Healthcare-Associated Infections.

3.4. Types of Healthcare-Associated Infections

Bacteremia were the most frequent healthcare-associated infections as highlighted in Figure 2.

Table 1. Presence of infection according to the type of invasive device.

Invasive device	Healthcare-Associated Infections		Total
	Yes n (%)	No n (%)	
Venous catheter			
Yes	81 (9.9)	740 (90.1)	821
No	0 (.0)	4 (100.0)	4
Urinary catheter			
Yes	21 (19.3)	88 (80.7)	109
No	60 (8.4)	656 (91.6)	716

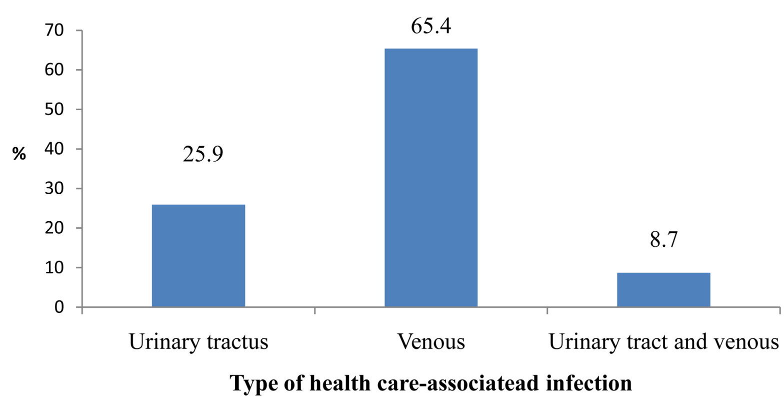

Figure 2. Patients distribution according to the type of healthcare-associated infections.

3.5. Germsidentified

Globally, germs most often identified irrespective of the site were respectively: *K. pneumonia* (38.5%), *S. aureus* (23.1%) *and E. coli* (20.0%) (Figure 3).

Germs were more often identified in blood than urine. The following germs were found in order of frequency in blood, *K. pneumonia*, *S aureus*, *E. coli and in urine*, *K. pneumonia*, *E. coli*, *S. aureus* (Table 2).

3.6. Frequency of Germs Identified According to Admission Ward

Frequency of germs identified according to admission ward is highlighted in Table 3.

K. pneumonia was predominant in internal medicine and *S. aureus* in nephrology.

3.7. Fatality of Healthcare-Associated Infection

Healthcare-associated infections are associated with significantly higher case fatality rate than other ailments. This case fatality rate is estimated 37.0% (Table 4).

Table 2. Distribution of different germs identified according to sample type.

	Sample	
	Urine n (%)	**Blood n (%)**
Klepsiellapneumonia	**8 (38.1)**	**23 (37.7)**
Staphylococcus aureus	**3 (14.2)**	**15 (24.6)**
Echericha coli	**8 (38.1)**	**12 (19.7)**
Pseudomonas aeruginosa	-	4 (6.5)
Acinetobacter SP	1 (4.8)	3 (4.9)
E. cloacae	1 (4.8)	2 (3.2)
Proteus mirabilis	-	1 (1.7)
Burkholderiacepacia	-	1 (1.7)
Total	21 (100.0)	61 (100.0)

Table 3. Distribution of germs identified according to admission ward.

	Internalmedicine n = 23 (%)	**Endocrinology n = 6 (%)**	**Nephrology n = 26 (%)**	**Neurology n = 9 (%)**
Klepsiella pneumonia	13 (56.5)	1 (16.7)	8 (30.8)	3 (33.3)
Echericha coli	3 (13.0)	1 (16.7)	5 (19.2)	3 (33.3)
Acinetobacter SP	2 (8.7)	1 (16.7)	1 (3.8)	---
E. cloacae	2 (8.7)	---	---	---
Staphylococcus aureus	2 (8.7)	1 (16.7)	10 (38.5)	2 (22.3)
Pseudomonas aerugino-sa	1 (4.4)	1 (16.7)	2 (7.7)	---
Proteus mirabilis	---	1 (16.7)	---	---
Burkholderiacepacia	---	---	---	1 (11.1)

Table 4. Case-fatality rate of healthcare-associated infection.

Fatality	Healthcare-associated infection		Total N (%)
	No n (%)	Yes n (%)	
Yes	103 (13.9)	**30 (37.0)**	133 (16.1)
No	641 (86.1)	51 (63.0)	692 (83.9)
Total	744 (100.0)	81 (100.0)	825 (100.0)

P < 0.001.

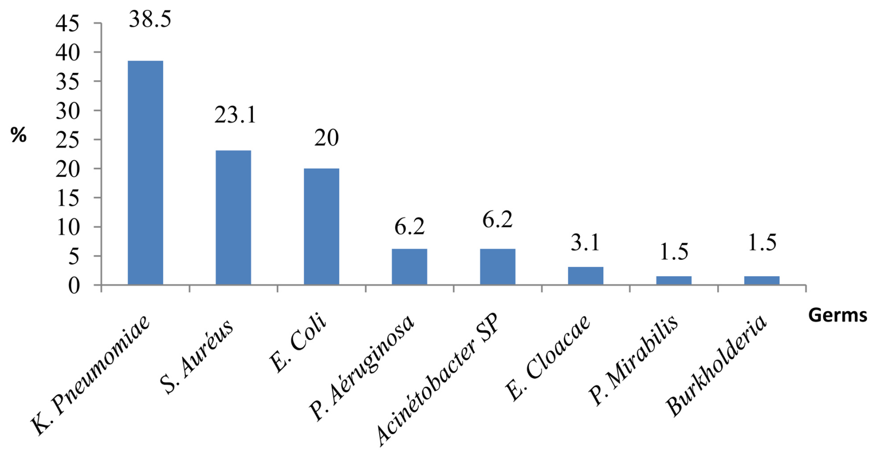

Figure 3. Distribution of different germs identified in patients.

3.8. Healthcare-Associated Infections Risk Factors

HIV+ status, Internal Medicine Department, Nephrology and Endocrinology, duration of admission and the use of urinary catheter represent factors statistically associated with the onset of healthcare-associated infections in this study (Table 5).

Among the risk factors for Healthcare-associated infections, HIV infection, hospital stay, and the port of urinary catheter are significantly associated with urinary infection onset.

4. Discussion

4.1. Limitations of the Study

This study could not analyse respiratory healthcare-associated infections and surgical site infections which are also indicators of hospital hygiene; the diagnostic means of respiratory infections are not available in our context. However, the method of study having taken into account all patients followed in a given service and the realization of a cohort study was to minimize this bias.

4.2. General Characteristics of the Study Population

The median age of patients included in our study was 49 years with extreme values of 15 and 94 years, and sex-ratio 1.1. These values are higher than those

Table 5. Healthcare-associated infections risk factors.

	Study population	Healthcare-associated infections		
		Present	Absent	p
	n	n (%)	n (%)	
Age				0.455
15 - 29	82	11 (13.4)	71 (86.6)	
30 - 44	228	25 (11.0)	203 (89.0)	
45 - 59	276	22 (8.0)	254 (92.0)	
≥60	239	23 (9.6)	210 (90.4)	
Gender				0.541
Male	422	46 (10.9)	396 (90.1)	
Female	383	35 (9.1)	348 (90.9)	
Diabetes				0.158
Yes	250	19 (7.6)	231 (92.4)	
No	575	62 (10.8)	513 (89.2)	
Kidneyinjury				0.519
Yes	279	30 (10.8)	249 (89.2)	
No	546	51 (9.3)	495 (90.7)	
HIV				0.004
Yes	80	15 (18.8)	65 (81.2)	
No	745	66 (8.9)	679 (91.1)	
Admission ward				0.027
Rheumatology	66	1 (1.5)	65 (98.5)	
Neurology	171	13 (7.7)	158 (92.3)	
Endocrinology	97	9 (9.3)	88 (90.7)	
Nephrology	261	30 (11.5)	231 (88.5)	
Internal Medicine	195	28 (14.4)	167 (85.6)	
Hepato-gastroenterology	35	0 (0.0)	35 (100.0)	
Duration of admission				<0.001
2 - 7	264	43 (16.3)	221 (83.7)	
8 - 15	350	19 (5.4)	331 (94.6)	
≥16	211	19 (9.0)	192 (91.0)	
Use of venouscatheter				0.660
Yes	821	81 (9.9)	740 (90.1)	
No	4	0 (0.0)	4 (100.0)	
Urinary catheter				0.001
Yes	109	21 (19.3)	88 (80.7)	0.001
No	716	60 (8.4)	656 (91.6)	

reported by Amazian and al in 2010 [9] in a multicenter study conducted in the mediterranean region within 27 hospitals (median age 41.1 years and sex ratio

0.99). This gap may be related to the difference in the study populations. Amazian and al included pediatric patients, while our study concerns exclusively patients aged 15 and above.

4.3. Prevalence of Healthcare-Associated Infections

Prevalence of HAI was 9.8%. This value is similar to records found by other authors in the sub-region; DIA *and al* in Senegal 10.9% [10], TRAORE *and al* in Mali 8.5% [11] and OUENDO *and al* in Benin 9.8% [13]. However, our prevalence is lower than that of AHOYO *and al* who recorded 19.1% in 2012 in Benin [14]. This gap may be due to the fact that AHOYO's team conducted a national cross-sectional study across 39 out of 45 hospitals including surgery department, gynecology and obstetrics unit, and internal medicine, while ours was conducted only in a single medical unit including 825 patients.

HAI prevalence is generally high in African hospitals while it records 5.7% on average in Europe according to ECDC in 2012 [5] [7]. As a matter of fact, non-compliance with the minimum standards of hygiene (care and hands hygiene practices), isolation procedures, biomedical waste management and rational use of antibiotics in our hospitals could explain the high rate recorded.

4.4. Patients Distribution According to Invasive Device

Respondents had one or two invasive devices, thus suggestive of gateway for germs. The study of healthcare-associated infections distribution according to the site revealed that: 25.9% of patients with bladder catheter developed urinary tract infection, and 65% of those with central venous catheter developed healthcare-associated infection. In AHOYO and al study [14], several infectious sites were identified, but the most frequent were urinary tract (37.0%), venous catheter (27.0%), and surgical site (19.2%). Thus, invasive procedures are significant risk of healthcare-associated infections in healthcare settings. This aspect was taken into account in BIAOU and al study in CNHU in 2011 with 6.3% prevalence of surgical site infections.

4.5. Distribution of Germs Identified

Major germs identified during our study were *K. pneumonia*, *S. aureus*, *and E. coli.* This result is similar to data obtained by OUENDO *and al* in Cotonou [13], and WALELEGN *and al* in Ethiopia [15]. However, in RAZINE and al study in Morocco [16], *S. aureus* was the most identified germ. In Italy, MANCINI and *al* identified *E. coli* as the most frequently found germ [17]. In Senegal, DIA and *al* study revealed *E. cloacae* as major germ [10]. These gaps may be due to the study population and microbial ecology which varies from one geographical area to another. However, *S. aureus*, *K. pneumonia* and *E. cloacae* characteristics are favorable ground for KAI. In fact, these are either commensal flora *S. aureus* germs which can develop rapidly especially in vulnerable patients, or biofilms which can be found on poorly sterilized or unsterilized equipment likely to play a role in bacteria transmission from a patient to another.

4.6. Distribution of Germs Identified According to Admission Ward

HAI prevalence was 14.4% in internal medicine. This study shows that there is a relationship between the admission ward and onset of HAI ($p = 0.027$). This result is similar to findings of AHOYO *and al* who reported that internal medicine was most affected behind surgery department. MANCINI *and al* made the same observation. Nevertheless, OUENDO *and al* and AMAZIAN *and al* identified respectively burn care center and intensive care unit as most-at-risk services [9] [13]. This could be due to the type of patients included in the study. Given that internal medicine admits most immunocompromised patients, the high prevalence can also be related to other factors especially non-compliance with hygiene measures. As regards nephrology, it provides care for patients with kidney injury and dialysis patients with arterio-venous fistula. Bladder catheter installation and handling may be source of hand-borne contamination which could justify *S. aureus* prevalence in this unit. This assumption was corroborated by KHANAL *and al* in his study which indicates that the rate *S. aureus* transmission is high among doctors and nurses [18].

4.7. Fatality of Healthcare-Associated Infection

HAI appears to be significantly associated with the deaths recorded in wards A and B of Medicine department ($p < 0.001$). This was the finding of WHO and ROSENTHAL *and al* [1] [19]. In fact, more often than not, HAI germs are multi-resistant; this leads to delayed treatment and increased fatality. The ever alarming situation in low-income countries such as Benin with limited financial resources, makes it difficult to secure appropriate antibiotics because they are too expensive for most patients with no medical cover.

4.8. Risk Factors of Healthcare-Associated Infections

There is no statistically significant relationship between factors such as age, gender, diabetes, kidney injury, dialysis, use of catheter and HAI. However, WALELEGN and al indicated that 1 - 14 age range patients were more exposed, while RAZINE *and al* reported that patients above 60 years were more exposed to risk of HAI. In fact, children and the elderly are most vulnerable to infections, and this was corroborated by these authors.

In our study, HIV infection is significantly associated with onset of HAI as reported by AMAZIAN and al [9]. However, unlike this author, we did not find statically significant association between HAI and diabetes, kidney injury and dialysis [9]. These pathologies are immunosuppressive conditions likely to foster onset of HAI. The absence of association could be due to the fact that the vast majority of diabetic patients in our study had normal blood sugar, with controlled immunity.

5. Conclusion

High prevalence of healthcare-associated infections in the medicine department is a leading cause of death. Germs responsible for HAI are mainly *K. pneumonia* and *S. aureus.* Non-compliance with basic standards of hygiene is the leading cause of this tragedy. There is pressing need to undertake steps in favor of healthcare actors so as to foster behavioral change at their level, and administrative officials responsible for these care units so that the least required material for good healthcare practices are made available to meet these standards, given that the situation is serious enough and affects practitioners.

Conflicts of Interest

The authors declare no potential conflict of interest as regards the research and publication of this article.

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