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Prevalence of Nosocomial Infections within the Regional Hospital of Garoua

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Abstract

Background: *The health care-associated infections or nosocomial infections (NI) represent a universal public health problem. They are favored by the absence of regulations concerning their epidemiological monitoring, resulting in the increase of morbidity and mortality in hospitals. Thus, the main objective of our research was to determine the prevalence of NI within the Garoua Regional Hospital (GRH) following the European Center of Diseases Control (ECDC) criteria.*

Methods*: Indeed, it was a cross-sectional study undertaken during the period extending from 22nd March to 22nd July 2014 using survey instruments and laboratory analyses.*

Results*: A total of 86 patients hospitalised for at least 48 hours were involved in the study. The prevalence of NI was 12.8 %. The « A » and « B » surgical wards both recorded the highest prevalence (33.3%) as compared to other wards. In the same view, skin and soft tissue infections following surgery had a prevalence of 26.7% in the« A » surgical ward. We also found a statistically significant relationship between admission after surgery and the surgical infection siteodds ratio 4.9 confidence interval (1.06-31.2), (p<0.002) as compared to other sites represented by the urinary infection site and bedsore infection site. Also, relative frequency of the « skin and soft » tissue infections following surgery was 54.55%; that of urinary infection site and bedsore infections site was respectively 27.27% and 18.18%. Moreover, the average duration of stay between admission and infection was not significantly higher (14.72±3.13 days), compared with that of non-infected patients (11.72±4.89 days); the time of stay above 9 days is a statistically significant risk factor associated with surgical site infectionodds ratio 21.67 confidence interval (2.3-199), (p <0.002). Bacterial culture and sensitivity carried out on agar media, as well as biochemical tests revealed that the main bacteria isolated were Staphylococcus aureus (27.3%) and Escherichia coli (18.2 %). 10% of the isolated Escherichia coli were multiresitant to the third generation Cephalosporin and were producing broad spectrum beta-lactamase. Those isolated E coli were also Carbapenem-sensitive. 83.72% of subjects included patients under antibiotic treatment, mainly the third generation Cephalosporin (18.6%).*

Conclusion: *The study of antibiotic resistance showed the existence of multiresistance that needs to be taken into consideration in the global prevention and fight strategy against NI in order to master the infectious risk and improve the vital prognosis of patients.*

Keywords:*Nosocomial infections, Prevalence, regional hospital, Garoua*

I. Introduction

The health care associated infections or nosocomial infections (NI) are a universal public health problem by increasing the morbidity and mortality in health facilities. They impact by extending the length of stay, complicating the therapeutic management and increasing the cost of treatment. 38.2% of mortality was observed in an intensive care unit and pediatric in rich countries in Europe [1-3]. In Cameroon, lethality was 72% in intensive care unit (ICU) at the Laquintinie Hospital of Douala (HLD) [4]. Indeed, NI are infections contracted in a health facility [5, 6]; they may be due to the patient's germs, caregiver or hospital environment [7]. Several risk factors may increase the risk of NI namely intrinsic risk factors and extrinsic risk factors [8-10]. Few countries have national statistics relating to NI; significant differences can be observed from one series to another depending on the country and type of establishment [11]. Thus, France has a national prevalence of 5.1% [12] and 3.8% in Germany. [13] In Mediterranean Africa the prevalence of NI was 10.5% [10]; similarly, in Benin, it was recorded a prevalence of 19.1% [14]. In Cameroon national prevalence is not known, however the prevalence of NI in the ICU in the hospital Laquintinie Douala was 12% [4]. In addition, surveillance and the fight against NI organized by the Committees for the Fight Against Nosocomial Infections (CLIN) of developed countries are much less visible in countries of low socioeconomic level [15]. This monitoring concern the pathogens involved in the occurrence of NI and exposure to risk factors in hospitals [10]. In Garoua the prevalence of NI is not known. In the opinion of nursing staff and patients, these NI are only grow, they must be addressed locally within hospitals to sensitize the staff of its gravity, in order to inform and educate all caregivers of the reality of NI and to establish a CLIN. For epidemiological surveillance of NI within the Garoua Regional Hospital (GRH), it was establishing as general objective to determine the prevalence of NI in the GRH. Specific objectives were: identify risk factors in nosocomial infections; determine the relationship between exposure to risk factors and the incidence of NI in GRH care services; isolate and identify the infectious agents responsible for NI and mount any resistance to antibiotics; determine the percentage of antibiotic consumption and key molecules prescribed.

II. Methods

Framework and type of study: We conducted a cross-sectional study, descriptive analytical referred. It was a non-probability sampling using survey instruments and laboratory analyses .We conducted this study at Garoua Regional Hospital and Centre Pasteur of Cameroon Annex of Garoua which is the reference laboratory for medical analysis in the region.

Study population: Patients who satisfy the criteria were selected. The inclusion criteria for this study were: patients hospitalized for at least 48 hours in each service; only active NI survey days were recorded. Exclusion criteria involved all inpatient for one day (Emergency, Maternity). Thus, the target population of the survey was represented by patients of different departments of the GRH: medicine, tuberculosis screening center (TDC), surgery-A, surgery-B, gynecology and obstetrics, medical intensive care, surgical intensive care, pediatrics, psychiatry,high standing.

Material: Materials for biological analysis of urine and pus.

Data collection procedure: Investigators analyzed the medical records and laboratory results together with that of the examining staff. Information was collected on anonymous survey cards and included the wards and patient information (date of admission, age, and sex). The intrinsic risk factors (immunocompromized HIV, score MacCabe); extrinsic risk factors (urinary catheter, peripheral or central vascular catheter, intubation / tracheotomy, surgical status for surgical patients) and anti-microbial treatments; the infectious status for subjects by identifying the NI site: only active infections were considered by noting the onset of infection, microbiological profile and resistance for certain bacteria. NIs was defined according to the criteria of the European Centre for Disease Control and Prevention (ECDC).

Ethics and confidentiality: The protocol was submitted to the expertise of the Ethics Commission of GRH; permission was obtained. The confidentiality of information obtained from the study subjects was respected. For minors, ascent was obtained from their parents or guardians.

Statistical analysis: The collection, management and analysis of the results were performed by the Epi Info (TM) (3.4.3) and R (2.13.0). The difference in proportion was calculated using the chi-square test and Fisher exact test for qualitative variables, the Kruskal Wallis test for comparison of means and p value <0.05 was considered significant in error set at 5%.

III. Results

Characteristic of Institutions: The GRH has a capacity of 220 beds. The two surgical wards A and B carry the majority with 52 beds (23.5%) followed by the medical ward with 37 beds (16.8%), obstetrics gynecology department 32 beds (14.5%). Whatever the length of stay of inpatients, the obstetrics gynecology department hospitalized the largest number of patients, followed by surgery wards -A and B and then, the pediatric. The occupancy rate of beds by patients who stayed more than 48 hours was 39% (86/220). **Description of patients and risk factors of nosocomial infections:** We received 86 patients with mean age of 30.91 ± 4.4 years, and a range of <1 to 80 years. There was 44.19% men and sex male / female ratio was 0.8. The average length of stay of patients at the time of the study was 12.1 ± 4.69 days, a median of 5 days and time of stay ranging from 2 days to165 days.

Of all patients, 10.5% had a MacCabe score of (1), 1.2% had a MacCabe score of (2) and 8.1% were immunocompromized. There was no significant difference between the NI percentages for each characteristic MacCabe score and HIV (p> 0.05).

Amongst the risk factors observed, surgery was one of the strongest, with exposed individuals are at risk of having an NI 4.9 times higher than unexposed subjects, with a statistically significant relationship (p <0.02). Thus, among the patients, 34 (39.5%) had undergone surgery as shown on **Table I**.

Tableau1: medical antecedents characteristic of patients and presence of extrinsic risk factors

characteristics	**NI**		**Prevalence of the characteristic**		*p*	OR(IC_{OR})
	not	yes	total			
	n	n	n	%		
Score Mac Cabe					0.2	-
mc0	67	9	76	88.4		
mc1	7	2	9	10.5		
mc2	1	0	1	1.2		
immunocompromized(HIV)					0.5	
Yes	7	0	7	8.1		
Not	68	11	11	91.9		
admission after surgery					0.02	4.9 (1.06-31.2)
not	49	3	52	60.5		
yes	26	8	34	39.5		
Urinarycatheter					0.3	1.8 (0.4-8.2)
not	52	6	58	67.4		
yes	23	5	28	32.6		
peripheralVenousCatheter					1	1.2 (0.13-58)
not	8	1	9	10.5		
yes	67	10	77	89.5		
Central VenousCatheter					1	0(0-37.4)
not	73	11	84	97.7		
yes	2	0	2	2.3		
Intubation	0	0	0			-

chi-square test and Fisher exact test
n (%): Sample size (percentage); *p*: P value; *OR: odds ratio; IC* **95%**: *confidence interval;* HIV: Human immunodeficiency Virus;**-** : not tested; *admission after surgery:* admission first action and surgery second action

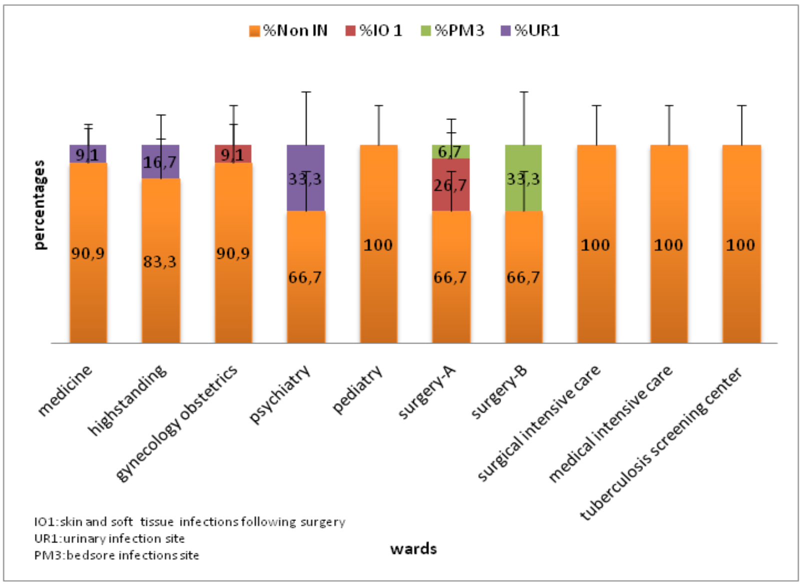
Prevalence of nosocomial infections: A total of 86 patients enrolled on the day of the survey, 11 showed signs of NI. Culture was carried out on the 11 in order to identify germs and determine the susceptibility of to antibiotics. The 11 had a positive culture, a global prevalence rate of 12.8% with a 95% confidence interval [95% CI] of [5.73-19.85].The average length of stay from day of admission was 14.72 ± 3.13 days, median 10 days with great variations between services from 2 to 50 days. This was against 11.72 ± 4.89 days among the non-infected, median of 5 days with even greater variations between services ranging from 2 to 165 days. The average length of stay was not significantly high (p = 0.104) in patients infected compared to uninfected patients. The mean time to onset of clinical signs of infection was 9.09 ± 1.67 days with a range of 2 to 28 days. Depending on the site, the time to onset of symptoms was 11.83 ± 2.02 days, with extremes of 2-28 days for surgical site infections; 9.00 ± 0.89 days with a range of 6 to 12 days for infections due to pressure ulcers and 3.67 ± 0.6 days and ranged from 2 to 7 days for urinary tract infections.We notice a significant difference (p <0.004) between the percentages in tranches of length of stay. In the tranche [2,8] days, we observe 4 NI giving a prevalence of 36.4%. Moreover, the duration of hospitalization [8, 50] days is the portion where the maximum NI (a prevalence of 63.6%) was observed. In addition, the hospital stay of >50 days shows no NI. This tranche corresponds to the length of stay of patients isolated CDT service the rest of the hospital's patients (**Table 2)**.

Tableau2: Distribution of the rate of prevalence according to the duration of hospitalization of the infected and not infected patients

Duration of hospitalization	Infected NI				*P*
	Yes		Not		0.004
	n	%	n	%	
[2, 8] days	4	36.4	59	78.7	
] 8, 50] days	7	63.6	12	16.0	
>50 days	0	0	4	5.3	
total	11	100	75	100	

chi-square test and Fisher exact test
n: Sample size ; (%):percentage; *p*: P value

Sites of nosocomial infections: The surgical site infections were the most frequent with frequency of 54.55% followed by urinary tract infections with a frequency of 27.27% and bedsore infections with frequency of 18.18%. Among the sites of infections, NI surgical site had a prevalence of 26.7%which wasalso leading in obstetrics and gynecology, with an overall prevalence of 9.1%. In addition, there is no significant difference between the percentages of patients infected amongst the wards and the site of infection (p=0.086) (**Figure1)**.



Chi-square test and Fisher exact test

Figure 1: Distribution of the prevalence according to the wards and the site of infected and no-infected.

Depending on risk factors, we find that a time of stay less than 9 days is a protective factor. For cons, the time of stay above 9 days is a statistically significant risk factor associated with surgical site infection (p <0.002). Similarly, surgery is a risk factor associated with the surgical site infection (p <0.002). Except for surgery upon admission and length of stay as mentioned above, all other risk factors, intrinsic and extrinsic, were not significantly associated with a higher incidence of nosocomial infections (**Table 3)**.

Tableau 3: Exposure to the infectious risks and sites of nosocomial infections

risks Factors	skin and soft tissue infections following surgery			
	yes	not	OR ($IC_{95\%}$)	*p*
Sex	n	n	0.37(0.03- 2.78)	0.3987
f	2	46		
m	4	34		
Age -years				<0.02505
< 1,16]	0	14		
]16,32]	1	38		
]32,48]	5	14		
]48,64]	0	4		
]64,80]	0	10		
Duration of hospitalization				0.002
<9days	1	65	0.05(10^{-2}- 0.5)	
≥9days	5	15	21.67(2.3-199)	
admission after surgery			Inf (1.98-Inf)	<0.0029
not	0	52		
yes	6	28		

Chi-square test and Fisher exact test
n:Sample size ; *OR: odds ratio; IC* **95%***:* confidence interval *95%.* Inf: infinite value; m:male; f: female

Isolated microorganisms and antibiotic resistance

For the 11 infections reported, culture was performed and all came out positive. Culture results gave the germs above with predominantly bacterial species representing 89.9% of the germs isolated: *Staphylococcus aureus* (27.2%), *Escherichia coli* (18.2%), *Staphylococcus epidermidis* (18.2 %), coagulase negative Staphylococcus other especies (9.1%), *Pseudomonas aeruginosa* (9.1%), *Klebsiellaoxytoca* (9.1%), *Candida spp* (9.1%) (**Figure 2)**.

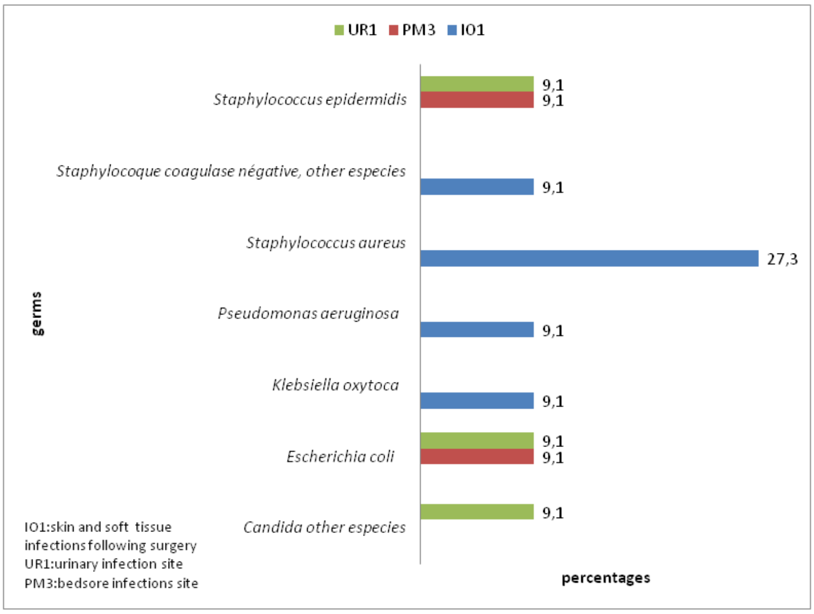


Figure 2: distribution of the categories of germs by sites of infection

Among the germs encountered, a case of the phenotype *Escherichia coli* extended or broad spectrum beta-lactamase (ESBLs) and one case of Staphylococcus epidermidis resistant to oxacillin (OXA) were revealed. Antibiotics tested on culturing bacteria have showed the following sensitivity profile: *Staphylococcus aureus* 100% sensitive, *Escherichia coli* (50%), *Staphylococcus epidermidis* (41.67%), *Staphylococcus* coagulase negative other (100%), *Pseudomonas aeruginosa* (100%), *Klebsiellaoxytoca* (100%). The resistance of *Escherichia coli* beta-lactams accounted for AMC: Amoxicillin Clavulanic Acid (50%), C3G: ceftazidime (50%) the fluoroquinolones ciprofloxacin (100%) the Aminoglycosides Gentamicin (50%); *Staphylococcus epidermidis* was resistant to oxacillin (50%), Erythromycin Macrolide (100%), Gentamicin (100%) Pefloxacin (100%)**.**

Prescription of antibiotics

The proportion of anti-microbials in patients on the day of the survey was (88.37%); the proportion of patients on antibiotics (ATB) was 83.72% with 41.67% receiving a single molecule, 37.50% receiving two molecules and 20.83% receiving three molecules of ATB. Among the antibiotics listed, the most consumed were the third generation Cephalosporins: Ceftriaxone (18.6%); Aminoglycosides: Gentamicin (13.17%); Nitro products: Metronidazole (11.62%); the Quinolones: Ciprofloxacin andNorfloxacine (10.8%). It was observed that 32% of antibiotics were prescribed for prophylaxis and 5% in treatment of NI. Among the listed antibiotics used for prophylaxis, Metronidazole and Ceftriazone made up 8.54% and 6.20% respectively.

IV. Discussion

The survey conducted in the GRH has allowed us to find that: the GRH has a capacity of 220 beds distributed in various hospital services; which ranks among the mid-level health facilities by the board of the health pyramid of Cameroon. [16] Despite this capacity, the hospital was under-exploited especially in this period of May 2014. Considering the inclusion criteria, we finally selected 86 patients who had been hospitalized at least for 48 hours.The majority of patients were young; however, our results are similar to those of Amazian who during a Mediterranean survey found an average age of 41.1 years with 19.4% of them aged 65 or more and a sex ratio M/F of 0.99 and an average of 15.14 days of stay [10]. The population of the study was young and they had different pathology with different gravity.The presence of intrinsic risk factors such as McCabe score and immunocompromized (HIV) observed on all patients permit us to remark that our results are relatively lower than those found by Thiolet and Kircharker et *al* who found 21% and 53.1% in the McCabe score 1 and 7.9% and 31.1% in the McCabe score 2 [17, 18]. The low frequency of the resulting McCabe score could be due to the size of our sample, it was small compared to other studies cited above with sizes of 358, 353 and 357 patients respectively included. Also, there are specialized services in diagnostics of serious diseases such as cancer ward which is nonexistent in our study. In addition, a rate of immunosuppression was recorded in our study while Amazian had found a slightly lower rate of 6.4% [10]. On the other and, Thiolet et al and Kircharker had found higher rates of 9.5% and 34.5%, respectively [17, 18]. The lack of early diagnosis of immune pathology can explain the low rate of immunosuppression in our study compared to the last survey.

Among the risk factors investigated, it was found that the rate amongst patients who had surgery, the urinary catheter and vascular catheters, were slightly higher than those obtained by other authors such as Amazian 27%, 4.6% and 13.5% [10]; Thiolet et *al* with 21.3%, 40.0 and 9.4 % [17]; and Kircharker with 9.2%, 35.6% and 9.2% respectively [18]. No cases of intubation had been observed in our study while other authors such as Amazian, Thiolet and Kircharker had recorded a rate of 2.5%, 1.8% and 5.3%, respectively [10 , 17, 18]. This leads us to believe that the widespread use of invasive techniques of diagnostic and therapeutic may promote the installation of NI [19].The NI prevalence rate in our study was higher than the prevalence found by Amazian with 10.5% Thiolet et *al* with 5.4% and 6.7% for Kircharker [10, 17, and 18]. This observed variation may be explained by the existence of an NI-monitoring program in some countries where the rate is low; it is the example of France for the last two studies. The relative frequency of infected patients in our study varied from one service to another. For example, some services such as surgery-A, Surgery-B, gynecology and obstetrics… infections had variable rate based on the infection site. We find that the frequency of NI is higher in services where the risk is high, such as surgery, confirming what had been observed in the survey of services. Among NI found in our study, the rates go from surgical site infections (IO1) to urinary tract infections (UR1) and the end of bedsores infections (PM3). Other authors found varying frequencies with predominance of urinary infections. Amazian in Mediterranean Africa, found on the same sites studied the NI rate of 17.2%, 25.9%, 16.6% [10] and Kircharker in France found 16.7%, 33.33%, 25.9% respectively [18]. We observe a predominance of surgical specialty infections compared to medical specialty of infections in our study. These results are similar to those of Bagheri et al, who describe different infectious sites with expanded focus on surgical site infections; the incidence varies between 2.5% and 30.9% [20]. Indeed, surgical specialty infections are surgical wound whose aseptic care is not very well done because of an improper environment, materials and staff; hence the occurrence of NI. The bedsores infections, which occur most in the surgery-A and surgery-B are characteristic of long hospital stay. They can be explained by a lack of hospital hygiene including personal hygiene of patients and staff, community hygiene and the failure aseptic conditions [21]. Urinary NI observed in psychiatry and the highstanding can be explained by a lack of personal hygiene of patients and the lack of control of the dissemination of infectious agents.

Regarding the average age, there was no significant difference between the average age of infected and uninfected patients. This means that there is no direct relationship between patient age and the occurrence of NI, despite the young population. On the other hand, some authors have found that the risk of infection increased with age [4, 19].Regarding the average length of stay for infected and uninfected patients, we did not observe a significant difference between the groups. Contrary to our study, Ak et *al*, found a significant difference between infected and uninfected patients in intensive care units with an average length of stay in infected patients of 33.92 ± 27.02 days and 8.12 ± 6.08 days for uninfected patients [8]. Prolonged stay observed in infected patients is due to infection, that causes the subject to extend his stay in the hospital and in addition to his original problem, there is the NI which is grafted, making slow healing of the patient.

The mean time to onset of clinical signs of NI is close to that observed by Amazian, where he found duration of 8 days [10]. As in Amazian, we observed that there was a statistically significant relationship between the 9 day stay duration and occurrence of NI ($p <0.004$). Indeed, there is a risk of occurrence of NI if the residence time is greater or equal to 9 days in hospital with an OR of 21.67. It was clear from our study that among the extrinsic risk factors studied, surgery and surgical site infection were important. Thus, it appears clear that the surgical site infection (ISO) is a risk for the occurrence of NI. On the other hand, other authors had found that ISO was the third cause of occurrence of NI with a rate of 14.6% for all patients and 38% for those of surgery [22, 23]. Other factors had no connection with the occurrence of NI.

Among the organisms isolated on samples taken from suspect cases of NI, we had principally*Staphylococcus aureus* and *Escherichia coli.* These germs were identified in most studies of NI [10, 17, 18, 20, 24- 26]. These germs of various origins could come from the patient, from the colonization of new sites in favor of an invasive procedure or a particular fragility as immunodeficiency, or could have an exogenous origin favored by cross contamination (sick, personnel, and environment) [7]. Viruses or parasites were not identified in our study; the small sample does not allow us to comment on the absence of these germs.Among the bacteria isolated, 10% were resistant phenotype: resistance to cephalosporins third-generation (C3G) sought in most Enterobacteriaceae, 10% of *E. coli* had more resistance to C3G; a ESBL was observed. The ESBL production phenomenon characterized by a champagne cork observed in the box of the antibiogram between the AMC andC3G orAztreonam. This phenotype is accompanied by a resistance to most antibiotics. It shows a very high risk of treatment failure due to multidrug resistance of bacteria encountered to the antibiotics used; the same observation was made by other authors in studies [27-31]. Furthermore, 10% Staphylococcus epidermidis were OXA-R; the resistance mechanism observed here would be the modification of the protein-bound penicillin 2a (PBP 2a), in the case were the phenomenon of the betalactamase production.The proportion of anti-microbials in patients on the day of the survey was high, and among these patients, the highest were on antibiotics, the most consumed were the C3G: Ceftriaxone. This strong antibiotic prescribing was also observed in a study by Amazian in the Mediterranean area [10]. During this study, high rate of antibiotics were prescribed as prophylaxis. The increased use of C3G observed is due to the fact that these molecules are less expensive in hospital pharmacies; and repetitive use compared to other antibiotics explain the probable origin of the spread of ESBL-producing enterobacteria and multidrug-resistant bacteria. Furthermore, the use of prophylactic antibiotics is also one of the factors that may cause the occurrence of resistance among bacteria isolated in our study. Also, we believe that the use of these prophylactic antibiotics leads to an overuse of antibiotics observed in our hospital services.

V. Conclusion

This study allowed for an initial status report on the epidemiological situation of NI in the GRH. This allowed us to meet a prevalence of NI of 12.8% with a much higher rate among patients hospitalized for surgical site infection. Patients with NI had higher hospital stay than other patients. The isolated germs during NI are much of *Staphylococcus aureus* and *Escherichia coli*, some already having multi-resistance. Among the prescribed antibiotics, C3G were most used in both curative and preventive level. It appears from this study that there is an overuse of antibiotics and especially C3G in our inpatient. It would be desirable in our hospital a comprehensive policy of prevention and fight against NI in order to master the infectious risk and improve the prognosis of patients.

Conflicts of interest

The authors declare no conflict of interest. We had no conflict of interest on antibiotics selected for the study.

Author Contributions

GAKE BOUBA: analysis, drafting the document; HIMNO PAHIMI: collecting, biological sample analysis, data analysis, drafting; Nelly Gake-Michèle: biological analysis of samples. All authors have read and approved the final manuscript.

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