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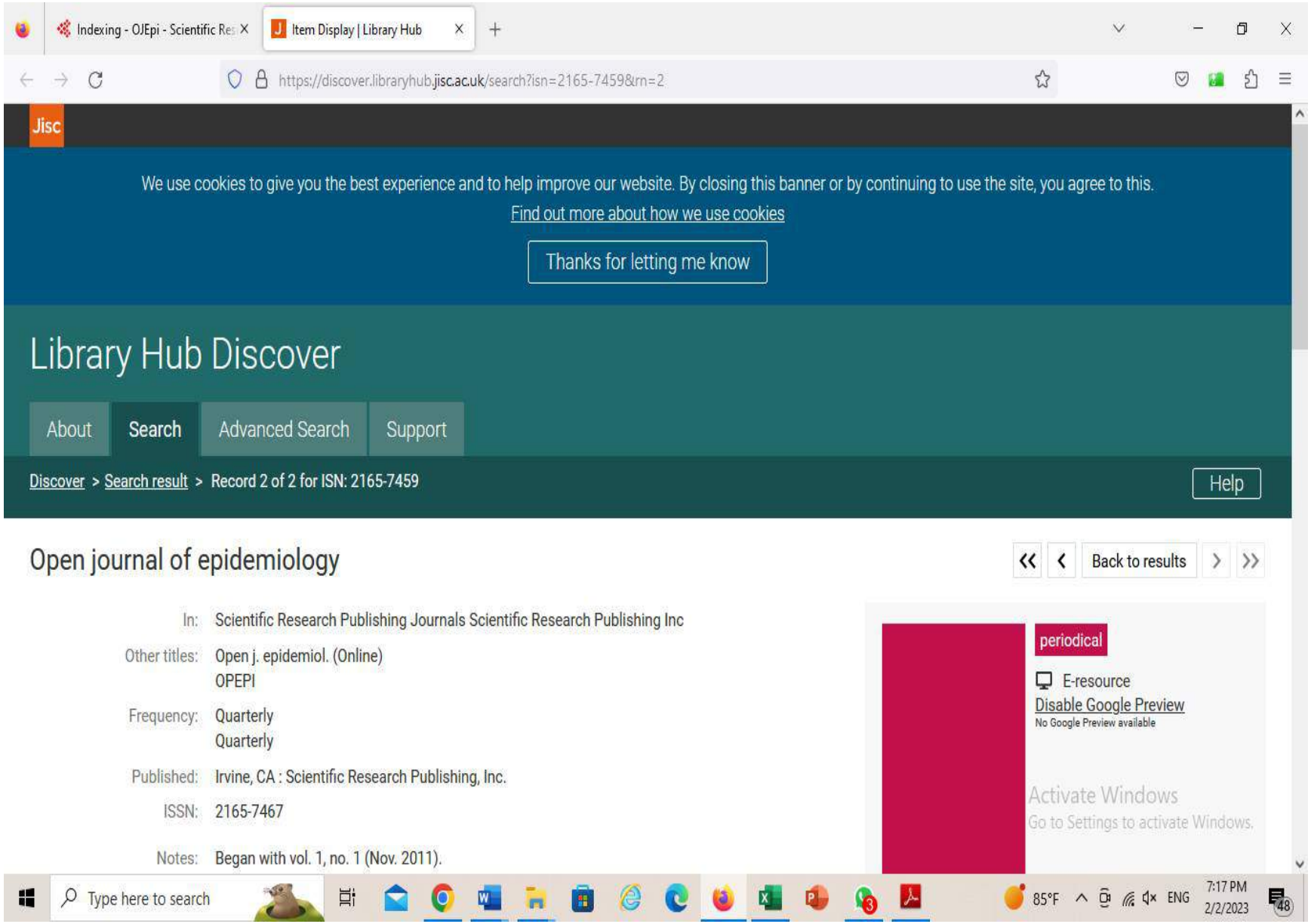
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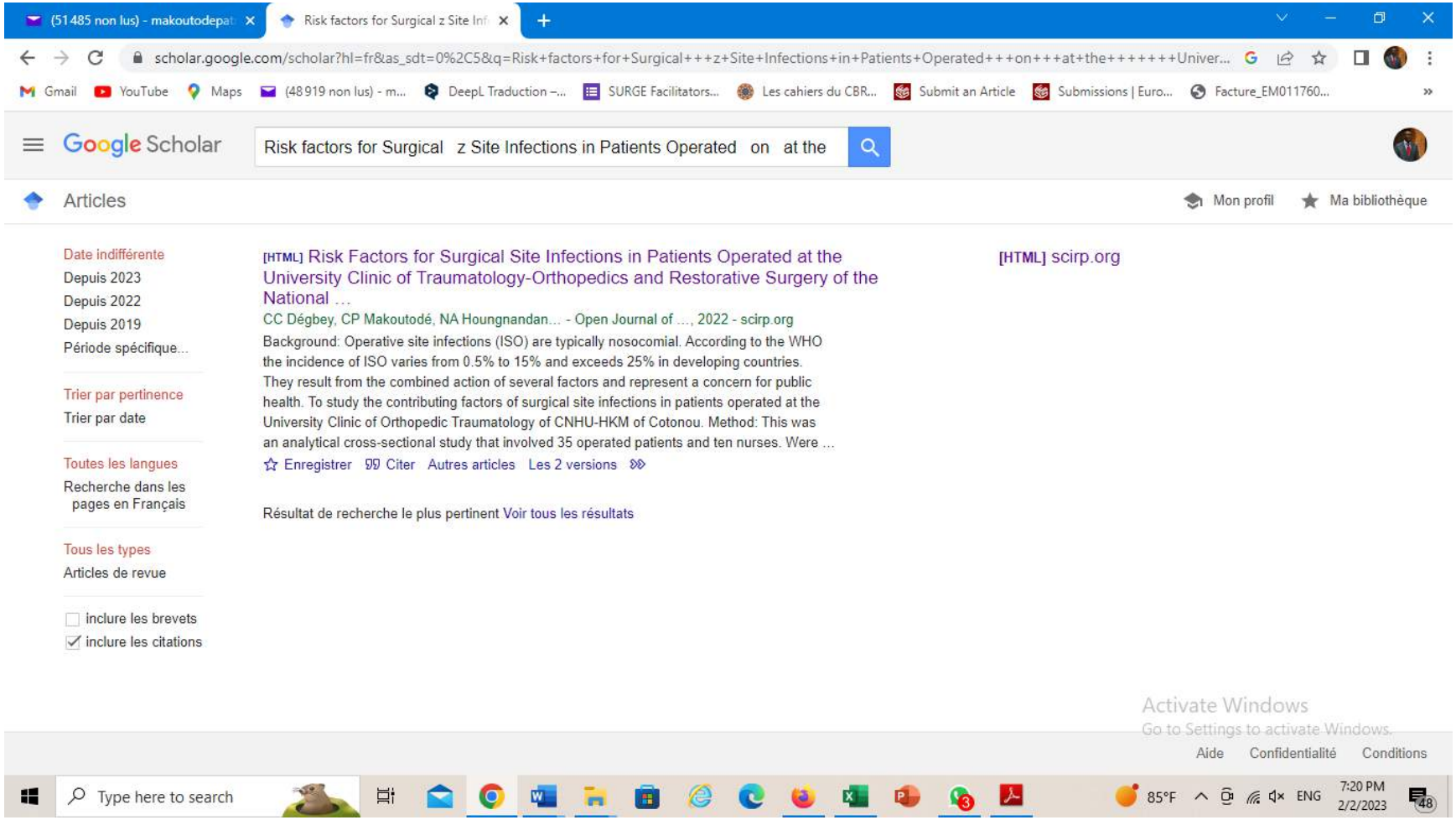
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Risk Factors for Surgical Site Infections in Patients Operated at the University Clinic of Traumatology-Orthopedics and Restorative Surgery of the National Hospital and University Center Hubert Koutoukou Maga in Cotonou

Comlan Cyriaque Dégbey[1,2*], Charles Patrick Makoutodé[1], Narjolès Augustino Houngnandan[3], Badirou Aguemon[4]

[1]Regional Institute of Public Health, University of Abomey-Calavi, Ouidah, Benin
[2]University Clinic of Hospital Hygiene, National Hospital and University Center Hubert Koutoukou MAGA, Cotonou, Benin
[3]National Medical and Health Institute, Higher School of Nurses, University of Abomey-Calavi, Cotonou, Benin
[4]Department of Public Health, Faculty of Health Sciences (FSS), University of Abomey Calavi (UAC), Cotonou, Benin
Email: *comlancy@yahoo.fr

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Abstract

Background: Operative site infections (ISO) are typically nosocomial. According to the WHO the incidence of ISO varies from 0.5% to 15% and exceeds 25% in developing countries. They result from the combined action of several factors and represent a concern for public health. To study the contributing factors of surgical site infections in patients operated at the University Clinic of Orthopedic Traumatology of CNHU-HKM of Cotonou. **Method:** This was an analytical cross-sectional study that involved 35 operated patients and ten nurses. Were included in our study: 1) All patients, without distinction of sex or age, having been operated on in the university clinic of orthopedic traumatology, during the survey period; 2) Patients hospitalized for post-operative care during the survey period; 3) The nursing staff on duty during our study period. The usual statistical measures were used according to the type of variables: means, standard deviations, percentages. Data analysis first involved calculating percentages for the qualitative variables and means followed by their standard deviations for the quantitative variables. Next, the Pearson Chi-square test was used to test the association between the dependent variable and the independent variables of interest. The significance level is set at $p < 0.05$. **Results:** The prevalence of surgical site infections was 28.58%. The main factors contributing to the occurrence of SSIs that were found were the patient's level of education ($p = 0.003$) and the reuse of ban-

dages used for dressing (p = 0.004). Other potential factors such as the economic status of the patient, the poor quality of technical dressings, and the preoperative stay were also highlighted. **Conclusion:** Surgical site infections remain a global concern. Risk factors were found on both the patient and nurse sides. It is urgent to address these various factors to minimize the occurrence of surgical site infections.

Keywords

Surgical Site Infection, Nosocomial Infections, Risk Factors, Patient, Benin

1. Introduction

Nosocomial Infections (NIs) are known worldwide and occur in both low- and middle-income countries as well as in high-income countries. These infections acquired in healthcare facilities are among the leading causes of patient morbidity and death. Surgical Site Infections (SSIs) are NIs that occur in the direct (30 days) or distant aftermath of surgery and are directly related to it. Statistics on the prevalence of NIs rank SSIs second only to Urinary Tract Infections (UTIs). They account for 2% of surgical interventions in developed countries [1]. SSIs remain a leading concern for health care facilities, despite the availability of antibiotics, improved anesthesia techniques, and advances in preventive measures [2].

Healthcare-Associated Infection (HCAIs) is a reflection of the quality of care delivery in a healthcare system [3]. The prevention of HCAIs is a requirement for the quality of care offered to populations [4]. The safety of care requires the strict application of hospital hygiene guidelines. There is a significant association between poor hospital hygiene and the occurrence of HCAIs [1].

The prevalence of such infections reveals the weakness of the health system in ensuring the safety of patient care [4]. The epidemiology of NIs complies with the main principles of communicable diseases. Studies conducted between 2005 and 2008 in developed countries in Europe and the United States revealed that the prevalence of HCAIs ranged from 5% to 15% among hospitalized patients. They can affect 9% to 37% of patients admitted to intensive care units, with a mortality rate from 12% to 80% [5] [6]. In France, a study conducted in 2006 reported that the prevalence of NIs was 5.38% [7]. In 2008, a study involving 55 hospitals in 14 countries showed that, on average, 8.7% of hospitalized patients were affected by Nis [1]. In Africa, various studies have highlighted the prevalence of HCAIs. In Morocco, the prevalence of HCAIs was 6.7% in 2007 [8]. Surveys in Tunisia in 2004 and Morocco from 1994 to 1995 (Ibn Rochd hospital in Casablanca) reported a prevalence of 6.5% and 2.03% [9] [10] [11]. Since 2006 in Benin, efforts have been made to control HCAIs, but data on the issue are not always available [4]. A study in 2012, conducted at the National Hospital and University Center Hubert Koutoukou Maga (CNHU-HKM), but in the operat-

ing theaters, reported a prevalence of NIs of 6.17% [12]. According to a study conducted in orthopedic trauma surgery at the CNHU-HKM in Cotonou, the prevalence of SSIs was 9.59% with a predominance of deep infections (85.2%) [13]. A recent study conducted in 2015 in the same center reported a prevalence of 9.84% [4]. Accepting to take charge of a patient implies the obligation for the health care staff to implement all means of preventing SSI. There is a great need for research on the prevalence and risk factors involved in the occurrence of SSI.

This study aimed to highlight the risk factors for SSIs in patients operated on at the University Clinic of Traumatology-Orthopedics and Restorative Surgery of the CNHU-HKM in Cotonou.

2. Materials and Methods

2.1. Study Area

This study took place at the University Clinic of Traumatology-Orthopedics and Restorative Surgery (CUTO-CR) of the CNHU-HKM. The CNHU-HKM offers reference care that cannot be provided in other health centers and is also the main health facility in Benin. It is a center for care, research, and training of health workers. It also carries out social actions. Within the CNHU-HKM, there is the University Clinic of Hospital Hygiene (CUHH). The CUHH is transversal to the visceral surgery, urology, and traumatology departments to improve their quality in terms of hygiene.

2.2. Study Design and Sampling

It was an analytical cross-sectional study that took place in 2019. The primary targets were patients who had been receiving surgery in the CUTO-CR during the study period. The secondary targets were the nurses on duty during the study period at the CUTO-CR. The sample size was 35 surgical patients and ten nurses.

2.3. Study Variables

The dependent variable was the occurrence of SSIs. SSI referred to:

- a purulent discharge from a surgical wound or surgical drain,
- a discharge from a wound or surgical drain with a positive or negative microbiological culture,
- a wound requiring reopening,
- and/or a diagnosis of infection by the surgeon.

The independent variables were:

- the patient's level of education,
- the patient's hospitalization category,
- the number of days spent in the department before the intervention,
- having a shower before the procedure,
- having shaved the area where the procedure will take place before the block,
- having received antibiotics before the procedure,

- using the same bandage strip that was applied for the dressing,
- having the financial means to purchase dressing materials each time and the frequency with which the hospital bed sheet is washed.

2.4. Data Collection and Analysis

We collected data through a document review, interviews, a questionnaire survey, and observations. Data analysis was conducted using SPSS 21. We first described the study variables by presenting the frequencies and percentages or the means and standard deviations. A Chi-square test was used to assess the associations between the dependent variable and each of the independent variables. The level of statistical significance was set at $p < 0.05$.

3. Results

3.1. Characteristics of the Nursing Staff

The mean age of nurses was 40.6, with a minimum of 35 and a maximum of 50. The nursing staff at CUTO-CR was equally divided between men and women. Only one nurse in ten was a specialized State Registered Nurse, compared to four who were health action controllers. The mean professional experience of the nurses was 16.4, with a minimum of 10 and a maximum of 24. Only 3 out of 10 nurses had professional experience of 5 years or more. More than half of the nurses (7/10) said they had received additional training in hospital hygiene guidelines.

3.2. Characteristics of Patients

The majority of patients surveyed (74.29%) were male. Nearly half (40%) of the patients were between 29 and 39 years old compared to 20% who were over 50 years old. Most of the patients (74.28%) were in a couple versus 22.86% who were single. Twenty percent of the patients were traders, 14.29% were civil servants, and 8.57% were artisans. Besides, 74.28% of the patients had a high level of education against 17.14% who had no formal education.

3.3. Process for Preventing Surgical Site Infections

All the nurses had reported having done the patient's hygiene, shaving, and disinfection of the operating site before each operation, *i.e.* the day before the operation. All nurses reported handwashing before and after each wound dressing. Most of the nurses (9/10) said that they had provided nursing care to patients undergoing surgery in the department.

3.4. Nurses' Perception of Factors that Promote Surgical Site Infections

According to the nurses, the multiple patient visits and the bringing of luggage to the hospital wards would favor the occurrence of SSIs. Five out of ten nurses indicated that wounds with external fixators would be at greater risk of SSIs,

compared to three nurses who said that wounds with drains would be at greater risk. The majority of nurses (8/10) reported that surgical wound dressing equipment was not adequate and nine out of ten nurses reported having defective dressing clips. Most of nurses highlight using sterile gloves and examination gloves when dressing. This situation reflects the lack of standardization of protocols when nurses perform dressing procedures on the ward. More than half of the nurses (7 out of 10) said that sterilization of dressing materials would not be adequate. All nurses surveyed pointed out that all dressing boxes on the ward are incomplete. This situation would influence the occurrence of SSIs, especially as the standards require a complete box in the production of dressings, in addition to those for surgery. More than half of the nurses (6/10) claimed that the ward is cleaned once a week. This could increase the accumulation of microorganisms in the ward environment, given that most patients are in common rooms.

3.5. Clinical and Therapeutic Patient Data

Table 1 presents the clinical and therapeutic data of the patients operated on. Almost all patients (94.29%) were admitted to the clinic because of a road traffic injury and were hospitalized in a common ward. We note that 48.57% of the patients had spent less than two days in the ward before the intervention, and about 45% of patients had spent 2 to 7 days. The majority of patients (71.43%) reported showering before the intervention. Notably, 54.29% of patients said shaving at the pre-block area of the intervention. Most patients (51.43%) pointed out that they had not received antibiotics before the intervention. The majority of patients (65.71%) said using Betadine (polyvidone-iodine) as their dressing, compared to 20% of those who reported using hydrogen peroxide, and only 2.86% reported using saline for their dressing. Besides, 11.43% of patients claimed they would re-use the same bandage again for dressing. Of the patients, 28.57% reported infection in their surgical wounds. Nearly half of the patients (48.57%) said they washed their sheets once every three days, compared with 34.29% who washed their sheets once a day. The majority of the patients surveyed (80%) reported that nurses did not perform nursing.

Factors associated with the occurrence of surgical site infection.

Among those operated on, 26.8% developed a surgical site infection. The analysis of Table 2 showed that there was a statistically significant association between the level of education of the patient ($p = 0.03$), the reuse of the same tape that was used for the dressing ($p = 0.004$) and the wound infection.

We note that 66.67% of patients who have no level of study have their wound which has been infected and 100% of patients who have reused the same strip which was used for the dressing declared that their wound has been infected.

There was no relationship between the patient's category of hospitalization, the number of days spent in the service, the fact of having had a shower before the intervention, the fact of having had the part where will take place the intervention before the block, the fact of having received antibiotics before the intervention, the fact of having financial means the fact of having financial means

Table 1. Distribution of patients according to clinical and therapeutic data of patients.

Variables	Frequency	%
Reason for entry		
Road accidents	33	94.29
Victim of armed robbery	1	2.86
Free fall	1	2.86
Category of hospitalisation		
Common room	33	94.29
Cabin	2	5.71
Number of days spent in the service		
before the operation		
Less than 2 days	17	48.57
2 to 7 days	16	45.71
More than a week	2	5.71
Shower before the operation		
Yes	25	71.43
No	10	28.57
Shaving of the intervention site		
Yes	19	54.29
No	16	45.71
Antibiotics received before the operation		
Yes	17	48.57
No	18	51.43
Type of antiseptic used during the dressing process		
Betadine	23	65.71
Hydrogen peroxide	7	20.0
Dakin	4	11.43
Salt serum	1	2.86
Re-use of the same bandage for the dressing		
Yes	4	11.43
No	31	88.57
Surgical wound infection		
Yes	10	28.57
No	25	71.43
Frequency of sheet washing		
Once a day	12	34.29

Continued

Once every 3 days	17	48.57
Once a week	6	17.14
Nursing provided by nursing staff		
Yes	7	20.00
No	28	80.00

Table 2. Factors associated with the occurrence of surgical site infection

Variables	Total (n = 35)	Surgical site infection		p-value
		Yes (%)	No (%)	
Level of education				
None	6	4 (66.67)	2 (33.33)	
Primary	3	0 (0)	3 (100.0)	0.03*
Secondary	13	1 (7.69)	12 (92.31)	
Superior	13	5 (38.46)	8 (61.54)	
Category of hospitalisation				
Common room	33	9 (27.27)	24 (72.73)	0.50
Cabin	2	1 (50.0)	1 (50.0)	
Number of days spent in the department before the intervention				
Less than 2 days	17	6 (35.29)	11 (64.71)	
2 to 7 days	16	3 (18.75)	13 (81.25)	0.39
More than a week	2	1 (50.0)	1 (50.0)	
Shower before the operation				
Yes	25	7 (28.0)	18 (72.0)	1
No	10	3 (30.0)	7 (70.0)	
Shaving done				
Yes	19	5 (26.32)	14 (73.68)	1
No	16	5 (31.25)	11 (68.75)	
Antibiotics received before the operation				
Yes	17	4 (23.53)	13 (76.47)	0.71
No	18	6 (33.33)	12 (66.67)	
Re-use of the same bandage that was applied for the dressing				
Yes	4	4 (100.0)	0	0.004*
No	31	6 (19.35)	25 (80.65)	
Existence of means to buy dressing material each time				
Yes	24	5 (20.83)	19 (79.17)	0.23
No	11	5 (45.45)	6 (54.55)	

Continued

Frequency of sheet washing				
Once a day	12	3 (25.0)	9 (75.0)	0.48
Once every 3 days	17	4 (23.53)	13 (76.47)	
Once a week	6	3 (50.0)	3 (50.0)	

and wound infection ($p > 0.05$).

4. Discussion

The prevalence of SSIs in the CUTO-CR at the CNHU HKM was 28.57%. In Tunisia, Latifa *et al.* (2018) reported a prevalence of 19.1% of SSIs in General and Visceral Surgery and 14.8% in Orthopedic [14]. Our study showed that the occurrence of SSIs is the result of the combined actions of factors related to patients and health care staff. Nearly half of the patients in our study were between 29 and 39 years old. El Rhazi *et al.* (2008) reported in their study that the mean age of patients was 35.25 ± 21 years. Our sample was composed of as many men as women [8]. Only one nurse was a specialist. The mean age of the nurses was 40.6 with a minimum of 35 and a maximum of 50. These data corroborate with the results found by Souli in 2017 in Burkina Faso (Souli 2017) [15]. On the other hand, (Yaouba 2014) found that 60% of the nursing staff were female, and the mean age of respondents was 35.85 years [15].

In our study, we did not find a significant association between the duration of the number of days spent in the department before the intervention and the occurrence of SSIs. There is no link between the category of hospitalization and SSIs. We have explored patient-specific factors that may directly or indirectly contribute to the occurrence of SSIs. These were the patient's level of education and re-use of dressing strips. These results are consistent with those of Yaouba in 2014, which showed that 91% of patients who used previous dressing strips and accessories developed SSI [16]. Our study did not reveal a significant association between having the financial means to purchase the material each time and wound infection. Laurence in 2012 also found that patients were blamed by the nursing staff for the occurrence of care-associated infections. All nurses reported the unavailability of good medical technical equipment in the ward. The equipment is obsolete and unsuitable, which would have a significant influence on the occurrence of SSIs. Laurence in 2012 found a similar discourse of nurses who denounced a lack of adequate equipment to take care of patients [17].

This situation is not conducive to the prevention of SSIs because, as Lucet and Birgand point out in 2016, the availability of material resources plays an important role in the effective application of infection control (Birgand and Lucet 2016) [18]. All nurses suggested increasing the number of staff to reduce the workload per person. To this end, the high workload is perceived by nurses as a factor that may contribute to the occurrence of SSI. The nurses of the difficulties in providing care in large numbers while meeting hospital hygiene requirements.

Amiel in 2005 highlighted the constraints faced by healthcare professionals who are concerned about the need to provide care over time, but also the risk of exposing themselves or the patient to infections [19].

The same perceptions were found among health care staff by Carricaburu *et al.* (2008), who pointed out that high workloads were associated with the occurrence of HCAIs. In our study, shaving was not associated with the occurrence of SSI. Our results are in contrast to those in the literature which reported that preoperative shaving influences surgical risk [20]. These studies reported that patients who did not have a preoperative shave were at greater risk of surgical site infection than those who had a shave (Haidara 2008) [21].

Several studies have shown an increased risk when hair was removed with a hand-held razor compared to an electric razor or epilation. Also, when a hand-held razor was used, the risk was double when shaving was done within 24 hours before surgery compared to shaving immediately before surgery. SSIs increased the length of the postoperative stay. The longer the postoperative stay, the greater the risk of site infection (Chadli *et al.* 2005; Garba *et al.* 2018) [22] [23]. Also, it should be noted that factors such as the number of preoperative days performed in the ward, the patient's economic situation, and the frequency of sheet washing could have a significant influence on the occurrence of SSIs.

Among the nursing staff, potential factors lead to SSIs were the lack of nurses specialized in trauma and orthopedic surgery in the department (one nurse out of ten); the problem related to the performance of nursing in the patient department. Other factors were noted such as the poor quality of the technical equipment used to make dressings, the inadequacy of the sterilization of equipment in the ward with boxes of dressings that were incomplete and filled with defective and obsolete clamps. All of the above could significantly influence the occurrence of SSIs. Strict adherence to the current standards for the prevention of SSIs is based on standard protocols that should be applied in all care facilities, especially in the surgical sector. In our study, it was found that the nursing staff was experienced in countering the threat of SSIs (70% of the nurses had received at least one continuous training course in hospital hygiene). Thus, the preparation of the patient for the operating room was essentially done by the nurses. According to their statements, they were responsible for 100% of body hygiene on the day before surgery, depilation of patients followed by disinfection of the operating site, preparation of the patient on the day of surgery, and nursing for the new patient. Besides, the majority of the operations were performed according to a well-defined and known schedule (32 out of 35 scheduled operations), so the staff had time to fine-tune the preparation. The gestures and procedures were not uniform and or in conformity with the standards.

Ten out of thirty-five patients reported not receiving a shower before going to the operating room, while sixteen out of thirty-five patients hammered at not being shaved before the procedure. Of the nineteen patients in whom hair removal was performed, a hair clipper was used in only one case vs. a blade for the others; this is in direct contravention of the provisions in force. The postpone-

ment of surgery due to infection was not negligible (41.67%), but paradoxically 51.43% of the patients operated on reported not receiving antibiotic prophylaxis before to surgery. The nurses responsible for 94.29% of the dressings in the ward, who were real workers in the management of surgical wounds, mostly used Polyvidone Iodine dressings (65.71% of the dressings), which made the majority of surgical wounds previously dry but not oozing. All these data lead us to say that the process of preparation for the operating theatre as well as the level of observance of hygiene rules would be insufficient and would not be regulated by a fixed protocol applicable in the ward.

The ISO prevention policy is centered on the combined action of the different actors in the system, including the patients themselves. Awareness among patients would be a considerable asset in the fight against the factors favoring SSIs. These patients would have information on SSIs and it is for this reason that they develop actions to counteract the factors.

5. Conclusion

The results we obtained show that the occurrence of SSIs in CUTO-CR is linked to the re-use of tapes from previous runs by patients, the patient's level of education who do not apprehend most of the time the consequences of SSIs. Among the personnel, potential factors were noted. Notably, there are the glaring lack of nurses specialized in trauma and orthopedic surgery in the department, the problems related to the nursing in the department for operated patients, the poor quality of the technical equipment used for the production of dressings, the inadequacy of the sterilization of the equipment in the department with boxes of dressings that are incomplete and filled with defective and obsolete clamps.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Questionnaire Pour Le Personnel

Dans le cadre de notre recherche sur les **Facteurs favorisants des infections du site opératoire chez les patients opérés à la clinique universitaire de Traumatologie Orthopédique du CHNU HKM de Cotonou."**

INFORMATIONS GENERALES

1-Age /____/_____/ ans

2-Sexe Masculin ☐ Féminin ☐

3-Qualification professionnelle: CAS/IDE ☐ IS/Infirmier Breveté ☐

IDE Spécialisé ☐ IAS/IDE ☐

4-Ancienneté professionnelle /____/_____/ ans

5-Ancienneté dans le service: moins de 5 ans ☐ ≥5 ans ☐

6-Faites-vous la toilette corporelle du patient a la veille des interventions? OUI ☐ NON ☐

7-Faites-vous le rasage a la veille des interventions? OUI ☐ NON ☐

8-Procéder vous a la désinfection du site opératoire a la veille des interventions? OUI ☐ NON ☐

9-Faites-vous le nursing au patient opérés? OUI ☐ NON ☐

10-Avez-vous suivis une fois une formation sur les mesures d'hygiènes hospitalières? OUI ☐ NON ☐

11-Faites-vous le lavage des mains avant et après chaque pansement? OUI ☐ NON ☐

12-selon vous, quels sont les comportements des patients qui favorisent les infections du site opératoire?

Beaucoup de visite ☐ Défaut d'hygiène corporelle ☐ Apport des bagages dans les salles ☐

13-Quels sont selon vous les types de plaies qui sont sujet aux infections du site opératoire

Plaies avec fixateur externe ☐ Plaies avec drain ☐

Autre à préciser----------

14-Disposez-vous du matériel adéquat pour le pansement OUI ☐ NON ☐

15-utilisez-vous toujours lors des pansements des: Gants stérile ☐ Gants d'examen ☐

16-Pensez-vous que le matériel de pansement est-il bien stérilisé? OUI ☐ NON ☐

17-à quel rythme se fait le nettoyage des locaux dans le service

Une fois par semaine ☐ une fois par mois ☐

18-Avez-vous des pinces en bon état? OUI ☐ NON ☐

19-Disposez-vous des boites a pansement au complet? OUI ☐ NON ☐

20-Quelles suggestions faites-vous pour éviter la survenue des infections du site opératoire?

Merci d'avoir répondu à nos questions

QUESTIONNAIRE POUR LES PATIENTS

Fiche N°……. Date de collecte: ……/…….

Dans le cadre de notre recherche sur les **"Facteurs favorisants des infections du site opératoire chez les patients opérés à la clinique universitaire de Traumatologie Orthopédique du CHNU HKM de Cotonou.**

A/IDENTIFICATION DU PATIENT

Nom et prénoms du malade……

1-Catégorie d'hospitalisation Salle commune ☐ Cabine ☐

2-Sexe M ☐, F ☐

3-Age: 18 à 28 ans ☐, 28 à 38 ans ☐, 38 à 48 ans ☐ 48 ans à plus ☐

4-Quelle est votre profession……

5-Situation Matrimoniale……

6-Quelle est votre nationalité: Béninoise ☐ Autres à préciser----------

7-Quel est votre niveau d'étude a) Illettré; b) primaire; c) secondaire; d) supérieure

8-Quel est votre motif d'entré…….

9-Date d'admission ……

10-Combient de jours avez-vous passé dans le service avant votre intervention …….. Jours

11-Avez-vous subi une douche avant votre intervention? OUI ☐ NON ☐

12-a-t-on rasé la partie où se déroulera l'intervention avant le bloc? OUI ☐ NON ☐

Si OUI, par quel matériel: Une tondeuse ☐ Une lame ☐

13-avez-vous reçu des antibiotiques avant l'intervention OUI ☐ NON ☐

Si oui pendant combien de jours----------

14-Votre intervention a-t-elle été reportée une fois? OUI ☐ NON ☐

Si oui cela est due à: Une infection ☐, indisponibilité du matériel ☐

manque de moyen financier ☐

15-votre intervention est-elle: programmée ☐ ou en urgence ☐

16-quel est le site de votre intervention? ----------

17-Quel est l'état de votre plaie actuellement: Plaie humide ☐ plaie sèche ☐

18-avec quoi votre pansement est-il réalisé? Bétadine ☐, Eau oxygéné ☐,

Dakin ☐, Autres à préciser----------

19-qui sont ceux qui se chargent de la réalisation de votre pansement?

Infirmier ☐ médecin ☐ aide-soignant ☐

20-Réutilisez-vous la même bande qui a servi pour le pansement? OUI ☐ NON ☐

21-Votre plaie a-t-elle été infectée? OUI ☐ NON ☐

22-Avez-vous les moyens pour acheter le matériel de pansement chaque fois? OUI ☐ NON ☐

23-Comment faites-vous la gestion des bandes: Eliminer ☐ Recycler ☐

24-A quelle fréquence votre drap est lavé?

25-le personnel infirmier vous assure-t-il le nursing? OUI ☐ NON ☐

26-Avez-vous été repris pour une nouvelle intervention? OUI ☐ NON ☐

27-Comment éviter l'infection des plaies opératoires selon vous?
