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Bacteriological Profile of Infections in the Surgical Department of the University Clinics of Kisangani in Democratic Republic of the Congo

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Abstract

Background: Infections are common in all surgical specialities. They include surgical site infections, osteoarticular infections, soft tissue infections and urinary tract infections. For efficient management, it is essential to know which germs are responsible and which antibiotics they are sensitive to. The aim of this study was to determine the bacteriological profile of these infections and assess their sensitivity to the antibiotics currently in use. **Material and Methods:** This was a cross-sectional descriptive study retrospective conducted over a 5-year period, from 1 January 2019 to 31 December 2023. It focused on the positive results of bacteriological samples taken from patients admitted to the Surgical Department of the University Clinics of Kisangani for an infectious pathology or who had developed an infection during their hospital stay (osteoarticular infections, soft tissue infections, surgical site infections, maxillofacial infections, ENT infections, urinary tract infections). The sample was non-probabilistic for convenience. **Results:** There were 181 positive cultures from all departments combined. In 11 cases (6%), the infection was due to 2 bacteria. A total of 192 bacteria were isolated. *Staphylococcus aureus* accounted for 43.8%, followed by *Escherichia coli* at 12.5%, *Citrobacter diversus* at 11% and *Enterobacter* at 8.9%. There was a high rate of germs with reduced sensitivity to commonly used antibiotics. The sensitivity study found 26 multi-resistant germs (13.5%). **Conclusion:** *Staphylococcus aureus* was found to be the most common germ at 43.8%, followed by *Escherichia coli* at 12.5%, *Citrobacter diversus* at 11% and *Enterobacter* at 8.9%. A high rate of germs with reduced sensitivity to commonly used antibiotics was noted. The antibiotic protocol needed to be changed, and an antibiotic prophylaxis based on the most active antibiotics in the bacterial ecology needed to be introduced.

Keywords

Bacteria, Infections, Sensitivity, University Clinics of Kisangani (CUKIS)

1. Introduction

Infection is the invasion of an organism by a foreign agent, such as a bacterium, virus, parasite or fungus, capable of multiplying, within it and all the pathological consequences that may result [1]. For centuries, surgical infections have been a real public health problem in all surgical specialties. Until the middle of the 19th century, the risk of post-operative infection was around 70% - 80% [2]. After Robert Koch discovered the pathogens responsible for infections in 1876, microbiologists began to isolate various microorganisms [2]. In the 21st century, infections are common in all surgical specialties. They include surgical sites, osteoarticular infections, soft tissue infections and urinary tract infections [3] [4]. Hospital-acquired or nosocomial infections are a major public health problem due to their frequency. In its 2017 report, the World Health Organisation (WHO) stated that worldwide, more than 1.4 million people suffer from a hospital-acquired infection. Despite advances in surgical care, asepsis intra-operative and antibiotic therapy, surgical site infections remain a major health problem to the public due to their high cost, long hospital stay and high morbidity and mortality. Surgical site infections are the 3rd most common nosocomial infection after urinary tract and respiratory infections [5]. Nosocomial infection in surgery is a disaster. It can ruin the benefits of surgery to improve function joint or repair a joint [6]. In developed countries, the incidence of infections, particularly infections on surgical sites, varies between 0.7% and 5%, rising to 33% in the case of abdominal surgery [7] [8]. In France, the network for monitoring and preventing infectious risk in surgery showed in 2021 that an Enterobacterium was found in 31% of SSIs (including *Escherichia coli*) and a gram-positive in 53% (*Staphylococcus cocci* 21.9%, *Staphylococcus epidermidis* 10.2% and *Enterococcus fecalis* 9%) [9].

In Sub-Saharan Africa, the prevalence of surgical site infections can vary from 6% to over 40%, depending on the case [10]. Osteoarticular infections, such as osteoarthritis, arthritis and osteitis, are common in children, but also in adults because of the frequency of road accidents, the development of orthopaedic and prosthetic, and the occurrence of nosocomial osteitis in osteosynthesis equipment surgery or prostheses [3] [11] [12]. Urinary tract infection is one of the most common bacterial infections in hospital. Management is often empirical, based on knowledge of the germs most frequently involved and their profile resistance [13]. A study of the bacteriological profile of surgical site infections carried out by Abdoulaye *et al.* in the Niamey National Surgical Department revealed the presence of a wide range of bacterial strains isolated 126 bacterial strains, with a predominance of *Staphylococcus aureus* (39.31%), *Escherichia coli* (29.23%) and *Pseudomonas aeruginosa* (12.95%). In the Democratic Republic of the Congo, the prevalence of nosocomial infections in Kinshasa hospitals was estimated at 15.0% in 2011, while in Upper Katanga in 2010, the overall prevalence of nosocomial infections was 34.5% [14]. Surgical site infections are the complication of most frequent surgical procedures. Statistics on the frequency of hospital-acquired infections rank infections on surgical sites second only to urinary tract infections [15] [16]. These infections are often caused by bacteria that are resistant to antibiotics and favoured by hygiene poor hospital [15] [16]. Bacterial resistance is a factor in the poor prognosis of patients, leading hospitalised to increased mortality and longer hospital stays. The World Health Organisation describes antimicrobial resistance as one of the most urgent health risks of our time, threatening to wipe out a century of progress. Many medical low- and middle-income countries have major gaps in access to effective and appropriate antibiotics [15]. If infections are to be managed efficiently, it is essential to know which germs are responsible and how sensitive they are to antibiotics. However, before this can be done, probabilistic antibiotic broad-spectrum therapy is often necessary, unfortunately which exposes patients to the selection of resistant bacteria. One of the challenges facing the Centres of Reference for Complex Osteoarticular Infections (CRIOAC), set up in 2008, is to introduce rational antibiotic prescribing in order to protect the most molecules active in these types of infections [3] [17].

The aim of this study was to establish the bacteriological profile of infections in the surgical department of the Clinics University of Kisangani and assess their sensitivity to commonly used antibiotics in order to improve the management of our patients.

2. Materials and Methods

2.1. Study Framework

Our study was carried out in the Department of Surgery at the University Clinics of Kisangani (CUKIS).

Geographical Location of the University Clinics of Kisangani

The University Clinics of Kisangani (CUKIS), the setting for our study, is a tertiary-level medical facility in the province of Tshopo and the city of Kisangani, capital of the province of Tshopo in the Democratic Republic of the Congo. They are located on Munyororo Avenue, in the Plateau Médical district in the commune of Makiso.

2.1.1. Study Population

The study population consisted of all patients admitted to and treated in the surgical department of the University Clinics of Kisangani during our study period who had presented with an infection (osteoarticular infections, soft tissue infections, surgical site infections, urinary tract infections, maxillofacial and infections stomatological, ENT infections).

2.1.2. Sample

Our sample consisted of patients admitted to and treated in the CUKIS surgical department who had presented with an infection with documented bacteriological results, including gram staining, culture and antibiotic susceptibility testing.

2.1.3. Study Period

The data was collected over a 5-year period, from 1 January 2019 to 31 December 2023.

2.2. Methods

2.2.1. Type of Study

This was a descriptive, cross-sectional study with retrospective data collection.

2.2.2. Sampling Technique

This was a non-probabilistic sample of convenience, which consisted of examining the patient files registering hospitalization and bacteriology laboratory registers that were made available to us.

2.2.3. Selection Criteria

1) Inclusion criteria

The study included:

Any patient admitted to the Department of Surgery of the University Clinics of Kisangani during the period of our study who presented with an infection (osteoarticular infections, soft tissue infections, surgical site infections, urinary tract infections, maxillofacial and infections stomatological, ENT infections) with well-documented containing positive bacteriological results the results of gram staining, culture and antibiogram.

2) Non-inclusion criteria

This study did not include:

Any patient admitted to the Department of Surgery of the University Clinics of Kisangani during the period of our study, who had not presented an infection or who had presented one, but whose file did not contain all the elements retained). in our collection form (gram staining, positive culture and antibiotic susceptibility test, etc.

2.2.4. Data Collection Technique

This was the documentary analysis technique. It consisted of examining patient files, patient hospitalisation records, doctors' duty report books, operating theatre records, anaesthetists' records, operating protocol records and bacteriology laboratory records, which were made available to us, and which contained the study parameters sought according to the study's inclusion criteria.

2.2.5. Study Variables

Socio-demographic data: age, gender, place of residence, occupation, marital status, province of origin.

Type of admission: Emergency, outpatient, transfer.

Clinical data: complaint, history, locoregional physical signs, admission diagnosis, etc.

Paraclinical data: Biology (Hb, Hct, GS and Rhesus factor, GB, FL VS; bacteriology (gram staining, culture and antibiogram); radiography; Therapeutic data: Treatment: probabilistic antibiotic therapy instituted, its duration and surgical treatment benefited.

Course: Onset or persistence of infection, time between surgical procedure and onset of infection.

Final outcome.

2.2.6. Sampling and Antibiotic Susceptibility Testing

Samples were taken either by puncture syringe if the suppurations were abundant, or by swabbing for minimal suppurations of the wound or ear. Urine samples were taken from patients with bladder catheters using a sterile bottle. The samples were taken under rigorous aseptic conditions in hospital wards, in the sampling room of the CUKIS bacteriology laboratory and in the operating theatre. Germ identification and sensitivity were assessed on the basis of culture and antibiogram results supplied by the laboratories of the University Clinics of Kisangani and EMA ESU. Microscopic examination: for each sample, direct observation without staining was carried out to look for cellular elements (leucocytes, red blood cells and bacteria). Examination after staining: using the suppuration fluid, an initial smear was taken and then stained with May Grunwald Giemsa (MGG). This was followed by a quantitative and qualitative cytology of the leukocyte elements, based on microscopic observation. Another smear was taken and Gram-stained to determine the bacterial morphology and its affinity dyeto Gentian violet and fuschin. If the bacterium is stained purple, it is gram-positive. On the other hand, if the bacterium is stained pink, it is gram-negative. The results of gram staining are used to guide the subsequent bacteriological treatment of the sample, particularly in the choice of culture media. Culture: each sample was inoculated onto agarordinary, fresh blood agar, Mannitol Salt Agar (MSA) and Mac Conkey; incubated at 37˚C for 18 to 24 hours, the antibiogram in the event of a positive culture was performed by Mueller-Hinton Agar the diffusion method using a bacterial suspension with a turbidity of 0.5 according to the Mac Farland scale. Antibiotic discs ranging from 5 mm to 10 mm were used. The same method was applied to the urine sample.

2.2.7. Data Analysis Technique

Our data were collected and recorded on Microsoft Excel 2016 and analysed using

SPSS 2020 software; we calculated percentages to analyse our qualitative variables, calculated the mean and standard deviation for our quantitative variables with a symmetrical distribution and the median for our quantitative variables with a non-symmetrical distribution. The results are presented in tables.

2.2.8. Ethical Considerations

Prior to data collection, the agreement of the Dean of the Faculty of Medicine and Pharmacy of the University of Kisangani and the medical management of the University Clinics of Kisangani was obtained. Files were processed anonymously.

3. Results

Out of a total of 342 files collated from patients who had presented with an infection in all departments, 218 cultures had been performed, 181 were positive, including 11 cultures polymicrobial with 2 germs and 170 monomicrobial cultures, giving a total of 192 strains. A frequency of 52.9%. The patients were 135 men and 46 women, with an average age of 45.6 years (range: 0 to 90 years).

3.1. Types of Infection

Table 1 shows the distribution of patients by type of infection.

Table 1. Breakdown of patients by type of infection.

Type of infection	Workforce	Percentage
A. General surgery		
Traumatic infected ulcer	9	5
Infected ulcer	11	6.1
Tropical ulcer	6	3.3
Infected vascular ulcer	14	7.7
Infected budding ulcer	2	1.1
Infected traumatic wounds	9	5
Myositis suppurativa	3	1.6
Hot wall abscess	3	1.6
Perianal fistula	3	1.6
Wet gangrene	4	2.2
Infected diabetic foot	1	0.6
Infected thyroglossal cyst	1	0.6
B. Urology		
Urinary tract infection	26	14.4

Continued

Surgical site infection	11	6.1
C. Orthopaedics and traumatology		
Chronic osteomyelitis	4	2.2
Osteitis	4	2.2
Infected pseudarthrosis	2	1.1
Infected vicious callus	1	0.6
Infected open fractures	24	13.3
Surgical site infection	9	5
D. Thoracic surgery		
Pyothorax	3	1.6
E. Paediatric surgery		
Visceral necrosis/omphalocele complicated by sepsis	1	0.6
F. Digestive surgery		
Surgical site infection	12	6.6
G. Stomatology and maxillofacial surgery		
Suppurated and fistulised jugo-cervical phlegmon/dental caries	12	6.6
H. Otorhinolaryngology		
Acute and/or chronic suppurative otitis media	6	3.3
Total	**181**	**100**

The table shows that infected leg and/or foot, surgical site infections, infection sulcersurinary tract, infected open fractures and suppurated and fistulised jugo-cervical phlegmon/dental caries were the main types of infection, with 43 respectively cases (23.75%), 32 cases (17.67%), 26 cases (14.3%), 24 cases (13.25%) and 12 cases (6.6%).

3.2. Types of Germs

Table 2 shows the different germs that are isolated in the surgery department.

Table 2. Breakdown of cases by germ type.

Types of germs	Workforce	Percentage
Gram-positive		
Sphaphylococcus aureus	84	43.8
Streptococcus viridance	2	1
Gram-negative		
Escherichia coli	24	12.5

Continued

Citrobacter diversus	22	11.5
Citrobacter	9	4.7
Citrobacter spp.	3	1.6
Enterobacter	17	8.9
Enterobacter spp.	7	3.6
Proteus mirabilis	7	3.6
Proteus vulgarus	5	2.6
Pseudomonas aeruginosa	11	5.7
Proteus gergovia	1	0.5
Total	**192**	**100**

Table 2 shows that *Staphylococcus aureus*, *Escherichia coli*, *Citrobacter diversus* and *Enterobacter* were the main germs, with 84 (43.8%), 24 (12.5%), 22 (11.5%) and 17 (8.9%) cases respectively.

3.3. Multi-Resistant Germs

Table 3 shows germs.

Table 3. Breakdown of cases by multi-resistant germs.

Multi-resistant bacteria	Workforce	Percentage
Staphylococcus aureus	11	42.3
Proteus vulgaris	2	7.69
Proteus mirabilis	1	3.85
Escherichia coli	5	19.23
Citrobacter	1	3.85
Citrobacter diversus	2	7.69
Pseudomonas aeruginosa	3	11.54
Enterobacter spp.	1	3.85
Total	**26**	**100**

Analysis of this table shows that the multi-resistant germs isolated were *Staphylococcus aureus* in 11 cases (42.3%), *Escherichia coli* in 5 cases (19.23%), *Pseudomonas aeruginosa* in 3 cases (11.54%), *Citrobacter diversus* in 2 cases (7.69%) and *Proteus vulgaris* in 2 cases (7.69%).

The antibiotics commonly used in the Department of Surgery for probabilistic antibiotic therapy are shown in Table 4.

3.4. Antibiotics

Table 4 shows the antibiotics most commonly used in the department for probabilistic antibiotic therapy.

Table 4. Breakdown of cases according to probabilistic antibiotic therapy.

Antibiotics	Workforce	Percentage
Metronidazole	134	74
Ceftriaxone	108	59.7
Ciprofloxacin	28	15.5
Tax	14	7.7
Gentamycin	9	4.9
Cloxacillin	5	2.8
Amoxicillin	5	2.8
Furadatine	7	3.9
Ampicillin	3	1.6
Erythromycin	2	1
Cefotaxime	1	0.5
Chloramphenicol	1	0.5

Table 4 shows that metronidazole, ceftriaxone and ciprofloxacin are the antibiotics most commonly used in the surgical department, often in combination, with 134 cases (74%), ceftriaxone 108 cases (59.7%) and 28 cases (15.5) respectively.

3.5. Antibiogram

The antibiograms of the most commonly used antibiotics are presented below:

Antibiotic susceptibility testing:

1) *Staphylococcus aureus*: Ceftriaxone 29/67 (43.2%), Ciprofloxacin 25/46 (54.3%), Ampicillin 42/65 (64.6%) Amoxycillin 30/56 (53.6%), Gentamycin 29/51 (56.8%), Metronidazole: not tested.

2) *Eschericha coli*: Ceftriaxone 13/21 (61.9%), Ciprofloxacin 6/14 (42.8%), Ampicillin 9/12 (75%), Amoxycillin 5/8 (62.5%), Gentamycin 15/20 (75%), Metronidazole: not tested.

3) *Citrobacter diversus*: Ceftriaxone 4/15 (26.6%), Ciprofloxacin 5/10 (50%), Ampicillin 7/12 (58.3%), Amoxycillin 7/18 (38.8%), Gentamycin 9/14 (64.2%), Metronidazole: not tested.

4) *Enterobacter*: Ceftriaxone 5/13 (38.4%), Ciprofloxacin 7/8 (87.5%), Ampicillin 7/12 (58.3%) Amoxicillin 7/15 (46.6%), Gentamycin 7/16 (43.7%), Metronidazole: not tested.

5) *Pseudomonas aeruginosa*: Ceftriaxone 7/9 (77.7%), Ciprofloxacin 4/7 (57.1%), Ampicillin 6/7 (85.7%), Amoxycillin 4/6 (66.6%), Gentamycin 2/6 (33.3%), Metronidazole: not tested.

4. Discussion

The aim of this study was to establish the bacteriological profile of the infections and to assess their sensitivity to commonly antibioticsused. To achieve this objective, we carried out a retrospective study over 5 years. We will discuss these results in relation to the types of infection, the germs isolated and their sensitivity to the antibiotics most commonly used.

With regard to the types of infection found in our study, infected leg and foot ulcers of all aetiologies were predominant (23.75%), followed by surgical site infections (17.7%), urinary tract infections (14.4%), infected open (13.2%) and jugo-cervical phlegmon fractures suppurated and fistulised (6.6%). The predominance of infected is linked to the fact that ulcers in our low-income environments, when faced with any spontaneous or post-traumatic wound on the lower limb, most patients first turn to traditional medicine and consult modern medicine as a second line of defence in the event of complications such as infection and delayed healing. The high frequency of infections on surgical sites in our series is consistent with many authors who have reported that surgical site infections are the most frequent complication of surgical procedures and represent the 3rd most common nosocomial infection after urinary and respiratory infections [5] [6] [15]. Urinary tract infections were the 3rd most common infection in our study, after surgical site infections. Our results are similar to those reported by Doutchi *et al.* [5]. Most patients admitted to the urology department for uropathies obstructive (benign prostatic hypertrophy, prostatic adenocarcinoma and urethral stricture) had developed a urinary tract infection.

This study showed a predominance of *Staphylococcus aureus* (43.8%), followed by various species of enterobacteria, and a high rate of germs with sensitivity reduced to the antibiotics most commonly used in the surgical department. Staphylococci Aureus, commensal micro-organisms of the skin and nostrils, are the agents most involved in suppuration [3] [14] [17]. The predominance of *Staphylococcus aureus* followed by various species of Enterobacteriaceae, in particular *Escherichia coli*, has been reported by several authors in Africa [3] [12] [14] [18] [19]. Their nature commensal, combined with the virulence of certain species, explains why these bacteria are the cause of many infections [3] [14] [19] [20]. Our results differ from those of Kimuni *et al.* [15], who found a predominance of *Pseudomonas aeruginosa* (50%), followed by *Escherichia coli* (22%), *Staphylococcus aureus* (20%) and Klebsiella pneumoniae (6.8%). We would say that contamination of the surgical site most often occurs during the operative period, *i.e.* from the patient's flora prior to incision [15] [21]. Gram-negative such as *Escherichia bacilli coli*, *Enterobacter*, *Citrobacter diversus* and *Pseudomonas aeruginosa* are frequently isolated from urinary tract infections at the surgical site. We noted a high rate of multi-microbial infections in 11 cases (5.72%); these results are close to those found by Abdoulaye *et al.* [14], and lower than those found by Kouassi *et al.* in Bouaké [3]. The rate of multi-resistant bacteria in this study was high at 26 germs (13.5%), and these results are close to those found by other authors [3] [14]. This high frequency of multi-resistant germs in our study is consistent with the findings of Carlet and le Coz in France, who reported that every year, more than 150,000 patients suffer from infections linked to multi-resistant bacteria, with more than 12,500 deaths

[5] [22]. Infections caused by multi-resistant bacteria are increasingly being described, reflecting the failings of hospital hygiene in Sub-Saharan Africa and requiring a paradigm shift in the prescription of antibiotic prophylaxis and probabilistic antibiotic therapy [5] [10] [14]. The main antibiotic molecules used in our department are metronidazole (74%) in combination with either ceftriaxone or ciprofloxacin; unfortunately, metronidazole is not tested in our laboratories due to a lack of appropriate discs. Ceftriaxone (59.7%) showed resistance of 43.2% to *Staphylococcus aureus*, 61.9% to *Escherichia coli*, 26.6% to *Citrobacter diversus* and 77.7% to *Pseudomonas aeruginosa*. Ciprofloxacin (15.5%) showed resistance to 54.3% of *Staphylococcus aureus*, 42.8% to *Escherichia coli*, 50% to *Citrobacter diversus*, 87.5% to *Enterobacter* and 57.1% to Pseudomonas. This resistance rate is slightly higher than those found by other authors [3] [14] [19]. We believe that this antibiotic resistance is due to the precarious socio-economic conditions that do not allow a large proportion of the population to access quality care in time, and to self-medication, unqualified, prescribed spoor quality antibiotics, probabilistic sometimes antibiotic therapy that is under-dosed, and absence the of antibiotic prophylaxis in our department.

5. Conclusion

A study of the profile of bacteriological infections in the Surgical Department of the University Clinics of Kisangani in the Democratic Republic of the Congo showed a predominance of *Staphylococcus aureus* (43.8%), followed by *Escherichia coli* (12.5%) and *Citrobacter diversus* (22 cases, 42.2%). 26 multi-resistant germs and a rate high of germs with sensitivity reduced to commonly used antibiotics. Carbapenems, meropenem, Amikacin and Fosfomycin, although rarely used in the surgical department, were very active against most bacterial strains. It is therefore necessary to revise the antibiotic prescription protocol in collaboration with biologists, introduce antibiotic prophylaxis using the most active antibiotics in order to reduce the risk of selection of resistant strains, raise public awareness of the risk of antibiotic resistance and improve hospital hygiene in the department.

Authors' Contributions

Each author contributed to the drafting of the manuscript (literature review, protocol development, data collection and analysis, drafting, and reading of the final version).

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Conflicts of Interest

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

References

[1] (2009) Medical Dictionary. 6th Edition, Elsevier.

[2] Popa, M., Şerban, B., Lupu, A., Iacobescu, G. and Cursaru, A. (2020) Orthopedic Surgery Related Infections; Study of Antibiotic Resistance and Associated Comorbidities. *Romanian Journal of Orthopaedic Surgery and Traumatology*, **3**, 55-63. https://doi.org/10.2478/rojost-2020-0009

[3] Kouassi, A., Adelaide, N., Yao, L., Krah, K., M'Bra, K., *et al.* (2019) Bacteriological Profile of Infections in Orthopaedic-Traumatology in Bouaké. *Revue Internationale des Sciences Médicales*, **4**, 326-329.

[4] Di Benedetto, C., Bruno, A. and Bernasconi, E. (2012) Site Infection Surgical: Risk Factor, Prevention, Diagnosis and Treatment. *Revue Médicale Suisse*, **8**, 890-893.

[5] Doutchi, M., Adamou, H., Yahaya, M.L., Ousmane, L., Magagi, I.A., Halidou, M., *et al.* (2020) Infections du Site Opératoire à l'Hôpital National de Zinder, Niger: Aspects Épidémiologiques et Bactériologiques. *European Scientific Journal ESJ*, **16**, 576-589. https://doi.org/10.19044/esj.2020.v16n6p576

[6] Bouhelo-pam, K.P.B., Shimi, M., Elayoubi, A., Khaissidi, A., Bachiri, M., El Ibrahimi, A., *et al.* (2014) Nosocomial Infections in Orthopaedic and Traumatological Surgery. *Revue Marocaine de Chirurgie Orthopédique et Traumatologique*, **55**, 24-29.

[7] Fournel, L. (2017) Les infections du site opératoire. *Revue Francophone de Cicatrisation*, **1**, 27-30. https://doi.org/10.1016/s2468-9114(17)30345-6

[8] Baker, A.W., Dicks, K.V., Durkin, M.J., Weber, D.J., Lewis, S.S., Moehring, R.W., *et al.* (2016) Epidemiology of Surgical Site Infection in a Community Hospital Network. *Infection Control & Hospital Epidemiology*, **37**, 519-526. https://doi.org/10.1017/ice.2016.13

[9] Formalised Expert Recommendations from the French Anesthesia and Intensive Care Society and the French Language Infectious Pathology Society (2024) Antibiotic Prophylaxis in Surgery and Interventional Medicine 2024.

[10] Ouédraogo, A.-S., Somé, D.A. Dakouré, P.W.H., Sanon, B.G., Birba, E., Poda, G.E.A. and Kambou, T. (2011) Profil bactériologique des infections du site opératoire au Centre hospitalo-universitaire de BOBO Diaoulasso. *Médecine Tropicale*, **71**, 49-52.

[11] Moulot, M.O., Ehua, M., Agbara, K. and Banko Lé, S.R. (2017) Osteoarticular Infections in Children at the Centre Hospitalo-Universitaire (CHU) de Treichville. *Revue Internationale des Sciences Médicales*, **19**, 293-297.

[12] Elouennass, M., El Hamzaoui, S., Frikh, M., Zrara, A., Chagar, B. and Ouaaline, M. (2007) Les aspects bactériologiques des ostéites dans un hôpital universitaire. *Médecine et Maladies Infectieuses*, **37**, 802-808. https://doi.org/10.1016/j.medmal.2007.04.002

[13] Jaova, M.A., Dhaief, S., Frigui, S., Oueslatil, M., Krir, A. and Thabet, L. (2021) Epidemiology and Evolution of Antibiotic Resistance in Community Uropathogenic Germs in the Ben Arous Region. *The 30th National Congress of the Tunisian Society of Infectious Pathology*, Tunisia, 9-11 September 2021, P0275.

[14] Abdoulaye, O. Amadou, M.L.H., Amadou, O., Adakal, O., Larwanou, H.M., Boubou, L. *et al.* (2018) Aspects épidemiologiques et bacteriologiques des infections du site opératoire dans le service de Chirurgie B à l'Hopital National de Niamey (HNN). *Pan African Medical Journal*, **46**, 330-332. https://doi.org/10.11604/pamj.2018.31.33.15921

[15] Kimuni, K., Mazono, M., Mwema, N., Mbaz, K.A., Kalenga, M., Kabengele, N., *et al.* (2021) Antibiotic Resistance to Carbapenems in Germs Isolated from Surgical Wounds in Surgical Wounds in Lubumbashi Hospitals: The Case of Jason Sendwe, Gécamines Sud, Sncc (Société Nationale de Chemin de fer du Congo) and Polyclinic Shalina IOSR.

Journal of Pharmacy and Biological Sciences, 16, 50-55.

[16] Raisin (2014) Surveillance of Nosocomial Infections in Adult Intensive Care. Institut de veille Sanitaire.

[17] Titécat, M., Senneville, E., Wallet, F., Dezèque, H., Migaud, H., Courcol, R.-J., *et al.* (2013) Épidémiologie bactérienne des infections ostéo-articulaires dans un centre de référence: Étude sur 10 ans. *Revue de Chirurgie Orthopédique et Traumatologique*, **99**, 543-549. https://doi.org/10.1016/j.rcot.2013.03.061

[18] Societé de la Pathologie Infectieuse de Langue Francaise (2009) Recommendations for Clinical Practice: Oteoarticular Infections on Equipment (Prosthesis, Implant, Osteosynthesis).

[19] Bengalay, B., Traoré, D., Tagola, B., Samogo, S., Coulibaly, M., Dembele, S., *et al.* (2020) Infection du Site Opératoire en Chirurgie "B" CHU du Point B. *Mali Medical*, **35**, 29-34.

[20] Zerouki, A., Abada, S., Tali-Maamar, H., Rahal, K. and Naim. M. (2015) Characterization of Methicillin-Resistant *Staphylococcus aureus* Strains Isolated from Surgical Site Infections in Orthopedic and Trauma Surgery in an Algerian Hospital. *Revue de Chirurgie Orthopédique et Traumatologique*, **101**, 176-180. https://doi.org/10.1016/j.rcot.2014.12.010

[21] Garba, I., Mohamed, A.W., Younssa, H., Habibou, D. Aristote, H.-M. (2018) Surgical Site Infection in Clean Ortho-Traumatological Surgery in Cotonou. *Health Sciences and Disease*, **19**, 108-111.

[22] Carl, J. and Le Coz, P. (2015) Together, Let's Save Antibiotics. Antibiotics Alert Plan 2011-2016. Proposals from the de travail spécial pour la préservation des antibiotiques. République Française, Ministry of Social Affairs, Health and Women's Rights.