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Bacteremia: Profile and Antibiotic Resistance at the Infectious and Tropical Diseases Clinic in Fann Hospital, Dakar, Senegal

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Abstract

The main objective of our study was to perform a situational analysis of bacteremia diagnosed at the Clinic of Infectious Diseases Fann University Hospital in Dakar. This was a retrospective, descriptive study based on the records of patients hospitalized for bacteremia from January 1, 2013 to December 31, 2014. Epidemiological, clinical, biological, therapeutic and evolutionary variables were collected. Data analysis was done using Stata/SE software version 12.1.

Seventy-nine cases of bacteremia were reported in 1922 hospitalized patients at a proportion of 4.1%, and 86 bacterial strains were isolated. The median age was 43 years [IQR: 32; 53]. The main comorbidities found were HIV infection (73%) and high blood pressure (22.2%). Hyperleukocytosis was found in 20 cases (25.32%). The average level of Protein C Reactive was 83.90 ± 56.08 mg/L. Blood culture was monomicrobial in 74 cases (93.7%). The most common isolated bacteria were coagulase-negative *staphylococci* (23.1%), followed by *Pseudomonas aeruginosa*/spp (15.1%), *Staphylococcus aureus* (10.5%), *Escherichia coli* and *Acinetobacter spp* (8.1%). Isolated strains had low resistance to Imipenem, Vancomycin and Fusidic Acid. In monotherapy or in combination, the mostly used antibiotic was Ceftriaxone. The average duration of antibiotherapy was 10.40 ± 5.39 days. Thirty-three patients (41.8%) had died.

Cases of bacteremia present a high mortality. Isolated bacterial strains are becoming more resistant to the antibiotics available in our clinic. As a result, the rationalization of their use is adamant.

Keywords: Bacteremia; Antibiotic resistance; Dakar

Introduction

Bacteremia is defined as the presence of bacteria in the blood stream, authenticated by positive blood cultures.

The incidence of bacteremia is variable from a country to another. The incidence rates of bacteremia reported were estimated at 109.2 and 189 per 100,000 people per year [1,2]. Approximately 1.8 million episodes and 250,000 deaths occur each year in North America and Europe [3]. Whether community-based or nosocomial, the consequences of bacteremia are dire in dire in terms of mortality [2,4], and monitoring costs [5].

Their prognosis depends on several factors such as the speed and especially the effectiveness of the antibiotic therapy of first intention among others.

Cases of bacteremia are considered serious, especially because more often they are acquired during intensive care, due to the precariousness of the patients under care and especially of the morbidity attributed to these infections which constitutes a risk factor of death. In developed countries, it was reported 30-day case fatality rates of 13%-20.6% [2,6,7].

As such, bacteremia is a real diagnostic and therapeutic emergency. They are usually revealed based on clinical arguments which are then confirmed by the positivity of blood cultures. Nonetheless the microbiological documentation is not always obvious. Their prognosis depends on several factors, including the speed and especially the effectiveness of first-line antibiotherapy.

The emergence and increase of bacterial resistance to antibiotics complicate the management of cases. In some cases, physicians are faced with a "therapeutic impasse", in other words, the inability to find effective treatment for a given infection [8,9].

At the same time, the number of new antibiotics available on the market is becoming increasingly limited, severely narrowing therapeutic options. In our clinic, the last study on bacteremia was carried out more than ten years ago and focused on cases occurring in people infected with HIV/AIDS [10].

It is in this context that we carried out this study which main objective was to perform an analysis of bacteremia diagnosed at the infectious diseases Clinic of Fann University Hospital in Dakar. The specific objectives consisted in describing epidemiological, clinical and prognostic features and determining the antibiotic resistance profile of the bacterial strains isolated.

Material and Methods

This was a descriptive and retrospective study based on inpatient records for infectious and tropical diseases, collected over a 24-month period from January 1, 2013 to December 31, 2014. All the patients, regardless of sex or age, diagnosed with bacteremia were included in this study.

The diagnosis of bacteremia was established by the blood culture that was performed in patients at the time of febrile peaks or shaking chills with aseptic conditions. The seeding of the balloons was carried out while patients were in their beds. Once optimal blood culture specimens are collected, they were then sent to the Department of Bacteriology where they were incubated at 37°C for 5 days. In case of visible microbial growth, blood and chocolate agar plates (Bio rad laboratories, Richmond, CA) were inoculated, incubated in an atmosphere of 5% CO_2 at 37°C and examined after 48 h. Once the identification of the germs was done according to conventional techniques, each isolate was subjected to a standard antibiogram by the method of diffusion of the antibiotic discs in agar medium Mueller Hinton (MH) in accordance with the recommendations of the Antibiogram Committee of the French Society of Microbiology (CASFM).

Data were collected from patients' records. A standard survey form was completed for each patient that had helped to collect demographic data (age, sex, geographical origin, occupation, marital status); clinical data (HIV status, reasons for admission, origin of infection, associated diagnosis); bacteriological data (isolated germs, bacterial resistance, mono or poly microbial culture); biological data (NFS, CRP, renal function, glycemia); therapeutic data (antibiotics used, duration of treatment, association or not); prognostic data (time and duration of hospitalization, evolutionary modalities).

Data entry was done using Epi-Data software version 3.5.1 and their analysis was carried out using Stata/E software version 12.1. Categorical variables were expressed in terms of frequency and percentage of data entered with 95% confidence intervals (CI) assuming a Poisson distribution. Quantitative variables were expressed in means ± standard deviation or median (IQR).

Results

During the study period, 79 cases of bacteremia were collected from the 1922 hospitalized patients, a proportion of 4.1% and 86 bacterial strains isolated.

Demographic characteristics and clinical aspects

The study population was predominantly female with 44 cases (55.7%). Male patients accounted for 44.3% with a sex ratio (H/F) of 0.79. The median age was 43 (IQR, 32–53). The distribution according to the age category had shown that bacteremia was more found in the age groups 20-40 years and 40-60 years with respectively 38% and 40.5%. Nearly half of the study population (49.4%) came from the suburban area 30.4% from the urban area. According to marital status, half of patients were married (50%) and singles accounted for 26.8%.

The main comorbidities found were HIV infection (46/63 or 73%) and high blood pressure (14/63 or 22.2%). The most common reasons for hospitalization were fever (88.6%), general impairment (46.8%) and obnubilation (16.5%). A point of entry was identified in 30 patients. It was most often urinary (21 cases). Demographic characteristics and clinical aspects of the population (Table 1).

Socio-epidemiological and clinical characteristics	Number N=79	Percentage %	CI (95%)
Sex			
Male	35	44.3	30.9-61.62
Female	44	55.7	40.5-74.8
Age (years)			
<20	06	7.6	2.8-16.5
20-40	32	38	25.6-54.2
40-60	30	40.5	27.7-57.2
60-80	09	11.4	5.2-21.6
>80	02	2.5	0.3-9.2
Co-morbidity			
HIV	46	73	53.5-97.4
HTA	14	22.2	12.1-37.3
Obesity	1	1.6	0.04-8.84
Diabetes	1	1.6	0.04-8.84
Sickle Cell	1	1.6	0.04-8.84

Reasons for hospitalization			
Fever	70	88.6	69.07-100
Loss of weight	37	46.8	32.9-64.6
Obnubilation	13	16.5	8.7-28.1
Diarrhea	09	11.4	5.2-21.6
Cough	06	7.6	2.8-16.5
Origin			
Not found	49	62	45.9-82
Urinary	21	26.6	16.4-40.6
Genital	4	5.1	1.3-12.9
Pulmonary	3	3.8	0.8-11.1
Skin and soft tissue	2	2.5	0.3-9.2

Table 1 shows the demographic characteristics and clinical profile of bacteremia (N=79) with predominance of women (44/79), 40-60 years age group (40.5%), HIV+ patients (n=43), and urinary origin of infection (n=21) when identified.

Table 1: Socio-epidemiological and clinical characteristics of patients with bacteremia diagnosed at SMIT Fann in Dakar from 2013 to 2014.

Bacteriological aspects

Blood culture was monomicrobial in 74 cases (93.7%). The 86 bacterial strains isolated were predominantly Gram-negative bacteria with 50 isolates (58.1%). The most frequently isolated bacteria were coagulase-negative *staphylococci* (23.1%), followed by *Pseudomonas aeruginosa*/spp (15.1%), *Staphylococcus aureus* (10.5%), *Escherichia coli* and *Acinetobacter* spp (8.1%) (Table 2).

Pathogens	Frequency (n)	Percent (%)	CI (95%)
Negative coagulase *staphylococcus*	20	23.3	14.4-36.3
Pseudomonas aeruginosa/spp	13	15.1	8.1-26.2
Staphylococcus aureus	9	10.5	4.8-20.1
Escherichia coli	7	8.1	3.3-17
Acinetobacter spp	7	8.1	3.3-17
Enterobacter spp	6	7	2.6-15.4
Streptococcus D	6	7	2.6-15.4
Klebsiella pneumoniae	5	5.8	1.9-13.7
Salmonella spp.	5	5.8	1.9-13.7
Flavobacterium spp	4	4.7	1.3-12
Xanthomonas spp.	2	2.3	0.3-8.5
Non-fermenting	1	1.2	0-6.6
Streptococcus pneumoniae	1	1.2	0-6.6
Total	86	100	

Table 2 shows species distribution of the 86 bacterial strains identified with mainly presence of Negative coagulase *staphylococcus* (n=20) and *Pseudomonas aeruginosa*/spp (n=13).

Table 2: species distribution of bacterial strains identified during bacteremia at Fann SMIT from 2013 to 2014.

Isolated *staphylococcal* strains showed high resistance to some antibiotics, including oxacillin (40.7%), gentamicin (37.1%), erythromycin (48.1%) and cotrimoxazole (25.9%). No resistance was found for vancomycin, ciprofloxacin and fusidic acid (Table 3).

Antibiotics	Staphylococcus N=27 (%)	Streptococcus N=08 (%)
Amoxicillin	1 (3.7)	2 (25)
Amoxicillin-clavulanate	1 (3.7)	0
Oxacillin	11 (40.7)	5 (62.5)
Cefoxitin	3 (11.1)	1 (12.5)
Third generation cephalosporin	3 (11.1)	3 (37.5)

Ciprofloxacin	0	0
Imipenem	0	0
Piperacillin	0	1 (12.5)
Gentamicin	10 (37.1)	4 (50)
Cotrimoxazole	7 (25.9)	4 (50)
Lincocin	7 (25.9)	6 (75)
Erythromycin	13 (48.1)	5 (62.5)
Fusidic acid	0	0
Vancomycin	0	0
Table 3 show antibiotic resistance of *Staphylococci* et *Streptococci* isolated strains. *Staphylocci* strains exhibit high resistance to oxacillin (40.7%) and *Streptococci* strains were all sensitive to amoxicillin-clavulanic acid.		

Table 3: Antibiotic resistance of strains of *Staphylococcus* and *Streptococci* identified during bacteremia occurring at Fann SMIT from 2013 to 2014.

Regarding strains of isolated *Streptococci*, they were all sensitive to amoxicillin-clavulanic acid, imipénème, ciprofloxacin, fusidic acid and vancomycin. Significant resistance was found in aminoglycosides (50%), third-generation cephalosporins (37.5%), pefloxacin (37.5%) and lincocin (75%) (Table 3).

For the *Escherichia coli* strains, resistance was high, of the order of 100% for amoxicillin-clavulanic acid, 71.5% for C3G and 42.8% for ciprofloxacin, aztreonam, and cotrimoxazole (Table 4).

Antibiotics	**Escherichia N=7 (%)**	**Klebsiella N=5 (%)**	**Enterobacter N=6 (%)**	**Acinetobacter N=7 (%)**
Amoxicillin	4 (57.1)	3 (60)	4 (66.67)	2 (28.6)
Amoxicillin-clavulanate	7 (100)	5 (100)	5 (83.3)	3 (42.8)
Third generation cephalosporin	5 (71.5)	3 (60)	3 (50)	2 (28.57)
Ciprofloxacin	3 (42.8)	2 (40)	1 (16.7)	1 (14.3)
Aztreonam	3 (42.8)	1 (20)	1 (16.7)	1 (14.3)
Imipenem	1 (14.3)	0	1 (16.7)	1 (14.3)
Piperacillin	1 (14.3)	0	1 (16.7)	1 (14.3)
Gentamicin	2 (28.6)	3 (60)	3 (50)	3 (42.8)
Cotrimoxazole	3 (42.8)	4 (80)	4 (66.7)	1 (14.3)
Colistin	0	0	0	1 (14.3)
Table 4 shows antibiotic resistance of the isolated Gram-negative *bacilli* with higher resistance to third generation cephalosporin and gentamicin.				

Table 4: Antimicrobial resistance of the main *Enterobacteria* identified during bacteremia occurring at Fann SMIT from 2013 to 2014.

Isolated *Klebsiella* strains also showed complete resistance (100%) to amoxicillin-clavulanic acid, 80% for cotrimoxazole and 60% for C3G, gentamicin and ciprofloxacin (Table 4).

For *Enterobacter*, there was resistance of 83.3% to amoxicillin-clavulanic acid, 50% to C3G and gentamicin. One patient showed resistance to ciprofloxacin, imipenem and aztreonam (Table 4).

Concerning *Acinetobacter*, resistance was also found (42.8%) to amoxicillin-clavulanic acid, and aminoglycosides. One patient showed resistance to imipenem, ciprofloxacin, and colistin (Table 4).

The *Pseudomonas* strains found presented a high resistance to ticarcillin (30.8%), C3G (30.8%), colistin (38.5%) and gentamicin (46.1%). One of the 13 strains was resistant to imipenem (Table 5).

Antibiotics	**Pseudomonas N=13 (%)**
Amoxicillin	0
Amoxicillin-clavulanate	2 (15.4)
Ticarcillin	4 (30.8)

Third generation cephalosporin	4 (30.8)
Ciprofloxacin	0
Aztreonam	1 (7.7)
Imipenem	1 (7.7)
Piperacillin	2 (15.4)
Gentamicin	6 (46.1)
Cotrimoxazol	0
Colistin	5 (38.5)
Table 5 shows isolated *Pseudomonas* strains (n=13) antibiotic resistance. One of the strains was resistant to imipenem.	

Table 5: Antimicrobial resistance of *Pseudomonas* strains identified during bacteremia occurring at Fann SMIT from 2013 to 2014.

Therapeutic and prognostic aspects

The treatment was based on at least the use of two antibiotics in thirty-nine patients. Ceftriaxone was the mostly used molecule alone or in combination.

The average duration of antibiotic therapy was 10.40 ± 5.39 days. The most frequent duration was between 7 and 14 days (43.9%). The average time to hospitalization was 30.52 ± 37.77 days. For most patients (41%), it was less than 10 days. Concerning the average duration of hospitalization, it was 39.25 ± 12.46. The evolution was marked by death in 33 patients (41.8%).

Discussion

Epidemiological aspects

In this study the prevalence of bacteremia is low compared to existing data. Thus, the prevalence found in similar cases in Senegal, Guinea-Bissau and Côte d'Ivoire between 2002 and 2015 ranged from 12.6% to 22.5% [11-13]. These differences could be explained by the retrospective nature of our study and a shorter period of study.

We noted a female predominance of bacteremia. However, the share of sex in the occurrence of bacteremia does not seem to be established since several studies differ on this subject [11,14,15]. The incidence of bacteremia seams to increase with age [2,16,17].

In our study, the average age was 43 years [IQR: 32; 53] and the most representative age group of patients with bacteremia was 40-60 years old (40.5%).

Nearly half of the study population (49.4%) came from the suburban area. Most of the time, these patients were consulted in the nearer health facilities to their living area, and they were referred based on their clinical status. The Clinic of Infectious and Tropical Diseases is the national reference center for the treatment of infectious and tropical diseases. This could explain this rate of patients coming from the suburbs of Dakar.

A high rate of comorbidity was found in our study (63 out of 79 patients). HIV infection was mostly found (46 cases) or arterial hypertension (14 cases). An earlier but unpublished study performed in the same clinic in 2002 found co-morbidities in 70.1% and predominated HIV infection [11]. This is related to the very high proportion of HIV-infected people hospitalized in the clinic. In fact, in that clinic, 60% of beds were occupied by patients infected with HIV (66%). In 2013, a study published in the United States reported the same rates (73%) but the main comorbidity found was diabetes (25%) followed by immunosuppression (8%) [18].

Clinical aspects

The peculiarity of our study population with most HIV-infected patients explains the predominance of clinical signs such as sepsis and impairment of general condition or tuberculosis as the main diagnosis associated with bacteremia [19]. However, during the bacteremia in patients with AIDS in Dakar, fever and deterioration of the condition were noted in 87% of cases [10]. Moreover, in HIV+patients in Senegal, tuberculosis is the first opportunistic infection found [19].

The origin of the infection was unknown in 49 patients. It was found in 30 patients (37.97%) and among these it was urinary in 21 patients and 6 had a urinary catheter. Urinary tract infection is involved in half of bacteremia cases, following the studies [14,18,20,21]. The urinary catheter is known to be a major risk factor for urinary tract infection.

The absence of protocol governing the installation, care and monitoring of urinary catheters in our department as well as asepsis defects are probably at the origin of the importance of this point of entry in bacteremia. We did not find a portal linked to peripheral catheters. This is due to a lack of surveillance of related infections. More attention should be given to this possible origin for bacteremia.

Bacteriological aspects

Blood cultures were predominantly mono bacterial (93.6%) as in other studies [10,12]. In our isolates, Gram-negative (50 strains) predominated. The most common bacteria were Gram-positive *cocci* and Gram-negative *bacilli* [8,11-13,22]. The main organisms identified in our study are coagulase-negative *staphylococci* (23.3%), *Pseudomonas* (15.1%) and *Staphylococcus aureus* (10.5%). This frequency of *Staphylococci* could be explained by their nosocomial nature, related to the increase in invasive procedures [23], or by contamination.

Isolated *staphylococcal* strains were resistant to oxacillin in 40.7%. This result is similar to data available in the literature.

In the United States, the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) ranges from 15 to 74% [24]. This is also found in countries of the Mediterranean basin such as Egypt, Greece and Cyprus with respective rates of 48, 45 and 52% [25,26]. However, this important methicillin resistance has been in marked decline in some countries [27]. In Dakar Diallo H [11] found 55.7% of MRSA strains, compared to our result, we can note a regression of 15% between 2002 and 2015. In South Africa [28] and in Canada [29] this rate increased from 40% and 53% respectively to 24.2% and 19.4% respectively between 2010 and 2012.

The possible predisposing factors of MRSA emergence are, long time hospitalization, consumption of antibiotics without doctor prescription, lack of awareness, receipt of antibiotics before coming to the hospital. Also, more and more MRSA strains are becoming resistant to clindamycin [30] or vancomycin [31] further reducing the possibilities of treating their causative infections.

For coagulase-negative *staphylococci* (CNS), they represent the most isolated *cocci* in our study. They are mainly responsible for nosocomial infections [32] and are favored by certain medical procedures. The preponderance of these *staphylococcal* strains in our study may be due to the predominance of patients with profound immunosuppression. However, contamination due to aseptic defects at the time of the realization of blood cultures cannot be ruled out. The infections with these bacteria deserve to be studied more in the future by identifying factors associated with the occurrence of these bacteremia. In addition, advocacy for strict compliance with aseptic measures must be put in place.

No strain was resistant to ciprofloxacin, vancomycin or fusidic acid that may offer potential for treatment with these molecules. The slow use of fusidic acid is mainly related to the cost of treatment is still very high in our country. On the other hand, the fact that ciprofloxacin is easy to acquire explains its overuse and thus to the occurrence of resistance to this molecule.

Pseudomonas is a common cause of bacteremia [22,33]. *Pseudomonas* bacteremia are mainly nosocomial or healthcare-associated, occurring preferentially in elderly or immunocompromised [34,35]. In our study it is the second most frequently isolated strain. The high prevalence of HIV-infected people in our study may be one of the causes.

These *Pseudomonas* strains showed high resistance to aminoglycosides and ticarcillin. Resistance to ceftriaxone was 30.8% and all isolated strains were sensitive to ciprofloxacin and cotrimoxazole, thus offering a possibility of treatment with these molecules.

In Europe, however, high resistance of isolated *P. aeruginosa* strains has been reported to aminoglycosides, ceftazidime, quinolones, piperacillin-tazobactam and carbapenems [36].

In our study only one strain was resistant to imipenem. Actually, increasing prevalence of carbapenem-resistant *Pseudomonas aeruginosa* is a major concern and represents emerging challenge to public health, as the range of therapeutic agents becomes increasingly constrained [37,38].

In our facility, effective surveillance should be done on these carbapenem-resistant strains of *Pseudomonas* because they have public health implications and in addition the only carbapenem available in our country is imipenem and it remains out of reach for most of our patients. Ceftazidim, piperacillin-tazobactam and colistin are not available.

Pseudomonas aeruginosa and *Staphylococcus aureus* are members of "ESKAPE" pathogens group (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter bau-manii*, *Pseudomonas aeruginosa*, and *Enterobacter species*). These ESKAPE pathogens are responsible for the majority of nosocomial infections and capable of "escaping" the biocidal action of antimicrobial agents [39,40]. Knowledge of resistance genes prevalence in ESKAPE pathogens is necessary to prepare feasible data about tracing and treatment of infection related to these microorganisms. In a study in Iran, the predominant resistant genes regarding the *Pseudomonas aeruginosa* and *Staphylococcus aureus* were Mex-B at 81.17% and mecA at 24.65% respectively [41].

Therapeutic aspects

The most commonly used antibiotic in monotherapy or combinating therapy was ceftriaxone, with a resistance rate between 11.1% and 71.5% based on isolated germs. This frequent use of ceftriaxone seems to be shared in our sub-region, particularly in Côte d'Ivoire (53%) [13] and Burkina Faso (70%) [42]. It helps to increase the selection pressure and could lead to therapeutic impasses. Thus, it is urgent to promote compliance with the recommendations of the use of antibiotics, to expand the range of antibiotics available in our hospitals and to introduce better regulation of the prescription of these antibiotics. In our patients, 72% received probabilistic antibiotic therapy. However, no study was carried out to see whether this probabilistic antibiotic therapy was suitable or not. Inadequate or delayed antibiotic therapy is a mortality factor in bacteremia [20,43]. In addition, it would increase mortality by 60% [44]. Antibiotic therapy is more suitable if the highlighted organism is a Gram-negative bacterium, *Streptococcus pneumoniae* or *Enterococcus* [45].

The duration of antibiotherapy in patients with bacteremia is very variable and often prolonged. Havey found an average duration of 11 days in his study of 100 patients with bacteremia, similar result was found in our series (10.40 ± 5.39 days) [18]. In this same review, the predictors of prolonged antibiotic therapy were: long-term treatment, underlying respiratory tract infection, *Staphylococcus aureus* infection, or *Pseudomonas* infection.

Regarding the antibiotic treatment used and the occurrence of death, Suzuki [46] had shown that the death rate was the same whether mono antibiotherapy or combination was used.

Evolutionary and prognostic aspects

The mortality rate for all infections, community or nosocomial bacteremia is between 11% and 20.6% in the first month following the infectious episode [2,6,7,20]. The mortality found in our series is even more important (42%). According to the literature, different factors are associated with death. Thus, immunodepression [14,47] has already been described as a risk factor four times higher than immunocompetence. Other factors identified by authors were hypoalbuminemia, moderate fever or hypothermia [48,49], elevated CRP [48], elevated serum creatinine [20], origin other than urinary and central venous catheter infection [50]. In the *Acinetobacter* and *Pseudomonas* bacteremia, the factors associated with death were the nosocomial nature of the infection, male sex, history of aminoglycoside and vancomycin exposure [51]. A finer analysis would identify factors associated with death in our patients.

The limits of our study are of several kinds. First, SMIT Fann is a reference center for the treatment of people infected with HIV, so these patients are found in the majority and they are often hospitalized at a later stage. This has an impact on the profile of isolated germs and on the outcomes of these patients. Moreover, most of our patients did not benefit from an health insurance and therefore could not afford several blood samples for blood culture. This induces an underestimation of the sensitivity of the blood culture. Another limitation is the retrospective nature of our study, which meant that the study population was not sampled and that some variables were missing in patients' observations. Also, catheter-related bacteremia was not listed, and a origin of the infection was not routinely sought.

Conclusion

Bacteremia plays a significant role at the clinic of infectious and tropical disease of Fann university hospital. Their prognosis is marked by a high lethality and they are characterized by a strong resistance to antibiotics in use. This requires a rigorous management of the prescription of antibiotics. The predominance of urinary point of entry imposes the establishment of procedures and a better respect of asepsis during the installation of urinary catheters. Active surveillance of these infections should be implemented including ESKAPE bacteria and would monitor antimicrobial resistance. Also, rationalization of the use of antibiotics is adamant.

Conflict of Interest

Authors declare no conflicts of interest.

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