Antibiotic Resistance and Environmental Contamination in Healthcare Facilities: A Case Study of the Regional Hospital Center of Banfora

Résistance aux antibiotiques et contamination environnementale dans les établissements de santé : étude de cas du Centre hospitalier régional de Banfora

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Abstract

Objective: Hospital surfaces are a reservoir for multidrug-resistant bacteria (MDROs), facilitating their transmission between patients and healthcare workers. The objective of this study was to assess bacterial contamination of frequently touched surfaces and the antibiotic resistance profile of bacteria at the Banfora Regional Hospital Center in Burkina Faso. **Methods**: A cross-sectional study was conducted at the Banfora Regional Hospital Center. Seventy-seven (77) surfaces were sampled in four clinical and administrative departments after routine cleaning procedures. Bacterial identification was performed using the API 20E gallery. Antimicrobial susceptibility was assessed by the disc diffusion method, in accordance with the 2015 CA-SFM recommendations. **Results:** A total of 94 bacterial strains were isolated, dominated by *Bacillus* spp. (60.64%) and *Acinetobacter baumannii* (6.38%). Door handles were the most contaminated surfaces. The isolated bacteria showed very high resistance to beta-lactam antibiotics. The prevalence of methicillin-resistant *Staphylococcus aureus* and extended-spectrum beta-lactamase-producing bacteria was 100% and 47.6%, respectively. **Conclusion**: This study conducted at the Centre Hospitalier Régional de Banfora reveals significant bacterial contamination of hospital surfaces. These results underscore the urgent need to strengthen cleaning and disinfection protocols to reduce the risk of healthcare-associated infections and the spread of MDROs.

Keywords: Antibiotic resistance, environmental contamination, MDROs, CHR Banfora, Burkina Faso.

Résumé

Objectif : Les surfaces environnementales hospitalières constituent un réservoir de bactéries multirésistants (BMR), favorisant leur transmission entre patients et personnels de santé. Cette étude avait pour objectif d'évaluer la contamination bactérienne des surfaces fréquemment touchées et le profil de résistance aux antibiotiques des bactéries au Centre Hospitalier Régional de Banfora, au Burkina Faso. **Méthodes :** Une étude transversale a été réalisée au Centre Hospitalier Régional de Banfora. Soixante-dix-sept (77) surfaces ont été échantillonnées dans quatre services cliniques et administratifs après les procédures de nettoyage de routine. L'identification bactérienne a été réalisée avec la galérie API 20E. La sensibilité aux antimicrobiens a été évaluée par la méthode de diffusion sur disque, conformément aux recommandations du CA-SFM 2015. **Résultats :** Au total, 94 souches bactériennes ont été isolées, dominées par *Bacillus* spp. (60,64 %) et *Acinetobacter baumannii* (6,38%). Les poignées de porte étaient les surfaces les plus contaminées. Les bactéries isolées ont montré une résistance très élevée aux antibiotiques de la famille des bêta-lactamines. La prévalence de *Staphylococcus aureus* résistant à la méthicilline et des bactéries productrices de bêta-lactamases à spectre étendu était respectivement de 100 % et de 47,6 %. **Conclusion :** Cette étude menée au Centre Hospitalier Régional de Banfora révèle une contamination bactérienne importante des surfaces hospitalières. Ces résultats soulignent la nécessité urgente de renforcer les protocoles de nettoyage et de désinfection pour réduire le risque d'infections associées aux soins et de dissémination des BMR.

Mots clés : Résistance aux antibiotiques, contamination environnementale, BMR, CHR Banfora, Burkina Faso.

BACKGROUND

Healthcare-associated infections (HAIs) represent a critical global health issue, affecting around 136 million of patients annually [1,2]. Defined as infections acquired more than 48 hours after hospital admission and absent at the time of admission, HAIs are associated with significant morbidity, mortality, prolonged hospital stays, and increased healthcare costs [3], [4,5,6]. Furthermore, HAIs contribute substantially to the emergence and spread of antimicrobial resistance (AMR), complicating infection management and threatening global public health [7]. One of the key factors driving the persistence and dissemination of HAIs is environmental contamination in healthcare facilities [8,9]. Surfaces and equipments that are inadequately cleaned or disinfected can serve as reservoirs for multidrug-resistant organisms (MDROs), such as methicillin-resistant *Staphylococcus aureus* (MRSA) and multidrug-resistant *Acinetobacter baumannii* [10,11]. These pathogens can survive on surfaces for extended periods, increasing the risk of transmission to patients, particularly in resource-limited settings [12,13]. In developing countries, the challenges of preventing HAIs are heightened by limited healthcare infrastructure, inconsistent cleaning protocols, and improper use of antibiotics [14]. According to the World Health Organization (WHO), the prevalence of HAIs in these regions is significantly higher, with rates up to 20 times greater than those observed in developed nations [15]. This underscores the urgent need to investigate and address the environmental and procedural factors contributing to HAIs in such contexts.

This study identified bacterial strains persisting on hospital surfaces after routine cleaning at the Banfora Regional Hospital Center to evaluate the effectiveness of current disinfection practices.

MATERIALS AND METHODS

❖ Ethical and administrative considerations

This study was conducted in accordance with administrative requirements for environmental research. Formal authorization was obtained from the General Management of the Regional Hospital Center (CHR) of Banfora (Authorization letter attached). As the study focused exclusively on inert environmental surfaces and did not involve human subjects, clinical samples, or personal medical data, formal approval from a health ethics committee was not required under local regulations.

❖ Study site and sample collection

This study was conducted at the Regional Hospital Center (CHR) of Banfora, situated in the Tannounyan region of Burkina Faso. Clinical departments, including pediatrics, gynecology and obstetrics, surgery, as well as the administration, served as primary sampling locations. Microbiological analyses were performed in the bacteriology section of the medical biology laboratory at CHR Banfora. Sampling focused on surfaces within these clinical and administrative areas, targeting frequently touched items such as door handles, patient beds, mattresses, faucet heads, chairs, care trays, desks, intravenous poles, sinks, surgical lamps, trolleys, workbenches, light switches, delivery tables, and delivery boxes. The selection of surfaces was guided by their potential infectious risk for patients and healthcare staff. A total of 77 surfaces (n=77) were sampled once during the October 1 to November 30, 2019 for data collection and December 1, 2019 to February 29, 2020 for data analysis and processing.

Sampling was carried out in the mornings after routine cleaning procedures. Sterile swabs moistened with 1 mL of sterile isotonic saline solution (0.9%) were used for sample collection. The swabbing technique involved systematic parallel strokes followed by perpendicular strokes at a 45° angle under uniform pressure, covering a surface area of approximately 25 cm^2. Samples were collected at 9:00 AM and transported to the laboratory within 15 minutes of collection.

❖ Laboratory Procedures

Each swab was eluted into 5 mL of Brain Heart Infusion (BHI) (REF:237510) broth and incubated at 37°C for 24 hours or up to 48 hours if the broth remained clear. Turbid broths were subjected to Gram staining, and 10 µL of the suspension was inoculated on to chocolate agar (CA) supplemented with polyvitex (PVX) (REF CM0003B et SR0050C et SR0090A). The following culture media were utilized according to the organisms suspected after Gram staining, isolated on the GC+PVX medium. The Chapman medium (REF CM0085B) was employed to isolate Gram-positive cocci in clusters, indicating suspected *Staphylococcus* species. Bile Esculin Azide (BEA) agar (REF CM0888B) was utilized to target Gram-positive diplococci or short chains, suggesting *Enterococcus* species. Eosin-

Methylene Blue (EMB) agar (REF CM0069B) supported the growth of Gram-negative bacilli, including suspected enterobacteria and non-fermenting bacilli. Müller Hinton agar (CM0337B) was used for Gram-positive bacilli and to detect pyoverdine production by *Pseudomonas aeruginosa*. Chocolate agar supplemented with PVX facilitated the isolation of Gram-positive cocci in chains, indicative of *Streptococcus* species. All media were incubated at 37°C under aerobic conditions for 24 hours or up to 48 hours in the case of CA+PVX.

❖ **Bacterial Identification**

The identification was carried out based on morphological, cultural and biochemical. After the oxidase test, all Gram-negative bacilli were identified using the API 20 E Gallery. The API 20E (bioMérieux API 20E Ref:20100) was used for biochemical identification. The API 20E was inoculated with a bacterial inoculum prepared from a single colony resuspended in 5 ml of sterile physiological water. This colony was derived from the growth of a pure bacterial strain on Müller-Hinton (MH) agar. After incubation, the gallery results were recorded on an identification sheet. The strain was identified using a code referenced in the associated catalogue. To identify Gram-positive cocci, we use the catalase and coagulase tests. The identification algorithm is shown in Figure 1.

❖ **Antibiotic Susceptibility Testing**

Müller-Hinton (MH) agar or chocolate agar (for streptococci) were used for antibiogram testing in accordance with the recommendations of the Antibiogram Committee of the French Society for Microbiology (CA-SFM) 2015. The inoculum was prepared using the Inoclic method. The standardized bacterial suspension was created by collecting the top of a colony from a pure and fresh culture (less than 24 hours old) with Inoclic, and resuspending it in 700 microliters of sterile physiological water. The MH agar was inoculated by swabbing. The antibiotic sensitivity profile was determined using the agar diffusion method, and interpreted according to CA-SFM / EUCAST V2 juillet 2015 criteria

❖ **Investigation of Resistance Phenotypes**

Detection of Extended-Spectrum Beta-Lactamase (ESBL)-Producing Strains

Strains of enterobacteria producing ESBL were identified using a synergy test combining Amoxicillin-clavulanic acid (AMC) (REF E110116K) with a third-generation cephalosporin Ceftriaxone (CRO) (REF CT0412B). The appearance of a synergy «champagne cork» pattern between these antibiotics confirmed the production of ESBL by the strain under study.

Quantitative Method for ESBL Detection

The quantitative method involved comparing the inhibition zone diameters of ceftazidime combined with clavulanic acid (CZC) (REF LF9145) and ceftazidime alone (REF 67298). A difference in diameter greater than 5 mm was interpreted as evidence of ESBL production.

Qualitative Snail Test for ESBL Detection

In cases of uncertainty regarding ESBL production, a qualitative test known as the "snail test" was performed. On agar pre-seeded with the suspected ESBL-producing strain, a disk containing ticarcillin-clavulanic acid (TIM) (REF LF9096) was placed in the center, surrounded by four cefepime (FEP) (REF CT0661B II) disks at increasing distances. After incubation at 37°C for 18 hours, the test was considered positive if a snail-shaped growth inhibition pattern appeared around the TIM disk.

Methicillin Resistance in *Staphylococcus* Strains

Methicillin resistance was assessed using a cefoxitin (30 µg) disk under standard antibiogram conditions. Strains with an inhibition zone diameter of less than 22 mm were classified as methicillin-resistant.

KT and KTG Phenotypes

Strains resistant to gentamicin (CN) (REFLF9026) also exhibit resistance to tobramycin (TOB) (REF LF9037) and kanamycin (K) (REF LF9015), corresponding to the KTG phenotype. Strains resistant to tobramycin are also resistant to kanamycin, defining the KT phenotype.

Inducible MLS Resistance Phenotype

The detection of the inducible MLSb phenotype was done by placing an erythromycin disk 20mm from a clindamycin disk in the standard antibiotic susceptibility test and observing the induction phenomenon after 24 hours.

❖ **Data analysis**

The data were analyzed using Epi Info software version 7.2.3.0, with a significance level set at 5%.

RESULTS

❖ **Distribution of samples by hospital ward and collection site**

Of the 77 samples collected, 74 yielded positive cultures, corresponding to a positivity rate of 94.8% (Table1). Notably, the gynecology-obstetrics, surgery/postoperative, and administrative departments exhibited a 100% contamination rate. A total of 94 bacterial strains were isolated. Among these departments, the postoperative surgery unit recorded the highest number of isolated bacterial strains, with 32 strains (32/94, 34.04%), followed by the gynecology-obstetrics department, where 26 strains (26/94, 27.65%) were identified, and the pediatrics department with 21 strains (21/94, 22.34%) **(Table 1).**

❖ **Prevalence of isolated bacteria**

The most frequent species were *Bacillus* spp. (60.6%; 95% CI [50.8–70.5]), followed by *Acinetobacter baumannii* (6.38% [1.44–11.32]) and *Staphylococcus epidermidis* (6.38%) [1.44–11.32]), *Staphylococcus saprophyticus* (5.32%) [0.79; 9.85] **(Table 2)**.

❖ **Distribution of isolated bacteria according to ward and collection site**

The distribution of isolated bacteria was relatively homogeneous across hospital wards. *Bacillus* spp. were frequently recovered from surfaces such as door handles, tables, and other miscellaneous surfaces, while opportunistic bacteria such as *Acinetobacter baumannii* and *Staphylococcus* spp. were more often associated with beds, benches, and care trays **(Table 3)**.

❖ **Antimicrobial resistance profile of Gram-negative bacilli**

Gram-negative bacilli exhibited an almost generalized resistance to the tested beta-lactams (amoxicillin/clavulanic acid, cefotaxime, ceftazidime) (8/13, 61.53%). Only one isolate showed resistance to imipenem, indicating an overall preserved susceptibility to carbapenems (1%) **(Figure 2)**.

❖ **Antimicrobial resistance profile of Gram-positive cocci**

Among Gram-positive cocci, an almost complete resistance to penicillin G was observed. (84.61%) A few isolates also showed resistance to ciprofloxacin, (50%) and vancomycin (50%) (Figure 2).

Resistance phenotypes detected

All isolates of *Klebsiella pneumoniae* 100% (2/2), *Escherichia coli* 100% (1/1) and *Citrobacter koseri* 100% (1/1) were extended-spectrum beta-lactamase (ESBL) producers. Both *Staphylococcus aureus* isolates were methicillin-resistant 100% (2/2). Among coagulase-negative staphylococci, resistance phenotypes to gentamicin (G) and inducible macrolide-lincosamide-streptogramin (iMLS) were observed **(Table 4)**

Table 1. Prevalence of Bacterial Contamination and Distribution of Isolated Strains Across Hospital Departments after the Cleaning

Hospital Department	Number of Samples Collected	Positive Cultures (%)	Number of Isolated Bacterial Strains (%)
Pediatrics	21	19 (90.5)	21 (22.34)
Gynecology-Obstetrics	22	22 (100)	26 (27.66)
Surgery/Post operative	21	21 (100)	32 (34.04)
Administration	13	13 (100)	15 (15.96)
Total	**77**	**74 (94.8)**	**94**

Table 2. Prevalence of isolated bacteria by species

Families	Bacteria	Count	Prevalence (%)	IC95%
Enterobacteria	*P. mirabilis*	4	4.25	[0.18; 8.32]
	E. cloacae	3	3.19	[0; 6.74]
	K. pneumoniae	2	2,13	[0; 5.04]
	C. koseri	2	2.13	[0; 5.04]
	E. coli	1	1.06	[0; 3.13]
	Pantoea spp.	1	1.06	[0; 3.13]
Non-fermenting Gram-negative bacilli (NF-GNB)	*A. baumannii*	6	6.38	[1.44; 11.32]
	P. aeruginosa	2	2.13	[0; 5.04]
Staphylococcus	*S. epidermidis*	6	6.38	[1.44; 11.32]
	S. saprophyticus	5	5.32	[0.79; 9.85]
	S. aureus	2	2.13	[0; 5.04]
Enterococcus	*Enterococcus sp.*	3	3.19	[0; 6.74]
Bacillus	*Bacillus sp.*	57	60.64	[50.77 ;70.51]

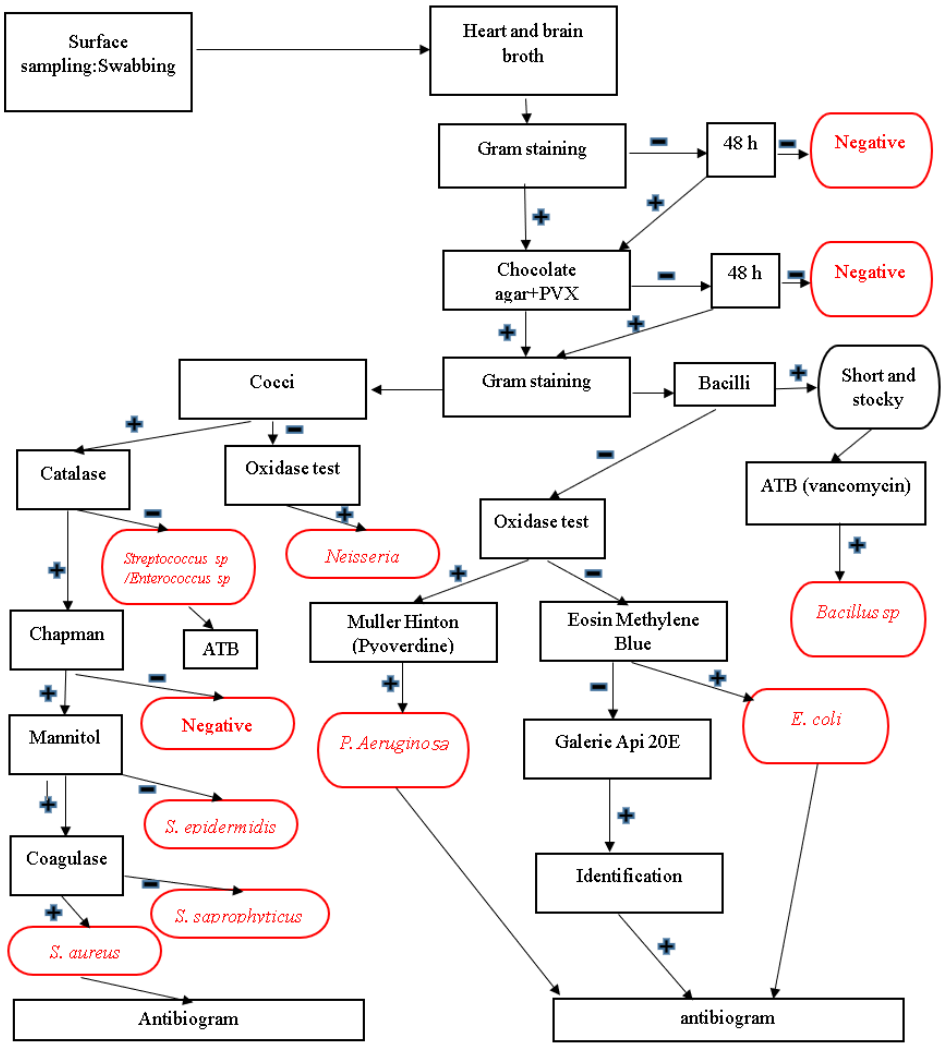
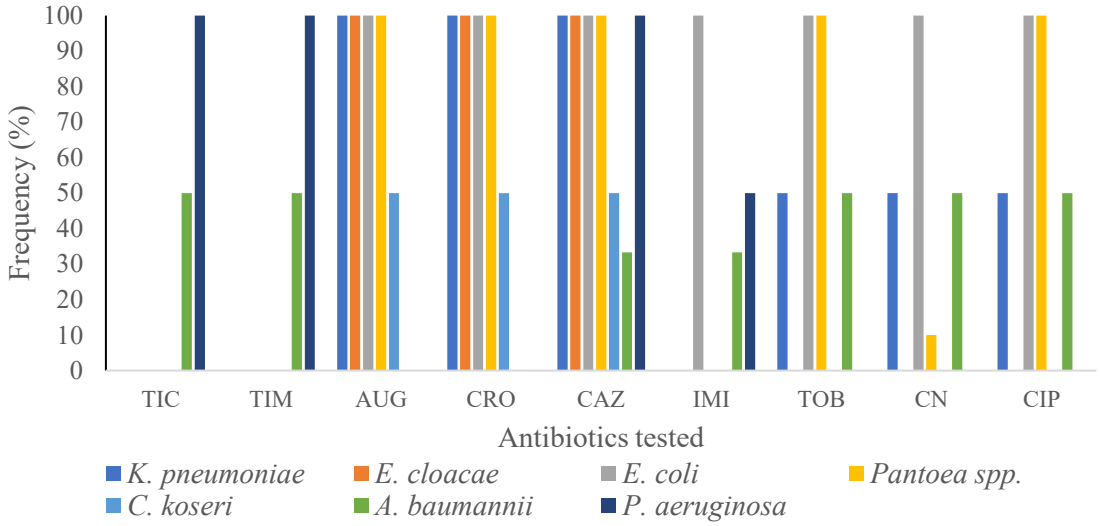


Figure 1: Sample analysis protocol



Figuree 2. Antimicrobial resistance profile of Gram-negative bacilli

TIC = Ticarcillin, IMP = Imipenem, AUG = Amoxicillin-clavulanate, TIM = Ticarcillin-clavulanate, CRO = Ceftriaxone, CAZ = Ceftazidime, CN = Gentamicin, CIP = Ciprofloxacin, TOB = Tobramycin

Table 3. Distribution of isolated bacteria according to ward and collection site

Hospital Department	Sites	Bacteria	Number (%)
Pediatrics	Door handles	*A. baumannii*	1 (1.01)
		Bacillus spp	3 (3.19)
	Beds	*S. epidermidis*	1 (1.01)
	Care trays	*S. epidermidis*	1 (1.01)
	Tables	*S. saprophyticus*	1 (1.01)
		K. pneumoniae	1 (1.01)
		Bacillus spp	1 (1.01)
	Workbenches	*E. cloacae*	1 (1.01)
	Other surfaces	*Bacillus* spp	11 (11.7)
Gynecology-Obstetrics	Door handles	*Bacillus* spp	1 (1.01)
		E. coli	1 (1.01)
		S. saprophyticus	1 (1.01)
	Mattresses	*K. pneumoniae*	1 (1.01)
	Beds	*A. baumannii*	1 (1.01)
	Tap handles	*P. aeruginosa*	1 (1.01)
	IV poles	*E. cloacea*	1 (1.01)
	Sinks	*Enterococcus* spp	1 (1.01)
		S. epidermidis	1 (1.01)
		Bacillus spp	1 (1.01)
	Workbenches	*Bacillus* spp	2 (2.12)
		E. cloacea	1 (1.01)
	Tables	*Bacillus* spp	2 (2.12)
		A. baumannii	1 (1.01)
	Door handles	*Pantoea* spp	1 (1.01)
	Other surfaces,	*Bacillus* spp	9 (9.57)
Surgery/Post operative	Door handles	*Bacillus* spp	3 (3.19)
		S. aureus	1 (1.01)
		S. epidermidis	1 (1.01)
	Mattresses	*P. mirabils*	1 (1.01)
	Beds	*P. mirabils*	1 (1.01)
		Bacillus spp	1 (1.01)
	Care trays	*Bacillus* spp	1 (1.01)
		Enterococcus spp	1 (1.01)
	Tables	*Bacillus* spp	1 (1.01)
		S. saprophyticus	1 (1.01)
		A. baumannii	1 (1.01)
	Intravenous pole	*Bacillus* spp	3 (3.19)
		S. saprophyticus	1 (1.01)
		A. baumannii	1 (1.01)
	Sinks	*C.koseri*	1 (1.01)
		S. saprophyticus	1 (1.01)
		Bacillus spp	1 (1.01)
	Workbenches	*Bacillus* spp	2 (2.12)
		S. aureus	1 (1.01)
		A. baumannii	1 (1.01)
		P. mirabilis	1 (1.01)
	Other surfaces	*Bacillus* spp	6 (6.38)
Administration	Door handles	*Bacillus* spp	2 (2.12)
		Enterococcus spp	1 (1.01)
		P. mirabilis	1 (1.01)
	Chairs	*Bacillus* spp	1 (1.01)
		S. epidermidis	1 (1.01)
	Sinks	*P. aeruginosa*	1 (1.01)
	Tap handles	*Bacillus* spp	1 (1.01)
		C.koseri	1 (1.01)
	Tables	*S. epidermidis*	1 (1.01)
	Other surfaces	*Bacillus* spp	5 (5.31)
Total			94 (100)

Table 4. Distribution of resistance phenotypes by bacterial species

Bacteria	Number of isolated bacteria	Number of resistant bacteria	Phenotypes detected	Number of phenotypes (%)
K. pneumoniae	2	2	ESBL	2 (100)
E. cloacae	3	3	ESBL	1 (33.3)
E. coli	1	1	ESBL	1 (100)
C. koseri	1	1	ESBL	1 (100)
A. baumannii	6	3	ESBL	1 (50)
S aureus	2	2	MRSA	2 (100)
S. epidermidis	6	4	Methicillin resistance G MLSB inductable	2 (33.3) 1 (16.6) 3 (50)
S. saprophyticus	5	2	MLSB inductable G	1 (20) 1 (20)

ESBL= Extended-spectrum beta-lactamase, MRSA= Methicillin Resistance Staphylococcus aureus, G= gentamicin, MLSB= Macrolide-lincosamide-streptograminB

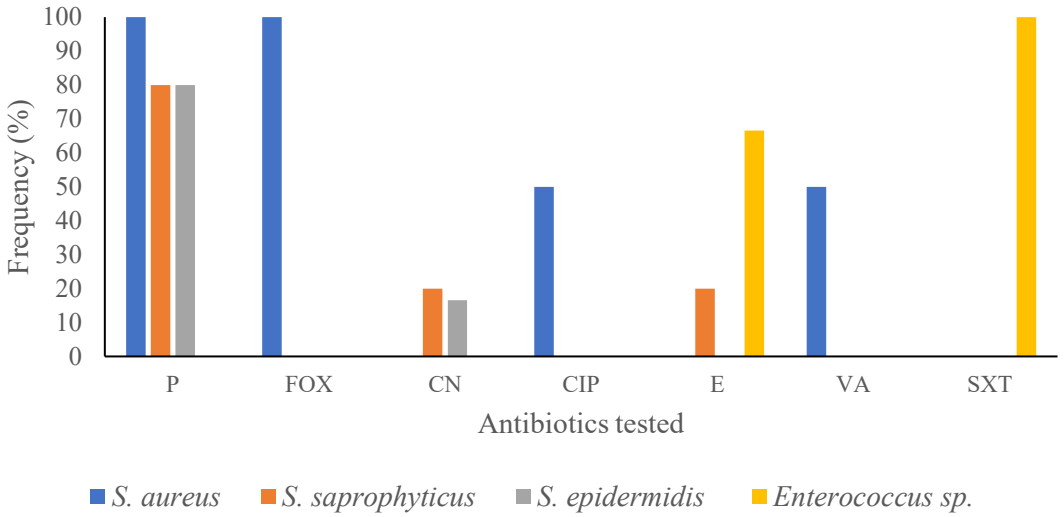


Figure 3. Antimicrobial resistance profile of Gram-positive cocci

P = Penicillin, *AMP = Ampicillin, CN = Gentamicin, CIP = Ciprofloxacin, E = Erythromycin, MY = Lincomycin, VA = Vancomycin, SXT = Cotrimoxazole, FOX = Cefoxitin*

DISCUSSION

This study conducted at the *Centre Hospitalier Régional de Banfora* reveals significant bacterial contamination of hospital surfaces, with a high positivity rate of 94.8%. Our results reveal an alarming level of environmental contamination by both indicator and clinically relevant multidrug-resistant organisms (MDROs), underscoring a critical challenge for infection prevention and control (IPC) in this resource-constrained setting. This finding aligns with several African studies demonstrating that hospital environments act as major reservoirs for pathogenic microorganisms, particularly in settings where hygiene protocols may be inadequately implemented [16]. The predominance of *Bacillus* spp., spore-forming bacteria known for their resistance to harsh environmental conditions, confirms their status as classic environmental contaminants in healthcare facilities. However, the notable presence of opportunistic pathogens such as *Acinetobacter baumannii* and *Staphylococcus* spp., particularly methicillin-resistant *Staphylococcus aureus* (MRSA), represents a significant risk to patient safety. Many pathogens can survive and retain their infectious potential in the environment for prolonged periods [17, 18] and their ability to form biofilms and withstand desiccation enables persistence on hospital surfaces [19]. Consequently, inadequate environmental cleaning considerably increases the risk of healthcare-associated infections (HAIs), particularly through contamination of frequently handled high-touch surfaces such as

sinks, patient beds, and linens [20, 21]. A total of 94 bacterial strains were isolated, with the highest proportion recovered from the postoperative surgery unit (34.04%), followed by gynecology-obstetrics (27.65%) and pediatrics (22.34%). This heterogeneous distribution reflects varying exposure to HAI risk factors. The high contamination in surgical units can be explained by the frequency of invasive procedures, prolonged hospitalization, and intensive or empirical use of broad-spectrum antibiotics, which generate strong selective pressure favoring multidrug resistance, as widely reported in tertiary hospitals. The substantial proportion observed in pediatrics is particularly concerning, as children-especially neonates-are highly vulnerable due to immune immaturity, frequent invasive procedures, and prolonged hospital stays. These findings are consistent with reports from African studies, notably in Kenya, documenting high contamination rates in pediatric and neonatal units [22]. Higher contamination levels in referral hospitals compared with lower-level facilities have also been reported and are often attributed to the admission of patients with severe infections or prior antibiotic exposure, increasing the risk of selection and transmission of MDROs [23].

The distribution of isolates further revealed that frequently touched surfaces act as key transmission hotspots. Door handles (15.95%), workbenches, and light switches (10.63%) were the most contaminated sites, consistent with global literature identifying high-touch items as critical vectors for MDROs transmission [10]. The isolation of clinically important strains such as *Escherichia coli* on door handles and *Staphylococcus aureus* on workbenches highlights sub-optimal hand hygiene practices and emphasizes the need for targeted, high-frequency disinfection of these surfaces. Regarding antibiotic resistance, Gram-negative bacilli showed almost generalized resistance to tested beta-lactams, while susceptibility to carbapenems remained largely preserved, with resistance observed in only one isolate. This pattern may reflect selective pressure due to overuse of commonly prescribed antibiotics such as ceftriaxone, favoring the emergence of cephalosporin resistance. Because of innate resistance to first- and second-generation cephalosporins, treatment options for Gram-negative infections are often limited to carbapenems, fluoroquinolones, and aminoglycosides [24] . *A. baumannii* is intrinsically resistant to several commonly prescribed antibiotics, making carbapenems the primary therapeutic option for MDROs infections [25]. Among Gram-positive cocci, high resistance to penicillin G (84.61%) was observed, with additional resistance to ciprofloxacin and vancomycin. Resistance to these antibiotics is clinically significant, as they are commonly used for enterococcal infections, and vancomycin often represents a last-line option [26]. Regarding phenotypes detected, the widespread dissemination of extended-spectrum beta-lactamases (ESBL). All *Klebsiella pneumoniae (2/2)*, *Escherichia coli (1/1)*, and *Citrobacter koseri (1/1)* isolates were ESBL producers, reflecting intense antibiotic pressure and active transmission of resistance genes, as widely documented in African and global literature [1]. This severely limits therapeutic options and underscores the importance of preserving carbapenems through judicious use [14]. Both *Staphylococcus aureus* isolates were methicillin-resistant 100% (2/2). This prevalence remains lower compared to that recorded by Worku et al., which is 73.7% [27]. This bacterium is one of the most commonly implicated agents in nosocomial infections. Recent estimates suggest MRSA causes between 11,000 and 18,000 deaths and 80,000 invasive infections in the US annually [28]. The emergence of drug-resistant strains, particularly methicillin-resistant *S. aureus* , is a serious problem in hospital settings, and infections caused by MRSA strains are associated with longer hospital stays, prolonged antibiotic administration, and higher costs than infections caused by methicillin-sensitive *S. aureus* strains [29]. Environmental contamination by MRSA and vancomycin-resistant enterococci has been frequently documented, particularly in epidemic settings [30]. The detection of complex resistance phenotypes, including inducible MLS resistance and aminoglycoside resistance, highlights the growing complexity of antimicrobial resistance mechanisms and the need for comprehensive surveillance and antimicrobial stewardship [10]. The increasing emergence and spread of multiresistant bacteria in hospitals is of great concern and continues to challenge infection control and hospital epidemiology practice worldwide.

The findings highlight the need to strengthen targeted cleaning of high-touch surfaces (bed rails, door handles, treatment tables) by using appropriate disinfectants and strictly adhering to established protocols. The implementation of

regular environmental cleaning audits and periodic microbiological surveillance is recommended. Finally, reinforcing antimicrobial stewardship programs, with a rationalized use of broad-spectrum antibiotics, is essential to limit the selection and spread of multidrug-resistant bacteria in hospital settings.

CONCLUSION

The hospital environment at CHR Banfora represents a significant and active reservoir of MDROs, including strains exhibiting 100% resistance to third-generation cephalosporins (ESBL) and methicillin (MRSA) among the relevant isolates. This high level of post-cleaning contamination underscores a critical gap in current infection prevention and control strategies, demanding an urgent review of disinfection protocols and enhanced targeted cleaning of high-touch surfaces to mitigate the severe risk of HAIs and further AMR dissemination. This study has several limitations that should be acknowledged. First, it was conducted in a single center and over a single time point, with environmental sampling performed only once after cleaning, which limits the generalizability and temporal interpretation of the findings. Second, the absence of molecular typing and clinical correlation does not allow confirmation of transmission pathways or direct links between environmental contamination and patient infections. In addition, the small number of isolates for certain species may have reduced the statistical robustness of some analyses. Finally, the potential risk of misclassification related to the identification tools used cannot be excluded. Despite these limitations, the findings provide valuable preliminary insights into environmental contamination in the hospital setting and highlight the need for larger, multicenter studies incorporating molecular approaches and clinical correlation to better understand transmission dynamics and guide targeted infection control strategies.

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