Société Ivoirienne de Microbiologie

Diversity and antimicrobial resistance of infectious bacteria isolated from surgical samples of the Treichville University Hospital, Abidjan (Côte d'Ivoire) during the year 2021

KOFFI Kouadio Stephane[1,2], AHONZO Avolah Flora Marie Ange Emmanuella[1], YAPI Yvanne Alexia[2], CAMARA Djibril Bilal[1], N'GORAN Sodji Emilie[2], KOFI Kobina Amandze Adams [1,3], BAMBA Aboubacar[1,3], BAHAN Armel Gninissemet[2], YAPI Adompo Jaures[2], KOUAKOU Amoin Nina Laurette[1], VAHO Magnificat[1], DIAKITE Imourana[1], BAIMEY Jessica[1], KACOU-N'DOUBA Adele[2]

1 Laboratoire de Bactériologie-Virologie, Centre Universitaire Hospitalier de Treichville, Côte d'Ivoire

2 Unité de Formation et de Recherche-Sciences Médicale, Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire

3 Unité de Formation et de Recherche– Biosciences, Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire

ABSTRACT

In order to study the bacterial ecology in the surgical wards of the Treichville University Hospital, a retrospective study was conducted from January to December 2021. Bacteriological analyses were performed on various clinical specimens, including pus, blood, genitourinary secretions, stool, and urine. Bacterial isolation and identification were carried out using conventional bacteriological methods, and antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method according to CA-SFM 2021 guidelines. Data were analysed using EPI INFO version 7.2. Infections in the surgical wards predominantly affected male patients (sex ratio: 3.73) with a mean age of 32.7 years, mainly from the urology department (63.2%) and mostly involving urine samples (76.4%). A total of 208 bacterial strains were isolated, primarily Gram-negative bacilli (84.4%) belonging to the Enterobacteriaceae family (70.2%). *Escherichia coli* (63.0%) and *Klebsiella pneumoniae* (27.4%) were the most frequently identified species. Antimicrobial resistance was high: 65.2% of Staphylococcus aureus isolates were methicillin-resistant. Among *Pseudomonas aeruginosa* isolates, resistance to ceftazidime and imipenem was 36.4% and 20.0%, respectively. Within Enterobacteriaceae, *E. coli* and *Proteus mirabilis* showed high resistance to amoxicillin (98.4% and 66.7%), while *E. coli, P. mirabilis*, and *K. pneumoniae* also exhibited elevated resistance to ceftriaxone (73.9%, 14.3%, and 53.3% respectively). These findings highlight the predominance of Gram-negative bacilli urinary tract infections and a high level of resistance to several first-line antibiotics in the surgical wards of Treichville University Hospital.

Key words: Bacteriological profile, Hospital surgical wards, Bacterial infection.

Volume 2, Issue 3 pages 241-251
ISSN 2664-388X
https://doi.org/10.26167/70EE-Q882

Corresponding author : AHONZO Avolah Flora Marie Ange Emmanuella, flo.ahonzo@gmail.com

The authors declare no conflict of interest

Received: 12th December 2026,
Accepted: 06th February 2026,
Published: 21st March 2026,

Introduction

Antimicrobial resistant bacteria refers to bacteria that have the ability to persist or proliferate in the presence of antibiotics that would normally inhibit or eliminate them (Davies et al., 2010). These bacteria are contributing to substantial morbidity and mortality worldwide (Abbara et al., 2022), representing a major global health threat. According to Murray et al. (2022), antimicrobial resistant bacteria were associated with 4.95 million deaths worldwide in 2019, including 1.27 million directly attributable to these bacteria. A systematic analysis covering 1990 - 2021 showed a continued rise of this threat reporting approximately 4.71 million associated deaths and 1.14 million deaths directed linked to antimicrobial resistant bacterial in 2021 (GBD 2021 Antimicrobial Resistance Collaborators, 2024). Projections are worse, indicating these numbers could reach 8.22 million associated deaths and 1.91 million attributable deaths in 2050 if no significant action is implemented (GBD 2021 Antimicrobial Resistance Collaborators, 2024). In Africa, antimicrobial resistant bacteria represent a serious public health issue. In 2023, the World Health Organisation (WHO) and the Institute for Health Metrics and Evaluation (IHME) estimated that the continent recorded more than 1.05 million deaths associated with antimicrobial resistant bacteria, including approximately 250,000 deaths directly attributable to these bacteria (Organisation mondiale de la santé, 2023a). Côte d'Ivoire is facing the same challenge. The national prevalence of antimicrobial resistance (AMR) is estimated between 25% and 45% (Organisation mondiale de la santé, 2023b). Local data reveal a significant increase in bacterial resistance rates. In 2015, a study conducted at the Cocody University Hospital found that 51.1% of Enterobacteriaceae produced extended-spectrum β-lactamases (ESBL) (Kacou N'Douba et al., 2015). By 2022, ORMICI (Observatoire de la Résistance des Microorganismes aux Anti-infectieux en Côte d'Ivoire) data showed that more than 60% of isolates were resistant to critical antibiotics such as gentamicin, norfloxacin and third-generation cephalosporins (Tahou et al., 2022). These data clearly illustrate the emergence and gradual consolidation of antimicrobial resistant bacteria in Ivorian hospitals. This emergence of antibiotic resistance requires data to be kept up to date, especially in surgical wards, where invasive procedures increase the risk of infection. Updated the antibiotic resistance profile in these wards could lead to better care of patients. This study aimed to describe the socio-demographic characteristics of infected surgical patients, identify the bacterial species involved, and describe the antibiotic resistance profile of isolated bacteria.

Materials and Methods

1. Sampling and bacterial isolation

This retrospective descriptive study was conducted at the Bacteriology Laboratory of Treichville University Hospital (TUH), Abidjan, from May to November 2023. A total of 804 patients from surgical wards who underwent bacteriological testing between January 1 and December 31, 2021, were selected. Surgical wards included urology, gynecology-obstetrics, pediatric surgery, digestive surgery, traumatology, stomatology, general surgery, proctology, surgical emergencies, plastic surgery, and otorhinolaryngology. Patients with incomplete bacteriological data or duplicate isolates—defined as repeated isolation of the same bacterial species from the same patient within the same period, regardless of the anatomical site—were excluded. All eligible patients were included exhaustively.

Clinical samples were collected following standard aseptic procedures and processed immediately in the laboratory. Bacterial isolation was performed on selective and differential media suitable for each species: EMB agar for Enterobacteriaceae, Chapman agar for Staphylococcus spp, and Cetrimide agar for Pseudomonas spp. Plates were incubated at 35–37 °C for 18–24 hours under aerobic conditions. Growth was monitored, and suspected colonies were selected for identification.

2. Identification of bacterial isolates

Bacterial isolates were identified using conventional biochemical methods. For Enterobacteriaceae, identification was performed using standard biochemical tests (lactose fermentation, indole, citrate, urease) on a Leminor reduced panel, allowing systematic and methodical tracking of reactions (Arbefeville et al., 2024; Koneman, 2016). Staphylococcus aureus was identified using catalase and coagulase tests (Becker et al., 2014; Koneman, 2016) . Pseudomonas aeruginosa was distinguished by the oxidase test, characteristic pigmentation on King A and King B agar (Kirchgessner et al., 2012). All procedures followed standard laboratory protocols.

3. Antimicrobial susceptibility testing

Antibiotic susceptibility testing (AST) was performed using the disk diffusion method on Mueller-Hinton (MH) agar, following 2021 French Society for Microbiology (CA-SFM) guidelines (Comité de la Société Française de Microbiologie, 2021). For each strain, inoculum was prepared from fresh cultures (18–24 h) and adjusted to 0.5 McFarland turbidity. The standardized suspensions were inoculated onto Mueller–Hinton agar plates by lawn culture. Antibiotic disks were applied within 15 minutes after inoculation, and plates were incubated aerobically at 37 °C for 24 hours. Inhibition zone diameters were measured in millimeters and interpreted as susceptible or resistant according to CA-SFM guidelines. Regarding beta-lactams, for Enterobacteriaceae, amoxicillin was used to test penicillin resistance, ceftriaxone for third-generation cephalosporins, and imipenem for carbapenems. For *Pseudomonas aeruginosa*, penicillin resistance was evaluated with piperacillin, piperacillin-tazobactam, ticarcillin, and ticarcillin-clavulanic acid; third-generation cephalosporin resistance with ceftazidime; and carbapenem resistance with imipenem. For *Staphylococcus aureus*, cefoxitin was used to assess β-lactam resistance. About other antibiotics, aminoglycosides (gentamicin) and quinolones (ciprofloxacin) were tested for all bacterial species, while fusidic acid, erythromycin, and tetracycline were tested only for S. aureus. Only bacterial species with ≥10 isolates were analyzed for resistance patterns.

4. Statistical analysis

Data were extracted from laboratory registers and analyzed using EPI INFO version 7.2 software. Quantitative variables were summarized as minimum, maximum, mean, and standard deviation. Age was categorized into predefined groups. Qualitative variables were expressed as counts and percentages and presented in tables and figures. All patient data were anonymized prior to analysis.

RESULTS AND DISCUSSION

1. Description and classification of the patient cohort

A total of 700 patients meeting the inclusion criteria were enrolled in the study. Patient age ranged from 0 days to 99 years, with a mean age of 32.73 ± 27.62 years. The most represented age groups were children under 5 years (27.96%) and adults over 60 years (24.25%), reflecting increased vulnerability at both extremes of life (Table I). A marked male predominance was observed (78.86%), with a sex ratio of 3.73. This male predominance is comparable to that reported by Abdoulaye et al. (2018) in Niger (76.66%, sex ratio = 3.30) and by Sangaré (2023) in Mali (69.40%, sex ratio = 2.27). This trend is frequently described in studies conducted in surgical settings in sub-Saharan Africa and may be explained by several factors. On one hand, men are more frequently affected by certain surgical conditions, particularly urological and traumatic disorders, which often require hospitalization and invasive procedures. On the other hand, sociocultural and behavioral factors, such as delayed healthcare-seeking behavior and greater occupational exposure to infectious risks, may also contribute to this predominance. In contrast, in 2015 Hounnasso et al. in Morocco reported a female predominance in bacterial infections, highlighting that sex distribution largely depends on the hospital context, the wards included, the types of infections studied, and the methodology adopted (Hounnasso et al., 2015). The urology ward was the most represented, accounting for 63.20% of patients. This finding differs from that reported by (Doutchi et al., 2020) in Niger, where urology ranked second (30.30%) after visceral surgery (45.50%). This discrepancy may be explained by differences in study design, as Doutchi et al. focused exclusively on surgical site infections, whereas our study included all types of infections occurring in surgical wards. In addition, the urology ward at Treichville University Hospital manages a high volume of patients requiring urinary catheterization, lithotomy, and endoscopic procedures, thereby increasing the likelihood of urine sampling. Finally, the routine use of urine culture in urology and as part of preoperative assessment across all surgical wards further contributes to this overrepresentation.

<u>Table I</u>: Structure and distribution of the studied population

Parameters	Specific characteristic	Number of patients (n)	Percentage (%)
Age	<5 Years	196	27.96
	5-15 Years	70	9.99
	15-30 Years	87	12.55
	30-45 Years	87	12.41
	45-60 Years	90	12.84
	>60 Years	170	24.25
Gender	Male	552	78.86
	Female	148	21.14
Care wards	Urology	443	63.20
	Emergency surgery	05	0.57
	Traumatology	28	3.85
	Stomatology	12	1.57
	Proctology	05	0.71
	Otorhinolaryngology	14	2.00
	Gynaecology-obstetrics	39	5.85
	Plastic surgery	07	1.00
	Paediatric surgery	126	17.97
	General surgery	1	0.14
	Digestive surgery	10	1.43
	Others	10	1.42
Samples analysed	Cerebrospinal fluid	2	0.29
	Joint fluid	1	0.14
	Ascites fluid	4	0.57
	Pus	109	15.59
	Blood	8	1.14
	Urethral secretions	16	2.29
	Vaginal secretions	15	2.15
	Faeces	5	0.72
	Semen	5	0.72
	Urine	534	76.39

2. Bacterial species isolated

A total of 208 bacterial isolates were recovered. Gram-negative bacilli predominated (84.36%), with Enterobacteriaceae accounting for the majority (70.20%). *Escherichia coli* was the most frequently isolated species (63.01%), followed by *Klebsiella pneumoniae* (27.39%) and Proteus mirabilis (5.45%). Escherichia coli was isolated in all surgical wards except proctology and otorhinolaryngology (Figure 1), reflecting its ubiquitous involvement in surgical infections. Similar distributions have been reported in studies conducted in West Africa, where *Escherichia coli* consistently predominates across different surgical wards (Guessennd et al., 2013, (Diarra et al., 2022). Among non-Enterobacteriaceae, Staphylococcus aureus (17.37%) and *Pseudomonas aeruginosa* (10.57%) were the main species identified (Table II). These findings are consistent with those reported by Guessend et al. in Côte d'Ivoire in 2013 (Guessennd et al., 2013) and Diarra et al. in Burkina Faso in 2022 (Diarra et al., 2022), who observed a predominance of E. coli (75.00% and 78.30%, respectively), followed by *K. pneumoniae* (25.00% and 18.03%, respectively). In contrast, other studies, such as that conducted by Khaoula et al. in Algeria in 2020, reported a predominance of Staphylococcus aureus over E. coli (27.10% versus 22.90%) (Khaoula & B, 2020). This discrepancy may be explained by differences in the types of specimens analyzed: Khaoula's study focused primarily on blood samples, whereas our study included a wide range of clinical specimens predominantly composed of urine samples. Therefore, bacterial distribution appears to be strongly influenced by the nature of the specimens and the hospital wards involved.

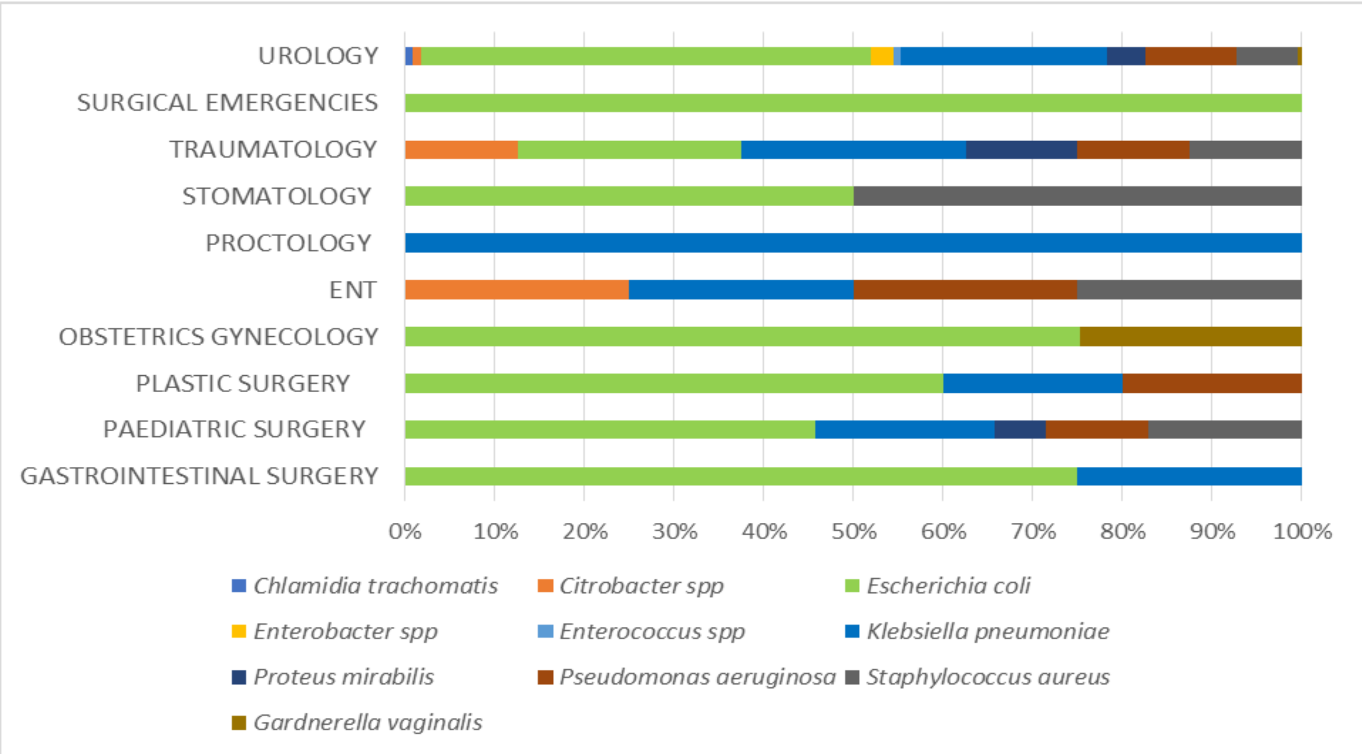

Figure 1: Distribution of bacteria by surgical ward

Table II: Bacterial isolates from surgical ward infections

Type	Bacteria	Number of isolates (n)	Percentage (%)
Bacterial flora	Gram-negative bacilli	171	82.20
	Gram-positive cocci	37	17.80
Enterobacteria	*Escherichia coli*	58	63.01
	Enterobacter spp	04	2.05
	Klebsiella pneumoniae	31	27.39
	Proteus mirabilis	11	5.45
	Citrobacter spp	04	2.05
Non Enterobacteria	*Staphylococcus aureus*	36	17.37
	Enterococcus sp	1	0.43
	Pseudomonas aeruginosa	22	10.57
	Others	03	1.43

3. Distribution of isolates according to the type of infection

The isolates were predominantly recovered from urinary tract infections, accounting for 76.39% of cases, followed by suppurative infections (15.59%). Other types of infections, including surgical site infections, soft tissue infections, and specimens from other anatomical sites, represented a smaller proportion (Table I). This proportion is higher than that reported by Diarra et al. in Mali in 2023 (Diarra et al., 2023), who found that urine samples accounted for 47.06% of isolates. This predominance can be explained, on one hand, by the high proportion of patients originating from the urology ward and, on the other hand, by the nearly systematic use of urine culture as part of the preoperative assessment. The literature indicates that the type of clinical specimen has a direct impact on the distribution of isolated bacteria, which should be taken into account when comparing results across studies (Diarra et al., 2023). Suppurative infections constituted the second most frequent source of isolates and were mainly associated with Staphylococcus aureus as well as certain non-fermenting Gram-negative bacilli, such as *Pseudomonas aeruginosa*. These findings further confirm that the nature of the specimens strongly influences the bacteriological profile, as previously reported by Diarra et al. (Diarra et al., 2023).

lates from surgical ward infections

4. Antibiotic Resistance Profiles

4.1. Enterobacteriaceae

Resistance to penicillins was very high, particularly among *Escherichia coli* (98.36%) and Proteus mirabilis (66.67%). Resistance to third-generation cephalosporins was also substantial, with rates of 73.85% for *E. coli*, 53.33% for *Klebsiella pneumoniae*, and 14.29% for *P. mirabilis*. In contrast, resistance to carbapenems remained relatively low, affecting 5% of K. pneumoniae, 4.85% of *E. coli*, and 3.50% of *P. mirabilis* isolates. High resistance rates were also observed for aminoglycosides (44.05%) and fluoroquinolones (65.31%) (Table III). Our findings regarding penicillin resistance are consistent with those reported by Diarra et al. in Mali in 2022, who observed a 92.50% resistance rate among *E. coli* isolates, and by Tabatabaei et al. in Iran in 2021, who reported a 62% resistance rate for *P. mirabilis* (Diarra et al., 2022; Tabatabaei et al., 2021).

This high level of resistance is mainly attributable to the production of β-lactamases and to the widespread, and sometimes inappropriate, use of aminopenicillins in both hospital and community settings. With respect to resistance to third-generation cephalosporins, Kot et al. reported rates that were partially different from ours, with resistance levels of 31.5% for *E. coli*, 16.7% for *P. mirabilis,* and 76.2% for *K. pneumoniae* (Kot et al., 2021). Our results indicate that carbapenems remain last-resort antibiotics that are still relatively preserved, likely due to their limited use as first-line agents, thereby reducing selective pressure. These findings are in agreement with those of Doutchi et al., who reported 100% susceptibility of *E. coli* isolates to imipenem (Doutchi et al., 2020). Regarding aminoglycosides, our results are comparable to those reported by Diarra et al., in 2022, who showed that gentamicin retained fairly good activity, with a susceptibility rate of 59.10%. The fluoroquinolone resistance rate observed in our study is similar to that reported by Diarra et al. in Mali in 2022 (65.22%) (Diarra et al., 2022). This high level of resistance is likely related to the extensive and sometimes inappropriate use of fluoroquinolones in both hospital and community settings, which promotes the emergence of mutations in DNA gyrase and topoisomerase IV, as well as the activation of efflux pump mechanisms (Sbiti et al., 2017).

4.2. *Staphylococcus aureus*

The proportion of methicillin-resistant *Staphylococcus aureus* (MRSA) was low, accounting for 8.70% of isolates. However, high resistance rates were observed for ciprofloxacin (62.5%), gentamicin (40%), erythromycin (34.78%), and tetracycline (30%) (Table IV). Methicillin resistance reflects a modification of the β-lactam target site and confers cross-resistance to all β -lactam antibiotics. The MRSA rate observed in our study differs markedly from those reported by Abdoulaye et al. and Njall et al., who documented methicillin resistance rates of 83% and 50%, respectively (Abdoulaye et al., 2018; Njall et al., 2013). This variation may be explained by differences in epidemiological context and study populations. Previous studies were conducted in high-risk hospital settings, particularly intensive care units and surgical wards, where antibiotic selective pressure is generally higher, thereby favoring the persistence of multidrug-resistant strains. It is also possible that the lower MRSA prevalence observed in our study reflects a genuine decline in MRSA carriage within the Ivorian population, potentially associated with improved microbiological surveillance and a reduction in inappropriate empirical antibiotic therapy. Resistance rate to gentamycin (KTG phenotype) was 40.00%. This resistance corresponding to cross-resistance to aminoglycosides, was comparable to the approximately 50% rate reported by Njall et al., suggesting the persistence of shared resistance mechanisms, notably the production of aminoglycoside-modifying enzymes (Njall et al., 2013). Regarding quinolones, resistance to ciprofloxacin in our study was higher than that reported by Abdoulaye et al. in Niger in 2018 (39.39%) (Abdoulaye et al., 2018). Macrolides resistance was close to the 41.93% reported by Abdoulaye et al. (Abdoulaye et al., 2018). These resistance patterns likely reflect the absence of structured antibiotic stewardship strategies, irrational prescribing practices, and widespread self-medication, leading to a progressive decline in the effectiveness of commonly used antibiotics (Diarra et al., 2023). Despite the low prevalence of MRSA, our findings indicate substantial resistance to several antibiotic classes among *S. aureus* isolates, probably driven by high selective pressure, self-medication, and inappropriate antibiotic use, as previously described in regional studies (Hounnasso et al., 2015).

Table III: Antibiotic resistance profile of Enterobacteriales isolates

Bacteria	Interpretive category	Penicillins n(%)	Cephalosporins n(%)	Carbapenems n(%)	Aminoglycosides n(%)	Quinolones n(%)
	R	57(98.36)	43(73.85)	3(4.85)	25(44.05)	38(65.31)
E. coli	I	0(00)	0(00)	3(4.85)	0(00)	2(3.06)
	S	1(1.64)	15(26.15)	84(90.29)	33(55.95)	18(31.63)
	R	7(66.67)	2(14.29)	1(3.50)	5(43.00)	7(62.00)
P. mirabilis	I	0(00)	0(00)	1(4.00)	0(00)	1(2.00)
	S	4(33.33)	9(85.71)	9(92.50)	6(57.00)	3(36.00)
	R	-*	17(53.33)	1(5.00)	14(45.00)	19(60.00)
K. pneumoniae	I	-*	0(00)	2(6.00)	0(00)	1(3.00)
	S	-*	14(46.67)	28(89.00)	17(55.00)	11(37.00)

Table IV: Antibiotic resistance profile of *Staphylococcus aureus* isolates

Interpretive category	Cefoxitin n(%)	Aminoglyco-sides n(%)	Quinolones n(%)	Macrolides n(%)	Cyclines n(%)	Fusidic acid n(%)
R	3(8.70)	14(40.00)	23(62.50)	13(34.78)	25(70.00)	2(4.76)
I	23(65.22)	2(5.00)	11(31.25)	0(00)	0(00)	0(00)
S	10(26.09)	20(55.00)	2(6.25)	23(65.22)	11(30.00)	34(95.24)

R: resistant; I: susceptible-dose dependant; S: susceptible

4.3. *Pseudomonas aeruginosa*

Pseudomonas aeruginosa exhibited notable resistance rates to ticarcillin (45.45%), ceftazidime (36.36%), and imipenem (20%). The resistance rate to ticarcillin observed in our study was lower than that reported in 2013 by Njall et al., who documented a 100% resistance rate among *P. aeruginosa* isolates (Njall et al., 2013). This discrepancy may be explained by differences in patient populations and the nature of the clinical specimens analyzed. Indeed, the study by Njall et al. focused on patients from intensive care units and on specimens mainly consisting of urine, skin, and blood samples, whereas in our study, patients were predominantly recruited from the urology ward and samples were largely urine specimens. Patients in urology wards are more prone to recurrent urinary tract infections, which often require repeated courses of antibiotic therapy, thereby promoting the emergence of resistance. Regarding third-generation cephalosporins, resistance to ceftazidime observed in our study (36.36%) is consistent with the 50.00% resistance rate reported by Gbegbe et al. in Côte d'Ivoire in 2024 (Gbegbe et al., 2024) as well as the 100% resistance rate reported by Njall et al. in Cameroon in 2013 (Njall et al., 2013). These high resistance rates may be attributed to enhanced production of AmpC β-lactamases and alterations in porin channels, leading to reduced antibiotic penetration. These mechanisms are frequently associated with the overexpression of efflux pumps, resulting in multidrug resistance. The persistence of such resistance profiles likely reflects sustained selective pressure related to the frequent use of third-generation cephalosporins in hospital settings (Gbegbe et al., 2024). Carbapenems were also affected by resistance in our study. In contrast, Njall et al. in Cameroon reported that imipenem remained highly active, with 100% susceptibility (Njall et al., 2013). This finding suggests a progressive emergence of carbapenem-resistant *P. aeruginosa* strains over time. This evolution is mainly driven by the increased use of carbapenems as last-resort therapies, generating strong selective pressure. It may also result from the production of carbapenemases or from combined mechanisms involving porin loss and efflux pump overexpression, which reduce bacterial permeability to antibiotics.

Overall, these findings highlight the emergence of resistance in *Pseudomonas aeruginosa* to second-line antibiotics and underscore the urgent need for rational antibiotic use, alongside strengthened infection prevention and control measures.

Table V: Antibiotic resistance profile of *Pseudomonas aeruginosa* and antibiotics

Interpretive category	Ticarcillin n(%)	Ticarcillin + Clavulanic Acid n(%)	Piperacillin n(%)	Piperacillin + Tazobactam n(%)	Ceftazidime n(%)	Carbapenem n(%)
R	10(45.45)	7(31.25)	8(35.29)	4(8.33)	8(36.36)	4(20.00)
I	12(54.55)	15(68.75)	14(64.71)	14(66.67)	14(63.64)	15(70.00)
S	0(00)	0(00)	0(00)	4(8.33)	0(00)	3(10.00)

R: resistant; I: susceptible-dose dependant; S: susceptible

CONCLUSION

This study highlights the predominance of Gram-negative bacilli, particularly multidrug-resistant Enterobacteriaceae (*Escherichia coli* and *Klebsiella pneumoniae*), in surgical wards. Urinary tract infections represented the main source of bacterial isolates, followed by suppurative infections. Despite a low prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA), *Staphylococcus aureus* and *Pseudomonas aeruginosa* exhibited concerning antimicrobial resistance profiles. These findings underscore the urgent need to strengthen rational antibiotic prescribing, microbiological surveillance, and infection prevention and control measures.

References

Abbara, S., Guillemot, D., Brun-Buisson, C., & Watier, L. (2022). From Pathophysiological Hypotheses to Case-Control Study Design: Resistance from Antibiotic Exposure in Community-Onset Infections. Antibiotics (Basel, Switzerland), 11(2). https://doi.org/10.3390/antibiotics11020201

Abdoulaye, O., Laouali, H. A., Amadou, O., Ousseini, A., Lawanou, H. M., Laouali, B., Djimraou, O., Moussa, A., & Mamadou, S. (2018). Aspects épidémiologiques et bactériologiques des infections du site opératoire (ISO) dans les services de chirurgie à l'Hôpital National de Niamey (HNN). The Pan African Medical Journal, 31(33). https://doi.org/10.11604/pamj.2018.31.33.15921

Arbefeville, S. S., Timbrook, T. T., & Garner, C. D. (2024). Evolving strategies in microbe identification—A comprehensive review of biochemical, MALDI-TOF MS and molecular testing methods. Journal of Antimicrobial Chemotherapy, 79(Suppl 1), i2–i8. https://doi.org/10.1093/jac/dkae275

Becker, K., Heilmann, C., & Peters, G. (2014). Coagulase-negative staphylococci. Clinical Microbiology Reviews, 27 (4), 870–926. https://doi.org/10.1128/CMR.00109-13

Comité de la Société Française de Microbiologie. (2021). CASFM 2021—Recommandations de l'Antibiogramme (pp. 37–134). Société Française de Microbiologie. https://www.sfm-microbiologie.org/wp-content/uploads/2021/04/CASFM2021__V1.0.AVRIL_2021.pdf

Davies, J., & Davies, D. (2010). Origins and Evolution of Antibiotic Resistance. Microbiology and Molecular Biology Reviews : MMBR, 74(3), 417–433. https://doi.org/10.1128/MMBR.00016-10

Diarra, L., Ouologuem, I., Dissa, M., Doumbia, T., Dembélé, D., Bagayoko, M., Doumbia, S., Marico, M., Diepkile, A., Sangaré, A., Diarra, S., & Coulibaly, S. (2022). Epidemiology and bacteriological pattern of urinary tract infections at the medical biology laboratory of the Sikasso hospital. HEALTH SCIENCES AND DISEASE, 23(12), Article 12. https://doi.org/10.5281/hsd.v23i12.4063

Diarra, L., Traore, M., Kalambry, A., Doumbia, S., & Guindo, I. (2023). Frequency and antibiotic susceptibility of extended-spectrum beta-lactamase-producing Escherichia coli isolated from the Sikasso Hospital (Mali). HEALTH SCIENCES AND DISEASE, 24(9), Article 9. https://doi.org/10.5281/hsd.v24i9.4759

Doutchi, M., Adamou, H., Yahaya, M. L., Ousmane, L., Magagi, I. A., Halidou, M., Taofik, M., Mansour, A., Karamba, S., & Ouedraogo, A. S. (2020). Infections Du Site Opératoire À l'Hôpital National De Zinder, Niger: Aspects Épidémiologiques Et Bactériologiques. European Scientific Journal, ESJ, 16(6), Article 6. https://doi.org/10.19044/esj.2020.v16n6p576

GBD 2021 Antimicrobial Resistance Collaborators. (2024). Global burden of bacterial antimicrobial resistance 1990-2021: A systematic analysis with forecasts to 2050. Lancet (London, England), 404(10459), 1199–1226. https://doi.org/10.1016/S0140-6736(24)01867-1

Gbegbe, D. A., N'zi, N. P., Monthaut, S., Guessennd-Kouadio, N., & Angaman, D. M. (2024). Antibiotic resistance profiles of uropathogenic bacterial isolates in Haut-Sassandra Region, Côte d'Ivoire from January 2019 to December 2022. African Journal of Clinical and Experimental Microbiology, 25(1), Article 1. https://doi.org/10.4314/ajcem.v25i1.5

Guessennd, K. N., Ouattara, M. B., Ouattara, N. D., Nevry, R. K., Gbanon, V., Tiekoura, K. B., Dosso, M., & Ger, B. M. R. (2013). Étude des bactéries multirésistantes des effluents hospitaliers d'un centre hospitalier et universitaire (CHU) de la ville d'Abidjan (Côte d'Ivoire). Journal of Applied Biosciences, 69, 5456–5464. https://doi.org/10.4314/jab.v69i0.95071

Hounnasso, P. P., Toré Sanni, R., & Avakoudjo, J. D. G. (2015). Epidémiologie et antibio-résistance des infections urinaires Ã entérobactéries chez l'adulte dans le CHU de Marrakech et implication thérapeutique. Uro-Andro : Revue d'Urologie et d'Andrologie de l'ASU, 1(4). https://revue-uroandro.org/index.php/uro-andro/article/view/31

Kacou N'Douba, A. (2015). Drug resistance bacterial isolates in inpatients at Cocody University Hospital, Abidjan, Côte d'Ivoire in 2014. Antimicrobial Resistance and Infection Control, 4(Suppl 1), P167. https://doi.org/10.1186/2047-2994-4-S1-P167

Khaoula, B., & B, H. (2020). Les hémocultures: Profil bactériologique et sensibilité aux antibiotiques [Thesis]. https://dspace.univ-bba.dz:443/xmlui/handle/123456789/517

Kirchgessner, M., Tully, T., Nevarez, J., Sanchez-Migallon Guzman, D., & Acierno, M. (2012). Magnesium therapy in a hypocalcemic African grey parrot (Psittacus erithacus). Journal of Avian Medicine and Surgery, 26(1). https://doi.org/10.1647/2009-021.1

Koneman, E. W. (2016). Koneman's Color Atlas and Textbook of Diagnostic Microbiology (7th edition). LWW.

Kot, B., Grużewska, A., Szweda, P., Wicha, J., & Urszula, P. (2021). Antibiotic Resistance of Uropathogens Isolated from Patients Hospitalized in District Hospital in Central Poland in 2020. Antibiotics, 10(4), 447. https://doi.org/10.3390/antibiotics10040447

Murray, C. J. L., Ikuta, K. S., Sharara, F., Swetschinski, L., Aguilar, G. R., Gray, A., Han, C., Bisignano, C., Rao, P., Wool, E., Johnson, S. C., Browne, A. J., Chipeta, M. G., Fell, F., Hackett, S., Haines-Woodhouse, G., Hamadani, B. H. K., Kumaran, E. A. P., McManigal, B., … Naghavi, M. (2022). Global burden of bacterial antimicrobial resistance in 2019: A systematic analysis. The Lancet, 399 (10325), 629–655. https://doi.org/10.1016/S0140-6736(21)02724-0

Njall, C., Adiogo, D., Bita, A., Ateba, N., Sume, G., Kollo, B., Binam, F., & Tchoua, R. (2013). Écologie bactérienne de l'infection nosocomiale au service de réanimation de l'hôpital Laquintinie de Douala, Cameroun. The Pan African Medical Journal, 14(140), Article 140. https://doi.org/10.11604/pamj.2013.14.140.1818

Organisation mondiale de la santé. (2023a). Antimicrobial resistance leads to more deaths and illnesses in the WHO African region than anywhere else | Institute for Health Metrics and Evaluation. https://www.healthdata.org/news-events/newsroom/news-releases/antimicrobial-resistance-leads-more-deaths-and-illnesses-who

Organisation mondiale de la santé. (2023b). L'OMS accompagne la Côte d'Ivoire pour la célébration de la semaine mondiale de la sensibilisation à la Résistance aux antimicrobiens 2023. Organisation mondiale de la Santé (OMS), Bureau régional pour l'Afrique. https://www.afro.who.int/fr/countries/cote-divoire/news/loms-accompagne-la-cote-divoire-pour-la-celebration-de-la-semaine-mondiale-de-la-sensibilisation-la

Sbiti, M., K, L., & Lhoussaine, L. (2017). Profil épidémiologique des entérobactéries uropathogènes productrices de bêta-lactamases à spectre élargi. The Pan African Medical Journal, 28(29), Article 29. https://doi.org/10.11604/pamj.2017.28.29.11402

Tabatabaei, A., Ahmadi, K., Shabestari, A. N., Khosravi, N., & Badamchi, A. (2021). Virulence genes and antimicrobial resistance pattern in Proteus mirabilis strains isolated from patients attended with urinary infections to Tertiary Hospitals, in Iran. African Health Sciences, 21 (4), 1677–1684. https://doi.org/10.4314/ahs.v21i4.22

Tahou, E. J., Ahouty Ahouty, B., Gba K M, K., Guessennd Kouadio, N., & N'guetta Assanvo, S. P. (2022). Detection and Dissemination of Extented-Spectrum Beta-Lactamases Genes (CTX-M-15 and SHV-187) Isolated in Multi-Drug Resistant Uropathogenic Klebsiella pneumoniae and Escherichia coli in Cote D'ivoire. Journal of Advances in Biology & Biotechnology, 20–29. https://doi.org/10.9734/jabb/2022/v25i7586