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Epidemiology and antimicrobial susceptibility profiles of bacteria from different swabs in Gabonese settings

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Original Research Article

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Abstract: Bacterial resistance is the cause of morbidity and mortality worldwide, particularly in Africa. However, data on antimicrobial susceptibility patterns are limited in many countries such as Gabon. 234 clinical isolates were screened for their resistance against usual antibiotics by using BioMerieux ATB test strips, ATB G, ATB-Staph and ATB-Strep; *Mycoplasma* IST 2 test strips (BioMérieux, France) and Vitek 2 compact automaton. *E. coli* (29.49%) was the most common pathogen causing various diseases isolated, followed by *U. urealyticum* (27.35%), *K. pneumonia* (14.96%), *P. mirabilis* (3.42%) and *P. aeruginosa* (2.56%). *S. aureus* is Gram + the most represented with 6.84%. 28.65% of Enterobacteriaceae isolates were resistant to antibiotics tested. Imipenem (β-Lactamine) and Amikacin (aminoglycoside) were the most effective antimicrobial agents, with susceptibility rates of 94.92% and 91.67%, respectively. Ampicilin and Amoxicillin were the least effective, with susceptibility rates of 19.09% and 37.58%, respectively, against Enterobacteriaceae. 68.75% isolates of *S. aureus* were phenotypically resistant to methicillin. *U. urealyticum* isolates were resistant to Clarythromycin (59.26%), Erythromycin (57.41%), Ciprofloxacin (53.7%) and Azithromycin (51.86%). Knowledge of bacterial ecology and monitoring of antibiotic resistance are needed to guide antibiotic therapy in our environment.

Keywords: Antibiotic resistance, Methicillin-resistant *Staphylococcus aureus*, Epidemiology, antimicrobial susceptibility, clinical isolates

INTRODUCTION

Since the beginning of the antibiotic era, sixty years ago, pathogenic bacteria for mammals have evolved towards resistance and, in many instances, multi-resistance. The ongoing explosion of antibiotic-resistant infections continues to plague global and worldwide health care. The emergence of antibiotic-resistant bacteria and their spread in hospitals, in urban areas, has become a major health issue since the 1980s [1].

The development of antibiotic resistance has become a global public health challenge which is causing ineffectiveness of antibacterial agents leading to increase in diseases and death rate [2]. The spread of antimicrobial resistance is a matter for concern, as its compromises the management of infectious diseases [3]. Epidemic antibiotic resistance has been described in numerous pathogens in varying contexts, including a global pandemic of methicillin-resistant *Staphylococcus aureus* (MRSA) infection. The global spread of drug resistance among common respiratory pathogens, including *Streptococcus pneumoniae* and *Mycobacterium tuberculosis*; and epidemic increases in multidrug-resistant Gram-negative bacilli [4]. Globally, 480000 people contract multidrug resistance tuberculosis (MDR-TB) every year, and resistance is

beginning to complicate the fight against HIV and malaria [5].

In contrast with this continuous evolution, there has been a decline in research over the last two decades to discover and develop new antibacterial agents. This contrasting tendency has led to an important decrease in therapeutic options and is particularly worrying if one considers that more than ten years are necessary to develop a new antibiotic.
As antibiotics are increasingly used and misused, the bacterial strains become resistant to antibiotics rapidly [3, 6].

Although good antibiotic use policies often used to control epidemics caused by resistant bacteria, the problem of resistance remains imposing and costly to society. It is therefore imperative to study the phenomenon to better understand the origin, operation and mechanisms of antibiotic resistance [7]. There are many ideas and strategies about the possibility of keeping control of infections in this "antibiotic resistance crisis" current [8, 9]. One of them consists in monitoring the effectiveness of drugs already on the pharmacy [10].

The objective of this study is to determine the bacteriological profile and antibiotic sensitivity of bacteria isolated from various swabs of Gabonese National Laboratory of Public Health and the Laboratory of Army Schooling Hospital Omar Bongo Ondimba in Libreville.

MATERIALS AND METHODS

Isolation and Identification of Bacterial Strains

This study was carried out during the last quarter of 2015. 1148 clinical specimens were obtained from inpatient and outpatient in two settings; Gabonese National Laboratory of Public Health (NLPHL) and the Laboratory of Army Schooling Hospital Omar Bongo Ondimba (LASH-OBO) in Libreville. As part of theirs routines activities, these swabs were tested for bacterial infections.

Bacteria were isolated from clinical specimens like urine, blood, pus, stools, ureteral, vaginal swabs collected from the inpatient, and outpatient came without distinction of ages and sexes. Samples were inoculated on various culture media and identification was performed by API 20E gallery, Vitek 2 compact and various Slidex kit (BioMérieux, France). All tests were done in accordance with the manufacturer's instructions and protocols. BioMérieux API 20E or API 10S strips (BioMérieux, France) were used for the identification of Enterobacteriaceae, whereas BioMérieux API kits identified staphylococci and streptococci for Micrococcaceae (Slidex kits were used for the confirmation of *Staphylococcus aureus*). The National Laboratory samples were focused on urine (ECBU), vaginal and urethral samples. All isolated organisms were tested for antibiotic sensitivity; the list of antibiotics tested is given in Table-1.

Table-1: List of antibiotics and abbreviations used

Antibiotic class	Antibiotics (abbreviations)
Aminoglycosides	Amikacin (AKN), Gentamicin (GEN), Tobramycin (TOB), Kanamycin (KAN)
β-Lactamines	Amoxicillin (AMC), Ampicilin (AMP), Ceftazidin (CAZ), Cefixim (CFM), Cefalotin (CFT), Cefotaxim (CTX), Cefuroxim (CXM), axetyl cefuroxim (CXO), Cefoxitin (CXT), Cefoxitin 32 (CXT 32), Cefepim (FEP), Cefriaxone (CRO), Imipenem (IMI), Meropenem (MERO), Oxacilin (OXA), Penicillin (PEN), Piperacilin (PIC), Ticarcilin (TIC), Piperacilin + Tazobactame (TZP)
Macrolides	Clindamycin (CLI), Erythromycin (ERY), Lincomycin (LIN), Pristinamycin (PRI), Quinupristin-Dalfopristine (QDA), Josamycin (JOS)
Quinolones	Ciprofloxacin (CIP), Levofloxacin (LVX), Nalidixic acid (NALF), Ofloxacin (OFL), Nofloxacin (NOR)
Glycopeptides	Teicoplanin (TEC), Vancomycin (VAN)
Tetracyclines	Minocyclin (MIN), Tetracyclin (TET), Doxycyclin (DOT)
Sulfamide & combination	Cotrimoxazol (TSU), Trimethoprim-Sulfamethoxazole (SXT)
Others	Fosfomycin (FOS), Fusidic acid (FUC), Rifampicin (RFA), Linezolid (LNZ), Nitrofurantoine (FUR), Tiamulin (T), Azithromycin (AZI), Clarythromycin (CLA), Chloramphenicol (C)

Antibiogram

Antibacterial sensibility test of the isolated bacteria has been made to BioMerieux ATB test strips (ATB UR EU (08), ATB G, ATB-Staph, and ATB-Strep; (BioMérieux, France); *Mycoplasma* IST 2 test strips (BioMérieux, France) and Vitek 2 compact automaton (Table 1). All tests were done following manufacturer's instructions and protocols. Resistance to both Penicillin G and Oxacillin indicated a methicillin-resistant-like profile [11]. National Laboratory of Public Health and Military Health Service review board approved this study protocol.

RESULTS

In the present study, the bacterial identification from inpatient and outpatient, and antibiotic resistance tests were determined in Libreville. National Laboratory of Public Health and the Laboratory of

Army Schooling Hospital Omar Bongo Ondimba are the medical analysis laboratories that receive the majority of patients. The data presented here represent the situation in Libreville (over 40% of Gabonese population lives).

Microorganisms Isolated

During the study, 234 isolates including 69 strains of *E.coli*, 39 of *Klebsiella* species, 6 of *Pseudomonas aeruginosa*, 8 of *Proteus mirabilis* and 17 of *Enterobactor* spp. were isolated. Bacterial strains were isolated from different specimen including urine, pus, urethral, vaginal and stool.

The summary of the distribution of isolates according to the source of clinical specimen is shown on table 2. 234 isolates were recovered. Overall, urine swab produced the highest number of bacteria 96 (41.02%) followed by pus swab 31 (13.25%); vaginal swab 28 (11.97%); urethral swab 8 (3.42%) and stool swab 7 (2.99%) in that order. *Mycoplasma* represented 27.35% of the bacteria isolated during this study. Enterobacteriaceae comprised 59.40% of the 234 isolates collected during the study period. *E. coli* (29.49%) was the most common pathogen causing various diseases, followed by *U. urealyticum* (27.35%), *K. pneumonia* (14.96%), *P. mirabilis* (3.42%) and *P. aeruginosa* (2.56%). Other Enterobacteria are less than 2% (Table -2). Three staphylococci were isolated during the study (8.55%). *S. aureus* is the most represented with 6.84%, the others (*S. hemolyticus* and *S. saprophyticus*) being less than 1.5% of all isolated bacteria. 2.99% of streptococci (*S. agalactiae*, 0.43%, *Streptococcus* B, 2.56%), 0.43% of *A. baumannii* and 1.28% of *N. gonorrhoeae* were also obtained during our study (Table 2).

Table-2: Prevalence of bacterial species isolated samples

Bacteria, n	Medical examination						Total n(%)
	Urethral swabs	Vaginal swabs	Urine	Pus	Stool	Mycoplasma	
Enterobacteriaceae							**139(59.40)**
C. farmeri	-	-	1	-	-	-	1(0.43)
E. cloacae	-	-	3	1	-	-	4(1.71)
E. coli	-	4	61	3	1	-	69(29.49)
K. oxytocae	-	1	2	1	-	-	4(1.71)
K. pneumoniae	-	2	20	9	4	-	35(14.96)
Pantoea sp	-	2	-	-	-	-	2(0.85)
P. mirabilis	-	-	1	7	-	-	8(3.42)
P. aeroginosa	-	1	2	3	-	-	6(2.56)
Salmonella spp	-	-	-	-	2	-	2(0.85)
S. fonticola	-	-	1	2	-	-	3(1.28)
S. liquefaciens	-	-	1	-	-	-	1(0.43)
S. odorifera	-	-	3	-	-	-	3(1.28)
Yersinia sp	-	-	1	-	-	-	1(0.43)
Mycoplasma							**64(27.35)**
U. urealyticum	-	-	-	-	-	64	64(27.35)
Staphylococci							**20(8.55)**
S. aureus	3	8	-	5	-	-	16(6.84)
S. hemolyticus	-	1	-	0	-	-	1(0.43)
S. saprophyticus	2	1	-	-	-	-	3(1.28)
Streptococci							**7(2.99)**
S. agalactiae	-	1	-	-	-	-	1(0.43)
Streptococcus B	-	6	-	0	-	-	6(2.56)
A. baumannii	-	1	-	-	-	-	1(0.43)
N. gonorrhoeae	3	-	-	0	-	-	3(1.28)
Total n(%)	8(3.42)	28(11.97)	96(41.02)	31(13.25)	7(2.99)	64(27.35)	234(100)

C. farmer : Citrobacter farmeri, E. cloacae : Enterobacter cloacae, E. coli : Escherichia coli, K. oxytocae : Klebsiella oxytoca, K. pneumoniae : Klebsiella pneumoniae, Pantoea sp, P. mirabilis : Proteus mirabilis, P. aeroginosa : Pseudomonas aeruginosa, Salmonella spp, S. fonticola : Serratia fonticola, S. liquefaciens : Serratia liquefaciens, S. odorifera : Serratia odorifera, Yersinia sp, U. urealyticum : Ureaplasma urealyticum, S. aureus : Staphylococcus aureus, S. hemolyticus : Staphylococcus hemolyticus, S. saprophyticus : Staphylococcus saprophyticus, S. agalactiae : Streptococcus agalactiae, Streptococcus B, A. baumannii : Acinetobacter baumannii, N. gonorrhoeae : Neisseria gonorrhoeae.

Table-3: Enterobacteriaceae resistance and sensitivity rates expressed in percentages

Antibiotics	Enterobacteriaceae isolates and their susceptibility pattern (%), n = 139																								Susceptibility / Isolates Total (%)	
	C. farmeri (n=1)		*E. cloacae* (n=4)		*E. coli* (n=69)		*K. oxytocae* (n=4)		*K. pneumoniae* (n=35)		*Pantoea sp* (n=2)		*P. mirabilis* (n=8)		*P. aeroginosa* (n=6)		*Salmonella spp* (n=2)		*S. fonticola* (n=3)		*S. liquefaciens* (n=1)		*S. odorifera* (n=3)		*Yersinia sp* (n=1)			
	S	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**
AMC	100	0	25	75	34.8	65.2	50	50	24.7	74.3	100	0	37.5	62.5	33.3	66.7	50	50	0	100	0	100	33.3	66.7	0	100	37.58	62.34
AMP	0	100	0	100	16	84.1	50	50	11.4	88.6	50	50	37.5	62.5	0	100	50	50	0	100	0	100	33.3	66.7	0	100	19.09	80.92
CAZ	100	0	75	25	68.1	31.9	100	0	48.6	51.4	100	0	87.5	12.5	66.7	33.3	100	0	66.7	33.3	100	0	100	0	0	100	77.89	22.11
CFM	100	0	75	25	60.9	39.1	75	25	54.3	45.7	100	0	75	25	83.3	16.7	100	0	66.7	33.3	100	0	66.7	33.3	0	100	73.61	26.39
CFT	100	0	25	75	36.2	63.8	75	25	22.9	77.1	100	0	37.5	62.5	50	50	0	100	0	100	100	0	66.7	33.3	100	0	54.87	45.13
CTX	100	0	75	25	66.7	33.3	100	0	40	60	100	0	25	75	50	50	50	50	66.7	33.3	100	0	100	0	0	100	67.18	32.82
CXM	-	-	25	75	43.5	56.5	-	-	28.6	71.4	100	0	37.5	62.5	50	50	0	100	0	100	100	0	-	-	-	-	42.73	57.27
CXO	100	0	100	0	91.3	8.7	100	0	91.4	8.6	-	-	-	-	-	-	-	-	-	-	-	-	100	0	100	0	97.53	2.47
CXT	100	0	100	0	66.7	33.3	100	0	42.9	57.1	100	0	62.5	37.5	50	50	100	0	100	0	100	0	66.7	33.3	100	0	83.75	16.25
CXT32	100	0	100	0	71.0	29	100	0	57.1	42.9	100	0	87.5	12.5	66.7	33.3	100	0	100	0	100	0	100	0	100	0	90.95	9.05
FEP	100	0	75	25	78.3	21.7	100	0	60	40	100	0	87.5	12.5	33.3	66.7	50	50	66.7	33.3	100	0	100	0	100	0	80.83	19.17
IMI	100	0	100	0	92.8	7.3	100	0	82.9	17.1	100	0	75	25	83.3	16.7	100	0	100	0	100	0	100	0	100	0	94.92	5.08
MERO	-	-	100	0	88.4	11.6	-	-	77.1	22.9	100	0	75	25	100	0	100	0	100	0	100	0	-	-	-	-	93.39	6.61
PIC	0	100	25	75	39.1	60.9	25	75	31.4	68.6	100	0	62.5	37.5	33.3	66.7	50	50	66.7	33.3	100	0	33.3	66.7	0	100	43.56	56.44
TIC	100	0	25	75	20.3	79.7	25	75	25.7	74.3	100	0	62.5	37.5	16.7	83.3	50	50	0	100	100	0	33.3	66.7	0	100	42.96	57.04
TZP	100	0	100	0	84.1	15.9	75	25	65.7	34.3	100	0	75	25	83.3	16.7	50	50	66.7	33.3	100	0	66.7	33.3	0	100	74.35	25.65
β-Lactamines	**85.7**	**14.3**	**64.1**	**35.9**	**59.9**	**40.1**	**76.8**	**23.2**	**47.8**	**52.2**	**96.7**	**3.3**	**61.7**	**38.3**	**53.3**	**46.7**	**63.3**	**36.7**	**53.4**	**46.6**	**86.7**	**13.3**	**71.4**	**28.6**	**42.9**	**57.1**	**66.4**	**33.6**
AKN	100	0	75	25	84.1	15.9	100	0	74.3	25.7	100	0	75	25	83.3	16.7	100	0	100	0	100	0	100	0	100	0	91.67	8.33
CIP	100	0	100	0	60.9	39.1	100	0	68.6	31.4	50	50	87.5	12.5	100	0	0	100	66.7	33.3	100	0	100	0	100	0	79.52	20.48
FOS	0	100	100	0	72.5	27.5	100	0	71.4	28.6	100	0	75	25	66.7	33.3	100	0	66.7	33.3	0	100	66.7	33.3	100	0	70.69	29.31
FUR	100	0	100	0	94.2	5.8	100	0	94.3	5.7	-	-	-	-	-	-	-	-	-	-	-	-	66.7	33.3	0	100	79.31	20.69
GEN	100	0	75	25	71.0	29	75	25	54.3	45.7	100	0	75	25	100	0	100	0	66.7	33.3	100	0	100	0	100	0	85.92	26.14
LVX	100	0	75	25	73.9	26.1	75	25	71.4	28.6	50	50	87.5	12.5	100	0	100	0	66.7	33.3	100	0	100	0	100	0	84.58	15.42
NALF	100	0	100	0	49.3	50.7	100	0	51.4	48.6	-	-	50	50	50	50	50	50	66.7	33.3	100	0	100	0	0	100	68.12	31.88
NOR	0	100	100	0	81.2	18.9	100	0	100	0	-	-	-	-	-	-	-	-	-	-	-	-	100	0	0	100	68.74	31.27
OFL	0	100	100	0	49.3	50.7	100	0	40	60	100	0	75	25	50	50	100	0	66.7	33.3	100	0	100	0	0	100	67.77	32.23
TET	-	-	50	50	66.7	33.3	100	0	42.9	57.1	100	0	50	50	50	50	100	0	100	0	100	0	-	-	-	-	75.96	24.04
TOB	100	0	75	25	66.7	33.3	75	25	51.4	48.6	100	0	75	25	83.3	16.7	100	0	66.7	33.3	100	0	100	0	100	0	84.08	20.69
TSU	100	0	25	75	49.3	50.7	100	0	51.4	48.6	50	50	50	50	50	50	50	50	66.7	33.3	100	0	66.7	33.3	100	0	66.08	33.92
Total (%)	**80**	**20**	**71.43**	**28.57**	**63.48**	**36.54**	**84.62**	**15.38**	**54.86**	**45.10**	**91.67**	**8.33**	**65**	**35**	**61.33**	**38.67**	**70**	**30**	**61.35**	**38.65**	**88**	**12**	**80**	**20**	**52**	**48**	**71.34**	**28.65**

Table-4: Staphylococci, Streptococci, *Acinetobacter* and *Neisseria* resistance and sensitivity rates expressed in percentages

Antibiotics	Bacteria isolates and their susceptibility pattern (%), n = 30												Susceptibility / Isolates Total (%)	
	***S. aureus* (n=16)**		***S. saprophyticus* (n=3)**		***S. agalactiae* (n=1)**		***Streptococcus B* (n=6)**		***A. baumannii* (n=1)**		***N. gonorrhoeae* (n=3)**			
	S	R	S	R	S	R	S	R	S	R	S	R	S	R
AMC	-	-	-	-	-	-	-	-	100	0	0	100	50	50
AMP	-	-	-	-	-	-	83.33	16.67	100	0	0	100	61.11	38.89
CIP	-	-	-	-	-	-	-	-	100	0	100	0	100	0
CTX	55.56	44.44	-	-	-	-	83.33	16.67	100	0	-	-	79.63	20.37
CRO	-	-	-	-	-	-	-	-	100	0	100	0	100	0
IMI	-	-	-	-	-	-	100	0	100	0	-	-	100	0
NALF	-	-	-	-	-	-	-	-	100	0	0	100	50	50
NOR	-	-	-	-	-	-	100	0	100	0	-	-	100	0
AKN	-	-	-	-	-	-	-	-	100	0	-	-	100	0
KAN	18.75	81.25	33.34	66.66	100	0	100	0	-	-	100	0	70.42	29.58
TOB	18.75	81.25	33.34	66.66	100	0	-	-	100	0	-	-	63.02	36.98
GEN	43.75	56.25	66.66	33.34	100	0	100	0	100	0	100	0	85.07	14.93
PEN	6.25	93.75	0	100	100	0	50	50	-	-	-	-	39.06	60.94
OXA	31.25	68.75	0	100	100	0	-	-	-	-	-	-	43.75	56.25
ERY	43.75	56.25	0	100	100	0	33.33	66.67	-	-	0	100	35.42	64.58
LIN	50	50	0	100	100	0	-	-	-	-	-	-	50	50
CLI	62.5	37.5	0	100	100	0	-	-	-	-	-	-	54.17	45.83
PRI	81.25	18.75	66.66	33.34	100	0	-	-	-	-	-	-	82.64	17.36
QDA	75	25	100	0	100	0	66.67	33.33	-	-	-	-	85.42	14.58
LVX	75	25	0	100	100	0	100	0	100	0	-	-	75	25
OFL	62.5	37.5	0	100	100	0	-	-	100	0	-	-	65.63	34.38
TET	25	75	33.34	66.66	100	0	50	50	0	100	-	-	41.67	58.33
MIN	56.25	43.75	100	0	100	0	-	-	-	-	-	-	85.42	14.58
VAN	87.5	12.5	100	0	100	0	50	50	-	-	-	-	84.38	15.63
TEC	81.25	18.75	100	0	100	0	33.33	66.67	-	-	-	-	78.65	21.36
LNZ	81.25	18.75	100	0	100	0	83.33	16.67	-	-	-	-	91.15	8.86
FUC	50	50	66.66	33.34	100	0	-	-	-	-	-	-	72.22	27.78
RFA	75	25	100	0	100	0	50	50	-	-	-	-	81.25	18.75
FOS	37.5	62.5	0	100	100	0	66.67	33.33	100	0	-	-	60.83	39.17
FUR	87.5	12.5	100	0	100	0	83.33	16.67	-	-	-	-	92.71	7.29
TSU	56.25	43.75	100	0	100	0	66.67	33.33	0	100	-	-	64.58	35.42
SXT	-	-	-	-	-	-	-	-	-	-	0	100	0	100
T	-	-	-	-	-	-	-	-	-	-	0	100	0	100
C	-	-	-	-	-	-	-	-	-	-	100	0	100	0
Total (%)	54.86	45.14	50	50	100	0	72.22	27.78	87.50	12.50	45.45	54.55	68.92	31.08

Antibiotic resistance

The results of activity of antibiotics tested against 233 clinical isolates from in two settings of Libreville are displayed on table 3 to 5. Analysis of the results showed varying degrees of resistance among isolates. Only *Streptococcus agalactiae* isolate is susceptible to all antibiotics tested on him, while the remaining 232 isolates were resistant at least to one of the antibiotics.

Overall, 28.65% of Enterobacteriaceae isolates were resistant to antibiotics tested (Table 3). 32.80% were resistant to whole β-Lactamines tested, 12.77% were resistant to three aminoglycosides tested, 22.26% were resistant to quinolones tested and tetracycline present 24.04% of resistance. Individually, with a percentage of resistance greater than 55%, these isolates were less susceptible to Ampicilin (80.92%), Amoxicillin (62.34%), Cefuroxim (57.27%), Ticarcilin (57.04%) and Piperacilin (56.44%). The rates of susceptibility to the other antimicrobial agents were at least 65%. Out of the total 139 isolates, Imipenem (β-Lactamine) and Amikacin (aminoglycoside) were the most effective antimicrobial agents, with susceptibility rates of 94.92% and 91.67%, respectively. Ampicilin and Amoxicillin were the least effective antimicrobial agents, with susceptibility rates of 19.09% and 37.58%, respectively, against Enterobacteriaceae isolates.

The Table-4 shown that frequency of resistance of the Gram-positive bacteria plus *Acinetobacter* and *Neisseria* to individual antibiotic was found to be 64.58% for Erythromycin, 60.94% for Penicillin and 56.25% for Oxacilin, for the least effective antimicrobial agents tested on maximum of bacteria. *S. aureus* and *S. saprophyticus* have a total resistance of 45.14% and 50%, respectively while *Streptococcus* B had 27.78%. A total susceptibility was detected in *S. agalactiae* and *A. baumannii* isolates in all the antibiotics examined except against Tetracyclin and Cotrimoxazol for *A. baumannii*. While *N. gonorrhoeae* present 54.55% of resistance in all the antibiotics examined.

Among 19 staphylococci isolated, 68.75% isolates of *S. aureus* and 100% isolates of *S. saprophyticus* were found phenotypically resistant to methicillin.

The rate of *Mycoplasma* susceptibility was 30.86% of resistances, 19.34% of intermediaries and 49.79% of sensitivities. *U. urealyticum* isolates were resistant to Clarythromycin (59.26%), Erythromycin (57.41%), Ciprofloxacin (53.7%) and Azithromycin (51.86%).

Table-5: Sensitivity and resistance of Mycoplasma

Antibiotics	***Ureaplasma urealyticum* isolates and their susceptibility pattern (%), n = 64**		
	Sensitivitie (%)	Resistance (%)	Intermediary (%)
DOT	88.89	9.25	1.85
JOS	85.18	1.85	12.96
OFL	20.37	12.96	66.66
ERY	25.92	57.41	16.66
TET	62.97	27.77	9.25
CIP	1.85	53.7	44.45
AZI	29.62	51.86	18.51
CLA	37.03	59.26	3.7
PRI	96.3	3.7	0
Total (%)	**49.79**	**30.86**	**19.34**

DISCUSSION

Gabonese National Laboratory of Public Health in Libreville and the Laboratory the Army Schooling Hospital Omar Bongo Ondimba are the main point laboratories in the country equipped to carry out bacteriological tests, we believe that the data presented here represents the situation in Libreville.

The information on the efficacy of antibacterial agents against clinical isolates is presented. Resistance rates of bacterial isolates were found to be significantly lower than those reported in some countries [12, 13, 14]. Indeed, the results demonstrated that 28.65%; 31.08% and 30.86% of Enterobacteria; Gram positives (staphylococci and streptococci), *Acinetobacter* and *Neisseria*; and *Mycoplasma* were resistant to one or more antibiotics, respectively. The percentage of resistant strains is sometimes comparable from one country to another; the "national inoculum" of resistant bacteria is much larger in some countries and makes the risk of transmission much higher. Differences in antibiotic therapy practice are undoubtedly among the possible causes of this difference [15]. The low proportion of overall resistance may be because we have a small number of isolates (1 to 4) for the majority of isolated bacterial species. Resistance to antimicrobial agents has become a major healthcare problem. Clinicians should be cognizant of their local antimicrobial resistance patterns in order to be more efficient in dealing with bacterial infections and to prevent the spread of drugresistant bacteria. Overall, except *Escherichia coli*, *Pantoea sp*, *Proteus mirabilis* and *Serratia liquefaciens*, the isolates exhibited statistically lower susceptibility rates to β-lactam agents

compared to sensitivity on all antibiotics tested. Ampicilin, Amoxicillin, Cefuroxim, Ticarcilin and Piperacilin are least likely to be effective in the treatment of infections due at Enterobacteria. This indicates a possibility of limited choice in antimicrobial agents for management of bacterial diarrhoeal diseases for example in the fighting of shedding of enteric pathogens.

Antimicrobial resistance is a complex problem driven by many interconnected factors. As such, single, isolated interventions have little impact. Coordinated action is required to minimize emergence and spread of antimicrobial resistance. Nevertheless, key tools to tackle antibiotic resistance – such as basic systems to track and monitor the problem – reveal considerable gaps. In many countries, they do not even seem to exist [16]. In addition to, few countries (34 out of 133 participating in the survey) have a comprehensive national plan to fight resistance to antibiotics and other antimicrobial medicines. Now, monitoring is key for controlling antibiotic resistance, but it is infrequent. In many countries, poor laboratory capacity, infrastructure and data management are preventing effective surveillance, which can reveal patterns of resistance and identify trends and outbreaks [17].

It is in this context of surveillance of the efficacy of antibiotics that Kouegnigan Rerambiah et *al*., [18, 19] published two major articles, on the resistance of bacteria in Libreville. They show that on all the bacteria isolated at National Laboratory of Public Health during the year 2010, the resistance rate to quinolones ranged between 58% and 78%. Low resistance rates to Teicoplanin (2–4%) was observed, Thirty-seven percent of isolated *Staphylococcus aureus* and 61% of isolated *Staphylococcus saprophyticus* were resistant to both Penicillin G and Oxacillin. Overall, with a percentage between 3% and 30%, *Klebsiella spp* and *Escherichia coli* isolates were found to be resistant to selected third and fourth-generation Cephalosporins [18]. Looking at *Mycoplasma*, *Ureaplasma urealyticum* strains isolated from singly infected subjects, the resistance rates to Erythromycin, Azithromycin and Clarithromycin were 34%, 29.54% and 32.78%, respectively. The sensitivity rates to Josamycin and Pristinamycin were 92 % and 90.8%, respectively [19].

However, the current study differs from Kouegnigan Rerambiah et *al*. [18, 19], studies' in that *Ureaplasma urealyticum* isolates were sensitive to Josamycin and Pristinamycin (85.18% and 96.3%, respectively) while the isolates were resistant to Clarythromycin (59.26%), Erythromycin (57.41%), Ciprofloxacin (53.7%) and Azithromycin (51.86%). 93.75% and 68.75% of isolated *Staphylococcus aureus* were resistant to both Penicillin and Oxacillin. One of the possible explanations for these differences is the sampling time (one year versus three months) and the number of bacterial strains tested. It is necessary to extend the study over a longer period of time and to expand the sampling at least to all Libreville hospitals and dispensaries to have a complete study.

CONCLUSION

From this finding, the results suggest that antimicrobial resistance is a growing problem. Our data will help to proper treatment of infectious diseases and reduces prolonged hospital stays and additional costs. However, it is clear that more need to be done about limiting resistance development and spread of resistant isolates once they occur. While ongoing efforts at developing new antibiotics and their use for treatments will certainly enhance our ability to treat infections caused by multidrug resistant pathogen. The detection of resistance found to commonly used antibiotics should serve as a warning call for close surveillance, identification and understanding of the epidemiology of the resistance with a view to setting up preventive strategies that can minimize or stop the emerging and spread of resistance to the antibiotic arsenal currently in use.

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Conflict of interest

The authors declare that there are no competing interests. All the authors read and approved the final version.

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