Microbes and Infectious Diseases 2024; 5(1): 295-300

Microbes and Infectious Diseases

Journal homepage: https://mid.journals.ekb.eg/

Original article

Detection of aztreonam, meropenem and imipenem resistant Gram negative bacteria from inpatient department in Federal Medical Center (FMC), Birnin Kebbi, Nigeria

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ARTICLE INFO

Article history:
Received 1 September 2022
Received in revised form 26 September 2022
Accepted 2 October 2022

Keywords:
Azetreonam
Meropenem
Imipenem
Inpatient department
MDR

ABSTRACT

Background: Antibiotic resistant infections were responsible for the deaths of 1.27 million people, with an overall 4.95 million deaths associated with complications from resistant bacterial infections globally. **Aim**: This study determined the antibiotics; aztreonam (ATM), meropenem (MEM) and imipenem (IMP) resistant Gram negative bacteria from inpatient department in FMC, Birnin Kebbi. **Methods:** Thirty (30) samples from different fomites in the inpatient department were aseptically collected using swab sticks. Streak plate technique was used to characterize and identify the bacterial isolates, then disc diffusion technique was employed to check the resistance pattern of the isolates to the antibiotics as in EUCAST guidelines version 12.0. **Results:** The biochemical technique further confirmed the occurrence of; *Escherichia coli (E. coli)* (35%), *Pseudomonas aeruginosa* (30%), *Klebseilla pneumonia* (20%) and *Acinetobacter baumannii (A. baumannii)* (15%). On the antibiotic resistance screening, *E. coli* and *A. baumannii* were found multi-drug resistant (MDR) to the antibiotics. The remaining isolates show resistance to the antibiotics except *Pseudomonas aeruginosa* and *Klebsiella pneumonia* were found sensitive to MEM and IPM respectively. **Conclusion:** Bacteria isolated are highly drug resistant to the antibiotics. The need for routine environmental sanitation, proper personal hygiene among the hospital participants, drug repositioning and molecular assay for rapid detection of MDR bacteria.

Introduction

Antibiotic resistance (AR) is defined as the ability of a micro-organism to develop and survive the exposure to an antibiotic that was designed to kill them or stop their growth [1]. The development of resistance by bacteria to different antibiotics has resulted in the difficult treatment of infectious diseases. Antibiotic resistance is a global problem especially in the developing countries. This

DOI: 10.21608/MID.2022.160057.1378
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condition increasingly compromises the outcome of various infections in Africa [2].

Antibiotic resistance also threatens public health in both developed and developing countries [3]. The problem is challenging in low-income nations because of high predominance of infection, over-the-counter availability of antibiotics, irrational uses of antibiotics, and poor infection avoidance practices [4].

In Nigeria, the Center for Disease Control and Prevention [5], has equally documented a high rate of resistance to the commonly used antibiotics. Despite the untenable rate of antibiotic resistant bacterial infections reported in most Nigerian cities, there is substantial gap in the surveillance of these infections in several Nigerian cities [6]. The aim of this research is detection of azetreonam, meropenem and imipenem resistance among Gram negative bacteria from inpatient department in FMC, Birnin Kebbi.

Materials and methods

Study area/Sites
The study was carried out at inpatient department at Federal Medical Center, Birnin Kebbi, with departments; pharmacy, theater, mortuary, records, medical laboratory, inpatients and outpatients.

Sampled unit
Accident and emergency ward, male ward, female ward, and pediatric ward

Sampled fomites
Bed rail, bed linen, door knob, drip stand, examination table, chair and sink knob.

Swab sample collection
Thirty (30) swab samples from fomites of the accident and emergency unit, male ward, female ward and pediatric ward of inpatient department were aseptically collected by rubbing sterile cotton wool swab on the fomites as described by Chessbrough [7]. The samples were sealed into sterile tubes and then transported to Kebbi State University for analyses.

Media preparation
The media (Eosin Methylene Blue, indole, MR-VP medium, citrate agar, nutrient agar and Mueller Hinton agar) used were aseptically prepared and sterilized at 121^{o}C for 15 minutes in accordance with [8].

Characterization of bacterial isolates
The cotton wool swab samples were streaked on selective and differential medium (EMB) to cultivate only Gram negative organisms, the developed colonies were later subcultured onto freshly sterilized and solidified nutrient agar plates to obtain pure culture of the isolates, this was then identified using conventional biochemical method as described in **Tiwari et al.** [9].

Antibiotic sensitivity testing
The antibiotics testing was carried out using Kirby-Bauer technique, whereby discrete colonies from the pure culture were emulsified in 5ml of sterile physiological saline and the turbidity was adjusted to 0.5 McFarland standard (approximately a cell density of 1.5 × 108 Cfu/ml). The standardized suspension was inoculated on Muller Hinton Agar using a sterile swab to ensure even distribution and confluent growth. The agar was impregnated with the antibiotics using automated disc dispenser (ADD) and incubated at 37 ^{O}C for 18- 24 hour, after which the plates were examined as described by European Committee on antimicrobial susceptibility [10].

Statistical analysis
The analysis employed comprised both the aspect of statistics that is descriptive which includes measures of central tendency and measure of deviation using Statistical Package for the Social Sciences Software (Version 22.0).

Results and discussion

Biochemical characterization of the isolates
Figure 1 shows the biochemical characterization and occurrence of the bacterial isolates; *E. coli* (35%), *Pseudomonas aeruginosa* (30%), *Klebsiella Pneumonia* (20%) and *A. baumannii* (15%). The occurrence of the bacteria could probably be members of the body flora of both asymptomatic carriers and sick persons [11]. These organisms can spread by the hand, expelled from the respiratory tract or transmitted by animate or inanimate objects [12]. The current finding corroborates the study of **Falah et al.** [13] and WHO [14] who reported *E. coli, Klebseilla pneumonia, Pseudomonas aeruginosa, Staphylococcus aureus A. baumannii, Citrobacter* spp*, and E.nterococcus faecalis* as the most prevalent bacteria in urinary tract infection (UTI) patients. These findings disagree with that of **Shawly** [15] who stated that Gram-positive bacteria have overtaken the Gram-negative as the predominant bacteria isolated from hospital fomites, but is in line with **Olowo-okere et al.** [6] who reported in two hospitals, *E. coli* (26.2%) and *Klebsiella* spp. (14.1%) were the most common pathogens implicated in all infections. Similarly, is consistent with **Olise et al.** [16] who reported the

high prevalence of *Pseudomonas aeruginosa and E. coli* on sink knob.

Sensitivity of the isolates to ATM, MEM and IMP

Table 1 indicates the diameter of the zone of inhibition of the antibiotics; *E. coli* and *A. baumannii* were resistant to the 3 examined antibiotics, *Pseudomonas aeruginosa* and *Klebseilla pneumonia* were sensitive to MEM and IPM respectively. Similarly, two studies on antibiotic resistance in one of the leading teaching hospital in the country equally revealed a resistance rate as high as 100% to most of the commonly prescribed antibiotics [17, 18]. The present finding correlates with the observation of National Center for Disease Control, [5] that observed a high prevalence of resistant bacterial infections across the different states of the nation. The high numbers of Gram-negative bacterial infections could be attributed to inadequate implementation of hospital hygiene practice and infection control [19]. Similarly, WHO [3] classified serious life-threatening pathogens; *Escherichia coli, Klebseilla pneumoniae* and *Pseudomonas* spp., as the most prevalent pathogens implicated in all infections. **Ayadele et al.** [20], reported a high resistance of *E. coli and Klebseilla pneumoniae* in prevalence of multi-antibiotic resistant *E. coli* and *Klebsiella* species obtained from a Tertiary Medical Institution in Oyo State, Nigeria. **Adam et al.** [21] reported the resistant pattern of *Pseudomonas aeruginosa* (70%). The resistance of *A. baumannii* in the present study corroborates with **Rit et al.** [22] who reported the resistant rate of *A. baumannii* to imipenem (5.2%) and meropenem (9.75%).

The finding is also in line with **Breijyeh et al.** [23] who reported *A. baumannii* to be a particular clinically important antibiotic-resistant bacterium and naturally resistant to many antibiotics due to both poor membrane penetration and active efflux pumps. The resistance of each isolate to the antibiotics can be traced in **figures 2, 3, 4** and **5**.

Table 1. Zone of the inhibitions (mm) diameter of the antibiotics

Antibiotic	**Potency**	***Escherichia coli***	***Pseudomonas aeruginosa***	***Klebsiella pneuminiae***	***Acinetobacter baumannii***
ATM	30µ	2.00±1.00	23.00±1.87	25.00±1.00	21.00±0.50
MEM	10µ	20.00±0.50	24.33±1.53	22.33±0.76	20.50±0.34
IDP	30µ	3.00±0.87	20.17±0.5	23.33±0.76	23.12±0.53

Keys: ATM = Aztreonam, MEM = Meropenem, IMP = Imipenem

Figure 1. Isolated organisms and their percentage of occurrence

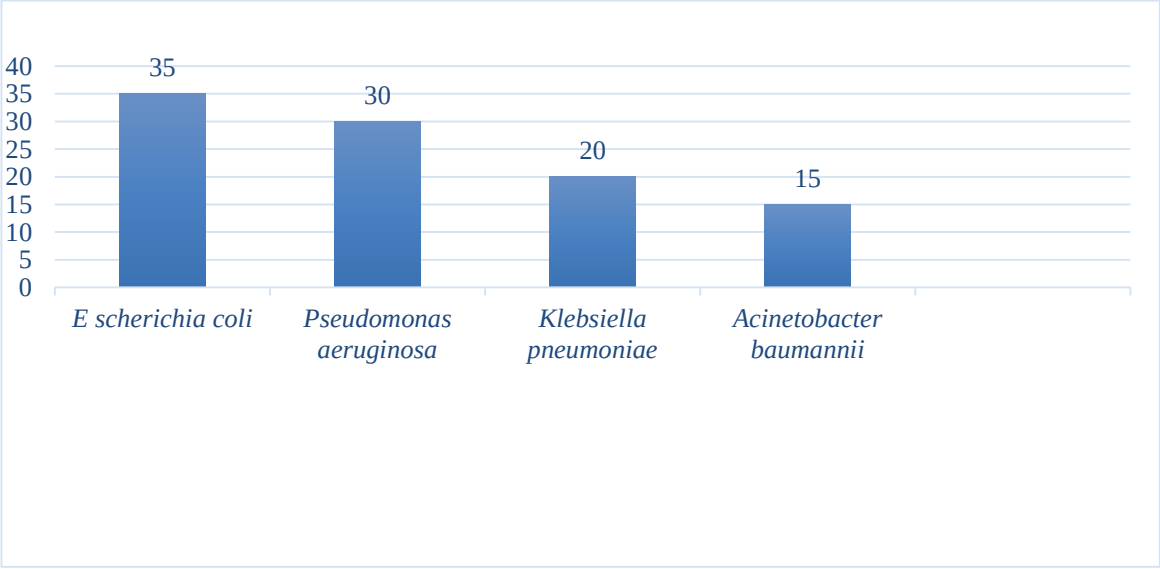


Figure 2. Percentage zone of diameter of *Escherichia coli.*

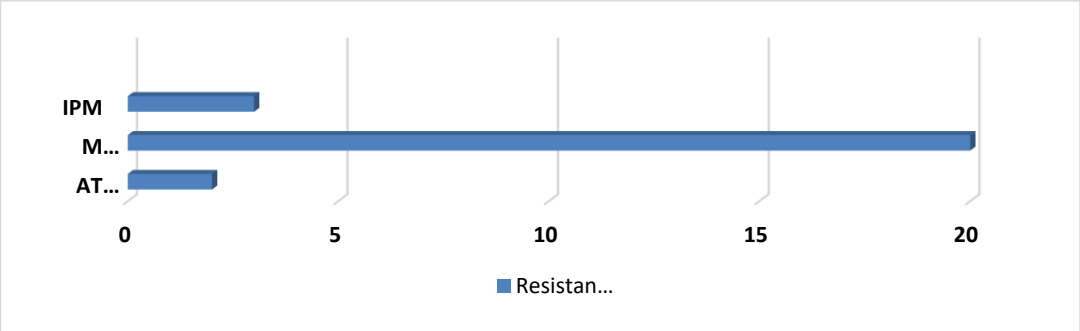


Figure 3. Percentage zone of diameter of *Pseudomonas aeruginosa.*

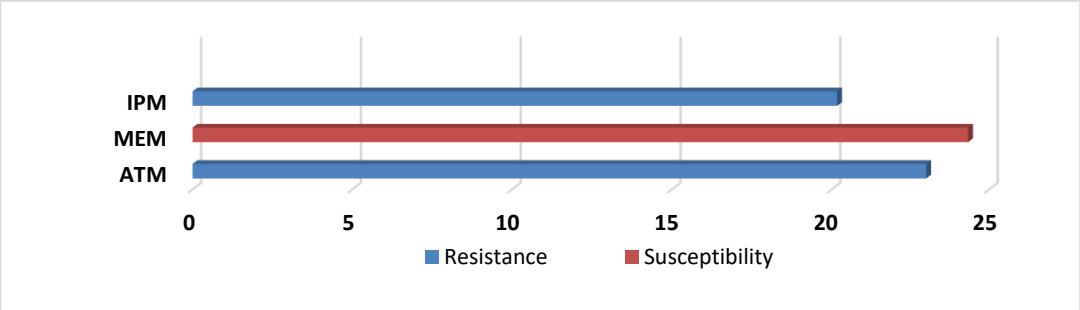


Figure 4. Percentage zone of diameter of *Klebsiella pneumoniae*

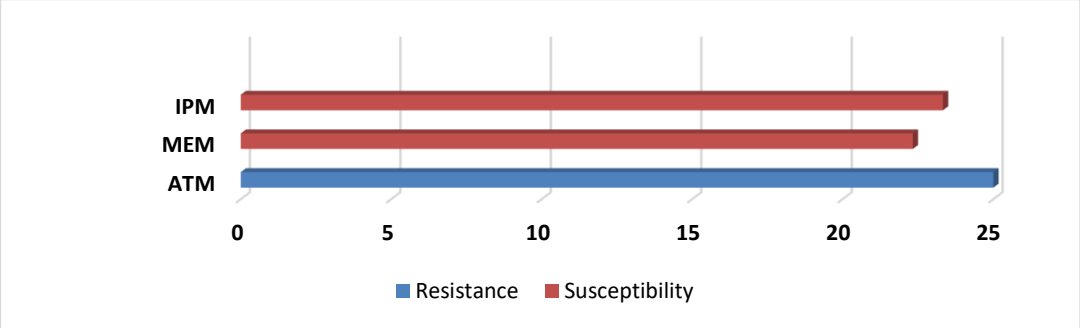
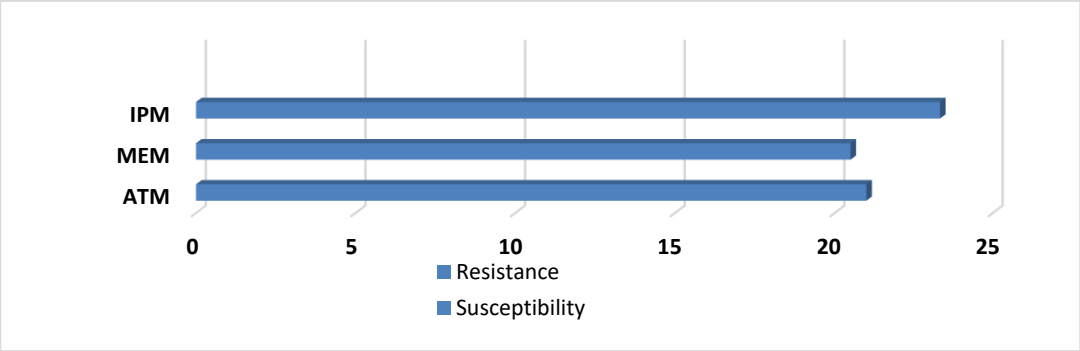


Figure 5. Percentage zone of diameter of *Acinetobacter baumannii*



Conclusion

Reference to our findings, the fomites in the inpatients department harbored resistance bacterial nosocomial pathogens with potentials of causing hospital acquired infections, as such, routine disinfection and contact control procedures should be put in place to minimize the spread of the pathogens.

Ethical approval

The Chief Medical Director (CMD) of the health center granted the conduct of the study but ethical approval letter was collected from the head of the inpatient department from January to March, 2022 for sample collection.

Conflict of interest: None.

Financial disclosure
Non to disclose.

Acknowledgments
All the contributions are hereby acknowledged.

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