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**Original Research Article**

# Antibiotic resistance profiles of *Acinetobacter baumannii* isolates from surgical wound infections at Kamuzu Central Hospital in Malawi: a retrospective study

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## ABSTRACT

**Background:** *Acinetobacter baumannii* has emerged as one of the most significant pathogen due to its ability to develop antimicrobial resistance to a broad range of commonly available antibiotics. It represents a serious iatrogenic complication of modern healthcare, where patients acquire infections in healthcare facilities with limited treatment options, resulting in increased morbidity, mortality and health costs.
**Methods:** In this retrospective study, results of culture and antimicrobial susceptibility tests of samples collected from surgical wounds of patients from January to December 2017 were extracted from Laboratory information management system at Kamuzu Central Hospital (KCH) in Malawi.
**Results:** This study ranks *A. baumannii* as the fourth common cause of surgical wound infections at KCH, with a prevalence of 12.3%. Other most prevalent isolates were: *E. coli* (25.9%), *S. aureus* (25.9%) and *Proteus species* (17.5%). All A. *baumannii* isolates were resistant to Amoxicillin/Clavulanate and Ceftriaxone; 96.4% were resistant to Ampicillin; 92.9% were resistant to Gentamycin, Ceftazidime and Sulphamethoxazole-trimethoprim; 89.3% were resistant to Ciprofloxacin; and 85.7% were resistant to Cefuroxime and Piperacillin/Tazobactam; while 17.9% were resistant to Meropenem. A total of 82% of the *A. baumannii* isolates were Multi-Drug Resistant (MDR), while 14% were Extremely Drug Resistant (XDR).
**Conclusion:** The emergence of MDR and XDR *A. baumannii* at KCH calls for rational use of available antibiotics and regular monitoring of antimicrobial resistance patterns to prevent dissemination of current strains and emergence of new resistant strains.

**Keywords:** *Acinetobacter baumannii*, Antibiotic resistance, surgical wounds

## INTRODUCTION

Surgical wound bacterial infections continue to be a major global challenge in the field of surgery leading to many complications, increased morbidity, mortality and health care costs.[1-3] Most surgical wound infections are nosocomial and may vary from one hospital to the other. Measures to control these infections have not completely

eradicated the problem because of lack of standardized criteria to monitor the epidemiology of infections. The emergence of high antimicrobial resistance among bacterial pathogens has made the management and treatment of surgical wound infections a nightmare.[4] In developing countries, the situation is further aggravated by the irrational prescriptions of antimicrobial agents and the lack of updated guidelines for empirical treatment of infections.

A Gram negative, strictly aerobic, non-fermenting, non-fastidious, non-motile *Acinetobacter baumannii* bacillus has emerged as one of the most troublesome pathogen associated with surgical wound infections and other nosocomial infections globally.[5] The bacteria's immense ability to acquire or upregulate antibiotic drug resistance determinants for a wide range of the locally available antibiotic have been of public health concern. *A. baumannii* is reported to have a natural resistance to antibiotics, but also an acquired resistance through production of enzymes such as the β-lactamases, especially metallo-β-lactamase and oxacillinases.[6] Carbapenems hydrolyzing β-lactamases belonging to oxacilinases enzymes are the main enzymes responsible for the inactivation of imipenem in *A. baumannii.* [7]

Data on antibiotic resistance patterns of *A. baumannii* in Africa is largely from South Africa.[8-11] with a few reports from other countries such as Kenya[4], Ethiopia, and Nigeria.[12-13] These studies have reported the emergence of *A. baumannii* isolates resistant to the last resort antimicrobials such as Carbapenems. The current study aimed at assessing the prevalence and resistance patterns of *A. baumannii* isolated from surgical wounds of patients at Kamuzu Central Hospital (KCH) in Lilongwe, Malawi.

## METHODS

### *Study design*

In this retrospective longitudinal survey, Authors analyzed test results of samples that were routinely obtained from surgical wounds of patients at KCH in Lilongwe, Malawi between January to December 2017. KCH is the only tertiary referral hospital in the central region of Malawi with about 600 to1,000 beds, though the true number of patients always exceeds the number of beds. It serves approximately 5 million people.

The hospital has well-established surgical wards and well-functioning laboratory department which is undergoing accreditation process. Data of samples collected from patients suspected of surgical wound infection between January and December 2017 was retrieved from Laboratory information management system (LIMS) and analysed. All cases with incomplete data and duplicates of the same patient were excluded in the study.

### *Laboratory procedures*

Wound swabs were collected using sterile cotton swabs and cultured on blood, MacConkey and mannitol salt agar. Culture positive samples were characterized by Gram stain, colony morphology and standard biochemical tests as is a routine diagnosis of bacteremia at KCH. Antimicrobial susceptibility testing was done according to the Kirby Bauer method and EUCAST guidelines as stipulated in the updated KCH Microbiology standard operating procedures. Isolates were considered Multi-Drug Resistant (MDR) if they were non-susceptible to ≥1 agent in ≥3 antimicrobial categories and Extremely Drug Resistant (XDR) if were non-susceptible to ≥1 agent in all but ≤2 antimicrobial categories to which reference strain (*E. coli* ATCC 25922) was susceptible.

## RESULTS

### *Social-demographic characteristics of patients*

A total of two hundred and seventy-three (273) patients suspected of surgical wound infection between January and December 2017 were investigated from Laboratory information management system database. Of these, 51% (n=140/273) were females and 49% (n=133/273) were males. The analysis showed that majority of the patients (n=66; 24%) were between 21 and 30 years of age. Among all the patients, 71% (n=194) were from the General surgery and Orthopaedic department while 29% (n=79) were from the Gynaecology and Obstetrics departments. Socio-demographic characteristics of patients are shown in Table 1.

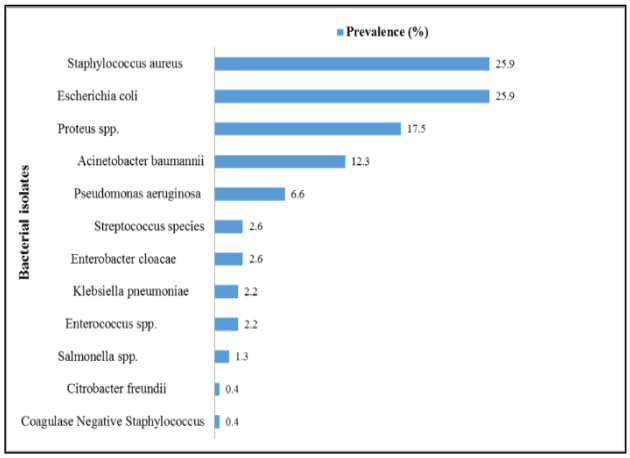


**Figure 1: Prevalence of bacterial isolates from surgical wounds at KCH between January and December 2017.**

### *Prevalence of bacterial isolates from surgical wounds*

The overall prevalence of bacterial isolates from surgical wounds suspected of infection was 84% (n=228/273). Among all bacterial isolates, 48% (n=110/228) of the

culture positives were from females and 52% (n=118/228) were from males. There were more (69%; n=157/228) Gram negatives than Gram positive isolates (31%; n=71/228). The more frequent bacteria isolated from surgical wound cultures were *S. aureus* 25.9% (n=59/228), *E. coli* 25.9% (n=59/228), *Proteus spp* 25.9% (n=40/228) and *A. baumannii* 12.3% (n=28/228) as shown in Figure 1.

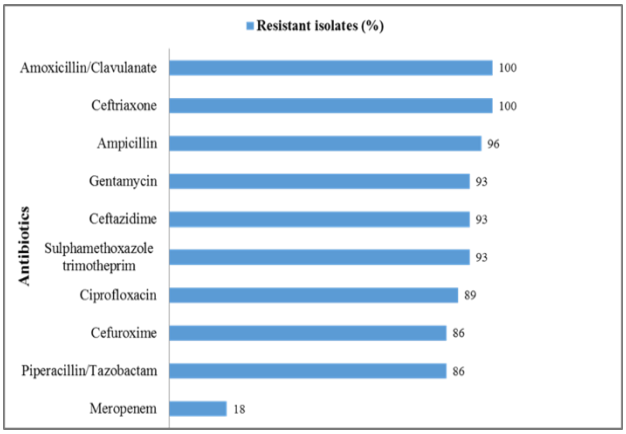


**Figure 2a: Antibiotic resistance patterns of A. baumannii isolated from surgical wounds of patients at KCH between January and December 2017.**

Majority of these bacteria were isolated in patients age group 21-30 and from the General surgery and Orthopaedic department Table 1.

***Antibiotic resistance patterns of A. baumannii isolated from surgical wounds***

As shown in Figure 2a, all the twenty-eight (n=28/28) *A. baumannii* isolates were resistant to Amoxicillin/Clavulanate and Ceftriaxone, while 96% (n=27/28) were resistant to Ampicillin. A total of 93% (n=26/28) of isolates were resistant to Gentamycin, Ceftazidime and Sulphamethoxazole trimethoprim, while 89% (n=25/28) were resistant to Ciprofloxacin; and 86% (24/28) were resistant to Cefuroxime and Piperacillin/Tazobactam.

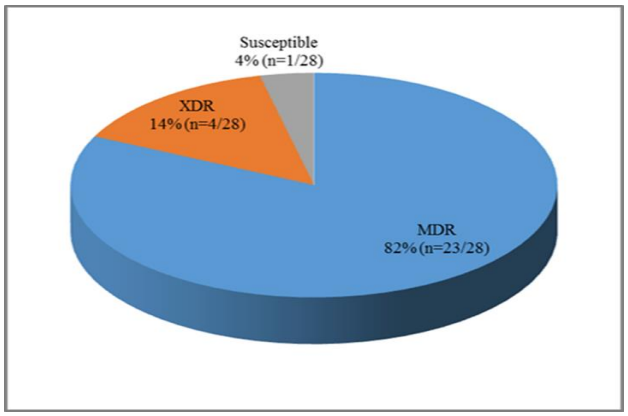


**Figure 2b: Categories of antibiotic resistance pattern of *A. baumannii* isolated from surgical wounds of patients at KCH between January and December 2017.**

**Table 1: Socio-demographic characteristics of participants suspected of surgical wound infections at KCH between January and December 2017.**

| | | Bacterial culture results | | |
|---|---|---|---|---|
| **Gender** | **Female** | **Positive** | **Negative** | **Total n (%)** |
| | Male | 110 | 30 | 140 (51) |
| Age group (Years) | ≤10 | 118 | 15 | 133 (49) |
| | 11-20 | 26 | 8 | 34 (12) |
| | 21-30 | 46 | 9 | 55 (20) |
| | 31-40 | 57 | 9 | 66 (24) |
| | 41-50 | 34 | 7 | 41 (15) |
| | >51 | 29 | 6 | 35 (13) |
| Department | General surgery and Orthopaedic | 36 | 6 | 42 (15) |
| | Gynaecology and Obstetrics | 170 | 24 | 194 (71) |
| | ≤10 | 58 | 21 | 79 (29) |
| Total | | 228 | 45 | 273 (100) |

only 18 % (n=5/28) were resistant to meropenem. consequently, 82% (n=23/28) of the isolates were mdr while 14% (n=4/28) of the isolates were xdr. only one (n=1/28) isolate was susceptible to almost all the antibiotics tested (figure 2b).

## DISCUSSION

In Malawian context, this is the first report on the prevalence of surgical wound bacterial infections and the antimicrobial resistance profile of the *A. baumannii* isolates. The overall prevalence of bacterial isolates from

surgical wounds with clinical suspicion of wound infections was 84%, with a large proportion of Gram negative than Gram positive bacteria isolates. On the contrary, lower rates (11.4%, 10.9%) of bacterial isolation with more Gram positive than Gram negative bacterial have been reported from the surgical wound infections of patients from other countries.[14,15] The possible explanaton for the difference could be due to variations in bacterial etiology and infection prevention practices in diverse geographical settings and at different sampling times.

This study ranks *A. baumannii* as a fourth cause of surgical wound infection at KCH in Malawi with a prevalence of 12.3%. Other common isolates were; *E. coli* (25.9%), *S. aureus* (25.9%) and Proteus species (17.5%). Comparably lower prevalence rates of *A. baumannii* isolates in surgical wound infections have been reported at a tertiary hospital in Kenya (7.1%) and the neighbouring country, Tanzania (10.2%). Contrary, *A. baumannii* was not isolated in surgical wound infections of patients at a Nigerian hospital. This could probably due to the non-uniformity in the practices of infection prevention measures among hospitals.[13,16,17]

All the *A. baumannii* isolates in this study were resistant to Ceftriaxone and Amoxicillin/Clavulanate (Augmentin), an observation consistent with a more recent finding on *Acinetobacter* spp isolated at Queens Elizabeth Central hospital, a KCH's sister hospital located in the southern region of Malawi.[18] High rates (above 80%) of A. baumannii isolates resistance to Ceftriaxone and Amoxicillin/Clavulanate were also noted elsewhere.[19,20] A total of 86% A. baumannii isolates in this study were equally resistant to piperacillin/tazobactam and cefuroxime; 89% were resistant to ciprofloxacin 89%, 93% were equally resistant to Ceftazidime, Gentamicin, and Sulphamethoxazole-Trimethoprim, and 96% were resistant to Ampicillin. These findings are consistent with reports from various studies globally i.e. in Egypt, Poland, Taiwan, Spain,Turkey, Ethiopia, Kenya, Nigeria, Tanzania, and in Malawi, reporting more than 80% Acinetobacter isolates resistant to these locally available antibiotics.

The emergence of multidrug resistant Acinetobacter highlights the growing challenge in treatment and management of the associated infections that will be impossible or/and costly to treat in this resource-limited setting. The increase in the rates of resistance to these antibiotics may be attributed to the frequent empirical usage in treatment of suspected bacterial infections globally as antibiotic resistance suggestively corresponds with previous exposure to specific class/category of antibiotic24 either direct or indirect.[12,17,21-25]

Eighty-two percent (82 %) of the *A. baumannii* isolates were multidrug resistant while 14% of the isolates were extremely drug resistant. Since Colistin and Tigecycline were not included in a panel of antibiotic disk for sensitivity testing, it is unknown whether some isolates were equally resistant to these antibiotics to be considered as pandrug resistant (PDR) isolates.

However, these findings are worrisome to a resource-limited country like Malawi, considering the limited availability of these drugs locally and the associated costs of reserved antibiotics.

The observed high rate of antibiotic resistance, and emergence of carbapenem resistant isolates in Malawi may reflect the irrational use of available antibiotics (perhaps due to unavailability of updated guidelines for selection of antibiotics), poor adherence to treatment recommendations, lack of regular monitoring of antimicrobial resistance patterns, and perhaps the breakdown of infection prevention measures in our hospitals.

There are a number of limitations in this study. Our investigation was limited to a one year and small LMIS dataset of patients who presented with surgical wound infections. A long-term survalence utilising a large bacteraemia dataset would have been ideal to properly decribe the prevalence and antimicrobial resistance patterns of *A. baumanni*. The lack of molecular tools to accurately identify the *A. baumannii* from other Acinetobacter species might have overestimated the prevalence of the *A. baumannii*. However, since the *A. baumannii* species are the most common and important human pathogens, the results of this current study remains valid. In addition, two important antimicrobial agents of two antimicrobial categories used to treat XDR *A. baumannii* isolates i.e. colistin (polymxins) and tigecyline (Tetracyclines) were not included in the antimicrobial susceptibility test, thus some isolates that have been categorised as suspectd XDR might be subjective.

## CONCLUSION

This study ranked *A. baumannii* as the fourth common cause of bacterial wound infections at KCH in Malawi. It also reports for the first time, the high rates of MDR and XDR *A. baumannii* isolates at KCH which will leave clinicians with few choices of drugs for the treatment of surgical wound infected patients. The current study calls for rational use of available antibiotics and regular monitoring of antimicrobial resistance patterns to prevent dissemination of current strains and emergence of new resistant strains.

### *Recommendations*

Although eradication of surgical wound infections is not entirely possible, proper precautions should be taken to minimize the occurrence, by strictly adhering to aseptic procedures and proper management of surgical wounds. In the context where guidelines for selecting appropriate

empirical therapeutic regimen for *A. baumannii* are unavailable, XDR or PDR bacteria which are resistant to carbapenems and perhaps polymixins, may be treated with a combination of carbapenem with amikacin or alternatively carbapenem with ceftazidyme or colistin with carbapenems.

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