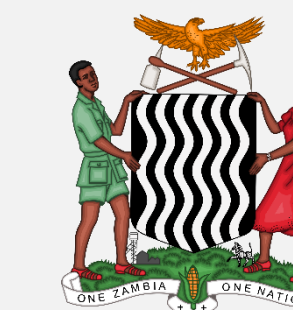




High Frequency of Multi-Drug Resistant Organisms (MDRO) at University Teaching Hospital (UTH), Lusaka, Zambia



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ABSTRACT

Background: Antibiotic resistance is a worldwide problem. Prior studies on patterns of resistance in Zambia depended on laboratory methods that lacked standardization. UTH is a 1655 bed quaternary care hospital and the primary teaching hospital of Zambia. Since 2015, the microbiology laboratory has used Vitek 2 Compact (bioMerieux, Inc., France) for standardized detection of resistance.

Methods: We conducted a retrospective cross-sectional study of data collected on bacterial isolates analyzed from July 2015 to April 2017. We entered the data into WHONET 5.6 and aggregated it to develop hospital antibiograms. Due to high levels of resistance, we defined susceptible, intermediate, and resistant as >70%, 40-70%, and <40% of isolates sensitive to a drug respectively. To improve usability, a version replacing the percent susceptible with these categories was developed.

Results: We analyzed 2019 isolates to identify susceptibility patterns to commonly used antibiotics at UTH. *Escherichia coli* and *Klebsiella pneumoniae*, the most commonly isolated Gram-negative (GN) organisms, were resistant to most drugs including ceftriaxone, indicating high rates of extended-spectrum beta-lactamase (ESBL) production. Methicillin resistant *Staphylococcus aureus* (MRSA) made up 37% of *S.aureus* isolates. MRSA and methicillin susceptible *S. aureus* (MSSA) were resistant to trimethoprim/sulfamethoxazole (TMP/SMX), a commonly used drug at UTH. *Streptococcus pneumoniae* was resistant to most drugs against which it was tested.

Conclusion: MDROs were common at UTH with carbapenems indicated for empiric GN therapy. Further research should assess the extent and depth of antibiotic resistance in Zambia. Antibiograms provide critical information for clinicians to strategically use antibiotics.

INTRODUCTION

Antibiotic resistance is a growing worldwide problem that requires a range of interventions and solutions. The limited data we have from Zambia depended on laboratory methods that lacked quality assurance. We used Vitek 2 Compact, less subjective than standard laboratory methods, to evaluate patterns of resistance at UTH and develop antibiograms to assist clinicians in choosing the most effective empiric antibiotic treatment.

RESULTS

- E. coli* and *K. pneumoniae* were the most commonly isolated GN organisms with 343 (25%) and 432 (31.5%) specimens respectively.
- E. coli* and *K. pneumoniae* were highly resistant to all drugs including ceftriaxone and other 3rd generation cephalosporins, indicating high rates of ESBL production.
- E. coli* and *K. pneumoniae* were resistant to all antibiotics except amikacin and carbapenems.

CONCLUSIONS

Our study confirms concerning trends in high degrees of MDROs through a methodology less prone to subjectivity and mistakes in identification and susceptibility testing. The improper use of antibiotics is a multifaceted problem with many proposed solutions. One solution is giving providers the tools to more effectively treat infections. This can be done in the form of antibiograms which provide important information on institutional resistance that can be utilized for empiric therapy while waiting for culture results or in cases where there is no laboratory testing or the lab can provide only limited results.

- There were 109 (20.3% of GP isolates) *S. aureus* isolates, 86 (16%) *Enterococcus* isolates, and 19 (3.5%) *S. pneumoniae* isolates.
- MRSA made up 37% of *S. aureus* isolates.
- MRSA and MSSA were highly resistant to TMP/SMX, a commonly used drug in the region.
- S. pneumoniae* was not tested against penicillin but did maintain sensitivities of 83.3% to ceftriaxone.
- Enterococcus faecalis* and *Enterococcus faecium* maintained good susceptibility to vancomycin.
- E. faecium* had 8.3% sensitivity to ampicillin.

UTH ANTI BIOGRAM FOR INFECTIOUS DISEASE SPECIALISTS

Gram Positive													
	# of isolates	Penicillins			Other								
		Ampicillin	Oxacillin	Penicillin G	Ceftriaxone	Erythromycin	Clindamycin	Linezolid	Quinupristin/Dalfopristin	Rifampin	Tetracycline	Trimethoprim/Sulfamethoxazole	Vancomycin
<i>Enterococcus faecalis</i>	50	S		85.4				100	18.2				94
<i>Enterococcus faecium</i>	36	8.3		5.6				100	100				100
<i>Staphylococcus aureus, MSSA</i>	69		100			77.9	95.6	100	100	98.5	78.8	I	100
<i>Staphylococcus aureus, MRSA</i>	40		0			32.5	90	97.4	90	27.5	37.5	I	94.9
<i>Staphylococcus species, coagulase negative</i>	324						86.3	99	91.8	59.3	58		94.9
<i>Streptococcus pneumoniae</i>	19*				83.3	50					50		94.7

Gram Negative																
	# of isolates	Aminoglycosides			B-Lactams			Cephalosporins			Quinolones		Other			
		Amikacin	Gentamicin	Amoxicillin/Clavulanic acid	Ampicillin	Ampicillin/Subactam	Imipenem	Ertapenem	Cefuroxime	Ceftriaxone	Cefepime	Ciprofloxacin	Nalidixic acid	Tetracycline	Nitrofurantoin	Trimethoprim/Sulfamethoxazole
<i>Acinetobacter baumannii</i>	114	94.7	40.2			72.9	87.7	R		R	50.9	27.9		31.5		15.5
<i>Acinetobacter lwoffii</i>	20*	100	72.2	71.4	45	84.2	94.4	R	50	66.7	89.5	57.9		78.6		27.8
<i>Aeromonas hydrophila</i>	17*	100	56.2	68.8		0	87.5			41.2	68.8	64.7				0
<i>Citrobacter freundii</i>	28*	100	62.5				91.7	100	76.2	78.3	91.7	70.8	66.7	54.5	95.7	25
<i>Enterobacter cloacae</i>	93	100	53	R	R	R	95.5	93.9		47	63.6	69.6	25	31	55.2	28.4
<i>Escherichia coli</i>	343	100	50.4	42.4	5.9	20.8	99.3	97.4	40.4	41.2	66.4	40.2	25.4	20.1	72.1	10.4
<i>Klebsiella pneumoniae</i>	432	100	30.2	20.7		12.5	99.2	96.2	17	15.6	74.3	48.5	23.1	36	40.8	12.3
<i>Morganella morganii</i>	28*	100	39.1				91.3	91.7		38.1	54.2	25	25	8.7	R	16.7
<i>Proteus mirabilis</i>	92	100	34.9	71.1	9.3	47.7	100	93	36.9	48.8	55.8	40.7	33.3	R	R	15.1
<i>Pseudomonas aeruginosa</i>	134	88.9	71.5				92.4	R		R	79.4	71.2				R
<i>Salmonella sp</i>	26*	100	56.5	60	22.7	22.7	100	100		52.4	50	0	33.3		R	27.3
<i>Serratia marcescens</i>	19*	100	68.4				89.5	94.7		61.1	68.4	73.7			R	71.4
<i>Stenotrophomonas maltophilia</i>	27*	R	R	R	R	R	R	R	R	R	R					81

*Interpret with caution given low number of isolates

UTH ANTI BIOGRAM FOR GENERAL PRACTITIONERS

Gram Positive										
	# of isolates	Penicillins			Other					
		Ampicillin	Oxacillin	Penicillin G	Ceftriaxone	Erythromycin	Clindamycin	Tetracycline	Trimethoprim/Sulfamethoxazole	Vancomycin
<i>Enterococcus faecalis</i>	50	S		S						S
<i>Enterococcus faecium</i>	36	R		R						S
<i>Staphylococcus aureus, MSSA</i>	69		S			I	S	I	I	S
<i>Staphylococcus aureus, MRSA</i>	40		R			R	S	R	I	S
<i>Staphylococcus species, coagulase negative</i>	324						S	I		S
<i>Streptococcus pneumoniae</i>	19				S	I		I		S

Gram Negative													
	# of isolates	Aminoglycosides			B-Lactams			Cephalosporins			Other		
		Amikacin	Gentamicin	Amoxicillin/Clavulanic acid	Ampicillin	Ampicillin/Subactam	Imipenem	Cefuroxime	Ceftriaxone	Cefepime	Ciprofloxacin	Tetracycline	Trimethoprim/Sulfamethoxazole
<i>Acinetobacter baumannii</i>	114	S	I			S	S		R	I	R	R	R
<i>Acinetobacter lwoffii</i>	20	S	S	S		I	S	I	I	S	I	S	R
<i>Aeromonas hydrophila</i>	17	S	I	I		R	S		I	I	I	I	R
<i>Citrobacter freundii</i>	28	S	I				S	S	S	S	S	I	R
<i>Enterobacter cloacae</i>	93	S	I	R	R	R	S		I	I	I	R	R
<i>Escherichia coli</i>	343	S	I	I	R	R	S	I	I	I	I	R	R
<i>Klebsiella pneumoniae</i>	432	S	R	R		R	S	R	R	S	I	R	R
<i>Morganella morganii</i>	28	S	R				S		R	I	R	R	R
<i>Proteus mirabilis</i>	92	S	R	S	R	I	S	R	I	I	I	R	R
<i>Pseudomonas aeruginosa</i>	134	S	R				S		R	S	S		R
<i>Salmonella sp</i>	26	S	I	I	R	R	S		I	I	R		R
<i>Serratia marcescens</i>	19	S	I				S		I	I	S		S
<i>Stenotrophomonas maltophilia</i>	27	R	R	R	R	R	R	R	R				S

S=sensitive, I=intermediate, R=resistant

NEXT STEPS

- Roll out the antibiogram at UTH and educate clinicians on its use.
- Further research to assess the extent and depth of antibiotic resistance in Zambia.
- Ongoing implementation of interventions at UTH to decrease antimicrobial resistance.
- Monitor antimicrobial resistance over time at UTH through the ongoing analysis of antibiotic resistance data and the development of updated antibiograms.

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