ORIGINAL RESEARCH

Knowledge, attitude and perception on antimicrobial use and antimicrobial resistance among final year medical students in the College of Medicine, Malawi

Alfred Kamoto[1], Gertrude Chapotera[2], Fatima Suleman[3]

1. Discipline of Pharmaceutical Sciences, School of Health Sciences, University of KwaZulu-Natal, Durban, KwaZulu-Natal, South Africa
2. Department of Public Health, School of Public Health and Family Medicine, College of Medicine, University of Malawi, Blantyre, Malawi
3. Discipline of Pharmaceutical Sciences, School of Health Sciences, Westville Campus, University of KwaZulu-Natal, Durban, KwaZulu-Natal, South Africa

Correspondence: Alfred Kamoto (alfredkamoto75@yahoo.co.uk)

Abstract

Background
Medical curricula need to provide adequate knowledge on antimicrobial medicine use and antimicrobial resistance (AMR). Such knowledge is critical in shaping correct attitudes and perceptions among future prescribers. However, the extent of preparation provided by medical curricula remains unknown.

Aim
The current study sought to determine knowledge, attitude and perception on antimicrobial use and AMR among final year medical students in Malawi.

Methods
A descriptive cross-sectional study was undertaken among all final year medical students at the College of Medicine, University of Malawi in 2016. Total population sampling and self-administered questionnaires were used. Data were entered using Microsoft Excel and analysed with Epi info. Descriptive analysis for categorical data was done using frequencies and proportions, and for continuous data using measures of central tendency.

Results
The response rate in this study was 95%. The mean and median aggregated scores were 7.2 and 7, respectively, for the 11 knowledge questions. Over 88% of the respondents answered more than half of the knowledge questions correctly. Respondents agreed that antimicrobials are overused both at national (50; 69%) and at hospital (52; 72%) levels.

Conclusion
This study reports high aggregated knowledge scores on antimicrobial use and resistance with wide variations on correct knowledge scores per question. The study further shows varying level in attitudes and perceptions among medical students. Overall, there were gaps on antimicrobial use and knowledge of AMR which the medical curriculum should addresses.

Key Words
Knowledge, attitude, perception, antimicrobial use, antimicrobial resistance, medical students, Malawi

Introduction

For decades, the use of antimicrobial medicines has contributed greatly to the decline in morbidity and mortality caused by infectious diseases[1]. However, over time microorganisms have developed resistance to these antimicrobial agents, thereby undermining the treatment advances of the past century. Attention is now focussing on the future of these antimicrobial medicines, reflecting the effectiveness of these medicines amidst the emerging threat of antimicrobial resistance (AMR). Many cases of AMR have been reported in Malawi and beyond[2-4]. It is clear from the literature that if this is not monitored and proper measures put in place, a huge burden of infectious diseases and increased cost of health care is likely to follow.

Antimicrobial medicine use which is often influenced by prescribing behaviour correlates positively with AMR[5]. Thus, any change in prescribing behaviour through interventions in education may help to control AMR by promoting the proper use of antimicrobial medicines. Pulcin and colleagues recommend that interventions focussing on

prudent antimicrobial use should be introduced early in the medical career[6]. They further argue for continued training at postgraduate level and during medical practice as has been previously suggested by other authors[7,8].

Medical students are future prescribers and need to be adequately prepared during training to help in the control of AMR. The knowledge acquired during training will help in shaping correct attitudes to and perceptions on antimicrobial use and AMR among future prescribers as has been shown elsewhere[7]. It is therefore not debatable that educational interventions especially at undergraduate level remain critical and should receive distinct attention in the fight against AMR. Failure to do so will result in AMR remaining a major public health problem with microorganisms developing resistance to virtually all antimicrobial agents including antiviral medicines for the treatment of HIV[9].

This study therefore aimed to assess how well the education among final year medical students at the College of Medicine in Malawi prepares them about AMR by determining the level of knowledge, attitude and perception on antimicrobial

medicine use and AMR.

Methods

Setting

The study was conducted at the College of Medicine, University of Malawi in Blantyre. The College of Medicine was established in 1991 initially providing Bachelor Medicine and Bachelor of Surgery (MBBS) degrees and was the only institution providing such training in Malawi until recently. Years later, the college added other undergraduate programmes in pharmacy, laboratory science, physiotherapy, among others.

Study population

All final year medical students were selected as the sample population for this study. A cross-sectional study was undertaken in February 2016 using a self-administered questionnaire. The questionnaire was created by modifying questionnaires previously used by Abbo et al.[10] and Thriemer et al.[11]. The questionnaire was piloted among 10 final year medical students in 2015.

The questionnaire was administered to medical students towards the end of their final year of study in February 2016. Informed consent was obtained prior to data collection. Data collected were entered in Microsoft Excel (2013 version) and was cleaned. Analysis was done using Epi info ™ version 7.1.5.2 (CDC, Atlanta, USA). Descriptive analysis for categorical data was done using frequencies and proportions while continuous data was analysed using measures of central tendency. Knowledge was assessed by calculating the total scores for the 11 multiple choice questions. A score of 11 denoted excellent, 9–10 was very good and 7–8 was denoted as good.

The study protocol was approved by the Humanities and Social Science Research Ethics Committee of the University of KwaZulu-Natal (approval number HSS/0345/015M) and the College of Medicine Research Ethics Committee (COMREC approval number P.05/15/1735). Permission to conduct the study at the College of Medicine was obtained from the Dean of the Faculty of Medicine and specific heads of departments or assignees.

Results

A total of 78 questionnaires were distributed and 74 were returned. This represents a 95% response rate. Two medical students who did not complete the questionnaire properly were excluded from the analysis.

Demographic characteristics

Of the medical students included in the analysis, 63 (88%) were aged between 21 and 25 years. Only nine (13%) were aged above 25 years. Thirty-seven (51.4%) were male (see Table 1).

Table 1. Demographic characteristics of Malawian final year medical students

Demographic characteristic	Male *n*=37 (51%)	Female *n*=35 (49 %)	Total *n* (72)
Aged between 21 and 25	28 (75.7 %)	35 (100%)	63
Aged above 26	9 (24.3%)	0 (0 %)	9

Results on knowledge

Participants were required to respond to questions that assessed their knowledge about antibiotic use and resistance. These were scored as correct or incorrect. High scores were obtained from questions on the treatment of diarrhoea (98.6%), and antimicrobial medicine safety during pregnancy (98.6%). The results are reflected in Table 2.

Table 2. Results on knowledge questions about AMR in Malawian medical students

Question	Percentage (%) of correct response
Antimicrobial medicine use in children with diarrhoea	98.6
Antimicrobial medicine use in children with purulent rhinitis and sore throat	22.2
Dosage optimisation for antimicrobial medicine in patients with renal failure[a]	11.1
Antibiotics safety in pregnancy	98.6
Antibiotics activity against anaerobes	97.2
Susceptibility of methicillin resistant *Staphylococcus aureus*:	13.9
– Antibiotic effectiveness to crosses the blood–brain barrier	69.4
– Dosage form for best activity of aminoglycosides	58.3
– Initiation and restarting of ART	81.9
– ART drug resistance	90.3
– Management of TB-HIV co-infection	77.8

[a]This is indicative of the situation in Malawi where no/limited facilities exist to assess aminoglycoside drug levels and renal function.

AMR, antimicrobial resistance; ART, antiretroviral therapy.

Overall knowledge score of the participants

For the 11 multiple choice knowledge questions, the mean and median aggregated scores per participant were 7.2 [standard deviation (SD 1.21)] and 7 [interquartile range (IQR) 6–8.5), respectively. A total of eight (11.1%) of the respondents achieved an aggregated score of 9 while 26 (36.1%) of the respondents achieved an aggregated score of 8 out of a possible total score of 11. Aggregated scores of 7 and 6 were achieved by 19 (26.4%) and 11 (15.3%) of

the respondents, respectively. For the other participants, the aggregated score was 5 or less. The difference in aggregated scores for males and females was not significant [mean (M)=7.12 for males vs. M=7.23 for females, P=0.817). Table 3 presents the scores of the respondents disaggregated by gender and previous experience.

Table 3. Aggregated knowledge score of the participants

Aggregated scores (out of 11 knowledge questions)	Percentage frequency				
	All (*n*=72)	Male (n=37)	Female (n=35)	Percentages with previous experience (*n*=10)	Percentages with no previous experience (*n*= 62)
9	11.1	13.5	8.6	10.0	11.3
8	36.1	29.7	42.9	40.0	35.5
7	26.4	27.0	25.7	20.0	27.4
6	15.3	18.9	11.4	30.0	12.9
5	9.7	10.8	8.6	0	11.3
4	1.4	0	2.7	0	1.6

Medical perceptions and attitude about antimicrobial use and resistance – percentage who agree/strongly agree with each statement

Table 4 details perceptions and attitudes of medical students on antimicrobial use and resistance. Nearly 70% of the participants felt antimicrobial medicines are overused on a national level. Only 16% of the participants felt that AMR is not a problem at a hospital level. There was no significant difference in most attitudes and perceptions between males and females.

Medical students' perceptions about antimicrobial stewardship education and preparedness

Results of the final year medical students' views about antimicrobial education are shown in Table 5. Sixty-three (88%) of the respondents reported being adequately prepared on how to deal with medical problems associated with HIV and 57 (79%) on how to transition from intravenous to oral antibiotics. Less than half understood how to interpret antibiograms.

Discussion

The study set out to determine the level of knowledge, attitude and perception on antimicrobial use and AMR among final year medical students. Primary analysis on aggregated knowledge scores shows relatively high knowledge scores among participants.

The aggregated high knowledge scores on antimicrobial use and resistance among the final medical students is not unique to Malawi. Previous studies[7,11] conducted in UK and Congo have recorded similar findings. This study however, reports slightly higher aggregated mean knowledge scores (7.2 out of 11) than those previously reported in Congo (4.9 out of 8). The difference in scores among these studies can be attributed to many factors including difference in

Table 4. Medical perceptions and attitudes about antimicrobial use and resistance – percentage who agree/strongly agree with each statement

Perception and attitude statements	Percentage *n*=72 (100%)	Percentage male *n*=37 (51.4%)	Percentage female *n*=35 (48.6%)	*P*-value
Antimicrobials are overused nationally	69.4	62.1	77.2	0.248
Antimicrobials are overused at the hospitals I have rotated through	72.3	73	71.4	0.270
AMR is not a significant problem nationally	13.9	18.9	8.6	0.592
AMR is not a significant problem at the hospital I rotated through	16.7	13.5	20	0.019[a]
Better use of antimicrobials will reduce problems with antimicrobial resistant organisms	79.2	78.4	80	0.798

[a]**Means statistically significant.**

AMR, antimicrobial resistance.

Table 5. Medical students' perceptions about antimicrobial stewardship education and preparedness – percentage who feel their education has been good/very good as a percentage

Perceptions	Percentages			
		Gender		
	All *n*=72	Male *n*=37	Female *n*=35	*P*-value
How to deal with medical problems associated with HIV infection	87.50	86.49	88.57	0.777
Transition from intravenous to oral antibiotics	79.17	78.38	80.00	0.989
When to start antimicrobial therapy	77.78	81.08	74.29	0.089
Select the best antimicrobial for a specific infection	66.67	70.27	62.86	0.166
Find reliable sources of information to treat infections	62.50	75.68	48.57	0.011[a]
Describe the correct spectrum of antimicrobial therapy for different antimicrobials (what is covered by each drug?)	59.72	67.57	51.43	0.149
Understand the basic mechanisms for AMR	52.78	64.86	40.00	0.043*
Streamline or deescalate antimicrobial therapy	40.28	54.05	25.71	0.014*
Interpret antibiograms	11.11	18.92	25.71	0.069

[a]**Significant at 0.05.**

AMR, antimicrobial resistance.

curriculum and study settings, consequently the results must be interpreted with caution. However, the current knowledge level shown in this study is useful for a review of medical curricula possibly in a manner similar to medical schools elsewhere[13,14].

With regards to attitudes and perceptions, the study shows that the majority of the participants considered AMR as a significant problem and this is consistent with findings within sub-Saharan Africa and beyond[8,11,13,14]. Locally the results agree with findings from a survey conducted at Kamuzu Central Hospital in which AMR was reported in all commonly used antibiotics[3]. Regarding antimicrobial use, participants perceived that antimicrobial medicines are overused both at hospital and national levels. While the actual burden of AMR in Malawi is not known beyond anecdotal data from practising physicians and a few surveys, it is critical that medical students are able to note this as a major threat. This serves as a better platform to negotiate for institutional as well as national strategies to limit the development or spread of AMR. Further evidence for more interventions is provided in this study where almost three quarters of the students indicated the need for antimicrobial education. This may not be a need for doctors in training only, the need for additional education among practicing doctors is well documented in the literature[14]. Granted that this study excluded practising prescribers, there is need for yet another study to document the level of knowledge, attitudes and perception among this population.

Additionally, the study shows that medical students felt that the education they had undergone prepared them least in how to interpret antibiograms. The authors concede that antibiograms are not routinely compiled by hospital laboratories in Malawi. This limits the chances of medical students at least to encounter an antibiogram during training. However, the authors feel this deficiency can be addressed by the curriculum. It is important to note that these findings compare sharply with those reported in America by Nand[15], yet presumptive treatment is practiced more in limited resource settings than in developed counterparts.

Conclusion

This survey demonstrates that there are gaps in knowledge on antimicrobial medicine use and AMR. Therefore, this study recommends that medical curricula should be tailored to addressing the challenges identified. Medical students can also use available online training courses to supplement their training. The acceptability and development of online training in this area is a topic for future research. This study further recommends undertaking a follow-up study when these students are practicing in order to assess knowledge, attitude and practice (KAP) vs. their prescribing habits. This will determine sustainability of knowledge and translation of knowledge to practice.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

Reference

1. Infectious Diseases Society of America (IDSA). Combating Antimicrobial Resistance: Policy Recommendations to Save Lives. Clin Infect Dis. 2011;52(Suppl 5):S397-S428. doi:10.1093/cid/cir153.

2. Musicha, P, Cornick J, Bar-Zeev N, French N, Masesa C, Denis B, et al. (2017). Trends in antimicrobial resistance in bloodstream infection isolates at a large urban hospital in Malawi (1998–2016): A surveillance study. Lancet Infect Dis. 2017;10.1016/S1473-3099(17)30394-8.

3. Makoka M, Miller W, Hoffman I, Cholera R, Gilligan P, Kamwendo D, et al. Bacterial infections in Lilongwe, Malawi: Aetiology and antibiotic resistance. BMC infect Dis. 2012.12.67.10.1186/1471-2334-12-67.

4. Tadesse BT, Ashley EA, Ongarello S, Havumaki J, Wijegoonewardena M, González IJ, et al. Antimicrobial resistance in Africa: a systematic review. BMC Infect Dis. 2017;17(1):616. doi: 10.1186/s12879-017-2713-1. PMID: 28893183; PMCID: PMC5594539.

5. Kallel H, Mahjoubi F, Dammak H, Bahloul M, Hamida CB, Chelly H, et al. Correlation between antibiotic use and changes in susceptibility patterns of *Pseudomonas aeruginosa* in a medical-surgical intensive care unit. Indian J Crit Care Med. 2008 Jan;12(1):18-23. doi: 10.4103/0972-5229.40945. PMID: 19826586; PMCID: PMC2760919.

6. Pulcini C, Williams F, Molinari N, Daveyc P, Nathwanie D. Junior doctors' knowledge and perceptions of antibiotic resistance and prescribing: a survey in France and Scotland. Clin Microbiol Infect. 2011,17(1):80-7. doi:10.1111/j.1469-0691.2010.03179.x.

7. Heaton A, Webb DJ, Maxwell SRJ. Undergraduate preparation for prescribing: the views of 2413 UK medical students and recent graduates.Br J Clin Pharmacol. 2008;66(1):128-34. doi:10.1111/j.1365-2125.2008.03197.x.

8. Ross S, Maxwell S. Prescribing and the core curriculum for tomorrow's doctors: BPS curriculum in clinical pharmacology and prescribing for medical students. Br Clin Pharmacol. 2012;74(4):644-61. doi:10.1111/j.1365-2125.2012.04186.x.

9. Laxminarayan R, Duse A, Wattal C, Zaidi A, Wertheim H, Sumpradit N, et al. Antibiotic resistance – the need for global solutions. Lancet Infect Dis. 2013;13(13):1057-98.

10. Abbo LM, Cosgrove SE, Pottinger PS, Pereyra M, Ronda Sinkowitz-Cochran R, Arjun Srinivasan A, et al. Medical students' perceptions and knowledge about antimicrobial stewardship: How are we educating our future prescribers? *Clin Infect Dis*. 2013;57(5), 631-8.

11. Thriemer K, Katuala Y, Batoko B, Alworonga J-P, Devlieger H, Van Geet C, et al. Antibiotic prescribing in DR Congo: A knowledge, attitude and practice survey among medical doctors and students. PLoS ONE. 2013;8(2). doi:10.1371/journal.pone.0055495.

12. Paterson Davenport LA, Davey PG, Ker JS. An outcome-based approach for teaching prudent antimicrobial prescribing to undergraduate medical students: report of a Working Party of the British Society for Antimicrobial Chemotherapy. J Antimicrob Chemother. 2005;56:196-203.

13. Ross S, Loke YK. Do educational interventions improve prescribing by medical students and junior doctors? A systematic review. Br J Clin Pharmacol. 2009;67(6):662-70. doi:10.1111/j.1365-2125.2009.03395.x.

14. Aminov RI. A brief history of the antibiotic era: lessons learned and challenges for the future. Front Microbiol. 2010;1:134. doi:10.3389/fmicb.2010.00134.

15. Nand P, Wilson MD, Cohen SH, Brown J. Curbing antimicrobial resistance: Do physicians receive adequate education about antibiograms? J infect. 2016;72(1):127-9. doi:10.1016/j.jinf.2015.09.036.