Original Research Article

A Content Analysis of Two African Medical Schools' Antibiotic Stewardship Curricula

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ABSTRACT

Background: Antibiotics are precious substances that have saved millions of lives since their discovery, resulting in significant advances in modern medicine. However, antibiotic resistance and a slowdown in the discovery of new antibiotics with novel mechanisms of action are affecting the sustainability of antibiotics. The objective of this study was to describe the content of South African and Nigerian medical students' curricula with respect to prudent antimicrobial prescribing. **Methods:** A content analysis framework was used to identify, describe, and count the keywords, key phrases, and sentences relevant to the teaching of prudent antimicrobial prescribing in the complete curricula content of two African countries' medical schools. The courses are taught in the Graduate Entry Medical Programme (GEMP) curriculum (years 3–6) of the South African medical school and years 4–6 of the Nigerian medical school. The frequency of keywords/key phrases relevant to prudent antibiotic prescribing such as antimicrobial stewardship, mechanisms of bacterial resistance, and principles of antibiotic therapy was determined. **Results:** The two curricula reviewed were found to be different. While the South African medical school uses an integrated curriculum in the GEMP (a stream where candidates with undergraduate degrees are enrolled into the 3rd year of medical school and spend 4 years), the Nigerian medical school operates a traditional (discipline based) curriculum from MBBS 1–6. A greater number of keywords and key phrases were found in the South African curriculum compared to the Nigerian curriculum in relation to prudent antibiotic prescribing and antimicrobial stewardship. The key phrase "antimicrobial stewardship" or "antibiotic stewardship" was absent in the Nigerian curriculum but appeared four times in the South African curriculum. **Discussion:** The findings of this curriculum review suggest a need for revision of the medical curricula of the two countries, to one that will better prepare learners for antimicrobial stewardship.

Keywords: Africa, antibiotic, antibiotic resistance, antibiotic stewardship, curriculum, medical education, medical schools, medical students

Background

The discovery of antibiotics is undoubtedly one of the major advancements in science in the 20th century. The discovery of the first antibiotic "penicillin" in 1928 by Alexander Fleming has saved millions of lives, especially during World War II. Antibiotics have transformed medical practice by playing a role in the management of infectious diseases, cancer chemotherapy, and organ transplantation.[1,2] However, the emergence of antimicrobial resistance (AMR), a global threat affecting public health and economic stability, is affecting this initial success.[1,3] AMR occurs due to inappropriate

Access this article online

Quick Response Code:

Website: www.educationforhealth.net

DOI: 10.4103/efh.efh_34_22

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How to cite this article: Bashar MA, van Zyl RL, Miot J, McInerney PA. A content analysis of two African medical schools' antibiotic stewardship curricula. Educ Health 2023;36:4-13.

Submitted: 31-Jan-2022 **Revised:** 01-Aug-2023
Accepted: 04-Aug-2023 **Published:** 05-Oct-2023

antimicrobial use from overuse, underuse, abuse, and misuse of antimicrobial agents.[4] The United Kingdom (UK) Commission report predicted that if left unchecked by 2050, AMR has the potential to cause 10 million deaths annually, of which 4.1 million will come from Africa. It will also result in a loss to the global economy of 100 trillion US dollars by 2050.[5,6] Similarly, a 2017 World Bank report which examined the economic consequences of AMR indicated that, if not addressed, AMR will push more than 28 million additional people into extreme poverty by 2050. Most of these people will be from low- and middle-income countries.[7]

Antimicrobial stewardship programs (ASPs) are one of the strategies that encourage responsible antibiotic use, thereby reducing AMR. The aim of ASPs is to optimise antimicrobial therapy and reduce inappropriate antibiotic use and collateral damage.[8] Education is viewed as an important tool in shaping prescribing behavior and encouraging prescribers to accept and adopt ASPs.[9] Most of the educational ASPs are implemented at the postgraduate level and among practising physicians, with the hope of changing their behavior. Little emphasis has been given to teaching prudent antibiotic prescribing to medical students.[10] It is suggested that medical schools incorporate courses on antimicrobial stewardship to ensure that aspiring doctors acquire basic skills in prudent antibiotic prescribing at an early stage in their careers.[11]

The World Health Organization has stressed the importance of incorporating courses in prudent antimicrobial prescribing in medical schools' curricula.[12] This needs to be done at the time when their knowledge and behaviour are being shaped.[10] A survey of antibiotic stewardship courses in American medical schools found that only 66% of schools included such courses.[13] Further, medical students across the world acknowledge that antibiotic resistance is a problem with 74%–95% of them desiring further education in prudent antibiotic prescribing.[14-16] In 2009 the General Medical Council in the UK highlighted the importance of integrating courses in responsible antibiotic prescribing into medical schools' curricula.[17] The UK[18] and the USA[19-23] have developed courses in prudent antibiotic prescribing. The same cannot be said about medical schools in Africa, where many countries still use the traditional curriculum adopted from the West decades ago.[24] South Africa is probably the most advanced nation on the African continent as far as innovations in medical education are concerned.[24] Our scoping review which maps available evidence on antimicrobial stewardship in medical schools did not find any literature on an ASP in an African medical school.[25]

In both countries, the medical degree is 6 years for students coming directly from high schools. The South African medical school has a Graduate Entry Medical Programme (GEMP) stream where candidates with undergraduate degrees are enrolled into the 3rd year of medical school and complete a further 4 years of study to graduate with a degree in medicine. There is no GEMP stream in Nigerian medical schools, but they have a Direct Entry Programme where candidates with an A level organised by the Joint Interim Matriculation Board are admitted into the 2nd year of medical school to spend 5 years of study.

Medical doctors are expected to be able to prescribe antibiotics as soon as they have qualified.[26] Hence, the need to teach prudent antibiotic prescribing and antimicrobial stewardship in the medical curriculum. The authors questioned the content of medical schools' curricula in relation to responsible antibiotic prescribing. The objective of this study then was to describe the content of the South African and Nigerian medical students' curricula with respect to prudent antimicrobial prescribing.

Methods

A summative content analysis framework as described by Hsieh and Shannon[27] was used to identify and count the keywords, key phrases, and sentences relevant to rational antimicrobial teaching in the curricula content of two African medical schools. Four disciplines (pharmacology, microbiology, medicine, and surgery) were chosen because they are likely areas where antimicrobials will be taught. The summative content analysis technique involves identifying and counting the number of times a keyword, key phrase or sentence appears in a document or text and interpreting the context in which they are used.[27] For instance, the number of times the phrase "antimicrobial stewardship" appears in a curriculum. This method was used because the curricula texts mostly consist of lists of words and sentences. They include antibiotic(s), antimicrobial stewardship, mode of bacterial resistance, mechanisms of bacterial resistance, mechanisms of AMR, rational choice of antibiotics, principles of antibiotic therapy, principles of anti-infective therapy, and principles of dose optimisation in the context of antimicrobial therapy. An initial review of the curricula resulted in four categories being identified by the authors, namely medical knowledge, surgical knowledge, practical knowledge, and contextual knowledge. The keywords were arranged and interpreted based on their affinity to fit into a category. The keywords in each category were then grouped based on their similarity to form subcategories.[28] The keywords, key phrases, and sentences were then counted to show their distribution across the subcategories and categories.[28]

Summative content analysis

Summative content analysis requires more than the counting of keywords. It also involves latent content analysis[27] – a process of interpretation of content.[29] Manifest content analysis refers

to the analysis of what the text says and deals with the content aspect and describes the visible, obvious components of the text.[30,31] Latent content analysis describes the meaning of the text and the relationships that exist between keywords. It requires an interpretation of the underlying meaning in the text.[30,31] The categories and subcategories show similarities in meaning and association between the keywords.[28,32] The two forms of content analysis refer to interpretation but at different levels and depth and level of abstraction.[33] Our study involved both types of analysis, i.e. the presence and frequency of keywords or key phrases and attempted to interpret their usage in the text. The process enabled the identification of the strengths and weaknesses of the curricula with respect to the teaching of antibiotic prescribing.

Data extraction from the curricula

Data were generated from the curricula of one South African and one Nigerian medical school. The curricula of these medical schools were selected because their final-year students had previously participated in a survey that aimed to identify gaps in knowledge of prudent antibiotic use.[34] The gap in knowledge identified among final-year South African and Nigerian medical students informed the review of the curricula content of one medical school in each country. One Nigerian medical school was selected because all Nigerian medical schools use the same curriculum.[35] The choice of the curriculum of one South African medical school was a matter of convenience where the MBBCh curriculum review was being conducted. Permission was granted to access the curricula of the two medical schools in South Africa and Nigeria. The curricula analysed were for the GEMP; years 3–6 of the South African medical school and years 4–6 of the Nigerian medical school.

Data analysis

A content analysis is a flexible method for analysing text data such as a curriculum.[32] However, there are no systematic rules for analysing data using content analysis, but the guiding principle of the technique is that several words within the text are classified into much smaller content categories.[36,37] Higher institutions of learning organise their educational programs into courses and each course has its curriculum, with a segment of the curriculum describing how it will be delivered and assessed.

The process of data analysis used in this study is based on that described by Sjölin *et al*.[28] The analysis process followed four steps [Figure 1]. In the first step, we read the course content several times to understand how the words were used in the curriculum. Methods used to teach the content were not analyzed. In the second step, the course content of the curriculum was split into units of analysis [Table 1], to facilitate the identification of relevant keywords, key phrases, and sentences.

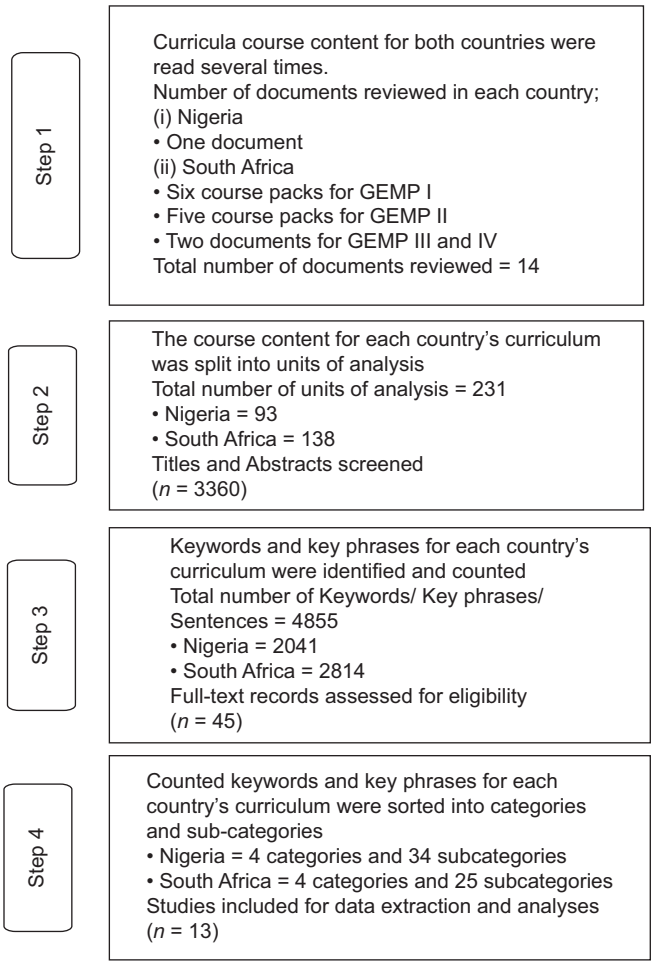

Figure 1: Four steps of data analysis

In this study, the unit of analysis was a paragraph or a section including phrases or descriptions related to the course curriculum. The units of analysis were transferred into a Word document. In the third step, keywords and key phrases were identified and counted [Table 2]. Absolute frequency was determined by counting the number of times a keyword or key phrase appeared in the curriculum from each medical school.[38]

The fourth step of the analysis was conducted by sorting the keywords. Similar keywords, key phrases or sentences were placed into categories and subcategories irrespective of whether they originally belonged to pharmacology, microbiology, medicine, or surgery. The process of sorting and placing keywords into different categories and subcategories involved an iterative process. There was agreement between authors on where keywords best fit into categories and subcategories.

Ethics

The study formed part of a bigger project that received ethics clearance from (the name is removed) (Clearance number: M1902108).

Table 1: Example of units of analysis and identification of keywords and key phrases

Units of analysis	Keywords	Curriculum
Principles of anti-infective therapy 2-antimicrobial stewardship Define antimicrobial stewardship and the desired outcomes of this intervention Discuss various antimicrobial stewardship strategies List and describe the important pharmacodynamic parameters associated with antimicrobial therapy List and describe the important pharmacokinetic considerations in antimicrobial prescription Discuss the principle of dose optimization in the context of antimicrobial therapy and stewardship	Principles of anti-infective therapy Antimicrobial stewardship Define antimicrobial stewardship Desired outcome of antimicrobial stewardship Various antimicrobial stewardship strategies Important pharmacodynamic parameters Antimicrobial therapy Important pharmacokinetic considerations Antimicrobial prescription Principle of dose optimization Antimicrobial therapy Antimicrobial stewardship	From microbiology curriculum of the South African medical school

Table 2: Comparison of the counted keywords, key phrases and sentences between South African and Nigerian curricula

South Africa				Nigeria			
Category	***n***	**Subcategory**	***n***	**Category**	***n***	**Subcategory**	***n***
Medical knowledge		Pharmacology	523	Medical knowledge		Pharmacology	347
		Medicine	744			Medicine	452
		Microbiology	599			Microbiology	417
		Haematology	30			Haematology	25
		Ethics	2			Ethics	45
		Clinical skills	76			Clinical skills	21
		Public health	25			-	-
	1999	Sub-total			1307	Sub-total	
Surgical knowledge		General surgery	154	Surgical knowledge		General surgery	121
		Trauma	101			Paediatric surgery	16
		Plastic surgery	16			Cardiothoracic surgery	15
		Urology	44			Plastic surgery	11
		Orthopaedics	127			Vascular surgery	8
		Neurosurgery	11			Urology	13
		Anaesthesia	1			Orthopaedics	75
		Otorhinolaryngology	89			Neurosurgery	16
		Ophthalmology	137			Anaesthesia	35
		Radiology	107			Otorhinolaryngology	60
		-	-			Ophthalmology	73
		-	-			Radiology	3
	787	Sub-total			446	Sub-total	
Practical knowledge		Pharmacology practical	6	Practical knowledge		Pharmacology practical	10
						Microbiology practical	137
	6	Sub-total			147	Sub-total	
Contextual knowledge		Global health	1	Contextual knowledge		Global health	15
		Interprofessional collaboration	2			Interprofessional collaboration	11
		Environment	10			Continuing medical education	5
		Learning	8			Environment	4
		Equality	1			Learning	49
						Technology	13
						Disaster management	12
						Immigration	5
						Family	8
						Economics	3
						Equality	11
						Family planning	5
	22	Sub-total			141	Sub-total	
Total	2814				2041		

n: Number of keywords/key phrases

Results

The two curricula were very different. The South African school has adopted an integrated curriculum while the Nigerian school uses a traditional (discipline based) curriculum. The differences between the two curricula are highlighted in Table 3.

The analysis did not involve years of internship and speciality training. Table 1 provides an example of how the content of the two curricula was split into units of analysis from which keywords were generated. There were more keywords and key phrases in the South African curriculum (2814) compared to the Nigerian curriculum (2041). Similarly, there are more keywords and key phrases relevant to prudent antibiotic prescribing in the South African curriculum compared to the Nigerian curriculum [Table 4].

Categories and their subcategories

The number of keywords, key phrases, or sentences in each category and subcategory are summarised in Table 2. There are four categories in each medical school with 25 and 34 subcategories in the South African and Nigerian schools, respectively. The medical category contains 1999 and 1307 keywords and phrases in the South African and Nigerian curricula, respectively. These were used in the curricula to describe the medical knowledge, perceptions, and skill domains which medical students should know to be able to effectively manage different medical conditions. In both countries, the medicine subcategory (South Africa, $n = 744$; Nigeria, $n = 452$) had the highest number of keywords that were used to describe the different medical conditions. In both countries, the microbiology subcategory had the second-highest number of keywords (South Africa, $n = 599$; Nigeria, $n = 417$). Keywords such as "AMR" and "principles of antibiotic therapy" were found in both countries. In the South African curriculum, the keyword "antimicrobial stewardship" appeared four times in the microbiology curriculum, but none was found in the Nigerian curriculum. The pharmacology subcategory is consistent with that of microbiology in terms of the number of keywords (South Africa, $n = 523$; Nigeria, $n = 347$). The subcategory contains keywords that explain pharmacokinetic and pharmacodynamic principles, mechanism of actions, interactions, and side effects of drugs. Keywords that describe antimicrobial agents and their indication, AMR, and rational antibiotic use were found, but the keyword "antimicrobial stewardship" was not found. More keywords on clinical skills were found in the South African curriculum (76) compared to the Nigerian curriculum (21).

The surgical category contained 787 and 446 keywords and phrases in the South African and Nigerian curricula, respectively; where they were used in the curricula to describe the basic surgical knowledge and skills. In both countries, the general surgery subcategory had the largest number of keywords (South Africa, $n = 154$; Nigeria, $n = 121$). Orthopaedic surgery had the second highest number of keywords in both countries (South Africa, $n = 127$; Nigeria, $n = 75$). In South Africa, the subcategories ophthalmology ($n = 137$) and trauma ($n = 101$) followed with the largest number of keywords compared to Nigeria where ophthalmology had 73 and otorhinolaryngology had 60 keywords.

The practical knowledge category contained 6 and 147 keywords and phrases in the South African and Nigerian curricula, respectively. They were used in the curricula to describe how students should be able to demonstrate practical skills such as the preparation of Gram stains. In the Nigerian curriculum, 137 and 10 keywords were used to describe microbiology and pharmacology practical knowledge, respectively; while in the South African curriculum six keywords were found in relation to pharmacology practical knowledge. The keywords were used in the curricula to describe students' ability to demonstrate laboratory skills. The Nigerian contextual category contained 141 keywords compared to 22 keywords in the South African curriculum. The keywords in this category described knowledge and skills students are likely to use outside clinical settings. Subcategories such as disaster management (12 keywords), immigration (five keywords), and economics (three keywords) were found in the Nigerian curriculum but were not found in the South African curriculum.

Discussion

The objective of this study was to describe the content of the South African and Nigerian medical students' curricula with respect to prudent antimicrobial prescribing. This information would contribute to the development of an antibiotic stewardship curriculum for both countries.

As shown in Table 2 there were more keywords related to prudent antibiotic prescribing in the South African curriculum compared to the Nigerian curriculum. Although the number of keywords used does not translate into how the concepts are taught, it provides information on the distribution and emphasis given to such topics in the curriculum. It is not surprising that the key phrase "antimicrobial stewardship" was not found in the Nigerian curriculum because the phrase was first coined in 1996[39] and Nigerian medical schools use a curriculum developed by English academics in the 1940s, with little modification.[35] The presence of fewer keywords related to prudent antibiotic prescribing in both curricula could explain the gap in knowledge identified in a recent study that aims to examine the knowledge and attitude among South African and Nigerian final-year medical students on antimicrobial use, AMR and antibiotic stewardship.[34] In that study, more than

Table 3: Nigerian versus South African medical curricula

Year	Nigerian medical school				South Africa medical school			
	Courses	Nature of curriculum	Assessment	Course name	Courses	Nature of curriculum	Assessment	Course name
Year 1	Biology, Chemistry, Physics, Mathematics, Introductory Genetics and Introductory Parasitology	Discipline-based curriculum	Semester examination	MBBS 1	Introduction to Medical Science I Chemistry I Physics I Psychological Foundations of Health Sociological Foundations of Health Medical Thought and Practice I First aid Computer Literacy	Discipline-based curriculum	Semester examination	MBBCh 1
Year 2	Human Anatomy, Physiology, Medical Biochemistry, Community Health	Discipline-based curriculum	End of course tests and pre-MBBS promotional examination in anatomy, physiology and medical biochemistry	MBBS 2	Human Anatomy Physiology and Medical Biochemistry I Molecular Medicine	Discipline-based curriculum	Semester examination	MBBCh 2
Year 3			End of course tests and 1st professional MBBS examination in anatomy, physiology and medical biochemistry after three semesters. Exams include essay type/or short answers, MCQ, practical examinations and viva voce	MBBS 3	GEMP 1 consist of six blocks: Basic concepts in medicine and health 1, basic concepts in medicine and health 2, haematology, respiratory, cardiovascular system, and renal GEMP II consist of five blocks: Neurosciences, musculoskeletal, GIT and nutrition, endocrine, and reproduction	Vertically integrated	6 blocks tests including MCQ, part 1 OSCE, and end of year exam and part 2 OSCE GEMP I have 6 critical medical science subject group tracks 1. Pathology (anatomical, haematological, chemical, genetics, immunology) 2. Microbiology (bacteriology, virology, mycology, parasitology) 3. Pharmacology (basic pharmacology, clinical pharmacology) 4. Basic sciences (anatomy, physiology) 5. Clinical sciences (medicine, obstetrics and gynaecology, surgery, paediatrics, neurosurgery, neurology, orthopaedics, psychiatry, ophthalmology, otorhinolaryngology) 6. Themes (PD theme including clinical skills, personal and professional development theme including evidence base medicine, biostatistics, CD theme - community health)	MBBCh 3/GEMP 1
Year 4	Introductory Medicine I, Introductory Medicine II, Introductory Surgery, Psychiatry, Medicine I, Surgery I (general surgery, trauma and emergency surgery, GIT surgery, congenital surgery), Community Health, Rural PHC rotation, pharmacology and therapeutics (general pharmacology, systemic pharmacology), Microbiology (Bacteriology, Virology, Mycology, Parasitology, Helminthology, Applied Medical Microbiology, Medical Entomology) Pathology (Chemical Pathology, Morbid Anatomy and Forensic Medicine, Haematology)	Discipline-based curriculum	End of course tests and 2nd professional MBBS examination in medical microbiology, pharmacology and pathology. Exams include essay type/or short answers, MCQ, practical examinations and viva voce	MBBS 4			5 blocks tests including MCQ, part 1 OSCE, and end of year exam and part 2 OSCE	MBBCh 4/GEMP 2

Contd...

Table 3: Contd…

Year	Nigerian medical school				South Africa medical school			
	Courses	Nature of curriculum	Assessment	Course name	Courses	Nature of curriculum	Assessment	Course name
Year 5	Medicine II (Cardiology I, Respiratory Medicine I, Gastroenterology I, Haematology [clinical], Metabolic and Endocrine Medicine, Neurology I and Nephrology I) Surgery II (Paediatric Surgery, Cardiothoracic Surgery, Burn and Plastic Surgery, Vascular Surgery, Endocrine Surgery), Radiology, Psychiatry, Paediatrics and Obstetrics and Gynaecology, Community Health	Discipline-based curriculum	End of course tests and part I final professional MBBS in paediatrics, obstetrics, gynaecology. Exams include essay type/or short answers, MCQ, clinical examinations and viva voce	MBBS 5	Integrated Clinical Medicine A is divided into seven rotational clinical blocks Obstetrics APC (anaesthesia/trauma/emergency medicine) Surgery Mixed I (Urology/Ophthalmology/ Otorhinolaryngology [ENT]) Internal Medicine Paediatrics Mixed II (Family Medicine, Psychiatry Public Health)	Integrated curriculum	Blocks tests and end of year exam	MBBCh 5/GEMP 3
Year 6	Psychiatry, Community Health and Research Project, Medicine III (Cardiology II, Respiratory Medicine II, Gastroenterology II, Nephrology II, Rheumatology, Clinical Immunology, Tropical Medicine and Infections, Special Topics and Neurology II, Dermatovenerology, Medical Ethics and Jurisprudence, Traditional Medicine and Telemedicine, Surgery III (Urology, Rural Surgery, Neurosurgery, Urology, Anaesthesia, Ophthalmology, Otorhinolaryngology [ENT], Orthopaedics, and Special topics in Surgery) Radiology	Discipline-based curriculum	End of course tests and part II final professional MBBS in medicine, surgery and community health. Exams include essay type/or short answers, MCQ, clinical examinations and viva voce	MBBS 6	Integrated Clinical Medicine B is divided into seven rotational clinical blocks as well as two learning components Internal Medicine Paediatrics Mixed (Orthopaedics/Internal Medicine) Psychiatry Gynaecology Integrated Primary Care	Integrated curriculum	Blocks tests and end of year exam	MBBCh 6/GEMP 4

MCQ: Multiple Choice Question, GEMP: Graduate Entry Medical Programme, OSCE: Objective structured clinical examination, GIT: Gastrointestinal tract, ENT: Ear, Nose and Throat, PD: Professional Development, CD: Communicable Diseases, APC: Acute and Perioperative Care, PHC: Primary Health Care

Table 4: Comparison between South African (2019) and Nigerian (from Student's Handbook Revised October, 2016) curricula as regards the frequency of the keywords, key phrases and sentences relating to teaching prudent antibiotic use, and their absolute frequency

Keywords/key phrases/sentences	Absolute frequency	
	South Africa	Nigeria
Antimicrobial stewardship	3	0
Mode of bacterial resistance, mechanisms of bacterial resistance, mechanisms of AMR	16	1
Rational choice of antibiotics, principle of antibiotic therapy, principle of anti-infective therapy	2	2
Principle of dose optimisation in the context of antimicrobial therapy	1	0
Total	22	3

AMR: Antimicrobial resistance

half of the Nigerian final-year medical students were either not familiar (43.8%) or not at all familiar (16.6%) with the term "antibiotic stewardship."

There is a difference in the distribution of keywords across the four categories, with the medical category having the highest number of keywords in both countries. This suggests that more emphasis is given to medical knowledge compared to other concepts that fall within the realm of surgical, practical and contextual knowledge. Subcategories such as medicine, microbiology and pharmacology where topics on prudent antibiotic prescribing are likely to be taught have the highest number of keywords in both countries, but only a few of the keywords are related to topics on responsible antibiotic prescribing. This means that little emphasis is given to teaching prudent antibiotic prescribing in both countries. AMR is a reason that pharmaceutical industries are shifting their attention away from the development of new classes of antibiotics toward research and the development of drugs used in the treatment of chronic conditions.[40] Hence, the need for curriculum developers to include topics on antimicrobial stewardship to equip medical students with adequate knowledge and skills in rational antibiotic prescribing to be able to manage the available antibiotics.

The South African medical school had more keywords compared to the Nigerian medical school. A possible explanation for this is that the South African medical school's curriculum has undergone modification in recent times. Some South African medical schools have dedicated Units for Undergraduate Medical Education mostly headed by medical educators, who regularly review and innovate the curriculum. On the other hand, Nigerian medical schools do not have such units.[41] Nigerian medical schools are mostly headed by clinicians who have little background in teaching and learning in higher education.[35] In an unpublished small survey, conducted among young academics at Bayero Medical School Nigeria, <10% of the respondents had heard of "medical education" as a field of specialty. Most of them had not heard of newer methods of teaching in health.[35]

Study limitation

One of the limitations of this study is that the reviewed curriculum from each country is not representative of other medical schools in the two countries. However, according to Ibrahim[35] in Nigeria, almost all medical schools without exception use a traditional curriculum developed by English academics in the 1940s. Interaction with academics teaching across Nigerian medical schools revealed that they still use the original curriculum. Despite that, the reviewed curricula provided us with sufficient relevant information to be able to extract keywords relevant to prudent antibiotic prescribing. While the counted keywords, key phrases and sentences provided us with information about their relative importance in the curricula, they did not explicitly provide us with data related to teaching methods used. The integrated nature of the South African curriculum made it difficult to separate it into different disciplines during analysis. Another limitation is the way antimicrobial stewardship is reported or worded in the curriculum outline, where it may be included but not clearly identifiable. Medical students on rural rotations may present a case where infection is present and includes antibiotic issues. The students may have received training during rural rotations that are not captured in course objectives.

Conclusions

A summative content analysis that sought to identify, describe, and count keywords relevant to prudent antibiotic prescribing in the curricula of two African medical schools found few such keywords. The two countries implement different curricula. The South African medical school uses an integrated curriculum, while the Nigerian medical school has adopted a traditional curriculum. The findings of this summative content analysis suggest a need for revision of the medical curricula of the two countries, as currently there is little emphasis on prudent antibiotic prescribing that will produce graduates who are competent as antimicrobial stewards. Medical schools should aim to produce doctors with the required knowledge and skills to face the health challenges of the 21st century, such as AMR.

Acknowledgments

This research received no specific grant from any funding agency in the public, commercial or nonprofit organisations. The first author would like to acknowledge the Faculty of Health

Sciences Research Office, University of the Witwatersrand and Tertiary Education Trust Fund, Nigeria for the funding received.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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