Educational antimicrobial stewardship programs in medical schools: a scoping review protocol

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ABSTRACT

Objective: The objective of this scoping review is to identify the available evidence on antimicrobial stewardship programs for teaching medical students about rational antimicrobial use, including the content taught and the method of instruction used.

Introduction: Antibiotics are life-saving drugs and their discovery is one of the most important advances of the 20th century. They have transformed modern medicine by playing a critical role in the management of infectious diseases. However, the rapid development of resistance of pathogens to antibiotics is gradually affecting this initial success. Antimicrobial stewardship programs have been shown to reduce the burden of antimicrobial resistance in hospitals.

Inclusion criteria: This scoping review will consider papers conducted in medical school curricula to improve the prescribing of antimicrobial medication. Studies that include other health profession students, such as nursing, pharmacy, or dentistry students, will be excluded. Studies published in English from 1996 onwards will be included.

Methods: Databases to be searched are PubMed, Wiley Online library, CINAHL Complete, Web of Knowledge, Scopus and Education Resources Information Center. Unpublished studies and gray literature will be included. Searching will follow a three-step process and will be conducted by two reviewers. Data will be extracted by two independent reviewers. Any disagreements that arise between the reviewers during the study selection process or data extraction will be resolved through discussion, or with a third reviewer. Results will be presented in tabular or diagrammatic form, together with a narrative summary.

Keywords Antimicrobial resistance; antimicrobial stewardship; education; medical students; teaching


Introduction

The discovery of penicillin by Alexander Fleming in 1928 has transformed modern medicine. Antibiotics have saved millions of lives since their discovery,² and are currently among the most commonly prescribed medicines in our health facilities.³-⁵

It has been reported that 20% to 50% of antibiotic utilization is inappropriate.⁶,⁷ Inappropriate antimicrobial use is associated with poor patient outcomes such as antimicrobial resistance, adverse drug reactions, organ failure, superinfections (especially with Clostridium difficile) and increased mortality.⁸-¹⁰

It is also associated with increased costs, as a result of prolonged hospital stays and the cost of managing complications.⁸-¹⁰ Inappropriate use of antimicrobials has the potential to end the successes achieved by modern medicine.² With the increase in antimicrobial resistance has come a slowing in the discovery of new effective antimicrobials due to the dwindling antibiotic pipeline. This has made it difficult to discover new antibiotics that have novel mechanisms of action, thus leading to the emergence of the post-antibiotic era.¹¹ The clinical result of this increased resistance is an increase in the number of deaths from infections that were previously treatable.¹¹

A United Kingdom study reported that the annual global number of deaths due to antibiotic resistance is around 700,000 and predicted that if this situation...
is not addressed, by 2050 nearly 10 million people will die every year as a result of drug-resistant infections.\textsuperscript{12,13} This would cause the global economy to lose approximately 60 to 100 trillion US dollars.\textsuperscript{12,13} In 2017 the World Bank reported that, if left unchecked, antibiotic resistance would have a cascade effect, such that by 2050, more than 28 million additional people, mostly from developing countries, would be pushed into extreme poverty.\textsuperscript{14} The treatment of resistant infections can be prohibitively expensive for people in lower socio-economic sectors and they would be disproportionately affected by a failure to address this issue. Antimicrobial stewardship is an emerging field in medicine and has been described as “coordinated interventions designed to improve and measure the appropriate use of antimicrobial agents by promoting the selection of the optimal antimicrobial drug regimen including dosing, duration of therapy, and route of administration”.\textsuperscript{15(p.323)} Antimicrobial stewardship also refers to how the responsible use of antimicrobials can enhance both their current effects and their future sustainability.\textsuperscript{16} Antimicrobial stewardship programs (ASPs) are described as one of the most important tools for preserving the value of antimicrobial agents and lowering their inappropriate use.\textsuperscript{17,18} An ASP has many strategies with different approaches that, when conducted properly, will impact positively on clinical patient outcomes.\textsuperscript{19} Education is considered fundamental in any ASP.\textsuperscript{20}

It is a prerequisite for medical students to learn the principles of infection diagnosis and management, and they must understand the link between antibiotic usage and antibiotic resistance.\textsuperscript{20,21} Students are expected to learn to prescribe antibiotics responsibly when they commence their careers as house officers.\textsuperscript{22} The World Health Organization highlights the need for all healthcare professionals, including medical students, to be educated in the rational use of antimicrobials and stewardship, as a step to address antimicrobial resistance.\textsuperscript{21,24} A survey to assess the teaching of rational antimicrobial prescribing in the curricula of European medical schools has found wide variation among medical schools — even those within the same country — and found that teaching was mainly delivered using passive techniques.\textsuperscript{23} In Nepal, the use of problem-based learning in small groups of medical students has recorded success in teaching prudent antimicrobial use in clinical pharmacology.\textsuperscript{26}

Medical school is perhaps the only avenue that some doctors have to learn prudent antibiotic prescribing. Apart from the teaching received in medical schools (and perhaps during preparation for internal board examinations), there is barely any requisite teaching after graduation on rational antibiotic prescribing.\textsuperscript{27} An antimicrobial stewardship program will probably be more successful when initiated at the medical school level, which is when student knowledge and attitudes are being shaped.\textsuperscript{21} For example, surgeons are likely to have a higher acceptance rate of surgical prophylactic guidelines if courses on rational prescribing and antimicrobial stewardship are taught in their medical curriculum.\textsuperscript{21}

Understanding the importance of ASP and ensuring their wide implementation is critical to achieving their success. Education in ASP should begin in medical schools to educate future prescribers on the importance of adhering to these programs. While it is acknowledged that medical curricula are often overloaded, the importance of ASP must be addressed by curriculum developers.\textsuperscript{21} In 2009, the General Medical Council in the United Kingdom emphasized the need to incorporate a course on prudent antibiotic prescribing into the medical curriculum.\textsuperscript{28} Integration of educational programs on prudent antibiotic prescribing into medical school curriculum has been achieved to a certain level in some developed countries such as the United Kingdom\textsuperscript{21,29} and the United States of America.\textsuperscript{30}

A study that assessed the knowledge, attitudes and perceptions of final year medical students in South Africa about rational antibiotic prescribing showed that graduating doctors are not adequately prepared to prescribe antibiotics.\textsuperscript{31} The findings of this study are similar to those of a multicenter study conducted on fourth-year medical students in the United States of America.\textsuperscript{32} This suggests a deficiency in the curriculum and a need for ASPs to be included in the curriculum to address such deficiencies. Several studies across the globe have revealed that medical students perceive antimicrobial resistance as a problem in their professional career and want additional teaching on prudent antimicrobial use.\textsuperscript{32-35} Many studies show that a wide knowledge gap in rational antibiotic prescribing exists among medical students.\textsuperscript{33-41}

A search of the literature did not reveal any published studies on educational ASPs in the curricula for medical students in Africa. So, although
Evidence suggests that students and newly qualified doctors lack the skills and confidence to engage in ASPs, in Africa no such programs appear to exist in the medical school environment. This scoping review serves to determine what programs have been developed and implemented on antimicrobial stewardship, in order to develop an appropriate educational program that is relevant for teaching medical students in South Africa and Nigeria.

A preliminary search of the JBI Database of Systematic Reviews and Implementation Reports, as well as PubMed, CINAHL, PROSPERO and ERIC databases did not identify any scoping reviews dealing with this topic. A search in Scopus revealed a 2017 published mapping review by Canadian researchers that looked at antimicrobial stewardship training in medical education. However, the review only examined the published studies indexed in Ovid MEDLINE and Ovid Embase databases that addressed ASP education for both undergraduate and postgraduate students. This review will focus on studies conducted on medical students in published, unpublished and gray literature. The objective of this scoping review is to identify and synthesize the available evidence on ASPs for teaching medical students about rational antimicrobial use, as well as the content taught and the method of instruction used.

**Review question**
What types of educational antimicrobial stewardship programs are used in medical school settings to teach medical students about rational antimicrobial prescribing?

**Inclusion criteria**

**Participants**
The review will consider studies that include medical students only. For the purpose of this review, a medical student is defined as a student studying for a bachelor degree in medicine. The name of this degree varies between countries, with the more common names being MBBS, MBChB and MBBCh. All these abbreviations refer to a bachelor of medicine and a bachelor of surgery. The review will exclude studies that involve other health profession students.

**Concept**
The concept of interest in this scoping review is antimicrobial stewardship programs — what is being taught, and how and when it is taught. This will include the content of the program, activities involved during the program, purpose of the activities, duration of the program and time allocated, those delivering the program, evaluation methods, curriculum design and impact of the program. It will also consider the methods of teaching, including online or face-to-face programs.

**Context**
This review will consider studies that are conducted in medical school settings. It will consider medical school programs that lead to the registration of the student as a beginning medical practitioner.

**Types of sources**
This scoping review will consider both experimental and quasi-experimental study designs including randomized controlled trials, non-randomized controlled trials, before-and-after studies and interrupted time-series studies. In addition, analytical observational studies including prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies will be considered for inclusion. This review will also consider descriptive observational study designs including case series, individual case reports and descriptive cross-sectional studies for inclusion. Qualitative studies that examine qualitative data will also be considered. In addition, systematic reviews that meet the inclusion criteria will also be considered. Text and opinion papers will also be considered for inclusion in this scoping review. Only studies published in English will be included because of the cost and time involved in translating non-English studies. The review will include studies published from 1996 onwards; 1996 was chosen as the starting date because it was the year in which the term “antimicrobial stewardship” was first introduced.

**Methods**
The proposed scoping review will be conducted in accordance with the JBI methodology for scoping reviews consisting of the following methods: develop review question(s) and review objective(s); determine the eligibility criteria; develop the literature search strategy; extract, analyze, and discuss the findings; and draw conclusions and discuss the implications for practice and further research.
**Search strategy**
The review will follow a JBI three-phase search strategy approach with an aim to locate both published and unpublished papers. An initial limited search was conducted in PubMed to identify relevant articles on this topic. The text words in the title and abstracts used in the retrieved articles as well as the index terms used to describe the articles were used to develop a full search strategy (Appendix I). The reference lists of all studies selected for inclusion will be screened for additional studies.

**Information sources**
The databases to be searched include PubMed, Wiley Online library, CINAHL Complete, Web of Knowledge, Education Resources Information Center and JBI Database of Systematic Reviews and Implementation Reports. The search for unpublished studies and gray literature will include Scopus and the ProQuest Dissertations and Theses Global database.

**Study selection**
Following the search, all identified records will be collated and uploaded into EndNote V8.2 (Clarivate Analytics, PA, USA), and duplicates will be removed. Titles and abstracts will then be screened by two independent reviewers for assessment against the inclusion criteria for the review. Potentially relevant studies will be retrieved in full and their citation details imported into the JBI System for the Unified Management, Assessment and Review of Information (JBI SUMARI; JBI, Adelaide, Australia). The full text of selected citations will be assessed in detail against the inclusion criteria by two independent reviewers. Reasons for exclusion of full text papers that do not meet the inclusion criteria will be recorded and reported in the scoping review. Any disagreements that arise between the reviewers at each stage of the selection process will be resolved through discussion, or with a third reviewer. The results of the search will be reported in full in the final scoping review and presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram for scoping reviews.

**Data extraction**
Data will be extracted from papers included in the scoping review by two independent reviewers using a data extraction tool developed by the reviewers. The data extracted will include specific details about the population, concept, context, study methods, types of educational antimicrobial stewardship programs and key findings relevant to the review question. Authors of papers will be contacted to request missing or additional data, where required. A draft data extraction tool (charting table) is provided in Appendix II. This tool will be modified and revised as necessary during the process of extracting data from each included paper. Modifications will be detailed in the full scoping review. Any disagreements that arise between the reviewers will be resolved through discussion or with a third reviewer.

**Data presentation**
Extracted data will be presented in diagrammatic or tabular form in a manner that aligns with the objective of this scoping review. The charting table will report on: distribution of papers by year of publication, country of origin, study design, research methods and the key findings/outcomes. A narrative summary will accompany the tabulated and/or charted results and will describe how the results relate to the review’s objective and question.

**Acknowledgments**
Devind Peter, librarian at the Health Sciences Library, University of the Witwatersrand, for his assistance in developing a search strategy and conducting the initial search of PubMed and Scopus.

**References**


**Appendix I: Search strategy**

PubMed

Search conducted on 25 October 2019

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<td>#5</td>
<td>1# AND 2# AND 3# AND 4#</td>
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</tr>
<tr>
<td>#6</td>
<td>Limit 5 to date range 1996 to onward and English language</td>
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</table>
# Appendix II: Data extraction instrument

<table>
<thead>
<tr>
<th>Study details and characteristics</th>
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<tbody>
<tr>
<td>Study number</td>
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<tr>
<td>Authors</td>
<td></td>
</tr>
<tr>
<td>Date/year of publication</td>
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<tr>
<td>Study design</td>
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<tr>
<td>Setting</td>
<td></td>
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<tr>
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<tr>
<td>Methodology/methods</td>
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<tr>
<td>Details/results extracted from study</td>
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<tr>
<td>Duration of the program</td>
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<tr>
<td>Outcomes and measures</td>
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<td>Quantitative results</td>
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<tr>
<td>Qualitative results</td>
<td></td>
</tr>
<tr>
<td>Curriculum design(^1)</td>
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<td>Impact of the program(^1)</td>
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<tr>
<td>Evaluation methods (including timing of evaluation)</td>
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<tr>
<td>Other findings relevant to review questions</td>
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</tbody>
</table>

\(^1\)The scientific method adopted to train students on rational antibiotic prescribing (for example, problem-based learning curriculum).

\(^1\)Identifies whether or not a measure of knowledge has been used in the study, and the measure used (for example, pre- and post-training assessments).