



## The development of a proposed antimicrobial stewardship curriculum for the South African Bachelor of Pharmacy programme

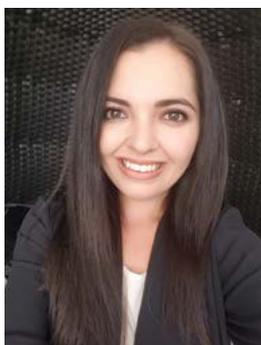
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### Introduction

Antimicrobial stewardship (AMS) is a clinical strategy which aims to minimise the progression of antimicrobial resistance by optimising antimicrobial prescribing.<sup>1</sup> The effective implementation of AMS also provides additional health benefits, including: improved therapeutic outcomes, minimised toxicity and improved cost-effectiveness.<sup>1,2</sup> Pharmacists are recognised as key role-players in the implementation of AMS, often serving as the “nucleus” of AMS teams, along with the physicians.<sup>1,2</sup>

In order to ensure that all qualifying pharmacists are equipped with the required knowledge and skills for effective execution of AMS, undergraduate training of pharmacists should include core curriculum content on AMS.<sup>1-3</sup> The South African National Department of Health has recommended inclusion of AMS in the undergraduate training of pharmacy students.<sup>1</sup> Although education of healthcare professionals is a recognised AMS strategy, the inclusion of AMS in the Bachelor of Pharmacy programme offered in South Africa has not been formalised or mandated.<sup>2</sup>

### Objective

The aim of the study was to develop a proposed AMS curriculum which would be suitable for implementation in the Bachelor of Pharmacy degree programmes offered by South African Schools of Pharmacy. The purpose of the AMS curriculum was to ensure that South African pharmacy students are equipped with the required AMS knowledge and skills for effective AMS practice.

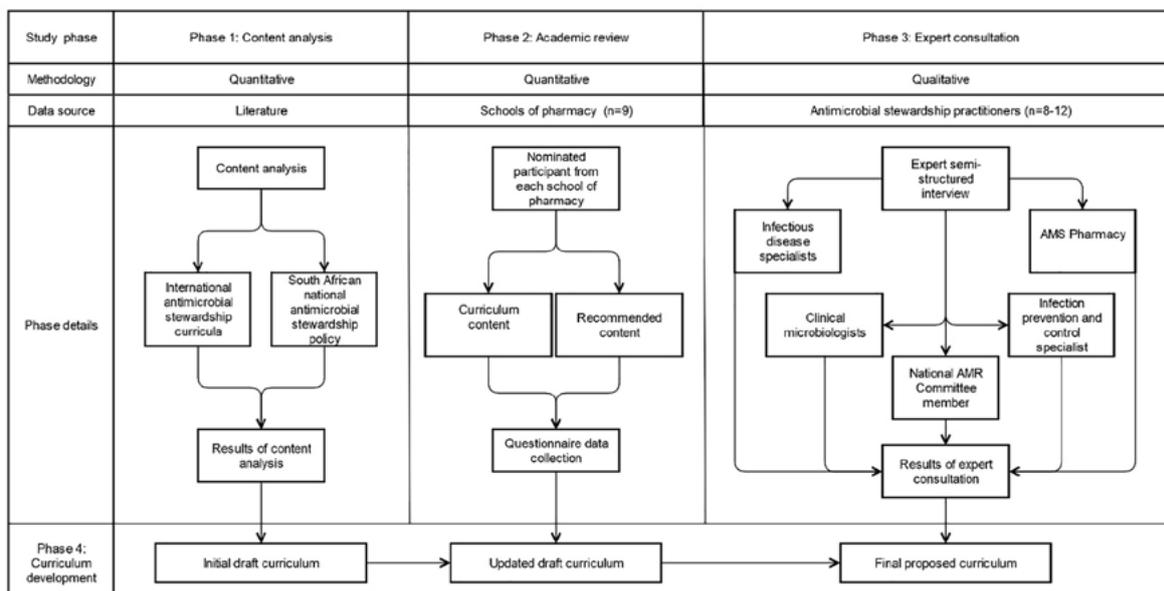


Figure 1: Summary of the methodology employed for the development of the final proposed antimicrobial stewardship curriculum

## Methods

The study consisted of four phases namely: content analysis, academic review, expert consultation and curriculum development (Figure 1). A mixed methods approach was utilised, which employed quantitative data analysis for the content analysis and academic review phases; and qualitative data analysis for the expert consultation. The results from each study phase was collated to inform the development of the final proposed AMS curriculum.

The content analysis phase involved a review of international literature pertaining to AMS curricula; and South African AMS policy documents. The review of international literature provided context regarding the structure and content of existing international AMS curricula.<sup>4,9</sup> The content analysis is however limited to published AMS curricula and may not be a complete reflection of AMS education internationally. The review of South African national AMS policy documents allowed for the proposed AMS curriculum to be aligned within the context of South African healthcare.<sup>1,10-14</sup>

During the academic review phase, questionnaires were disseminated to a nominated academic pharmacist from each School of Pharmacy in South Africa. The questionnaires investigated the extent of AMS tuition in current undergraduate pharmacy degree programmes offered by South African Schools of Pharmacy and AMS content which participants perceived to be important for inclusion in the curriculum.

Investigating the current extent of AMS tuition highlighted the variation in AMS education between the various Schools of Pharmacy in South Africa, which emphasised the need for a baseline AMS curriculum. The academic review phase also assisted in determining an appropriate structure for the final proposed AMS curriculum, since it furnished insight into the structure of the Bachelor of Pharmacy programmes offered at South African Schools of Pharmacy, and how AMS was incorporated into existing programmes.

During the expert consultation phase, semi-structured qualitative interviews were conducted telephonically with a multi-disciplinary panel of AMS experts ( $n = 12$ ), including: infectious disease specialists ( $n = 3$ ), clinical microbiologists ( $n = 2$ ), an infection prevention control specialist ( $n = 1$ ), a representative of the Ministerial Advisory Committee for AMR in South Africa ( $n = 1$ ); and hospital pharmacists ( $n = 5$ ). The interviews explored the perceived role of the pharmacist in AMS in South Africa, and the recommended knowledge and skills that pharmacists should possess for effective implementation of AMS.

The results of the first three study phases were collated during the fourth study phase, in order to develop the final proposed baseline AMS curriculum for the South African Bachelor of Pharmacy programme. Ethical approval to conduct the study was obtained from the Nelson Mandela University Research Ethics Committee (ethical clearance number: H17-HEA-PHA-002).

Confidentiality was maintained during the academic review and expert consultation phases as data was not linked to participant or institutional identifiers.

## Results and discussion

The final proposed curriculum offers recommendations regarding the proposed structure and content of the curriculum. Recommendations relating to curriculum structure include: proposed pedagogical techniques, assessment methods, dedicated contact hours and year level of inclusion in the Bachelor of Pharmacy programme. The proposed content for inclusion in the AMS curriculum includes key AMS principles and strategies which should be incorporated in the undergraduate training of pharmacy students.

### Curriculum structure

It is recommended that the proposed AMS curriculum be incorporated during the third- or fourth-year level of the Bachelor of Pharmacy programme. This recommendation is based on the level of inclusion of antimicrobial pharmacology and microbiology in existing Bachelor of Pharmacy programmes (as investigated in the academic review phase) as well as the review of international literature, which suggested inclusion in the final two-years of the pharmacy programme (9.8%,  $n = 51$ ).

During the academic review, participants were required to indicate the year-level of inclusion of antimicrobial pharmacology and microbiology, which provides the foundational knowledge required for understanding of AMS practices. The results revealed that most programmes presented antimicrobial pharmacology in the third- or fourth-year level when investigated in the academic review (Table 1). All programmes reported presenting microbiology either before or concomitantly with antimicrobial pharmacology. It is thus recommended that the proposed AMS curriculum be incorporated at the third- or fourth-year level of the Bachelor of Pharmacy degree, so that it aligns with the presentation of the foundational antimicrobial pharmacology and microbiology content.

**Table 1: Year level of presentation of antimicrobial pharmacology\***

Year of study	Frequency distribution ( $n = 10$ )			
	No		Yes	
Study year 1	7	70%	3	30%
Study year 2	9	90%	1	10%
Study year 3	3	30%	7	70%
Study year 4	6	60%	4	40%

\* All appropriate options were selected by respondents, thus more than one response may exist per responder

Bachelor of Pharmacy programmes in South Africa were found to dedicate few contact hours to AMS with Schools of Pharmacy dedicating either 1–4 contact hours (50%,  $n = 10$ ); or 5–9 contact hours (40%,  $n = 10$ ) to AMS. Thus, a minimum of 1–4 contact hours

is specified in the final proposed AMS curriculum, but a greater number of contact hours is recommended (between 10–19 hours) since the content of the curriculum is extensive.

It was evident from the content analysis that the use of multiple pedagogical and assessment techniques were preferred for delivery of AMS content to undergraduate pharmacy students.<sup>5-7,9,14</sup> Furthermore, during the academic review, when academic pharmacists were asked for their opinions on the extent to which various AMS principles should be taught in the curriculum, the majority of respondents (on average, for all AMS principles, 68% of participants,  $n = 10$ ) felt that principles should be taught initially through didactic lectures and applied practical sessions, and then further applied in the pharmacy environment through work-integrated learning opportunities.

Participants of the expert consultation phase also emphasised the perceived importance of ensuring work-integrated opportunities are provided at the undergraduate level, such that the principles and strategies of AMS can be applied, and the AMS skills and knowledge of pharmacy students can be developed. It was, therefore, strongly recommended that the final proposed AMS curriculum incorporates opportunities for application of knowledge in the hospital ward environment or through the conduction of clinical case scenarios.

## Curriculum content

The AMS content has been categorised into four course units: antimicrobial pharmacology, microbiology, AMS in practice and hospital AMS programmes. Unit 1 and Unit 2 are intended to provide a foundational understanding of the key pharmacological and microbiological principles that underlie AMS. Unit 3 and Unit 4 provides recommended AMS principles and strategies which should be incorporated in the undergraduate training of pharmacy students.

It was important to note that in the case of antimicrobial pharmacology (Unit 1) and microbiology (Unit 2), the full details of the topics will be covered separately in the Bachelor of Pharmacy programme in pre-existing dedicated modules. The content to be included in the proposed AMS curriculum would include only a brief introduction to concepts from pharmacology and microbiology which are directly related to the skills required for AMS. These units were included based on the content of international AMS curricula, as well as the results of the expert consultation phase, where several participants emphasised the importance of foundational pharmacokinetic, pharmacodynamic and microbiological knowledge for effective AMS practice.

The content of Unit 3 was largely informed by the content analysis phase, which highlighted key principles and strategies included in the national policy documents for containment of antimicrobial resistance in South Africa.<sup>1,10-13</sup> The results of the academic review phase and expert consultation phase were collated in order to rank

AMS principles and strategies according to the relative perceived importance for inclusion in the proposed AMS curriculum.

Based on the relative perceived importance rankings, AMS principles and strategies were grouped as high, moderate or low importance. The purpose of the relative importance rankings is to assist in determining the extent to which each principle/strategy should be taught in the curriculum, considering the potential limited contact time available to deliver the curriculum content.

The final unit of the proposed AMS curriculum includes content on hospital AMS programmes. Unit 4 involves the application of content covered in Unit 3 within the hospital environment (work-integrated learning) as well as an overview of the structure of hospital antimicrobial stewardship programmes and tools utilised for implementation of antimicrobial stewardship in the hospital environment.

The content and structure of the proposed curriculum was partially informed by prior studies that involved the development of AMS curricula for undergraduate pharmacy students.<sup>4-9</sup> However, the structure and content incorporated in the final proposed AMS curriculum does vary from the recommendations made in other studies because the structure of the final proposed curriculum was aligned with the Bachelor of Pharmacy programme in South African Schools of Pharmacy as well as the health environment in South Africa.<sup>1,10-13</sup> Furthermore, ranking the AMS principles according to relative importance was a unique finding of this study and considered the recommendations made by both academic pharmacists and a multi-disciplinary panel of AMS experts in South Africa.

## Conclusion

This is the first study conducted in South Africa that involved the development of an undergraduate AMS curriculum for pharmacy students.<sup>15</sup> South African AMS policy guidelines and the perceptions of South African healthcare professionals informed the content of the final proposed AMS curriculum, which is contextualised to the South African healthcare setting. The methodology employed in this study could serve as a model for the development of similar AMS curricula for inclusion in other healthcare degrees nationally and internationally. It is recommended that further studies be conducted which investigate the feasibility for implementation of the proposed baseline AMS curriculum in South African Schools of Pharmacy, as well as the impact of the curriculum on the AMS knowledge and skills of pharmacy students.

For further details regarding the structure and content of the proposed South African AMS curriculum, refer to the full curriculum which is published in the American Journal for Pharmaceutical Education: <https://www.ajpe.org/content/early/2019/12/10/ajpe.7669>.

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