

Original Article

## Investigating knowledge regarding antibiotics among pharmacy and allied health sciences students in a Sri Lankan university

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### Abstract

**Introduction:** Education and adequate training regarding the appropriate use of antibiotics for health care professionals is essential in developing countries. Educational strategies can also influence appropriate antibiotic use in the community. The aim of this study was to assess and compare knowledge of antibiotics and antimicrobial resistance (AMR) between pharmacy and other allied health sciences (AHS) students at the University of Peradeniya, Sri Lanka.

**Methodology:** A cross-sectional study was conducted at the University of Peradeniya, Sri Lanka, which offers undergraduate teaching in pharmacy and other AHS; nursing, radiography and medical laboratory sciences. All students in each program were invited to participate in this study. Data was collected using a self-administered questionnaire. Descriptive data analysis and Chi square tests were performed.

**Results:** Pharmacy (n = 102) and other AHS students (n = 284) completed the questionnaire (response rate 69%). A majority of participants (76%) reported antibiotic use in the past year. A significantly higher proportion of pharmacy students reported antibiotic use was appropriate for the management of skin wound infection, urinary tract infection and sore throat compared to AHS students,  $p < 0.05$ . No significant differences were observed between pharmacy and AHS students regarding knowledge of AMR. Most students understood terms related to antibiotic resistance through their undergraduate studies.

**Conclusion:** Pharmacy students demonstrated better knowledge and understanding regarding antibiotics utilization than AHS students. Both pharmacy and AHS students had good understanding regarding AMR. The undergraduate curricula of pharmacy and AHS have contributed significantly to understanding the terminology associated with antibiotics and AMR.

**Key words:** Antibiotics; antibiotic resistance; pharmacy education; developing country; Sri Lanka.

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### Introduction

Antimicrobial resistance (AMR) has been identified as a major global health threat by the World Health Organization (WHO) [1,2]. Excessive and inappropriate antibiotic consumption is recognised as a major driver for the development and spread of AMR [3,4]. Over-the-counter availability of antibiotics, poor antibiotic prescribing practices and absence of enforcement of medicines regulations and guidelines related to antibiotic use have largely contributed to the inappropriate use of antibiotics in many developing countries [5,6]. Action is needed on global scale to minimise the spread of AMR; otherwise the world is heading towards a post-antibiotic era in which common infections could once again become a major health burden related to morbidity and mortality [7]. A number

of strategies have been suggested to overcome the challenge of AMR [7,8]. Appropriate education and adequate training regarding the optimal use of antibiotics and recognition of AMR emergence by health care professionals is considered as a powerful tool [9,10] and is one of the objectives of the WHO global action plan on AMR [7]. Therefore, the education and training of pharmacists is crucial to improve the appropriate antibiotic use [10].

Many surveys have investigated the medication practices among student populations in the health care field [11-16]. These studies identified that antibiotics are utilized regularly by the students in medicine, pharmacy, nursing and paramedical sciences. Students with an educational background in the health disciplines believe that they have the potential to self-

manage illnesses [16]. This perception is highly influenced by the education they receive during their undergraduate studies [17] and has an effect on the use of many medicines including antibiotics [18]. Studies from many South Asian countries including Bangladesh [11], Nepal [19], India [13] and Pakistan [20,21], have investigated the prevalence of antibiotic use, the reasons behind this use, the procurement sources and the factors influencing medication practices by university students with health educational backgrounds.

Local data on antimicrobial use is essential to understand the situation in a given country and to aid in identifying strategies to be implemented. Therefore, studies conducted in Sri Lanka are critical in order to determine any interventions relevant to Sri Lanka's health care system. We have previously reported [22] a nationwide survey about the use of antibiotics, knowledge of antibiotics and AMR among undergraduate pharmacy students in six Sri Lankan universities. However, there is no current information comparing knowledge of antibiotic use between pharmacy and other AHS students in Sri Lanka. Therefore, the aim of this study was to assess and compare the knowledge of pharmacy and other AHS students at the University of Peradeniya, Sri Lanka regarding the use of antibiotics and AMR.

## Methodology

### *Study Design and setting*

This study was a cross-sectional study investigating the prevalence of antibiotic use, knowledge of antibiotics and AMR among undergraduate students studying in pharmacy and AHS in a Sri Lankan university. The relevant AHS students included were from the disciplines of nursing, radiography and medical laboratory sciences (MLS).

### *Sample size*

The study population represented the total number of students enrolled at the time of data collection for the following degree programmes: Bachelor of Pharmacy, B. Sc in Nursing, B. Sc in Radiography and B. Sc in MLS at the University of Peradeniya. Accordingly, the number of students in the various disciplines during the data collection period was 114 in pharmacy, 169 in nursing, 152 in radiography and 128 in MLS representing a total of 563 students overall.

### *Inclusion and exclusion criteria*

All students enrolled in undergraduate programmes in pharmacy, nursing, radiography and MLS at the

University of Peradeniya, Sri Lanka were eligible to take part in the study. Students who were not willing to voluntarily take part in this survey were excluded from the study.

### *Survey administration and data collection*

Approval to collect data from undergraduate students was obtained prior to the data collection from relevant Heads of Departments at the Faculty of AHS, University of Peradeniya. Data were collected from January the 1<sup>st</sup> to April the 30<sup>th</sup> 2016. A self-administered questionnaire was distributed by the researcher following a short introduction to the research project. Written informed consent was obtained from all eligible study participants. The self-administered questionnaire was completed by the students and returned to the researcher. This study was approved by the committee on Ethics Review, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka, dated on 3<sup>rd</sup> November 2015.

### *Data collection tool: the questionnaire*

A paper-based questionnaire was used for the data collection. The instrument was modified from a WHO report published in 2015 [23] and is the same questionnaire used in our previous research [22]. This questionnaire was selected because of its comprehensive nature and its coverage of all the relevant objectives including antibiotics use and knowledge of antibiotics and antibiotic resistance. The questionnaire consisted of five major sections: (A: Basic demographic information, B: Antibiotic use, C: Knowledge of antibiotics, D: Knowledge of antibiotic resistance and E: Antibiotic use in the community.

### *Data Analysis*

Data were entered into Statistical Process for Social Sciences (SPSS) software (Version 22.0 SPSS IBM, USA). Descriptive data analyses were undertaken including frequencies and percentages. Chi-square analysis was used to test for significant associations between pharmacy and AHS students. The limit for statistically significant differences was set at  $p < 0.05$ .

## Results

### *Demographic data*

The questionnaire was completed by 386 students (69% response rate), of which 268 (70%) were females. Similar proportions of female students were in each student group: 72% of pharmacy and 69% of AHS students.

**Table 1.** Demographic data of study participants.

Demographics	Pharmacy (N = 102)	AHS (N = 284)
	n (%)	n (%)
<b>Age (Yrs.)</b>		
20-25	88 (86)	269 (95)
26-34	14 (14)	15 (5)
<b>Gender</b>		
Male	29 (28)	89 (31)
Female	73 (72)	195 (69)
<b>Year of study</b>		
1st year	48 (47)	79 (28)
2nd year	11 (11)	82 (29)
3rd year	22 (22)	99 (35)
4th year	21 (21)	24 (8)
<b>Field of study</b>		
Pharmacy	102 (100)	
Nursing		87 (31)
Medical laboratory sciences		94 (33)
Radiography		103 (36)

N = total sample size, n = total respondents, % percentage of respondents.

**Table 2.** Questions on antibiotic use among pharmacy and AHS students in a Sri Lankan university.

Questions	Pharmacy (N = 102)	AHS (N = 284)
	n (%)	n (%)
<b>When did you last take antibiotics?</b>		
In the last month	36 (35)	130 (46)
In the last 6 months	35 (34)	64 (23)
In the last year	8 (8)	21 (7)
More than a year ago	11 (11)	16 (6)
Never	1 (1)	4 (1)
Can't remember	10 (10)	49 (17)
<b>Did you get the antibiotics from a doctor's prescription?</b>		
Yes	83 (81)	221 (78)
No	13 (13)	28 (10)
Can't remember	2 (2)	21 (7)
<b>Did you get advice from a doctor, nurse or pharmacist on how to take them?</b>		
Yes	59 (58)	196 (69)
No	36 (35)	48 (17)
Can't remember	3 (3)	26 (9)
<b>On that occasion, where did you get the antibiotics?</b>		
Pharmacy	90 (88)	234 (82)
Stall or hawker	1 (1)	1 (0)
The internet	0	0
Friend or family member	3 (3)	9 (3)
I had them saved up from previous time	2 (2)	6 (2)
Somewhere/someone else	0	4 (1)
Can't remember	1 (1)	12 (4)

The majority of respondents in pharmacy (86%) and AHS (95%) student cohorts were aged between 20 and 25 years. The demographic characteristics of the students are presented in Table 1.

*Antibiotic use*

The pattern of antibiotic use by both pharmacy and AHS students are summarized in Table 2. A significant proportion of pharmacy (35%) and AHS (46%) students had taken antibiotics in the last month. The majority of them [pharmacy (81%) and AHS students (78%)] reported that they had obtained the antibiotic using a doctor’s prescription. Thirteen percent of pharmacy and 10% of AHS students reported obtaining the antibiotic without a prescription. More than half the students, 58% of pharmacy and 69% of AHS students, reported receiving advice from a health care professional when obtaining the antibiotics. The majority of pharmacy (88%) and AHS (82%) students obtained antibiotics from a pharmacy.

Students had mixed views about the optimal duration of antibiotic courses. The majority of the pharmacy students (71%) believed that the duration of antibiotic use should be as prescribed while only 43% of AHS students agreed with this duration of antibiotic use. Comparably higher proportion of AHS students (36%) reported antibiotics should be stopped when one feels better compared with 22% of pharmacy students.

Two statements assessed participants’ attitudes to sharing antibiotics and using the same antibiotic with similar previous experiences. Ninety-two percent of pharmacy and 83% of AHS students disagreed with the statement, “it’s okay to use antibiotics that were given to a friend or family member, as long as they were used to treat the same illness”. Eighty-six percent of pharmacy and 70% AHS students disagreed with the statement, “it’s okay to buy the same antibiotics, or request these from a doctor if you are sick and they

helped you to get better when you had the same symptoms”.

*Knowledge of antibiotics*

This study examined the students’ overall knowledge of disease conditions and antibiotic use (Table 3). Compared to AHS students, pharmacy students exhibited greater knowledge regarding the appropriate antibiotic use for certain disease conditions such as skin infections [pharmacy (85%) versus AHS (70%) students ( $p = 0.003$ )], urinary tract infections [pharmacy (77%) versus AHS (59%) students ( $p = 0.003$ )], and sore throats [pharmacy (70%) versus AHS (54%) students ( $p = 0.01$ )]. Students had misconceptions about some antibiotic use and reported that the following disease conditions could be cured by antibiotics: cold / flu [pharmacy (63%) versus AHS (59%) students], infections caused by human immunodeficiency virus (HIV) [pharmacy (12%) AHS (9%)] body-aches [pharmacy (13%) AHS (18%)] and headaches [pharmacy (4%) AHS (18%)] ( $p = 0.001$ ).

*Knowledge of terminology related to antibiotic resistance*

We examined the students’ understanding of terminology related to antibiotic resistance (Table 4). The majority of participants were familiar with the following terms: antibiotic resistance [pharmacy (90%) versus AHS (85%) ( $p = 0.155$ )], antimicrobial resistance [pharmacy (80%) versus AHS (52%) ( $p = 0$ )], drug resistance [pharmacy (73%) versus AHS (74%) ( $p = 0.838$ )] and antibiotic resistant bacteria [pharmacy (7%) versus AHS (67%) ( $p = 0$ )]. However, the students were not familiar with the terms, ‘superbugs’ [pharmacy (15%) and AHS (9%)] and the abbreviation for antimicrobial resistance, ‘AMR’ [pharmacy (7%) and AHS (10%)]. When asked about how they knew the terminology, the majority reported

**Table 3.** Response for the disease conditions and knowledge on antibiotics.

Disease conditions	Pharmacy (%)	AHS (%)	P Value
HIV	12	9	0.32
Gonorrhoea	24	24	0.99
Bladder infection	76	59	0.00
Diarrhea	55	48	0.25
Cold /Flu	63	59	0.49
Fever	46	52	0.32
Malaria	27	19	0.11
Measles	14	8.1	0.1
Skin wound infection	85	70	0.00
Sore Throat	69	54	0.01
Body aches	13	18	0.26
Headaches	4	18	0.00

\*P value: P < 0.05 considered significant.

**Table 4.** Knowledge of terminology related to antimicrobial resistance reported by study participants.

Terms	Pharmacy (N = 102)	AHS (N = 284)
	n (%)	n (%)
Antibiotic resistance	92 (90)	240 (84)
Superbugs	15 (15)	24 (8)
Antimicrobial resistance	82 (80)	148 (52)
AMR	7 (7)	27 (10)
Drug resistance	74 (72)	209 (74)
Antibiotic resistant bacteria	89 (7)	189 (66)

that their undergraduate studies followed by the media were their main sources of information.

*Knowledge of antibiotic resistance*

The knowledge of antibiotic resistance by the respondents revealed, no significant differences between pharmacy and AHS students. The majority of the students [pharmacy (78%) versus AHS (71%)] reported agreeing with the statement “if bacteria are resistant to antibiotics, it can be very difficult or impossible to treat the infections they cause” and a greater number of the students [pharmacy (85%) versus AHS (70%)] disagreed with the statement “antibiotic resistance is an issue in other countries but not here”.

*Antibiotic use in the community*

The students had sufficient knowledge on the broader use of antibiotics in agriculture and in food producing animals. Pharmacy (40%) and AHS (45%) reported that they knew about antibiotics usage in agriculture and food products. Ten percent of pharmacy students and 14% of AHS students stated antibiotics are not used in agriculture while 43% of pharmacy and 36% of AHS students stated having no knowledge of the usage of antibiotics in agriculture.

**Discussion**

*Statement of principal findings*

This study indicates a high prevalence of antibiotic use during the past year by pharmacy and AHS (non-pharmacy) students in a large public university in Sri Lanka. The undergraduate students from pharmacy and the AHS disciplines were well aware that antibiotic resistance is a current and growing problem. Most of them had a good understanding of the terms used relating to antimicrobial resistance. Notably, pharmacy students showed comparably better knowledge than AHS students regarding antibiotics and terminology related to antibiotic resistance.

*Strengths and weaknesses of the study*

To our knowledge this is the first study from Sri Lanka to explore the knowledge of antibiotics and AMR among pharmacy and AHS students. The main strength of this study was that relatively uniform age and educational level of the study population. This study also compared the understanding of antibiotic use and AMR between pharmacy and AHS students. The limitations are mainly related to a relatively lower response rate than expected. This lower response was likely due to external placements of final year AHS students. Other limitations include the reliance of data from a single institution and that results may be different in other contexts. Although this study was conducted anonymously, students might believe they should provide an answer that the researcher would like to hear, especially about whether antibiotics was purchased on prescription or not. The lead researcher is a lecturer affiliated at the University of Peradeniya.

*Strengths and weaknesses in relation to other studies, discussing particularly any differences in results*

This study highlights that the majority of pharmacy and AHS students consumed antibiotics with a doctor’s prescription. Only a few utilized antibiotics by self-prescription. This result is different to findings from other South Asian countries [11,20]. Those studies found that, because university students acquire knowledge about antibiotics through their academic curriculum and online learning resources, they believe they are well equipped with antibiotic knowledge and have high tendency to self-prescribe antibiotics. Another important finding in our study is that only a few students stored antibiotics at home or shared with family and friends. Participants in a study conducted in Pakistan [24] revealed that the majority believed that antibiotics should be routinely available at home for utilization; hence they frequently stored antibiotics at home for future use.

Further, another notable finding of this study is that, not a single student purchased antibiotic through the internet. Availability of antibiotics for purchase through

the internet without a prescription is a major challenge for many countries [25]. The results of this study demonstrated that Sri Lankan university students do not appear to be familiar with internet shopping for medicines. It is pleasing to note that the university population in Sri Lanka do not have the practice of buying antibiotics through the internet. Results from a South Indian study provide empirical support for our findings. This study highlighted the association between antibiotic purchase with a prescription and increasing education level of consumers [26].

Pharmacy students exhibited greater antibiotic knowledge compared to AHS students. A large number of pharmacy students correctly identified which disease conditions could be treated by antibiotics. Moreover, a significantly higher proportion of AHS students reported, incorrectly, that antibiotics are suitable for use in headache. This accords with another study that found headache was a common indication for inappropriate medication practices among university students [11].

*Meaning of the study: possible mechanisms and implications for clinicians or policymakers*

Antibiotics differ from other medicines in that their use in one person can influence their future use in others. Educating patients about safe and appropriate use of medicines is an important aspect of prescribing and using any medicine. Upon graduation, pharmacists and allied health care professionals will be involved in educating patients about medication-taking practices, based on their education as well as on their own experiences. Their counselling approaches will influence patients' medication-taking behaviour. Ultimately, patients' awareness on the outcomes of inappropriate antibiotic use should make them to consume antibiotics wisely. These attitudes are an important strategy for a developing country and can contribute to a reduction in the emergence and spread of antibiotic resistance.

Appropriate education and adequate training for pharmacy and other AHS students could make future Sri Lankan health care professionals to become more cautious in handling antibiotics. New educational modules regarding antimicrobials could be incorporated into the AHS curriculum. Further, continuous professional development programmes on AMR through workshops, seminars, posters and educational video clips could be other effective solutions to improve the knowledge on AMR. These steps will assist in addressing the gaps in knowledge regarding antibiotics and disease conditions among AHS students.

*Unanswered questions and future research*

Additional research is needed to determine the most appropriate training and educational content for judicious and appropriate antibiotic use that should be provided to future pharmacist and AHS professionals.

**Conclusions**

Pharmacy students showed better knowledge and understanding of antibiotics use than other AHS students. Pharmacy students also exhibited greater knowledge for antibiotic use with certain disease conditions. Both pharmacy and allied health science students had good understanding regarding antibiotic resistance. The undergraduate curricula of pharmacy and AHS have contributed to the understanding of terminology related to antibiotics and antibiotic resistance.

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