The Knowledge and Attitude Among the Science and Non-Science Stream Undergraduates on The Use of Antibiotics and Antibiotic Resistance: A Pilot Study

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ABSTRACT Antibiotic resistance is becoming a serious global threat. Studies have shown that the limited understanding of antibiotics and its use are some of the factors that contribute to the rise of antibiotic resistant bacteria. A group administered cross-sectional survey was conducted among 252 undergraduates comprising 125 science and 127 non-science undergraduates. An arbitrary scoring system was used to determine undergraduates' knowledge and attitude level towards antibiotic and antibiotic resistance (ABR). Descriptive statistics and Chi-Square test were used to summarize demographic characteristics and to test the influence of undergraduate program on undergraduates' knowledge and attitude respectively. Spearman correlation analysis was used to determine the relationship between participants' knowledge and attitude regarding antibiotic use and ABR. The Cronbach's alpha was used to determine the reliability of the attitude-based questions. It was found that 40.8% of science undergraduates have a good level of knowledge compared to non-science undergraduates (11.8%). More than half from the total undergraduates participants (66.3%) knew that the course of antibiotics must be completed and 75% knew that antibiotics are used to kill bacteria. However, 54.4% of science and 85.0% of non-science undergraduates have indicated that antibiotics can be used to treat viral infections. The alternative hypothesis was accepted through the chi square test, that is, there is a correlation between participants' knowledge and attitude towards the use of antibiotic as well as to antibiotic resistance. However, this was only a weak correlation ($r = 0.368$, $n = 252$, $p < 0.001$) which means, individuals with a good level of knowledge on antibiotics and its use might not imply positive attitude towards the use of antibiotics. A more dynamic and constant educational interventions are needed to enhance and raise awareness towards antibiotic resistance as well as to promote the appropriate use of antibiotics among the student population.

KEYWORDS: Antibiotics; Antibiotic Resistance; Undergraduates; Knowledge; Attitude

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INTRODUCTION

The discovery of antimicrobial agents in the 20th century have led to the successful treatment of many microbial-related diseases (Davies & Davies, 2010). However, the inappropriate prescription patterns and imprudent use of antimicrobial agents (Jamshed *et al.*, 2014; Simpson, Wood, & Butler, 2007) have led to the emergence of antimicrobial resistance (AMR). This has greatly reduced the effectiveness of antimicrobial agents which are widely used in combating infectious diseases caused by bacteria, virus, parasite, and fungi (O' Neill, 2014). It is estimated that AMR could claim the lives of at least ten million people in 2050 (O'Neill, 2014) a value predicted to be higher than the number of people dying due to cancer.

The global burden of AMR calls for a collaborative efforts in developing a series of effective strategies in dealing with AMR. In May 2015, a global action plan on AMR was endorsed by World Health Assembly (WHA), the decision making body of WHO. The strategies include creating awareness towards AMR among the healthcare settings and the society, surveillance and research, and the development of sustainable investment in novel drugs, diagnostic technologies, and vaccines (WHO, 2015). Numerous studies are being conducted to understand the molecular mechanisms linked to the spread of antibiotic resistance (James & Wong, 2015)

TRANSACTIONS ON SCIENCE AND TECHNOLOGY

Previous studies show that there is a need to create awareness among the public as well as among the physicians on the use of antibiotics, the consequences of self-medication, the provision of a clear and proper ways on antibiotic administration and consumption by Ministry of Health Malaysia (Lim & Teh, 2012; Oh *et al.*, 2011). Furthermore, as there is limited awareness and understanding of AMR among the public (Hawkings *et al.*, 2007), therefore, enhancing the knowledge of public and correcting their attitude towards the use of antibiotics can help to preserve the effectiveness of antibiotics, subsequently, helping to limit the spread of AMR (Awad & Aboud, 2015).

In Malaysia, perception studies concerning AMR or antibiotic resistance among undergraduates are limited but studies have been conducted among the public and practitioners in a hospital (Islahudin *et al.*, 2014; Lim & Teh, 2012). Thus, this paper has explored the undergraduates' perception towards antibiotics and antibiotic resistant bacteria, and has preliminarily determined their knowledge level and attitude towards the appropriate use of antibiotics.

METHODOLOGY

Study Design and Target Identification

A total of 252 second and third year undergraduates aged between 18-23 years old were recruited into this study. These undergraduates were randomly identified and grouped into two streams; (a) science (comprising of undergraduates from Bachelor of Biotechnology and Bachelor of Quantity Surveying) and (b) non-science (comprising of undergraduates from Bachelor of Mass Communication and Bachelor of Accountancy). A cross-sectional perception study was conducted using the group administered survey style. A two-minute video was made to briefly explain the nature of this study and to provide instructions in answering the questionnaire. The link to the video in Youtube and a consent form were uploaded to Blackboard. Participants were given at least three days to view the video and to provide consent of their participation before the conduct of the survey. The survey was conducted in 20 minutes during lecture hour. No questionnaires were allowed to be brought back home.

Development of Questionnaire

The questionnaires used in this study were modified from Jamshed *et al.* (2014) and Oh et al. (2011). No face and content validation were done as these questions were already validated by experts in survey design and pharmacy practice research (Oh *et al.*, 2011). In addition, these questions were reviewed by ten pharmacy and medical faculties (Jamshed *et al.*, 2014). The questions were divided into two categories; knowledge-based and attitude-based, with a total of five parts (A-E). Parts A to D contain knowledge-based questions whereas, Part E solely consists of attitude-based questions. Part A had four questions on the role of antibiotics. Part B consisted of two questions on the importance of completing the full course of antibiotics. 6 questions in Part C were used to address the understanding towards antibiotic resistance. Four questions in Part D were to determine student's knowledge of their role in minimizing the spread of antibiotic resistant bacteria. Part E consisted of seven questions, to evaluate the attitude towards the use of antibiotics. Students were requested to answer each questions by ticking either 'YES', 'NO', or 'NOT SURE'.

Analysis of the Score

A 'not sure' was considered as an incorrect answer. One mark was awarded to each correct answer and zero for every incorrect answer. By calculating the scores as a continuous variable by adding up the total number of correct answers (Awad & Aboud, 2015), a total knowledge score of 13

and a total attitude score of 7 were obtained. An arbitrary scoring system was used to assess to determine the knowledge level of participants (Oh *et al.*, 2011). Students' knowledge and attitude score were classified into three levels based on the arbitrary scoring system (Table 1). In order to enhance the reliability of this scoring system, the knowledge and attitude score was calculated over the total score in terms of percentage, followed by equally distributing them into three classes; poor, moderate, and good (Tables 1 and 2). The final scores consist only of round figures.

Table 1. Classification of total knowledge score in percentage.

Knowledge level	Intervals	Percentage (%)
Poor	0-3	0 - 27
Moderate	4-7	36 - 64
Good	8-11	73 - 100

Table 2. Classification of total attitude score in percentage.

Attitude level	Intervals	Percentage (%)
Poor	0-2	0 – 29
Moderate	3-4	43 – 57
Good	5-7	71 – 100

Statistical Analysis

The data obtained in this study was analyzed using SPSS software version 23 at a significance level of 5% and confidence level of 95%. The demographic characteristics (gender, ethnicity, and highest academic qualification), total knowledge and attitude score of participants were presented as frequency with the percentages (Oh et al., 2011).

The Chi-Square test was used to test the influence of demographic characteristics, particularly participant's current programme of study, on their knowledge level as well as attitude, Spearman correlation was used to determine the relationship between knowledge and attitude, whereas the Cronbach's alpha was used to examine the reliability of the questionnaire and the reliability test was performed on the attitude responses from this study following the method used by Oh *et al.* (2011).

RESULT AND DISCUSSION

Level of Knowledge

Science undergraduates were more knowledgeable than the non-science undergraduates (Table 3) as 40.8% of science undergraduates have a good level of knowledge concerning antibiotics and antibiotic resistance with a score of 8-11 compared to the non-science undergraduates (11.8%). Poor level of knowledge (0-3) was also found to be higher among non-science undergraduates (35.4%) than science undergraduates (12.8%). From the Chi-Square test, a statistically-significant difference was noted between knowledge level and current undergraduate program ($p < 0.001$). Science undergraduates were likely to have gained their knowledge on antibiotics during their high school and pre university programs as well as during the course of their study especially the undergraduates of Bachelor of Biotechnology (Gunawardhana *et al.*, 2015; Pan *et al.*, 2012). This result was also similar to the study done in University of Peradeniya, Sri Lanka by Gunawardhana *et al.* (2015) and in Northeastern China by Huang *et al.* (2013). Results generated from Gunawardhana et al. (2015) revealed that high percentage of non-health science undergraduates (n = 58, 54.7%) had 'poor' score (1-6) compared to health science undergraduates (n = 15, 21.7%).

Table 3. Level of Knowledge by Stream in Percentage.

Level of Knowledge	Total Score	n (%)	
		Science	Non-Science
Poor	0-3	16 (12.8)	45 (35.4)
Moderate	4-7	58 (46.4)	67 (52.8)
Good	8-11	51 (40.8)	15 (11.8)
	Total	125 (100)	127 (100)

Relationship Between Knowledge and Attitude in the use of Antibiotics

Table 4. Response of Undergraduate to Knowledge-Based Questions by Stream of Studies.

Question	Correct Answer		Incorrect Answer		P value (χ^2 test)
	Science	Non-science	Science	Non-science	Undergraduate study
Understanding the role of antibiotics					
Antibiotics are medicines that you need to complete within a specific period of time	92 (73.6%)	75 (59.1%)	33 (26.4%)	52 (40.9%)	0.015
Can antibiotics be used to kill bacteria?	105 (84.0%)	84 (66.1%)	20 (16.0%)	43 (33.9%)	0.001
Can antibiotics be used to treat viral infections?	57 (45.6%)	19 (15.0%)	68 (54.4%)	108 (85.0%)	< 0.001
Are antibiotics used to treat common cold or flu?	52 (41.6%)	23 (18.1%)	73 (58.4%)	104 (81.9%)	< 0.001
Understanding the completion of treatment course					
Do you know that the effectiveness of the treatment reduces when antibiotics is not completed according to the instruction?	90 (72.0%)	70 (55.1%)	35 (28.0%)	57 (44.9%)	0.005
Understanding of antibiotic resistance					
Do you know that bacteria can become resistant to antibiotics?	93 (74.4%)	60 (47.2%)	32 (25.6%)	67 (52.8%)	< 0.001
Do you think that the antibiotic resistant bacteria can only spread in the clinical setting and not in other places?	73 (58.4%)	57 (44.9%)	52 (41.6%)	70 (55.1%)	0.032
Do you think that there is a connection between the indiscrete use of antibiotics and the high occurrence of antibiotic resistant bacteria?	64 (51.2%)	41 (32.3%)	61 (48.8%)	86 (67.8%)	0.002
Understanding the role and ways in minimizing antibiotic resistance					
Does the ministry of health (any country) plays the ultimate role in controlling the spread of antibiotic resistant bacteria?	31 (24.8%)	37 (29.1%)	94 (75.2%)	90 (70.9%)	0.438
Do you have a role in limiting the spread of antibiotic resistant bacteria?	57 (45.6%)	38 (29.9%)	68 (54.4%)	89 (70.1%)	0.010
Can the proper use of antibiotics (taking antibiotics according to instruction on the label and finishing the course as prescribed) help in limiting the spread of antibiotic resistance?	89 (71.2%)	76 (59.8%)	36 (28.8%)	51 (40.2%)	0.058

75% of the total number of undergraduates knew that antibiotics are used to kill bacteria but 69.8% of the undergraduates think that antibiotics can be used to treat viral infections (Table 4). However, more of non-science undergraduates have this perception (85%) compared to the science undergraduates (54.4%). A study by Suaifan *et al.* (2012) in Jordan also produced similar result in which, 67.2% of non-medical students indicated that antibiotics can be used to treat viral infections compared to medical students (28.1%). This shows that the academic background does affect the understanding of the appropriate use of antibiotics. The lack of understanding of the effective treatment for infectious diseases is one of the main reasons for the inappropriate use of antibiotics (Igbeneghu, 2013).

Majority of the non-science undergraduates (65.4%) do not complete the full course of antibiotics even though they know that antibiotic regimen should always be completed (Table 4). Another 51.2% of the total undergraduate students stopped taking the prescribed antibiotics when the symptoms of an illness have improved (Table 4). The outcome obtained was similar to the study performed by Jacqueline *et al.* (2011) on undergraduates in Makerere University, Uganda. Both health science and non-health science undergraduates (63.6%) agreed that the antibiotics should be finished but they failed to act on this knowledge.

A high percentage of non-science undergraduates (67.8%) disagreed that an indiscrete use of antibiotics could lead to the high occurrence of antibiotic resistant bacteria compared to science undergraduates (48.8%). Only 29.9% of non-science undergraduates (n = 38) and 45.6% of science undergraduates (n = 57) realized that they too play a role in limiting the spread of antibiotic resistant bacteria ($p = 0.010$). Failing to know that individuals play important roles in minimizing the spread of antibiotic resistant bacteria is also a reason for the increasing incidences of diseases caused by antibiotic-resistant bacteria.

From the Spearman's correlation analysis, a strong negative correlation was noted between knowledge and attitude with $r_s = -0.783$, $n = 252$). This means that there is an inverse relationship between two variables (knowledge and attitude), where students with higher level of knowledge of antibiotic resistance or of the proper use of antibiotics are not necessarily to have the correct attitude towards the use of antibiotics. At the 5% significance level, the two-tailed p-value obtained was 0.000, which was less than 0.05. Therefore, the alternative hypothesis was accepted, indicating there is a significant evidence to show that students' knowledge and attitude towards the use of antibiotics and antibiotic resistance correlated to each other. This is in consensus with Buke et al. (2005) that also pointed out that knowledge is not always correlated with attitude. Despite having a good knowledge on antibiotics, individuals may not necessarily use antibiotics correctly as they do not seem to practice what they have known (McNulty *et al.*, 2007; Pan *et al.*, 2012; Scaioli *et al.*, 2015). The same trend was also seen in the study by Oh *et al.* (2011), as a weak correlation was found between knowledge and attitude among the participants ($r = 0.276$, $n = 408$, $p < 0.001$).

CONCLUSION

Science undergraduates were more knowledgeable than non-science undergraduates in the use of antibiotics and antibiotic resistance. However, more than 50% of the undergraduates were unaware that antibiotics are ineffective against viral infections. Although the majority of the undergraduates knew the use of antibiotics, they fail to complete the course of antibiotics hence indicating a weak correlation between knowledge and attitude towards the use of antibiotics and the spread of antibiotic resistant bacteria. Excellent and well-established antibiotic awareness campaigns should be conducted constantly in both public and private hospitals, colleges and universities as

well as within the community to raise awareness in the proper use of antibiotics and antibiotic resistant bacteria.

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