University of KwaZulu-Natal

ANTIMICROBIAL RESISTANCE AND ANTIBIOTIC STEWARDSHIP: KNOWLEDGE, ATTITUDES AND PERCEPTIONS AMONGST FINAL-YEAR UNDERGRADUATE HEALTH PROFESSIONAL STUDENTS IN A SOUTH AFRICAN UNIVERSITY

By

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DECLARATION

I, **Shanay Singh,** declare that

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2. This dissertation has not been submitted for any degree or examination at any other university.
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X 

Shanay Singh

Date

2016-11-04

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ABBREVIATIONS AND ACRONYMS

ABS	Antibiotic Stewardship
AMR	Antimicrobial Resistance
ANOVA	Analysis of Variance
CPE	Carbapenemase-Producing *Enterobacteriaceae*
ESBL	Extended-Spectrum Beta-Lactamase
GAP	Global Action Plan
KAP	Knowledge, Attitudes and Perceptions
MRSA	Methicillin Resistant *Staphylococcus Aureus*
SASCM	South African Society for Clinical Microbiology
WHO	World Health Organisation

ABSTRACT

Antimicrobial resistance (AMR) is a major threat to human health. The World Health Organization (WHO) and subsequently the South African Department of Health have developed detailed plans to combat AMR including recommendations to implement Antibiotic Stewardship (ABS) in the curricula of healthcare students. A number of studies have measured the knowledge, attitudes and perceptions (KAP) of healthcare students globally. However, in South Africa, no multidisciplinary studies have been performed. This study thus ascertained KAP on AMR and antibiotic stewardship amongst final year medical, nursing and pharmacy students at a South African university by means of a cross-sectional questionnaire based survey. A total of 132 questionnaires were completed (response rate 33%), with individual response rates of 63% (n=63), 86% (n=46) and 9% (n=23) for pharmacy, nursing and medical students respectively. The mean correct knowledge score was 88.9%, with significantly lower scores seen for nursing students when compared to other two groups. The perceived seriousness of AMR at international, national and local levels was also significantly lower amongst nursing students. Only a third of all students and 45% of nursing students agreed that use of antibiotics contributes to AMR. Large percentages of nursing and medical students prefer to take antibiotics for viral illnesses whilst, 76% of all students consult a doctor before starting an antibiotic. Several knowledge gaps were identified, as well as key differences between the student groups. Curriculum review to educate students about their role in contributing to AMR and antimicrobial stewardship is imperative as sub-optimal KAP are likely to lead to negative patient outcomes.

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CHAPTER 1

Introduction and Literature Review

1.1 Introduction

Antimicrobial resistance (AMR) is the ability of a microorganism to grow or survive in the presence of an antimicrobial at a concentration that is usually sufficient to inhibit or kill microorganisms of the same species (1). AMR has been described as a global threat to the future of healthcare (2) and is associated with longer illnesses, increased mortality, prolonged stays in hospitals and compromised protection for patients undergoing surgical procedures(3)

By contrast antibiotic stewardship (ABS) is the use of co-ordinated interventions to limit resistance (1) and is widely recognised as a key strategy in curbing the increases seen in resistance.

A key factor in ensuring this practice of antibiotic stewardship is the education of healthcare professionals at both undergraduate and postgraduate level(3).

In the South African context, the Antimicrobial Resistance National Strategy Framework(4) describes the education of healthcare professionals as the foundation of their ABS stewardship efforts and calls for the integration of antibiotic stewardship into the curricula of medical, nursing, pharmacy and other healthcare students. To this end various training facilities and tertiary institutions have included antibiotic stewardship in both their undergraduate and post graduate curricula to varying degrees.

Antibiotic stewardship has become a priority considering that it is estimated that 25000 people per year die from infections caused by multi-drug resistant infections in Europe (2) and that it is estimated that AMR costs the EU €1.5 billion per year in both healthcare expenses and lost productivity in 2009 (1). The total number of antimicrobial prescriptions in communities has increased by 20% since 2000 in the UK (5) and up to 25% percent of patients in England do not finish their antibiotics(1), thus without intervention we can expect AMR to become increasingly prevalent.

These statistics, which refer to the UK and Europe, become far more staggering when one considers the amount of effort that the UK government, in particular, has put into creating AMR and ABS awareness amongst the public and healthcare professionals. Whilst there is no

quantification of the burden of AMR in South Africa or Africa, one would expect the effect in these regions to be far greater given the resource-constrained health systems, limited laboratory capacities and dearth of surveillance on antimicrobial use and resistance to quantify the nature and extent of AMR and its impact.

The South African Society for Clinical Microbiology (SASCM) provides surveillance data from eight academic centres nationally(6). These centres are located in urban areas and data surrounding AMR in rural areas is sparse. It can be assumed that a large percentage of patients infected with a resistant organism, particularly those not hospitalised, do not have microbial cultures sent for microbiological testing. It is however known that Methicillin resistant *Staphylococcus aureus (*MRSA), Vancomycin-resistant enterococci (VRE), Extended-spectrum beta-lactamase (ESBL)-producing Gram-negative bacteria and Carbapenemase-producing Enterobacteriaceae (CPE) are common occurrences in both public and private institutions(4).

This implementation of AMR and ABS into curricula has not been standardised, nor has its success been measured in the South African context. In addition to academic knowledge, the attitudes and perceptions developed at undergraduate level will influence future ABS practice. Thus all three aspects (knowledge, attitudes and perceptions) need to be evaluated for students in the final-year of their studies; and the result of the evaluation should be used to guide education-related efforts in the future.

Knowledge is defined as facts, information and skill acquired through experience and education(7). Thus by measuring knowledge through a questionnaire one can ascertain the degree of competence students display with regard to ABS and AMR. This is crucial as it is assumed that students can be expected to draw on their existing knowledge during their practice.

Attitude is defined as a settled way of thinking or feeling about something(8) and ultimately determines the students' acceptance of the ABR and AMR concepts. Perception is defined as the way in which something is regarded, understood, or interpreted(9).

The determination of the knowledge, attitudes and perceptions (KAP) of healthcare students is vital in providing a baseline on which any future improvement work can be done with respect to the ABS and AMR curricula.

1.2 Literature Review

1.2.1 Global and National Action Plans on AMR

The World Health Organisation (WHO) considers AMR a global crisis and has created a Global Action Plan (GAP) on antimicrobial resistance to guide member states.(3) The plan details five objectives in the fight against AMR, the first of which is to improve awareness and understanding of AMR through communication and educational efforts. This should be directed at both the public and those working within the healthcare space. Key to attaining this first objective is the integration of AMR as a core component of undergraduate programmes as well as continuous professional development in the healthcare sector(3). The WHO has recommended that this happen with immediate effect(3).

The use of surveillance tools and evidence based medicine is a key action recommended to address gaps in knowledge. Information provided on global, national and local levels on epidemiology and patterns of resistance is required in order to inform prescribers and assist in the monitoring of the effectiveness of intereventions(3). The integration of AMR and ABS into curricula would also form a foundation which would promote and support further research into the development of resistance; development of new treatments; and economic research into the financial burden of AMR(3).

The WHO expects member states to create their own plans and adopt new policies in an effort to curb rising AMR rates.(3) The South African National Department of Health has developed a National Strategy Framework to combat AMR spanning 10 years, from 2014 to 2024. This was in response to the WHO's GAP, with key objectives including the promotion of responsible and rational use of antibiotics(4). Aligned to the WHO, one of the key enablers of the objectives is the education of healthcare providers in the areas of AMR, infection control and pharmacology, amongst others, and the incorporation of this as an essential part of undergraduate and postgraduate curricula in order to build expertise in AMR(4). It order to ensure the validity and applicability of these AMR modules in the curricula, various health professional councils and training institutions will collaborate, thereby helping to pool knowledge(4). Education on AMR and ABS will extend beyond the formative training process and will be re-enforced during practice by way of continuous professional development training(4). To our knowledge, ABS and AMR is present in the curricula of pharmacy, nursing and medical students but the extent of this implementation has not been examined.

Thus far there have been efforts by regulatory bodies, organizations, clinical societies and hospital groups in the promotion of the implementation of ABS into daily routines of healthcare practitioners in South Africa. Evidence of this can be seen at various clinical conferences where the results of their interventions are presented.

Given that the World Economic Forum has identified AMR as a global risk that is beyond the capability of a single organization or nation to manage alone(3), a concerted effort is required from all stake holders including doctors, nurses, pharmacists and the associated training institutions to respond to the call to arms.

1.2.2 A Synopsis of Selected KAP Studies on AMR amongst Health Professionals

A number of studies on the knowledge, attitudes and perceptions or practices (KAP) of health professional practitioners and students have been undertaken globally(10–17). These studies provide a measure of current KAP within the healthcare fraternity and can be used as a benchmark for future work. Studies have shown that the manner in which healthcare providers approach antibiotic use has an impact on the public, with many patients looking to doctors and pharmacists for guidance(18).

In South Africa, we know of only one study published by Burger *et al.* (2016)(10) that measures KAP in final-year pharmacy students across eight institutions. The study shows that whilst ABS is not mandatory in the pharmacy curricula of the institutions, 83.5% of students knew what ABS is, with 71.9% knowing of ABS programmes in South Africa indicating that the topic is covered in the curriculum to some degree. Only 24.6% of these students believe that the prescribing and use of antimicrobials are appropriate in South Africa. Looking at student perceptions, only 33.8% of students shared the notion that AMR is promoted by poor handwashing practice and 89.5% due to poor patient compliance. This possibly shows a shift of blame from practitioner to patient, with pharmacy students unaware that infection control and practitioner accountability are key aspects of AMR. The majority of students indicated that they would like more education on antibiotic prescribing (96.5%) and AMR (93.1%). Overall the study showed education on ABS and AMR as one of the most important interventions. The study by Burger *et al.* (2016) is encouraging but had a response rate of only 26.6%. Additionally this was conducted through electronic means and thus the rationale for the study could not be explained to the participants in person. The length of the questionnaire may have also led to questionnaire fatigue.

Within Africa, another study performed by Thriemer *et al.* (2013)(11) measured KAP amongst 184 final year medical students and working medical doctors in the Democratic Republic of Congo. The study looked at in-depth practical knowledge of antimicrobials, with a mean knowledge score of 4.9/8 (61.25%), with no significant differences noted between doctors and medical students. Participants cited pharmaceutical companies, internet and guidelines as their major source of information for both groups. In contrast, only 37.2% of medical doctors cited their university courses as a source of information against 83.0% of students. Local antibiotic surveillance data was not available as an option and as such we cannot evaluate if the participants use this resource or not. The percentage of doctors and students that perceived that AMR is a problem worldwide; in their country; and in their practices were 85.4%, 92.9% and 67.4%, respectively, showing that the participants recognise AMR as a larger issue in their country than others, but not within their own practices.[11]

In China, Huang *et al.* (2013)(12) administered a questionnaire survey on 2500 students from 3 different universities. A comparison was made between medical students and non-medical students with regard to their knowledge, attitudes and perceptions of AMR and ABS. The findings of the study show no difference between medical and non-medical students in the first year of study. However results from final-year students show significant improvement in knowledge over non-medical students, but also shows a tendency to personally use antibiotics excessively in the same group of students.

Suaifan *et al.* (2012)(13) conducted a study on KAP among 679 medical and non-medical students in Jordan. The study defined medical students as belonging to the disciplines of medicine, dentistry, pharmacy, nursing and rehabilitation services, with these professions forming 29.5% of the total sample size. The study demonstrated that only 70.4% of medical students agreed that antibiotics are indicated for bacterial infections, worryingly a large number of medical students incorrectly indicated that antibiotics are also indicated for viral infections (28.1%); viz., common cold, cough and nasal congestion (43.7%); fever (22.2%); and stomach ache (27.9%). A significantly higher number of non-medical students had incorrect answers when compared to the medical group. The majority of medical students agreed that AMR is due to irrational antibiotic use (80.1%), patient non-compliance (84.3%) and use without a prescription (71%). Most notably, over half (54.7%) of medical students attributed AMR to generic substitution. This study clearly showed deficiencies in the understanding of indications associated with antimicrobials amongst medical students which

are further pronounced in the non-medical group of participants. Suaifan *et al.* (2012) did not, however, stratify the medical group by profession and thus we cannot determine which specialities showed the greatest deficiencies along with the different roles that they play in the ABS process.

In Europe a multicentre study on KAP of antibiotic prescribing and resistance was undertaken(14). The study surveyed 338 final year medical students from 7 universities and found that 92% and 79% of students felt that AMR was a national problem and a problem in their own hospital, respectively. The majority of students believed that over prescription and the use of broad spectrum antibiotics, and thus irrational use was the most important factor leading to AMR. Overall most students wanted further education on antibiotics. Whilst this large multicentre trial provides useful information that could be generalized to Europe, this study should be viewed conservatively due to the low response rate (35%). Results were not stratified by school or country and thus comparisons could not be made.

In the USA, Justo *et al.* (2014)(15) performed a cross-sectional KAP questionnaire survey on 1445 final-year Doctor of Pharmacy students across multiple schools. A response rate of 40% (579) showed significant variability between schools. The overall results showed that pharmacy students were aware of ABS and the challenges of AMR. In addition, a large proportion of students (69%) did not perceive any problems in the hospitals in which they had clinical rotations and 73% believed that new drug developments would not keep up with the progression of AMR. Interestingly, the percentage of students desiring further education on AMR and ABS was 82% and 89% respectively. The majority of students in this study anticipated that they would pursue pharmacy careers in community hospital pharmacy and as such we can expect that they would be an antibiotic knowledge resource and role model for attitudes for their future patients. Given that this study took place in the USA, where pharmacists enjoy an increased scope of practice and responsibilities; a longer curriculum; as well as avenues for infectious disease specialization, it would be difficult to compare these results reliably to those of other countries.

Another study in the USA by Abbo *et al.* (2013)(16), which took place prior to the study by Justo *et al.* (2014), sought to determine the knowledge, attitudes and perceptions of 519 Medical students in 3 universities. Ninety-seven percent (97%) of students agreed that inappropriate use of antimicrobials can both harm patients and cause resistance, with 83% agreeing that AMR could be spread by poor infection control. Overall 90% of students

wanted further education on appropriate antimicrobial use, with only 72% recalling having had lecture about this. In contrast, only 79% of students wanted further education on AMR. This difference possibly highlights a disconnection between appropriate antimicrobial use and AMR, as it is evident that many students are unaware that the rational use of antimicrobials is a core component to reducing AMR. Additionally, students who had clinical rotations in infectious disease were more likely to rate their education on antimicrobials as useful, which should form as part of future interventions in countries that do not practice this concept. Overall very few significant differences were found between the 3 universities and this many point to a high degree of homogeneity in the ABS curricula.

In India, a questionnaire survey on knowledge, attitudes and perceptions towards AMR and ABS was performed on 97 second-year medical students in order to obtain a baseline for future interventions(17). The results of the study showed differences in the manner in which students view AMR in that 86% of students recognised that AMR is an important issue nationally whilst only 68% of students acknowledged that AMR is a problem in their own hospitals. Additionally 38% of students also believed that antibiotics should be given when developing a cold, even though it is widely known that most colds are viral in nature. Given that the questionnaire survey was performed on medical students so early in their academic training we cannot be sure that these results would reflect their final KAP and would influence the manner in which they would conduct their practice post-graduation. Additionally, India is a country in which dispensing of all antibiotics frequently occurs at a pharmacy level(19) and thus this area should perhaps be prioritized for intervention first.

Mahajan *et al.* (2014) also conducted a study on second year medical students in India, measuring KAP towards AMR and ABS(20). The study found that 43% of students found antibiotics to be safe drugs with half of all students believing that antibiotics should be used for a cough and the common cold. In light of excellent knowledge scores but poor attitudes and perceptions, Mahajan *et al.* discussed that education strategies should not only aim to increase knowledge but change behaviour. supported by the fact that only one third of students believed that judicious and rational use of antibiotics would be important in solving AMR.

Staying in India and following on from the study by Khan *et al.* (2013), a study was conducted on 210 medical students in their third and fourth years of study using a similar questionnaire(21). The study showed that numbers of students that believed that antibiotics

should be used for cold and flu were still high (28%) and a large percentage of students were unaware of AMR as serious cause of concern in their own hospitals. The study also highlighted large proportions of students (19-57%) who were uncertain about the knowledge questions regarding AMR, a trend which also extended to the attitude and perception questions. The study also did not stratify the results by year so we are unable to assess if there was any progression in KAP from the third to fouth year of study.

Sharma *et al.* (2015) performed a study on 120 medical and 48 dental students in india, assessing their KAP(22). A key finding from the study was that 98% of all students believed that antimicrobial pharmacology should be integrated into their clinical learning. Additionally and interestingly 50% of medical and dental students combined did not realize the importance of the education of nurses and pharmacists in ABS, which should emphasis the need for collaboration between healthcare professionals in the battle against AMR.

The only KAP study on ABS and AMR performed in Central America, to our knowledge, examined 105 pharmacy students in their third and fourth years of study(23). It was noted that whilst the students knowledge was good, their attitudes and perceptions were described as poor. Results of third and fourth year students were not compared and thus we cannot determine if attitudes and perceptions improve in the fourth year of study. Notably students cited pharmacists in a retail setting as their main source of information on antibiotics. This is an area that would need significant focus as retail pharmacists are known to build trust within their communities and thus could communicate the message of ABS more effectively to the public.

All the studies mentioned above primarily consider doctors, pharmacists, nurses and non-medical students for measurement of KAP. In South Africa, the study performed only considered pharmacy students. This leaves a gap in measurement of the KAP of medical and nursing students who are key in the practice of ABS, with doctors being the primary prescribers and nurses and pharmacists prescribing in limited circumstances. Nurses further play a key role in the administration of antimicrobial medicines. This study therefore sought to ascertain the KAP of AMR and ABS amongst final year medical, pharmacy and nursing students at a single University in Durban, South Africa

1.3 Aims and Objectives

The study aimed to ascertain the knowledge, attitudes and perceptions on antimicrobial resistance and antibiotic stewardship amongst final-year medical, pharmacy and nursing students using a previously validated questionnaire survey formulated by Khan et al (2013)[17] to inform curriculum interventions as appropriate.

The objectives were to:

1. To ascertain the antimicrobial resistance and antibiotic stewardship knowledge amongst students using a questionnaire survey.
2. To determine the attitudes towards antimicrobial resistance and antibiotic stewardship amongst students using a questionnaire survey.
3. To determine the perceptions of antimicrobial resistance and antibiotic stewardship amongst students using a survey.
4. To compare the knowledge, attitudes and perceptions of pharmacy, nursing and medical students.

1.4 Study design and methodology

1.4.1 Study population

The study was a cross-sectional questionnaire based survey on the knowledge, attitudes and perceptions of final-year pharmacy, nursing and medical students in a South African University. The university caters for students across the country with its primary population being from within the province of Kwa-Zulu Natal. All students admitted into health science programmes are evaluated for academic competence and the standard of education is such that only those students that display competence akin to that of a working health professional will progress to the final-year of study. Students have varied economic backgrounds due to a mixture of self-funded and bursary-funded students.

Inclusion criterion required the student to be in the final-year of their undergraduate studies in the professional Medicine, Pharmacy or Nursing programme. All other students were excluded.

1.4.2 Sampling

Total sampling was used used in that every effort will be made to reach all final-year of the students in these disciplines. The minimum sample size was calculated to be be 96 students (confidence level: 95%; Confidence interval: 10%) (http://www.surveysystem.com/sscalc.htm). This is similar to the numbers found in the study conducted by (12).

1.4.3 Data collection tool

The data collection tool used, comprised of a questionnaire (Appendix C) from the study by Khan *et al.* (2013)(17). Permission was received for use of the questionnaire survey tool from Khan *et al.* (2013)(17). The questionnaire itself was a shortened version of that used by Khan *et al.* (2013)(17) and was comprised of 26 questions which were further stratified as follows: 10 knowledge based questions comprising of 7 true /false type questions and 3 questions based on a 5-point likert scale, which range from strongly agree to strongly disagree; 5 attitude based questions, rated on a 5-point likert scale, which range from strongly agree to strongly disagree; and 8 perception based questions, rated on a 5-point likert scale, which range from always to never. In addition to the questions above, socio-demographic questions were also asked, including age, gender, discipline of study, urban or rural residence.

The use of the questionnaire from the study from Khan *et al.* (2013)(17) was previously validated during that particular study and is a good indicator of generalizability with that study, however the tool was piloted amongst 4 experienced healthcare professionals in order to ensure non-ambiguity and relatability.

1.4.4 Data collection

Data collection for the study took a number of months due to scheduling difficulties and student examinations. Data was collected by going to classrooms of these health professional students. With the permission of the lecturer, the purpose, intended impact and the right not to participate in the survey was explained. Students were asked to complete the declaration of consent form first if they chose to participate in the study. Surveys were numbered and handed out for anonymous completion by the students before being re-collected. Numbering was not used for identification purposes but rather to determine completion rate of the survey. The healthcare disciplines had no preferred order for data collection and in the case of

medical students, an administrator had to administer the questionnaires due to student rotations at different clinical facilities.

1.4.5 Data Analysis

Data analyses was performed, using IBM SPSS, in a similar fashion to some previously performed studies (12,15,17), with a ANOVA and post-hoc tukey tests being used to compare the data between various health professionals. Descriptive statistical methods (mean, mode, range, etc.) as well as percentage answered correctly were used to aggregate the scores of each knowledge based question. Attitude and perception based questions were displayed as a percentage of answers that correspond to strongly agree/agree and always/usually. Data was be presented in table form in order to maintain comparability with other studies(15,17).

Table: Desciption of data collected

Variable	**Variable type**	**Descriptive measures**	**Statistical test**
Age	Continuous	Mean, median and mode	ANOVA, Post-hoc Tukey
Gender	Categorical	Proportions	ANOVA, Post-hoc Tukey
Profession	Categorical	Proportions	ANOVA, Post-hoc Tukey
Locality	Categorical	Proportions	ANOVA, Post-hoc Tukey
Knowledge based questions	Discrete	Mean, median,mode, proportions	ANOVA, Post-hoc Tukey
Attitude based questions	Discrete	Proportions	ANOVA, Post-hoc Tukey
Perception based questions	Discrete	Proportions	ANOVA, Post-hoc Tukey

The data was completely void of participant identification data from the point of collection, thus storage of the data was in the form of a Microsoft Excel database, employing AES-128 bit encryption. The data was only be available to members of the research team. The data will be held for a period of 10 years, the electronic data will be disposed of by the use of using non-recoverable techniques such as overwriting, whilst the physical data will be disposed of using an established confidential data disposal service provider.

1.4.6 Ethical considerations

Participants were not be required to provide any identifying data, other than their professional discipline and biographical information. Students were free to choose not to participate and were informed beforehand that their identities would remain anonymous, this occurred along with the explanation of the rationale of the study. Students who elected to not to participate did so by handing their blank form in or drawing a cross across the page.

No incentives were offered and ethics approval was obtained from the university. The nature of the study ensured that adverse events were not possible.

CHAPTER 2

Paper for Publication in the Southern African Journal of Infectious Diseases

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Contributions

- Mr S. Singh, as the principle investigator, developed the protocol for the study; undertook data collection and analysis and drafted the manuscript.
- Professor S.Y. Essack, as supervisor, co-conceptualized the study; facilitated data collection and analysis and undertook critical revision of the manuscript.

Antimicrobial Resistance and Antibiotic Stewardship: Knowledge, Attitudes and Perceptions amongst Final-Year, Medical, Pharmacy and Nursing Students at a South African University

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RUNNING TITLE: KAP of medical, pharmacy and nursing students on AMR and ABS

KEY WORDS: antimicrobial resistance, stewardship, knowledge, attitude, perceptions, students

ABSTRACT

Background

Antimicrobial resistance (AMR) is a major public health threat, with the World Health Organization and South African Department of Health identifying the education and training of healthcare professionals on AMR and antimicrobial stewardship (ABS) in the Global Action Plan and National Strategy Framework respectively. This study describes the knowledge, attitudes and perceptions (KAP) of AMR and ABS amongst final year medical, pharmacy and nursing students at a single University in Durban, South Africa.

Methods

The study was a cross-sectional questionnaire based survey on the KAP of final-year medical, pharmacy and nursing students at a South African University.

Results

A total of 132 questionnaires were completed (response rate 33%), with individual response rates of 63% (n=63), 86% (n=46) and 9% (n=23) for pharmacy, nursing and medical students respectively. The mean correct knowledge score was 88.9%, with significantly lower scores seen for nursing students when compared to other two groups. The perceived seriousness of AMR at international, national and local levels was significantly lower amongst nursing students. Only a third of all students and 45% of nursing students agreed that use of antibiotics contributes to AMR. Several nursing and medical students reported taking antibiotics for viral illnesses whilst almost a quarter of all students sampled did not consult a doctor before starting an antibiotic.

Conclusion

Several gaps in knowledge were identified, with key differences between the student groups. Attitudes and perceptions also differed substantively indicating the need for curriculum review on AMR and ABS content as suboptimal KAP may lead to negative patient outcomes.

Introduction

There is a global consensus that antimicrobial resistance (AMR) is a major threat to human health(3) with antibiotics considered a resource at risk of depletion(24). Antimicrobial stewardship (ABS) is a multifactorial approach seeking to limit resistance (1).

The World Health Organization (WHO) has formulated a Global Action Plan to address growing resistance to antimicrobials(3), with improvements in knowledge and education forming part of the key objectives. The Antimicrobial Resistance National Strategy Framework(4) was published by the National Department of Health in South Africa following the initial call of action by the WHO. The framework aims to control the extent of AMR with education being one of the interventions enabling the achievement of its objectives.

Healthcare professionals are a key factor in ensuring the practice of antibiotic stewardship and the education of healthcare professionals at both undergraduate and postgraduate level is thus particularly important as they play a pivotal role maintaining the efficacy of antimicrobials through dedicated efforts. These efforts include ensuring rational use, curbing indiscriminate use as well as promoting infection control practices (3). This requires the comprehensive integration of ABS and AMR into curricula of undergraduate and postgraduate healthcare professionals along with continuous professional development in order to build expertise in AMR and ABS.

This study was thus conducted to establish a baseline measurement of knowledge, attitudes and perceptions of AMR and ABS amongst final year medical, pharmacy and nursing students at a South African university with a view to inform curriculum interventions as appropriate.

Methodology

Ethical considerations

Ethical approval (HSS/0266/015M) was received from the Human and Social Sciences Ethics Committee of the University of KwaZulu-Natal. Informed consent was obtained from participants prior to the administration of the questionnaire survey.

Study design

The study was a cross-sectional questionnaire based survey on the knowledge, attitudes and perceptions of final-year medical, pharmacy and nursing students at a South African University. These professional groups were chosen as prescribers and/or dispensers and/or administrators of antimicrobial medicines who would necessarily have been educated and trained on antimicrobial medicines, AMR and ABS.

Total sampling was envisaged in that every effort was be made to reach all final-year of the students in these disciplines. Data was collected by going to classrooms of these health professional students and addressing all students present in class. The purpose of the survey; its intended impact; as well as the right not to participate was explained to the students, with the permission of the lecturer. Numbered surveys were handed out for anonymous completion by the students. Students were asked to complete the declaration of consent form first if they chose to participate in the study. Numbering was not used for identification purposes but rather to determine completion rate of the survey.

Data Collection Tool

The data collection tool used was a questionnaire from the KAP study by Khan *et al.* (2013), which was previously assessed for its validity and reliability. Formal permission was received for use of the questionnaire from the authors (17). The questionnaire was piloted amongst four experienced healthcare professionals to assess for understanding and applicability with no changes reported.

The questionnaire consisted of 26 questions, 10 of which were knowledge based questions comprising of 7 true/false type questions and 3 questions based on a 5-point Likert scale, which ranged from strongly agree to strongly disagree; 5 attitude based questions, rated on a

5-point Likert scale, which ranged from strongly agree to strongly disagree; and 8 perception based questions, rated on a 5-point Likert scale, which ranged from always to never. In addition to the questions above, socio-demographic questions were included, specifically age, gender, discipline of study, urban or rural residence.

Data analysis

Knowledge questions were marked against a model template containing the correct answers. All true/false type correct knowledge questions counted for one mark each, whilst those questions that were answered incorrectly counted for zero marks. This resulted in an individual knowledge score out of 8, which was then converted to a percentage, listed as the knowledge score.

Questions answered on a five point Likert-scale were reduced to two options prior to statistical analysis, with only "strongly agree/agree" and "always/usually" used for analysis in order to clearly identify the number of students with appropriate KAP on the AMR and ABS aspects investigated.

Statistical analysis

SPSS version 23.0 (IBM Corp ®) was used for statistical analysis, P-value <0.05 (confidence interval: 95%) were considered as statistically significant. All values were considered in the analyses, including missing values. One-way ANOVA was performed to determine if there was a significant difference between answers from the three professional groups. Descriptive statistical analysis in the form of frequency tables and cross-tabs showing percentages were performed.

Results

A total of 400 questionnaires were sent out to the pharmacy, nursing and medical students. Of this 400, a total of 132 students chose to provide consent to participate in the study (response rate of 33%). The questionnaires, when stratified by professional group, showed that 63, 46 and 23 pharmacy, nursing and medical students respectively, participated in the study corresponding to 63%, 86% and 9% of the total pharmacy, nursing and medical students respectively. Results are tabulated in Tables 1-4 per question.

As evident from Tables 1 and 2, Pharmacy students had the greatest mean knowledge score followed by medical students and nurses, commensurate with the pharmacology curriculum content in that pharmacy students are taught pharmacology in the greater depth and breadth compared to the medical and nursing students.

150 Table 1: Comparison of ABS/AMR knowledge (Questions 1-3) across professional groups

Knowledge Question	Number of participants that answered correctly (%)				Correct Answer	Comments
	Pharmacy Students	Nursing Students	Medical Students	Total		
K1. Indiscriminate and Injudicious use of antibiotics can lead to						
a) Ineffective treatment	58 (98.3%)	36 (90%)	21 (95.5%)	115 (95.0%)	TRUE	No significant differences observed
b) Increased adverse events	56 (94.9%)	29 (72.5%)	21 (95.5%)	106 (87.6%)	TRUE	Significant differences observed between Pharmacy and nursing students (p=0.004)); as well as between medical and nursing students (p=0.02)
c) Exacerbation or Prolongation of illness	57 (96.6%)	28 (70%)	17 (77.3%)	102 (84.3%)	TRUE	Significant differences observed between Pharmacy and nursing students (p=0.001)
d) Emergence of bacterial resistance	59 (100%)	36 (90%)	21 (95.5%)	116 (95.9%)	TRUE	Significant differences observed between Pharmacy and nursing students (p=0.036)
e) Additional burden of medical cost to the patient	58 (98.3%)	36 (90%)	21 (95.5%)	115 (95%)	TRUE	No significant differences observed
K2. If taken too often, antibiotics are less likely to work in the future.	55 (93.2%)	36 (90%)	20 (90.9%)	111 (91.7%)	TRUE	No significant differences observed
K3. Bacteria are germs that cause common cold and flu.	51 (84%)	19 (47.5%)	18 (81.8%)	88 (72.7%)	FALSE	Significant differences observed between Pharmacy and nursing students (p<0.001); as well as between medical and nursing students (p=0.001)
Mean correct (Knowledge Score)	**95,04%**	**78,57%**	**90,29%**	**88.89%**	-	Significant differences observed between Pharmacy and nursing students (p<0.001); as well as between medical and nursing students (p=0.001)

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Table 2: Comparison of knowledge question 4 across professional groups

	Number of participants that answered Strongly agree/ Agree (%)				Comments
	Pharmacy Students	Nursing Students	Medical Students	Total	
K4. Antibiotic Resistance is:					
a) An important and serious public health issue facing the World.	59 (100%)	35 (87.5%)	22 (100%)	116 (95.9%)	Significant differences observed between Pharmacy and nursing students (p=0.001); as well as between medical and nursing students (p=0.017)
b) An important and serious public health issue in our Country.	56 (94.9%)	29 (72.5%)	20 (90.9%)	105 (86.8%)	Significant differences observed between Pharmacy and nursing students (p=0.002)
c) An important and serious public health issue in our Hospital	59 (100%)	35 (87.5%)	19 (86.4%)	113 (96.4%)	Significant differences observed between Pharmacy and nursing students (p=0.019)

155 Table 3: Comparison of attitudes towards ABS/AMR across professional groups

Attitude Questions	Number of participants that answered Strongly agree/ Agree (%)				Comments
	Pharmacy Students	Nursing Students	Medical Students	Total	
A1. When I have a cold, I should take antibiotics to prevent getting a more serious illness.	3 (5.1%)	10 (25%)	0 (0%)	13 (10.7%)	Significant differences observed between Pharmacy and nursing students (p=0.003); as well as between medical and nursing students (p=0.005)
A2. When I get fever, antibiotics help me to get better more quickly.	4 (6.8%)	10 (25%)	2 (9.1%)	16 (13.2%)	Significant differences observed between Pharmacy and nursing students (p=0.001); as well as between medical and nursing students (p=0.049)
A3. Whenever I take an antibiotic, I contribute to the development of antibiotic resistance.	14 (23.7%)	18 (45%)	9 (40.9%)	41 (33.9%)	Significant differences observed between Pharmacy and nursing students (p=0.013)
A4. Skipping one or two doses does not contribute to the development of antibiotic resistance.	4 (6.8%)	4 (10%)	5 (22.7%)	13 (10.7%)	No significant differences observed
A5. Antibiotics are safe drugs, hence they can be commonly used.	10 (16.9%)	5 (12.5%)	5 (22.7%)	20 (16.5%)	No significant differences observed

156 Table 4: Comparison of medication practice and perceptions towards ABS/AMR across professional groups

Medication Practice Questions	Number of participants that answered Always/Usually (%)				Comments
	Pharmacy Students	Nursing Students	Medical Students	Total	
P1. The Doctor prescribes a course of antibiotic for you. After taking 2–3 doses you start feeling better.					
a) Do you stop taking the further treatment?	1 (1.7%)	0 (0%)	2 (9.1%)	3 (2.5%)	No significant differences observed
b) Do you save the remaining antibiotics for the next time you get sick?	1 (1.7%)	7 (17.5%)	0 (0%)	8 (6.6%)	Significant differences observed between Pharmacy and nursing students (p=0.007); as well as between medical and nursing students (p=0.027)
c) Do you discard the remaining, leftover medication?	16 (27.1%)	9 (22.5%)	8 (36.4%)	33 (27.3%)	No significant differences observed
d) Do you give the leftover antibiotics to your friend/roommate if they get sick?	2 (3.4%)	3 (7.5%)	0 (0%)	5 (4.1%)	No significant differences observed
e) Do you complete the full course of treatment?	53 (89.8%)	36 (90%)	18 (81.8%)	107 (88.4%)	No significant differences observed
P2. Do you consult a doctor before starting an antibiotic?	48 (81.4%)	27 (67.5%)	17 (77.3%)	92 (76%)	No significant differences observed
P3. Do you check the expiry date of the antibiotic before using it?	49 (83.1%)	35 (87.5%)	17 (77.3%)	101 (83.5%)	No significant differences observed
P4. Do you prefer to take an antibiotic when you have cough and sore throat?	2 (3.4%)	5 (12.5%)	5 (22.7%)	12 (9.9 %)	Significant differences observed between Pharmacy and medical students (p=0.028)

When analysed by means of a one-way ANOVA, a significant difference is observed in the knowledge score between the three professions, with a post-hoc tukey analysis showing that this difference lies between the nursing students and the other two professions. It can be seen from Table 1 that the nursing students achieved significantly lower mean knowledge scores when compared to the pharmacy ($p<0.001$) and medical students ($p=0.001$), thereby indicating lower knowledge of antibiotic stewardship and antimicrobial resistance.

A significantly lower number of nursing students agreed that irrational use could lead to increased adverse effects when compared to pharmacy ($p=0.004$) and medical (p-0.02) students. Significant differences in knowledge are also observed between pharmacy and nursing students as significantly fewer nursing students agreed that irrational use could lead to AMR ($p=0.036$) and prolongation or worsening of illness ($p=0.001$).

Gaps were identified in the cause of the common cold and flu, where 52.5% of nursing students believe that bacteria are the cause. This is significantly higher when compared to the pharmacy ($p<0.001$) and medical students ($p=0.001$).

It can be seen from table 2 that whilst all pharmacy and medical students believe that antibiotic resistance is an important issue facing the world; a significantly lower percentage of nursing students (87.5%) ($p=0.001$ and $p=0.017$, respectively) believe the same.

Differences are also observed when asking if antibiotic resistance is an important health issue in our country, and the student's hospitals. A high percentage of pharmacy and medical students strongly agree or agree with the statements, whilst fewer nursing students share the same outlook. These differences are significant when comparing nursing and pharmacy students with p-values of 0.002 and 0.019 for questions 4B and 4C respectively.

When examining the answers of the attitude based questions after being subjected to analyses, no (0%) medical students and only 3 (5.1%) pharmacy students strongly agree/agree that antibiotics should be taken when one has the common cold in order to prevent serious illness, whilst 25% of all nursing students believe that this should be the case ($p=0.003$ and $p=0.005$, respectively). Additionally a significantly lower percentage of pharmacy (6.8%, $p=0.001$) and medical (9.1%, $p=0.049$) students strongly agree and agree that antibiotics help resolve a fever more quickly. This is a stark contrast to 25% of nursing students who strongly agree and agree with the statement, which once again goes against ABS principals unless a non-viral infection has been diagnosed(25).

Conversely, higher numbers of nursing students (45%) understood that antibiotic use contributes to AMR, which is different from that of pharmacy students at a significant level (p=0.013). Overall only 33.9% of all students sampled strongly agree and agree with the concept.

The results of the answers to the attitude questions, with the exception of question A3, show an overall understanding of the majority of students sampled of the risk of resistance when using antibiotics and the need to conserve usage. One can argue that more needs to be done to make students aware of the impact that inappropriate use can have on AMR as a whole.

Questions relating to perceptions saw similar results (Table 4) from all 3 professional groups. Encouragingly, 88.4% of all students would complete a full course of antibiotic treatment, however this does conflict with question P1 C, in where a large percentage of students (27.3%) indicated that they would discard any leftover medication. Additionally 83.5% of all students seek a doctor's consultation before starting an antibiotic, which is in line with prescribing legislature.

Significant differences were seen for questions P1 B and P4. Based on these statistical observations, it is noted that the percentage of nursing students that strongly agree/agree to save remaining antibiotics for the next time they get sick (17.5%) is significantly higher than the pharmacy (1.7%, p= 0.007) and medical students (0%, p=0.027). Furthermore a significantly higher percentage of medical students (22.7%) would prefer to take an antibiotic for symptoms of common viral infections such as a sore throat or a cough, when compared to pharmacy (3.4%, p=0.028) students.

Discussion

The study set out to assess the knowledge, attitudes and perceptions of pharmacy, nursing and medical students. These results form a baseline from which educational and curricular interventions can be identified. Notwithstanding the low response rate of medical students in the study, the following are our observations:

South African legislation is in place to aid the ABS process(4), with the National Health Act ensuring that structures are in place. The Health Professions, Nursing and Pharmacy Acts regulate inter alia the education and training of doctors, nurses and pharmacists respectively(26) Additionally the Medicines and Related Substances Control Act defines the scope of each profession's interaction with antibiotics(27). Doctors are primary prescribers of

antibiotics, with nurses and pharmacists being delegated this task in specific situations; nurses perform the administration of antibiotics as well as patient monitoring; and pharmacists are tasked with being the custodians of antibiotics, providing oversight. Thus within the antibiotic stewardship process, doctors, nurses and pharmacists occupy different roles that require interaction between groups and the sharing of information in order to reach the goal of reducing AMR.

Whilst the overall average knowledge score of all students was 88.89%, the overall lower scores achieved by nursing students highlights an area were further emphasis on AMR and ABR is required.

At a granular level, it can be seen that nursing students require further reinforcement of knowledge relating to adverse effects and complications associated with irrational antibiotic use. Given the role that nurses play in the patient care process as well as the ability to prescribe antibiotics in select situations in South Africa, it is essential that these gaps in knowledge are addressed. Additionally awareness of the prevalence of ABR and its seriousness is noticeably lower in the nursing group. Students and practitioners would be more likely to integrate ABS into their daily practice if their KAP, and particularly their knowledge was improved both theoretically and in practice situations as shown in the study by Abbo *et al.* (2013)(16) where medical students who had rotated in a clinical infectious disease service were more likely to rate their antimicrobial education as useful.

In addition to theoretical microbiology and pharmacology knowledge, students should be exposed to sources of knowledge, such as AMR surveillance data as well as data presented at ABS and infection prevention and control meetings. The aim of surveillance data would be to arm practitioners with knowledge on the prevalence of organisms, resistance patterns and areas of risk. The strengthening of this surveillance data forms part of the national framework(4), and the South African Society for Clinical Microbiology is able to provide data from large academic centres(6).

The rational use of antibiotics forms the backbone of the antibiotic stewardship process and is the highlighted within the plans proposed by the WHO and National Department of Health (3,4). The attitudes of students towards the prescription, administration and patient use will form a basis for their future practice. Nursing students in particular require intervention as significant numbers are unaware that antibiotics are not indicated for the common cold and fever except where evidence of bacterial infection is provided or strongly suspected(25).

Notwithstanding the low response rate of medical students, it was also observed in the practice portion of the questionnaire that almost a quarter of these students would prefer an antibiotic for a cough or sore throat, when it is known that the effectiveness of antibiotics in these self-limiting illnesses most commonly of viral aetiology cases are limited(28). Confusion regarding the indication of antimicrobials is documented by a study in Jordan, in which large percentages of the healthcare student group believed that antibiotics are indicated for viral infections or the common cold(13). Given that both nurses and doctors form the back bone of many primary healthcare facilities in South Africa, it is essential that they are able to identify situations where antibiotics are not indicated, with pharmacists ensuring rational use.

The occurrence of AMR during routine practice is poorly understood, with a third of students unaware that even valid/necessary prescription and use of antibiotics adds to the phenomenon. This is an important observation as it refers to the potential to exacerbate AMR even when antibiotics are indicated and a complication of justifiably using antibiotics necessitating that risks be weighed against the benefits. The training and curricula of these students should be examined for the inclusion of infectious diseases and ABS ward rounds, so that students are exposed to and are able to identify areas of irrational use as well as the ability to witness the ramifications of AMR. This is likely to improve their ability to assimilate ABS into the daily practice as demonstrated by Abbo *et al.* (2013)(16) during their study which observed that 83% of medical students who had rotated in clinical infectious diseases found their antimicrobial education to be useful, compared to 54% who had not completed a rotation(16). Although the study was restricted to medical students, conceptually this could be implemented into the curricula for all relevant healthcare students.

Practices were assessed by assuming that the current perceptions of students around ABS and AMR would guide their future practice and have already been partially formed by their personal behaviour and limited practical experience. Current legislation in South Africa requires antibiotics to be prescribed by an authorised person, including nurses and pharmacists that meet select criteria, before they can be dispensed(26,27,29,30). We have observed that almost a quarter of students do not consult a doctor before starting an antibiotic, which is an example of unauthorised self-medication and poor practice. The large number of students that discard their medication once they feel better is also of concern. Whilst this has a major impact on compliance and the promotion of AMR, there are also secondary effects on the environment which arguably adds to the impact on resistance. As we have noted, students

perceptions are likely to influence their future professional practice and thus it is important to re-enforce the concept of compliance at an early stage.

In a study on pharmacy students by Burger *et al.* (2016)(10), education on antimicrobial therapy has been identified as one of the most important interventions and whilst ABS is currently not a mandatory requirement for curricula(10), the Antimicrobial Resistance National Strategy Framework(4) calls for its integration into the curricula of medical and allied health science students.

Conclusion

This study aimed to ascertain the current knowledge, attitudes and perceptions/practices of final year pharmacy, nursing and medical students. In doing so, several gaps in knowledge were identified, with key differences between the student groups. Attitudes and perceptions also differed substantively indicating the need for curriculum review on AMR and ABS content as suboptimal KAP may lead to negative patient outcomes.

Greater focus on ABS and AMR in the curricula of students as well as the application of knowledge in practical situations such as ward rounds is recommended. Additionally exposing students to various sources of AMR surveillance and ABS knowledge would help ensure that they are aware of resources available to them in future practice.

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References

1. Department of Health Department for Environment Food and Rural Affairs. UK Five Year Antimicrobial Resistance Strategy 2013 to 2018 [Internet]. 2013 [cited 2016 Nov 1]. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244058/20130902_UK_5_year_AMR_strategy.pdf

2. Ashiru-Oredope D, Cookson B, Fry C, Cookson B, Ashiru-Oredope D, Avery T, et al. Developing the first national antimicrobial prescribing and stewardship competences. J Antimicrob Chemother [Internet]. 2014 Nov 1 [cited 2016 Nov 1];69(11):2886–8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25213273

3. World Health Organization (WHO). Global Action Plan on Antimicrobial Resistance [Internet]. 2015 [cited 2016 Nov 1]. Available from: http://www.wpro.who.int/entity/drug_resistance/resources/global_action_plan_eng.pdf

4. National Department of Health. Antimicrobial Resistance National Strategy framework: 2014-2024 [Internet]. 2014 [cited 2016 Nov 1]. Available from: http://www.mm3admin.co.za/documents/docmanager/3C53E82B-24F2-49E1-B997-5A35803BE10A/00090160.pdf

5. McNulty C a M, Cookson BD, Lewis M a O. Education of healthcare professionals and the public. J Antimicrob Chemother [Internet]. 2012 Jul [cited 2016 Nov 1];67 Suppl 1:i11-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22855873

6. Apalata T, Bamford C, Druss B, Botha M, Brink A, Crowther-Gibson P, et al. Situation Analysis: Antibiotic use and resistance in South Africa. South African Med J [Internet]. 2011 [cited 2016 Nov 1];101(8):549–96. Available from: http://www.cddep.org/publications/situation_analysis_antibiotic_use_and_resistance_south_africa

7. Oxford Dictionaries. Definition of knowledge in English [Internet]. 2016 [cited 2016 Nov 1]. Available from: https://en.oxforddictionaries.com/definition/knowledge

8. Oxford Dictionaries. Definition of attitude in English [Internet]. 2016 [cited 2016 Nov 1]. Available from: https://en.oxforddictionaries.com/definition/attitude

9. Oxford Dictionaries. Definition of perception in English [Internet]. 2016 [cited 2016

Nov 1]. Available from: https://en.oxforddictionaries.com/definition/perception

10. Burger M, Fourie J, Loots D, Mnisi T, Schellack N, Bezuidenhout S, et al. Knowledge and perceptions of antimicrobial stewardship concepts among final year pharmacy students in pharmacy schools across South Africa. South African J Infect Dis [Internet]. 2016 Jul 18 [cited 2016 Nov 1];31(3):84–90. Available from: https://www.tandfonline.com/doi/full/10.1080/23120053.2016.1192808

11. Thriemer K, Katuala Y, Batoko B, Alworonga J-P, Devlieger H, Van Geet C, et al. Antibiotic prescribing in DR Congo: a knowledge, attitude and practice survey among medical doctors and students. PLoS One [Internet]. 2013 [cited 2016 Nov 1];8(2). Available from: http://dx.plos.org/10.1371/journal.pone.0055495

12. Huang Y, Gu J, Zhang M, Ren Z, Yang W, Chen Y, et al. Knowledge, attitude and practice of antibiotics: a questionnaire study among 2500 Chinese students. BMC Med Educ [Internet]. 2013 Dec 9 [cited 2016 Nov 1];13(1):163. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4028935&tool=pmcentrez&rendertype=abstract

13. Ghadeer A. R. Y. Suaifan. A cross-sectional study on knowledge, attitude and behavior related to \ antibiotic use and resistance among medical and non-medical university students in Jordan. African J Pharm Pharmacol [Internet]. 2012 Mar 15 [cited 2016 Nov 1];6(10):763–70. Available from: http://www.academicjournals.org/ajpp/abstracts/abstracts/abstract 2012/15 Mar/Suaifan et al.htm

14. Dyar OJ, Pulcini C, Howard P, Nathwani D, Nathwani D, Beovic B, et al. European medical students: a first multicentre study of knowledge, attitudes and perceptions of antibiotic prescribing and antibiotic resistance. J Antimicrob Chemother [Internet]. 2014 Mar 1 [cited 2016 Nov 1];69(3):842–6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24191307

15. Justo JA, Gauthier TP, Scheetz MH, Chahine EB, Bookstaver PB, Gallagher JC, et al. Knowledge and Attitudes of Doctor of Pharmacy Students Regarding the Appropriate Use of Antimicrobials. Clin Infect Dis [Internet]. 2014 Oct 15 [cited 2016 Nov 1];59(suppl 3):S162–9. Available from: http://cid.oxfordjournals.org/content/59/suppl_3/S162.long

16. Abbo LM, Cosgrove SE, Pottinger PS, Pereyra M, Sinkowitz-Cochran R, Srinivasan A, et al. Medical Students' Perceptions and Knowledge About Antimicrobial Stewardship: How Are We Educating Our Future Prescribers? Clin Infect Dis [Internet]. 2013 Sep 1 [cited 2016 Nov 1];57(5):631–8. Available from: http://cid.oxfordjournals.org/lookup/doi/10.1093/cid/cit370

17. Khan A K A, Banu G, K K R. Antibiotic Resistance and Usage-A Survey on the Knowledge, Attitude, Perceptions and Practices among the Medical Students of a Southern Indian Teaching Hospital. J Clin Diagn Res [Internet]. 2013 Aug [cited 2016 Nov 1];7(8):1613–6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24086854

18. Napolitano F, Izzo MT, Di Giuseppe G, Angelillo IF. Public knowledge, attitudes, and experience regarding the use of antibiotics in Italy. PLoS One [Internet]. 2013 [cited 2016 Nov 1];8(12):e84177. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24376793

19. Shet A, Sundaresan S, Forsberg BC. Pharmacy-based dispensing of antimicrobial agents without prescription in India: appropriateness and cost burden in the private sector. Antimicrob Resist Infect Control [Internet]. Antimicrobial Resistance and Infection Control; 2015 [cited 2016 Nov 1];4(1):55–62. Available from: http://aricjournal.biomedcentral.com/articles/10.1186/s13756-015-0098-8

20. Mahajan M, Dudhgaonkar S, Deshmukh S. A Questionnaire based Survey on the Knowledge, Attitude and Practises about Antimicrobial Resistance and Usage among the Second year MBBS Students of a Teaching tertiary care Hospital in Central India. Int J Pharmacol Res [Internet]. 2014 [cited 2017 Mar 10];4(4):175–9. Available from: http://ssjournals.com.md-in-1.webhostbox.net/index.php/ijpr/article/view/1478

21. Rekha MS, Khan A K, Bagewadi HG, Venkatadri T V. A study of Knowledge, Attitude, Perceptions and Practices reagrding Antimicrobial Resistance and usage among third and fourth year medical students. Int J Pharmacol Ther [Internet]. 2014 [cited 2017 Mar 10];4(4):32–7. Available from: http://www.earthjournals.in/ijpt_289.pdf

22. Sharma K, Jain P, Sharma A. Knowledge, attitude and perception of medical and dental undergraduates about antimicrobial stewardship. Indian J Pharmacol [Internet]. 2015 [cited 2017 Mar 10];47(6):676–9. Available from: http://www.ijp-

online.com/article.asp?issn=0253-7613;year=2015;volume=47;issue=6;spage=676;epage=679;aulast=Sharma

23. Ahmad A, Dhingra S, Khan M, Maharaj S, Pandey S, Patel I. Knowledge, attitude and practice of B.Sc. Pharmacy students about antibiotics in Trinidad and Tobago. J Res Pharm Pract [Internet]. 2015 [cited 2017 Mar 10];4(1):37. Available from: http://www.jrpp.net/text.asp?2015/4/1/37/150057

24. World Health Organization (WHO). The evolving threat of antimicrobial resistance: Options for action [Internet]. WHO Publications. 2014 [cited 2016 Nov 1]. Available from: http://www.ijmr.org.in/article.asp?issn=0971-5916;year=2014;volume=139;issue=1;spage=182;epage=183;aulast=Kapi

25. Brink A, Ritchie A, Barnard A, Karim B, du Toit B, Lawrence C, et al. Antibiotic Stewardship in the Hospital Environment: Getting Started Guide [Internet]. 2011 [cited 2016 Nov 1]. Available from: http://www.bestcare.org.za/file/view/Antibiotic+Stewardship+Getting+Started+Guide+v1.pdf

26. South African Nursing Council. Nursing Act: Regulations: Keeping, supply, administering, prescribing or dispensing of medicine by registered nurses [Internet]. Pretoria: National department of health; 2011 p. 2–8. Available from: http://www.sanc.co.za/regulat/RegsForPublicComment/gg34851gon1044_20111214Keeping_Medicines.pdf

27. National Department of Health. Medicines and Related Substances Act 101 of 1965 [Internet]. Republic of South Africa; 1965 p. 1–19. Available from: http://www.mccza.com/Publications

28. Butler CC, Rollnick S, Pill R, Maggs-Rapport F, Stott N. Understanding the culture of prescribing: qualitative study of general practitioners' and patients' perceptions of antibiotics for sore throats. BMJ [Internet]. 1998 Sep 5 [cited 2016 Nov 1];317(7159):637–42. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9727992

29. South African Pharmacy Council. Scope of practice and qualification for authorised pharmacist prescriber [Internet]. National department of health; 2011 p. 3–15. Available from: http://www.gov.za/sites/www.gov.za/files/34428_bn122.pdf

30. National Department of Health. Medicines and related substances Act 101 of 1965, Amendment to schedules [Internet]. Department of Health 2013 p. 11–30. Available from: http://www.mccza.com/Publications

CHAPTER 3

3.1 Conclusions

The cross-sectional study measured KAP of a total of 132 final-year students comprising of 63, 46 and 23 pharmacy, nursing and medical students respectively by means of a questionnaire survey. In doing so, several gaps in knowledge were identified, with key differences between the student groups. Attitudes and perceptions also differed substantively indicating the need for curriculum review on AMR and ABS content as suboptimal KAP may lead to negative patient outcomes.

The following are the main conclusions from the study:

- Knowledge results show the, pharmacy students having the greatest mean knowledge score out of the 3 professional groups in line with the pharmacology curriculum content in that pharmacy students are taught pharmacology in the greater depth and breadth compared to the medical and nursing students.
- Nursing students achieved significantly lower mean knowledge scores compared to pharmacy and medical students. Nursing students require further knowledge regarding adverse effects and complications associated with irrational antibiotic use.
- Awareness of the prevalence of ABR and its seriousness is noticeably lower in the nursing group.
- Two thirds of all students were not aware that self-use of antibiotics contributes to increased AMR rates.
- A high percentage of students sampled would discard left over antibiotics after stopping their course of treatment pre-maturely. It is important for students to understand the environmental consequences of discarding antibiotics and the correct channels through which this should be done.
- A third of all students and 45% of nursing students agreed that use of antibiotics contributes to AMR. This leaves large portions of students that are unaware of this correlation.
- Several gaps in knowledge were identified, with key differences between the student groups.
- Attitudes and perceptions also differed substantively indicating the need for curriculum review on AMR and ABS content as suboptimal KAP may lead to negative patient outcomes.

3.2 Limitations

The study was limited by a number of factors, including:

- An inability to access medical students directly given the fact that their curriculum entails hospital rotations at different locations. This led to the small sample size.
- Perceptions were used *in lieu* of practices as students are not allowed to practice autonomously. It is assumed that perceptions will shape future practices.
- Given the low response from medical students (9%), we were not able to generalize for this group.
- The study did not look at all possible facets of AMR and ABS.

3.3 Recommendations

- There should be greater focus on and integration of ABS and AMR into curricula for all healthcare students, with particular emphasis on nursing students.
- Students should be exposed to various diverse sources of knowledge, such as AMR surveillance and use data in order to increase awareness and to assist patient treatment.
- Implementing multi-disciplinary ABS ward rounds in the training of doctors, nurses and pharmacists would re-inforce this knowledge in a practical situation.
- Further studies should be conducted in this area, aiming to achieve higher response rates in relation to medical students, specifically.

REFERENCES

1. Department of Health Department for Environment Food and Rural Affairs. UK Five Year Antimicrobial Resistance Strategy 2013 to 2018 [Internet]. 2013 [cited 2016 Nov 1]. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244058/20130902_UK_5_year_AMR_strategy.pdf

2. Ashiru-Oredope D, Cookson B, Fry C, Cookson B, Ashiru-Oredope D, Avery T, et al. Developing the first national antimicrobial prescribing and stewardship competences. J Antimicrob Chemother [Internet]. 2014 Nov 1 [cited 2016 Nov 1];69(11):2886–8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25213273

3. World Health Organization (WHO). Global Action Plan on Antimicrobial Resistance [Internet]. 2015 [cited 2016 Nov 1]. Available from: http://www.wpro.who.int/entity/drug_resistance/resources/global_action_plan_eng.pdf

4. National Department of Health. Antimicrobial Resistance National Strategy framework: 2014-2024 [Internet]. 2014 [cited 2016 Nov 1]. Available from: http://www.mm3admin.co.za/documents/docmanager/3C53E82B-24F2-49E1-B997-5A35803BE10A/00090160.pdf

5. McNulty C a M, Cookson BD, Lewis M a O. Education of healthcare professionals and the public. J Antimicrob Chemother [Internet]. 2012 Jul [cited 2016 Nov 1];67 Suppl 1:i11-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22855873

6. Apalata T, Bamford C, Druss B, Botha M, Brink A, Crowther-Gibson P, et al. Situation Analysis: Antibiotic use and resistance in South Africa. South African Med J [Internet]. 2011 [cited 2016 Nov 1];101(8):549–96. Available from: http://www.cddep.org/publications/situation_analysis_antibiotic_use_and_resistance_south_africa

7. Oxford Dictionaries. Definition of knowledge in English [Internet]. 2016 [cited 2016 Nov 1]. Available from: https://en.oxforddictionaries.com/definition/knowledge

8. Oxford Dictionaries. Definition of attitude in English [Internet]. 2016 [cited 2016 Nov 1]. Available from: https://en.oxforddictionaries.com/definition/attitude

9. Oxford Dictionaries. Definition of perception in English [Internet]. 2016 [cited 2016

Nov 1]. Available from: https://en.oxforddictionaries.com/definition/perception

10. Burger M, Fourie J, Loots D, Mnisi T, Schellack N, Bezuidenhout S, et al. Knowledge and perceptions of antimicrobial stewardship concepts among final year pharmacy students in pharmacy schools across South Africa. South African J Infect Dis [Internet]. 2016 Jul 18 [cited 2016 Nov 1];31(3):84–90. Available from: https://www.tandfonline.com/doi/full/10.1080/23120053.2016.1192808

11. Thriemer K, Katuala Y, Batoko B, Alworonga J-P, Devlieger H, Van Geet C, et al. Antibiotic prescribing in DR Congo: a knowledge, attitude and practice survey among medical doctors and students. PLoS One [Internet]. 2013 [cited 2016 Nov 1];8(2). Available from: http://dx.plos.org/10.1371/journal.pone.0055495

12. Huang Y, Gu J, Zhang M, Ren Z, Yang W, Chen Y, et al. Knowledge, attitude and practice of antibiotics: a questionnaire study among 2500 Chinese students. BMC Med Educ [Internet]. 2013 Dec 9 [cited 2016 Nov 1];13(1):163. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4028935&tool=pmcentrez&rendertype=abstract

13. Ghadeer A. R. Y. Suaifan. A cross-sectional study on knowledge, attitude and behavior related to \ antibiotic use and resistance among medical and non-medical university students in Jordan. African J Pharm Pharmacol [Internet]. 2012 Mar 15 [cited 2016 Nov 1];6(10):763–70. Available from: http://www.academicjournals.org/ajpp/abstracts/abstracts/abstract 2012/15 Mar/Suaifan et al.htm

14. Dyar OJ, Pulcini C, Howard P, Nathwani D, Nathwani D, Beovic B, et al. European medical students: a first multicentre study of knowledge, attitudes and perceptions of antibiotic prescribing and antibiotic resistance. J Antimicrob Chemother [Internet]. 2014 Mar 1 [cited 2016 Nov 1];69(3):842–6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24191307

15. Justo JA, Gauthier TP, Scheetz MH, Chahine EB, Bookstaver PB, Gallagher JC, et al. Knowledge and Attitudes of Doctor of Pharmacy Students Regarding the Appropriate Use of Antimicrobials. Clin Infect Dis [Internet]. 2014 Oct 15 [cited 2016 Nov 1];59(suppl 3):S162–9. Available from: http://cid.oxfordjournals.org/content/59/suppl_3/S162.long

16. Abbo LM, Cosgrove SE, Pottinger PS, Pereyra M, Sinkowitz-Cochran R, Srinivasan A, et al. Medical Students' Perceptions and Knowledge About Antimicrobial Stewardship: How Are We Educating Our Future Prescribers? Clin Infect Dis [Internet]. 2013 Sep 1 [cited 2016 Nov 1];57(5):631–8. Available from: http://cid.oxfordjournals.org/lookup/doi/10.1093/cid/cit370

17. Khan A K A, Banu G, K K R. Antibiotic Resistance and Usage-A Survey on the Knowledge, Attitude, Perceptions and Practices among the Medical Students of a Southern Indian Teaching Hospital. J Clin Diagn Res [Internet]. 2013 Aug [cited 2016 Nov 1];7(8):1613–6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24086854

18. Napolitano F, Izzo MT, Di Giuseppe G, Angelillo IF. Public knowledge, attitudes, and experience regarding the use of antibiotics in Italy. PLoS One [Internet]. 2013 [cited 2016 Nov 1];8(12):e84177. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24376793

19. Shet A, Sundaresan S, Forsberg BC. Pharmacy-based dispensing of antimicrobial agents without prescription in India: appropriateness and cost burden in the private sector. Antimicrob Resist Infect Control [Internet]. Antimicrobial Resistance and Infection Control; 2015 [cited 2016 Nov 1];4(1):55–62. Available from: http://aricjournal.biomedcentral.com/articles/10.1186/s13756-015-0098-8

20. Mahajan M, Dudhgaonkar S, Deshmukh S. A Questionnaire based Survey on the Knowledge, Attitude and Practises about Antimicrobial Resistance and Usage among the Second year MBBS Students of a Teaching tertiary care Hospital in Central India. Int J Pharmacol Res [Internet]. 2014 [cited 2017 Mar 10];4(4):175–9. Available from: http://ssjournals.com.md-in-1.webhostbox.net/index.php/ijpr/article/view/1478

21. Rekha MS, Khan A K, Bagewadi HG, Venkatadri T V. A study of Knowledge, Attitude, Perceptions and Practices reagrding Antimicrobial Resistance and usage among third and fourth year medical students. Int J Pharmacol Ther [Internet]. 2014 [cited 2017 Mar 10];4(4):32–7. Available from: http://www.earthjournals.in/ijpt_289.pdf

22. Sharma K, Jain P, Sharma A. Knowledge, attitude and perception of medical and dental undergraduates about antimicrobial stewardship. Indian J Pharmacol [Internet]. 2015 [cited 2017 Mar 10];47(6):676–9. Available from: http://www.ijp-

online.com/article.asp?issn=0253-7613;year=2015;volume=47;issue=6;spage=676;epage=679;aulast=Sharma

23. Ahmad A, Dhingra S, Khan M, Maharaj S, Pandey S, Patel I. Knowledge, attitude and practice of B.Sc. Pharmacy students about antibiotics in Trinidad and Tobago. J Res Pharm Pract [Internet]. 2015 [cited 2017 Mar 10];4(1):37. Available from: http://www.jrpp.net/text.asp?2015/4/1/37/150057

24. World Health Organization (WHO). The evolving threat of antimicrobial resistance: Options for action [Internet]. WHO Publications. 2014 [cited 2016 Nov 1]. Available from: http://www.ijmr.org.in/article.asp?issn=0971-5916;year=2014;volume=139;issue=1;spage=182;epage=183;aulast=Kapi

25. Brink A, Ritchie A, Barnard A, Karim B, du Toit B, Lawrence C, et al. Antibiotic Stewardship in the Hospital Environment: Getting Started Guide [Internet]. 2011 [cited 2016 Nov 1]. Available from: http://www.bestcare.org.za/file/view/Antibiotic+Stewardship+Getting+Started+Guide+v1.pdf

26. South African Nursing Council. Nursing Act: Regulations: Keeping, supply, administering, prescribing or dispensing of medicine by registered nurses [Internet]. Pretoria: National department of health; 2011 p. 2–8. Available from: http://www.sanc.co.za/regulat/RegsForPublicComment/gg34851gon1044_20111214Keeping_Medicines.pdf

27. National Department of Health. Medicines and Related Substances Act 101 of 1965 [Internet]. Republic of South Africa; 1965 p. 1–19. Available from: http://www.mccza.com/Publications

28. Butler CC, Rollnick S, Pill R, Maggs-Rapport F, Stott N. Understanding the culture of prescribing: qualitative study of general practitioners' and patients' perceptions of antibiotics for sore throats. BMJ [Internet]. 1998 Sep 5 [cited 2016 Nov 1];317(7159):637–42. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9727992

29. South African Pharmacy Council. Scope of practice and qualification for authorised pharmacist prescriber [Internet]. National department of health; 2011 p. 3–15. Available from: http://www.gov.za/sites/www.gov.za/files/34428_bn122.pdf

30. National Department of Health. Medicines and related substances Act 101 of 1965, Amendment to schedules [Internet]. Department of Health 2013 p. 11–30. Available from: http://www.mccza.com/Publications

APPENDICES

Appendix 1: Ethical Clearance Letter

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

18 June 2015

Mr Shanay Singh 206501875
School of Health Sciences-Pharmacy
Westville Campus

Dear Mr Singh

Protocol reference number: HSS/0266/015M
Project title: Antimicrobial Resistance and Antibiotic Stewardship: Knowledge, attidues and perceptions amongst final - year, multidisciplinary undergraduate students in a South African University

Full Approval – Expedited Application

In response to your application received on 24 March 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....

Dr Shamila Naidoo
On behalf of Dr Shenuka Singh (Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

Cc Supervisor: Professor SY Essack
Cc Academic Leader Research: Professor J van Heerden
Cc School Administrator: Ms P Nene

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
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Website: www.ukzn.ac.za

Appendix 2: Declaration of consent

Declaration of consent

PROJECT TITLE: Antimicrobial Resistance and Antibiotic Stewardship: Knowledge, attitudes and perceptions amongst final-year, multidisciplinary undergraduate students in a South African University.

Protocol reference number: HSS/0266/015M

RESEARCHER
Full Name: Shanay Singh
School: Pharmacy
College: Health sciences
Campus: Westville
Proposed Qualification: Master of Pharmacy
Contact: 073 934 0493
Email: shanaysingh87@gmail.com

SUPERVISOR
Full Name of Supervisor: Sabiha Essack
School: Pharmacy
College: Health sciences
Campus: Westville
Contact details
Email: essacks@ukzn.ac.za

HSSREC RESEARCH OFFICE
Full Name: Prem Mohun
HSS Research Office
Govan Bheki Building
Westville Campus
Contact: 0312604557
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Dear student

I, Shanay Singh, student number 206501875, am a Master of Pharmacy student at UKZN.
You are invited to participate in my research project entitled: Antimicrobial Resistance and Antibiotic Stewardship: Knowledge, attitudes and perceptions amongst final-year, multidisciplinary undergraduate students in a South African University.

The research consists of an anonymous research questionnaire consisting of 26 questions that aims to answer the following question:
Does the current curriculum adequately influence the knowledge, attitudes and perceptions of final-year students from various healthcare professions?
The survey questionnaire contains 26 multiple choice questions and should take 10 minutes to complete. Your identity and personal information will be kept strictly confidential and you shall face no negative consequences should you choose not to participate.

Declaration of consent

I.....(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that participation is completely voluntary and that I shall face no negative consequences should I choose not to participate.

Participants Signature:……

Date:…….

Appendix 3: Data Collection tool

Demographic Questions	Answer
What is your healthcare profession? (medical doctor / pharmacist / nurse)	
What is your age?	
What is your gender?	
Do you live in an urban or rural area?	

Knowledge Questions	TRUE	FALSE
K1. Indiscriminate and Injudicious use of antibiotics can lead to		
a) Ineffective treatment		
b) Increased adverse events		
c) Exacerbation or Prolongation of illness		
d) Emergence of bacterial resistance		
e) Additional burden of medical cost to the patient		
K2. If taken too often, antibiotics are less likely to work in the future.		
K3. Bacteria are germs that cause common cold and flu.		

K4. Antibiotic Resistance is:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
a) An important and serious public health issue facing the World.					
b) An important and serious public health issue in our Country.					
c) An important and serious public health issue in our Hospital					

Attitude Questions	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
A1. When I have a cold, I should take antibiotics to prevent getting a more serious illness.					
A2. When I get fever, antibiotics help me to get better more quickly.					
A3. Whenever I take an antibiotic, I contribute to the development of antibiotic resistance.					
A4. Skipping one or two doses does not contribute to the development of antibiotic resistance.					
A5. Antibiotics are safe drugs, hence they can be commonly used.					

Medication Practice Questions	Always	Usually	Sometimes	Seldom	Never
P1. The Doctor prescribes a course of antibiotic for you. After taking 2–3 doses you start feeling better.					
a) Do you stop taking the further treatment?					
b) Do you save the remaining antibiotics for the next time you get sick?					
c) Do you discard the remaining, leftover medication?					
d) Do you give the leftover antibiotics to your friend/roommate if they get sick?					
e) Do you complete the full course of treatment?					
P2. Do you consult a doctor before starting an antibiotic?					
P3. Do you check the expiry date of the antibiotic before using it?					
P4. Do you prefer to take an antibiotic when you have cough and sore throat?					

Appendix 4: Statistical Analysis

1. Comparison of knowledge score between Pharmacy, Nursing and Medical students

Anova

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
K1 A	Between Groups	.229	2	.115	2.292	.105
	Within Groups	6.397	128	.050		
	Total	6.626	130			
K1 B	Between Groups	1.334	2	.667	6.260	.003
	Within Groups	13.426	126	.107		
	Total	14.760	128			
K1 1	Between Groups	1.807	2	.904	7.544	.001
	Within Groups	15.092	126	.120		
	Total	16.899	128			
K1 D	Between Groups	.229	2	.115	3.130	.047
	Within Groups	4.576	125	.037		
	Total	4.805	127			
K1 E	Between Groups	.152	2	.076	1.724	.183
	Within Groups	5.569	126	.044		
	Total	5.721	128			
K2	Between Groups	.002	2	.001	.012	.988
	Within Groups	10.081	129	.078		
	Total	10.083	131			
K3	Between Groups	5.154	2	2.577	14.893	.000
	Within Groups	22.323	129	.173		
	Total	27.477	131			
Knowledge Score	Between Groups	9305.467	2	4652.733	17.918	.000
	Within Groups	33496.866	129	259.666		
	Total	42802.333	131			

Post-Hoc Tukey HSD

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Profession	(J) Profession	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
K1 A	Pharmacy Student	Nursing Student	.093	.044	.088	-.01	.20
		Medical Student	.027	.055	.871	-.10	.16
	Nursing Student	Pharmacy Student	-.093	.044	.088	-.20	.01
		Medical Student	-.065	.057	.490	-.20	.07
	Medical Student	Pharmacy Student	-.027	.055	.871	-.16	.10
		Nursing Student	.065	.057	.490	-.07	.20
K1 B	Pharmacy Student	Nursing Student	.208*	.064	.004	.06	.36
		Medical Student	-.021	.080	.962	-.21	.17
	Nursing Student	Pharmacy Student	-.208*	.064	.004	-.36	-.06
		Medical Student	-.229*	.084	.020	-.43	-.03
	Medical Student	Pharmacy Student	.021	.080	.962	-.17	.21
		Nursing Student	.229*	.084	.020	.03	.43
K1 C	Pharmacy Student	Nursing Student	.256*	.068	.001	.09	.42
		Medical Student	.185	.085	.079	-.02	.39
	Nursing Student	Pharmacy Student	-.256*	.068	.001	-.42	-.09
		Medical Student	-.071	.089	.700	-.28	.14

	Medical Student	Pharmacy Student	-.185	.085	.079	-.39	.02
		Nursing Student	.071	.089	.700	-.14	.28
K1 D	Pharmacy Student	Nursing Student	.095*	.038	.036	.00	.19
		Medical Student	.043	.047	.621	-.07	.15
	Nursing Student	Pharmacy Student	-.095*	.038	.036	-.19	.00
		Medical Student	-.052	.050	.551	-.17	.07
	Medical Student	Pharmacy Student	-.043	.047	.621	-.15	.07
		Nursing Student	.052	.050	.551	-.07	.17
K1 E	Pharmacy Student	Nursing Student	.077	.042	.156	-.02	.18
		Medical Student	.028	.051	.852	-.09	.15
	Nursing Student	Pharmacy Student	-.077	.042	.156	-.18	.02
		Medical Student	-.050	.054	.634	-.18	.08
	Medical Student	Pharmacy Student	-.028	.051	.852	-.15	.09
		Nursing Student	.050	.054	.634	-.08	.18
K2	Pharmacy Student	Nursing Student	.008	.054	.989	-.12	.14
		Medical Student	.008	.068	.993	-.15	.17
	Nursing Student	Pharmacy Student	-.008	.054	.989	-.14	.12
		Medical Student	.000	.071	1.000	-.17	.17
	Medical Student	Pharmacy Student	-.008	.068	.993	-.17	.15
		Nursing Student	.000	.071	1.000	-.17	.17
K3	Pharmacy Student	Nursing Student	.422*	.081	.000	.23	.61

		Medical Student	.031	.101	.950	-.21	.27
	Nursing Student	Pharmacy Student	-.422*	.081	.000	-.61	-.23
		Medical Student	-.391*	.106	.001	-.64	-.14
	Medical Student	Pharmacy Student	-.031	.101	.950	-.27	.21
		Nursing Student	.391*	.106	.001	.14	.64
Knowledge Score	Pharmacy Student	Nursing Student	18.339*	3.125	.000	10.93	25.75
		Medical Student	3.360	3.926	.669	-5.95	12.67
	Nursing Student	Pharmacy Student	-18.339*	3.125	.000	-25.75	-10.93
		Medical Student	-14.978*	4.115	.001	-24.74	-5.22
	Medical Student	Pharmacy Student	-3.360	3.926	.669	-12.67	5.95
		Nursing Student	14.978*	4.115	.001	5.22	24.74

*. The mean difference is significant at the 0.05 level.

The ANOVA shows that there is a significant difference in knowledge score between the three professions (p= 0.000). The post hoc analysis shows that the difference is mainly in the scores of the Nursing students when compared to the other two professions. No significant difference was seen between Pharmacy and Medical student knowledge scores

2. Comparison of knowledge question 4 score between Pharmacy, Nursing and Medical students

ANOVA

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
K4 A	Between Groups	.694	2	.347	7.543	.001
	Within Groups	5.935	129	.046		
	Total	6.629	131			
K4 C	Between Groups	.568	2	.284	4.621	.012
	Within Groups	7.809	127	.061		
	Total	8.377	129			
K4 B	Between Groups	1.296	2	.648	6.105	.003
	Within Groups	13.481	127	.106		
	Total	14.777	129			

Post-Hoc Tukey HSD

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Profession	(J) Profession	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
K4 A	Pharmacy Student	Nursing Student	-.152*	.042	.001	-.25	-.05
		Medical Student	.000	.052	1.000	-.12	.12
	Nursing Student	Pharmacy Student	.152*	.042	.001	.05	.25
		Medical Student	.152*	.055	.017	.02	.28
	Medical Student	Pharmacy Student	.000	.052	1.000	-.12	.12
		Nursing Student	-.152*	.055	.017	-.28	-.02
K4 C	Pharmacy Student	Nursing Student	-.133*	.049	.019	-.25	-.02
		Medical Student	-.130	.061	.083	-.27	.01

	Nursing Student	Pharmacy Student	.133*	.049	.019	.02	.25
		Medical Student	.003	.064	.999	-.15	.15
	Medical Student	Pharmacy Student	.130	.061	.083	-.01	.27
		Nursing Student	-.003	.064	.999	-.15	.15
K4 B	Pharmacy Student	Nursing Student	-.218*	.064	.002	-.37	-.07
		Medical Student	-.039	.080	.879	-.23	.15
	Nursing Student	Pharmacy Student	.218*	.064	.002	.07	.37
		Medical Student	.180	.084	.084	-.02	.38
	Medical Student	Pharmacy Student	.039	.080	.879	-.15	.23
		Nursing Student	-.180	.084	.084	-.38	.02

*. The mean difference is significant at the 0.05 level.

The ANOVA shows that there is a significant difference in responses for questions K4 A and K4 B between the three professions with P-values of 0.001 and 0.003 respectively. The post hoc analysis shows that the difference is mainly in the scores of the Nursing students when compared to the other two professions for both the questions with no significant difference seen between Pharmacy and Medical student knowledge scores

The ANOVA results for question K4 C shows that the difference in responses between the 3 professions was not significant (p=0.012)

3. Comparison of attitudes between Pharmacy, Nursing and Medical students

One-way ANOVA

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
A1	Between Groups	1.288	2	.644	7.402	.001
	Within Groups	11.227	129	.087		
	Total	12.515	131			
A2	Between Groups	1.643	2	.822	6.872	.001
	Within Groups	15.303	128	.120		
	Total	16.947	130			
A3	Between Groups	1.858	2	.929	4.219	.017
	Within Groups	28.407	129	.220		
	Total	30.265	131			
A4	Between Groups	.262	2	.131	1.227	.297
	Within Groups	13.798	129	.107		
	Total	14.061	131			
A5	Between Groups	.029	2	.015	.093	.911
	Within Groups	20.236	129	.157		
	Total	20.265	131			

Post-Hoc Tukey HSD

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Profession	(J) Profession	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
A1	Pharmacy Student	Nursing Student	.192*	.057	.003	.06	.33
		Medical Student	-.048	.072	.786	-.22	.12
	Nursing Student	Pharmacy Student	-.192*	.057	.003	-.33	-.06
		Medical Student	-.239*	.075	.005	-.42	-.06
	Medical Student	Pharmacy Student	.048	.072	.786	-.12	.22

		Nursing Student	.239*	.075	.005	.06	.42
A2	Pharmacy Student	Nursing Student	.241*	.067	.001	.08	.40
		Medical Student	.027	.086	.945	-.18	.23
	Nursing Student	Pharmacy Student	-.241*	.067	.001	-.40	-.08
		Medical Student	-.213*	.090	.049	-.43	.00
	Medical Student	Pharmacy Student	-.027	.086	.945	-.23	.18
		Nursing Student	.213*	.090	.049	.00	.43
A3	Pharmacy Student	Nursing Student	.262*	.091	.013	.05	.48
		Medical Student	.153	.114	.376	-.12	.42
	Nursing Student	Pharmacy Student	-.262*	.091	.013	-.48	-.05
		Medical Student	-.109	.120	.637	-.39	.18
	Medical Student	Pharmacy Student	-.153	.114	.376	-.42	.12
		Nursing Student	.109	.120	.637	-.18	.39
A4	Pharmacy Student	Nursing Student	.013	.063	.975	-.14	.16
		Medical Student	.122	.080	.279	-.07	.31
	Nursing Student	Pharmacy Student	-.013	.063	.975	-.16	.14
		Medical Student	.109	.084	.397	-.09	.31
	Medical Student	Pharmacy Student	-.122	.080	.279	-.31	.07
		Nursing Student	-.109	.084	.397	-.31	.09
A5	Pharmacy Student	Nursing Student	-.017	.077	.975	-.20	.17
		Medical Student	.027	.096	.958	-.20	.26

	Nursing Student	Pharmacy Student	.017	.077	.975	-.17	.20
		Medical Student	.043	.101	.903	-.20	.28
	Medical Student	Pharmacy Student	-.027	.096	.958	-.26	.20
		Nursing Student	-.043	.101	.903	-.28	.20

*. The mean difference is significant at the 0.05 level.

Significant differences between the answers of professional groups were seen for questions A1 and A2 (p=0.001 and 0.001 respectively). For Question A1 this difference between groups was significant between the pharmacy and medical students when compared to the nursing students (P=0.003 and P= 0.005 respectively).The same overall result is seen in question A2 with differences between nursing students and the pharmacy students were significant (P=0.001) as well as between the nursing and medical students (P=0.049). Questions A3-A5 showed no significant differences in answers between the professions.

4. Comparison of perceptions between Pharmacy, Nursing and Medical students

One-way ANOVA

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
P1 A	Between Groups	.121	2	.061	2.758	.067
	Within Groups	2.810	128	.022		
	Total	2.931	130			
P1 B	Between Groups	.616	2	.308	5.720	.004
	Within Groups	6.895	128	.054		
	Total	7.511	130			
P1 C	Between Groups	.164	2	.082	.402	.670
	Within Groups	25.867	127	.204		
	Total	26.031	129			
P1 D	Between Groups	.073	2	.036	.982	.377
	Within Groups	4.737	128	.037		
	Total	4.809	130			
P1 E	Between Groups	.130	2	.065	.677	.510
	Within Groups	12.385	129	.096		
	Total	12.515	131			
P2	Between Groups	.506	2	.253	1.376	.256
	Within Groups	23.736	129	.184		
	Total	24.242	131			
P3	Between Groups	.187	2	.094	.720	.489
	Within Groups	16.782	129	.130		
	Total	16.970	131			
P4	Between Groups	.653	2	.326	3.804	.025
	Within Groups	11.067	129	.086		
	Total	11.720	131			

Post-Hoc Tukey HSD

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Profession	(J) Profession	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound

P1 A	Pharmacy Student	Nursing Student	-.016	.029	.847	-.08	.05
		Medical Student	.071	.036	.124	-.01	.16
	Nursing Student	Pharmacy Student	.016	.029	.847	-.05	.08
		Medical Student	.087	.038	.061	.00	.18
	Medical Student	Pharmacy Student	-.071	.036	.124	-.16	.01
		Nursing Student	-.087	.038	.061	-.18	.00
P1 B	Pharmacy Student	Nursing Student	.140*	.045	.007	.03	.25
		Medical Student	-.016	.057	.958	-.15	.12
	Nursing Student	Pharmacy Student	-.140*	.045	.007	-.25	-.03
		Medical Student	-.156*	.059	.027	-.30	-.01
	Medical Student	Pharmacy Student	.016	.057	.958	-.12	.15
		Nursing Student	.156*	.059	.027	.01	.30
P1 C	Pharmacy Student	Nursing Student	-.030	.088	.939	-.24	.18
		Medical Student	.074	.110	.782	-.19	.33
	Nursing Student	Pharmacy Student	.030	.088	.939	-.18	.24
		Medical Student	.103	.116	.645	-.17	.38
	Medical Student	Pharmacy Student	-.074	.110	.782	-.33	.19
		Nursing Student	-.103	.116	.645	-.38	.17
P1 D	Pharmacy Student	Nursing Student	.035	.038	.622	-.05	.12
		Medical Student	-.032	.047	.777	-.14	.08
	Nursing Student	Pharmacy Student	-.035	.038	.622	-.12	.05

		Medical Student	-.067	.049	.369	-.18	.05
	Medical Student	Pharmacy Student	.032	.047	.777	-.08	.14
		Nursing Student	.067	.049	.369	-.05	.18
P1 E	Pharmacy Student	Nursing Student	.008	.060	.990	-.13	.15
		Medical Student	-.079	.075	.552	-.26	.10
	Nursing Student	Pharmacy Student	-.008	.060	.990	-.15	.13
		Medical Student	-.087	.079	.516	-.27	.10
	Medical Student	Pharmacy Student	.079	.075	.552	-.10	.26
		Nursing Student	.087	.079	.516	-.10	.27
P2	Pharmacy Student	Nursing Student	-.136	.083	.237	-.33	.06
		Medical Student	-.027	.105	.964	-.27	.22
	Nursing Student	Pharmacy Student	.136	.083	.237	-.06	.33
		Medical Student	.109	.110	.583	-.15	.37
	Medical Student	Pharmacy Student	.027	.105	.964	-.22	.27
		Nursing Student	-.109	.110	.583	-.37	.15
P3	Pharmacy Student	Nursing Student	.050	.070	.755	-.12	.22
		Medical Student	-.059	.088	.783	-.27	.15
	Nursing Student	Pharmacy Student	-.050	.070	.755	-.22	.12
		Medical Student	-.109	.092	.467	-.33	.11
	Medical Student	Pharmacy Student	.059	.088	.783	-.15	.27
		Nursing Student	.109	.092	.467	-.11	.33

P4	Pharmacy Student	Nursing Student	.099	.057	.195	-.04	.23
		Medical Student	.186*	.071	.028	.02	.35
	Nursing Student	Pharmacy Student	-.099	.057	.195	-.23	.04
		Medical Student	.087	.075	.478	-.09	.26
	Medical Student	Pharmacy Student	-.186*	.071	.028	-.35	-.02
		Nursing Student	-.087	.075	.478	-.26	.09

*. The mean difference is significant at the 0.05 level.

Significant differences in perceptions between professions of antibiotic stewardship and antimicrobial resistance were observed for questions P1 B and P4. Regarding question P1 B, a significant differences are seen when comparing nursing students to pharmacy students (P=0.007) and medical students (P=0.027). For question P4, a significant difference is seen when comparing medical students against pharmacy students (P=0.028). When looking at the analysis of answers for questions P1 A, P1 C-E and P2-3; we observe no significant differences.

5. Descriptive statistical analysis of biographical/demographical data

		Profession	Age	Gender	Location
N	Valid	132	132	132	132
	Missing	0	0	0	0
Mean		1.70	23.02	1.83	1.27
Median		2.00	22.00	2.00	1.00
Mode		1	22	2	1
Std. Deviation		.751	2.547	.381	.443
Range		2	17	1	1
Minimum		1	20	1	1
Maximum		3	37	2	2

The table above reflects that the mean age was 23.02

Profession

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Pharmacy Student	63	47.7	47.7	47.7
	Nursing Student	46	34.8	34.8	82.6
	Medical Student	23	17.4	17.4	100.0
	Total	132	100.0	100.0	

The table above reflects that the majority of students were pharmacy students (47.7%).

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	23	17.4	17.4	17.4
	Female	109	82.6	82.6	100.0
	Total	132	100.0	100.0	

The table above reflects that the majority of students were female (82.6%).

Location

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Urban	97	73.5	73.5	73.5
	Rural	35	26.5	26.5	100.0
	Total	132	100.0	100.0	

The table above reflects that the majority of students were from an urban location

6. Descriptive analysis of knowledge score

		Knowledge Score
N	Valid	132
	Missing	0
Mean		87.17
Median		86.00
Mode		100
Std. Deviation		18.076
Range		86
Minimum		14
Maximum		100

The table above reflects that the mean knowledge score was 87.17%, with minimum and maximum values of 14% and 100% respectively.

7. Frequency tables per question

Knowledge Score

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	14	1	.8	.8	.8
	29	5	3.8	3.8	4.5
	43	1	.8	.8	5.3
	57	4	3.0	3.0	8.3
	71	16	12.1	12.1	20.5
	86	40	30.3	30.3	50.8
	100	65	49.2	49.2	100.0
	Total	132	100.0	100.0	

The table above reflects that 94.7% of students obtained a score of 57% and above.

K4 A

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree & Agree	125	94.7	94.7	94.7
	Neutral, Disagree & Strongly disagree	7	5.3	5.3	100.0
	Total	132	100.0	100.0	

The table above reflects that 94.7% of students strongly agree and agree that antibiotic resistance is an important and serious public health issue facing the World.

K4 B

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree & Agree	113	85.6	86.9	86.9
	Neutral, Disagree & Strongly disagree	17	12.9	13.1	100.0
	Total	130	98.5	100.0	
Missing	System	2	1.5		
Total		132	100.0		

The table above reflects that 85.6% of students strongly agree and agree that antibiotic resistance is an important and serious public health issue in our Country.

K4 C

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree & Agree	121	91.7	93.1	93.1
	Neutral, Disagree & Strongly disagree	9	6.8	6.9	100.0
	Total	130	98.5	100.0	
Missing	System	2	1.5		
Total		132	100.0		

The table above reflects that 91.7% of students strongly agree and agree that antibiotic resistance is an important and serious public health issue in their Hospital

A1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree & Agree	14	10.6	10.6	10.6
	Neutral, Disagree & Strongly disagree	118	89.4	89.4	100.0
	Total	132	100.0	100.0	

The table above reflects that 10.6% of students strongly agree & agree that one should take an antibiotic when one has a cold to prevent serious illness.

A2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree & Agree	20	15.2	15.3	15.3
	Neutral, Disagree & Strongly disagree	111	84.1	84.7	100.0
	Total	131	99.2	100.0	
Missing	System	1	.8		
Total		132	100.0		

The table above reflects that 15.2% of students strongly agree & agree that antibiotics assist in getting better when one has a fever.

A3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree & Agree	47	35.6	35.6	35.6
	Neutral, Disagree & Strongly disagree	85	64.4	64.4	100.0
	Total	132	100.0	100.0	

The table above reflects that 35.6% of students strongly agree & agree that whenever they take an antibiotic they contribute to the development of resistance.

A4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree & Agree	16	12.1	12.1	12.1
	Neutral, Disagree & Strongly disagree	116	87.9	87.9	100.0
	Total	132	100.0	100.0	

The table above reflects that 12.1% of students strongly agree & agree that skipping one or two doses of an antibiotic course does not contribute to resistance.

A5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree & Agree	25	18.9	18.9	18.9
	Neutral, Disagree & Strongly disagree	107	81.1	81.1	100.0
	Total	132	100.0	100.0	

The table above reflects that 35.6% of students strongly agree & agree that antibiotics are safe drugs.

P1 A

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always & Usually	3	2.3	2.3	2.3
	Sometimes, Seldom & Never	128	97.0	97.7	100.0
	Total	131	99.2	100.0	
Missing	System	1	.8		
Total		132	100.0		

The table above reflects that 2.3% of students Always & Usually stop taking further treatment, when they feel better after the first 2-3 treatments of a prescribed antibiotic course

P1 B

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always & Usually	8	6.1	6.1	6.1
	Sometimes, Seldom & Never	123	93.2	93.9	100.0
	Total	131	99.2	100.0	
Missing	System	1	.8		
Total		132	100.0		

The table above reflects that 6.1% of students Always & Usually save their antibiotics for the next time they get sick, when they feel better after the first 2-3 treatments of a prescribed antibiotic course

P1 C

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always & Usually	36	27.3	27.7	27.7
	Sometimes, Seldom & Never	94	71.2	72.3	100.0
	Total	130	98.5	100.0	
Missing	System	2	1.5		
Total		132	100.0		

The table above reflects that 27.3% of students Always & Usually discard the remaining, leftover medication, when they feel better after the first 2-3 treatments of a prescribed antibiotic course

P1 D

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always & Usually	5	3.8	3.8	3.8
	Sometimes, Seldom & Never	126	95.5	96.2	100.0
	Total	131	99.2	100.0	
Missing	System	1	.8		
Total		132	100.0		

The table above reflects that 3.8% of students Always & Usually give the remaining, leftover medication to a friend/roommate, when they feel better after the first 2-3 treatments of a prescribed antibiotic course

P1 E

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always & Usually	118	89.4	89.4	89.4
	Sometimes, Seldom & Never	14	10.6	10.6	100.0
	Total	132	100.0	100.0	

The table above reflects that 89.4% of students Always & Usually complete the full course of treatment

P2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always & Usually	100	75.8	75.8	75.8
	Sometimes, Seldom & Never	32	24.2	24.2	100.0
	Total	132	100.0	100.0	

The table above reflects that 75.8% of students Always & Usually consult a doctor before starting an antibiotic.

P3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always & Usually	112	84.8	84.8	84.8
	Sometimes, Seldom & Never	20	15.2	15.2	100.0
	Total	132	100.0	100.0	

The table above reflects that 84.8% of students Always & Usually check the expiry date of the antibiotic before using it.

P4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always & Usually	13	9.8	9.8	9.8
	Sometimes, Seldom & Never	119	90.2	90.2	100.0
	Total	132	100.0	100.0	

The table above reflects that 9.8% of students Always & Usually prefer to take an antibiotic when they have a cough and sore throat.

8. Cross-tabs showing percentages per profession

Knowledge Score

Crosstab

			Knowledge Score							
			14	29	43	57	71	86	100	Total
Profession	Pharmacy Student	Count	0	0	0	1	1	14	43	59
		% within Profession	0.0%	0.0%	0.0%	1.7%	1.7%	23.7%	72.9%	100.0%
		% within Knowledge Score	0.0%	0.0%	0.0%	33.3%	9.1%	36.8%	67.2%	48.8%
		% of Total	0.0%	0.0%	0.0%	0.8%	0.8%	11.6%	35.5%	48.8%
	Nursing Student	Count	0	3	1	2	10	15	9	40
		% within Profession	0.0%	7.5%	2.5%	5.0%	25.0%	37.5%	22.5%	100.0%
		% within Knowledge Score	0.0%	100.0%	100.0%	66.7%	90.9%	39.5%	14.1%	33.1%
		% of Total	0.0%	2.5%	0.8%	1.7%	8.3%	12.4%	7.4%	33.1%
	Medical Student	Count	1	0	0	0	0	9	12	22
		% within Profession	4.5%	0.0%	0.0%	0.0%	0.0%	40.9%	54.5%	100.0%
		% within Knowledge Score	100.0%	0.0%	0.0%	0.0%	0.0%	23.7%	18.8%	18.2%
		% of Total	0.8%	0.0%	0.0%	0.0%	0.0%	7.4%	9.9%	18.2%
Total		Count	1	3	1	3	11	38	64	121
		% within Profession	0.8%	2.5%	0.8%	2.5%	9.1%	31.4%	52.9%	100.0%
		% within Knowledge Score	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

	% of Total	0.8%	2.5%	0.8%	2.5%	9.1%	31.4%	52.9%	100.0 %

K4 A

Crosstab

			K4 A		
			Strongly agree & Agree	Neutral, Disagree & Strongly disagree	Total
Profession	Pharmacy Student	Count	59	0	59
		% within Profession	100.0%	0.0%	100.0%
		% within K4 A	50.9%	0.0%	48.8%
		% of Total	48.8%	0.0%	48.8%
	Nursing Student	Count	35	5	40
		% within Profession	87.5%	12.5%	100.0%
		% within K4 A	30.2%	100.0%	33.1%
		% of Total	28.9%	4.1%	33.1%
	Medical Student	Count	22	0	22
		% within Profession	100.0%	0.0%	100.0%
		% within K4 A	19.0%	0.0%	18.2%
		% of Total	18.2%	0.0%	18.2%
Total		Count	116	5	121
		% within Profession	95.9%	4.1%	100.0%
		% within K4 A	100.0%	100.0%	100.0%
		% of Total	95.9%	4.1%	100.0%

The table above reflects that although 94.7% of all students strongly agree and agree that antibiotic resistance is an important and serious public health issue facing the World; a lower percentage (87.5%) of nursing students strongly agree and agree when compared to the other professions. This is in line with the significant differences seen in the one-way ANOVA.

K4B

Crosstab

			K4 B		
			Strongly agree & Agree	Neutral, Disagree & Strongly disagree	Total
Profession	Pharmacy Student	Count	56	3	59
		% within Profession	94.9%	5.1%	100.0%
		% within K4 B	53.3%	18.8%	48.8%
		% of Total	46.3%	2.5%	48.8%
	Nursing Student	Count	29	11	40
		% within Profession	72.5%	27.5%	100.0%
		% within K4 B	27.6%	68.8%	33.1%
		% of Total	24.0%	9.1%	33.1%
	Medical Student	Count	20	2	22
		% within Profession	90.9%	9.1%	100.0%
		% within K4 B	19.0%	12.5%	18.2%
		% of Total	16.5%	1.7%	18.2%
Total		Count	105	16	121
		% within Profession	86.8%	13.2%	100.0%
		% within K4 B	100.0%	100.0%	100.0%
		% of Total	86.8%	13.2%	100.0%

The table above reflects that although 85.6% of all students strongly agree and agree that antibiotic resistance is an important and serious public health issue in our Country; a lower percentage (72.5%) of nursing students strongly agree and agree when compared to the other professions. This is in line with the significant differences seen in the one-way ANOVA.

A1

Crosstab

			A1		
			Strongly agree & Agree	Neutral, Disagree & Strongly disagree	Total
Profession	Pharmacy Student	Count	3	56	59
		% within Profession	5.1%	94.9%	100.0%
		% within A1	23.1%	51.9%	48.8%
		% of Total	2.5%	46.3%	48.8%
	Nursing Student	Count	10	30	40
		% within Profession	25.0%	75.0%	100.0%
		% within A1	76.9%	27.8%	33.1%
		% of Total	8.3%	24.8%	33.1%
	Medical Student	Count	0	22	22
		% within Profession	0.0%	100.0%	100.0%
		% within A1	0.0%	20.4%	18.2%
		% of Total	0.0%	18.2%	18.2%
Total		Count	13	108	121
		% within Profession	10.7%	89.3%	100.0%
		% within A1	100.0%	100.0%	100.0%
		% of Total	10.7%	89.3%	100.0%

The table above reflects that although 10.6% of all students strongly agree & agree that one should take an antibiotic when one has a cold to prevent serious illness; a higher percentage (25.0%) of nursing students strongly agree and agree when compared to the other professions. This is in line with the significant differences seen in the one-way ANOVA.

It is also noted that no (0%) medical students strongly agree & agree.

A2

Crosstab

			A2		
			Strongly agree & Agree	Neutral, Disagree & Strongly disagree	Total
Profession	Pharmacy Student	Count	4	55	59
		% within Profession	6.8%	93.2%	100.0%
		% within A2	25.0%	52.4%	48.8%
		% of Total	3.3%	45.5%	48.8%
	Nursing Student	Count	10	30	40
		% within Profession	25.0%	75.0%	100.0%
		% within A2	62.5%	28.6%	33.1%
		% of Total	8.3%	24.8%	33.1%
	Medical Student	Count	2	20	22
		% within Profession	9.1%	90.9%	100.0%
		% within A2	12.5%	19.0%	18.2%
		% of Total	1.7%	16.5%	18.2%
Total		Count	16	105	121
		% within Profession	13.2%	86.8%	100.0%
		% within A2	100.0%	100.0%	100.0%
		% of Total	13.2%	86.8%	100.0%

The table above reflects that although 15.2% of all students strongly agree & agree that antibiotics assist in getting better when one has a fever; a higher percentage (25.0%) of nursing students strongly agree and agree when compared to the other professions. This is in line with the significant differences seen in the one-way ANOVA.

P1 B

Crosstab

			P1 B		
			Always & Usually	Sometimes, Seldom & Never	Total
Profession	Pharmacy Student	Count	1	58	59
		% within Profession	1.7%	98.3%	100.0%
		% within P1 B	12.5%	51.3%	48.8%
		% of Total	0.8%	47.9%	48.8%
	Nursing Student	Count	7	33	40
		% within Profession	17.5%	82.5%	100.0%
		% within P1 B	87.5%	29.2%	33.1%
		% of Total	5.8%	27.3%	33.1%
	Medical Student	Count	0	22	22
		% within Profession	0.0%	100.0%	100.0%
		% within P1 B	0.0%	19.5%	18.2%
		% of Total	0.0%	18.2%	18.2%
Total		Count	8	113	121
		% within Profession	6.6%	93.4%	100.0%
		% within P1 B	100.0%	100.0%	100.0%
		% of Total	6.6%	93.4%	100.0%

The table above reflects that although 6.1% of all students Always & Usually save their antibiotics for the next time they get sick, when they feel better after the first 2-3 treatments of a prescribed antibiotic course; a higher percentage (17.5%) of nursing students strongly agree and agree when compared to the other professions. This is in line with the significant differences seen in the one-way ANOVA.

P4

Crosstab

			P4		
			Always & Usually	Sometimes, Seldom & Never	Total
Profession	Pharmacy Student	Count	2	57	59
		% within Profession	3.4%	96.6%	100.0%
		% within P4	16.7%	52.3%	48.8%
		% of Total	1.7%	47.1%	48.8%
	Nursing Student	Count	5	35	40
		% within Profession	12.5%	87.5%	100.0%
		% within P4	41.7%	32.1%	33.1%
		% of Total	4.1%	28.9%	33.1%
	Medical Student	Count	5	17	22
		% within Profession	22.7%	77.3%	100.0%
		% within P4	41.7%	15.6%	18.2%
		% of Total	4.1%	14.0%	18.2%
Total		Count	12	109	121
		% within Profession	9.9%	90.1%	100.0%
		% within P4	100.0%	100.0%	100.0%
		% of Total	9.9%	90.1%	100.0%

The table above reflects that although 9.8% of all students Always & Usually prefer to take an antibiotic when they have a cough and sore throat; a higher percentage (22.7%) of medical students strongly agree and agree when compared to the other professions. This is in line with the significant differences seen in the one-way ANOVA.