Brief Original Article

Understanding of antibiotic use and resistance among final-year pharmacy and medical students: a pilot study

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Abstract

Introduction: This study is aimed to investigate the understanding of antibiotic use and antibiotic resistance and its correlate factors among final-year medical and pharmacy students at International Islamic University Malaysia (IIUM).

Methodology: This was a cross-sectional study. The study instrument was developed by extensive literature search and was subjected to face validity and content validity to medical and pharmacy academics. A pilot study was conducted to ascertain the reliability coefficient. Data was entered to SPSS version 17 and descriptive and inferential statistics were applied.

Results: A total of 123 questionnaires were included in the study. Out of 123 respondents, 58.5% (n = 72) were final-year medical students, while 41.5% (n = 51) were final-year pharmacy students. The majority of the respondents showed adequate knowledge regarding the course contents related to antibiotics (n = 116; 94.3%). Almost all the respondents correctly reported the difference between bactericidal and bacteriostatic antibiotics. Only 15.4% (n = 19) and 27.6% (n = 34) of students were able to recognize *Streptococcus pyogenes* as non-pencillin resistant bacterium and *Enterococcus* as vancomycin-resistant bacterium, respectively.

Conclusions: The students showed good understanding regarding antibiotic resistance. In comparison to medical students, pharmacy students showed better understanding and more adequate knowledge, as the mean value for each domain was slightly higher for pharmacy students. Extensively improving the curriculum and educating healthcare professionals, especially physicians and pharmacists, right from the time of their educational training can inculcate a moral responsibility toward the judicious use of antibiotics, which can serve to eradicate antibiotic resistance.

Key words: antibiotic resistance; pharmacy students; medical students; Malaysia

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Introduction

The initiation of antibiotic use in the form of indiscriminate prescribing and dispensing has led to an upsurge in the resistance gene in the commensal flora in hospitals, in communities, and in the environment [1]. Imprudent use of antibiotics is a fundamental factor for an upsurge in the prevalence of antimicrobial resistance [2,3]. Factors such as patients' demands, doctors' personal experiences, lack of culture and sensitivity results leading to uncertain diagnosis, sales of antibiotics without prescription, and pharmaceutical promotional tactics are some of the most common contributors towards antibiotic resistance [4,5]. The report of Malaysian Statistics on Medicine 2007 indicated anti-infective agents as the most commonly prescribed therapeutic category in Malaysia with a 7% increase in consumption of anti-infectives from 2006 to 2007. Systemic use of antibacterial drugs added the highest increase, accounting for 89% of the total increase [6]. This is not unexpected, as antibacterial drugs (124 drugs) constitute the largest group of anti-infective drugs. Pencillins were the chief therapeutic category consumed in 2007, with macrolides and tetracyclines trailing behind penicillins. Ampicillin, amoxicillin, and bacampicillin were extensively used in both public and private sectors for initiating the empiric treatment of upper respiratory tract infections (URTIs), urinary tract infections (UTIs), and mild community-acquired pneumonia (CAP) [6]. It is interesting to note that, as

per National Antimicrobial Resistance Surveillance data, high resistance of Gram-negative bacteria such as *Klebsiella* spp. (99%), *Enterobacter* spp. (93%), *Escherichia coli* (69%), *Proteus* spp. (48%) and *Haemophilus influenzae* (20%) was observed towards ampicillin. There is a need to analyze the use of these antibiotics as empirical therapy in the primary healthcare setting. Previously published research from Malaysia reflected on the need for creating awareness among the general public and hospital doctors about the role of antibiotics in viral infections, the aftermath of self-medication in cough and cold symptoms, and as well as compliance with guidelines on antibiotic use issued by the Ministry of Health, Malaysia [5,7,8]. Patient-focused educational outreach to change patients' mindsets is a key area to be targeted [9]. Therefore, before embarking on any interventions to patients or the public, it is necessary to ascertain the understanding of future healthcare practitioners; this study is an attempt in this regard.

Methodology

Study design and sampling

This was a cross-sectional study that used a pre-validated, pre-tested study instrument.

As this study was conducted to investigate the understanding of antibiotic resistance among final-year medical and pharmacy students, all the students in their final year (medical = 110, pharmacy = 104) were contacted. A total of 104 questionnaires were distributed during break time to pharmacy students with the help of a faculty member, and 110 questionnaires were distributed to medical students after class after notification had already been sent to the Dean, Kuliyyah of Medicine, IIUM. The questionnaires were completed by the students and collected on the same day. Of 214 questionnaires distributed, only 123 responses were successfully collected back, with 51 from pharmacy students and 72 from medical students.

Study instrument, its validity and reliability

The study instrument was a questionnaire which was formed on the basis of extensive literature search [2,3,8,10-12]. The questionnaire was subjected to face validity and content validity by being sent to 10 pharmacy and medical faculty for review. Major changes were made by reducing the numbers of questions and rearranging the questions according to a correct format. The questionnaire was further pilot tested with 10 third-year medical students and 10 third-year pharmacy students to determine the clarity of the language used and the questionnaire structure. The pilot data was entered in SPSS version 17 to evaluate the reliability coefficient. Reliability coefficient was found to be 0.85. Data was analyzed using SPSS version 17. Descriptive and inferential statistics were applied.

Results

A total of 124 questionnaires were returned. One questionnaire was found to have missing values in the first domain and was discarded. Therefore, a total of 123 questionnaires were included in the study. A response rate of 57.4% was achieved. Out of 123 final-year respondents, 58.5% (n = 72) were final-year medical students, while 41.5% (n = 51) were final-year pharmacy students. Forty-two (34.1%) of the subjects were male, and 81 (65.9%) were female. The majority of the respondents (n = 116) were in the age range of 23-25 years (94.3%); five (4.1%) were in the 20-22-year age range. Only two respondents (1.6%) were older than 26 years of age (Table 1).

Understanding of antibiotic use

Regarding understanding of antibiotic use, the majority of the students answered most of the questions correctly (Table 2). No statistical difference was observed on comparing the means of both the groups.

Table 1. Demographic characteristics of respondents

	Characteristics	Frequency (%)
Age range	20-22	5 (4.1)
	23-25	116 (94.3)
	> 26	2 (1.6)
Gender	Male	42 (34.1)
	Female	81 (65.9)
Kulliyyah	Pharmacy	51 (41.5)
	Medicine	72 (58.5)
Year of study	4	51 (41.5)
	5	72 (53.8)

Table 2. Understanding of antibiotic use

Questions	Correct responses n (%)	Incorrect responses n (%)
Antibiotics are the most commonly prescribed anti-infective agents by both public and private health-care sectors.	121 (98.4)	2 (1.6)
Common cold and cough should always be treated with antibiotics as this will make the patient recover more quickly.	117 (95.1)	6 (4.9)
Antibiotic should be prescribed as preventive measures to fight against future microbial attacks.	98 (79.7)	25 (20.3)
Antibiotics cannot treat influenza.	23 (18.7)	100 (81.3)
Antibiotics are indicated to relieve pain/ inflammation.	116 (94.3)	7 (5.7)
Antibiotics might develop allergy in susceptible individuals and sometimes lead to death.	118 (95.9)	4 (3.3)
Diphenhydramine is an antibiotic used in treating upper respiratory infections.	97 (78.9)	26 (21.1)
Cefotaxime belongs to third-generation cephalosporins.	93 (75.6)	27 (22.0)
Patients can stop taking the antibiotic when the symptoms are improving.	116 (94.3)	7 (5.7)
Keeping the leftover antibiotic course for next time treatment of same infection is a good practice.	119 (96.7)	4 (3.3)
Antibiotics treatment can eliminate all the sensitive bacteria.	52 (42.3)	69 (56.1)
Antibiotics can be obtained without prescriptions in Malaysia.	97 (78.9)	26 (21.1)

Table 3. Understanding of phenomenon and mechanism of antibiotic resistance

Questions	Correct responses n (%)	Incorrect responses n (%)
Antibiotic refers to any agent used to kill or inhibit the growth of microorganisms.	100 (81.3)	23 (18.7)
Resistant bacteria cannot spread in healthcare institutions and communities.	120 (97.6)	3 (2.4)
Healthcare workers often serve as vectors carrying resistant strains from infected patients to uninfected patients.	105 (85.4)	18 (14.6)
Exposure to antibiotics appears to be the principal risk factor for emergence of antibiotic-resistant bacteria.	117 (95.1)	6 (4.9)
Inadequate doses contribute to antibiotic resistance due to poor patient compliance.	114 (92.7)	9 (7.3)
Inadequate duration of therapy contributes to antibiotic resistance due to or a poorly designed dosing regimen.	106 (86.2)	16 (13.0)
Antimicrobial resistance can be minimized by changing empiric therapy to narrow-spectrum therapy in response to the availability of culture and sensitivity results.	119 (96.7)	4 (3.3)
Cross resistance is the condition in which the resistance occurs to a particular antibiotic that often results in resistance to other antibiotics, usually from a similar chemical class.	116 (94.3)	7 (5.7)
Beta-lactamase is the enzyme produced by bacteria that break down the beta-lactam antibiotics.	118 (95.9)	5 (4.1)
Bacteria acquire efflux pumps that extrude the antibacterial agent from the cell before it can reach its target site and exert its effect.	100 (81.3)	23 (18.7)
There is no resistance to penicillin for *Streptococcus pyogenes* bacterium.	19 (15.4)	103 (83.7)
Bacteriostatic antibiotics are same as bactericidal antibiotics.	122 (99.2)	1 (0.8)
Antibiotic refers to any agent used to kill or inhibit the growth of microorganisms.	100 (81.3)	23 (18.7)
Enterococcus is a vancomycin-resistant bacterium.	34 (27.6)	88 (71.5)

Understanding of the phenomenon of antibiotic resistance

On understanding the management such as empirical therapy selection and narrow-spectrum antibiotics, the majority of the students (97%) answered correctly (Table 3).

Understanding of mechanism of action of antibiotic resistance

In the domain of understanding the mechanism of action of antibiotic resistance, less than one-fourth of the students (n = 19; 15.4%) reported correctly about the fact that there is no issue of resistance towards penicillin in *Streptococcus pyogenes* (Table 3). In terms of comparison of mean scores, pharmacy students scored slightly higher (4.25) than medicine students (3.83), thus indicating they had a better understanding about the action mechanism of antibiotic resistance.

Understanding of the factors of antibiotic resistance

The majority of the respondents (> 80%) gave correct responses to all of the questions (Table 4). Regarding the mean scores, medicine students scored higher (6.08) than pharmacy students (5.47), showing that their understanding was better in terms of factors of antibiotic resistance.

Awareness towards minimizing antibiotic resistance

In terms of awareness towards minimizing antibiotic resistance, slightly more than three-quarters of the respondents (n = 95, 77.2%) reported correctly that the proper use of antibiotics may have an impact on the hospital's total cost expenses on medications (Table 4). The mean score of the pharmacy students (4.65) was slightly higher than the mean score of the medical students (4.60), but no statistically significant difference was observed.

Discussion

The findings of the current research showed good understanding of future medical and pharmacy practitioners towards antibiotic use, antibiotic resistance, and awareness of minimizing antibiotic resistance. Lower levels of understanding were found for treatment of influenza by antibiotics, resistance to penicillin for *Streptococcus pyogenes* bacterium, and for *Enterococcus* being a vancomycin-resistant bacterium. These current research findings are not in accordance with a study done in the United Kingdom in which medical students showed good knowledge about antibiotic resistance amongst freely isolated bacteria [12]. The issue of treatment of influenza by antibiotics is supported by another Malaysian study where respondents reported that antibiotics were

Table 4. Factors contributing towards antibiotic resistance and minimization

Questions	Correct responses n (%)	Incorrect responses n (%)
Mutation is a prevalence factor in changing the bacterial protein which is often the target of antibiotic treatment.	114 (92.7)	9 (7.3)
Prescribing antibiotics over the phone is good patient care since it can save time.	112 (91.1)	11 (8.9)
Pharmacists should be encouraged to dispense antibiotics to meet patients' demands.	100 (81.3)	23 (18.7)
The use of broad spectrum antibiotics (fourth-generation cephalosporins) as initial therapy for mild infection may increase the risk of antibiotic resistance.	105 (85.4)	18 (14.6)
The use of commercially available biocide antiseptics, disinfectants, and preservatives in products such as soaps, lotions, and washes is highly recommended to patients who have skin infections.	65 (52.8)	58 (47.2)
Prescribing a continuous long term of low-dose antibiotics will have the same efficacy as prescribing higher doses in a shorter period of time.	105 (85.4)	18 (14.6)
Patients should be advised to keep part of the antibiotic course for another occasion, which will also be an added advantage for them in cutting down their medical costs.	116 (94.3)	7 (5.7)
Educating health professionals in greater coverage of appropriate antibiotic prescribing and antibiotic resistance may reduce the chance of antibiotic resistance.	119 (96.7)	4 (3.3)
Formal teaching on proper usage of antimicrobial agents among healthcare students may minimize the phenomena of antibiotic resistance.	120 (97.6)	3 (2.4)
Antimicrobial education is needed to be well received by house staff physicians and pharmacists.	120 (97.6)	3 (2.4)
The usage of antibiotics must be related to specialties to enhance the awareness of antibiotic resistance.	114 (92.7)	9 (7.3)
Appropriate use of antibiotics may not have any impact on hospital's total cost expenses on medications.	95 (77.2)	28 (22.8)

effective for viral infections [8]. Another Malaysian study highlighted the unawareness of the public of the role of antibiotics in viral infections [7]. This shows a clear need for future healthcare practitioners to be well taught about the indications of antibiotic usage and to feel obligated to relay the information to their patients. Mass-media campaigns repeatedly emphasizing the prudent and judicious use of antibiotics are another option.

As Nugent and Okeke stated, resistance to antibiotics creates a staggering blow to the cost of treating the patient [13]. In the current research, a very large majority of the respondents understood that appropriate use of antibiotic may not have any impact on the hospital's total cost expenses on medications. In terms of understanding therapeutic categories, the majority of the respondents correctly reported that cefotaxime belongs to third-generation cephalosporins. This is not in accordance with a study done in the UK where more than half of the respondents were not able to comprehend that metronidazole and Flagyl were same [12]. The current results are quite promising for keeping leftover antibiotics – a very large majority answered correctly that it is not a good practice to do so. This finding is not in accordance with studies done in Jordan and in the United Arab Emirates, where the surveyed population believed that antibiotics should be routinely available at home [14] and stored antibiotics at home without a prescription [15], respectively. The current research examined the rationale of healthcare professionals with formal training in prescribing and dispensing antibiotics, which presumably minimizes the chances of antibiotic resistance. This is supported by the regional review of Borg *et al*., which advocated better education and training of healthcare professionals by informing them about changes in epidemiological trends in critical pathogens and identifying antibiotic consumption practices [16]. Moreover, healthcare professionals should share information with the public regarding the consequences of misuse of antibiotics.

The current study's findings are not generalizable, as the study was performed in one public institution only.

Conclusions

The students showed good understanding regarding antibiotic resistance. In comparison to medical students, pharmacy students showed better understanding. Extensively improving the curriculum and educating healthcare professionals, especially physicians and pharmacists, right from the time of their educational training can inculcate a moral responsibility toward the judicious use of antibiotics, which can help to minimize antibiotic resistance.

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