J Young Pharm, 2016; 8(4): 447-455
A multifaceted peer reviewed journal in the field of Pharmacy
www.jyoungpharm.org | www.phcog.net

Original Article

Insight of Medical Students of Clinical Years to Antimicrobials Prescribing and Resistance in Private Medical School, Chittagong, Bangladesh

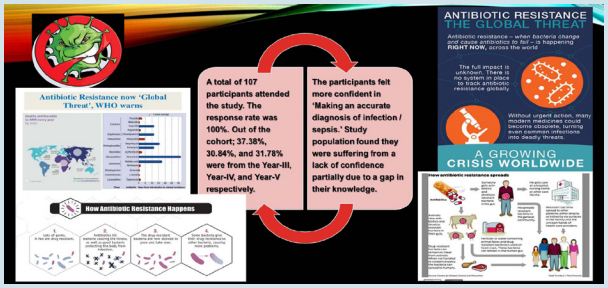
Rozina Hoque[1], Asma Mostafa[2], Mainul Haque[3*]
[1]Department of Pharmacology, Chattagram Maa O Shishu Hospital Medical College, Agrabad, Chittagong, Bangladesh.
[2]Department t of Anatomy, Chattagram Maa O Shishu Hospital Medical College, Agrabad, Chittagong, Bangladesh.
[3]Unit of Pharmacology, Faculty of Medicine and Defense Health, National Defence University of Malaysia, Kem Sungai Besi, 57000 Kuala Lumpur, Malaysia.

ABSTRACT

Background: Physicians formally receive education regarding antimicrobials and microbial resistance during a 5-6 year curriculum of the undergraduate medical program. However, the once magical bullet of antibiotics is now threatened by AR, which has become a significant hazard to global health. Thus, a doctor must possess the adequate knowledge to select an antibiotic or other drug for use in a particular disease. This issue is not currently being addressed in the undergraduate curriculum resulting in irrational prescribing. Therefore, it is essential to possess a comprehensive knowledge regarding drugs, including antimicrobials at an undergraduate level. Currently, there is no comprehensive evaluation of medical students' perception of AR in Bangladesh. This was the driving force to conduct this study and to identify gaps in KAP of medical students about AR, as well as to enrich the medical curriculum. **Methods:** This is a cross-sectional, randomized, questionnaire-based study. Data were collected using a validated instrument. **Results:** 107 students were selected using a quota sampling technique. A total of 107 participants (32.71% male and 67.29% female) attended the study. The response rate was 100%. Out of the cohort; 37.38%, 30.84%, and 31.78% were from the Year-III, Year-IV, and Year-V respectively. The participants felt more confident in 'Making an accurate diagnosis of infection/ sepsis.' **Conclusion:** Our study population found to be suffering from a lack of confidence partially due to a gap in their knowledge about the proper selection of antimicrobials.

Key words: Antibiotic, Prescribing, Resistance, Medical Students, Bangladesh.

PICTORIAL ABSTRACT



Correspondence :

Mainul Haque

Professor and Head of the Unit of Pharmacology, Faculty of Medicine and Defense Health, National Defence University of Malaysia, Kem Sungai Besi, 57000 Kuala Lumpur, Malaysia. **Cell Phone:** + 60 10 926 5543

E-mail: runurono@gmail.com
DOI: 10.5530/jyp.2016.4.22

INTRODUCTION

Physicians formally learn about antimicrobials and also AR during the 5-6 year of the undergraduate medical program. MS in Bangladesh and in many other countries usually undertake a course of Pharmacology in Year-III and IV, in which they start acquiring knowledge about drugs and medication including antimicrobials and AR. Their knowledge regarding medicine prepares them to prescribe rationally when they eventually graduate. MS are not allowed to prescribe drugs independently. AR is an important growing global health concern and needs serious intervention. Awareness about AR is an essential concern for undergraduate students, as they are the future practitioners.[1] A doctor must possess the knowledge to correctly select an antibiotic or other drug for a particular disease. This issue is not currently being addressed in the undergraduate course curriculum; which may leads to irrational prescribing and promotes AR.[2] Therefore, it is essential to have a comprehensive knowledge regarding drugs, including antimicrobials during their undergraduate level to improve the judicious use of antimicrobials.[3]

Consequently, it is important for the MS to have the KAP study on antimicrobials and AR to help policy makers to develop an adequate education program prescribers.[4] WHO states that all healthcare workers and MS should be educated on rational antimicrobial prescribing or 'Antimicrobial stewardship' and this is an integral part of AR containment activities.[5,6] Very few studies have been conducted to find the MS' perception about their education and knowledge of antibiotic use in Bangladesh. A study reported that only ≤25% of their study participants could answer questions relating to treating urinary tract infection, cellulites, or Neisseria gonorrhea correctly.[7] Even senior MS did not choose antimicrobials appropriately in various clinical settings.[8] MS will enter soon in the global health workforce and should be the target group for intervention to decrease AR.[9] They should be motivated and reinforced to take action about the ongoing problem.[10] Although, MS have received much theoretical teaching in their coursework for antimicrobials and AR but suffers from the lack of practical and clinical knowledge.[2] Most of the young graduates select antimicrobials by copying older colleagues rather from official guidelines.[2] It is dangerous to learn from older members whose knowledge is not up to date. Hence, it is essential to give emphasis to the medical curriculum to improve knowledge regarding antimicrobials and AR.

Over three-quarters of MS suggested more training programs on antimicrobial selection. There was no definitive resource for antimicrobial selection, and most of the MS have depended on 'Epocrates' software.[2]

In the UK, an important component of the undergraduate program is learning about prescribing. The importance of undergraduate training is reflected in GMC's Tomorrows' Doctors.[11] Once the doctors become qualified, it is hard to change their behavior.[12] The critical time to give more emphasis to shape their proper prescribing attitudes is during undergraduate coursework and can establish a robust knowledge base for future professional practice. The perfect stage is during their studentship and also their Internship/foundation years.[13] Once a MS is a registered medical practitioner, they are detached from the curriculum. Their attitude can no longer be monitored, and they are dependent entirely on their surrounding environment. Therefore, to produce a rational and safe doctor intervention is essential during the early learning phase of their medical education. Hence, the target of our study is to find the knowledge, attitude and perception of antimicrobials and AR during this period. To best of our knowledge there has no multicenter study evaluating the medical student's KAP level about AR in Bangladesh. At the same time, data on medical student's education on the appropriate antimicrobial use or their proper prescribing attitudes are lacking. The study will identify gaps in knowledge, attitude, and perception of MS about AR as well as enriches the medical curriculum with appropriate remedies, thus wish to bring change in the behavior of future physicians from irrational to the rational use of antimicrobials. The gap in knowledge, attitude and perception on antimicrobials and AR among MS should be minimized. Thus, this study aims to assess the knowledge, attitude and perception level of Year III, IV, and V MS of CMOSHMC.

MATERIALS AND METHODS

This study was a cross-sectional, randomized, questionnaire-based survey which was undertaken at CMOSHMC, Chittagong, Bangladesh; among Year-III, IV, and V medical students. Data were collected using a validated instrument. The corresponding author was impressed with the multicenter study conducted in Europe.[14] Therefore, with due permission from the mentioned research group, the same validated instrument was used in the current study. The questionnaire was again validated by subject experts for its content and relevance prior to the current study. The pretest was conducted with 15 students (5 from each of the clinical year students (5×3=15). Data was collected in the month May 2015. Study participants were selected using a quota sampling technique. All of the respondents (excluding the pre-test subjects) were given a questionnaire after their class in pre-selected hours to complete the survey anonymity. The questionnaire consisted of 21 questions. Initially, demographic features were recorded. The first question was a 5-point Likert scale, whose responses ranged from 'very confidence' to 'uncertain'. It was used to assess the confidence in prescribing of students. Six questions were set to gauge an idea of the training in antimicrobial prescribing the students had. Five questions were arranged on the Likert scale based questions with options on 'yes,' 'no' and 'unsure.' One question was to measure the total hours of training they have received during their undergraduate study. Five successive questions were set to assess the knowledge of AR. Two were set to put tick mark either in 'yes', 'no' or 'unsure'. Three questions were arranged in six rows that indicated the percentage range in the following manner: row 1 is <1%, row 2 is 1-20%, row 3 for 21-40%, row 4 for 41-60%, Row 5 included 61-80%, and the last row showed a % range from 81-100%. The self-reported practices regarding the antimicrobial usage of the study population were also assessed by using two questions that consisted of five rows. Each row showed the % ranged in the answer. Ranges of % were 1-20% in 1st row, 21-40% in the 2nd row, 41-60% in the 3rd row, 61-80% in the 4th row and finally 81-100% in the 5th row. Their perception about the contributors to AR was assessed by another question which consisted of a 4-point Likert scale, whose responses ranged from 'very important' to 'not important at all.' The next two knowledge-based questions were there to find the number of new classes of antimicrobials that became clinically available in the last thirty years as well as a prediction for the next thirty years. The last three questions were used to assess the perceptions of AR of the participants. Research ethics were strictly maintained. Informed written consent was obtained from the participants to utilize their data for research purposes. The institutional ethical approval certificate on 7 April 2015 was obtained from CMOSHMC, Chittagong, Bangladesh. Data was analyzed using the SPSS-20 software. Simple descriptive statistics and also the Chi-square test and independent t test were used.

RESULTS

Demographic Profile

A total of 107 participants (32.71% male and 67.29% female) attended the study. The response rate was 100%. Out of 107, 37.38%, 30.84%, and 31.78% were from the Year-III, Year-IV, and Year-V respectively.

Areas of Confidence in Prescribing

The participants felt more confident in 'MADI'. The respondents felt less confident in 'DNPA'. Their percentage of confidence level in 'CCA', 'CCDIA, 'UCT', 'CIVOA' 'IMR', 'PSSA' and 'PDAT' were average (Table 1). Statistically significant different findings were observed in 'DNPA' (p=0.03) and 'CCDIA' (p=0.05) among three groups (Table 2). Year-V was statistically significant in being more confident than the Year-IV in 'DNPA'. For 'CCDIA' 'Year-V' were less confident than 'Year-III' and more confidence than 'Year-IV' (Table 2). The remaining questions with confidence, there was no statistically significant (p>0.05) difference observed (Table 2). There was also no statistically significant (p>0.05) difference observed in all areas of confidence in prescribing between sexes when compared with independent t test.

Training in Antimicrobials Prescribing

Out of 107, 60 students answered 'how many hours of training in the principles of prudent antimicrobials use' they had received in their undergraduate study (Range in hours=1-72, Mean=26. 40 ± 15.72). The majority of students (N=101, 94.4%) would like more education on antimicrobial selection at medical school. All most all students (N=104, 97.2%) believed that prescribing inappropriate or unnecessary antimicrobials was professionally unethical. 49.5% (N=53) students were unaware of any antimicrobials guidelines in the hospital. 66.4% (N=71) students never got a copy of their hospital's antimicrobials guidelines or come across them on the internet. 76.6% (N=82) students have never personally used or consulted antimicrobials guidelines when considering antimicrobials for patients.

Knowledge that may Shape Perceptions of AR

92.5% (N=99) students thought that AR was a national problem and 55.1% (N=59) students considered that the same problem also existed in their own hospital. 32.7% (N=35) students stated that 41-60% *Staphylococcus aureus* bloodstream infections were due to MRSA in their country, whereas, 29% (N=31) and 26.2% (N=28) students answered that the percentage was 21-40% and 1-20% respectively. The percentage was 1-20%, according to 41.1% (N=44) participants in the same situation 10 years back. According to the statement of one-third of respondents (31.8%, N=34), 1-20% *Staphylococcus aureus* bloodstream infections were due to 'VRSA' areas in their country. However, 30.8% (N=33) students replied that 21-40% infection recorded in the same situation. 41.1% (N=44) participants responded that 1-20% clinically relevant bacterial infections, excluding TB, in the Bangladesh were resistant to all known antimicrobials.

Table 1: Levels of Confidence in Antibiotics Prescribing

Areas of confidence in prescribing	Very Unconfident N (%)	Unconfident N (%)	Confident N (%)	Very confident N (%)	Uncertain N (%)
MADI	1 (0.9)	17 (15.9)	79 (73.8)	4 (3.7)	6 (5.6)
DNPA	5 (4.7)	23 (21.5)	57 (53.3)	12 (11.2)	10 (9.3)
CCA	4 (3.7)	20 (18.7)	66 (61.7)	12 (11.2)	5 (4.7)
CCDIA	4 (3.7)	19 (17.8)	61 (57.0)	20 (18.7)	3 (2.8)
UCT	3 (2.8)	19 (17.8)	65 (60.7)	12 (11.2)	8 (7.5)
CIVOA	2 (1.9)	16 (15.0)	64 (59.8)	18 (16.8)	7 (6.5)
IMR	2 (1.9)	19 (17.8)	66 (61.7)	15 (14.0)	5 (4.7)
PSSA	4 (3.7)	18 (16.8)	65 (60.7)	13 (12.1)	6.5 (6.5)
PDAT	2 (1.9)	25 (23.4)	58 (54.2)	17 (15.9)	5 (4.7)

N=107.

Table 2: Comparison among Year-III, IV, and V in Levels of Confidence of Antibiotics Prescribing

Areas of confidence in prescribing	Academic year	N	Mean ± SD	Statistical significance	
				F value	*P* value
MADI	III*	40	2.93 ± 0.66	0.73	0.48
	IV	33	3.09 ± 0.72		
	V	34	2.91 ± 0.67		
DNPA	III	40	3.03 ± 1.05	3.55	0.03
	IV	33	2.67 ± 0.69		
	V	34	3.26 ± 0.96		
CCA	III	40	2.80 ± 0.88	2.25	0.11
	IV	33	2.88 ± 0.60		
	V	34	3.18 ± 0.83		
CCDIA	III	40	2.99 ± 0.84	3.19	0.05
	IV	33	2.83 ± 0.63		
	V	34	2.90 ± 0.83		
UCT	III	40	2.93 ± 0.92	2.02	0.14
	IV	33	2.90 ± 0.72		
	V	34	3.26 ± 0.83		
CIVOA	III	40	3.28 ± 0.93	1.61	0.20
	IV	33	2.94 ± 0.50		
	V	34	3.09 ± 0.87		
IMR	III	40	3.05 ± 0.78	0.05	0.95
	IV	33	3.00 ± 0.75		
	V	34	3.00 ± 0.78		
PSSA	III	40	3.10 ± 0.81	1.24	0.29
	IV	33	2.82 ± 0.73		
	V	34	3.09 ± 0.97		
PDAT	III	40	3.08 ± 0.89	0.99	0.38
	IV	33	2.89 ± 0.58		
	V	34	3.03 ± 0.90		

Table 3: Respondents View Regarding Contributors to Resistance

Contributors to resistance	Very important N (%)	Moderately important N (%)	Slightly important N (%)	Not important at all N (%)
TMA	57 (53.3)	15 (14.0)	16 (15.0)	19 (17.8)
TMBA	52 (48.6)	19 (17.8)	7 (6.5)	29 (27.1)
TLDAT	19 (17.8)	39 (36.4)	31 (29.0)	18 (16.8)
DATL	17 (15.9)	41 (38.3)	35 (32.7)	14 (13.1)
EUAL	51 (47.7)	19 (17.8)	11 (10.3)	26 (24.3)
PHH	44 (41.1)	21 (19.6)	27 (25.2)	15 (14.0)
NRFI	55 (51.4)	32 (29.9)	17 (15.9)	3 (2.8)
PTMAPR	48 (44.9)	40 (37.4)	12 (11.2)	7 (6.5)

N=107.

Antimicrobials Use

36.4% (N=39) of participants claimed that 41-60% all antimicrobials use occurred in the hospital, compared to the community in their country, whereas, 29% (N=31) students answered that the percentage of the same was 21-40%. Inappropriate antimicrobial usage in Bangladesh was 21-40% and 61-80%, according to 35.5% (N=38) and 22.4% (N=24) participants respectively.

Contributors to Resistance

Most of the students agreed that 'TMA', 'TMBA,' 'EUAL,' 'PHH' and 'NRFI' were prime factors to contribute to AR (Table 3). Students gave the opinion that 'TLDAT' and ' DATL' were moderate to slightly necessary to generate AR (Table 3). The thought-provoking opinion given by the cohort was that 82.3% (N=88) thought that AR was due to 'PTMAPR' (Table 3). There was no statistically significant (p>0.05) difference found between the three groups of respondents when considering contributes to resistance (Table 4). Similiarly, there was no statistically significant (p>0.05) difference found between the three group respondents when considering contributes to resistance excepting in one area of 'NRFI' (p=0.00).

Development of Antimicrobials

29% (N=31) and 26.2% (N=28) students thought that 11 to 15 and 6 to 10 classes of antimicrobials respectively were clinically available between 1980 and 2011. 32.7% (N=35) students thought that more than 20 categories of antimicrobials would be clinically available between 2011 and 2020. 43% of Year-III students, estimated the number of new antimicrobials will be >20 and 25% thought it would be between in 11-15 number. 28% of Year-IV students stated the number >20 and 21% said it would be between 16-20. The rate of Year-V students is saying the number of new antimicrobials would be 1-5 was 21%. About 27% Year-V respondents answered, the number of new antimicrobials in a range of 6-10 and >20. There was statistically significant (p=0.01) difference between the Year-III and Year-V students.

Perceptions of AR

The one-third student thought that 'Deaths from RTA' and 'Deaths from lung cancer' was four to eight times higher than AR (Figure 1 & 2). 60.8% (N=65) students felt that antimicrobials prescribed by them as a doctor would contribute to the problem of resistance. 93.4% (N=100) students thought that AR would be a greater problem later in their medical career.

DISCUSSION

Students of Year-III, IV, and V are taught about antimicrobials, their combination of use, route of administration, and adverse drug effects in Pharmacology. The other relevant information regarding antimicrobials, choice of sensitive antimicrobials, and microbiological reports in the department of Microbiology. This may be the reason why they have an average confidence level in some of the parameters asked of them. Although MS of Bangladesh needs to perform extensive clinical clerks during the clinical years; actual clinical experience is found to be lacking during student life. So, minimum confidence is seen in other parameters provided to them. The appropriate decision to give antimicrobials in two situations (patient with fever, but no severity criteria and during the confusion to diagnose the disease) needs clinical knowledge to develop. Year-V students come in contact with clinical cases much more than another two years during their ward schedule. They can correlate the clinical and theoretical knowledge at this time. Probably, for this reason, they feel more confident to make a decision during these two situations. Year-III students learn the dosing schedule of different drugs from the book in class. They have the knowledge fresh and feel more confident in choosing the correct dose schedule calculation. Though they have only theoretical ideas, we must give emphasis on this confidence to be carried out later in their professional practice. Both self-reported confidence and the lack of it in prescribing were found in the study subjects of another study, and this finding was broadly consistent across all medical schools. 92% of respondents were confident in making an accurate diagnosis of infection.[14] A European study reported that their overconfidence may be worse due to misdiagnosis, and more educational programs were advocated to address this possible overconfidence in students and doctors alike.[15] Similar, research shows consistent results with current study findings. It was encouraged that MS should learn better communication skills to establish rapport with the patient, which will promote better diagnosis and reduce unnecessary medication.[4]

The higher degree of confidence in Year-V students in decision making for antimicrobials prescription and choosing a correct dose as well as the interval of drug administration was probably due to the fact that their clinical eye was sharper than Year-IV students. More demand for education on an antimicrobial selection of our study population more or less coincides with a multi-center study.[14] Other studies also show the same attitude of the subjects.[2,4] The majority of respondents gave an opinion for more teaching and learning sessions about the appropriate antimicrobial use in medical school.[4] MS of the USA also shows more or less consistent findings to our result (94.4%).[2] 71% of the study population would like more feedback on antimicrobial selection. A very recent review article mentioned similarly that to promote prudent antibiotic prescribing the best time of intervention is during undergraduate medical studies.[16]

Regarding the source of antimicrobial information, nearly half of current study respondents were uncertain about the presence of hospital guidelines. This was because the MS were not allowed to prescribe for the patients during their study periods in Bangladesh. They can only see the prescriptions provided by the interns and physicians of their medical college hospital. Interns rather depend on the senior colleagues for selecting antimicrobials. Again, the majority of trainees did not use any guideline or know whether their teaching hospital had any guideline.[17] The finding of the source of information was closer to another research report that revealed senior MS trusted on older colleagues for drug information.[8] The US MS rely on more senior colleagues and handheld devices.[2] 77% physicians stated that they have confidence in locally developed guidelines for antimicrobial use over the national ones.[18]

MRSA was first detected over 54 years back in 1961 in the UK.[19] MRSA in 1972 was only 2% in the USA, but it has now increased to more than 60%.[20, 21] The prevalence rate of MRSA in the world was highest in Japan and Brazil, and nearly 60-70% MRSA bacteremia.[22,23] Strains of Vancomycin Intermediate *Staphylococcus aureus* started to appear in the late 1990s and was first identified in 1996 in a Japanese patient.[22] The first completely resistant strains of VRSA was reported from the USA in 2002.[19] The first published report in Bangladesh about MRSA isolates was made in 1991[24] and thereafter focus on the burden of MRSA was reported in a number of scientific articles.[25,26] The majority of the studies mainly highlight Bangladeshi AR as similar to the global burden. MRSA infection was reported 37.2% and 21.6% respectively in hospitalized and non-hospitalized diabetic patients respectively in Bangladesh.[27] The proportion of MRSA bacteremia stated by our student population was less than that of students in the European study.[14] European MS predicted MRSA infection is less than 5%, 10 years back, which is much closer to current study findings (1-20%). Estimation of VRSA bloodstream infection of our students (1-20%) is similar to that of the students of Europe.[14] Views of Bangladeshi Interns are also consistent with current findings.[18] Interns predicted the resistant situation for MRSA (21-40%) and Vancomycin (1-20%), which is closer to our pupils (32.7% and 1-20%, for MRSA and Vancomycin respectively).[17] The current prevalence rate of MRSA

Table 4: Comparison of Year-III, IV, and V View Regarding Contributors to Resistance

Contributors to resistance	Academic year	N	Mean ± SD	Statistical significance	
				F value	*P* value
TMA	III	40	2.00 ± 1.22	0.02	0.98
	IV	33	1.94 ± 1.14		
	V	34	1.97 ± 1.22		
TMBA	III	40	2.18 ± 1.36	0.21	0.81
	IV	33	2.00 ± 1.18		
	V	34	2.18 ± 1.29		
TLDAT	III	40	2.23 ± 0.90	1.76	0.18
	IV	33	2.55 ± 1.03		
	V	34	2.62 ± 0.99		
DATL	III	40	2.68 ± 0.83	2.58	0.08
	IV	33	2.21 ± 0.82		
	V	34	2.35 ± 1.04		
EUAL	III	40	2.20 ± 1.24	0.84	0.43
	IV	33	1.88 ± 1.22		
	V	34	2.23 ± 1.28		
PHH	III	40	2.28 ± 1.20	0.61	0.54
	IV	33	2.03 ± 0.92		
	V	34	2.03 ± 1.17		
NRFI	III	40	1.75 ± 0.74	0.53	0.59
	IV	33	1.58 ± 0.75		
	V	34	1.76 ± 1.02		
PTMAPR	III	40	1.78 ± 0.92	0.02	0.98
	IV	33	1.82 ± 0.88		
	V	34	1.80 ± 0.88		

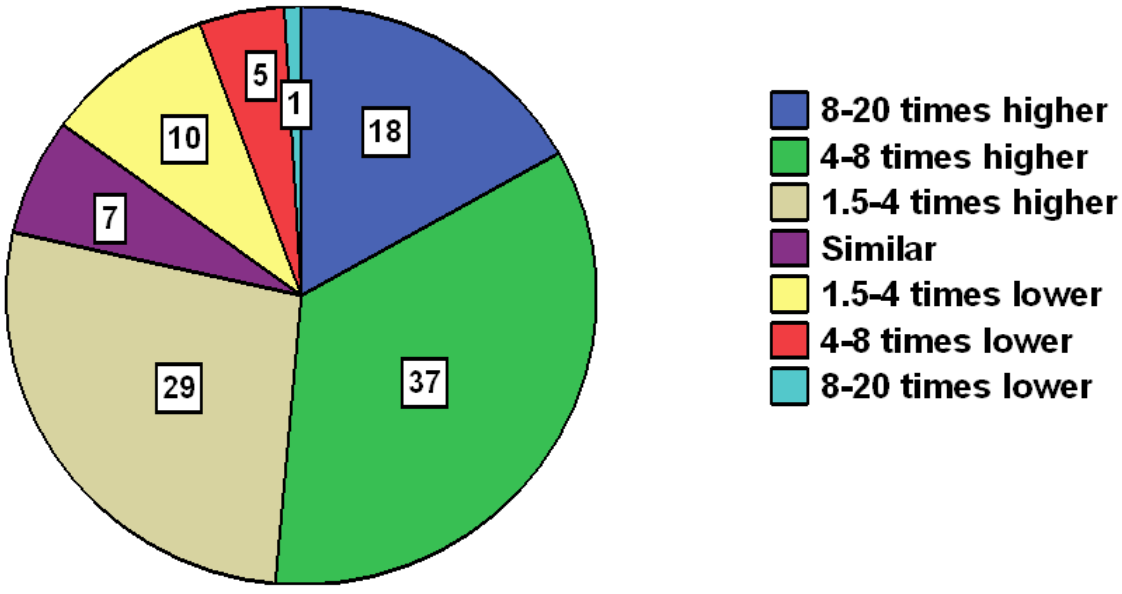


Figure 1: Respondents perception and comparison with death from RTA compared to AR.
Abbreviations: AR, antimicrobial resistance; RTA, road traffic accident.

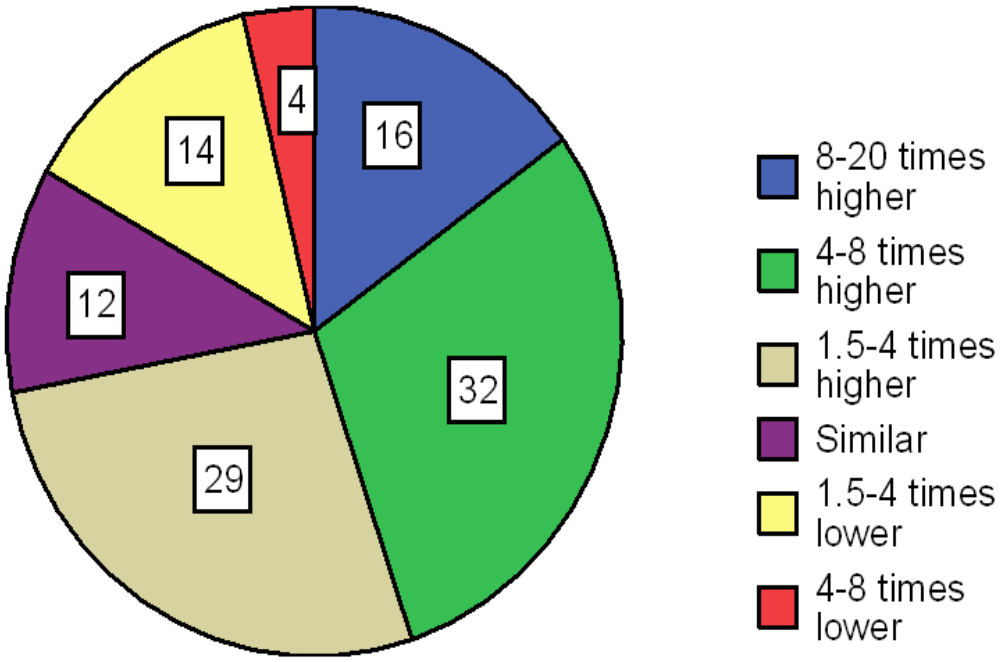


Figure 2: Respondents perception and comparison with death from lung cancer compared to AR.
Abbreviation: AR antimicrobial resistance.

(43.7%) mentioned by our respondents was quite similar to another Bangladeshi study (21-40%).[28] The estimations of our student population are much less than the findings were seen in one more Bangladeshi study; according to that research, about 77% of *Staphylococcus aureus* isolates were MRSA.[29] Prediction of our study population about MRSA bacteremia was also quite similar to a different European study.[30] It can be identified from various studies that substantial increase in the prevalence of MRSA has occurred in hospital patients over the last 4-5 years.

The prediction of current study respondents on AR as a national problem (92.5%) was closer to an additional study of the modern world (92%). Their respondents thought that the problem was more in their own hospital than current findings (55.1%).[14] 98% of intern doctors believe that AR was a national problem, and 64% thought that the same problem also existed in their teaching hospital.[18] 94-98% of the participants of different research respondents agreed that antimicrobials were overused nationally.[4,31] This result is also closer to the current study outcomes. 12% of infections worldwide are hospital-acquired infections. The almost similar proportion of (8-10%) of, infections were hospital acquired, in East Asia, Europe, and the Western Pacific region.[32] An extensive study conducted in 14 countries showed that, on average, 8.7% of patients had hospital-acquired infections, but that the burden is highest in Southeast Asia, where 10% of patients develop such infections.[33] Recent data from lower-income countries suggest that 6.5%-33% of patients have hospital-acquired infections, with pneumonia being among the most frequent.[34] Exact data is not available for a Bangladeshi perspective, but the value is probably similar to South East Asian Regions. It has been detected that misuse of antimicrobials is from 50-62% in Bangladesh.[35,36] Only 8% of total medicine consumption of Bangladesh were prescribed by qualified physicians and rest of drug sellers.[37] It was also reported that inappropriate antimicrobial prescription rates in hospital settings in Bangladesh was 50%.[38]

The finding of our study population regarding the perception of antimicrobial use in their hospital (41-60%) is more or less similar to that of the Ethiopian study.[39] Our current study result also closely resembles to another study conducted in Bangladesh.[40] Perception of the students about antimicrobial use in their hospital also coincides with that of Intern doctors in their hospital.[17] 71.14% of total patients had received antimicrobials in rural Bangladesh, which is higher than other parts of Asia, Europe or the USA.[41] This result is also close to the statement of our students (41-60%) with a number of studies.[42,43] The emergence and accelerated the spread of AR is also due to inappropriate use of antimicrobial drugs, e.g. animal husbandry.[44] It was estimated by the US government researchers that exorbitant antimicrobial prescription rates were up to 50%.[45] Moreover, it was suggested that 75% of antimicrobials used were of questionable therapeutic value.[46] The US consumed 24.6 million pounds of antimicrobials for non-therapeutic purposes annually via livestock.[47] The two main culprits were identified to be the substantial contributors of AR. **i**. Overuse of antimicrobials; **ii**. The EUAL.[48] Recently, the WHO also cited that inappropriate use of antimicrobial drugs in animal husbandry has accelerated the emergence and spread of AR.[44] It has been reported that PHH promotes more microbial infection and AR, especially in hospital acquired infections.[49,50] Current study subjects also agreed to the contribution of PHH as being an important cause of AR.

The main driving force for the development of AR is irrational to use of antimicrobials.[51] One Indian study concluded that three principal causes of AR are: mutation of microorganism, evolution in the microorganism, and lack of restrictions on antimicrobial usage.[52] Inadequate infection control measures were highlighting the lack of awareness to be responsible for AR.[53] The respondents opined that AR development was 86%, 80%, and 78.4% due to patient's poor adherence to prescribed antimicrobials, widespread use of antimicrobials, and excessive use of broad-spectrum antimicrobials respectively.[39] This result is a little higher than the estimation of current study respondents. 53.3% and 48.6% of present study respondents thought that overuse of antibiotics, and also overuse of broad-spectrum antimicrobial respectively were a contributor to AR.

A comparative study of the opinion of contributors to the resistance between Year III, IV and V students of this research was not statistically significant (Table 3). The respondents of the current study thought that

more antimicrobials (>20) would be clinically available in next 30 years. One study reported that the most powerful beta-lactamase inhibitor, carbapenem, has also developed resistance.[54] At present, there are no antimicrobials in the pipeline to appear in 2015 to combat such a threat.[54] Another review article listed 22 new antimicrobials were launched since 2000, and another 2 antimicrobials appeared in 2011 and 2012.[55] The PEW charitable trusts published data in 2015, and presumes about 36 new antimicrobials are in the pipeline for the U.S. market.[56] The Infectious Disease Society of America (IDSA) reported that only 7 new antimicrobials targeting multidrug-resistant gram-negative bacilli have reached phase II or III clinical trial levels since 2010. IDSA has established an initiative to develop another 10 new antimicrobials by 2020.[57] These findings of few new antimicrobials in development in the pipeline are quite alarming. The current study respondents are concerned about the worrying future for humanity as like other study.[58] The percentage of students with the feeling that they could be a contributor to the AR as a doctor in the future was 60.8%. This is probably due to the fact that they observed increased incidence of AR. 93.4% of them forecasted a greater problem in AR in their future medical career.

Limitation of the study

As this is a cross-sectional study, and the findings need to be evaluated on a larger scale to have the exact perception about the AR in the MS of Bangladesh.

CONCLUSION

The current study population was suffering from a lack of confidence partially due to the gap in information about the proper choice of antimicrobials as well as inadequate guidance from senior colleagues who they themselves may not knowledgeable in choosing the appropriate antimicrobial. MS are our future hope to provide an excellent health service. Awareness and encouragement should be given to students on the importance of combating AR by being a good prescriber. They should be given input during their critical early period that the benefit and the welfare of the patient are not their only duty as prescriber but also the interest of the society as a whole. The overconfidence of students about antimicrobial selection needs attention. MS must be trained properly regarding prescribing antimicrobials during the undergraduate student and housemanship.

ACKNOWLEDGEMENT

The authors are grateful to the medical students who participated the study in their much busy schedule. We are also thankful to the Institutional Review Board and Principal of CMOSHMC, Agrabad, Chittagong, Bangladesh. Authors like to extend their sincere thanks to Seraj Zohurul Haque, Year-IV Medical Student, Faculty of Medicine, University of Dundee, Dundee DD1 4HN, Scotland, UK. Finally, we thank Dr. Mohd Afandi Muhamad, Malaysia, for his comments.

DISCLOSURE

This study is not officially funded.

CONFLICT OF INTEREST

Authors possess financial and any other conflict of interest.

ABBREVIATIONS USED

AR: Antimicrobial Resistance; **CMOSHMC:** Chattagram Maa O Shishu Hospital Medical College; **CIVOA:** Choosing between IV and oral administration; **CCA:** Choosing the correct antimicrobials; **CCDIA:** Choosing the correct dose and interval of administration; **DNPA:** Deciding not to prescribe antimicrobials if the patient has a fever but no severity criteria, and if you are not sure about your diagnosis; **DATL:** Dosing of antimicrobials is too low; EUAL: Excessive use of antimicrobials in livestock; **GMC's**: General Medical Council's; **IDSA:** Infectious Disease Society of America; **IMR:** Interpreting microbiological results; **KAP:** Knowledge, Attitude, and Understanding of Practice; **MADI:** Making an accurate diagnosis of infection/sepsis; **MS:** Medical students; **NRFI:** Not removing the focus of infection; **PTMAPR:** Paying too much attention to pharmaceutical representatives/advertising; **PDAT:** Planning the duration of the antimicrobials treatment; **PSSA:** Planning to streamline/stop the antimicrobials treatment, according to clinical evaluation and investigations; **PHH:** Poor hand hygiene; **TLDAT:** Too long durations of antimicrobials treatment; **TMA:** Too many antimicrobials prescriptions; **TMBA:** Too many broad spectrum antimicrobials used; **UCT:** Using a combination therapy if appropriate; **VRSA:** Vancomycin-resistant *Staphylococcus aureus*.

ABOUT AUTHORS

Rozina Hoque: Obtained her Bachelor of Medicine and Bachelor of Surgery in 1999 from the Institute of Applied Health Science, under Chittagong University, Chittagong, Bangladesh and Master of Philosophy in 2007 from the Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. Her career objective is to perform a job that offer a challenging modern environment, that opens the barrier of scopes to apply all the knowledge and experience that she gathered so far from respective job fields. She is currently working as Associate Professor and Head, Department of Pharmacology and Therapeutics, CMOSHMC, Agrabad, Chittagong, Bangladesh.

Asma Mostafa: Obtained her Bachelor of Medicine and Bachelor of Surgery in 2005 from Chittagong Medical College, under Chittagong University, Chittagong, Bangladesh and Master of Philosophy (Anatomy) in 2010 from the Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. Her career objective is to combine her range of experience with her ability to be a compassionate and enthusiastic teacher who will make a positive contribution to the society. She love to motivate and inspire her students through a disciplined educational approach which is needed for their growth as a best student, best doctor and best human being. She is currently working as Associate Professor, Department of Anatomy, CMOSHMC, Agrabad, Chittagong, Bangladesh.

REFERENCES

1. Mahajan M, Dudhgaonkar S, Deshmukh S. A questionnaire-based survey on the knowledge, attitude and practices about antimicrobial resistance and usage among the second year MBBS students of a teaching tertiary care hospital in Central India. Int J Pharm Res. 2014;4(4):175-9.
2. Minen MT, Duquaine D, Marx MA, Weiss D. A survey of knowledge, attitudes, and beliefs of medical students concerning antimicrobial use and resistance. Microb Drug Resist. 2010;16(4):285-9.
3. Steinberg I. Clinical choices of antibiotics: judging judicious use. Am J Manag Care. 2000;6(23 Suppl):S1178-88.
4. Abbo LM, Cosgrove SE, Pottinger PS, Pereyra M, Sinkowitz-Cochran R, Srinivasan A. Medical student's perceptions and knowledge about antimicrobial stewardship: how are we educating our future prescribers?. Clin Infect Dis. 2013;57(5):631-8.
5. World Health Organization. The evolving threat of antimicrobial resistance. Options for action. 20 Avenue Appia, 1211 Geneva 27, Switzerland. 2012. Available at: http://apps.who.int/iris/bitstream/10665/44812/1/9789241503181_eng.pdf [Accessed on January 10, 2016]
6. Vickers H. International antibiotic resistance crisis. Better training needed to maintain therapeutic arsenal. Student BMJ. 2011;19;d3207.
7. Humphreys H, Dillane T, ÓConnel B, Luke LC. Survey of recent medical graduates' knowledge and understanding of the treatment and prevention of infection. Ir Med J. 2006;99(2):58-9.
8. Ibia E, Sheridan M, Schwartz R. Knowledge of the principles of judicious antibiotic use for upper respiratory infections: a survey of senior medical students. South Med J. 2005;98(9):888-95.
9. Kållberg C. Medical students view on the current and future antibiotic resistance situation. Sahlgrenska Academy, University of Gothenburg. Available at: http://www.reactgroup.org/uploads/react/resources/260/Medical%20students%E2%80%99%20views%20on%20the%20current%20and%20future%20antibiotic%20resistance%20situation.en.319.pdf [Accessed on January 10, 2016]
10. Discipline of social and administrative pharmacy (DSAP), school of pharmaceutical science, Universiti Sains Malaysia, Action on antibiotic resistance (ReAct) Uppsala University, Sweden (2011) Education on antibiotic resistance in medical and pharmacy schools: findings from a curriculum survey in selected Southeast Asian Universities. Available at: http://www.reactgroup.org/resources/react-publications/general-documents.html [Accessed on January 10, 2016]
11. General Medical Council. Tomorrow's Doctors: outcomes and standards for undergraduate medical education. 2009. Available at: http://www.gmc-uk.org/Tomorrow_s_Doctors_1214.pdf_48905759.pdf [Accessed on January 10, 2016]
12. Simpson SA, Wood F, Buller CC. General practitioners' perceptions of antimicrobial resistance: a qualitative study. J Antimicrob Chemother. 2007;59(2):292-6.
13. Lecky DM, McNulty CA, Adriaenessens N, Koprivová HT, Holt J, Touboul P. e-bug working group. J Antimicrob Chemother. 2011;66(5):13-21.
14. Dyar OJ, Pulcini C, Howard P, Nathawani D. European medical students: a first multicenter study knowledge, attitudes and perceptions of antibiotic prescribing and antibiotic resistance. J Antimicrob Chemother. 2014;69(3):842-6.
15. Pulcini C, Cua E, Lieutier F, Landraud L, Dellamonica P, Roger PM. Antibiotic misuse: a prospective clinical audit in a French University Hospital. Eur J Microbiol Infect Dis. 2007;26(4):277-80.
16. Lee CR, Lee JH, Kang LW, Jeong BC, Lee SH. Educational Effectiveness, Target, and Content for Prudent Antibiotic Use. Biomed Res Int. 2015;2015:214021.
17. Hoque R, Mostafa A, Haque M. Intern doctor's view on the current and future antibiotic resistance situation of Chattagram Maa O Shishu Hospital Medical College, Bangladesh. Ther Clin Risk Manag. 2015;11:1177-85.
18. Srinivasan A, Song X, Richard A, Sinkowitz-Cochran R, Cardo D, Tand C. A survey of knowledge, attitudes, and beliefs of house staff physicians from various specialties concerning antimicrobial use and resistance. Arch Intern Med. 2004;164(13):1451-6.
19. Science Daily. Antibiotic resistance. Antibiotic resistance is the ability of a microorganism to withstand the effects of an antibiotic. Available at: http://www.sciencedaily.com/terms/antibiotic_resistance.htm.
20. Sydnor ERM, Perl TM. Hospital Epidemiology and Infection Control in Acute-Care Settings. Clin Microbiol Rev. 2011;24(1):141-73.
21. Morell EA, Balkin DM. Methicillin-resistant *Staphylococcus aureus*: A Pervasive Pathogen Highlights the need for new Antimicrobial development. Yale J Biol Med. 2010;83(4):223-33.
22. David MZ, Daum RS. Community-Associated Methicillin-Resistant *Staphylococcus aureus*: Epidemiology and Clinical Consequences of an Emerging Epidemic. Clin Microbiol Rev. 2010;23(3):616-87.
23. Rodríguez-Noriega E, Seas C. Grupo Latino Americano de Trabajo sobre Resistencia en Gram-Positivos. The changing pattern of methicillin-resistant *Staphylococcus aureus* clones in Latin America: implications for clinical practice in the region. Braz J Infect Dis. 2010;14(Supl.2):S87-S96.
24. Khan MA, Morshed MG, Khan WA, Aziz KMS. The emergence of methicillin resistant *Staphylococcus aureus* isolated from skin lesions. Bangladesh J Microbiol. 1991;8(1):21-5.
25. Murphy CR, Hudson LO, Spratt BG, Quan V, Kim D, Peterson E. Predicting high prevalence of community methicillin-resistant *Staphylococcus aureus* strains in nursing homes. Infect Control Hosp Epidemiol. 2013;34(3):325-6.
26. Dutta S, Hassan MR, Rahman F, Jilani MSA, Noor R. Study of antimicrobial susceptibility of clinically significant microorganisms isolated from selected areas of Dhaka, Bangladesh. Bangladesh J Med Sci. 2013;12(1):34-42.
27. Jinnah F, Chowdhury K, Begum J, Sohail M, Rahman MT, Ahmed S. Multi-resistant *Staphylococcus aureus* isolated from wound of diabetic patients. J Infect Dis Antimicrob Agents. 1998;15:15-8.
28. Haque ME, Shariar M, Haq A, Gomes BC, Hossain MM, Razzak MA. Prevalence of beta-lactamase-producing and non-producing methicillin resistant *Staphylococcus aureus* in clinical samples in Bangladesh. J Microbiol Antimicrob. 2011;3(5):112-8.
29. Barai L, Fatema K, Haq JA. Bacterial profile and their antimicrobial resistance pattern in an intensive care unit of a tertiary care hospital of Dhaka. Ibrahim Med Coll J. 2010;4(2):66-9.
30. Pulcini C, Williams F, Molinari N, Davey P, Nathwani D. Junior doctor's knowledge and perceptions of antibiotic resistance and prescribing: A survey in France and Scotland. Clin Microbiol Infect. 2011;17(1):80-7.
31. Nyquist AC, Gonzales R, Steiner JF, Sande MA. Antibiotic prescribing for children with colds, upper respiratory tract infections, and bronchitis. JAMA. 1998;279(11):875-7.
32. Kheder SI. Physicians' knowledge and perception of antimicrobial resistance: a survey in Khartoum State Hospital Settings. Br J Pharm Res. 2013;3(3):347-62.
33. Mayon-White RT, Ducel G, Kereselidze T, Tikomirov E. An international survey of the prevalence of hospital-acquired infection. J Hosp Infect. 1988;11(Suppl A):43-8.
34. Danchivijitr S, Judaeng T, Sripalakij S, Naksawas K, Plipat T. Prevalence of nosocomial infection in Thailand 2006. J Med Assoc Thai. 2007;90(8):1524-9.
35. Rashid HU, Chowdhury SAR, Islam N. Pattern of antibiotic use in two teaching hospitals. Trop Doct. 1986:16(4):152-4.
36. De Varies TPGM, Henning RH, Hogerzeil HV, Fresle DA. Guide to good prescribing: A practical manual. WHO/ DAP. 1994; 94: 11. Available at: http://apps.who.int/medicinedocs/pdf/whozip23e/whozip23e.pdf [Accessed on February 10, 2016]
37. Hossain MM, Glass RI, Khan MR. Antibiotic use in a rural community in Bangladesh. Int J Epidemiol. 1982;11(4):402-5.
38. Siddique MA. Current trends of antibiotic use in Bangladesh and its possible outcomes. Department of Pharmacy, East-West University, Mohakhali, Dhaka, Bangladesh. Available at: https://www.scribd.com/doc/69862030/Current-Trends-of-Antibiotic-Use-in-Bangladesh-and-Its-Possible-Outcomes# [Accessed on February 10, 2016]
39. Abera B, Kibert M, Mulu W. Knowledge and beliefs on antimicrobial resistance among physicians and nurses in hospitals in Amhara Region, Ethiopia. BMC Pharmacol Toxicol. 2014;15(1):26.
40. Gurley ES, Zaman RU, Sultana R, Bell M, Fry AM, Srinivasan A, *et al*. Rates of hospital-acquired respiratory illness in Bangladeshi tertiary care hospitals: results from a low cost pilot surveillance strategy. Clin Infect Dis. 2010;15;50(8):1084-90.
41. Fahad BM, Matin A, Shill MC, Asish KD. Antibiotic usage at a primary health care unit in Bangladesh. AMJ. 2010;3(7):414-21.
42. Larson E, Lin SX, Gomez-Duarte C. Antibiotic use in Hispanic Households, New York City. Emerg Infect Dis. 2003;9(9):1096-102.
43. Dimina E, Kula M, Caune U, Vigante D, Liepins M, Zeidaka L. Repeated prevalence studies on antibiotic use in Latvia, 2003-2007. Euro Surveill. 2009;14(33):ii-19307.
44. World Health Organization. Media Centre, Fact Sheet N° 194. April 2015. Available at: www.who.int/mediacentre/factsheets/fs194/en/ [Accessed on February 10, 2016]
45. Centers for Disease Control and Prevention. US Department of Health and Human Services. Antibiotic Resistance Threats in the United States, 2013. Available at: http://www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf [Accessed on February 10, 2016]
46. Harrison FP, Lederberg J. Eds. Antimicrobial resistance: issues and opinions. Washington, DC: National Academy Press, 1998. Available at: http://www.ncbi.nlm.nih.gov/books/NBK100885/pdf/Bookshelf_NBK100885.pdf [Accessed on February 10, 2016]
47. Mellon M, Benbrook C, Benbrook KL. Hogging it: Estimates of Antimicrobial Abuse in Livestock (2001). Union of Concern Scientists, 2 Brattle Square, Cambridge MA 02138-3780, 2001. Available at: http://www.iatp.org/files/Hogging_It_Estimates_of_Antimicrobial_Abuse_in.pdf [Accessed on February 10, 2016]
48. Renter E. 2 main contributors to the antibiotic-resistance crisis. Natural Society. 2013. Available at: http://naturalsociety.com/2-main-contributors-antibiotic-resistant-crisis [Accessed on February 10, 2016]
49. World Health Organization. WHO Guidelines on Hand Hygiene in Health Care. First Global Patient Safety Challenge Clean Care is Safer Care. 20 Avenue Appia, 1211 Geneva 27, Switzerland, 2009. Available at: http://apps.who.int/medicinedocs/documents/s16320e/s16320e.pdf [Accessed on February 10, 2016]

50. Kampf G, Löffler H, Gastmeier P. Hand Hygiene for the Prevention of Nosocomial Infections. Dtsch Arztebl Int. 2009;106(40):649-55.
51. World Health Organization. Media Centre. World Health Day 2011. Combat drug resistance: no action today means no cure tomorrow. Statement by WHO Director-General, Dr Margaret Chan 6 April 2011. Available at: http://www.who.int/world-health-day/2011/presskit/WHD2011-DGstate-EN.pdf?ua=1 [Accessed on February 10, 2016]
52. Khan AKA, Banu G, Reshma KK. 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. 2013;7(8):1613-6.
53. Guerra CM, Pereira CAP, Neves Neto AR, Cardo DM, Correa L. Physicians' perceptions, beliefs, attitudes, and knowledge concerning antimicrobial resistance in a Brazilian teaching hospital. Infect Control Hosp Epidemiol. 2007;28(12):1411-4.
54. Ahammad F. Antimicrobial resistance–a global concern for human survival. Faridpur Med Col J. 2014;9(1):1-2.
55. Butler MS, Blaskovich, Cooper MA. Antibiotics in the clinical pipeline in 2013. J Antibiot (Tokoyo). 2013;66(10):571-91.
56. The Pew Charitable Trusts. A data table from the Pew charitable trusts. 2015. Available at: http://www.pewtrusts.org/~/media/Assets/2015/03/AntibioticsInnovationProject_DataTable_March2015.pdf [Accessed on February 10, 2016]
57. Boucher HW, Talbot GH, Benjamin Jr DK, Bradley J, Guidos RJ, Jones RN, Murray BE, Bonomo RA, Gilbert D. 10×'20 progress–Development of new drugs against gram-negative bacilli: an update from the Infectious Disease Society of America. Clin Infect Dis. 2013.
58. Haque M, Rahman NIA, Zulkifli Z, Ismail S. Antibiotic prescribing and resistance knowledge level of medical students of clinical years of University Sultan Zainal Abidin. Ther Clin Risk Manag. 2016;12:413-26.