Mediscope The Journal of GMC

ORIGINAL ARTICLE

DOI: https://doi.org/10.3329/mediscope.v13i1.87094

Assessment of Awareness among Medical Students on the WHO Access, Watch, and Reserve (AWaRe) Classification of Antibiotics

*S Sultana[1], SBA Sonia[2], SB Wahid[3], N Sultana[4], SA Nipu[5], R Sharmin[6]

Abstract

Background and objective: Antibiotics are essential for the treatment of bacterial infections. Inappropriate antibiotic prescribing patterns lead to the development of increasingly resistant bacterial strains. One of the most effective methods to combat antibiotic resistance is the WHO Access, Watch, and Reverse (AWaRe) classification of antibiotics. The study was therefore an effort to determine whether there is any impact on increasing awareness of the WHO AWaRe antibiotic classification among third-year medical students who will become future doctors. **Methods:** Interventional study with an educational intervention was conducted in the Department of Pharmacology & Therapeutics, Gazi Medical College, Khulna, and Armed Forces Medical College, Dhaka, from April 2026 to November 2026. A total of 183 participants of 3rd year medical students were participated. The awareness of medical students on knowledge, attitude, and antibiotic prescribing perception was assessed and compared using a 10-item structured questionnaire. **Results:** Students who had not heard about the AWaRe classification of antibiotics in the pre-interventional phase were 80.9%, but the knowledge regarding the meaning and purpose of AWaRe classification of antibiotics increased from 6.6% to 44.3% after receiving the intervention. The percentage of students who agreed to follow the AWaRe classification of antibiotics in their future practice increased from 65.6% to 78.1%, and the percentage of students who agreed that the AWaRe classification of antibiotics can suggest safe choices of antibiotics increased from 47.5% to 64%. A significant increase ($p < 0.05$) in knowledge, attitude, and perception score was found after educational intervention. **Conclusion:** This study revealed significant gaps in knowledge and attitudes towards AWaRe, emphasizing the necessity of increasing awareness amongst medical practitioners to promote rational use of antibiotics.

Keywords: Antibiotic, AWaRe classification, Antibiotic resistance, Medical students.

Introduction

The discovery and development of Antimicrobial agents (AMA) have been the most notable advancements in medicine,[1] and the important medical advancement of the 20th century was the use of antibiotics.[2] Antibiotics are considered to be one of the most often sold medication types,[3] but are frequently sold without a prescription.[4] An extremely high prevalence of self-medication and unnecessary consumption of antibiotics has been revealed.[5] Furthermore, various patterns of improper prescription, such as the incorrect dosage form, incorrect route of administration, overuse and misuse, incorrect duration, and improper dispensing, were documented.[6] The overuse was also documented in Bangladesh.[7,8]

These improper uses result in adverse reactions and financial burden on the nation's healthcare system,[9] as well as the development of resistant bacterial strains.[10] The nations with the highest consumption of antibiotics showed the largest prevalence of resistant organisms.[11,12] Antimicrobial resistance (AMR) reduces the efficacy of antibiotics, harms patient outcomes[9,13] and often increases morbidity and mortality[14,15] Antibiotic resistance has a well-established relationship

1. Dr. Sarmin Sultana, Assistant Professor, Department of Pharmacology & Therapeutics, Gazi Medical College, Khulna, Bangladesh. Email: sarmin.kmc@gmail.com ORCID: 0000-0002-8701-9024
2. Dr. Sadia Binte Anwar Sonia, Assistant Professor, Department of Pharmacology & Therapeutics, Armed Forces Medical College, Dhaka Cantonment, Bangladesh.
3. Dr. Sumaiya Binte Wahid, Assistant Professor, Department of Pharmacology & Therapeutics, Gazi Medical College, Khulna, Bangladesh.
4. Dr. Niger Sultana, Assistant Professor, Department of Pharmacology & Therapeutics, Gazi Medical College, Khulna, Bangladesh.
5. Dr. Shaon Akter Nipu, Assistant Professor, Department of Pharmacology & Therapeutics, Ad-din Akij Medical College, Khulna, Bangladesh.
6. Dr. Rumana Sharmin, Lecturer, Department of Pharmacology & Therapeutics, Bangladesh Medical College, Dhaka, Bangladesh.

with its use,[16,17], also with the lack of concern of physicians about long-term resistance in Bangladesh.[18]

There is no adequate monitoring system for regulating physicians' prescribing practices.19 Moreover, the existing regulatory laws are not enforced in the community pharmacies to prevent antibiotic dispensing without a prescription.[20] The policymakers, governmental bodies, and global health organizations have been paying more and more attention to this issue.[21] To stop the spread of AMR, appropriate prescribing is crucial,[22] as well as new and effective strategies must be developed and implemented.[23]

The Antimicrobial Stewardship (AMS) program is one of the most effective strategies to combat AMR.[24] The World Health Organization (WHO) developed a Global Strategy and Global Action Plan.[25,26] In 2017, the WHO Access, Watch, and Reserve (AWaRe) classification of antibiotics was developed with the goals of preserving the efficacy of the Reserve group and reducing antibiotic resistance. Access groups are readily accessible, relatively safe and are prescribed as first-line or second-line treatments. The Watch groups are more toxic and resistant than the Access group; the stewardship programs primarily focus on the Watch group. The Reserve group is used when all other treatments are ineffective.[27,28] Antibiotic usage displayed an excessive prescription of the 'Watch' group in both district and tertiary hospital settings and pharmacies in Bangladesh, pointing to an irrational use.[29]

A nationwide antimicrobial stewardship program is therefore an urgent need, with an emphasis on the WHO AWaRe Classification of antibiotics, regular in-service training on AMR, and proper law enforcement.[30] Most of the strategies for controlling AMR are educational programs, training, workshops, guidelines, and policies, and focus on prescribers.[31] A previous study on medical students showed that specific training is needed to increase awareness about antibiotic use and resistance.[32] Educational intervention has been shown to enhance the knowledge, attitude & prescribing perception in physicians.[33]

In Bangladesh, research involving educational intervention in undergraduate medical students is lacking. Taking into account the present study is designed to investigate the potential impact of increasing awareness of the WHO AWaRe classification of antibiotics on knowledge, attitude, and prescribing perception in third-year undergraduate medical students who will become the future doctors.

Materials and methods

Study Design

Interventional study with an educational intervention.

Study Place and Duration

The study was conducted in Gazi Medical College, Khulna, and Armed Forces Medical College, Dhaka, between April 2026 and November 2026.

Study Population

Third-year undergraduate medical students.

Sampling Technique

Convenient sampling.

Inclusion Criteria

(i) The third-year undergraduate medical students of the selected medical colleges, (ii) both male and female students, and (iii) those who will be present and given oral consent.

Ethical Considerations

Protocol was reviewed, and the IERB of GMC issued a clearance letter, memo no. GMC/IERB/approval/2026/07.

Data Collection

Development of the tool

A 10-item structured English questionnaire is formulated through a literature review.[33]

Intervention schedule

Pre-interventional phase

A printed copy of the questionnaire was distributed and collected at the same session.

Educational intervention

After collecting the questionnaire, a 40-minute educational intervention in the form of a lecture using a PowerPoint presentation was delivered. The lecture included the definition of antimicrobial resistance and its contributing factors; inappropriate use of antibiotics; the WHO global action plan and strategy for containment of antimicrobial resistance; Standard Treatment Guidelines (STG) on Antibiotic Use of Bangladesh; description of the WHO AWaRe classification of antibiotics with examples and the uses of antibiotics that fall into each category (Access, Watch, Reserve); and the role of physician and undergraduate medical students in decreasing antibiotic resistance by using the AWaRe classification of antibiotics.

Post-interventional phase

A printed copy of the questionnaire was filled out and collected in the same setting.

Assessment and scoring

The questionnaire was divided into three parts, and five-point Likert scale questions were used to measure the responses. Part 1 included demographic characteristics of the student. The total attainable score

was 46 points in parts 2 and 3. Part 2 will assess the participants' knowledge; the first question was assigned the response of "yes" or "no"; 1 score was given for a yes answer, while 0 score was given for a no answer. The second question was assigned the response on a five-point Likert scale, "strongly agree", "agree", "neutral", "disagree", and "strongly disagree", valued 5 to 1, respectively. The sum of the two questions in part 2 gives a maximum score of 6. Students were categorized based on their overall knowledge scores using the Bloom's cutoff points as "good knowledge" if a score ranges 80-100% (5-6 points), "moderate knowledge" if a score ranges 60-79% (4 points), and "poor knowledge" if a score ranges <60% (<4 points) of the maximum score. Part 3 assesses the participants' attitude and perception; each question of this section was assigned to the response on a five-point Likert scale, "strongly agree", "agree", "neutral", "disagree", and "strongly disagree", valued 5 to 1, respectively. The sum of all questions in part 3 gives a maximum score of 40. Students were categorized based on their overall attitude and perception scores using Bloom's cut-off point, as a "positive attitude and good perception" if the score was 80-100% (32-40 points), "moderate attitude and perception" if the score was 60-79% (24-31 points) and "negative attitude and perception" if the score was less than 60% (<24 points).[34,35]

Data Analysis

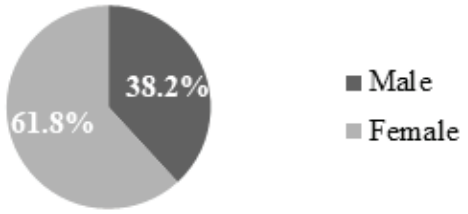
Data were analyzed using a paired t-test and described as means, standard deviations, and frequencies in Microsoft Office Excel. A p-value lower than 0.05 was considered as the level of significance.

Results

A total of 183 students completed the survey and were finally analyzed.

Demographic Characteristics of the Study Sample

More than half of the students (113) were females (Figure 01).



Assessment of Knowledge about AWaRe Classification of Antibiotics

More than three-quarters of the students (80.9%) stated that they had not heard about the AWaRe classification of antibiotics before, but the knowledge increased from 6.6% to 44.3% after the intervention (Table 01). Also, the poor knowledge was 78.7% increased, moderate knowledge was 17.5% increased, and good knowledge was 61.2% increased (Table 02).

Table 01. Assessment of Knowledge towards AWaRe Classification of Antibiotics

Variables		Frequency n (%)		Improvement (%)
		Pre-Interventional	Post-Interventional	
Heard about AWaRe	Yes	35 (19.1)	169 (92.3)	73.2
classification of antibiotics	No	148 (80.9)	14 (7.7)	
Good knowledge regarding	Strongly agree	7 (3.8)	8 (4.4)	0.6
the meaning and purpose	Agree	12 (6.6)	81 (44.3)	37.7
	Neutral	134 (73.2)	77 (42)	31.2
	Disagree	27 (14.8)	15 (8.2)	6.6
	Strongly disagree	3 (1.6)	2 (1.1)	0.5

n = number of frequencies

Table 02. Assessment of Student Category based on Knowledge Scores

Knowledge Scores	Frequency n (%)		Improvement (%)
	Pre-Interventional	Post-Interventional	
Poor knowledge (<4 points)	149 (81.4)	5 (2.7)	78.7
Moderate knowledge (4 points)	12 (6.6)	44 (24.1)	17.5
Good knowledge (5-6 points)	22 (12)	134 (73.2)	61.2

n = number of frequencies

Assessment of Attitude and Perception about (AWaRe) Classification of Antibiotics

The percentage of respondents who agreed to suggest safe choices of antibiotics increased to 64% after the intervention and the percentage of respondents who agreed to follow in future practice increased to 78.1% after the intervention (Table 03). Finally, the poor attitude and perception were 8.7% increased, moderate attitude and perception were 15.4% increased, and good attitude and perception were 24.1% increased after intervention (Table 04).

Table 03. Assessment of Attitude and Perception towards AWaRe Classification of Antibiotics

Variables		Frequency n (%)		Improvement
		Pre-Interventional	Post-Interventional	(%)
Appropriate with the scientific knowledge	Strongly agree	3 (1.6)	19 (10.4)	8.8
	Agree	83 (45.3)	118 (64.5)	19.2
	Neutral	49 (26.8)	24 (13.1)	13.7
	Disagree	36 (19.7)	21 (11.5)	8.2
	Strongly disagree	12 (6.6)	1 (0.5)	6.0
Suggest safe choices of antibiotics	Strongly agree	12 (6.6)	16 (8.7)	2.1
	Agree	87 (47.5)	117 (64)	16.5
	Neutral	55 (30)	45 (24.6)	5.4
	Disagree	27 (14.8)	5 (2.7)	12.1
	Strongly disagree	2 (1.1)	0 (0)	1.1
Helps in the reduction of antibiotic resistance	Strongly agree	22 (12)	42 (23)	11
	Agree	55 (30)	85 (46.4)	16.4
	Neutral	69 (37.8)	49 (26.8)	11
	Disagree	36 (19.7)	6 (3.3)	16.4
	Strongly disagree	1 (0.5)	1 (0.5)	0
Suggest cost-effective choices of antibiotics	Strongly agree	12 (6.6)	10 (5.5)	-1.1
	Agree	35 (19.1)	65 (35.5)	16.4
	Neutral	91 (49.7)	61 (33.3)	16.4
	Disagree	36 (19.7)	30 (16.4)	3.3
	Strongly disagree	9 (4.9)	17 (9.3)	-4.4
Follow in future practice	Strongly agree	11 (6.1)	19 (10.4)	4.3
	Agree	120 (65.6)	143 (78.1)	12.5
	Neutral	37 (20.2)	15 (8.2)	12
	Disagree	15 (8.3)	6 (3.3)	5
	Strongly disagree	0 (0)	0 (0)	0
Follow the hospital's regulations and guidelines that consider AWaRe classification	Strongly agree	44 (24)	52 (28.4)	4.4
	Agree	87 (47.5)	118 (64.5)	17
	Neutral	41 (22.4)	4 (2.2)	20.2
	Disagree	11 (6.1)	9 (4.9)	1.2
	Strongly disagree	0 (0)	0 (0)	0
More information should be available	Strongly agree	22 (12)	22 (12)	0
	Agree	118 (64.5)	143 (78.1)	13.6
	Neutral	39 (21.3)	15 (8.3)	13
	Disagree	2 (1.1)	2 (1.1)	0
	Strongly disagree	2 (1.1)	1 (0.5)	0.6
Training is needed	Strongly agree	12 (6.6)	19 (10.4)	3.8
	Agree	31 (16.9)	77 (42.1)	25.2
	Neutral	128 (69.9)	84 (45.9)	24
	Disagree	8 (4.4)	2 (1.1)	3.3
	Strongly disagree	4 (2.2)	1 (0.5)	1.7

Table 04. Assessment of Student Category based on Attitude and Perception Scores

AP Scores	Frequency n (%)		Improvement (%)
	Pre-Interventional	Post-Interventional	
Negative attitude and perception (<24 points)	18 (9.8)	2 (1.1)	8.7
Moderate attitude and perception (24-31 points)	147 (80.4)	119 (65)	15.4
Positive attitude and good perception (32-40 points)	18 (9.8)	62 (33.9)	24.1

AP = attitude and perception, n = number of frequencies

Comparison of Overall Knowledge, Attitude, and Perception (KAP) Score

A significant increase ($p < 0.05$) in knowledge, attitude, and perception score was found after educational intervention (Table 05).

Table 05. Comparison of the Overall KAP Score between Pre-Interventional and Post-Interventional Phases

Variables		Score		P-value[x]
		Pre-Interventional (n = 183)	**Post-Interventional** (n = 183)	
Knowledge	mean ± SD	3.2 ± 0.9	4.8 ± 0.7	0.001*
Attitude and perception	mean ± SD	27.6 ± 3.4	30.2 ± 2.8	0.001*

n = number of students, SD = standard deviation, x = paired 't' test, * = significant ($p < 0.05$)

Discussion

Antimicrobial resistance (AMR) is considered a critical challenge to the world's health system because it decreases the efficacy of drugs and increases morbidity and mortality.[36] Educational programs, training, and workshops provide physicians with an opportunity to focus on the proper use of antibiotics.[37] A previous study showed that medical students needed specific training and courses about antibiotics in their undergraduate core curriculum.[38] The data showed that 36% of 163 countries had adopted the AWaRe classification of antibiotics in their medicine list. It also showed that the knowledge of the "AWaRe" tool increased compared to last year by 26%.[39] Standard Treatment Guidelines (STG) on Antibiotic Use in Common Infectious Diseases of Bangladesh recommended promoting "AWaRe" classification and approaching at all levels before prescribing an antibiotic.[40] Only a few studies have performed surveys similar to this one, so there was a need for a more comprehensive study. The primary purpose of the study was to determine the impact of improving the knowledge about WHO Access, Watch, and Reserve (AWaRe) antibiotics classification on medical students' attitudes and antibiotic prescribing practices in a pre-post interventional study design.

In this study, the intervention caused a 73.2% increase in the percentage of students who had heard about the AWaRe classification of antibiotics. Furthermore, the knowledge of the students regarding the meaning and purpose of AWaRe classification of antibiotics was 37.7% improved after receiving the interventions.

In addition to that, after the intervention, around 78.1% of respondents followed the AWaRe classification of antibiotics in their future practice, while approximately 64% of respondents agreed that the AWaRe classification of antibiotics can suggest safe choices of antibiotics. Similar findings were reported by a previous study that took place in Jordan on the physicians in 2023.[33]

This study was strengthened by the fact that it evaluated the impact of AWaRe tool-targeted educational programs on the knowledge, attitude, and practice of medical students of Bangladesh in an interventional design.

Limitations

However, the study has some limitations. Firstly, the study was conducted in a specific setting, i.e., among third-year students at two medical colleges. The study

would benefit from being repeated in other years of medical students and intern doctors at both government and private medical colleges to improve the generalizability of the findings. In addition, the follow-up post-intervention period did not allow for capturing the sustainability of the intervention. Further research with longer follow-up study periods is needed.

Conclusion

It is clearly demonstrated from the study results that a significant gap regarding the knowledge and attitudes towards AWaRe classification of antibiotics among medical students is present and needs to be narrowed, highlighting the need for increasing the awareness of the AWaRe tool among medical students to ensure rational use of antibiotics and reinforce policymakers to develop antibiotic prescribing guidelines.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

References

1. Hutchings MI, Truman AW, Wilkinson B. Antibiotics: past, present and future. Current opinion in microbiology. 2019 Oct 1; 51:72-80.
2. Katz L, Baltz RH. Natural product discovery: past, present, and future. Journal of Industrial Microbiology and Biotechnology. 2016 Mar 1;43(2-3):155-76.
3. Buke AC, Ermertcan S, Hosgor-Limoncu M, Ciceklioglu M, Eren S. Rational antibiotic use and academic staff. International journal of antimicrobial agents. 2003 Jan 1;21(1):63-6.
4. Shankar PR, Partha P, Shenoy N. Self-medication and non-doctor prescription practices in Pokhara valley, Western Nepal: a questionnaire-based study. BMC family practice. 2002 Dec; 3:1-7.
5. Sawair FA, Baqain ZH, Abu Karaky A, Abu Eid R. Assessment of self-medication of antibiotics in a Jordanian population. Medical Principles and Practice. 2008 Dec 4;18(1):21-5.
6. Van Boeckel TP, Gandra S, Ashok A, Caudron Q, Grenfell BT, Levin SA, et al. Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. The Lancet infectious diseases. 2014 Aug 1;14(8):742-50.
7. Biswas M, Roy MN, Manik MI, Hossain MS, Tapu ST, Moniruzzaman M, et al. Self-medicated antibiotics in Bangladesh: a cross-sectional health survey conducted in the Rajshahi City. BMC Public Health. 2014 Dec; 14:1-7.
8. Hoque R, Ahmed SM, Naher N, Islam MA, Rousham EK, Islam BZ, et al. Tackling antimicrobial resistance in Bangladesh: A scoping review of policy and practice in human, animal and environment sectors. PloS one. 2020 Jan 27;15(1): e0227947.
9. Otaigbe II, Elikwu CJ. Drivers of inappropriate antibiotic use in low-and middle-income countries. JAC-Antimicrobial Resistance. 2023 Jun;5(3): dlad062.
10. Prescott JF: The resistance tsunami, antimicrobial stewardship, and the golden age of microbiology. Vet Microbiol 2014, 171:273-278.
11. Versporten A, Zarb P, Caniaux I, Gros MF, Drapier N, Miller M, et al. Antimicrobial consumption and resistance in adult hospital inpatients in 53 countries: results of an internet-based global point prevalence survey. The Lancet Global Health. 2018 Jun 1;6(6): e619-29.
12. Goossens H, Ferech M, Vander Stichele R, Elseviers M. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. The Lancet. 2005 Feb 12;365(9459):579-87.
13. Cosgrove SE. The relationship between antimicrobial resistance and patient outcomes: mortality, length of hospital stays, and health care costs. Clinical Infectious Diseases. 2006 Jan 15;42: S82-9.
14. de Kraker ME, Davey PG, Grundmann H; BURDEN study group. Mortality and hospital stay associated with resistant Staphylococcus aureus and Escherichia coli bacteraemia: estimating the burden of antibiotic resistance in Europe. PLoS Med 2011; 8: e1001104.
15. Murray CJ, Ikuta KS, Sharara F, Swetschinski L, Aguilar GR, Gray A, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. The Lancet. 2022 Feb 12;399(10325):629-55.
16. Jirjees FJ, Al-Obaidi HJ, Sartaj M, Conlon-Bingham G, Farren D, Scott MG, et al. Antibiotic use and resistance in hospitals: time-series analysis strategy for determining and prioritising interventions. Hospital Pharmacy Europe. 2020. Available online: https://hospitalpharmacyeurope.com/news/reviews-research/antibiotic-use-andresistance-in-hospitals-time-series-analysis-strategy-for-determining-and-prioritising-interventions/ (accessed on 1 March 2024).

17. Costelloe C, Metcalfe C, Lovering A, Mant D, Hay AD. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. BMJ. 2010 May 18;340.
18. Bonna AS, Pavel SR, Ferdous J, Khan SA, Ali M. Antibiotic resistance: An increasingly threatening but neglected public health challenge in Bangladesh. International Journal of Surgery Open. 2022 Dec 1; 49:100581.
19. Jarab AS, Mukattash TL, Nusairat B, Shawaqfeh M, Farha RA. Patterns of antibiotic use and administration in hospitalized patients in Jordan. Saudi Pharmaceutical Journal. 2018 Sep 1;26(6):764-70.
20. Albsoul-Younes A, Wazaify M, Yousef AM, Tahaineh L. Abuse and misuse of prescription and nonprescription drugs sold in community pharmacies in Jordan. Substance use & misuse. 2010 May 1;45(9):1319-29.
21. World Health Organization. WHO Report on Surveillance of Antibiotic Consumption: 2016–2018 Early Implementation. World Health Organization; 2018. Available online: https://apps.who.int/iris/handle/10665/277359 (accessed on 25 February 2024).
22. Nathwani D. Antimicrobial prescribing policy and practice in Scotland: recommendations for good antimicrobial practice in acute hospitals. Journal of Antimicrobial Chemotherapy. 2006 Jun 1;57(6):1189-96.
23. Boggan JC, Navar-Boggan AM, Jhaveri R. Pediatric-specific antimicrobial susceptibility data and empiric antibiotic selection. Pediatrics. 2012 Sep 1;130(3): e615-22.
24. Dyar OJ, Huttner B, Schouten J, Pulcini C. What is antimicrobial stewardship? Clinical microbiology and infection. 2017 Nov 1;23(11):793-8.
25. World Health Organization. Anti-Infective Drug Resistance Surveillance and Containment Team. WHO Global Strategy for Containment of Antimicrobial Resistance. World Health Organization; 2001. Available online: https://apps.who.int/iris/handle/10665/66860 (accessed on 1 February 2024).
26. Mendelson M, Matsoso MP. Guest Editorial: The World Health Organization Global Action Plan for antimicrobial resistance. South African medical journal. 2015 Dec 8;105(5):325-.
27. World Health Organization. The 2019 WHO AWaRe Classification of Antibiotics for Evaluation and Monitoring of Use. Geneva: World Health Organization; 2019. Available online: https://www.who.int/publications/i/item/WHOEMPIAU2019.11 (accessed on 10 February 2024).
28. Mugada V, Mahato V, Andhavaram D, Vajhala SM. Evaluation of prescribing patterns of antibiotics using selected indicators for antimicrobial use in hospitals and the access, watch, reserve (AWaRe) classification by the World Health Organization. Turkish journal of pharmaceutical sciences. 2021 Jun;18(3):282.
29. Rashid MM, Akhtar Z, Chowdhury S, Islam MA, Parveen S, Ghosh PK, et al. Pattern of antibiotic use among hospitalized patients according to WHO access, watch, reserve (AWaRe) classification: Findings from a point prevalence survey in Bangladesh. Antibiotics. 2022 Jun 16;11(6):810.
30. Islam MA, Akhtar Z, Hassan MZ, Chowdhury S, Rashid MM, Aleem MA, et al. Pattern of antibiotic dispensing at pharmacies according to the WHO Access, Watch, Reserve (AWaRe) classification in Bangladesh. Antibiotics. 2022 Feb 14;11(2):247.
31. Alsayed AR, El Hajji FD, Al-Najjar MA, Abazid H, Al-Dulaimi A. Patterns of antibiotic use, knowledge, and perceptions among different population categories: A comprehensive study based in Arabic countries. Saudi Pharmaceutical Journal. 2022 Mar 1;30(3):317-28.
32. Scaioli G, Gualano MR, Gili R, Masucci S, Bert F, Siliquini R. Antibiotic use: a cross-sectional survey assessing the knowledge, attitudes and practices amongst students of a school of medicine in Italy. PloS one. 2015 Apr 1;10(4): e0122476.
33. Abu-Ajaleh S, Darwish Elhajji F, Al-Bsoul S, Abu Farha R, Al-Hammouri F, Amer A, et al. An Evaluation of the Impact of Increasing the Awareness of the WHO Access, Watch, and Reserve (AWaRe) Antibiotics Classification on Knowledge, Attitudes, and Hospital Antibiotic Prescribing Practices. Antibiotics. 2023 May 23;12(6):951.
34. Dejene H, Birhanu R, Tarekegn ZS. Knowledge, attitude and practices of residents toward antimicrobial usage and resistance in Gondar, Northwest Ethiopia. One Health Outlook. 2022 May 18;4(1):10.
35. Bloom BS, Engelhart MD, Furst EJ, Hill WH, Krathwohl DR. Taxonomy of educational objectives. New York: Longmans, Green; 1964.

36. Institute of Medicine; Forum on Emerging Infections. The National Academies Collection: Reports funded by National Institute of Health. In The Resistance Phenomenon in Microbes and Infectious Disease Vectors: Implications for Human Health and Strategies for Containment: Workshop Summary; National Academies Press: Washington, DC, USA, 2003.
37. Alzoubi, K.; Al-Azzam, S.; Alhusban, A.; Mukattash, T.; Al-Zubaidy, S.; Alomari, N.; et al. An audit on the knowledge, beliefs and attitudes about the uses and side-effects of antibiotics among outpatients attending 2 teaching hospitals in Jordan. East. Mediterr. Health J. 2013, 19, 478–484.
38. Scaioli, G.; Gualano, M.R.; Gili, R.; Masucci, S.; Bert, F.; Siliquini, R. Antibiotic use: A cross-sectional survey assessing the knowledge, attitudes and practices amongst students of a school of medicine in Italy. PLoS ONE 2015, 10, e0122476.
39. WHO. More Countries Committing to Tackling Antimicrobial Resistance. World Health Organ. (WHO). 2021. Available online: https://www.who.int/news/item/11-11-2021-more-countries-committing-to-tackling-antimicrobial-resistance (accessed on 1 January 2024).
40. Standard Treatment Guidelines (STG) on Antibiotic Use in Common Infectious Diseases of Bangladesh Version: 1.0 Date: 1 December, 2021. Available online: https://amr.cdc.gov.bd/wp-content/uploads/2018/10/STG-guideline-for-antimicrobial-use-version-1.0-date-1-december21.pdf (accessed on 25 January 2024).