Original Article

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Patterns of Antibiotic Use in a Corporate Hospital in Bangladesh: A Point Prevalence Survey

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Abstract:

Objective: Inappropriate use of antimicrobials is the major contributor to the emergence of antimicrobial resistance (AMR). This study explored the pattern of antibiotic use in a corporate hospital to mitigate the risk of AMR and patient safety.

Material and Methods: This cross-sectional study was piloted at the Apollo Imperial Hospitals, Chattogram, Bangladesh. This study followed the WHO methodology for the Point Prevalence Survey. A total of 86 patients from different inpatient departments were enrolled for this survey on 8th April, 2025.

Results: Out of 86 patients, the overall prevalence of antibiotic use was 79.1%. Among patients receiving antibiotics, 61.8% and 35.3% were female and children below 14 years of age, respectively. Approximately 43%, 44%, and 13% of patients received single, double, and triple antibiotic therapies, respectively. In this study, 12%, 56%, and 32% antibiotics were used according to the WHO AWaRe classification of Access, Watch, and Reserve categories, respectively. A higher rate of both third-generation cephalosporins (35%) and carbapenems (32%) use was noted among all user groups, followed by aminoglycosides (22%), second-generation cephalosporins (19%), and fluoroquinolones (19%). Indications

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of prescription included community-acquired infection (43%), surgical prophylaxis (37%), and medical prophylaxis (20%). Antibiotic use had a significant association with patients' age, hospital departments, and infection categories (p-value<0.05).
Conclusion: In the absence of national PPS data from corporate hospitals in Bangladesh, our findings of frequent antibiotics use with higher prescribing rates in Watch and Reserve groups should get the urgent attention of policymakers in order to contain AMR in Bangladesh.

Keywords: Antimicrobial resistance, antimicrobial stewardship, Bangladesh

Introduction

Antimicrobial resistance (AMR) is one of the most significant threats to global health and Sustainable Development Goals 2030[1]. AMR leads to severe negative health consequences and a substantial economic burden[1,2]. Due to the high prevalence of AMR pathogens in healthcare settings, healthcare-associated infections (HAIs) occupy a significant infection burden[3]. According to the Global Point Prevalence Survey (PPS), half of the hospitalized patients were given antibiotics in Africa, while it was one out of three in Asia and Europe[4]. This extensive use of antimicrobials is largely facilitating the development of AMR, resulting in treatment failure and increasing the risk of mortality and morbidity consequences of AMR, with a high economic burden. It has been estimated that the European health system spends around €1.5 billion on antimicrobials, and the United States considers about 30% of all antimicrobial therapy inappropriate[5,6]. The situation in African nations is even worse, with inappropriate prescribing exceeding 45%[7,8]. Healthcare facilities, particularly those with frequent antimicrobial usage, are at high-risk settings for the development of AMR[9]. To contain such an impending pandemic threat, the Antimicrobial Stewardship (AMS) program has proven to be urgent and beneficial. To shape prescribing behavior, some high-income countries have already implemented the AMS program without increasing healthcare costs[10,11]. While antibiotic resistance is a mounting danger to humankind, the discovery of new antibiotics is slow and scarce[12]. The situation is particularly worse in low- and middle-income countries (LMICs), which are burdened with a high number of infectious diseases and low access to effective antibiotics due to the high costs[13].

Inappropriate and irrational use of antimicrobials, self-medication, incomplete treatment courses, and substandard antibiotic quality contribute to AMR[14]. Conversely, HAIs are contributing to AMR, as they are mainly transmitting the resistant pathogens to susceptible hosts[3]. To address such challenges, the World Health Organization's (WHO) expert committee developed the 'AWaRe' (Access, Watch and Reserve) classification of antibiotics and Essential Medicine List (EML) to support, strengthen, and monitor the AMS program[15]. To contain AMR, the WHO recommended 60% consumption of Access group antibiotics over Watch and Reserve groups. They broadly urge each member state to develop the National Action Plan (NAP) by following the recommended Global Action Plan (GAP)[16,17].

Following the GAP, Bangladesh developed the NAP for 2017–2022, which has been updated for the period 2021-2026. Though the country has started a surveillance system to generate reliable data on AMR and conducted three national PPS in 2021, 2022, and 2024, data on the patterns of antimicrobial use (AMU) are still largely unknown[18]. This data gap presents a considerable barrier to the development and implementation of effective AMS programs[19]. Moreover, all national PPS were conducted in public hospitals only and excluded corporate private hospitals[20]. However, this PPS is an observational study where data were collected at a single point in time to capture a "snapshot" of AMU. It identifies the scopes to improve prescribing practices. Aligning with the Global-PPS and the WHO Guidelines, the present PPS was conducted at the Apollo Imperial Hospitals in Chattogram, Bangladesh, to understand the prevalence of AMU in inpatient departments, practice gap on AWaRe antibiotics, and to identify the areas of interventions to promote prudent use of antimicrobials towards containing AMR.

Material and Methods

Study setting and study population

The study was carried out on 8th April, 2025, at the Apollo Imperial Hospitals, one of two major corporate hospitals in the Chattogram Division. This cross-sectional study was conducted following the WHO Global PPS methods for antimicrobial use in hospital settings to determine the variability in the use of antibiotics among indoor patients[21]. The study targeted all patients ranging from newborns to adults warded under different departments of the hospital. The departments included Pediatrics, Obstetrics and Gynaecology, Medicine, Nephrology, Neurosurgery, Cardiology, Haematology, Orthopaedics, Surgery, and Ear, Nose and Throat (ENT). Later on, the departments were broadly sub-grouped as (a) Paediatrics, (b) Obstetrics and Gynaecology, (c) Medicine, (d) Surgery, and (e) Cardiology. Neurosurgery, ENT, and Orthopaedics were included under the Surgery Department; Nephrology and Haematology were considered part of the Medicine Department. The Psychiatry and Eye Departments were absent from this hospital, and there was no patient in the Intensive Care Unit (ICU) during the survey. A group of trained physicians completed the survey before 8.00 AM on the mentioned day.

Inclusion and exclusion criteria

All admitted patients or their eligible attendants were randomly interviewed after being informed of the study purpose and obtaining written informed consent from patients or eligible caregivers. The socio-demographic, clinical, diagnostic, and treatment-related data were collected from patient treatment cards by trained physician data collectors. The patients from the outpatient department, the emergency department, and the intensive care unit were excluded. Patients who received treatment after 8.00 AM on the same day were also excluded. This study was conducted without bias of any kind (time or selection bias).

Tool for data collection

A customized structured questionnaire was adapted from the Global-PPS for data collection. Field testing was done before actual data collection. The clinical, epidemiological, and microbiological data were collected from each patient using a survey questionnaire and patient treatment cards. Four indications were set for the use of antibiotics: (a) Community Acquired Infection (CAI), (b) Healthcare Associated Infection (HAI), (c) Medical Prophylaxis (MP), and (d) Surgical Prophylaxis (SP). Patients admitted with a prior infection or symptoms of infection were considered CAI. Patients who developed infections or symptoms after 48 hours of admission were considered HAI. Meanwhile, MP was indicated by the provision of antibiotics to prevent infection among patients with other medical conditions but without symptoms of current infection. Similarly, SP was to prevent surgical site infection. SP was categorized as SP1, SP2, and SP3, where SP1 means provision of one dose of antibiotics for one day, SP2 means multiple doses for one day, and SP3 means multiple doses for more than one day. Patient age was grouped as 0-14 years (children admitted to the Paediatric Ward), 15-64 years (adults), and 65 years and above (elderly patients admitted to any department).

Data analysis

The collected data were coded and analyzed using statistical software SPSS Version 25.0. For descriptive analysis, data pertaining to department, demographic and clinical information of patients, and antimicrobial use data were analyzed. The Chi-square test was done to see the association between AWaRe and relevant factors. Levels of significance of p-value<0.01 and p-value<0.05 were considered.

Ethical declaration and consent statement

The study was approved by the Institutional Review Board (IRB) of the Apollo Imperial Hospitals Ltd. After a thorough review of the protocol by the Research Review Committee and Ethical Review Committee, this study received approval (Approval No: AIHL/IRB/2025/02), dated on the 10th of March 2025. We followed the proper steps of the Helsinki Declaration regarding ethical approval and consent to participate. After sharing the purpose, risks and benefits, freedom to participate or reject and withdraw at any time, the estimated time of the interviews, privacy and anonymization, the use of data and other relevant information, all in accordance with the Helsinki Declaration, verbal consent was obtained from each participant or legal guardian.

Results

A total of 86 eligible patients were included during the study period. Among them, 68 (79.1%) were prescribed antibiotics. The mean age in years and SD was 30.73±24.13. Among the antibiotics users, 61.8%, 35.3%, and 57.4% were female, children aged 0-14 years, and in the adult age group, respectively. Out of nine major health problems, 25.0% was Obstetrical and Gynaecological, followed by Respiratory (17.6%) and Gastrointestinal infection (16.2%). For the diagnosed cases, 42.6%, 44.1%, and 13.2% patients were prescribed single, double, and triple antibiotics, respectively (Table 1). For at least one (single) antibiotic use, only 11.8% was from the Access group, whereas 55.9% and 32.4% were from the Watch and Reserve groups, respectively (Figure 1).

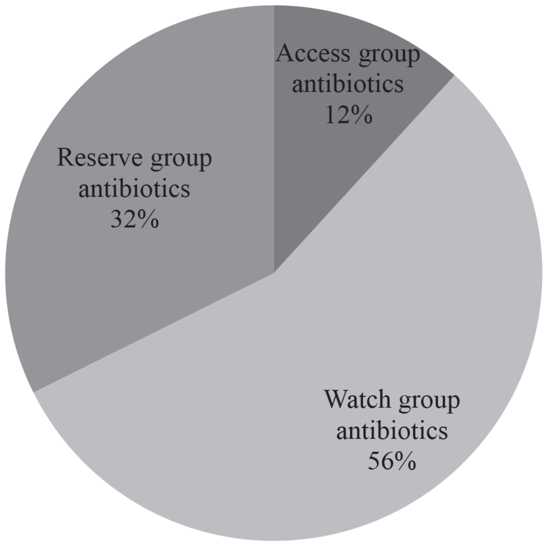

Figure 1 Frequency of antibiotics used according to AWaRe classification

Out of four categories of indications, antibiotics were prescribed for three categories of health risk. Of them, 42.6%, 36.8%, and 20.6% were for CAI, SP, and MP, respectively. During the survey period, there was no patient in the HAI category. However, among SP, 11.8% was SP3. The majority of the patients were from the Paediatric Department (33.8%), followed by the Obstetrics and Gynaecology (25.0%) and Medicine (20.6%) Departments (Table 1).

A total of 36.8% patients underwent biomarker tests (i.e., WBC, C-reactive protein) and 47.1% culture and sensitivity (CS). The other laboratory tests included urine, blood, sputum, and CSF, either single or in combination, based on the physician's suggestions. However, overwhelmingly, 94.1% patients received empirical antibiotic therapy, against only 5.9% who received targeted treatment (Table 1).

Table 1 Demographics, clinical characteristics, laboratory tests, and pattern of treatment (n=68)

Characteristics	Number	(%)
Patient number		
Total patients	86	100
Total antibiotics received	68	79.1
Mean age in years	30.7	
±S.D.	24.1	
Age group		
0-14 years (Child)	24	35.3
15-64 years (Adult age group)	39	57.4
65 years and above (Old age group)	05	07.4
Gender		
Male	26	38.2
Female	42	61.8
Diagnosed health problems		
Obstetrics and gynaecological	17	25.0
Skin and soft tissue infection	04	05.9
Respiratory infection	12	17.6
Urinary tract infection	03	04.4
Gastrointestinal infection	11	16.2
Cardio-vascular infection	06	08.8
Pyrexia of unknown origin	07	10.3
Central nervous system infection	04	05.9
Sepsis/blood-borne infection	04	05.9
Number of antibiotics per patient		
One	29	42.6
Two	30	44.1
Three	09	13.2
Indication for prescribing antibiotics		
Community Acquired Infection (CAI)	29	42.6
Medical Prophylaxis (MP)	14	20.6
Surgical Prophylaxis (SP)	25	36.8
[Surgical Prophylaxis (SP1)_One dose for one day]	(05)	(07.4)
[Surgical Prophylaxis (SP2)_ Multiple doses for one day]	(12)	(17.6)
[Surgical Prophylaxis (SP3)_ Multiple doses for more than one day]	(08)	(11.8)

Table 1 (continued)

Characteristics	Number	(%)
Major departments		
Paediatric	23	33.8
Obstetrics and Gynaecology	17	25.0
Medicine	14	20.6
Surgery	08	11.8
Cardiology	06	08.8
Biomarker		
Yes	25	36.8
No	43	63.2
[C Reactive Protein (CRP)]		
Yes	19	27.9
No	49	72.1
[White Blood Cell (WBC) count]		
Yes	23	33.8
No	45	66.2
[Other Blood Tests]		
Yes	25	36.8
No	43	63.2
Urine Test		
Yes	14	20.6
No	54	79.4
Sputum Test		
Yes	2	2.9
No	66	97.1
Cerebrospinal Fluid (CSF) Test		
Yes	1	1.5
No	67	98.5
Culture and Sensitivity Test		
Yes	32	47.1
No	36	52.9
Culture and Sensitivity Test Results		
Growth found	4	5.9
No growth found	28	41.2
Test not done	36	52.9
Treatment Pattern		
Targeted treatment	4	5.9
Empirical treatment	64	94.1

The Chi-square test revealed that there was a significant association of AWaRe class antibiotics with age, department, and infection categories. The majority of the children and adults were treated with Watch and Reserve group antibiotics. Of them, children were treated with the maximum (50.0%) Reserve group antibiotics over the Access and Watch groups (p-value<0.05). As this age group was mostly treated at the Paediatric Department, a similar percentage (52.2%) of paediatric patients were treated with the Reserve group, whereas the Obstetrics and Gynaecology and Medicine Departments used the maximum percentage of Watch group antibiotics (82.4% and 57.1% respectively) (p-value<0.05). There was an alarming rate of use of the Reserve group for CAI (48.3%) (p-value<0.14). According to the infection category, 82%, 75%, 71%, and 67% of the Watch group were used for Obs. and Gynae, CNS, PUO, and Cardio-vascular infection, respectively (p-value<0.05) (Table 2).

A total of 21 types of antibiotics were used under 15 categories. Out of 15 categories, 9 were used as the first (at least one) antibiotic. Of them, the maximum percentage of patients was prescribed 3rd-generation cephalosporin (32.4%) and carbapenem (29.4%), followed by 2nd-generation cephalosporins (16.2%). The average use was noted for 1st generation cephalosporins (5.9%), fluoroquinolones (5.9%), and Extended Spectrum Beta

Table 2 Use of antibiotics following AWaRe classification in different age groups, gender, departments, indications, and infection categories

Characteristics	Access group [n, (%)]	Watch group [n, (%)]	Reserve group [n, (%)]	p-value	Total [n, (%)]
Age group					
0-14 years	01 (04.2)	11 (45.8)	12 (50.0)	0.002	24 (100.0)
15-64 years	04 (10.3)	26 (66.7)	09 (23.1)		39 (100.0)
65 years and above	03 (60.0)	01 (20.0)	01 (20.0)		05 (100.0)
Gender					
Male	02 (07.7)	13 (50.0)	11 (42.3)	0.342	26 (100.0)
Female	06 (14.3)	25 (59.5)	11 (26.2)		42 (100.0)
Departments					
Paediatric	01 (04.3)	10 (43.5)	12 (52.2)	0.004	23 (100.0)
Obs. and Gynae	02 (11.8)	14 (82.4)	01 (05.9)		17 (100.0)
Medicine	01 (07.1)	08 (57.1)	05 (35.7)		10 (100.0)
Surgery	04 (50.0)	02 (25.0)	02 (25.0)		08 (100.0)
Cardiology	00 (00.0)	04 (66.7)	02 (33.3)		06 (100.0)
Indication of antibiotics					
CAI	02 (06.9)	13 (44.8)	14 (48.3)	0.138	29 (100.0)
Medical prophylaxis	01 (07.1)	08 (57.1)	05 (35.7)		14 (100.0)
Surgical prophylaxis_1	01 (20.0)	04 (80.0)	00 (00.0)		05 (100.0)
Surgical prophylaxis_2	03 (25.0)	06 (50.0)	03 (25.0)		12 (100.0)
Surgical prophylaxis_3	01 (12.5)	07 (87.5)	00 (00.0)		08 (100.0)
Infection category					
Obs. and Gynae related	02 (11.8)	14 (82.4)	01 (05.9)	0.001	17 (100.0)
Skin and soft tissue inf.	03 (75.0)	00 (00.0)	01 (25.0)		04 (100.0)
Respiratory infection	00 (00.0)	06 (50.0)	06 (50.0)		12 (100.0)
Urinary tract infection	01 (33.3)	01 (33.3)	01 (33.3)		03 (100.0)
Gastrointestinal infect.	00 (00.0)	03 (27.3)	08 (72.7)		11 (100.0)
Cardio-vascular infect.	00 (00.0)	04 (66.7)	02 (33.3)		06 (100.0)
Pyrexia of unknown ori	01 (14.3)	05 (71.4)	01 (14.3)		07 (100.0)
CNS infection	01 (25.0)	03 (75.0)	00 (00.0)		04 (100.0)
Sepsis/blood-borne inf.	00 (00.0)	02 (50.0)	02 (50.0)		04 (100.0)

N.B. CAI=Community Acquired Infection, ori=origin, inf. and infect.=infection

Lactamase (ESBL) inhibitors (4.4%). The remaining categories were prescribed as combination antibiotics (double or triple therapy). In this study, the majority of patients from the Obstetrics and Gynaecology Department received single antibiotics (37.9%), whereas the majority of paediatric patients received double (43.3%) and triple (22.2%) antibiotics. Similarly, the Cardiology Department did not use any single antibiotic; instead, they used a higher percentage (33.3%) of combination triple antibiotics. According to the infection categories, the majority of patients received double and triple antibiotics for respiratory infections (30% and 22%), followed by cardiovascular infections (10% and 33%) (Table 3).

Table 3 Frequency of use of AWaRe antibiotic groups and number of antibiotics used based on department and disease categories

Antibiotic groups	AWaRe	1st antibiotic, Number, (%)	With 2nd antibiotic, Number (%)	With 3rd antibiotic, Number (%)
1st GCEFs	Access	04 (05.9)		
2nd GCEFs	Watch	11 (16.2)	02 (02.9)	
3rd GCEF	Watch	22 (32.4)	02 (02.9)	
ESBL inhibitors	Access	03 (04.4)	01 (01.5)	
Carbapenems	Reserve	20 (29.4)	02 (02.9)	
Glycylcyclines	Reserve	01 (01.5)	03 (04.4)	
Fluoroquinolones	Watch	04 (05.9)	06 (08.8)	03 (04.4)
Aminoglycosides	Access	02 (02.9)	11 (16.2)	02 (02.9)
Oxazolidinones	Reserve	01 (01.5)	02 (02.9)	01 (01.5)
Imidazoles	Access		02 (02.9)	01 (01.5)
Monobactams	Reserve		03 (04.4)	
Macrolids	Watch		01 (01.5)	
Lincosamides	Access		02 (02.9)	
Polymyxins	Reserve		02 (02.9)	
Glycopeptides	Watch			02 (02.9)
No antibiotics			30 (44.1)	59 (86.8)
Department-wise antibiotic prescribing frequency				
Paediatrics		08 (27.6)	13 (43.3)	02 (22.2)
Obs. and Gynae		11 (37.9)	05 (16.7)	01 (11.1)
Medicine		05 (17.2)	07 (23.3)	02 (22.2)
Surgery		05 (17.2)	02 (06.7)	01 (11.1)
Cardiology		00 (00.0)	03 (10.0)	03 (33.3)
Disease-wise antibiotic prescribing frequency				
Obs. and Gynae related		11 (37.9)	05 (16.7)	01 (11.1)
Skin and soft tissue inf.		03 (10.3)	01 (03.3)	00 (00,0)
Respiratory infection		01 (03.4)	09 (30.0)	02 (22.2)
Urinary tract infection		01 (03.4)	02 (06.7)	00 (00.0)
Gastrointestinal infect.		08 (27.6)	03 (10.0)	00 (00.0)
Cardio-vascular infect.		00 (00.0)	03 (10.0)	03 (33.3)
PUO		02 (06.9)	04 (13.3)	01 (11.1)
CNS infection		03 (10.3)	00 (00.0)	01 (11.1)
Sepsis/blood-borne inf.		00 (00.0)	03 (10.0)	01 (11.1)

N.B. GCEF=Generation Cephalosporins, ESBL=Extended Spectrum Beta Lactamase, PUO=Pyrexia of Unknown Origin, inf. and infect.=Infection, CNS=Central Nervous System

The use of meropenem was the highest (29.4%) among 21 antibiotics. However, use of ceftriaxone (22%), cefuroxime (16%), and amikacin (16%) was comparatively higher than other antibiotics (Figure 2).

Discussion

We found a prevalence of antimicrobial use (AMU) of around 79% in the inpatient departments of Apollo Imperial Hospitals, a reputed corporate hospital in Chattogram Division, Bangladesh. Surprisingly, the last national PPS on AMU conducted in 2024 in eight divisional government medical college hospitals in Bangladesh found the same prevalence (79%). They found maximum AMU (87.7%) at Rangpur Medical College Hospital and minimum AMU (63.7%) at Khulna Medical College Hospital[20]. Worldwide, antibiotic prescriptions are widely used in both inpatient and outpatient settings. Antibiotic prescribing rates in Iran ranged from 39.5% to 75.3% in various inpatient wards[15]. Studies found a comparatively lower prevalence in primary care settings, around 52% in low- and middle-income countries[21,22]. The higher prevalence of antibiotic prescribing across various settings highlights the urgent need for robust Antimicrobial Stewardship (AMS) initiatives to mitigate the risk of AMR and associated deaths[23].

In this study, among the total antibiotic users, the Pediatric Department accounted for 33.8%, which was higher than all other departments. Our result is consistent with a population-based survey in Bangladesh, where around 40% of antibiotic use was noted among children under five years with acute respiratory infection[18]. The last national PPS also found the highest AMU (89%) in the pediatric ward in comparison to other wards[20]. This practice is augmenting the risk of AMR from childhood. Thus, the AMS program should prioritize the pediatric ward to prevent

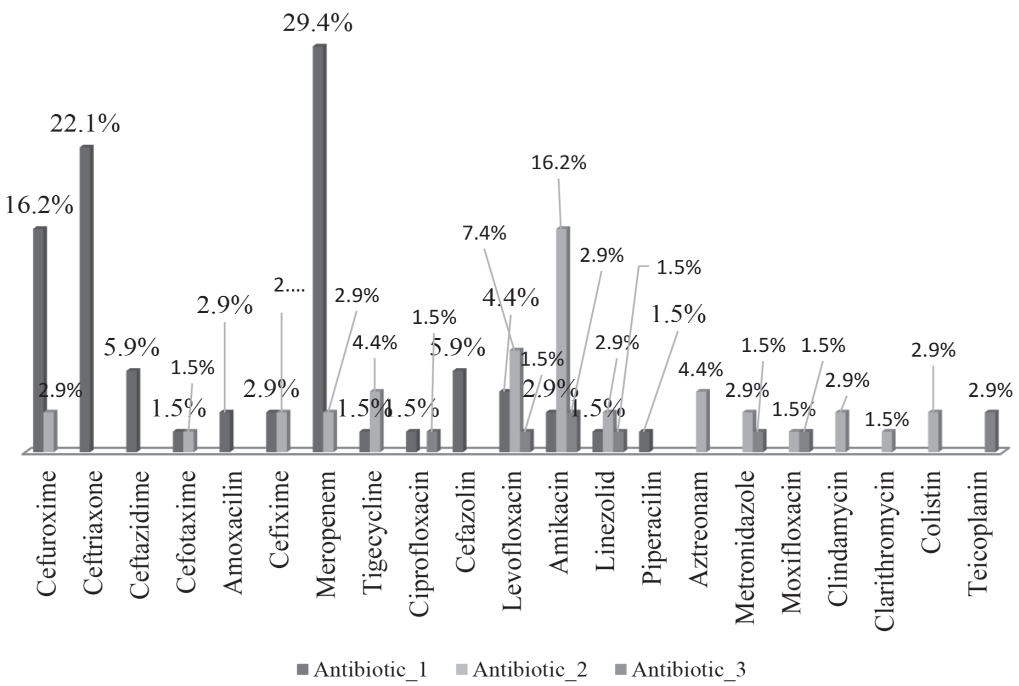

Figure 2 Percentage of patients prescribed AWaRe antibiotics as single, double, and triple compositions

the risk of AMR. We found around 94% empirical antibiotic therapy, with a significant percentage (44%) of patients receiving double, and a portion of patients (13%) receiving triple antibiotics. Again, this practice of double and triple antibiotics was notably higher in the Paediatric (43% and 22%) and Medicine Wards (23% and 22%). These findings are markedly higher than the national PPS (12.8% and 1.1%, respectively) conducted in 2021 in Bangladesh[15]. However, the last national PPS conducted in 2024 showed an increasing trend of prescribing double (35.5%) and triple (15%) antibiotics, which corroborates our findings[20]. Empirical antibiotic therapy using multiple antibiotics must be stopped to shape physicians' prescribing behavior towards targeted treatment, thereby reducing treatment costs and risk of resistance. At the same time, additional efforts, including health education, are required to shape the patient's behavior regarding antibiotics, such as demanding costly antibiotics for rapid cure, self-medication, or prescription by non-graduates or medicine shopkeepers. Studies have demonstrated that interventions like prescription audits and pharmacist-led AMS programs can reshape prescribing procedures[24,25].

In this study, only 12% of patients received Access group antibiotics, against the WHO recommendation for 60% in the Access group[21]. In contrast, around 56% and 32% patients received Watch and Reserve groups, respectively, which was also higher than the recent national PPS (63% and 1%, respectively)[20]. As the Apollo Imperial Hospitals is a 120- bed, reputable corporate private hospital, most of the patients admitted have a higher purchasing capacity for costly medicines, and they also expect a rapid cure, which might have influenced the prescribing behavior of the working physicians. Moreover, non-compliance with the available standard treatment guidelines, lack of physician training, and the absence of national prescribing instructions are speculated to be underlying factors that encouraged the care providers, with full freedom, to prescribe unnecessary Watch and Reserve group antibiotics. Additionally, the lack of infectious disease specialists and commercial attitudes are among the important barriers to implementing the AMS program in a corporate hospital.

We observed that around 37% of patients received antibiotics as a surgical prophylaxis (SP), indicating antibiotics were given to prevent surgical site infections (SSIs). Of them, 30% received multiple antibiotics prescribed either for one day or more than one day. But studies suggest that a single dose of antibiotics is sufficient to prevent SSI[26]. We found no HAIs during the survey period, suggesting that no patients developed signs or symptoms of infection after 48 hours of admission. This indicates good functioning of the Infection Prevention and Control (IPC) Practice by the hospital. In general, private hospitals in Bangladesh strive to ensure cleanliness, quality treatment, and better patient care. The IPC is one of the major components for patient satisfaction against costs, and it is an effective way to interrupt the transmission of AMR pathogens.

Around 37% and 47% patients were suggested for biomarker and bacterial culture and sensitivity with other relevant tests (urine, sputum, CSF), respectively, indicating a good investigation practice. By aiding these tests, the unnecessary prescriptions of antibiotics and antibiotic resistance can be reduced. Studies have suggested a proper diagnostic process to reduce AMU with no detrimental effects on patient recovery or other unfavorable outcomes[27,28]. Out of 47% culture and sensitivity tests, only 6% yielded growth, indicating either the real picture of culture-positive samples or a low rate of isolation due to the samples being provided after taking antibiotics. Proper history taking with culture-based administration of antibiotics could substantially reduce the irrational use of antibiotics and risk of AMR[29]. Following the antimicrobial susceptibility pattern of Pseudomonas aeruginosa, a study in India also suggests mitigating the misuse of antibiotics[30]. Another study in Vietnam on the resistance situation of *K. Pneumoniae* also suggests restricting the widespread use of antibiotics[31].

In our study, the carbapenems (32%), oxazolidinones (6%), and glycylcycline (6%) were used mostly as Reserve group antibiotics. The Watch group antibiotics were mostly used for obstetrics and gynaecological (82%), CNS infection (75%), respiratory and blood born infection (50%), cardiovascular diseases (67%), and pyrexia of unknown origin (71%), whereas most Reserve group antibiotics were used for gastro intestinal infection (73%), blood born and respiratory infection (50%), and cardio-vascular infection (33%). Ideally, the appropriate class of antibiotics should only be administered based on culture and susceptibility results, or empirical therapy should be replaced with targeted therapy using the available susceptibility reports. Our study observed higher rates of use of meropenem and ceftriaxone over Access group antibiotics, particularly for common infections. In order to avoid excessive, unnecessary, or inappropriate use, the AMS program should provide a list of restricted antibiotics and approved antibiotics against common infections. The WHO suggests prescribing at least 60% from the Access group antibiotics due to their lower resistance potential, using the Watch group only as an alternative and reserve group as a last resort[32]. The use of higher percentages of Watch and Reserve groups, revealed by the present study and also from the national PPS, reflects the scenario of irrational use in private and public hospitals. Only by establishing the AMS program in hospitals and adopting the AMS guidelines with regular monitoring can we optimize the practice of prescribing antibiotics in Bangladesh.

Limitations

A comparatively small sample size, the cross-sectional design (which limits the causal inference), minimum demographic data (only age and gender), and a lack of comparison with other corporate hospitals were the major limitations of this study. The inclusion of the outpatient department, the emergency department, and the intensive care unit could have been another critical zone for reviewing the pattern of antibiotic use, which is also missing. We could not consider the potential influences of geographical location, promotional activities of pharmaceutical companies, and the role of local administration in antibiotic use. Furthermore, lack of antibiotic indication validation, potential selection bias, and the absence of outcome data, such as infection resolution and adverse events, could also be limiting factors for this study.

Conclusion

Our study findings, as well as the findings from the national PPS, demonstrated an antibiotic use rate of approximately 79%, including much higher Watch and Reserve groups, underscoring the urgent need for the AMS program to reshape the pattern of antibiotic use through the proper implementation of the AWaRe classification. In order to address this alarming situation, we recommend the nationwide implementation of community awareness regarding the appropriate use of antibiotics, frequent in-service training on AMS, including a list of restricted antibiotics and approved antibiotics, a national antibiotic policy, and regular monitoring in both public and corporate hospitals. These efforts could prevent the non-judicious use of antimicrobials, thereby mitigating AMR in Bangladesh.

Author contributions

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Data availability

All data and the data file are available from the corresponding author.

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Conflict of interest

The authors declare no conflict of interest. The funders have no conflict of interest with the study or the contents of the manuscript.

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