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Review Article

Antibiotic resistance situation in Pabna, Bangladesh: a review

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ABSTRACT

Antibiotic abuses and overuses are factors in the global issue of antibiotic resistance (ABR) which is becoming more acute in densely populated urban areas. To offer a concise summary of the present status of ABR in Pabna city, identify any deficiencies and generate recommendations based on findings, a comprehensive analysis was performed. We conducted a search for articles related to ABR published between 2003 to 2022 using search engines such as Google Scholar, PubMed, online and offline journals in Bangladesh. In the past, it was possible to determine the median and interquartile ranges of an organism's ABR. Forty-two research articles were included in this review. For determining antibiotic susceptibility, approximately 95.96% of the investigations used the disk diffusion method, and about 91.98% followed the clinic and laboratory standards institute's recommendations. However, information about susceptibility testing procedures and the source of infections-whether they were hospital-based or community-based-was conspicuously absent from about 11.19%, 12.62%, and 92.24% of the study studies, respectively. Many of the diseases studied exhibited high levels of resistance, and traditional first-line antibiotics were largely ineffective. Most of the patients displayed only mild resistance to carbapenem. A developing trend in ABR across the majority of antibiotic classes was also revealed by our findings, in addition to severe monitoring and informational gaps.

Keywords: ABR, Pathogens, Insufficient antibiotics, Pabna

INTRODUCTION

The ability of antibiotics to save lives is universally known. However, some argue that they are medications specifically designed to target particular disease-causing microbes.[1]

ABR presents a global health concern due to the overuse and inappropriate application of antibiotics, compounded by inconsistent monitoring practices. In various countries, epidemiological differences further complicate the issue. Despite past successes in combating infectious diseases, the continuous and substantial increase in antimicrobial resistance (AMR) has eroded confidence over the last three decades.[2,3] For several reasons, with one of the most important ones being the availability of resistance genes brought on by the incorrect use of antibiotics, the idea of promoting ABR is appealing.[4] AMR has a variety of negative effects, including increased healthcare expenditures, a rise in the incidence of illnesses, and a rise in the number of fatalities. These effects affect both developed and developing countries. In South Asia and Africa, multidrug resistance (MDR) is thought to be responsible for about 45% of fatalities, according to a world health organization (WHO) research. Bangladesh, a developing country in South Asia, is experiencing a sharp rise in ABR. There is a common claim that when doctors in Bangladesh prescribe antibiotics to patients, they usually make educated estimates.[6-8]

According to the most recent reports, a potential increase of 10 million deaths by 2050, along with substantial economic losses globally, if effective measures are not taken to address this threat. The present review focuses on the available data regarding ABR situations in Pabna, as reported in various published articles. The ultimate objective is to offer recommendations for future initiatives and guide policymakers toward an optimal strategy to reduce the prevalence of ABR.[9]

METHODS

In order to perform this research, we devised specific methods that were focused on examining the level of ABR in Bangladesh, notably in Pabna. The goals of this review included a variety of research questions, including one that looked into the causes of the ABR epidemic in Pabna. To find pertinent literature on ABR in Pabna, extensive searches were conducted between 2004 and 2022 using search engines including Google Scholar, PubMed, BioMed, and Banglajol. The WHO global priority list was taken into consideration as the review covered a variety of pathogens listed in the publications. Antibiotics, resistance, Pabna, and Bangladesh-related keywords were included as part of a review strategy. The information received from various sources was arranged in tabular form.

The resistance patterns of the pathogens were recorded, and for each bacterium, the resistance pattern was presented using median and interquartile range values. Data analysis was conducted using Microsoft excel 2016.

DISCUSSION

The study presented the resistance pattern for each bacterium using the median and interquartile range values.[10] It documented the resistance patterns of diverse diseases. In order to analyze the data, Microsoft Excel 2016 was used. The research's main area of interest was Pabna, Bangladesh.[11,12] The disc diffusion method was used in 96.16% of the investigations (34 of the 44), out of the many susceptibility testing techniques used. The criteria for antimicrobial susceptibility testing from the Clinical and Laboratory Standard Institute (CLSI) were used to interpret the bulk of the results (94.31%, or 36 out of 44). There were 44 studies, and 18.51% (7 out of 44) examined urine samples from urinary tract infections (UTIs), and 16.07% (6 out of 44) examined blood and gastroenteritis culture samples. An overview of these studies has been given in Table 1.

9 of the 14 pathogens chosen for analysis had median and interquartile range values that were determined as shown in Table 2. In some cases, there was insufficient data to calculate the interquartile range (IQR), which normally requires at least three data points.

Escherichia coli, which is the most common culprit in urinary tract infections (UTIs), was the subject of investigation in 21 research articles. The results pointed to a significant resistance to several commonly prescribed drugs, including ampicillin (with a resistance rate of 96.5%, ranging from 92% to 100%), amoxiclav (with a resistance rate of 65.5%, ranging from 52% to 92.9%), ciprofloxacin (with a resistance rate of 65.2%, ranging from 59.4% to 80.85%), and co-trimoxazole (with a resistance rate of 79%, with no specified IQR).[13-21]

For other microorganisms responsible for UTIs, similar trends were observed. In the case of *Klebsiella spp.*, resistance rates of 100% (ranging from 99.98% to 100%), 54.85% (ranging from 10.7% to 85.3%), 66.4% (ranging from 49.6% to 82.9%), and 76.9% (ranging from 38% to 88.5%) were recorded for ampicillin, amoxiclav, ciprofloxacin, and co-trimoxazole, respectively.[22,23]

In the case of *Pseudomonas spp.* isolates, 66.5% (with a range of 39.1% to 98.9%) displayed resistance to co-trimoxazole, while *Enterococcus spp.* isolates showed non-susceptibility in 88.5% of cases (with a range of 84.2% to 99%). Both *Enterococcus spp.* isolates and Pseudomonas spp. isolates exhibited resistance to ciprofloxacin, with 62% (ranging from 74.3% to 97.7%) for *Enterococcus spp.* and 69.3% (ranging from 24% to 88.3%) for *Pseudomonas spp*. These findings indicated the presence of extended-spectrum beta-lactamase (ESBL) production, as evidenced by the high resistance to beta-lactam antibiotics.

For *E. coli*, the resistance rates to cefotaxime, ceftazidime, and ceftriaxone were 54.4%, 62.3%, and 49%, respectively. In contrast, *Klebsiella spp.* exhibited higher resistance rates of 98.4%, 81.5%, and 76% to these antibiotics, respectively.

Conversely, carbapenem antibiotics demonstrated significant efficacy against the majority of the previously mentioned microorganisms. Only a minimal 1.3% (with a range of 0% to 9.9%) of *E. coli*, 0% (with a range of 0% to 13.5%) of *Klebsiella spp.*, 15.4% (with a range of 6.4% to 39.6%) of *Pseudomonas spp.*, and 31.9% (with a range of 11.6% to 58.7%) of these bacteria exhibited resistance to imipenem. Resistance to meropenem was observed in 12.3% (with a range of 0.2% to 36%).

Isolates of *Streptococcus pneumoniae* obtained from pneumonia patients were found to be highly susceptible to penicillin (with a resistance rate of 3%, ranging from 2.5% to 18%) and ampicillin (with a resistance rate of 0%, ranging from 0% to 16%). In contrast, Staphylococcus aureus displayed substantial resistance to penicillin, ampicillin, co-trimoxazole, and amoxicillin (with resistance rates of 89.7%, 82.8%, 53.2%, and 66.5%, respectively).

Methicillin-resistant Staphylococcus aureus (MRSA) was detected in four studies through oxacillin susceptibility testing, identifying 93 out of 199 isolates as MRSA. In the case of *Salmonella spp.*, eight studies reported their antibiotic resistance patterns. These bacteria exhibited high susceptibility to cefixime (with a resistance rate of 0%, ranging from 0% to 9.5%) and ceftriaxone (with a resistance rate of 2%, ranging from 0% to 9.2%). For Shigella spp. isolates, only 9.9% (with a range of 2.4% to 18.8%) were resistant to ciprofloxacin.[24-48]

The misuse of first-line antibiotics in the treatment of urinary tract infections (UTIs) has drawn criticism, and recent studies in Africa have found a trend that is consistent with this problem.[49] Because *E. coli* bacteria have demonstrated increased resistance to amoxicillin and amoxiclav, it has been advised to use additional antibiotics when necessary, such as tigecycline and nitrofurantoin.[50]

Staphylococcal infections caused by MRSA have been linked to increased mortality risks, prolonged hospital stays, and greater healthcare costs. These studies have shown that vancomycin is an effective MRSA therapy. Initially, Streptococcus pneumoniae was the chosen option for treating pneumococcal illness since its antibiotic resistance was relatively low.

However, a recent Asian study has shown contradictory findings. Only three of 140 isolates of Enterococcus spp. were identified to have vancomycin resistance in a specific study (resulting in a 0% resistance rate). It's important to note that just three studies examined vancomycin susceptibility; hence, in-depth investigation is required to fully comprehend the problem.

This research has revealed significant shortcomings in surveillance methods. The study was conducted in Pabna, where the effectiveness of prescribed antibiotics was limited due to widespread antibiotic resistance resulting from their improper use. This issue affected a substantial portion of the data, with susceptibility results standing at 26.82% and 90.24% for hospital and community infections, respectively.

These discrepancies pose challenges when comparing this study with others of high quality. Further investigation is necessary, particularly for diseases that have been overlooked since there haven't been enough studies done on them, as is mentioned in the results section, even though ongoing efforts are being made to battle antimicrobial resistance (ABR). The urgent need for appropriate antibiotic usage is highlighted by the lack of novel antibiotics in the market. To protect the effectiveness of current antibiotics, achieving this goal might necessitate the implementation of more stringent antibiotic usage regulations.[51]

Table 1: Analysis in brief, (n=44).

Characteristics	N	Percentages (%)
Year of publication		
2004-2010	6	17.07
2011-2014	12	29.82
2015-2018	19	45.90
2019-2022	7	15.30
Origin of infection		
Community-acquired	5	10.75
Hospital-acquired	6	12.19
Both	3	7.75
Unknown	32	69.31
Patient category or classification		
In-patient	14	37.28
Out-patient	15	13.75
In-patient and out-patient	9	18.31
Did not mention	6	32.24
Method for testing susceptibility		
Disk diffusion	34	96.16
Dilution	6	27.17
E-test	4	3.67
Standard for susceptibility testing		
CLSI	36	94.31
Eucast	3	3.02
Did not mention	5	2.67
Medical condition or illness category		
Urinary tract infection	7	18.51
Bloodstream infection	6	16.07
Gastroenteritis	8	15.27
Wound infection	2	3.93
Respiratory tract infection	2	4.73
Multiple syndromes	18	36.02
Unavailable	2	5.47

Table 2: Calculated pathogens' MR and IQR.

Drugs	*Acinetobacter spp.*, MR (IQR) total sample	*Enterococcus spp.*, MR (IQR) total sample	*E. coli*, MR (IQR) total sample	*Klebsiella spp.*, MR (IQR) total sample	*Pseudomonas spp.*, MR (IQR) total sample	*Salmonella spp.*, MR (IQR) total sample	*Shigella spp.*, MR (IQR) total sample	*S. aureus*, MR (IQR) total sample	*S. pneumoniae*, MR (IQR) total sample
Amikacin	65.75 (24.40-89.8) 415	66.6 (63.42-77.49) 161	11.5 (7.24-29.9) 1957	38.11 (12.97-67.9) 290	55.8 (34-75) 1273	N/A	N/A	N/A	N/A
Azithromycin	N/A	N/A	61.5 (27-79.9) 1320	N/A	56.5 (22-89.9) 320	N/A	N/A	37.9 (20.6-69.9) 180	42.5 (30.24-63.9) 159
Amoxyclav	N/A	N/A	65.5 (52-92.9) 745	54.85 (10.7-85) 146	85.5 (82-98.9) 145	N/A	N/A	N/A	N/A
Amoxicillin	N/A	45.5 (32-62.9) 56	91.6 (29-92.04) 867	95.5 (92-99.9) 215	N/A	N/A	N/A	N/A	66.5 (42-82.9) 745
Ampicillin	N/A	N/A	96.5 (92-100) 1465	100 (99.98-100) 179	N/A	36.5 (28.9-59.9) 9685	46.1 (18-59.9) 3545	82.8 (72-94.1) 365	0 (0-16) 321
Aztreonam	N/A	N/A	76 (32-94.8) 153	N/A	N/A	66.5 (38.9-89.9) 9341	N/A	N/A	N/A
Cephradine	N/A	N/A	65.6 (52.8-74.8) 613	N/A	N/A	N/A	N/A	N/A	25 (22-44.8) 103
Cefixime	75 (41.5-82.74) 49	N/A	66.4 (27-74.8) 798	76 (50-88) 245	N/A	0 (0-9.5) 6853	N/A	N/A	42.7 (7-48.9) 157
Cefepime	N/A	N/A	65.35 (44.3-73.59) 378	N/A	N/A	N/A	N/A	59.3 (58.16-66.7) 109	26 (17.2-44.8) 110
Ceftazidime	78 (54-95) 427	N/A	62.3 (32.5-85.4) 1655	81.5 (55.8-99.2) 313	56.8 (29.6-73.4) 1279	N/A	N/A	N/A	N/A
Cefotaxime	82.8 (61.9-95.4) 62	N/A	54.4 (12.1-92.4) 119	98.8 (85.2-100) 72	49 (45.6-77.5) 138	N/A	N/A	N/A	N/A
Ceftriaxone	72.6 (44.5-91.5) 826	73.3 (52.8-96.9) 136	49 (31.7-71.8) 2791	76 (44.1-94.6) 729	65 (52.9-79.2) 190	2 (0-9.2) 9962	N/A	46.4 (26.8-39.1) 314	10 (0-32.1) 342
Cefuroxime	86 (52-82.5) 46	100 (50.9-100) 65	88.8 (49.9-99.9) 686	78.7 (58.9-98.4) 146	N/A	N/A	N/A	59.3 (43.1-68.78) 1129	N/A
Chloramphenicol	N/A	N/A	23.7 (0-87.5) 520	33.8 (43.8-74.3) 117	N/A	30.8 (23-47.1) 3575	N/A	17.4 (2-34) 265	N/A

Continued.

Drugs	*Acinetobacter spp.*, MR (IQR) total sample	*Enterococcus spp.*, MR (IQR) total sample	*E. coli*, MR (IQR) total sample	*Klebsiella spp.*, MR (IQR) total sample	*Pseudomonas spp.*, MR (IQR) total sample	*Salmonella spp.*, MR (IQR) total sample	*Shigella spp.*, MR (IQR) total sample	*S. aureus*, MR (IQR) total sample	*S. pneumoniae*, MR (IQR) total sample
Cloxacillin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	44.6 (25.7-59.7) 144	N/A
Ciprofloxacin	83.2 (45.6-92.7) 819	62 (74.3-97.7) 194	65.2 (59.4-80.85) 3162	66.4 (49.6-82.9) 855	69.3 (24-88.3) 2194	36.6 (6-94.5) 1053	9.9 (2.4-18.8) 3443	54.7 (45.4-69.5) 586	18.3 (14-38.3) 438
Colistin	N/A	N/A	N/A	28.8 (0-31.4) 48	N/A	45.8 (10-21.6) 44	N/A	N/A	23.9 (4-11.4) 56
Cotrimoxazole	72.5 (58.6-96) 79	88.5 (84.2-99) 100	79 (66.5-92.2) 3162	76.9 (38-88.5) 456	66.5 (39.1-98.9) 159	19.8 (10.8-36.7) 9875	79.5 (61-89.9) 3645	53.2 (21-75) 383	66.6 (84.5-98.02) 479
Erythromycin	N/A	N/A	45 (34.2-89.5) 195	N/A	N/A	N/A	N/A	67 (52.2-79.7) 269	N/A
Doxycycline	25 (13.77-92.43) 1021	N/A	615.1 (34.5-97.8) 1313	N/A	N/A	N/A	N/A	45 (23.47-82.3) 104	N/A
Imipenem	22.3 (2-55.1) 360	N/A	1.3 (0-9.9) 1727	0 (0-13.5) 555	15.4 (6.4-39.6) 1365	N/A	4 (2.1-37.71) 642	6 (4.5-8.6) 124	N/A
Gentamicin	89.3 (43.4-96) 766	27.1 (22.3-89) 124	7.14 (0.55-93.15) 1667	21.65 (2.5-45.82) 218	54 (7.95-92.05) 758	N/A	29.8 (19.7-40.1) 558	10 (7.7-52.2) 119	N/A
Levofloxacin	N/A	N/A	30.97 (33.4-51) 856	49.03 (33.9-72.87) 89	8.3 (7.65-18.99) 327	57 (39.7-89.2) 894	N/A	N/A	N/A
Nalidixic acid	N/A	N/A	15 (6-66.7) 774	28.57 (17-33.3) 100	60.8 (42.5-92.9) 226	N/A	76.6 (36.5-89.4) 3416	69.9 (33-89.8) 540	N/A
Meropenem	N/A	N/A	12.3 (0.2-36.2) 929	66 (30-72.5) 224	31.9 (11.6-58.7) 134	N/A	N/A	N/A	N/A
Nitrofurantoin	N/A	N/A	10 (20-57) 980	35.3 (16-46) 256	45.67 (1.5-54.5) 84	N/A	N/A	N/A	N/A
Oxacillin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	46.7 (34-68.1) 218
Penicillin	N/A	N/A	N/A	N/A	N/A	N/A	N/A	89.7 (68-96.5) 212	3 (2.5-18) 342
Tetracycline	N/A	N/A	65 (42.6-72) 1520	N/A	N/A	N/A	N/A	N/A	43.5 (22.9-59.6) 235

CONCLUSION

Considering the prevalence of alarming microorganism strains in several hospitals throughout this city, the situation with ABR in Pabna, Bangladesh, is particularly bad. There are significant obstacles to the effectiveness of antibiotics prescribed at Pabna's hospitals, suggesting possible abuse and overuse of these drugs. ABR currently poses a greater threat to the citizens of Pabna than antibiotic misuse problems do in other cities. Therefore, more research is really necessary in peripheral cities. This work has successfully located antibiotic-resistant bacterial infections in Pabna and emphasized their susceptibility patterns, despite the lack of comprehensive resistance data. Healthcare practitioners can use the information from this study to help them choose an appropriate course of antibiotic medication. Additionally, prescription analysis results imply that tetracycline, amoxicillin, and fourth-generation cephalosporins have evolved resistance in Pabna, providing important information for future research and treatment approach improvements.

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REFERENCES

1. Aminov RI. A brief history of the antibiotic era: lessons learned and challenges for the future. Front Microbiol. 2010;1:134.
2. Fauci A. Infectious diseases: considerations for the 21st century. Clin Infect Dis. 2001;32:675-85.
3. Antimicrobial resistance: global report on surveillance. Geneva, 2014. Available at: https://www.who.int/antimicrobial-resistance/publications/surveillancereport/en/. Accessed on 20 January, 2024.
4. O'Neill J. Tackling drug-resistant infections globally: final report and recommendations. Available at: https://amr-review.org/sites/default/files/160518_Final%20paper_with%20cover.pdf. Accessed on 20, January 2024.
5. Gulen TA, Guner R, Celikbilek N, Keske S, Tasyaran M. Clinical importance and cost of bacteremia caused by nosocomial multi drug resistant Acinetobacter baumannii. Int J Infect Dis. 2015;38:32-5.
6. Faiz MA, Rahman MR. Rational antimicrobial use. J Chittagong Med Coll Assoc. 2004;15(1):1-3.
7. Global action plan on antimicrobial resistance. Available at: https://www.who.int/antimicrobial-resistance/global-action-plan/en/. Accessed on 20 January, 2024.
8. Brooks WA, Hossain A, Goswami D, Nahar K, Alam K, Ahmed N, et al. Bacteremic typhoid fever in children in an urban slum, Bangladesh. Emerg Infect Dis. 2005;11(2):326-9.
9. Mahbubur R, Shoma S, Rashid H, El Arifeen S, Baqui AH, Siddique A, et al. Increasing spectrum in antimicrobial resistance of *Shigella* isolates in Bangladesh: resistance to azithromycin and ceftriaxone and decreased susceptibility to ciprofloxacin. J Health Popul Nutr. 2007;25(2):158.
10. Shahriar M, Hossain M, Kabir S. A survey on antimicrobial sensitivity pattern of different antibiotics on clinical isolates of *Escherichia coli* collected from Dhaka City, Bangladesh. J Appl Sci Environ Manage. 2010;14(3):54-9.
11. Monjur F, Rizwan F, Asaduzzaman M, Nasrin N, Ghosh N, Apu A, et al. Antibiotic sensitivity pattern of causative organisms of neonatal septicemia in an urban hospital of Bangladesh. Indian J Med Sci. 2010;64(6):265.
12. Shill MC, Huda NH, Moain FB, Karmakar UK. Prevalence of uropathogens in diabetic patients and their corresponding resistance pattern: results of a survey conducted at diagnostic centers in Dhaka, Bangladesh. Oman Med J. 2010;25(4):282-5.
13. Khan SA, Feroz F, Noor R. Study of extended-spectrum β-lactamase-producing bacteria from urinary tract infections in Bangladesh. Tzu Chi Med J. 2013;25(1):39-42.
14. 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.
15. Ud-Din AI, Wahid SU, Latif HA, Shahnaij M, Akter M, Azmi IJ, et al. Changing trends in the prevalence of *Shigella* species: emergence of multi-drug resistant *Shigella sonnei* biotype g in Bangladesh. PLoS One. 2013;8(12)e82601.
16. Afroz H, Hossain MM, Fakruddin M. A 6-year retrospective study of bloodstream *Salmonella* infection and antibiotic susceptibility of *Salmonella enterica* serovar *Typhi* and *Paratyphi* in a tertiary care hospital in Dhaka, Bangladesh. Tzu Chi Med J. 2014;26(2):73-8.
17. Akram F, Pietroni MA, Bardhan PK, Bibi S, Chisti MJ. Prevalence, clinical features, and outcome of *Pseudomonas* bacteremia in under-five diarrheal children in Bangladesh. Microbiol. 2014;5(8):67-9.
18. Akter S, Shamsuzzaman S, Jahan F. Community acquired bacterial pneumonia: aetiology, laboratory detection and antibiotic susceptibility pattern. Malays J Pathol. 2014;36(2):97-103.
19. Chiou C-S, Lauderdale T-L, Phung DC, Watanabe H, Kuo J-C, Wang P-J, et al. Antimicrobial resistance in *Salmonella enterica* serovar *Typhi* isolates from Bangladesh, Indonesia, Taiwan, and Vietnam. Antimicrob Agents Chemother. 2014; 58(11):6501-7.
20. Hossain MD, Ahsan S, Kabir MS. Antibiotic resistance patterns of uropathogens isolated from catheterized and noncatheterized patients in Dhaka, Bangladesh. Tzu Chi Med J. 2014;26(3):127-31.

21. Islam QT, Siddiqui MMR, Raz F, Asrafuzzaman M, Amin MR. Patterns of antimicrobial resistance among intensive care unit patients of a private medical college hospital in Dhaka. Bangladesh J Med. 2014;25(2):47-51.
22. Khanam F, Sayeed MA, Choudhury FK, Sheikh A, Ahmed D, Goswami D, et al. Typhoid fever in young children in Bangladesh: clinical findings, antibiotic susceptibility pattern and immune responses. PLoS Negl Trop Dis. 2015;9(4):e0003619.
23. Islam TAB, Shamsuzzaman S. Prevalence and antimicrobial susceptibility pattern of methicillin-resistant, vancomycin-resistant, and Panton-valentine leukocidin positive *Staphylococcus aureus* in a tertiary care hospital Dhaka, Bangladesh. Tzu Chi Med J. 2015;27(1):10-4.
24. Aftab H, Miftahussurur M, Subsomwong P, Ahmed F, Khan AA, Yamaoka Y. *Helicobacter pylori* antibiotic susceptibility patterns in Bangladesh: emerging levofloxacin resistance. J Infect Dev Countries. 2016;10(03):245-53.
25. Ullah B, Ahmed S, Shahariar M, Yesmine S. Current trend of antibiotic resistance in lower respiratory tract infections (LRTIs): an experience in a teaching hospital in Bangladesh. Bangladesh Pharm J. 2016;19(1):85-91.
26. Ahsan AA, Fatema K, Barai L, Faruq MO, Ahmed F, Saha DK, et al. Prevalence and antimicrobial resistance pattern of blood isolates in patients of septicemia in ICU: single centre observation. Bangladesh Crit Care J. 2016;4(2):100-4.
27. Akter T, Hossain MJ, Khan MS, Sultana H, Fatema K, Al Sanjee S, et al. Isolation, identification and antimicrobial susceptibility pattern analysis of *Escherichia coli* isolated from clinical samples of Bangladesh. Asian J Biomed Pharm Sci. 2016;6(54):13.
28. Jobayer M, Afroz Z, Nahar SS, Begum A, Begum SA, Shamsuzzaman S. Antimicrobial susceptibility pattern of extended-spectrum beta-lactamases producing organisms isolated in a tertiary care hospital, Bangladesh. Int J Appl Basic Med Res. 2017;7(3):189.
29. Nazme NI, Al Amin A, Jalil F, Sultana J, Fatema NN. Bacteriological profile of urinary tract infection in children of a tertiary care hospital. Bangladesh J Child Health. 2017;41(2):77-83.
30. Roy S, Ahmed MU, Uddin BMM, Ratan ZA, Rajawat M, Mehta V, et al. Evaluation of antibiotic susceptibility in wound infections: a pilot study from Bangladesh. F1000 Res. 2017;6:2103.
31. Suchi SE, Shamsuzzaman S, Uddin BMM, Yusuf MA. Detection of virulence factors and antimicrobial resistance in *Enterococci* isolated from urinary tract infection. Bangladesh J Infect Dis. 2017;4(2):30-4.
32. Global priority list of antibiotic-resistance bacteria to guide research, discovery, and development of new antibiotics. Available at: https://www.who.int/medicines/publications/WHO-PPL-Short_Summary_25Feb-ET_NM_WHO.pdf. Accessed on 20 January, 2024.
33. Ahmed I, Rabbi MB, Sultana S. Antibiotic resistance in Bangladesh: A systematic review. Int J Infect Dis. 2019;80:54-61.
34. Khan A, Huq S, Malek M, Hossain M, Talukder K, Faruque A, et al. Shigella serotypes among hospitalized patients in urban Bangladesh and their antimicrobial resistance. Epidemiol Infect. 2004;132(4):773-7.
35. Nahar S, Mukhopadhyay AK, Khan R, Ahmad MM, Datta S, Chattopadhyay S, et al. Antimicrobial susceptibility of Helicobacter pylori strains isolated in Bangladesh. J Clin Microbiol. 2004;42(10):4856-8.
36. Yasmeen BN, Islam S, Islam S, Uddin MM, Jahan R. Prevalence of urinary tract infection, its causative agents and antibiotic sensitivity pattern: a study in Northern International Medical College Hospital, Dhaka. North Int Med Coll J. 2015;7(1):105-9.
37. Mia MF, Mia MAA, Saha D, Khan AA, Chakraborty A. Antibiotic resistance pattern and stewardship programme in critical care settings. Bangla Med Res Counc Bull. 2017;43:131-7.
38. Ahmed D, Nahid MA, Sami AB, Halim F, Akter N, Sadique T, et al. Bacterial etiology of bloodstream infections and antimicrobial resistance in Dhaka, Bangladesh, 2005-2014. Antimicrob Resist Infect Control. 2017;6(1):2.
39. Bello-López JM, Cabrero-Martínez OA, Ibáñez-Cervantes G. Horizontal gene transfer and its association with antibiotic resistance in the genus *Aeromonas* spp. Microorganisms. 2019;7(9):363.
40. Mamuye Y. Antibiotic resistance patterns of common gram-negative uropathogens in St. Paul's hospital millennium medical college. Ethiop J Health Sci. 2016;26(2):93-100.
41. Hoque R, Ahmed SM, Naher N. Tackling antimicrobial resistance in Bangladesh: A scoping review of policy and practice in human, animal and environment sectors. PLoS One. 2020;15(1):e0227947.
42. Islam S, Yasif KS, Monjur-Al-Hossainand ABM. Study on the pattern of antibiotic use including the resistance episodes in Bangladesh. Dhaka Univ J Pharm Sci. 2019;18(2):135-43.
43. Rahman SR, Ahmed MF, Begum A. Occurrence of urinary tract infection in adolescent and adult women of shanty town in Dhaka City, Bangladesh. Ethiop J Health Sci. 2014;24(2):145-52.
44. Suchi SE, Shamsuzzaman S, Uddin BMM, Yusuf MA. Detection of virulence factors and antimicrobial resistance in *Enterococci* isolated from urinary tract infection. Bangladesh J Infect Dis. 2017;4(2):30-4.
45. Haque R, Akter ML, Salam MA. Prevalence and susceptibility of uropathogens: a recent report from a teaching hospital in Bangladesh. BMC Res Notes. 2015;8(1):416.
46. Monjur F, Rizwan F, Asaduzzaman M, Nasrin N, Ghosh N, Apu A, et al. Antibiotic sensitivity pattern

of causative organisms of neonatal septicemia in an urban hospital of Bangladesh. Indian J Med Sci. 2010;64(6):265.

47. Akter S, Ferdousi RS, Siddiqua M. Bacterial isolates and antimicrobial susceptibility in children with acute diarrhea at Ibn Sina Medical College, Bangladesh. Indian J Med Sci. 2017;8(2):80-6.
48. Begum YA, Talukder K, Azmi IJ, Shahnaij M, Sheikh A, Sharmin S, et al. Resistance pattern and molecular characterization of enterotoxigenic *Escherichia coli* (ETEC) strains isolated in Bangladesh. PLoS One. 2016;11(7):e0157415.
49. Tadesse BT, Ashley EA, Ongarello S, Havumaki J, Wijegoonewardena M, González IJ, et al. Antimicrobial resistance in Africa: a systematic review. BMC Infect Dis. 2017;17(1):616.
50. Garau J. Other antimicrobials of interest in the era of extended-spectrum beta-lactamases: fosfomycin, nitrofurantoin and tigecycline. Clin Microbiol Infect. 2008;14(1):198-20.
51. Ahmed I, Rabbi MB, Sultana S. Antibiotic resistance in Bangladesh: A systematic review. Int J Infect Dis. 2019;80:54-61.

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