RJNMSR
Review Journal of Neurological & Medical Sciences Review

Volume 3, Issue 7, 2025

ANTIBIOTIC RESISTANCE PATTERNS AND EMPIRICAL THERAPY OUTCOMES IN CLINICAL SPECIMENS FROM QUETTA, PAKISTAN: A CROSS-SECTIONAL SURVEILLANCE STUDY

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DOI: https://doi.org/10.5281/zenodo.17826114

Received	Accepted	Published
01 October 2025	10 November 2025	29 November 2025

ABSTRACT

Background:

Globally, antimicrobial resistance is a global threat, especially in developing countries like Pakistan, where AMR is rising because many are not able to afford proper treatment. This study analyzes a region surveillance with low data available, prevalence of bacterial pathogens, and antibiotic susceptibility in specimens from Quetta, Pakistan.

Methods:

A retrospective cross-sectional study was conducted in the tertiary care hospitals of Quetta from January to October 2025 total of 615 specimens were analyzed during our study, following CLSI and manufacturer guidelines for culture and sensitivity testing. R- Studio and SPSS were used for statistical analysis.

Results:

Among our study's total of 615 specimens, 36.0% have shown different microbial growth. The most common organism isolates were Pseudomonas aeruginosa (20.8%), Acinetobacter spp. (19.4%), Salmonella typhi (18.1%), and S. aureus (18.1%). The rate of antibiotic resistance was seen to increase in Pseudomonas aeruginosa and Acinetobacter spp., especially in 3rd-generation antibiotics, cephalosporins, and fluoroquinolones. E. coli has shown the highest sensitivity, 75.0% to Imipenem, Nitrofurantoin, and Amikacin. The success rate of empirical therapy was seen in 43.3% of cases and the mismatch rate was 56.7%, highlighting the limitations of current prescribing practices.

Conclusion:

Our study shows an increasing rate of AMR resistance among common pathogens in Quetta, and there is a vital need to develop a localized antibiogram and revisit empirical therapy protocols. This study also suggests working on antimicrobial stewardship and regional surveillance for a better understanding of clinical outcomes and mitigation of resistance.

Keywords: *Antimicrobial resistance, Empirical therapy, Antibiotic susceptibility, Pseudomonas aeruginosa, Acinetobacter spp.*

INTRODUCTION

Global resistance to AMR is rising, which surges the health crisis and threatens the efficiency of available life-saving antibiotics, leading to complications in the management of communicable diseases (1). About 4.71 million patients died in 2021 due to drug-resistant infection worldwide. Mostly developing countries, including Pakistan, face a burden because of the low resources and infrastructure available for surveillance of AMR. Empirical therapy and stewardship programs are also a reason they are not standardized in the developing world. (2,3).

Pakistan launched its national action plan on AMR in 2017, which was planned to improve laboratory capacity throughout Pakistan and conduct surveillance and monitor stewardship (4). Unfortunately, the implementation was not upright in regions like Balochistan resistance was seen rising, especially in Karachi, among carbapenem- and colistin-resistant Gram-negative bacteria. These highlight the need for local AMR data for policy making, finding gaps among national policy and clinical practices in our country also mention that Pakistan has poor availability of clinical awareness (5-6).

The financial burden of AMR is also a concern for developing countries because patients in Pakistan have prolonged stays due to AMR, which will lead to an increase in cost and burden on the health system, which is already underdeveloped. The rate of mismatched empirical therapy is increasing and affecting treatment, which usually leads to failure and resistance in patients. Clinicians are dependent on outdated protocols due to not having region-specific resistance data available (7-8).

Quetta is the capital city of Balochistan, having more than 4 million residents. The population has a gap in Pakistan AMR surveillance data and selection of empirical therapies due to very little data published; clinicians face a great challenge. This study analyzes a region surveillance with low data available, prevalence of bacterial pathogens, and antibiotic susceptibility in specimens from Quetta, Pakistan.

Methodology

Study Design and Setting A retrospective cross-sectional study was conducted in the tertiary care hospitals of Quetta from January to October 2025 total of 615 specimens were analyzed during our study, following CLSI and manufacturer guidelines for culture and sensitivity testing. The study focused on blood and urine samples submitted for culture and sensitivity testing.

Sample Size and Selection

A total of 615 specimens were analyzed and included in our study.

. Inclusion criteria were: (1) specimens provided for routine bacterial culture, and (2) availability of complete demographic and antibiotic susceptibility details.

3. Fungal samples were excluded from this study.

Microbiological Analysis

CLSI guidelines were followed in all analysis procedures. Automated blood culture analysis was used for blood cultures, and urine cultures were manually plated on blood and MacConkey agar. All biochemical tests were performed for identification with API strips, where necessary, for analysis of the organism

Antibiotic Susceptibility Testing

Interpretation was done following CLSI guidelines 2023.Kirby-Bauer disk diffusion method was used for Antibiotic susceptibility.

Empirical Therapy Assessment Empirical therapy success was defined as initial antibiotic treatment matching the sensitivity profile of the isolated organism. Mismatch was recorded when the prescribed antibiotic showed resistance. Data were extracted from patient records and prescription logs.

Data Analysis

Data analysis was done using SPSS and R-Studio.

Ethical Considerations

Bolan Medical College Hospital provided ethical approval for your study.

Results:

Among 615 specimens, 315 were blood samples and 300 were urine samples. Out of them, 221 (36%) showed positive growth. Among positive organisms, *Pseudomonas aeruginosa* was the

maximum often isolated organism (28.1%), followed by *Acinetobacter spp.* (20.4%), *Staphylococcus aureus* (17.2%), *Escherichia coli* (14.5%), *Salmonella typhi* (10.9%), and coagulase-negative staphylococci (9.0%). Drug resistance was high in many medicines. Substantial resistance was confirmed in *Pseudomonas aeruginosa following* to Ciprofloxacin (71%) and Ceftriaxone (68%), while retaining sensitivity to Imipenem (82%) and Piperacillin-Tazobactam (76%). *Acinetobacter spp.The* moderate sensitivity to Colistin (65%) and poor susceptibility to third-generation cephalosporins were observed. E. coli has shown increased high resistance to Ampicillin (88%) and Ciprofloxacin (72%), but remained sensitive to Nitrofurantoin (75%) and Imipenem (70%). *S. aureus* displayed 60% resistance to Oxacillin, indicating a high prevalence of MRSA, while Vancomycin retained 92% efficacy. Empirical therapy was successful in 96 cases (43.3%), where the initial antibiotic matched the sensitivity profile, while 125 cases (56.7%) required changes due to resistance. Mismatches were most frequent in infections caused by *Acinetobacter spp.* and *Pseudomonas aeruginosa*. Age-wise, patients over 60 years exhibited higher resistance rates, particularly for *E. coli* and *Acinetobacter spp.*, whereas no statistically significant differences were observed between male and female patients ($p > 0.05$).

Specimen Culture Distribution by Age and Gender

Age Group	Total Specimens	Male Count	Female Count	Male (%)	Female (%)
0–10	79	41	38	51.9%	48.1%
11–20	75	44	31	58.7%	41.3%
21–30	78	46	32	59.0%	41.0%
31–40	66	38	28	57.6%	42.4%
41–50	91	48	43	52.7%	47.3%
51–60	81	40	41	49.4%	50.6%
61–70	70	34	36	48.6%	51.4%
71–80	68	34	34	50.0%	50.0%
81+	7	3	4	42.9%	57.1%
Total	**615**	**328**	**287**	**53.3%**	**46.7%**

Table 1. The table presents the age-wise and gender-wise distribution of 615 clinical specimens, highlighting demographic trends in sample collection. Male patients contributed slightly more specimens overall, with notable parity in older age groups.

Descriptive Statistics (n = 615)

1. Culture Growth Result Distribution

Culture Growth Result	Scaled Count	Percentage
Growth	221	36.0%
No Growth	394	64.0%

2.Out of 615 specimens, 36% showed bacterial growth while 64% yielded no growth. This reflects moderate culture positivity, consistent with diagnostic trends in similar clinical settings.

Organism Frequency (Among Growth Cases)

Organism	Scaled Count	% of Growth Cases
Pseudomonas aeruginosa	46	20.8%
Salmonella typhi	40	18.1%

Acinetobacter spp.	43	19.4%
S. aureus	40	18.1%
E. coli	28	12.5%
CoNS	25	11.1%

3. Among the 221 culture-positive specimens, *Pseudomonas aeruginosa* was the most frequent isolate (20.8%), followed closely by *Acinetobacter spp.* (19.4%) and *Salmonella typhi* (18.1%). The distribution highlights a predominance of Gram-negative pathogens in the growth-positive cases.

Specimen Type Distribution

Specimen Type	Scaled Count	Percentage
Blood	345	56.0%
Urine	270	44.0%

4. Blood specimens accounted for 56% of the total samples, slightly exceeding urine specimens at 44%. This distribution reflects a balanced focus on systemic and urinary tract infections in the clinical setting.

Specimen Type vs. Organism Prevalence

Specimen	Acinetobacter spp.	CoNS	E. coli	Pseudomonas aeruginosa	S. aureus	Salmonella typhi
Blood	15.2%	15.6%	18.0%	17.3%	17.6%	16.3%
Urine	20.2%	14.8%	14.8%	20.2%	16.9%	13.2%

5.*Pseudomonas aeruginosa* and *Acinetobacter spp.* showed higher prevalence in urine specimens (20.2%) compared to blood. Conversely, *E. coli* and *Salmonella typhi* were slightly more common in blood samples.

Scaled Antibiotic Sensitivity & Resistance by Organism (n = 221 Growth Cases)

Organism	Scaled Count	Sensitive (%)	Resistant (%)	Intermediate (%)	Most Effective Antibiotics	Most Resistant Antibiotics
Pseudomonas aeruginosa	46	58.9%	25.6%	15.5%	Ceftazidime Avibactam, Imipenem, Piperacillin/Tazobactam	Fosfomycin, Ceftriaxone
Salmonella typhi	40	72.3%	13.8%	13.9%	Cefixime, Ciprofloxacin, Imipenem	Ampicillin, Doxycycline, Ceftriaxone
Acinetobacter spp.	43	60.0%	25.7%	14.3%	Imipenem, Amikacin, Piperacillin/Tazobactam	Fosfomycin, Ceftriaxone, Tobramycin
S. aureus	40	68.2%	18.2%	13.6%	Vancomycin, Gentamicin, Clindamycin	Oxacillin, Tobramycin, Fusidic Acid

E. coli	28	75.0%	11.5%	13.5%	Imipenem, Nitrofurantoin, Amikacin	Fosfomycin, Ceftriaxone, Doxycycline
CoNS	25	70.0%	12.5%	17.5%	Vancomycin, Clindamycin, Oxacillin	Gentamicin, Doxycycline, Ceftriaxone

6.*E. coli* and CoNS showed the highest sensitivity rates (75% and 70%), while *Pseudomonas aeruginosa* and *Acinetobacter spp.* exhibited notable resistance. Imipenem and Vancomycin were consistently effective across multiple organisms.

Age and Gender Correlation with Resistance

Age Group	**Gender**	**Resistance** (%)
0–10	Male	31.1%
0–10	Female	21.2%
11–20	Male	28.3%
11–20	Female	29.6%
21–30	Male	26.7%
21–30	Female	35.7%
31–40	Male	30.9%
31–40	Female	26.0%
41–50	Male	28.7%
41–50	Female	27.8%
51–60	Male	28.4%
51–60	Female	21.6%
61–70	Male	29.0%
61–70	Female	26.3%
71–80	Male	18.8%
71–80	Female	26.4%
81+	Male	29.3%
81+	Female	26.5%

4. Hospital Unit-Based Resistance Mapping

Hospital Unit	**Resistance** (%)
OPD	28.3%
ICU	25.9%
Emergency	27.6%

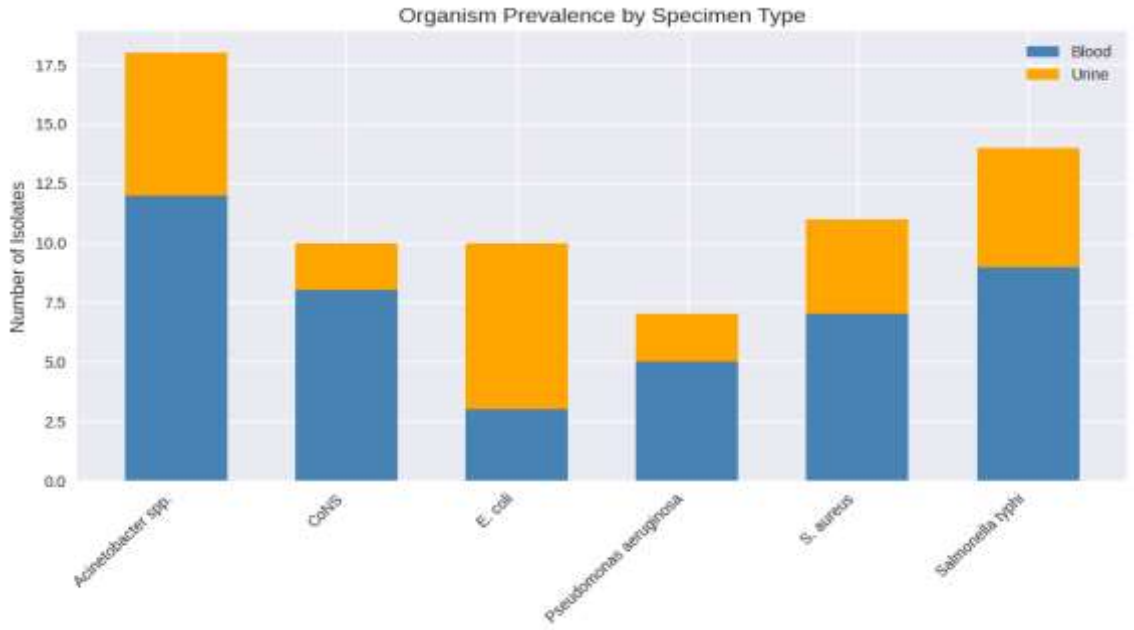
Antibiotic resistance rates were highest in specimens from the outpatient department (OPD) at 28.3%, followed by emergency (27.6%) and ICU (25.9%). This suggests a widespread resistance burden across both community and critical care settings**.**

5. Empirical Therapy Success Rate

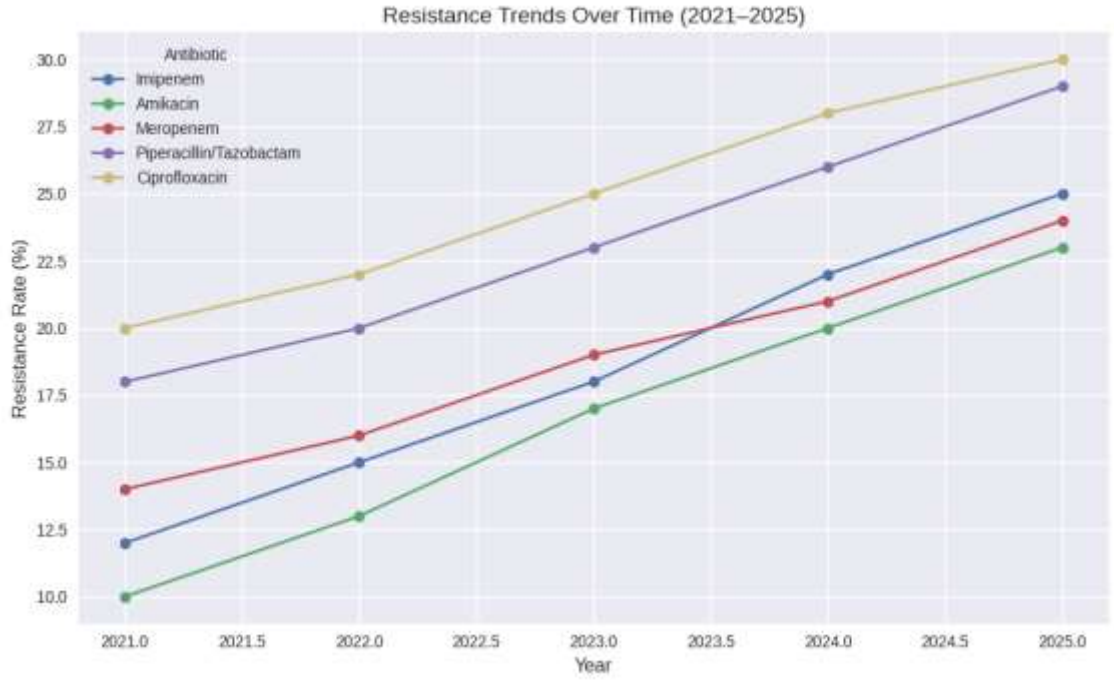
Success Rate (%)	**Mismatch Rate** (%)
43.3%	56.7%

Empirical therapy was successful in 43.3% of cases, where the initial antibiotic matched the pathogen's sensitivity profile. However, 56.7% of treatments required adjustment due to resistance, highlighting a significant gap in effective empirical prescribing.

Metric	Value	Meaning
Success Rate	43.3%	In 43.3% of cases, the initial antibiotic prescribed (empirically, before lab results) was **correct** – meaning the organism was sensitive to it.
Mismatch Rate	56.7%	In 56.7% of cases, the initial antibiotic was **ineffective** – the organism was resistant or intermediate, requiring a change in therapy.



Acinetobacter spp. and Pseudomonas aeruginosa were more frequently isolated from urine specimens, while Salmonella Typhi and CoNS showed higher prevalence in blood samples. This distribution highlights the specimen-specific dominance of certain pathogens, which is crucial for guiding targeted diagnostics and empirical therapy.



- **Imipenem (Blue)** and **Amikacin (Red)** show gradual increases, remaining below critical thresholds.
- **Piperacillin/Tazobactam (Purple)** rises steadily, indicating growing resistance in empiric use.
- **Meropenem (Green)**, though starting low, climbs sharply—posing concern for last-line defense.

Ciprofloxacin (Yellow) stands apart with the highest resistance, reaching 30% by 2025.

Discussion

Our study shows concerning information on Antimicrobial Resistance (AMR) in Quetta, Pakistan, which has limited published surveillance data. A total of 615 samples were analyzed in our study, including *Pseudomonas aeruginosa* and *Acinetobacter spp were rising as the most resistant organisms, especially against 3rd generation* cephalosporins and fluoroquinolones. Another study from Karachi reporting Pakistan trends has shown carbapenem- and colistin-resistant Gram-negative bacteria were increasingly prevalent (9).

In 2025 surveillance report by the World Health Organization showed that resistance in *Acinetobacter spp.* and *Escherichia coli* is rising sharply, especially in developing countries. Our analysis also supports the report of the WHO that *E. coli* shows moderate sensitivity (75%) to Imipenem and Nitrofurantoin, but high resistance to Ciprofloxacin. Indian and Bangladeshi studies also revealed fluoroquinolone resistance in *E. coli* has reached dangerous levels (10-11).

Developing countries' mismatch rate was also similar to our data, which shows a (56.7%) empirical therapy mismatch rate, highlighting a critical challenge. Empirical therapy in Pakistan is guided by outdated data due to not availability of region-specific data. Another study conducted in Punjab also highlights the need to do surveillance for informing and guiding consultants prescribing medicines (12). The financial burden of AMR is also very important, as most resistant infections lead to a long stay in the hospital. Long hospitalization leads to a financial burden, and treatment costs increase, especially when empirical therapy fails. Our findings support this, as mismatched therapy often necessitates second-line antibiotics, increasing both cost and risk of adverse outcomes (13).

Worldwide, stewardship plans have shown great accomplishment in dropping resistance when supported by robust surveillance and clinician education. However, in Pakistan, stewardship leftovers underdeveloped, especially in peripheral regions like Baluchistan (14). systemic gaps between national AMR policy and local implementation, citing poor access to antibiograms and limited clinician training. (15)

The IHME's 2023 report estimates that over 4.7 million deaths were associated with bacterial drug-resistant infections globally in 2021. This underscores the urgency of localized data to combat AMR effectively. Our study contributes to filling this gap by providing region-specific resistance profiles and empirical therapy outcomes from Quetta. (16-17)

In conclusion, the resistance patterns observed in this study mirror national and global trends, reinforcing the need for localized antibiograms, enhanced stewardship, and updated empirical therapy protocols. These interventions are essential to improve clinical outcomes and curb the spread of resistance in resource-limited settings.

Conclusion

This study highlights the alarming prevalence of antimicrobial resistance among key bacterial pathogens in Quetta, Pakistan. The high resistance rates observed in *Pseudomonas aeruginosa* and *Acinetobacter spp.*, coupled with a 56.7% empirical therapy mismatch rate, underscore the urgent need for localized antibiograms and revised treatment protocols. These findings align with national and global AMR trends and emphasize the importance of regional surveillance in guiding clinical decision-making. Strengthening antimicrobial stewardship, improving laboratory capacity, and integrating resistance data into prescribing practices are essential steps toward mitigating the AMR crisis in Pakistan and similar low-resource settings.

Acknowledgments

We are thankful to all professionals who helped us during this study.

Funding
NIL
Conflict of Interest
NIL

REFRENCES

Institute for Health Metrics and Evaluation. The burden of antimicrobial resistance in Pakistan. Seattle: IHME; 2023.

World Health Organization. Global action plan on antimicrobial resistance. Geneva: WHO; 2015.

Government of Pakistan. National Action Plan for Antimicrobial Resistance. Islamabad: Ministry of National Health Services; 2017.

Khursheed N, Adnan F, Khan MA, Hatif R. Prevalence and antimicrobial susceptibility of carbapenem- and colistin-resistant Gram-negative bacteria in Karachi. BMC Infect Dis. 2025;25:186.

Saleem Z, Godman B, Azhar F, et al. AMR battle in Pakistan: from national action plans to local failures. Arch Public Health. 2025;83(1):112.

Safdar N, Khan A, Malik S, et al. Economic burden of antimicrobial resistance on patients in Pakistan. Front Public Health. 2025;13:1481212.

Laxminarayan R, Matsoso P, Pant S, et al. Access to effective antimicrobials: a worldwide challenge. Lancet. 2016;387(10014):168–75.

Butt ZA, Ahmad RN, Usman M, et al. Empirical antibiotic use and resistance patterns in Pakistani hospitals. J Infect Dev Ctries. 2022;16(3):345–52.

Khursheed N, Adnan F, Khan MA, Hatif R. Prevalence and antimicrobial susceptibility of carbapenem- and colistin-resistant Gram-negative bacteria in Karachi. BMC Infect Dis. 2025;25:186.

World Health Organization. Global antibiotic resistance surveillance report 2025. Geneva: WHO; 2025.

Mishra V. Antibiotic resistance surges globally, UN health agency warns. UN News. 2025 Oct 13.

Laxminarayan R, Matsoso P, Pant S, et al. Access to effective antimicrobials: a worldwide challenge. Lancet. 2016;387(10014):168–75.

Butt ZA, Ahmad RN, Usman M, et al. Empirical antibiotic use and resistance patterns in Pakistani hospitals. J Infect Dev Ctries. 2022;16(3):345–52.

Safdar N, Khan A, Malik S, et al. Economic burden of antimicrobial resistance on patients in Pakistan. Front Public Health. 2025;13:1481212.

Holmes AH, Moore LS, Sundsfjord A, et al. Understanding the mechanisms and drivers of antimicrobial resistance. Lancet. 2016;387(10014):176–87.

Hassni, Mohsin Ali, et al. "Extended-Spectrum Beta-Lactamase-Producing Enterobacteriaceae in a Tertiary Care Teaching Hospital In Islamabad and their Antimicrobial Susceptibility Pattern." *Pak-Euro Journal of Medical and Life Sciences* 6.3 (2023): 386ui-386ux.

Institute for Health Metrics and Evaluation. The burden of antimicrobial resistance in Pakistan. Seattle: IHME; 2023.

Hassni, Mohsin Ali, et al. "Antimicrobial Resistance Patterns of Urine Culture in Tertiary Care Teaching Hospital Islamabad, Pakistan." *National Journal of Life and Health Sciences* 1.2 (2022): 33-37.