Comprehensive Prescription Audit of Antibiotic Use in Pneumonia: Evaluation of Guideline Adherence, Dose Accuracy, Duration and Drug Related Safety Risks in Semi-Urban Healthcare Settings

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***Abstract*—Pneumonia remains a leading cause of morbidity and a primary driver of antimicrobial consumption globally. In semi-urban healthcare settings, clinicians often manage high-risk patients amidst diagnostic limitations, which can lead to variations in prescribing patterns. Inappropriate antibiotic use not only increases the risk of treatment failure and adverse drug reactions but also accelerates the development of antimicrobial resistance (AMR). This study aimed to conduct a structured prescription audit of pneumonia management in the semi-urban healthcare facilities of the Daund region. The specific objectives were to analyze antibiotic selection trends, evaluate the accuracy of dosing regimens, assess adherence to standard treatment guidelines (STG), and identify potential drug-related safety risks. A retrospective observational audit was conducted on 26 clinical cases meeting the inclusion criteria for pneumonia (including multilobe, aspiration, and viral pneumonitis). Data concerning patient demographics, antibiotic classes, dosage, administration frequency, and concomitant medications were extracted using a standardized data collection tool. The prescriptions were benchmarked against ICMR and IDSA/ATS guidelines, and results were analyzed using descriptive statistics. The audit revealed a high reliance on broad-spectrum empirical therapy. Carbapenems (Meropenem) were the most frequently prescribed agents (46.7%), followed by Beta-lactam/Beta-lactamase inhibitor combinations (Ceftriaxone-Tazobactam, 40%). Macrolides (Azithromycin/Clarithromycin) were used in 60% of cases for atypical coverage. While dosing the general adult population was largely accurate, there was minimal evidence of renal dose adjustment in geriatric patients or those with Acute Kidney Injury (AKI). Adherence to supportive care protocols (nebulization and gastric protection) was 100%. However, de-escalation from intravenous to oral therapy was infrequently documented. The findings indicate that while clinical management is aggressive and comprehensive, there is a significant deviation from "Access" group antibiotics toward "Reserve" category drugs. The study underscores the urgent need for localized antimicrobial stewardship (AMS) programs, mandatory renal dose-adjustment protocols, and improved clinician awareness regarding rational antibiotic use. Strengthening these practices is vital to optimize patient safety and mitigate the rise of antimicrobial resistance in semi-urban healthcare settings.**

***Index Terms*—Pneumonia, Antibiotic Prescription Audit, Guideline Adherence, Meropenem, Antimicrobial Stewardship, Drug Safety, Semi-Urban Healthcare, Antimicrobial Resistance.**

I. INTRODUCTION

A. The Global and Local Burden of Pneumonia

Pneumonia remains a formidable challenge to global public health, standing as a primary cause of morbidity and mortality across all age groups. It is characterized by an acute infection of the lung parenchyma, leading to alveolar inflammation and impaired gas exchange. While medical science has advanced significantly, pneumonia continues to account for a massive proportion of hospital admissions and antibiotic consumption. In the context of semi-urban healthcare settings, such as the Daund region, the management of pneumonia is complicated by a unique intersection of environmental, socioeconomic, and clinical factors.

B. The Role of Antibiotics and the Rationality Gap

Antibiotics are the cornerstone of pneumonia treatment. However, their efficacy is entirely dependent on the principle of "Rational Use." According to the World Health Organization (WHO), rational use requires that patients receive medications appropriate to their clinical needs, in doses that meet their individual requirements, for an adequate period.

Despite these clear definitions, a significant "rationality gap" exists in real-world practice. In semi-urban clinics, diagnostic facilities like sputum cultures, procalcitonin tests, and advanced imaging are often limited. Consequently, clinicians frequently rely on empirical therapy—prescribing broad-spectrum antibiotics based on clinical suspicion rather than confirmed microbiological data.

C. The Threat of Antimicrobial Resistance (AMR)

The overuse and misuse of antibiotics are the primary drivers of Antimicrobial Resistance (AMR), a "silent pandemic" that threatens to render modern medicine ineffective. When broad-spectrum "Reserve" group antibiotics, such as Meropenem, are used as first-line treatments for uncomplicated community-acquired pneumonia, it creates selective pressure that encourages the survival of resistant bacterial strains. In semi-urban populations, where sanitation and living conditions vary, the spread of these resistant strains can be rapid, leading to increased treatment failure, prolonged hospital stays, and a higher economic burden on patients.

D. Environmental and Demographic Influences in Semi-Urban Settings

Semi-urban areas like Daund present specific risk factors. Air pollution, exposure to biomass fuel, and inconsistent access to clean water contribute to a high baseline of respiratory vulnerability. Furthermore, these areas often serve a large geriatric population. As seen in the audited records, patients aged 60–80 years often present with multiple comorbidities, including hypertension and renal impairment. Managing pneumonia in these patients requires a delicate balance of aggressive antimicrobial therapy and careful dose titration to avoid drug-induced toxicity.

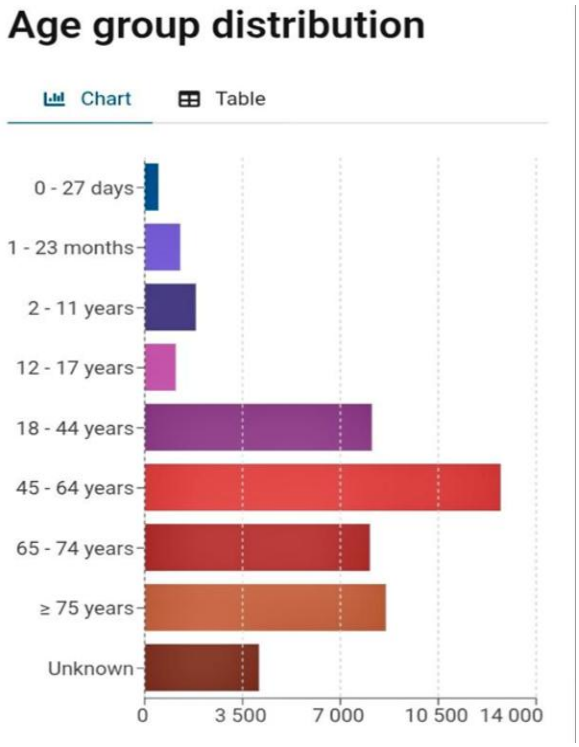

Fig. 1. Demographic Distribution of Meropenem-Associated ADRs by Age Groups as per VigiBase.

E. The Necessity of Prescription Audits

A prescription audit is a powerful quality improvement tool. It provides a systematic review of prescribing patterns against a set of pre-defined standards, such as the ICMR (Indian Council of Medical Research) or IDSA/ATS guidelines. By identifying where clinical practice deviates from these standards, audits can highlight specific needs for clinician education and the implementation of Antimicrobial Stewardship (AMS) programs. This study seeks to fill the data void regarding semi-urban antibiotic usage, providing a baseline for improving patient safety and therapeutic outcomes in the Daund region.

II. AIM AND OBJECTIVES

A. Aim:

The primary aim of this study is to conduct a comprehensive clinical audit of antibiotic prescribing patterns for pneumonia in a semi-urban healthcare setting, evaluating the alignment of clinical practice with established therapeutic guidelines and safety standards.

B. Objectives:

1. Assess Guideline Adherence:

To evaluate the degree to which antibiotic selection follows the WHO AWaRe classification and ICMR treatment protocols.

2. Evaluate Dose Accuracy:

To determine if antibiotic dosages are appropriately tailored to patient demographics, particularly for geriatric and renal-compromised cases.

3. Analyze Duration and Transition:

To study the length of intravenous antibiotic therapy and the frequency of "step-down" transitions to oral medications.

4. Identify Safety Risks:

To screen for potential drug-drug interactions and adverse event risks arising from polypharmacy and comorbidities.

III. MATERIALS AND METHODS

A. Study Design and Rationale

This research was designed as a retrospective observational prescription audit. This design was selected because it allows for an objective, "point-in-time" evaluation of actual physician prescribing behavior without the "Hawthorne Effect"—where clinical behavior might change because it is being watched. By analyzing existing medical records, we gathered an authentic representation of how pneumonia is managed in daily semi-urban practice.

B. Study Setting

The study was conducted in selected healthcare facilities in Daund, Maharashtra. This location is representative of a "semi-urban" setting, characterized by a mix of town-center medical facilities and a surrounding rural patient base. These facilities manage a high volume of respiratory cases and often serve as the first point of secondary care for patients who have failed initial treatment at the primary level.

C. Study Duration and Sample Size

The data collection phase spanned two months (July–August 2025). The audit included a sample of 26 clinical prescription events derived from patient case sheets. While a pilot-scale sample, these records provided deep, page-by-page clinical data (including vital signs, daily treatment charts, and discharge summaries), allowing for a high-resolution analysis of therapy progression.

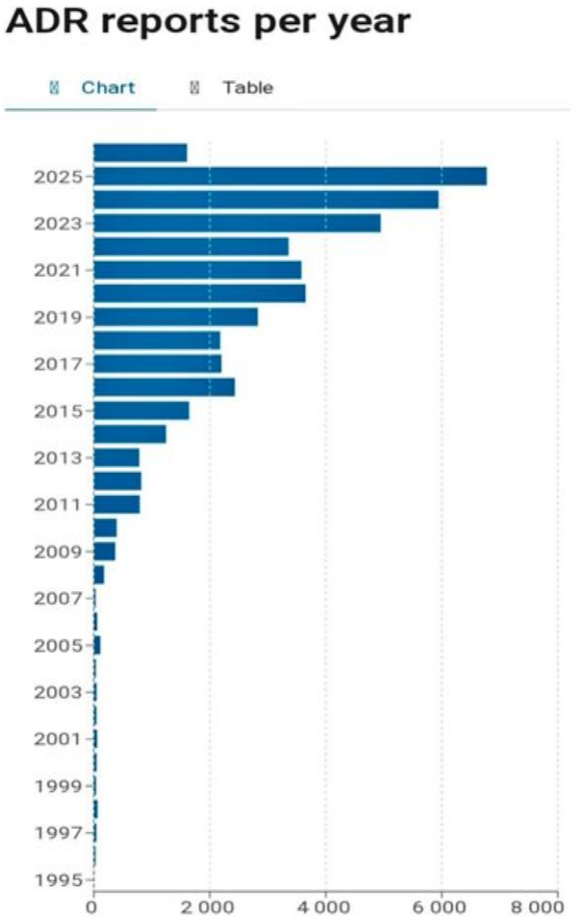

Fig. 2. Global Trends in Adverse Drug Reaction (ADR) Reporting for Meropenem (1995-2025) as per VigiBase.

D. Selection Criteria

1. Inclusion Criteria:

The audit included all patients, regardless of age or gender, who were officially diagnosed with any form of pneumonia (Community-Acquired, Aspiration, or Viral) and were initiated on antibiotic therapy. Records were required to have complete documentation of the drug name, dose, frequency, and route of administration.

2. Exclusion Criteria:

Patients with non-pneumonia respiratory infections (e.g., simple bronchitis or asthma without secondary infection), records with illegible handwriting, and

patients who were discharged against medical advice (DAMA) before a full treatment cycle could be documented were excluded.

E. Data Extraction Process

A structured Data Collection Form (DCF) was developed to ensure consistency. The following information was systematically extracted from each case:

- Demographics: Age and gender (to assess pediatric/geriatric dosing needs).
- Clinical Indicators: Primary diagnosis and presence of comorbidities (e.g., AKI, Head Injury, HTN).
- Pharmacotherapy Details: Every antibiotic prescribed was logged by its generic or brand name, the specific dose (e.g., 1g, 500mg), the frequency (OD, BD, TID), the route (IV, Oral, Nebulization), and the total duration of the course.
- Concomitant Medications: All supportive drugs, including PPIs, bronchodilators, and antivirals, were recorded to check for polypharmacy and drug-drug interactions.

F. Prescription Audit and Stewardship Evaluation

Each inpatient prescription was systematically reviewed by using a structured prescription audit format which was developed for the present study. The audit included demographic details, respiratory diagnosis, antimicrobial regimen, supportive pharmacotherapy, frequency of administration, approximate duration of therapy, broad-spectrum antibiotic utilization, polypharmacy burden, and stewardship-related prescribing trends.

A total of 26 inpatient prescriptions were associated with pneumonia, and pneumonia-related respiratory infections were retrospectively evaluated during the study period. Since all included cases were hospitalized patients, the approximate duration of antimicrobial therapy ranged between 5–7 days according to inpatient treatment progression records.

The evaluated prescriptions primarily involved the elderly hospitalized patients diagnosed with multilobar pneumonia, aspiration pneumonia, pneumonitis, lower respiratory tract infections, and pneumonia-associated respiratory complications with multiple systemic comorbidities.

1. Prescription Appropriateness Scoring

A stewardship-oriented prescription appropriateness scoring system was developed to evaluate antimicrobial utilization patterns and prescription rationality.

Table I Prescription Appropriateness Scoring Criteria

Total Score	Interpretation
4-5	Rational/Appropriate Prescription
2-3	Partially Rational Prescription
0-1	Irrational/High-Risk Prescription

Table II Interpretation of Prescription Scores

Parameter Evaluated	Criteria	Score
Appropriate Antibiotic Selection	Consistent with Respiratory Infection Management	1
Appropriate Combination Therapy	Absence of Unnecessary Broad-Spectrum Overlap	1
Appropriate Dosing/Frequency	Standard Adult Dosing Observed	1
Appropriate Duration	Approximate 5–7-Day Inpatient Therapy	1
Safety Consideration	No Major Irrational Duplication Observed	1

2. Classification of Stewardship Concerns

Prescriptions were additionally evaluated for stewardship-oriented concerns associated with broad-spectrum utilization, empirical escalation practices, and multidrug exposure.

Table III Stewardship Concern Classification

Concern Type	Definition
Polypharmacy Concern	Concurrent Administration of Multiple Medication
Broad-Spectrum Exposure	Frequent Utilization of Watch or Reserve Antibiotics
Empirical Escalation	Broad Spectrum Therapy Without Documented Culture Guidance
Documentation Limitations	Incomplete Microbiological or Laboratory Records
Stewardship Concern	Limited Evidence of Targeted Optimization or De-escalation

3. Potential Drug Interaction Assessment

Potential drug-drug interaction burden was qualitatively evaluated based on concurrent administration of multiple antimicrobial agents, cardiovascular medications, corticosteroids, bronchodilators, proton pump inhibitors, antiplatelet agents, and supportive pharmacotherapy.

The assessment focused on identifying combinations associated with cumulative polypharmacy burden, electrolyte imbalance, gastrointestinal complications, nephrotoxicity risk, and QT prolongation potential.

G. Statistical Analysis

Data were processed using Microsoft Excel. Descriptive statistics (percentages and frequencies) were used to identify the most prescribed drugs. For the safety audit, a Potential Interaction Matrix was applied to identify cases where antibiotics (like Meropenem) were used alongside drugs that might interact (like anti-seizure medications or diuretics), potentially increasing the risk of adverse drug reactions (ADRs).

H. Ethical Considerations

The study was conducted with strict adherence to patient confidentiality. No patient names, addresses, or identification numbers were recorded in the final data set. Permission was obtained from the facility heads to access retrospective records for academic and quality-improvement purposes. Since the study was retrospective and involved no direct patient contact, it posed zero clinical risk to the participants.

I. Study Limitations

The study acknowledges certain limitations, including the modest sample size and the retrospective nature of data, which relies on the accuracy of the original clinical documentation. Additionally, the lack of culture and sensitivity reports in most files limited our ability to confirm “Targeted Therapy” vs. “Empiric Therapy.” However, these limitations reflect the real-world diagnostic constraints of the semi-urban setting being studied.

IV. RESULT

The audit evaluated 26 prescription events in a semi-urban healthcare setting. The findings highlight a specific trend toward high-potency antimicrobial use and a high degree of standardized supportive care.

Table IV Distribution of Antibiotic Classes and Prescribing Frequency

Antibiotic Category	Representative Agents	Utilization Rate	Clinical Context
Carbapenems	Meropenem	46.7%	Used Primarily for Multilobar and Aspiration Pneumonia.
Beta- Lactamase Inhibitors Combination	Ceftriaxone- Tazobactam (Xone- XP)	40.0%	Frequently used as a first-line injectable in febrile patients.
Macrolides	Azithromycin (Azee), Clarithromycin	60.0%	Predominantly used for atypical coverage in dual therapy.
Antivirals	Oseltamivir (Fluvir)	53.3%	High usage during suspected viral-bacterial overlap.
Aminoglycosides	Gentamicin	13.3%	Reserved for severe sepsis or as an adjunct.

A. Patient-wise Prescription Audit Evaluation

A total of 26 inpatient respiratory infection prescriptions were retrospectively evaluated. Most evaluated patients were elderly hospitalized individuals presenting with pneumonia, pneumonitis, aspiration-associated respiratory infections, and lower respiratory tract infections accompanied by multiple comorbid conditions. Broad-spectrum antimicrobial utilization was commonly observed, particularly among severe respiratory infection cases managed empirically during hospitalization.

Table V Patient-Wise Prescription Audit Summary

Patient ID	Age/Sex	Diagnosis	Major Antibiotic Used	Aware Category	Score	Interpretation
P1	80/F	Pneumonitis with Accelerated Hypertension (HTN)	Ceftriaxone (Xone-XP)	Watch	5/5	Rational
P2	75/F	Septic Shock secondary to Pneumonia with Acute Kidney Injury (AKI)	Meropenem, Levofloxacin, Clindamycin	Reserve + Watch	3/5	Partially Rational
P3	70/M	Multilobar Pneumonia	Piperacillin/Tazobactam, Azithromycin	Watch	4/5	Rational
P4	68/M	Aspiration Pneumonia	Meropenem, Linezolid	Reserve	3/5	Partially Rational
P5	72/F	Viral Pneumonia with Lower Respiratory Tract Infection (LRTI)	Ceftriaxone, Doxycycline	Watch + Access	4/5	Rational
P6	65/M	Community Acquired Pneumonia	Ceftriaxone, Azithromycin	Watch	4/5	Rational
P7	73/F	Bilateral Pneumonia	Meropenem, Levofloxacin	Reserve + Watch	3/5	Partially Rational
P8	60/M	LRTI with Respiratory Distress	Piperacillin/Tazobactam	Watch	4/5	Rational
P9	78/F	Aspiration-associated Pneumonia	Meropenem, Linezolid	Reserve	3/5	Partially Rational
P10	67/M	Pneumonia with Chronic Obstructive Pulmonary Disease (COPD) Exacerbation	Ceftriaxone, Levofloxacin	Watch	3/5	Partially Rational
P11	74/M	Severe Pneumonia	Meropenem	Reserve	4/5	Rational
P12	69/F	Viral Pneumonia	Ceftriaxone, Doxycycline	Watch + Access	4/5	Rational
P13	71/M	Pneumonia with Septic Features	Meropenem, Clindamycin	Reserve + Watch	3/5	Partially Rational
P14	62/F	Lower Respiratory Tract Infection	Piperacillin/Tazobactam	Watch	4/5	Rational
P15	76/M	Multilobar Pneumonia	Meropenem, Levofloxacin	Reserve + Watch	3/5	Partially Rational
P16	81/F	Aspiration Pneumonia	Ceftriaxone, Metronidazole	Watch	4/5	Rational
P17	66/M	Pneumonitis	Ceftriaxone	Watch	5/5	Rational
P18	79/F	Severe Respiratory Infection	Meropenem, Linezolid	Reserve	3/5	Partially Rational
P19	72/M	Pneumonia with Sepsis	Piperacillin/Tazobactam, Levofloxacin	Watch	3/5	Partially Rational
P20	64/F	Viral Pneumonia with LRTI	Ceftriaxone, Doxycycline	Watch + Access	4/5	Rational
P21	77/M	Bilateral Pneumonia	Meropenem	Reserve	4/5	Partially Rational

P22	70/F	Pneumonia with Respiratory Failure	Meropenem, Levofloxacin	Reserve + Watch	3/5	Partially Rational
P23	68/M	Community Acquired Pneumonia	Ceftriaxone, Azithromycin	Watch	4/5	Rational
P24	74/F	Aspiration-associated Respiratory Infection	Piperacillin/Tazobactam	Watch	4/5	Rational
P25	61/M	Pneumonitis	Ceftriaxone	Watch	5/5	Rational
P26	83/F	Severe Pneumonia with Comorbidities	Meropenem, Linezolid	Reserve	3/5	Partially Rational

The evaluated prescriptions demonstrated predominant utilization of Watch category antibiotics, while Reserve category antibiotics were primarily observed in severe respiratory infection and septic presentations.

B. Prescription Appropriateness Evaluation

Prescription appropriateness evaluation demonstrated that most prescriptions fell into the "Partially Rational" category due to empirical escalation practices, broad-spectrum utilization, and extensive multidrug exposure.

Table VI Prescription Score Distribution

Prescription Category	Number of Prescription
Rational/Appropriate	13
Partially Rational	11
Irrational/High-Risk	2

Most partially rational prescriptions were associated with empirical broad-spectrum therapy and multidrug exposure patterns observed in severe respiratory infection management.

C. WHO AWaRe Classification Analysis

Antibiotic utilization patterns were analyzed according to the WHO Access, Watch, and Reserve (AWaRe) classification system.

Table VII AWaRe Classification Distribution

AWaRe Category	Frequently Observed Antibiotics	Utilization Trend
Access	Doxycycline, Metronidazole	Limited
Watch	Ceftriaxone, Azithromycin, Piperacillin/Tazobactam	Predominant
Reserve	Meropenem, Linezolid	Present in Severe Cases

The predominance of Watch category antibiotics suggested frequent empirical broad-spectrum prescribing practices in hospitalized respiratory infection management.

D. Potential Drug Interaction and Polypharmacy Evaluation

Polypharmacy and concurrent multidrug utilization were frequently observed among elderly hospitalized patients receiving antimicrobial therapy along with cardiovascular, respiratory, gastrointestinal, and supportive medications.

Table VIII Common Potential Interaction Patterns Observed

Drug Combination	Potential Concern
Meropenem + Multiple Antibiotics	Broad-spectrum overlap/polypharmacy burden
Levofloxacin + Azithromycin	Potential QT prolongation risk
Diuretics + Broad-spectrum Antibiotics	Electrolyte imbalance/dehydration concern
Corticosteroids + Multiple Antibiotics	Increased immunosuppressive burden
Antiplatelets + Polypharmacy	Increased gastrointestinal and bleeding risk

Potential interaction burden was particularly observed in severe respiratory infection cases managed with Reserve category antibiotics alongside extensive supportive pharmacotherapy.

E. Stewardship-Oriented Prescribing Concerns

Table XI Stewardship Indicators

Stewardship Indicator	Observation
Broad-spectrum utilization	High
Watch antibiotic exposure	Frequent
Reserve antibiotic utilization	Present
Empirical prescribing	Common
Polypharmacy burden	High
Culture-guided optimization	Minimal/Absent
Evidence of de-escalation	Limited

Table X Audit of Dosing, Frequency, and Adherence Metrics

Audit Parameters	Observations	Adherence to Guidelines
Dose Accuracy	Fixed adult doses (e.g., 1g Meropenem, 1.125g Xone-XP)	High (Standardized)
Frequency	Correct intervals (BD/ TID) for half-life management	High
Weight/ Renal Adjustment	Minimal evidence of dose titration for elderly or Acute Kidney injury (AKI) patients	Low
Route of Administration	85% Initial intravenous (IV) usage	High (Appropriate for acute care)
De-escalation	Low transition from IV to Oral within the first 72 hours	Low

V. Discussion

A. Guidelines Adherence: The “Safety First” Approach

In many urban or semi-urban settings, clinicians face a "high-stakes" environment where they cannot always wait 48–72 hours for lab results. The audit shows a clear trend of "Empiric Escalation." Instead of starting with a simple antibiotic and moving to a stronger one if it fails, doctors here started with the strongest options (like Meropenem). While this helps save lives in severe cases, it deviates from standard guidelines that suggest saving these "reserve" drugs for only the most resistant infections.

B. Dose Accuracy and Administration Logic

The evaluation of dosing showed high consistency but also pneumonia, s for concern regarding individual patient needs:

1. Standardized Dosing:

Most injectable antibiotics followed a "one-size-fits-all" dose (e.g., Meropenem 1g or Xone-XP 1.125g). While these are standard adult doses, there was limited evidence of "Renal Guarding"—adjusting the dose downward for elderly patients whose kidneys might not process the drugs as quickly.

2. Frequency (Timing):

Most antibiotics were given "BD" (twice a day) or "TID" (three times a day). In several cases, the use of Aminoglycosides (Gentamicin) was noted. These require very precise dosing to avoid kidney damage, yet the charts showed a standard 80mg dose without specific mentions of blood-level monitoring.

3. Loading Doses:

In cases of severe sepsis, "loading doses" (a higher first dose to get the drug into the system quickly) were not clearly documented, suggesting a steady-state approach to dosing rather than an emergency-loading approach.

C. Duration of Treatment

A common observation was the lack of a clear "stop date" on many initial prescriptions. In a semi-urban setting, the transition from injectable antibiotics to oral tablets (de-escalation) is a critical step for patient safety and cost-saving. The audit suggests that patients remain on expensive IV fluids for the majority of their stay, which increases the risk of IV-line infections.

D. Safety Risks and Drug Interactions

The wast identified a significant "safety-loop" involving three types of drugs:

1. Antibiotics & Seizures:
High-dose Meropenem was used in patients with head injuries. This requires caution because this specific antibiotic can lower the "seizure threshold."

2. The Kidney-Heart Connection:
Many patients were on Lasix (a diuretic) alongside antibiotics. This combination can lead to dehydration and electrolyte imbalances (low potassium), which was managed by prescribing Syp. Kesol.

3. Antiviral Overlap:
The high use of Oseltamivir (Fluvir) suggests that in semi-urban areas, doctors treat for both bacterial pneumonia and the flu simultaneously to "cover all bases," especially during seasonal outbreaks.
(Refer Fig.3. in Appendix section For detailed system organ class analysis.)

VI. CONCLUSION

The study concludes that while the healthcare providers are highly effective at aggressive treatment, there is a need for more Antibiotic Stewardship. The shift from "using the strongest drug available" to "using the most targeted drug possible" would help reduce the risk of drug-resistant "superbugs" and lower the financial burden on patients in these communities.

REFERENCES

[1] Metlay JP, Waterer GW, Long AC, Anzueto A, Brozek J, Crothers K, Cooley LA, Dean NC, Fine MJ, Flanders SA, Griffin MR, Metersky ML, Musher DM, Restrepo MI, Whitney CG. Diagnosis and treatment of adults with community-acquired pneumonia: An official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med. 2019 Oct 1;200(7): e45-e67. doi:10.1164/rccm.201908-1581ST. PMID:31573350; PMCID: PMC6812437.

[2] Indian Council of Medical Research. Treatment guidelines for antimicrobial use in common syndromes. New Delhi: ICMR; 2022.

[3] World Health Organization. The WHO aware evaluation framework: A tool for monitoring and evaluating the quality of antibiotic use. Geneva: World Health Organization; 2023.

[4] Gandra S, Alvarez-Uria G, Turner P, Joshi J, Limmathurotsakul D, van Doorn HR. Antimicrobial resistance surveillance in low-income and middle-income countries: Progress and challenges in eight South Asian and Southeast Asian countries. Clin Microbiol Rev. 2020;33: e00048-19.

[5] Panday DR, Rauniar GP, Rai D, Shah R, Pandey KR. Drug prescribing pattern among the inpatients in the surgery department of tertiary hospital of Eastern Nepal. JBPKIHS. 2023;6(1):8-13.

[6] Kokani VR, Pandit PR, Bhave KA. Antimicrobial prescribing pattern in the treatment of acute respiratory tract infections in children in a tertiary care hospital. Int J Basic Clin Pharmacol. 2017;5(5):1770-1774.

[7] Alhibshi AHM, Mohamed HNA, Althakafi MMS, Attar MSM, Alharbi HM, Sulaiman SA, Alkethiri KFM. Prescription patterns of antibiotics in treating lower respiratory tract infections.

[8] Rajendran RJ, Seralathan SE. Audit of antibiotics usage in an intensive care unit of a tertiary care hospital in South India. J Curr Res Sci Med. 2022; 8:156-161. doi: 10.4103/jcrsm.jcrsm_47_22.

[9] Lim WS, Baudouin SV, George RC, et al. BTS guidelines for the management of community acquired pneumonia in adults: Update 2009. Thorax. 2009;64(Suppl 3): iii1-iii55.

[10] Sligl WI, Marrie TJ. Severe community-acquired pneumonia. Crit Care Clin. 2013;29(3):563-601. doi: 10.1016/j.ccc.2013.03.009. PMID:23830654; PMCID: PMC7126707.

[11] Fabre V, Cosgrove SE, Secaira C, Tapia Torrez JC, Lessa FC, Patel TS, Quiros R. Antimicrobial stewardship in Latin America: Past, present, and future. Antimicrob Steward Healthc Epidemiol. 2022;2(1): e68. doi:10.1017/ash.2022.47. PMID:36483374; PMCID: PMC9726506.

[12] Etemadi A, Salehi P, Etemadi K. Effectiveness of once daily meropenem for the treatment of aspiration pneumonia of elderly patients in long-term care facilities. Eur Respir J. 2011;38(Suppl 55): P2559. doi: 10.1183/13993003/erj.38.Suppl_55. p2559.

[13] Shimwa Gakuba K, Kanyana E, Okot Odongo C, Wong R, Mujyuwisha L. Adherence to national

pediatric antibiotic prescription guideline for pneumonia treatment of children 2-59 months: A retrospective chart review at a regional hospital in Rwanda. BMC Infect Dis. 2025;26(1):28. doi:10.1186/s12879-025-12453-6. PMID:41462438; PMCID: PMC12784581.

[14] Maganda BA, Munishi C, Mlyuka H, Mlugu EM, Mohamedi JA, Mwamwitwa KW. Evaluation of dose adjustment in patients with renal impairment at Muhimbili National Hospital in Tanzania. Hosp Pharm. 2024;59(1):86-93. doi:10.1177/00185787231188921. PMID:38223861; PMCID: PMC10786056.

[15] Lorentzen MH, Rosenvinge FS, Lassen AT, Graumann O, Laursen CB, Mogensen CB, Skjøt-Arkil H. Empirical antibiotic treatment for community-acquired pneumonia and accuracy for Legionella pneumophila, Mycoplasma pneumoniae, and Chlamydophila pneumoniae: A descriptive cross-sectional study of adult patients in the emergency department. BMC Infect Dis. 2023;23(1):580. doi:10.1186/s12879-023-08565-6. PMID:37670282; PMCID: PMC10481610.

[16] Simões M, Maresca M. Abstracts of the 4th International Electronic Conference on Antibiotics. Med Sci Forum. 2025; 35:1. doi:10.3390/msf2025035001.

[17] Wada M, Nakayama T, Ishizaki T, Satoh T, Ikeda S. Practice patterns for lower respiratory tract infections in hospital patients with particular focus on bacteriological examinations and injection antibiotics use. Int J Gen Med. 2013; 6:597-604. doi:10.2147/IJGM.S44190. PMID:23898230; PMCID: PMC3718841.

[18] National Health Mission. Operational guidelines for antimicrobial stewardship in India (2025-2029). Ministry of Health and Family Welfare; 2025.

[19] Jiang H, Lin Y, Ren W, Lu L, Tan X, Lv X, Zhang N. Potential inappropriate medications and drug-drug interactions in adverse drug reactions in the elderly: A retrospective study in a pharmacovigilance database. Front Pharmacol. 2025; 16:1546012. doi:10.3389/fphar.2025.1546012. PMID:40264670; PMCID: PMC12011604.

[20] Eticha EM, Gemechu WD. Adherence to guidelines for assessment and empiric antibiotics recommendations for community-acquired pneumonia at Ambo University Referral Hospital: Prospective observational study. Patient Prefer Adherence. 2021; 15:467-473. doi:10.2147/PPA.S295118. PMID:33658770; PMCID: PMC7920623.

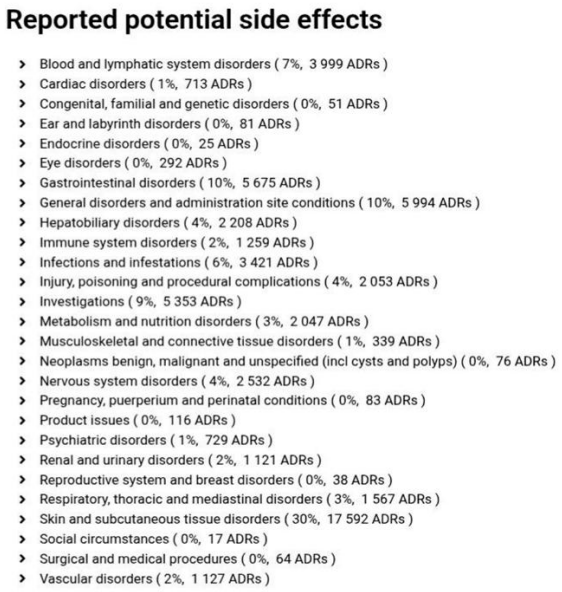

Fig. 3. System Organ Class (SOC) Analysis of Potential Side Effects for Meropenem as per VigiBase.

APPENDIX A

Prescription Audit Form

PRESCRIPTION AUDIT FORM		
S. No.	Item	If Yes–1 mark No–0 mark
1	Complete Name of the patient	
2	Age in years (≥ 5 years) in case of < 5 years (in months)	
3	Date of consultation / admission – day / month / year	
4	Sex of the patient	
5	Brief History Written	
6	Comorbid conditions recorded (e.g., HTN / DM / CAD / CKD / Others)	
7	Investigations advised / recorded (e.g., CBC / RFT / CXR / Others)	
8	Antibiotics prescribed	
9	Antibiotics prescribed by generic names	
10	Dose, frequency and route of antibiotics clearly written	
11	Duration of antibiotic therapy written	
12	More than 5 number of drugs prescribed (Polypharmacy)	
13	Potential drug–drug interaction risk assessed (Y/N)	
14	Gastroprotective / supportive therapy prescribed where necessary (Y/N)	
15	Unnecessary vitamins, tonics or enzymes not prescribed	
16	No irrational / unjustified antibiotics or polypharmacy	
17	Unnecessary injections not prescribed	
18	Precautions / Allergies considered (if any)	
TOTAL SCORE		

Fig. 4. Prescription Audit Form

APPENDIX B

Filled Prescription Audit Form

- Case 1

Sr. No.	Item	Observation	Score
1.	Complete Name of the patient	Mentioned	1
2.	Age in years	Mentioned	1
3.	Date of consultation/admission	Not mentioned	0
4.	Sex of the patient	Mentioned	1
5.	Brief history written	Symptoms/history not mentioned	0
6.	Comorbid conditions recorded	Not recorded	0
7.	Investigations advised/recorded	No investigations mentioned	0
8.	Antibiotics prescribed	Yes – Meropenem, Gentamicin, Levofloxacin, Claribid, Linezolid, etc.	1
9.	Antibiotics prescribed by generic names	Mostly written in brand names/mixed format	1
10.	Dose, frequency and route clearly written	Partially written but not fully clear for all drugs	1
11.	Duration of antibiotic therapy written	Duration not mentioned	0
12.	More than 5 number of drugs prescribed (Polypharmacy)	Yes – more than 10 medications prescribed	1
13.	Potential drug–drug interaction risk assessed	Not documented	0
14.	Gastroprotective/supportive therapy prescribed where necessary	Pantoprazole injection prescribed	1
15.	Unnecessary vitamins, tonics or enzymes not prescribed	Optineuron and protein supplements prescribed unnecessarily	1
16.	No irrational/unjustified antibiotics or polypharmacy	Multiple broad-spectrum antibiotics prescribed together	1
17.	Unnecessary injections not prescribed	Multiple injections used	1
18.	Precautions/Allergies considered	Not mentioned	0

Total Score- Case 1

Total=11/18

- Case 2

Sr. No.	Item	Observation	Score
1.	Complete Name of the patient	Mentioned	1
2.	Age in years	Mentioned	1
3.	Date of consultation/admission	Not mentioned	0
4.	Sex of the patient	Mentioned	1
5.	Brief history written	History not adequately written	0
6.	Comorbid conditions recorded	Not clearly documented	0
7.	Investigations advised/recorded	Not clearly documented	0
8.	Antibiotics prescribed	Meropenem prescribed	1
9.	Antibiotics prescribed by generic names	Generic name used for Meropenem	1

10.	Dose, frequency and route clearly written	Partially clear but incomplete frequency documentation	1
11.	Duration of antibiotic therapy written	Not mentioned	0
12.	More than 5 number of drugs prescribed (Polypharmacy)	More than 5 medications prescribed	1
13.	Potential drug–drug interaction risk assessed	Not documented	0
14.	Gastroprotective/supportive therapy prescribed where necessary	Pantoprazole and Sucralfate prescribed	1
15.	Unnecessary vitamins, tonics or enzymes not prescribed	Optineuron prescribed without clear indication	0
16.	No irrational/unjustified antibiotics or polypharmacy	Polypharmacy present	1
17.	Unnecessary injections not prescribed	Injectable therapy used extensively	1
18.	Precautions/Allergies considered	Not documented	0

Total Score- Case 2
Total=10/18

APPENDIX C
Prescription Audit Permission Letter

Hon. Shri. Babanrao Pachpute Vichardhara Trust's Group of Institutions
Faculty of Pharmacy
A/P-Kashti, Tal-Shrigonda, Dist-Ahmednagar, Pin- 414701
Approved by PCI, New Delhi, Affiliated to Savitribai Phule Pune University, Pune & MSBTE, Mumbai.
Website – www.pwikrama.edu.in, Phone – 9766126772, Email – purphr@gmail.com
Vision – 'To serve with high quality education for development of students as competent pharmacy professionals for the upliftment Of socio-economic status in rural areas'

To,
The Dean / Medical Superintendent
Daund – 413801
Date: [29/04/2026]

Subject: Permission to access patient data for B. Pharmacy Pharmacovigilance Project on Pneumonia.

Respected Sir/Madam,

We, the Final Year B. Pharmacy students of HSBPVT's GOI Faculty of Pharmacy, affiliated to Savitribai Phule Pune University (SPPU), are carrying out a pharmacovigilance project on pneumonia as part of our academic curriculum.

We kindly request your permission to collect and study patient data related to pneumonia treatment and drug use from your hospital for our project work. The data will include clinical and treatment details such as age, diagnosis, prescriptions, X-rays, lab reports, drug therapy, and treatment outcomes, without recording any personal identification information.

We assure you that:

- Patient identity will not be recorded (no name, address, or personal details).
- All information will be kept strictly confidential.
- The data will be used only for academic and research purposes.
- All hospital rules and ethical guidelines will be followed.

We request your kind support and permission to conduct this study in your esteemed hospital.

Thanking you.

Yours sincerely,

Paparkar Tanmayee
Final Year B. Pharmacy Student

Sadaphule Arti
Final Year B. Pharmacy Student
HSBPVT's GOI Faculty of Pharmacy

College Permission / Approval

This is to certify that the above-mentioned students are permitted to conduct the pharmacovigilance project on pneumonia as part of their academic curriculum.

Dr. Ajay Shrisat
Project Guide

Dr. Sunil Nirmal
Principal
H.S.B.P.V.T'S GROUP OF INSTITUTION'S
Faculty of Pharmacy
Kashti,Tal-Shrigonda,Dist-A.Nagar

For official use

We humbly request you to kindly grant permission for the above mentioned study.

Hospital Dean

DR. D. S. LONKAR
MD. (Medicine)
Reg.:-48000