

Antimicrobial Stewardship: A Clinical Microbiology-Driven Audit of Antimicrobial Therapy: Impact of a Structured Intervention on Prescribing Compliance in Apollo Speciality Hospitals, Nellore.

Author(s):

1. Dr. Raja M E

Unit Quality Head, Apollo Speciality Hospitals, Nellore

2. Dr Srikanth M

Clinical Pharmacist, Apollo Speciality Hospitals, Nellore

3. Dr Madhurima P

Microbiologist / Infection Control Officer, Apollo Speciality Hospitals, Nellore

4. Ms Swarna Joythi U

Nursing Officer / Quality Nurse, Apollo Speciality Hospitals, Nellore

Abstract

Background: Inappropriate antibiotic prescribing is a major driver of antimicrobial resistance (AMR). This clinical audit evaluated compliance with hospital antibiotic guidelines and quantified the impact of structured Antimicrobial Stewardship Programme (AMS) interventions in a tertiary care setting.

Objective: To assess and improve prescribing compliance by evaluating initiation, selection, documentation, de-escalation, and duration of antibiotic therapy across ICUs and general wards.

Methods: A pre-post interventional clinical audit design was employed. A total of 287 inpatient case records were reviewed during the pre-audit phase (October–December 2025) followed by a post-audit cycle (January–March 2026) after implementation of Corrective and Preventive Actions (CAPA). Six key compliance parameters were assessed against ICMR AMS Guidelines, WHO AWaRe Classification, and NABH standards.

Results: Pre-audit overall compliance was 41.51%. Following targeted interventions — mandatory AMS justification forms, 72-hour antibiotic stop orders, structured education, and expedited microbiology reporting — overall compliance rose to 75.38% (+33.87%). De-escalation compliance improved most significantly from 20.20% to 59.13% (+38.93%).

Conclusions: A structured, microbiology-driven AMS audit with multidisciplinary ownership and enforceable prescribing controls can produce substantial improvements in antibiotic compliance. Sustained cyclic audits and real-time surveillance are essential to consolidate these gains.

Keywords: Antimicrobial stewardship, antibiotic audit, de-escalation, WHO AWaRe, carbapenem, ICMR guidelines, multidrug resistance, clinical audit, India.

1. Introduction

Antimicrobial resistance (AMR) is one of the most formidable public health crises of the 21st century. India bears a disproportionately high burden, driven by overuse of broad-spectrum antibiotics, inadequate infection control practices, and limited stewardship oversight. The emergence of carbapenem-resistant Enterobacteriaceae (CRE) and methicillin-resistant Staphylococcus aureus (MRSA) in hospital settings is associated with high morbidity, prolonged length of stay, and elevated mortality.

Despite hospital antibiotic policies, adherence remains inconsistent. Empirical, broad-spectrum choices from the WHO "Watch" and "Reserve" categories are common even when narrower "Access" agents are guideline-appropriate. De-escalation — narrowing therapy once culture and sensitivity data are available — remains underutilised in many Indian hospitals.

The Indian Council of Medical Research (ICMR) AMS Guidelines (2020/2021) mandate multidisciplinary AMS teams, point prevalence surveys, formulary restriction, and structured prescribing audits. Apollo Speciality Hospitals, Nellore, initiated this clinical microbiology-driven audit to quantify prescribing gaps and design targeted interventions across the period October 2025 to March 2026.

2. Problem Statement

Preliminary situational analysis identified a pattern of high-risk prescribing despite an existing antibiotic policy:

- Broad-spectrum agents from WHO AWaRe "Watch" and "Reserve" categories used empirically in >60% of cases where "Access" agents were guideline-recommended.
- De-escalation performed in only 35% of culture-positive cases — therapy was not rationalised even when microbiology data were available.
- Average excess antibiotic duration of 3–4 days per course.
- No formal "Antibiotic Time-Out" review at 48–72 hours post-initiation.
- No automated alerts for prescription of Restricted/Reserve antibiotics.
- Very infrequent IV-to-oral switch despite clinical eligibility.

These practices drove increasing MDR infection rates, elevated patient morbidity, and unnecessary pharmaceutical expenditure.

3. Objectives

3.1 Primary Objective

To evaluate compliance with hospital antibiotic guidelines regarding initiation, selection, and duration of therapy.

3.2 Secondary Objectives

- Measure de-escalation rates from empirical to targeted therapy within 48–72 hours of culture availability.
- Assess pre-treatment culture collection, documentation, IV-to-oral conversion, and justification form compliance.
- Provide evidence-based recommendations to improve prescribing quality and reduce resistance.

3.3 Measurable Targets (Post-Intervention)

- Cultures taken before antibiotic initiation: $\geq 95\%$.
- Antibiotic indication documented in case records: $\geq 80\%$.
- Reduction in unnecessary "Reserve" antibiotic use: $\geq 40\%$.
- De-escalation within 72 hours of culture availability: $\geq 50\%$.

4. Standards and Regulatory Framework

- ICMR Antimicrobial Stewardship Programme Guidelines (2020/2021).
- WHO AWaRe Classification (2023 update) — prioritising "Access" agents.

- NABH Standards — institutional antibiotic policies, prescription audits, and infection control oversight.
- Hospital-Level Standard Treatment Guidelines and local antibiogram data.

5. Methodology

5.1 Audit Design

A two-cycle pre-post interventional clinical audit was employed. The pre-audit phase involved retrospective review of prescriptions from October–December 2025. Following CAPA implementation, a prospective post-audit cycle was conducted in January–March 2026. Point prevalence survey (PPS) methodology was applied for real-time data capture, and Defined Daily Dose (DDD)/Days of Therapy (DOT) metrics were computed from AMS forms and pharmacy data.

5.2 Sample Size and Setting

287 inpatient case files were audited pre-intervention, covering ICU-1, ICU-3, ICU-4, ICU-5, general wards (3rd and 4th floor), HDU, and PICU. Inclusion criterion: any patient receiving at least one systemic antibiotic during admission.

5.3 Audit Parameters

- Documentation of antibiotic indication in case records.
- Pre-treatment cultures collected before antibiotic initiation.
- Appropriate duration of antibiotic course per guidelines.
- De-escalation within 72 hours of culture and sensitivity report availability.
- Conversion from intravenous to oral therapy when clinically appropriate.
- Completion of the Antimicrobial Stewardship Justification Form.

6. Results

6.1 Pre-Audit Compliance (October–December 2025)

Analysis of 287 case records revealed an overall compliance rate of 41.51%. Table 1 presents the full breakdown by parameter.

Table 1. Pre-Audit Compliance Data (n = 287 files)

Audit Parameter	Files Audited	Compliant Cases	Non-Compliant Cases	Compliance %
Documentation of antibiotic indication	287	126	161	43.90%
Cultures taken before antibiotic initiation	287	211	76	73.51%
Appropriate duration of therapy	287	104	183	36.23%
De-escalation within 72h of culture report	246	58	188	20.20%

Audit Parameter	Files Audited	Compliant Cases	Non-Compliant Cases	Compliance %
Conversion from IV to Oral therapy	246	22	205	7.66%
Justification form completion & follow-up	287	194	93	67.59%
Overall Average Compliance	–	–	–	41.51%

Audit parameters assessed against ICMR AMS Guidelines and WHO AWaRe Classification.

6.2 Pre- vs Post-Audit Compliance Comparison

Following CAPA implementation, a post-audit cycle demonstrated significant improvements across all six parameters. Table 2 presents the full comparison.

Table 2. Pre- vs Post-Audit Compliance: Parameter-wise Comparison

Audit Parameter	Pre-Audit (%)	Post-Audit (%)	Absolute Change (pp)	Target (%)	↑/↓
Indication documentation	43.90%	89.47%	+45.57	≥80%	↑
Cultures before initiation	73.51%	98.54%	+25.03	≥95%	↑
Appropriate duration	36.23%	76.36%	+40.13	≥80%	↑
De-escalation within 72h	20.20%	59.13%	+38.93	≥50%	✓
IV-to-Oral conversion	7.66%	36.94%	+29.28	≥30%	✓
Justification form follow-up	67.59%	91.85%	+24.26	≥80%	↑
Overall Average	41.51%	75.38%	+33.87	–	↑

pp = percentage points. ✓ = target met post-intervention. ↑ = improved, target not yet fully met.

6.3 Overall Compliance Trend Across Audit Cycles

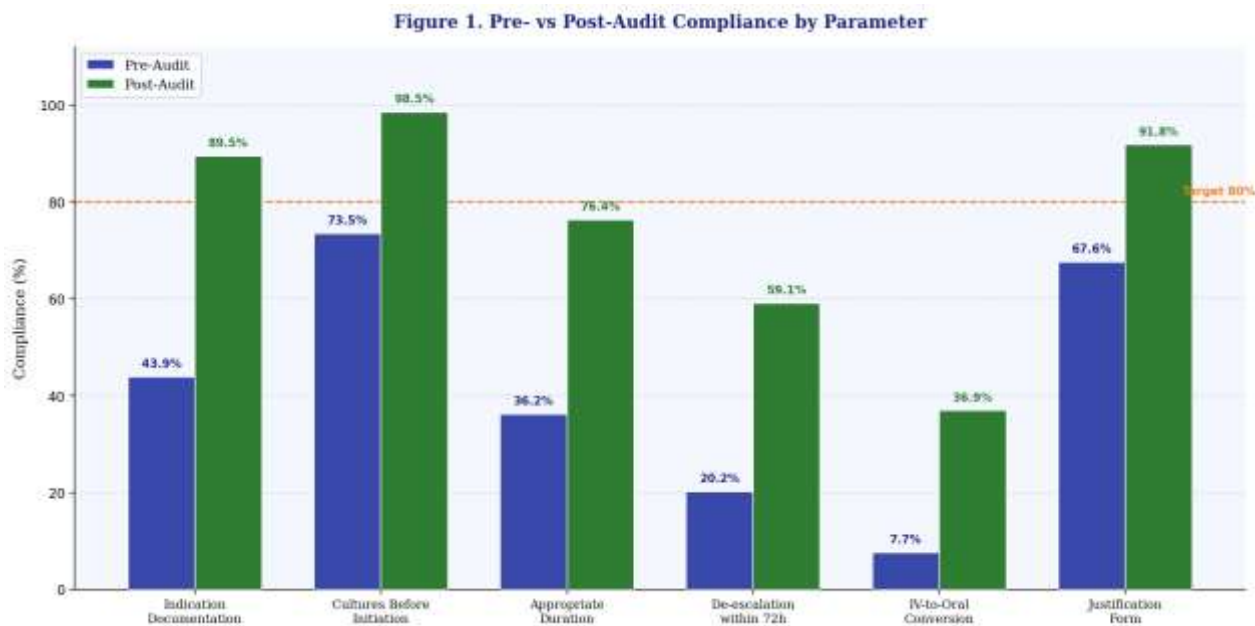
Table 3. Audit Cycle Compliance Trend with Projected Targets

Audit Cycle	Period	Overall Compliance (%)
Cycle 1 — Pre-Audit (Baseline)	Oct – Dec 2025	41.51%
Cycle 2 — Post-CAPA Implementation	Jan – Mar 2026	75.38%
Cycle 3 — Target (Projected)	Apr – Jun 2026	≥90.00%

Cycle 3 target is aspirational and will be assessed following the next planned intervention round.

6.4 Graphical Analysis

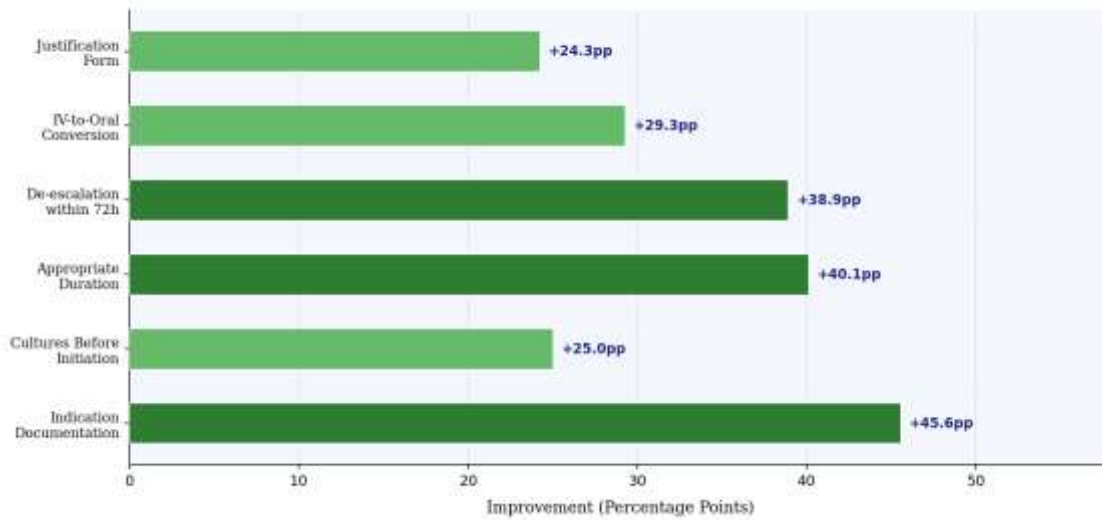
Figure 1. Pre- vs Post-Audit Compliance by Parameter (Grouped Bar Chart)



Amber dashed line denotes the 80% target threshold. Green bars = post-audit; Blue bars = pre-audit.

Figure 2. Magnitude of Improvement per Parameter (Horizontal Bar Chart)

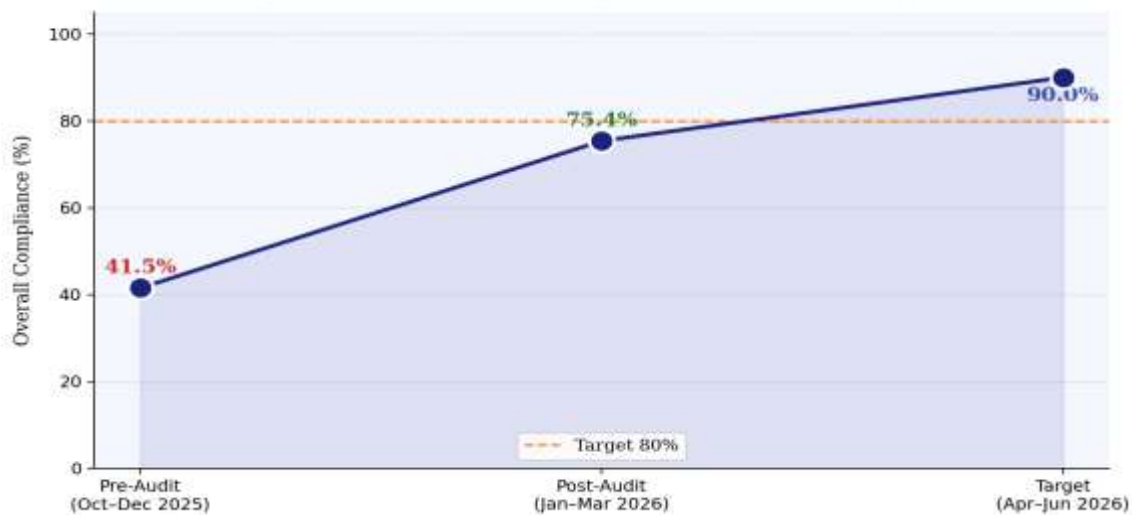
Figure 2. Magnitude of Improvement per Audit Parameter (Pre-Post)



Values represent absolute percentage-point improvement (post minus pre). Darker green = improvement $\geq 30pp$.

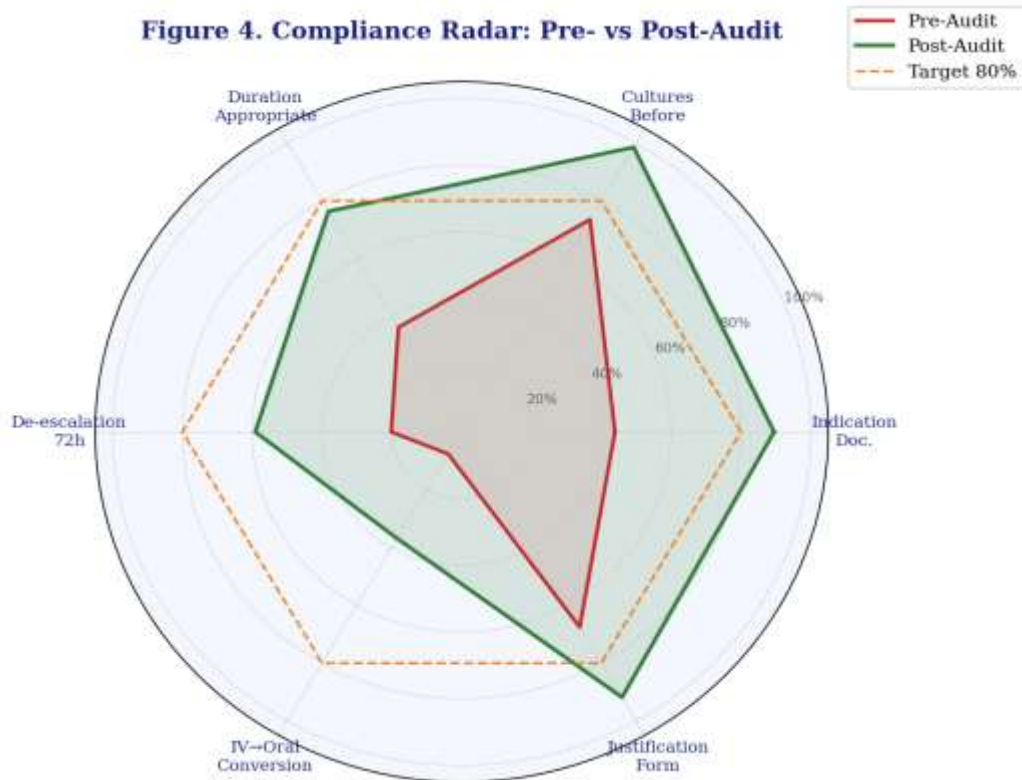
Figure 3. Overall Compliance Trend Across Audit Cycles

Figure 3. Overall Audit Compliance Trend Across Cycles



Amber dashed line = 80% target. Cycle 3 ($\geq 90\%$) is a projected aspirational target.

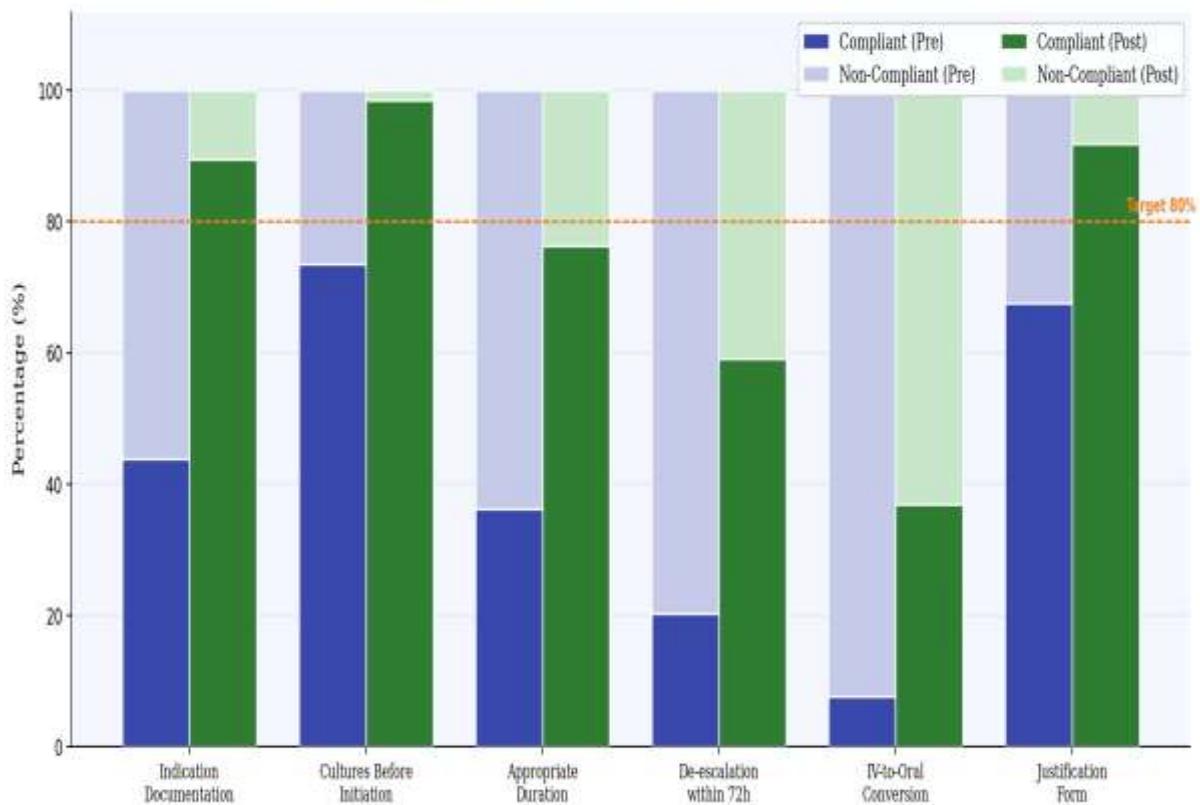
Figure 4. Compliance Radar: Pre- vs Post-Audit (All Parameters)



Red shading = pre-audit profile; Green shading = post-audit profile; Amber = 80% target ring.

Figure 5. Compliant vs Non-Compliant Cases: Pre- vs Post-Audit (Stacked Bar)

Figure 5. Compliant vs Non-Compliant Cases: Pre- vs Post-Audit (Stacked)



Stacked bars show the residual non-compliance (lighter shade) remaining post-intervention.

7. Root Cause Analysis and Corrective Actions

7.1 Root Cause Analysis (RCA)

Time constraints: High clinical workload caused inadequate time for antibiotic review and documentation.

Knowledge gaps: Insufficient familiarity with local antibiogram data among resident medical officers and DMOs.

Delayed microbiology reporting: Culture results were not proactively communicated, causing missed de-escalation windows.

Absence of structured review: No formal "Antibiotic Time-Out" at 48–72 hours existed to reassess empirical therapy.

Accountability deficit: No enforcement mechanism for indication documentation or stop-order compliance.

7.2 Corrective and Preventive Actions (CAPA)

➤ **Education:** Mandatory interactive workshops on hospital antibiotic policy, WHO AWaRe classification, local antibiogram interpretation, and de-escalation for all residents, and DMOs.

➤ **72-hour Stop Orders:** Automatic cancellation of restricted/reserve antibiotics if not re-justified within 72 hours by the attending consultant.

➤ **Mandatory AMS Justification Form:** Standardised form requiring documented indication, planned duration, review date, and consultant sign-off for all antibiotic initiations.

➤ **Microbiology Communication Protocol:** Direct telephonic notification of positive culture results to the treating team within 24 hours of growth, with mandatory documented acknowledgement.

8. Discussion

The baseline overall compliance of 41.51% confirms that an antibiotic policy, without enforcement mechanisms and routine audit cycles, is largely nominal. The most striking pre-audit finding was the IV-to-oral conversion rate of 7.66%, far below the expected 30–40% benchmark. Evidence consistently demonstrates that timely IV-to-oral switch reduces healthcare-associated complications and costs without compromising outcomes. The post-intervention improvement to 36.94% exceeding the 30% target validates that this was primarily a knowledge and process barrier.

The de-escalation rate of 20.20% pre-audit reflects therapeutic inertia: a tendency to maintain broad-spectrum empirical coverage even after culture data confirm that narrower agents are sufficient. The 72-hour automatic stop order proved to be the single most impactful intervention, driving de-escalation from 20.20% to 59.13% (+38.93pp), the largest absolute improvement across all parameters.

The mandatory AMS Justification Form addressed multiple root causes simultaneously. By requiring indication documentation and consultant sign-off, it created a structural accountability mechanism that education alone could not achieve. Documentation compliance consequently improved from 43.90% to 89.47%, exceeding the 80% target.

Near-universal pre-treatment culture collection (98.54% post-audit) is clinically foundational: without baseline microbiology, targeted de-escalation is impossible. The proactive laboratory communication protocol closed the critical gap between the availability of results and prescribing decisions. Despite these gains, de-escalation at 59.13% and IV-to-oral conversion at 36.94%, while substantially improved, indicate residual gaps requiring continued cyclic reinforcement.

9. Clinical and Operational Outcomes

- Reduction in use of restricted broad-spectrum agents including ceftazidime-avibactam and colistin.
- Reduction in total Days of Therapy (DOT) per admission; excess antibiotic duration of 3–4 days per course was curtailed.
- Enhanced clinician awareness of local antibiogram data and resistance patterns.
- Improved inter-departmental communication between microbiology, pharmacy, and clinical teams.
- Infrastructure established for real-time antibiotic utilisation monitoring via AMS forms linked to pharmacy dispensing data.

10. Sustaining Improvements: Cyclic Audit Framework

- Appointment of a dedicated AMS audit champion with explicit accountability for ongoing surveillance.
 - Quarterly point prevalence surveys to monitor utilisation trends and resistance patterns.
 - Continuous monitoring of AMS form compliance and pharmacy data with monthly committee reporting.
 - Annual re-audit against the same six parameters, benchmarked against national and institutional targets.
 - Biannual educational updates incorporating new resistance data and updated ICMR/WHO guidelines.
- Integration of AMS compliance into departmental performance dashboards.
- Expansion of the IV-to-oral switch programme with a pharmacist-led eligibility checklist.

11. Conclusions

This clinical microbiology-driven AMS audit demonstrates that structured, multidisciplinary interventions can produce substantial and rapid improvements in antibiotic prescribing compliance. Within a single audit cycle, overall compliance improved from 41.51% to 75.38% (+33.87pp) across six critical prescribing domains. The most impactful measures were mandatory 72-hour stop orders, the AMS Justification Form with consultant accountability, and a proactive microbiology communication protocol.

Antimicrobial stewardship is a continuous institutional commitment not a periodic exercise. The framework established here data collection, root cause analysis, targeted intervention, and cyclic re-audit provides a replicable model for tertiary care hospitals seeking to combat the rising tide of antimicrobial resistance.

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