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Original Research Article

Implementation of quality improvement principles for antimicrobial stewardship program in the level III B neonatal intensive care unit of a tertiary care public hospital

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ABSTRACT

Background: Antibiotic overuse in neonatal intensive care units (NICUs) is associated with increased mortality, multidrug-resistant organisms (MDROs) and adverse neurodevelopmental outcomes. This study aimed to implement and evaluate a Quality improvement (QI)-based Antimicrobial stewardship program (AMSP) to reduce unnecessary antibiotic use in a busy public sector NICU in Chhatrapati Sambhaji Nagar in Central Maharashtra, India.
Methods: A quasi-experimental interrupted time-series study was conducted from July 2024 to June 2025. After a 2-month baseline phase, AMSP interventions were implemented through nine sequential Plan–do–study–act (PDSA) cycles, including standardized antibiotic policy, early discontinuation of antibiotics at 48-72 hours, preauthorization for higher antibiotics and de-escalation based on blood culture. This intervention phase lasted for 7 months, followed by a 3-month sustenance phase. The primary outcome was Antibiotic usage rate (AUR; Days of therapy per 1000 patient-days).
Results: Among 3696 neonates (52.2% male; median GA 37.6 weeks; median birth weight 1990 g), baseline admission-antibiotic exposure was 63.66%. After implementation, admission-antibiotic exposure decreased to 56.73% ($p=0.0075$) and AUR decreased from 540.09 to 441.71 (18.21% relative reduction, $p=0.0018$). Culture-negative AUR decreased by 10.50%. Early discontinuation in screen-negative neonates increased from 14.4% to 29.15% ($p<0.0001$). Two outbreaks (Klebsiella pneumoniae, Candida tropicalis) occurred during implementation and were controlled through revised antibiograms and antifungal protocols.
Conclusions: Structured Point-of-care-quality improvement (POCQI)-based AMSP implementation reduced antibiotic use in this high-burden NICU. AMSP scale-up across Indian NICUs is urgently warranted.

Keywords: Multidrug-resistant organisms, Plan-do-study-act, Preauthorization, De-escalation, Antibiograms

INTRODUCTION

Antibiotics are commonly used in the neonatal intensive care unit (NICU). Antibiotics are powerful, life-saving drugs, but when misused, they may have serious adverse effects.[1] Prolonged empirical broad-spectrum antibiotic use (more than 5 days) among preterm neonates with negative cultures is associated with an increased risk of mortality and morbidities such as late onset sepsis (LOS), necrotizing enterocolitis (NEC) stage III or higher, retinopathy of prematurity, emergence of invasive fungal infections and colonization and multi-drug-resistant

organisms (MDROs) and poor neurodevelopmental outcomes. Antibiotic overuse disrupts the gut microbiome and alters the natural developmental trajectory of gut microbiota, potentially leading to long-term consequences such as dysbiosis. Bifidobacterium, involved in the digestion of human milk oligosaccharides and its removal following prolonged antimicrobial therapy, is associated with adverse effects on growth and development and increased carriage of antibiotic resistance genes and MDROs.[2,3] Liem and colleagues in the Netherlands described a survey of antibiotic use in the highest volume NICU, where the use was almost three times higher than in the lowest volume NICU, despite similar patient populations.[4] The largest meta-analysis conducted in 2019 in South Asia reported that the highest percentage of isolates resistant to ampicillin was 86.8% in hospital settings and 87.9% in community settings. The minimum resistance was observed in meropenem (10.4% in hospital settings and 0% in community settings). Resistance to even "reserve" antibiotics has increased, and 50-70% of common gram-negative isolates are now multidrug-resistant, necessitating the use of a reserve group of antibiotics point prevalence surveys in Indian NICUs have reported antibiotic exposure rates of 70-80%.[5,6] India carries one of the most significant burdens of drug-resistant pathogens, with high resistance among both gram-negative and gram-positive bacteria.[7] Antibiotic use is high, reported at 40% in the community and 70-80% among NICU admissions. The WHO and Government of India recommend hospital-based Antimicrobial stewardship programs (AMSPs) to rationalize antibiotic use.[5,8] However, AMSP implementation in resource-limited NICUs remains challenging due to high patient loads, staffing shortages, and poor compliance with standard prescribing practices.[9] AUR is expressed as Days of therapy (DOT) per 1000 patient-days. and calculated as: AUR=DOT/(total patient-days of hospitalisation)×1000. AUR is typically expressed as a proportion, used to compare antibiotic use within and across NICUs. DOT is calculated by counting each antibiotic administered per day. For example, if an infant receives both ampicillin and gentamycin for two days, the DOT is 4 (2 antibioticsx2 days). The initial mean AUR in our unit was 540.09. It is observed that AUR varies across different studies. In one Indian study, it was 574.[10] while in two international studies, it was 343 and 270.[3,11] Therefore, we planned a POCQI intervention to reduce antimicrobial use in our unit. This one-year study evaluated the impact of a structured QI-based AMSP in a high-volume NICU in Central Maharashtra, India. We aimed to optimise the AUR by 25% (from 540.09 to 405.06) and reduce the proportion of antibiotic usage in hospitalised neonates by 20% (from 63.66%) in one year.

METHODS

This was a quasi-experimental time-series study conducted in a 52-bed tertiary-care NICU in Chhatrapati Sambhaji Nagar in Central Maharashtra, India from July 2024 to June 2025. Out of 52 beds, 20 are level III beds. The bed occupancy rate ranges from 110-150%, with a doctor-to-patient ratio of 1:7 and a nurse-to-patient ratio of 1:12 in critical high dependency blocks. There is poor compliance with the standard practices of antibiotic prescription and AMSP. A QI team was formed, consisting of a team leader (senior resident) and other members, including junior residents, consultants, nurses, housekeeping staff and microbiologists. Many sick babies are prescribed antibiotics. Approximately 30 % of total admissions are critically ill. All 3696 neonates admitted during the study period were included. The study was conducted in three phases as shown in table 1.

Table 1: Various phases of AMSP implementation.

Phase	Name	Duration	Interventions
1	Baseline phase	2 months	Routine point prevalence of the proportion of antibiotic usage and AUR observed Baseline data collected for outcome indicator
2	Intervention phase	7 months	A QI team formed, comprising residents, nursing staff, faculty members and microbiologists Fishbone and process flow diagrams used to analyse factors responsible for high AUR Various changes in ideas developed through team meetings and ideas tested through sequential (PDSA) cycles Sessions conducted to improve the new antibiotic policy and implement it Discussions held with the head of the department of microbiology for early culture validation Additional measures taken to curb the klebsiella pneumoniae and fungal sepsis outbreak
3	Sustainability phase	3 months	Periodic checking is done to ensure the implementation of antibiotic policies implementation Additional measures taken to curb the candida tropicalis outbreak in

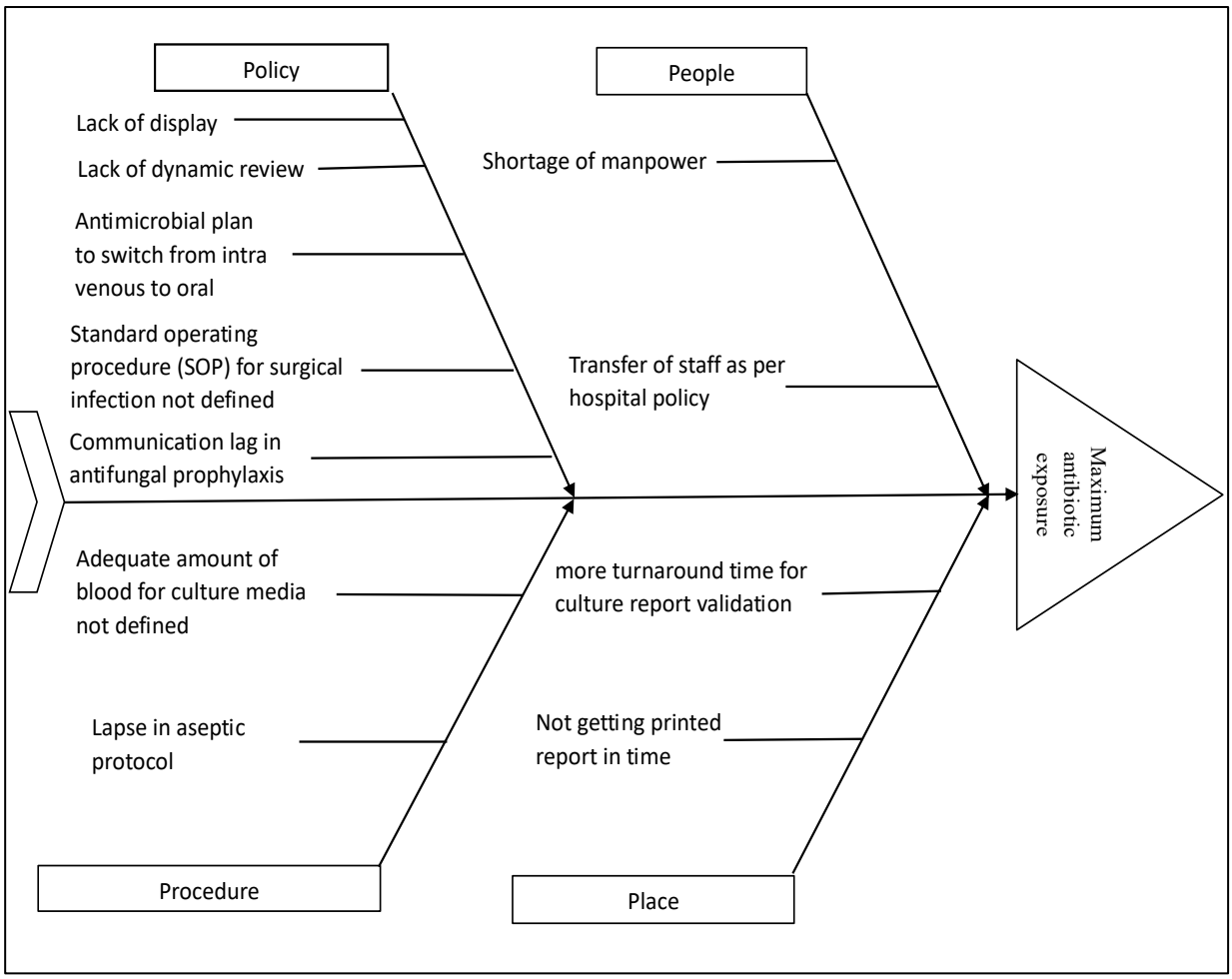

Figure 1: Ishikawa fish bone analysis.

Table 2: Summary of plan-do-study-act (PDSA) cycles.

PDSA	Plan	Do	Study	Act
	To form a SOP for standardising antibiotic prescription	Adaptation of ICMR STW criteria for starting and use of correct antimicrobial drug, regimen, dose, interval, duration and route.	Starting antibiotics was rationalised. AUR reduced from 540.09 to 497.66	Adapted
	Rational upgradation of antibiotics	Preauthorisation was made mandatory before starting the reserve group of antibiotics. The resident would take written permission from the consultant.	Antibiotic misuse was prevented. Written permission was not possible in an emergency. Reserve antibiotics reduced. AUR reduced from 497.66 to 479.3	Telephonic preauthorisation was adopted.
	Defining antibiotics time out for antibiotics	Asymptomatic babies with two negative septic screens 24 h apart, antibiotics stopped.	Feasible. Observed babies for a minimum of 2 days after stopping. Total AUR reduced from 479.3 to 454.82	Adapted it increased the duration of stay for observation, but reduced the total days of hospitalisation.
	Reducing TAT With a microbiology lab for negative reports	Posting the culture report in the Whatsapp group	It was feasible to get reports early on whatsapp and printed later on, hence TAT was	Adapted

Continued.

PDSA	Plan	Do	Study	Act
			reduced to 48 h.	
	Reducing TAT by rapid automated reporting	Providing automated bactec culture bottles	It was feasible, but it had an increased cost. And sometimes it lapsed due to a stockout of bactec bottles.	Adapted
	Reducing TAT With a microbiology lab for positive reports	Requested the micro team to use MALDI-TOF for early reporting if the bactec flags positive.	MALDI TOF provided early identification of the organism, but it was feasible only if a batch of samples was available. Hence, it was not possible every time.	Abandoned due to limited resources.
	De-escalation of antibiotics	If clinically well, two consultants will concur and de-escalate antibiotics based on the culture sensitivity report.	It was feasible; subsequent monitoring was required. AUR increased from 437.99 to 486.17 due to a fungal outbreak	Adapted
	Optimization of initiation and upgradation of antibiotics	Individualized newborn assessment clinically and correlate with the lab report. Upgradation to the second line of antibiotics after at least 36 h if the baby deteriorates or does not clinically improve with proper documentation	Period prevalence of antibiotic usage. Reduced from 63.66% to 56.73%.	Adapted
	Justification forms	Form filled for the upgradation of antibiotics by the resident doctor who upgraded the antibiotics	Due to a heavy workload, the resident was unable to fill out the complete form.	Abandoned

In the baseline phase (July-August 2024), 619 neonates were admitted with risk factors and symptoms. These neonates were investigated and started on antibiotics as per the protocol. Root cause problem analysis was done using Ishikawa fishbone analysis depicted in Figure 1. In the intervention phase (September 2024 to March 2025), AMSP was implemented in 2152 babies with nine plan-do-study-act (PDSA cycles. PDSA cycles were conducted to implement the protocols, engage actively in the laboratory and streamline antibiotic usage shown in table 2. In the post-implementation sustenance phase (April to June 2025), 855 babies were followed. Regular data monitoring, review and discussions were held to ensure compliance. We observed babies not exposed to antibiotics, the antibiotic usage rate and those receiving prolonged antibiotic use in all phases of the study.

Measurement indicators

A baseline evaluation was carried out in the NICU for 2 months to study the indications of admission, reasons for starting antibiotics and to obtain data on the number of antibiotic days per baby. The calculated point prevalence of antibiotic usage is defined as the number of babies receiving antibiotics in the NICU at that point, divided by the total number of babies admitted to the NICU at that point. This point prevalence was considered as the process indicator. Appropriate antibiotic selection, initial evaluation (septic screen, cerebrospinal fluid examination, blood culture and sensitivity, urine routine and microscopy) and antibiotic de-escalation were the other process indicators.

The outcome indicators

Primary indicators-AUR

We have collected data in the form of DOTs of all antibiotics weekly every Sunday for one year then calculated their mean DOTs monthly and written them systematically in table three and further calculated AUR.

AUR in culture negative=(DOTs of antibiotic use in culture negative/total days of admission)×1000.

Secondary indicators

Prolonged antibiotic use was defined as antibiotic duration more than 48 hours in screen negative and culture negative, more than 7 days in screen positive and culture negative and more than 14 days in culture positive. We have collected at least 1 ml and maximum up to 3 ml blood volume for culture. 1-2% chlorhexidine gluconate was used as topical disinfectant.

Statistical analysis

Data collected for the process and outcome indicators were maintained monthly in an excel sheet. Continuous variables were summarized using means, medians and standard deviations. Data were analysed using standard statistical tests with computer software. Outcome measures were evaluated across the three study phases using a Chi–square test, Fisher's exact tests for categorical variables and one-way analysis of variance (ANOVA) for continuous variables. All statistical analyses were performed using Stata 18 (Stata Corp and the College Station, TX), with the two-tailed significance threshold set at $P<0.05$. The trend in the incidence rate of antibiotic use over time was displayed and analysed using process control charts in Microsoft excel software. Approval from the institutional ethical committee was obtained before starting this study. Written informed consent was obtained from caregivers of all neonates before inclusion in the study.

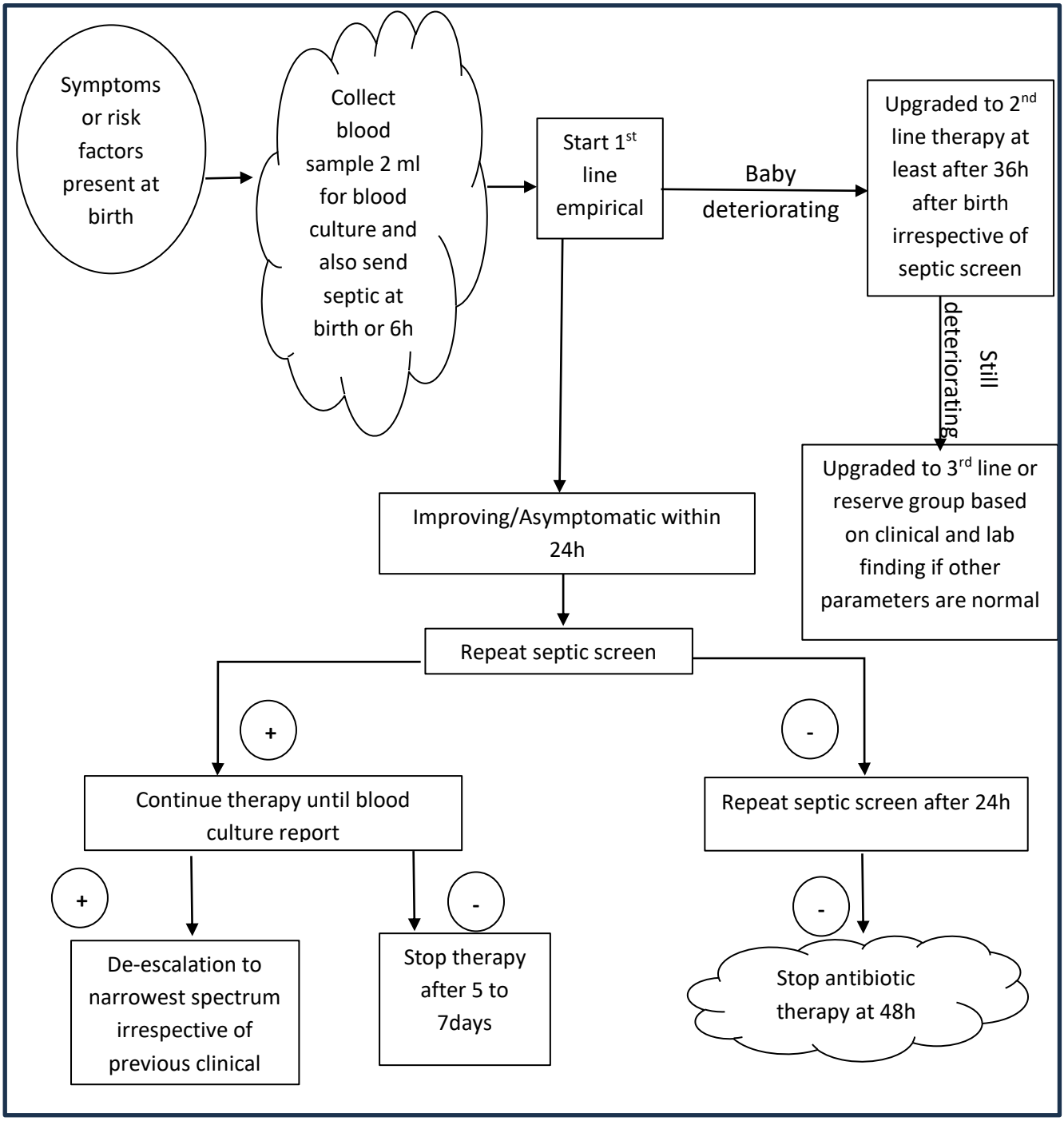

Figure 2: Flow chart showing the approach towards antimicrobial therapy.

Table 3: Table depicting data of dots of antimicrobials over a period of one year.

Date	Piperacillin	Amikacin	Meropenem	Ciprofloxacin	Colistin	Vancomycin	Linezolid	Amphotericin	Fluconazole	Gentamicin	Ampicillin
July 2024 (baseline) Total patient days-2605	219.92	291.83	475.35	84.87	132.47	79.12	20.37	30.25	48.55	24.23	0
August 2024 (baseline) Total patient days-2733	217.70	369.05	450.05	76.87	159.55	68.24	19.65	25.10	48.45	0	0
September 2024 (PDSA-1) Total patient days-2945	226.38	362.34	454.52	85.76	134	90.34	21.02	36.16	49.76	5.33	0
October 2024 (PDSA-1) Total patient days-2990	230.72	380.97	471.22	74.02	112.62	79.95	14.77	29.82	39.02	0	0
November 2024 (PDSA-2) Total patient days-2791	193.50	327.60	417.25	69.45	118.55	61.90	15.87	23.77	41.52	0	0
***December 2024 (PDSA-3) Total patient days-2202**	220.20	370	360.51	46.69	119.12	58.72	34.22	59.37	39.54	0	0
January 2025 (PDSA- 4,5,6) Total patient days-2779	220.20	0	269.38	53.31	258.42	51.55	44.56	78.06	17.43	259.34	39.71
February 2025 (PDSA-7) Total patient days-2652	0	0	258.54	53.06	200.91	49.29	44.56	78.06	17.43	234.34	225.36
***March 2025 (PDSA-8,9) Total patient days-2995**	0	0	300.24	56.98	260.41	61.83	50.47	127.81	62.67	270.02	265.65
April 2025 (sustainability) Total patient days-2727	6.25	0	259.88	52.30	124.41	61.56	43.96	68.79	80.93	254.23	251.30
May 2025 (sustainability) Total patient days-2567	27.25	0	257.29	53.86	121.56	60.74	43.10	72.02	90.92	251.23	150.30
June 2025 (sustainability) Total patient days-2527	9.25	0	257.67	53.20	120.21	60.34	42.99	68.79	91.66	257.04	155.06

**Sepsis outbreak*

RESULTS

This QI study includes the 3,696 NICU admissions over a period of 1 year (July 2024-June 2025). Of the 3,696 admitted neonates, 52.2% were male. Median gestational age was 37.6 weeks (27.25-40.0) and birth weight 1990 g (840.12-3900). We found no differences between the preintervention and postintervention cohorts in maternal or foetal characteristics as compared in table 4.

Table 4: Baseline characteristics of the neonates in the two phases of the study.

Characteristics	Preintervention Mothers (n=593) Neonates (n=619)	Postintervention Mothers (n=2077) Neonates (n=2152)	Sustenance Mothers (n=826) Neonates (n=855)	P value[C]
Maternal (%)				
Antepartum antibiotic exposure	10.4	10.7	11.1	0.6834
Antenatal steroids coverage	7.6	7.8	8.1	0.7186
Premature rupture of membranes (PROM) term >24h	14.6	15.1	16.1	0.4628
Preterm premature rupture of membranes (PPROM), any duration	21.2	20.8	20.2	0.6364
Maternal high vaginal swab positive	13.1	14.2	13.7	0.7742
Maternal urine culture positive	6.1	5.8	6.3	0.8627
Chorioamnionitis	5.2	5.6	6.1	0.5085
Neonatal				
Gestational age (weeks)[a]	37.4 (27-39.4)	37.5 (27.2-39.6)	37.1 (27-40)	0.0664
Birth weight (g)[a]	2225.0 (925.0-3700)	2300.0 (860.0-3900)	2125.0 (840.12-3875)	0.0087
Prematurity <34 (weeks)[a]	13.2%	12.7%	13.6%	0.8588
Male[b]	52.2%	50.7%	50.2%	0.4471
Length of stay (days)[a]	8.0 (1.0-21.0)	7.0 (1.0-27.0)	8.0 (1.0-29.0)	1.0000
Neonatal risk (%)				
Non-invasive ventilator support	30.61	29.54	30.25	0.9210
Invasive ventilator support	10.8	10.2	10.12	0.6879
Perinatal asphyxia	31.22	30.27	30.11	0.6447
Respiratory distress syndrome	35.65	34.81	35.21	0.8436
Shock requiring inotropes	12.21	12.86	12.11	0.9473
Meningitis	18.21	17.96	19.1	0.6943
Culture-proven sepsis	12.32	12.11	12.10	0.8934
Probable sepsis	25.32	26.62	26.25	0.7177

[a]median (Q1, Q3), [b]N (%), [C]P value between preintervention phase and sustenance phase (Z-test).

Table 5: Outcome indicators.

	Mean AUR	Not exposed to antibiotics (%)	Stop antibiotics at 48 h (apparently well/ screen positive) (%)	Stop antibiotics at 7 days (culture negative/screen positive) (%)	AUR (culture negative)	Prolonged use of antibiotics (%)
Baseline	540.09	36.34	14.40	52.17	415.12	27.84
PDSA 1	497.66	41.53	21.76	58.26	400.52	25.57
PDSA 2	479.30	42.56	23.80	61.84	397.05	19.15
PDSA 3	454.82	41.95	23.95	60.22	352.84	21.43
PDSA 4, 5, 6	594.00	46.94	26.10	59.45	356.34	22.44
PDSA 7	437.99	45.22	27.52	60.21	361.20	23.15
PDSA 8, 9	486.17	46.32	28.79	59.35	366.35	22.61

Continued.

	Mean AUR	Not exposed to antibiotics (%)	Stop antibiotics at 48 h (apparently well/ screen positive) (%)	Stop antibiotics at 7 days (culture negative/screen positive) (%)	AUR (culture negative)	Prolonged use of antibiotics (%)
Sustainability	441.71	43.27	29.15	58.44	371.51	22.41
P value[a]	0.0018	0.0075	<0.0001	0.0111	0.00015	0.1181

a-Chi-square test for comparing proportions.

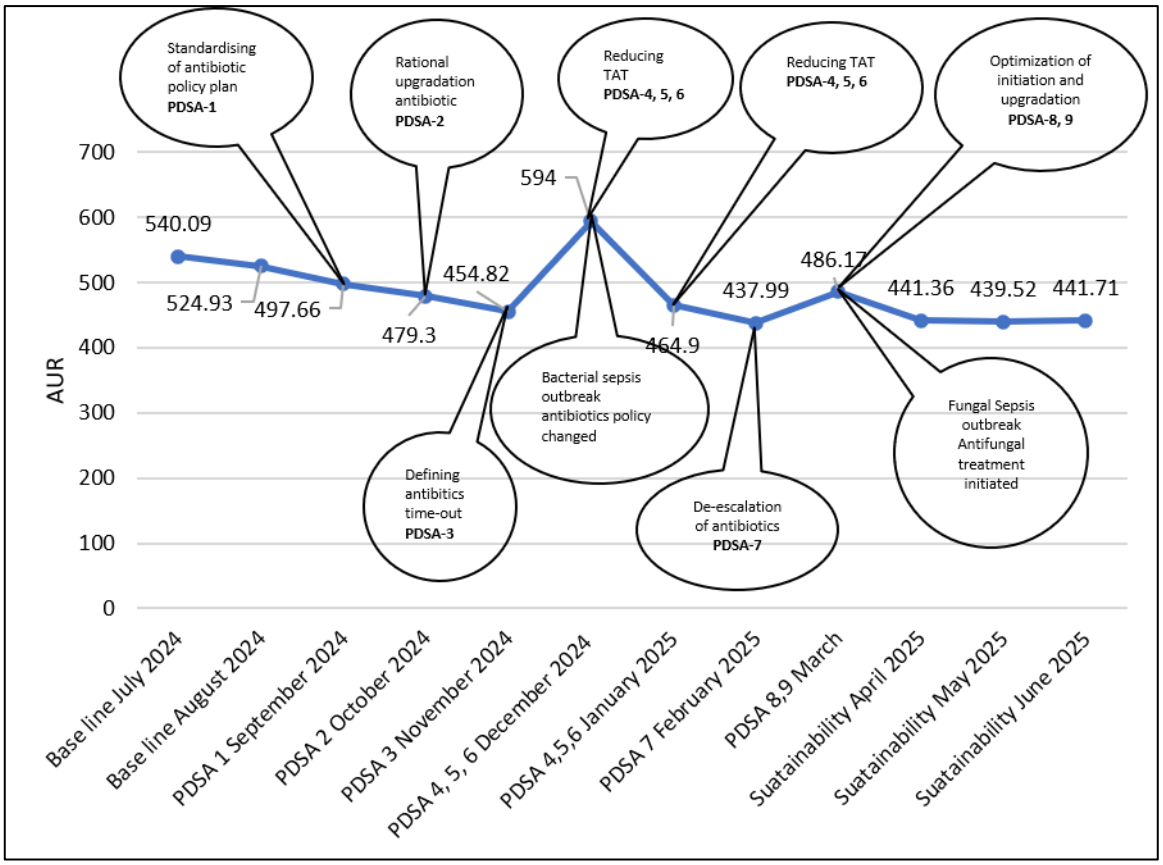

Figure 3: Control chart showing AUR trends over time during AMSP implementation.

Baseline admission neonates not exposed to antibiotics were 36.34%, and this increased to 43.27% after AMSP (p=0.0075). AUR decreased from 540.09 to 441.71 (18.21% relative reduction, p=0.0018). AUR in culture-negative babies reduced from 415.12 to 371.51 (10.50%). Early discontinuation in screen-negative neonates increased from 14.40% to 29.15% (p<0.0001). Our primary outcome, AUR and its trend throughout the study, is depicted in figure 3.

There is a significant reduction in AUR from 540.09 to 497.66 after the first PDSA cycle itself, after which there was only a mild reduction in AUR following PDSA 2. AUR was further reduced to 454.82 after PDSA 3. During PDSA 4, 5, 6, a Klebsiella pneumoniae outbreak raised AUR to 594.00. A revised antibiogram and reinforced infection control reduced AUR to 437.99 by February 2025 after reinforcement of PDSA 6.

Hence, with appropriate clinical management and strengthening infection prevention and control measures, we could control the spike of AUR by February 2025. A Candida tropicalis outbreak in March 2025 was controlled by strengthening infection prevention practices and revising the antifungal policy (fluconazole loading at 25 mg/kg, then 12 mg/kg/day) and prophylactic antifungal therapy twice weekly for the first 2 weeks, followed by every alternate day for 6 weeks. Terminal disinfection was done by fumigation with 40% formalin/ 20% eco-shield. In organisms showing intermediate resistance to meropenem, increase the dose to 40 mg/kg/dose three times a day and prolong the infusion for at least four hours because it causes time-dependent killing.

Maximum AUR reduction was seen after implementing PDSA-1 (540.09 to 497.66). At the end of the sustainability phase, in June 2025, overall AUR decreased from 540.09 to 441.71, representing an almost

18.21% reduction (p value=0.0018). We also measured other process indicators, such as the early stopping of antibiotics at 48 hours, in sepsis-screen-negative patients who were apparently well.

These neonates were 14.40% during the baseline and increased to 29.15% during the sustainability phase, which was statistically significant (p<0.0001) and tabulated in table 5. The proportion of neonates colonized with MDROs during the study decreased from 1.4% at baseline to 1.0% postintervention. The safety metrics, such as readmission for sepsis within 15 days, were reduced from 1.2 to 1.1%, though the change was not statistically significant. The Clostridium difficile rate was not recorded, whereas the multidrug-resistant organism rate was reduced from 70 to 58%. In December 2024, during the Klebsiella outbreak, the increase in AUR was accompanied by a rise in the use of prolonged antibiotics.

Antibiotics caused by a sepsis outbreak and an antibiotic policy change according to the antibiogram the overall effectiveness of antibiotic use was compromised. But we calculated the AUR reduction of meropenem and vancomycin, which were consistently used antibiotics. meropenem AUR declined by 44.12% (182.47 to 101.96 and vancomycin by 21.40% (30.37 to 23.87).

DISCUSSION

Our findings demonstrate that a POCQI-based AMSP can significantly reduce unnecessary antibiotic use even in a high-burden, resource-limited NICU. Small, iterative PDSA interventions improved confidence in stopping antibiotics early and encouraged rational prescribing. This QI taught us to introduce small steps at the appropriate time rather than targeting a big goal. Instead of studying the monthly data, we focused on presenting it in weekly meetings to discuss our shortcomings and take measures at the appropriate time.

This POCQI methodology demonstrated an improvement in antibiotic prescribing patterns with prudent use of antimicrobials. Our relative AUR reduction (18.21%) was lower than the 43% reported by Makri et al in the UK.[5] Our study showed a comparatively higher AUR, possibly because our NICU is a very busy public hospital set-up with a high workload and attends referred antenatal patients with a high sepsis rate. The whole course of antenatal steroid coverage is <8%. We could reduce our AUR primarily by decreasing antibiotic usage in culture-negative babies, as culture-positive babies would require appropriate antibiotics for an adequate duration. Since we could reduce AUR in culture-negative babies by only 10.50%, we can focus more on decreasing antibiotic usage in these patients. However, our culture-negative AUR reduction aligns with recent stewardship trials showing early discontinuation is safe and reduces resistance.[12,13] Two PDSA cycles focused more on this reduction: first, restricting the initiation of antibiotics, and second, stopping antibiotics 48 hours early.

The current intervention targeted the admission order set because we suspected that admission antibiotics were inadvertently continued beyond 48 hours, despite documentation of the intent to stop. The findings of Shulman et al were similar, revealing that 12% of the time, antibiotic therapy was continued beyond 48 hours, even when there was supporting evidence to stop it.[9] In one of the NICUs participating in Vermont Oxford Network's "Choosing Antibiotics wisely" initiative, neonates discharged without receiving antibiotics (no antibiotics) increased from 15.8 to 35% and in our study, the proportion of neonates never exposed to antibiotics rose from 36.34% to 43.27%.[14]

We observed two sepsis outbreaks: klebsiella pneumoniae species in December 2024 and fungal sepsis (candida tropicalis) in March 2025. Klebsiella and candida outbreaks highlight the need to integrate AMSP with infection prevention and control (IPC). Similar findings were reported in a global review where NICUs accounted for 37.9% of ICU outbreaks, mostly by enterobacteriaceae.[15] Since klebsiella reservoirs are mainly healthcare workers and contaminated sinks, strict hand hygiene, contact precautions and barrier nursing measures were periodically reinforced and audited to ensure compliance.

Before the fungal sepsis outbreak, extensive building construction and renovation were occurring on hospital premises, which may have contributed to the outbreak. We had a discussion with hospital management about prioritizing the NICU and completing the early construction.

Antibiotic with good oral bioavailability, switched over from intravenous to oral, after 48 to 72 hours or once the baby is clinically stable, to reduce the days of hospitalization and utilization of hospital resources, except in meningitis, because we cannot afford to mitigate bioavailability in CNS infection.

Escalation of antimicrobials was based on clinical deterioration rather than the blood culture report due to the high turnaround time and high mortality associated with delayed initiation of antibiotics. Schedule review done at 48 hours, 5 days to decide about continuation of antimicrobial in apparently well baby with risk of sepsis due to perinatal risk factors or culture-negative sepsis. In case of pan-resistant organisms with intermediate sensitivity to one or other antibiotic, consider a higher dose of that antibiotic, preferably in combination.[16]

When time was mentioned in the routine lab investigation form, workers were required to report the investigation promptly, which they received during their duty hours. This has reduced misplacement, technical errors and repeated blood sampling and it has helped in making decisions about antimicrobials.

Automated blood culture technology is preferred over conventional blood culture after collaboration with the microbiology department to reduce turnaround time and improve sensitivity. the sensitivity of blood culture pathogen detection is improved by increasing volume of blood because truly infected neonates may also have falsely negative blood culture if there is low-level circulating bacteremia. 0.5 ml blood culture volume only has 39% probability of pathogen detection. 63% probability of pathogen detection at 1 (colony forming units (CFU)/ml during 1 ml blood culture volume collection is increased to 95% probability during 3 ml blood collection.[17] Povidone iodine was not used as topical disinfectant for reason of potential systemic absorption and risk of hypothyroidism.[18]

Minimizing unnecessary antibiotic exposure confers benefits, including reduced morbidity and fewer deaths from antibiotic-resistant bacterial infections. Reserve drugs according to the WHO AWaRe classification 2023, like colistin, tigecycline, daptomycin, meropenem, vancomycin or linezolid, should not be used empirically to prevent antibiotic resistance.

Implementation challenges included high staff turnover, causing lapses in infection prevention practices, limited microbiology capacity and a lack of real-time CRP values. Nevertheless, simple low-cost measures standardized policies, preauthorization, hand hygiene drills were impactful. Structured AMSP implementation using QI principles significantly reduced antibiotic exposure in this high-burden NICU. AMSP scale-up across Indian NICUs is feasible and urgently needed to curb rising neonatal AMR.

CONCLUSION

This QI initiative implemented a context-adapted, stepwise antibiotic stewardship model using nine iterative PDSA cycles in a Level III NICU. Interventions included development of a Standard operating procedure (SOP), mandatory preauthorization for reserve antibiotics, defined antibiotic 'time-outs,' and reduced turnaround time for microbiology reporting. The antibiotic use rate (AUR) decreased from 540.09 to 441.71 without compromising clinical outcomes. AUR is another matrix which can be used in QI projects to compare antibiotic use within and across NICUs.

Broad-spectrum antibiotics must be replaced by culture-sensitive, low-cost, narrow-spectrum options to prevent MDRO emergence and preserve the reserve group of antimicrobials. When clinically asymptomatic and culture-negative growth, antibiotic therapy can be stopped at 48-72 hours of life. In case of pan-resistant organisms, with intermediate sensitivity to one or other antibiotics, a higher dose and prolonged infusion of that antibiotic, preferably in combination can be given. The model demonstrated feasibility, adaptability and sustainability even in constrained public-sector settings.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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