

**Blood culture contamination reduction, quality improvement in NICU, MGM Hospital, Warangal****Kagithapu Surender<sup>1</sup>, Mohan Amgothu<sup>2</sup>, G. Karunakar<sup>3</sup>, Ayesha Begum<sup>4</sup>, P. Srivani<sup>5</sup>, Ragha Sanjana K.<sup>6</sup>**<sup>1</sup>Professor & HOD, Department of Pediatrics, Government Medical College, Jayashankar Bhupalpally<sup>2</sup>Professor, Department of Pediatrics, Government Medical College, Mahabubabad, Telangana, India<sup>3</sup>Associate Professor, Department of Pediatrics, Government Medical College, Mahabubabad, Telangana, India<sup>4</sup>Professor & HOD, Department of Pediatrics, Government Medical College, Mahabubabad, Telangana<sup>5</sup>Medical Officer, Mohammadabad PHC, Mahabubnagar, Telangana, India<sup>6</sup>Senior Resident, Department of Paediatrics, Government Medical College, Siddipet, Telangana, India

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Corresponding Author: Dr. G Karunakar

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**Abstract:****Introduction:** Neonatal sepsis is a leading cause of neonatal mortality, especially in LMICs, with the highest incidence in the Indian subcontinent. Blood culture (BC) is the gold standard for diagnosis but has limitations like low positivity, false positives, and delays. This study aimed to reduce BC contamination using the plan do study act (PDSA) cycle.**Methods:** This prospective study included all neonatal intensive care unit (NICU) admitted newborns, excluding uncooperative parents. A research team collaborated with microbiology experts to understand and reduce BC contamination using a three-cycle PDSA approach. Training, protocol reinforcement, and supply monitoring improved compliance, significantly reducing BC contamination, leading to large-scale intervention implementation.**Results:** The study demonstrated a significant reduction in BC contamination rates from 10.7% (20) to 1.9% (5) through PDSA cycles. Compliance with hand hygiene, personal protective equipment (PPE) usage, antiseptic application, and proper sample collection improved notably. These structured interventions led to enhanced infection control, minimizing unnecessary antibiotic use and hospital stays in the NICU.**Conclusion;** Implementation of a structured PDSA cycle-driven intervention significantly improved adherence to aseptic BC collection techniques, reducing contamination rates. The intervention emphasized staff training, supply monitoring, and adherence to standard protocols, leading to sustained improvements.**Keywords:** Blood Culture Contamination, PDSA Cycles, Neonatal Sepsis, Infection Control, Quality Improvement.**DOI:** 10.25258/ijcpr.18.4.30This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Neonatal sepsis (NS) is the most common and primary cause of neonatal mortality especially in low- and middle-income countries (LMICs) [1]. As per the literature, in the global neonatal mortality, the LMICs holds 99% stake and the incidence is highest in Indian subcontinent [2, 3]. NS can be very early onset, early onset and late onset, manifest within 24 hours, within 1 – 7 days and 8 – 28 days of birth, respectively; fatality rate is high in early onset. 2 The death rate due to NS has doubled in the past 20 years.

Blood culture (BC) is the gold standard technique for the diagnosis NS [4]. But low positivity is the major limitation, positive around 25 – 45% cases. In

addition, false positive (FP) results due to improper sample handling, requirement of 48 – 72 hrs, limited availability, antenatal antibiotic usage are the added obstacles [4]. Minimal sample handling and rapid result can be possible with the automated methods, but cost is the limitation. Culture independent techniques and prediction-based techniques are also available, but the diagnostic utility is a debate.

Due to the difficulty in samples collection the BC contamination rate is more among the neonates. This FP report leads to prolonged hospital stay, unnecessary usage of antibiotics, mental agony to the family and financial burden. Multiple studies have been reported to introduce standard protocols

for BC so that FP results can be minimized. As per the unpublished data, the contamination rate was 10.7% in the Neonatal Intensive Care Unit (NICU) of this organization. With this a study was conducted with an aim to reduce the BC contamination to the recommended standards by following plan do study act (PDSA) cycle.

### Materials and Methods:

It was a prospective, quality improvement (QI) study conducted in the department of Pediatrics, Kakatiya Medical College, Hanumakonda. Study was conducted from 1st July 2023 to 15th September 2023, 10 weeks. Study protocol was approved by the Institutional Ethics Committee. An informed written consent was taken from the parents.

All newborns admitted in NICU were included in the research. Newborns of the noncooperative parents were excluded from the study. Research team was formed with faculty, postgraduates, nursing staff and lab technician. Initially team approached the Microbiology department to get information such what is BC contamination, various reasons for this and also how to mitigate these issues. After getting thorough knowledge blood collection bundle was introduced to reduce culture contamination by PDSA in 3 cycles. BC bundle consists of hand wash, personal protective equipment (PPE), 70% isopropyl alcohol (IPA) syringes, cotton, sterile tubes and so on. As part of study protocol, the team was informed to collect specimen for BC followed by specimen for other investigations.

In PDSA Cycle 1, a six-component bundle was introduced to minimize BC contamination, focusing on staff training through lectures, audiovisual aids, live demonstrations, and hands-on sessions. Over 15 days, sample collection practices were observed to ensure adherence to proper procedures (Table 1). Compliance was monitored using a checklist, and the results were analyzed and compared with pre-intervention data. Based on the findings, a second PDSA cycle was initiated to further improve the process.

In PDSA Cycle 2, a review meeting was conducted with NICU nurses to acknowledge their efforts and missed steps from the previous cycle were addressed. Additional training was provided using audiovisual aids and live demonstrations to reinforce adherence to the bundle. To overcome supply shortages, a designated nurse was assigned to monitor and ensure the regular availability of necessary materials. Compliance with protocols was closely observed using a checklist, and the results were analyzed and compared with those from PDSA

cycle 1. Based on the findings, a third PDSA cycle was planned for further improvement.

In PDSA Cycle 3, efforts were focused on reinforcing previously missed steps through continued staff training and monitoring. A designated nurse ensured the regular supply of necessary material to maintain adherence to protocols. Data was collected, analyzed, and compared with previous cycles to assess improvements. Due to a significant reduction in blood culture contamination, the intervention was scaled up for broader implementation.

**Statistical Analysis:** Data were analysed using SPSS software version 22.0. The BC contamination rates were compared across the three PDSA cycles. A chi-square test assessed the significance;  $P < 0.05$  was considered statistically significant. Compliance improvements were analyzed using descriptive statistics, and trend analysis confirmed the effectiveness of the intervention in reducing contamination rates over time.

### Results

Before intervention, just 9.6% (18) of staff followed proper hand hygiene with liquid soap and six-step hand wash, which was improved to 65% (156) after PDSA1, 86% (206) in PDSA2, and 89.6% (215) in PDSA3. Usage of PPE also improved: gloves [63.1% (118) to 90.8% (208)], masks [54% (101) to 85.8% (206)], and caps [85.6% (160) to 92.9% (223)] across cycles. Initially, nurses were unaware of using betadine for blood collection for culture; its usage increased from 0 to 94% (226) in PDSA1 and remained above 93% (223) in later cycles.

Usage of 70% IPA improved from 95.2% (178) to nearly 100% (240). Sterile gauze, unavailable before, was introduced, leading to usage rates of 51% (122) in PDSA1, 71.9% (173) in PDSA2, and 68.3% (164) in PDSA3. Proper site cleaning technique improved from 35.8% (67) to 97.9% (235), and adherence to allowing skin antiseptic to dry increased from 51.3% (51.3) to 90% (216). Cleaning culture bottle tops with 70% IPA improved from 17.6% to 96.3%, and drying the bottles increased from 7% to 96.3%.

Initially the rate of specimen collection was 78.6% (147), reached 86.3% (207) in PDSA3. Culture contamination decreased from 10.7% (20) before intervention to 2% (5) in PDSA3, with an overall reduction to 3.3% (3/98) across the study. Among all the bundles, there was statistically significant difference after successful PDSA (Table 2).

<b>Problem</b>	<b>Measures initiated</b>
Hand wash without liquid soap	Procured liquid soap from CSSD. Training secession was conducted on hand wash to the staff nurses and lab technicians.
PPE kits scarcity	Procured PPE kits from CSSD
Lack of sterile gauze	Procured from CSSD on daily basis as per the requirement
Improper usage of betadine as skin antiseptis and 70% IPA,	The staff nurses trained thoroughly about specimen collection for BC, skin disinfection by practical demonstration, hands on training and audio-visual aids.
Few staff nurses were cleaning the top of culture bottle with 70% IPA	All the staff nurses were instructed to clean the top of culture bottle
Priority for the BC specimen collection	Explained several times that specimen for BC should be collected first followed by specimen for other investigations.
PPE: Personal protective equipment; CSSD: Central sterile supply department. BC: Blood Culture; IPA: Isopropyl alcohol	

<b>Bundles</b>	<b>Material in the bundle</b>	<b>Before intervention 187 (100)</b>	<b>After intervention 240 (100)</b>		
			<b>PDSA 1</b>	<b>PDSA 2</b>	<b>PDSA 3</b>
Hand wash liquid soap following all steps*		18 (9.6)	156 (65)	206 (86)	215 (89.6)
PPE*	Gloves	118 (63.1)	206 (86)	221 (92.1)	218 (90.8)
	Mask	101 (54)	226 (94)	202 (84.2)	206 (85.8)
	Cap	160 (85.6)	240 (100)	220 (91.6)	223 (92.9)
Skin antiseptic*	Betadine	0	226 (94)	223 (93.1)	224 (93.3)
	IPA	178 (95.2)	233 (97)	240 (100)	238 (99.2)
Cleaning the puncture site*	Sterile gauze	0	122 (51)	173 (71.9)	164 (68.3)
	In circular motion	67 (35.8)	226 (94)	236 (98.5)	235 (97.9)
	Allowed to dry	96 (51.3)	168 (70)	228 (95.1)	216 (90)
Cleaning the top of culture bottle*	IPA	33 (17.6)	180 (75)	240 (100)	231 (96.3)
	Allowed to dry	15 (8)	149 (62)	217 (90.4)	203 (84.6)
Priority for BC specimen collection*		147 (78.6)	206 (86)	207 (86.2)	207 (86.3)
Contamination*		20 (10.7)	19 (8)	7 (3)	5 (2)
PPE: Personal Protective Equipment; IPA: Isopropyl alcohol; BC: Blood Culture					

## Discussion

PDSA cycles enable clinicians to improve patient care through a structured, experimental approach to testing changes. This method promotes individual, team, and organizational learning, ensuring continuous quality improvement [5, 6]. With this we attempted to find how effective the QI in BC results which is an important technique but reducing the rate of contamination is a tough task due to the involvement of various factors [7].

Hand hygiene of health care workers is crucial area to prevent hospital acquired infection (HAI) because touch is an essential act in our daily life [8]; Thorough the touch various microorganisms are transmitted and skin itself contain so much flora. When we correlate touch aspect to this study, proper hand hygiene compliance, and hand washing with soap water by following 6 steps was 9.6% (18) before intervention and it was changed to 89.6% (215) at the end of PDSA 3, statistically it was significant (Table 2). In continuation, skin asepsis and cleaning puncture area also essential not only to

reduce BC contamination but also minimize or can avoid entry of foreign pathogens, ultimately reduces the HAI.

With thorough implementation of PDSA there was significant changes in the skin antiseptic utility as well as cleaning the punctured area (Table 2). Proper hand hygiene significantly reduces neonatal infections by preventing pathogen transmission. Studies by Pittet et al. [9] and Larson et al. [10] reinforce that comprehensive hand hygiene training leads to sustained adherence and infection reduction. In the literature also the increased utility of IPA after some kind of awareness programme was reported [11]. Even PPE utilization was also significantly improved after PDSA; as we are aware that PPE can prevent the highly infectious diseases [12]. Utilization by the staff alone is not the only issue in this study, availability was also important aspect which was resolved after discussion with the concern central sterile supply department (CSSD) officer.

In continuation to the specimen collection by following the aseptic precautions, thorough cleaning the bottle cap is also important to minimise the contamination. Studies have been reported that changing needle before inoculation of BC bottle does not decrease contamination rate [13, 14]. Hence cleaning bottle cap is the best way to reduce the contamination rate. With proper training there was significant increment in cleaning the BC bottle cap (Table 2). With all these measures, the contamination rate before intervention was 10.7% (20). After the introduction of PDSA Cycles, contamination reduced to 8.1% (19) in Cycle 1, 3.06% (7) in Cycle 2, and 2% (5) in Cycle 3. Overall, the study achieved a significant reduction to 3.3% (3/98). These results align with findings from Robertson P et al. [15] and Alahmadi YM et al. [16] demonstrating that structured QI initiatives effectively reduce BC contamination. As per the reports, blood is priority specimen for BC to for blood stream infections diagnosis [17]. Before intervention, the specimen collection for BC was 78.6% (147) cases, increased to 86.3% (207) by Cycle 3; statistically there was significant difference (Table 2).

The study was limited by its single-center design, which may affect the generalizability of the findings. The short study duration of 10 weeks restricted long-term follow-up on sustained compliance and outcomes. Data collection relied on direct observation, which may introduce observer bias. Additionally, resource constraints and variable staff availability occasionally impacted bundle implementation.

### Conclusion

Implementation of a structured PDSA cycle-driven intervention significantly improved adherence to aseptic BC collection techniques and reducing contamination rates. The intervention emphasized staff training, supply monitoring, and adherence to standard protocols, leading to sustained improvements. Similar studies support that continuous education, protocol reinforcement, and resource allocation contribute to effective infection control measures in NICU settings.

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