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Original Research Article

Quality improvement initiative to improve the availability of mother's own milk for feeding preterm babies admitted to NICU

Ezhil Vanan Natarajan Ramachandran, Arun Karthik Thangavadivel, S. Mangala Bharathi*

Department of Neonatology, Institute of Obstetrics and Gynaecology, Madras Medical College, Chennai, Tamil Nadu India

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***Correspondence:**
Dr. S. Mangala Bharathi,
E-mail: drmangalabharathi@gmail.com

ABSTRACT

Background: Ensuring timely availability of mother's own milk (MOM) for preterm infants admitted to neonatal intensive care units is challenging. We aimed to improve MOM availability for feeding preterm infants by postnatal day 5 (PND5) through a structured quality improvement approach.
Methods: This prospective pre–post intervention QI study was conducted over 6 months in a tertiary-care NICU. Preterm infants <34 weeks with hospital stay ≥5 days were included. The QI phases were baseline (August 2023), three sequential monthly PDSA cycles (September–November 2023) and sustenance (December 2023–January 2024). The primary outcome was a unit-day metric: the mean proportion of prescribed enteral milk requirement met by MOM from PND1–PND5, with PND5 as the primary endpoint. Infant-days with nil per oral status or zero prescribed enteral volume were excluded. Process measures were proportion of mothers expressing milk within 4 hours of birth; and proportion of mothers expressing milk ≥8 times/day.
Results: In all phases of the study, the expression of milk within 4 hours showed improvement and the availability of MOM increased from day 1 to day 5. Process measures improved. Expression within 4 hours and Expression ≥8 times/day also increased from baseline values.
Conclusions: A phased package of counselling, family participatory care, reminder systems and lactation counsellor support were associated with improved MOM availability by PND5. This was accompanied by improved early and frequent milk expression and gains were maintained subsequently.

Keywords: Mother's own milk, Neonatal intensive care unit, Preterm infants, Quality improvement

INTRODUCTION

Exclusive breastfeeding is an effective intervention to improve child survival. It is reported to prevent 13% of under-five deaths globally each year. Early initiation of breastfeeding within the first hour of birth, along with exclusive breastfeeding, is reported to reduce 22% of newborn deaths.[1] In India, around 27 million babies are born every year. Of these, 3.5 million are preterm and 7.5 million are low birth weight. About 47% are small for gestational age. Many of these infants have feeding difficulties due to medical illness and immaturity. Direct breastfeeding is often not feasible during the early NICU stay. In such situations, the next best alternative is expressed breast milk, preferably from the biological mother.[2] When expressed breast milk is not adequate or not available, infants may be fed with infant formula. Formula feeding in preterm infants is associated with an increased risk of sepsis and necrotizing enterocolitis, with implications for both survival and quality of survival. The World Health Organization recommends donor human milk through human milk banks as the next best feeding

option for sick infants when mother's milk is not available.[3] National Health Mission initiatives have also focused on establishing lactation management centres at secondary and tertiary level public health facilities to provide lactation support.[4] However, mother's own milk has advantages over donor human milk and is associated with reduced morbidity in preterm infants and maternal health benefits.[2,6]

Point-of-care quality improvement (POCQI) is a structured approach intended to improve care processes through iterative testing and sustaining change. Plan–Do–Study–Act (PDSA) cycles and fishbone (Ishikawa) analysis are commonly used tools to analyze system problems and test change ideas. Previous quality-improvement studies have reported improvement in the use of mother's milk or expressed breast milk with interventions such as counseling and staff engagement.[5-8] As a tertiary care referral centre, many high-risk antenatal mothers with multiple and preterm gestations are referred to our hospital. A large proportion of infants admitted to our NICU are preterm. Ensuring timely and adequate availability of mother's own milk for these infants remains challenging.

Aim

To improve the mean proportion of prescribed enteral milk requirement met by mother's own milk on postnatal day 5 for preterm babies admitted in NICU from 19% to at least 50% and sustain this over 6 months (August 2023 to January 2024).

Objective

To measure the mean proportion of prescribed enteral milk requirement met by mother's own milk on postnatal day 5 of life (unit-level mean of infant-level proportions).

METHODS

Study design and setting

This was a prospective pre–post intervention quality improvement (QI) study conducted over 6 months (August 2023 to January 2024) in the neonatal intensive care unit (NICU) of the Institute of Obstetrics and Gynecology, Egmore, Chennai. The QI phases were baseline (August 2023), an intervention phase consisting of three sequential monthly Plan–Do–Study–Act (PDSA) cycles (September–November 2023) and a sustenance phase (December 2023–January 2024). The phase timeline is shown in Figure 1.

Participants

Consecutive sampling was used. All preterm infants <34 weeks admitted to the NICU with a hospital stay of at least 5 days were eligible for inclusion. Exclusion criteria were: major congenital anomalies; direct breastfeeding at any time during the initial five days of life; surgical or medical conditions precluding enteral feeding; and mothers with contraindication for expressing breast milk.

Measures

Primary outcome (unit-day metric)

For each eligible infant-day, the proportion of prescribed enteral milk requirement met by MOM was calculated as (MOM volume received that day÷prescribed enteral milk requirement for that day)×100. The unit daily outcome was the mean of these infant-level proportions. The outcome was tracked from PND1 to PND5, with PND5 as the primary endpoint. Infant-days with nil per oral (NPO) status or zero prescribed enteral volume were excluded from the day's mean calculation. For QI monitoring, the outcome was reported as mean only. Dispersion measures were not calculated.

Process measures

proportion of mothers who expressed breast milk within 4 hours of birth and proportion of mothers who expressed breast milk at least 8 times per day.

Problem analysis and QI approach

During the baseline phase, existing practices related to counselling, initiation of milk expression and provision of MOM were observed and barriers were identified. Root cause analysis was performed using a fishbone diagram (Figure 2). Based on these findings, sequential change ideas were tested through three PDSA cycles, followed by a sustenance phase to maintain the gains (Figure 1).

Interventions (PDSA cycles)

PDSA cycle 1 (September 2023)

Postnatal counselling to attendants regarding the importance of MOM and early expression was reinforced in addition to standard counselling. A 3 days International Lactation and Milk Banking Conference (LAMBCON) workshop was conducted for healthcare providers. Weekly audits and periodic motivation of staff and residents were carried out. As the target was not met, the approach was adapted into a more comprehensive structured counselling process for the next cycle.

PDSA cycle 2 (October 2023)

A structured counselling process was implemented with emphasis on family participatory care. Counselling occurred at two points in the labour ward, to mothers and attendants while awaiting delivery, regarding the importance of MOM and preparedness for breastfeeding; and in the NICU, to the father or attendant regarding colostrum, the benefits of MOM and expression technique, along with standard counselling about the baby's clinical status. If colostrum was not expressed within 4 hours, telephonic reminders were given by ward

staff. Structured counselling sessions were conducted daily. A WhatsApp group was created to motivate residents and staff and to monitor counselling implementation.

PDSA cycle 3 (November 2023)

In addition to the above measures, a lactation counsellor was arranged to improve, monitor and sustain the ongoing process.

Sustenance phase (December 2023–January 2024)

Interventions introduced during the PDSA cycles were continued and monitoring of MOM provided to preterm infants was maintained.

Data collection

After informed consent, a structured data collection form was used. Baseline information included maternal demographic profile and MOM availability after admission. Daily observation was carried out for milk expression and quantity expressed from PND1 to PND5. Daily records were maintained regarding the use of MOM versus pasteurized donor human milk (PDHM). Daily data on expression timing, quantity and type of milk were recorded on the structured data collection form using information from feeding charts. Data were entered into MS Excel by the study team. No formal inter-observer reliability assessment was performed.

Analysis

Data were entered in MS Excel and analyzed using SPSS. Outcomes and process measures were summarized descriptively. The unit daily outcome was calculated as the mean of infant-level proportions. For quality improvement monitoring, these values and the process measures were aggregated into weekly means and displayed using statistical process control charts (Figure 1–3).

Written informed consent was obtained from parents or guardians. The study was approved by the Institutional Ethics Committee of Madras Medical College, Chennai (No. 08122023).

RESULTS

Participant flow and phase-wise inclusion

A total of 266 preterm infants were screened for eligibility. Of these, 125 were excluded due to death (n=8), maternal illness requiring transfer (n=5), feeds not initiated (n=12) and hospital stay <5 days (n=100). A total of 141 preterm infants were included in the analysis: baseline phase (n=25), PDSA 1 (n=32), PDSA 2 (n=27), PDSA 3 (n=27) and sustenance phase (n=30) (Figure 4).

Baseline clinical profile

Baseline clinical profile by phase is shown in table 1 (descriptive case-mix). Gestational age and birth weight distributions varied across phases, while sex distribution was broadly similar.

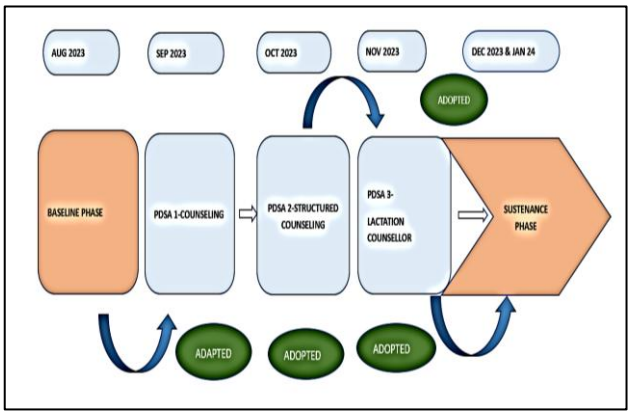

Figure 1: Study phase timeline showing Baseline phase, three sequential PDSA cycles and Sustenance phase (August 2023–January 2024).

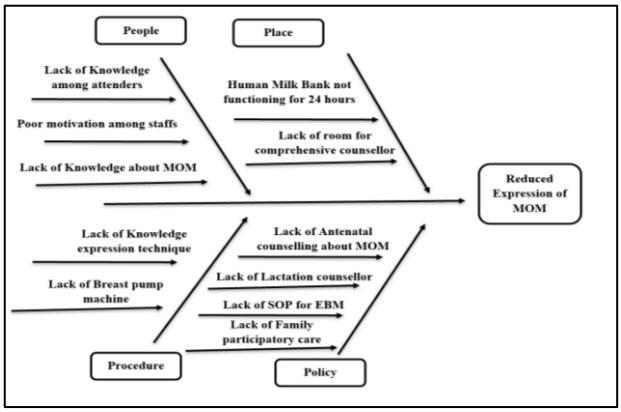

Figure 2: Fishbone analysis (cause–effect diagram) showing contributors to reduced availability of mother's own milk in the NICU.

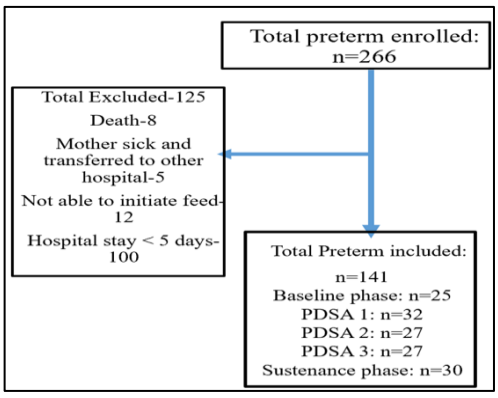

Figure 3: Participant flow diagram showing screening, exclusions with reasons and phase-wise inclusion (Baseline, PDSA 1–3, Sustenance).

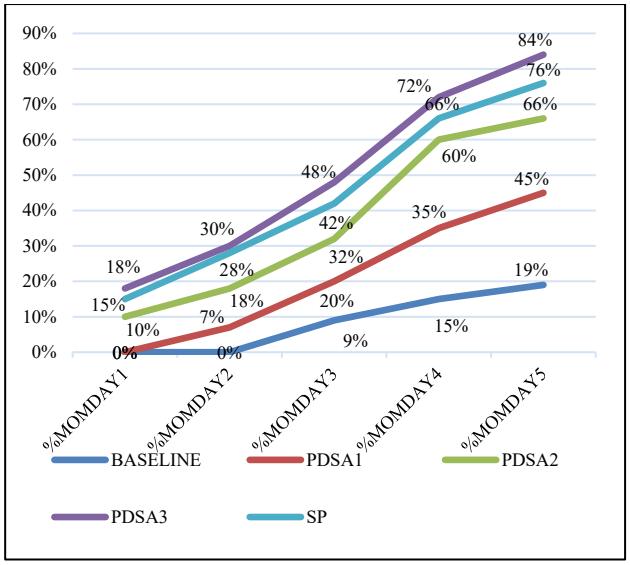

Figure 4: Statistical process control chart for primary outcome: Mean proportion of prescribed enteral milk requirement met by mother's own milk on postnatal day 5 (PND5) across study phases (Baseline → PDSA 1–3 → Sustenance), plotted as weekly means.

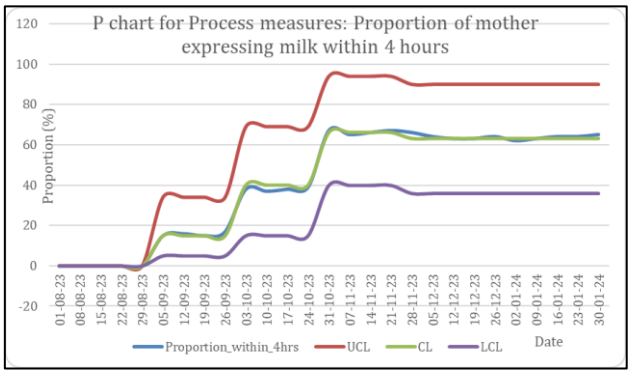

Figure 5: Statistical process control chart for process indicator 1: Proportion (percentage) of mothers expressing milk within 4 hours of birth across study phases (Baseline (0%) → PDSA 1–3 (66%) → Sustenance (61%)), plotted as weekly means.

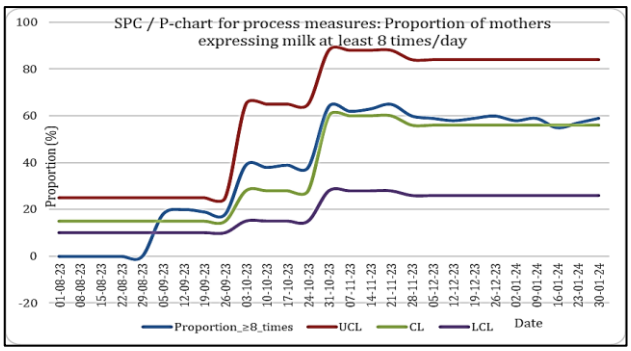

Figure 6: Statistical process control chart for process indicator 2: Proportion (percentage) of mothers expressing milk at least 8 times per day across study phases (Baseline (0%) → PDSA 1–3 (64%) → Sustenance (59%)), plotted as weekly means.

Primary outcome (PND5)

On statistical process control monitoring of weekly means, the mean proportion of prescribed enteral milk requirement met by MOM on PND5 increased across phases (Figure 1). The baseline value was 19%. The chart shows improvement up to a peak value of 84% during the later intervention period, with a sustenance end value of 76%. During the intervention phase, implementation of the structured counselling package in PDSA cycle 2 was associated with an increase in the outcome measure to 66%, following which this change was adopted.

Process measures

On statistical process control monitoring of weekly means, process measures increased across phases (Figure 2–3). Milk expression within 4 hours increased from 0% at baseline to 66% in PDSA cycle 3 and 61% at sustenance end (Figure 2). Milk expression at least 8 times per day increased from 0% at baseline to 64% in PDSA cycle 3 and 59% at sustenance end (Figure 3). These process measures are presented descriptively using the SPC chart values. No formal statistical tests were performed for process measures.

Table 1: Phase-wise clinical profile included preterm infants.

Characteristics	Baseline (n=25)	PDSA 1 (n=32)	PDSA 2 (n=27)	PDSA 3 (n=27)	Sustenance (n=30)
Gestational age (in weeks)					
<28	4 (16.0)	1 (3.1)	1 (3.7)	1 (3.7)	5 (16.7)
28–31+6	14 (56.0)	26 (81.3)	21 (77.8)	25 (92.6)	23 (76.7)
32–33+6	7 (28.0)	5 (15.6)	5 (18.5)	1 (3.7)	2 (6.7)
Birth weight (g)					
<1000	6 (24.0)	13 (40.6)	8 (29.6)	10 (37.0)	12 (40.0)
1000–1499	12 (48.0)	18 (56.3)	18 (66.7)	17 (63.0)	18 (60.0)
1500–2499	7 (28.0)	1 (3.1)	1 (3.7)	0 (0.0)	0 (0.0)
Sex					
Male	12 (48.0)	19 (59.4)	14 (51.9)	14 (51.9)	16 (53.3)
Female	13 (52.0)	13 (40.6)	13 (48.1)	13 (48.1)	14 (46.7)

Values are n (%). Statistical comparisons across phases were not performed, the table is descriptive.

DISCUSSION

Main findings

In this NICU QI initiative, the mean proportion of prescribed enteral milk requirement met by mother's own milk on postnatal day 5 increased over the study phases. Similar QI initiative by Priyadharshini et al, showed 3 times more increase in daily milk output.[9]

In the study the outcome increased from 19% in baseline to higher values during the later intervention period, with a sustenance end value of 76% (Figure 4). The study results are consistent with the study done by Vasanth Kumar et al, which showed EBM provision gradually improving from 20% to 72% by a QI initiative and sustaining above 70 % over 10 months.[10] Similarly in a QI initiative by Sumandeep Kaur et al, proportion of preterm infants on MOM increased from 10% to 81% during intervention phase at day 7 and remained 66% during sustenance phase.[11]

The process measures also improved across phases for early initiation of expression within 4 hours and for expression frequency of at least 8 times per day. Milk expression within 4 hours increased from 0% at baseline to 66% in PDSA cycle 3 and 61% at sustenance end (Figure 5). The study results are consistent with the study done by Nikita S Kalluri et al, which showed improvement in the rate of first milk expression < 6 hours after birth.[12] Similarly in a study by Nitasha Bagga et al, the median age of the first EBM improved from 2.5 days to 1.16 days.[13] Milk expression at least 8 times per day increased from 0% at baseline to 64% in PDSA cycle 3 and 59% at sustenance end (Figure 6). The study results are consistent with the study done in a tertiary care hospital using PDSA cycles by Anup Thakur et al, in which the mean time of availability and volume of expressed breast milk within 48 hours, improved gradually from 73.3 h to 20.9 h and 4.7 mL to 15.8 mL, respectively.[14]

Interpretation

The intervention package was implemented incrementally. The first cycle reinforced postnatal counselling of attendants, staff training through a workshop and weekly audits. The second cycle added structured counselling at two contact points (labour ward and NICU), family participatory care, a reminder system when colostrum was not expressed within 4 hours and monitoring through daily sessions and a WhatsApp group. The third cycle added lactation counsellor support to reinforce and sustain practice. These changes likely supported improvement in early expression and expression frequency, with corresponding improvement in MOM availability by postnatal day 5. Because this was a pre–post QI design and case-mix varied across phases, the observed improvements should be interpreted as association rather than causation.

Limitations

This was a single-centre pre–post QI study and generalizability may be limited. Balancing measures were not predefined, assessed or reported. The primary outcome was reported as mean only and dispersion measures were not calculated. Because infant-days with NPO or zero prescribed enteral volume were excluded, the number of infant-days contributing to daily means varied across days and phases, which may limit comparability with other settings. Data were obtained from routine clinical records and may be subject to measurement error.

Implications

A structured counselling approach with family participatory care, early reminders, staff engagement and lactation counsellor support may be feasible strategies to improve the availability of mother's own milk in similar NICU settings. Future QI work should include predefined balancing measures and clearer day-wise reporting across postnatal days 1–5 to aid interpretation across different case-mix profiles.

CONCLUSION

In this single-centre NICU quality improvement initiative, a phased package of counselling, family participatory care, reminder systems and lactation counsellor support was associated with improved mean proportion of prescribed enteral milk requirement met by mother's own milk for preterm infants by postnatal day 5. This was accompanied by improved early and frequent milk expression and gains were maintained subsequently.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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