

BMJ Open Quality Sustaining extended Kangaroo mother care in stable low birthweight babies in NICU: a quality improvement collaborative of six centres of Karnataka

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ABSTRACT

Background Kangaroo mother care (KMC) is a proven intervention for intact survival in preterms. Despite evidence, its adoption has been low. We used a point of care quality improvement (QI) approach to implement and sustain KMC in stable low birthweight babies from a baseline of 1.5 hours/baby/day to above 4 hours/baby/day through a series of plan-do-study-act (PDSA) cycles over a period of 53 weeks.

Methods All babies with birth weight <2000 g not on any respiratory support or phototherapy and or umbilical lines were eligible. The key quantitative outcome was KMC hours/baby/day. A QI collaborative was formed between six centres of Karnataka mentored by a team with a previous QI experience on KMC. The potential barriers for extended KMC were evaluated using fishbone analysis. Baseline data were collected over 3 weeks. A bundled approach consisting of a variety of parent centric measures (such as staff awareness, making KMC an integral part of treatment order, foster KMC, awareness sessions to parents weekly, recognising KMC champions) was employed in multiple PDSA cycles. The data were aggregated biweekly and the teams shared their implementation experiences monthly.

Results A total of 1443 parent–baby dyads were enrolled. The majority barriers were similar across the centres. Bundled approach incorporating foster KMC helped in the quick implementation of KMC even in outborns. Parental involvement and empowering nurses helped in sustaining KMC. Two centres had KMC rates above 10 hours/baby/day, while remaining four centres had KMC rates sustained above 6 hours/baby/day. Cross-learnings from team meetings helped to sustain efforts. Extended KMC could be implemented and sustained by low intensity training and QI collaboration.

Conclusions Formation of a QI collaborative with mentoring helped in scaling implementation of extended KMC. Extended KMC could be implemented by parent centric best practices in all the centres without any additional need of resources.

INTRODUCTION

Problem description

Nearly 15 million preterm neonates are born each year, and more than 1 million of them

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Evidence from systematic reviews has shown that Kangaroo mother care (KMC) improves survival, breastfeeding rates, reduces hypothermia and nosocomial infections in the short-term and long-lasting positive effects on behaviour up to 20 years. Many quality improvement (QI) initiatives have been undertaken to sustain increased KMC duration in their individual units. These studies have tested various interventions such as awareness of staff and parents, foster KMC, simpler KMC documentation, increasing resources like KMC chairs and provision of beds to mothers, rewarding staff and parents sequentially.

WHAT THIS STUDY ADDS

⇒ Using a bundled approach encompassing parent-centric strategies aids in quick implementation of KMC. The collaborative model helped mutual learning between centres, served as a platform for sharing innovative ideas and helped scale up the intervention in multiple centres despite varied sickness and limitations in resources.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Bundled approach could be used to increase KMC duration in future QI initiatives to reduce implementation time. This collaborative initiative provides a framework for scaling up KMC in larger state or nationwide collaborations without any additional need for resources and can be replicated in similar contexts across the developing world.

pass away.¹ As per UNICEF, more than 35% of all neonatal deaths are caused by complications from preterm birth.² Many preterm infants who live experience sensory, cognitive and language impairments as a result of their early birth.³ India is accountable for about 25% of preterm births and 42% of low birthweight (LBW) infants worldwide.⁴ Kangaroo



mother care (KMC) is a simple, cost-effective and proven intervention for both survival and improved neurobehavioural outcomes of preterms.⁵⁻⁷ The important component of KMC involves continuous and prolonged skin-to-skin contact between the caregiver, especially the mother and the baby. Although the effectiveness of KMC has been well documented, there is a huge knowledge-practice gap and poor implementation of the intervention in many units.⁸ The common challenges for KMC implementation are low healthcare staff awareness, non-availability of mothers in the initial few days both in postcaesarean delivery and outborn settings, resistance to foster KMC (KMC by a family member), and lack of a structured policy.⁸⁻¹⁰

Quality improvement (QI) collaboratives help organisations identify and target implementation barriers by training them in QI processes, providing an infrastructure for addressing common barriers (provider concerns, leadership support, logistics, structural challenges), and developing an interorganisational support network from which participating centres can learn from each other's successes and challenges.^{11 12} Most of the challenges for implementation of KMC are similar and possibly the solutions too. Collaborations between organisations is the need of the hour to help scale up KMC to improve preterm quality care.

Setting

A KMC QI collaboration was formed between six centres of Karnataka, India. All these six centres were tertiary care neonatal intensive care units (NICUs) with annual admission load ranging from 250 to 1200. All the centres admitted both inborn and outborn neonates with majority centres catering to the outborn population. The relevant information of the participating centres has been summarised in [table 1](#).

Available knowledge and rationale

Evidence from systematic reviews has shown that KMC improves survival, breastfeeding rates, reduces hypothermia and nosocomial infections in the short term.^{8 13} The KMC done in the initial few days can have long-lasting positive effects on behaviour even up to 20 years with less hyperactivity, school absenteeism, etc.⁷ Many QI initiatives have been undertaken to implement and sustain increased KMC duration in their individual units. These QI initiatives have implemented KMC ranging from 2 months to 9 months. These studies have tested various interventions such as awareness of staff and parents, foster KMC, simpler KMC documentation, increasing resources such as KMC chairs and provision of bed to mother, rewarding staff and parents sequentially.¹⁴⁻¹⁹

Either supervision or high intensity training (>5 days training combined with >1 interactive method) alone or even in combination is unable to bring greater changes in quality care. While low intensity training combined with QI collaborative has a greater impact on improving quality care in low-income and middle-income countries.¹² With one of the centres already having a prior experience of QI in KMC,¹⁶ we decided to form a QI collaboration to implement extended KMC across different centres.

Aim

We aimed to implement extended KMC for eligible babies (babies with no respiratory support/need of phototherapy/no umbilical central lines) admitted in the NICU of collaborative centres from a baseline of 1.5 hours (range) (40 min to 2.7 hours) per baby per day to above 4 hours per baby per day over a period of 8 weeks.

Table 1 Summary of the participating centres and demographic features

| Hospital ID | Centre 1 | Centre 2 | Centre 3 | Centre 4 | Centre 5 | Centre 6 |
|-------------------------------------|---------------|--------------|---------------------|--------------|---------------------|-----------------|
| Organisation type | Public sector | DNB teaching | Fellowship training | DNB teaching | Fellowship training | Medical college |
| No of admissions/month | 120 | 80 | 50 | 30 | 20 | 130 |
| Average patient occupancy/day | 25 | 18 | 8 | 6 | 6 | 35 |
| Patient:nurse ratio | 8:1 | 5:1 | 3:1 | 3:1 | 2:1 | 4:1 |
| Entry collaboration | January 2022 | January 2022 | January 2022 | April 2022 | June 2022 | June 2022 |
| Baseline KMC rate in hours/baby/day | 0.6 | 2.9 | 2.7 | 1.6 | 1 | 2.7 |
| No of parent baby dyads enrolled | 845 | 187 | 84 | 51 | 22 | 254 |
| Mean gestational age at birth (SD) | 34 (2) | 32 (1) | 33 (2) | 32 (2) | 32 (1) | 31 (3) |
| Mean birth weight (SD) | 1689 (210) | 1670 (275) | 1554 (329) | 1543(344) | 1470 (290) | 1450 (330) |
| Outborns (%) | 460 (54) | 51 (27) | 53 (63) | 11 (21) | 6 (27) | 37 (15) |
| Caesarean delivery (%) | 321 (38) | 153 (82) | 68 (81) | 46 (90) | 21 (96) | 162 (64) |
| Twin gestation (%) | 66 (8) | 40 (21) | 3 (3) | 6 (11) | 3 (14) | 27 (11) |

DNB, Diplomate of National Board; KMC, Kangaroo mother care.

METHODS

Design

A multidisciplinary QI collaborative was formed between 6 centres of Karnataka, India. Each centre had a team of at least two nurses and two doctors. The study was conducted in the NICU and step-down wards from January 2022 to December 2022. Both inborn and outborn stable babies below the birth weight of 2 kg were eligible for the study. A stable baby was defined as a baby not requiring respiratory support, phototherapy for jaundice and/or having umbilical central lines. The babies on respiratory support were also given KMC in the unit, but were not part of the data collection. Extended KMC was defined as KMC hours more than 4 hours per baby per day as per the national guidelines.²⁰ We used a point of care QI approach to implement KMC in stable LBW babies through a series of plan-do-study-act (PDSA) cycles.

All teams of centres except centre 6 were trained together at a QI Workshop held at Bangalore which helped to form the collaboration. The six collaborative centres were enrolled sequentially. Mentoring unit (centre 3) enrolled centre 1 and 2 first in January 2022. After implementation of extended KMC in the first two centres, centre 4 was enrolled in April 2022. Centres 5 and 6 were enrolled in June 2022. Due to lack of funding and non-availability of research staff, sequential enrolment into the collaboration was done.

Each centre had a team of 2–3 nurses and 2 doctors. Each of the participating sites chose a nurse-led team leader. Two nurses and one doctor ensured implementation of the bundle approach and entered data to the common database. Other doctor was a senior consultant who ensured team meetings and supervision of the data. The change package (bundled approach) that was given to them was based on interventions that helped implement KMC in the mentoring unit and the first two centres. Our collaborative faculty consisted of the mentoring team and senior paediatricians (with prior research/QI experience in KMC). Run charts of each centre were updated once every 2 weeks in a common whatsapp group. Monthly meetings on a virtual platform held every 4 weeks provided the teams with the opportunity for learning and served as a motivation. If there was a sudden dip in the rate of KMC in 2-weekly run charts, the team meetings with individual centres were held and supervised by the mentoring team. This assisted in creating a helpful communication system for early escalation and tackling of challenges.

Patients and public involvement

Patients and/or the public were not involved in the design, or reporting, or dissemination plans of this research. However, mothers were involved indirectly during implementation phase (PDSA 2) and during sustenance phase. In the implementation phase, mothers were the judges for the counselling competition for nurses. During the sustenance phase, mothers were trained on KMC on a weekly basis and mothers with prior KMC experience

(after discharge) were involved for peer counselling of new parents.

Measurements

The key quantitative outcome was KMC hours per baby per day. The number of hours of KMC per baby was taken as a numerator. The number of eligible babies was taken as the denominator. Twin babies were taken as two eligible babies. We also recorded the percentage of parents completing extended KMC as another outcome indicator since May 2022. Audits were done by two nurses and was supervised by one doctor from each centre. KMC duration was uploaded in the common Google form of the collaboration on a daily basis. The number of KMC hours was calculated from 08:00 the previous day to 07:59 the next day. Descriptive statistics were used to describe the demographic variables. We obtained 2–3 weeks of baseline data to calculate the median. Monthly compliance rates were collected thereafter and displayed using run charts from Microsoft Excel software. We defined a shift according to evidence-based rules.²¹ When we identified a shift, we recalculated the new median using the points that made up the shift and compared new data to this new median. We followed the Standards for Quality Improvement Reporting Excellence 2.0 guidelines for reporting.²²

Strategy

During the baseline period (at least 2 weeks), the two nursing officers from individual centres collected daily data on KMC hours per baby per day from eligible infant–mother dyads on a predesigned Excel sheet. The data were supervised by doctors from individual centres and submitted to the core team of collaboration. The potential barriers for prolonged KMC were evaluated using fishbone analysis. After the baseline period, we implemented extended KMC sequentially over a period of 2 months through a series of two PDSA cycles. In each phase, the duration of KMC per baby per day was recorded daily and displayed in the run charts every 2 weeks. The collaborative meetings were held every 4 weeks with all the teams on a virtual platform which, if there was a sudden dip in the rate of KMC in 2-weekly run charts, the team meetings with individual centres were supervised by the mentoring team.

PDSA cycles

PDSA #1 (2–4 weeks)

A change package (bundled approach) was employed in the first PDSA based on the previous experience of centre 3.¹⁶ The major process concerns addressed were staff awareness, availability of mothers and hesitation for foster KMC. The components of the bundle were staff sensitisation, issues related to mother's preparedness, availability of KMC chairs, structured counselling, promoting foster KMC, making KMC part of day to day practice and simpler KMC documentation. The staff sensitisation was the first component addressed by training sessions at



each centre virtually through live CME by the mentoring team (<https://www.youtube.com/watch?v=3Vlu76uR-r0I&t=36s>). The session consisted of evidence, procedure and monitoring of KMC. In addition, applying QI principles for implementation of KMC was also discussed. The recorded session was used to train the nurses who missed the session. Following that, the remaining components of the bundled approach were ensured simultaneously.

Available mothers were convinced that sponging should suffice instead of bath as in one of the centres bathing facilities were not available for mothers and in few centres there was a cultural taboo to delay mothers' bath in the initial few days. A structured counselling was followed by playing a video explaining the benefits of KMC to the parents on the first visit (<https://www.youtube.com/watch?v=U0yBG59AfdS>). Foster KMC was promoted by explaining the importance of KMC in daily NICU counselling sessions. Entry restrictions were removed for fathers or other close family members willing to do KMC as earlier entry was there only for a fixed period of time. The visiting restriction display outside NICU was modified to allow fathers or other close family members at any time for doing KMC. The posters encouraging foster KMC were placed at the counselling room.

KMC was made part of the daily routine by prescribing it in the treatment chart. A poster competition on KMC for nurses also instilled a lot of enthusiasm.

Nurses recorded KMC hours in the respiratory rate column and calculated total KMC hours at the end of the day with input-output calculations. The total KMC hours were then transferred to the daily dashboard of the unit which served both as a visual reminder and an acknowledgement. These data were transferred to the common Google form of the collaboration every day by the nursing officer.

PDSA # 2 (2–4 weeks)

In PDSA 2, the bundled approach of the first PDSA was adopted and the major process concern of parental awareness was addressed. Hence, attempts were focused towards parental involvement. The 'parental awareness session on the importance of KMC' was conducted by doctors at each centre once a month (all centres). A unique competition of KMC counselling was conducted at two centres (centres 1 and 2) where nurses had to counsel a mother on KMC. The judges were a panel of parents doing KMC and the audience consisted of parents of admitted babies in NICU. As KMC mothers participated in the session just as much as the participant did, the competition served as an interactive learning experience for them. The success of extended KMC was celebrated by nurses and parents by cutting a cake which helped in further parental motivation.

Sustenance phase

The bundled approach especially sensitisation, foster KMC and simpler data collection helped to implement extended KMC. Parental involvement was key in ensuring

sustenance of KMC. Parental involvement was continued by weekly sensitisation sessions (every wednesday afternoons) by nursing officers at each centre. These sessions were also facilitated by mothers who had previous KMC experience (after discharge). This peer counselling served as a platform for promoting foster KMC and raising awareness on KMC. Monthly celebrations by cake cutting were also continued by nursing officers with mothers at all centres. KMC continued to be prescribed in treatment chart by doctors, while nurses documented in the nursing monitoring sheets, thus KMC became part of daily routine at all centres. One of the factors helping sustenance was a simpler data collection method of updating on a daily dashboard and uploading the results on the collaboration's common Google form (which was accessible via mobile devices). Knowledge attrition was one of the concerns raised during team meetings. This was addressed by using a questionnaire to assess knowledge of the nursing officers once in 3 months. The initial recorded video of KMC sensitisation was used to retrain staff if the scores were less than 80% on the questionnaire. The nursing officers promoting maximum KMC were identified as KMC champions on a monthly basis and were rewarded with prizes and certificates. The housekeeping staff in one of the centres (centre 1) assisted in helping mothers for KMC (placing and removing) as the high patient: nurse ratio was a concern. The 2-weekly display of run charts of each centre in whatsapp group served as a motivation. The centre having a sudden dip was also identified and a team meeting was done supervised by the mentoring team. The monthly team meetings were held on a virtual platform to assess the progress of KMC and discuss challenges. These meetings were chaired by senior paediatricians (with research experience in KMC) across the country on a 3-monthly basis. They not only motivated the teams but also guided the collaboration with their experience. Two centres were given lead to present the results of collaboration at both national and international level. The rewards instilled enthusiasm among the collaboration.

Currently, extended KMC is being sustained in six centres. Two more new centres are in the baseline phase of data collection and will be part of collaboration. The key interventions and drivers are summarised in [figure 1](#). The SOP of key steps of the collaboration is summarised in online supplemental material.

RESULTS

A total of 1443 neonates below 2kg were part of the QI initiative across 6 centres. There were a total of 145 (10%) twins and 618 (43%) were outborns. The demographic features of enrolled neonates are summarised in [table 1](#).

The fishbone analysis revealed lack of healthcare professional awareness, non-availability of mothers, no formal counselling and thus lack of parental awareness as major concerns for KMC (online supplemental figure 1).

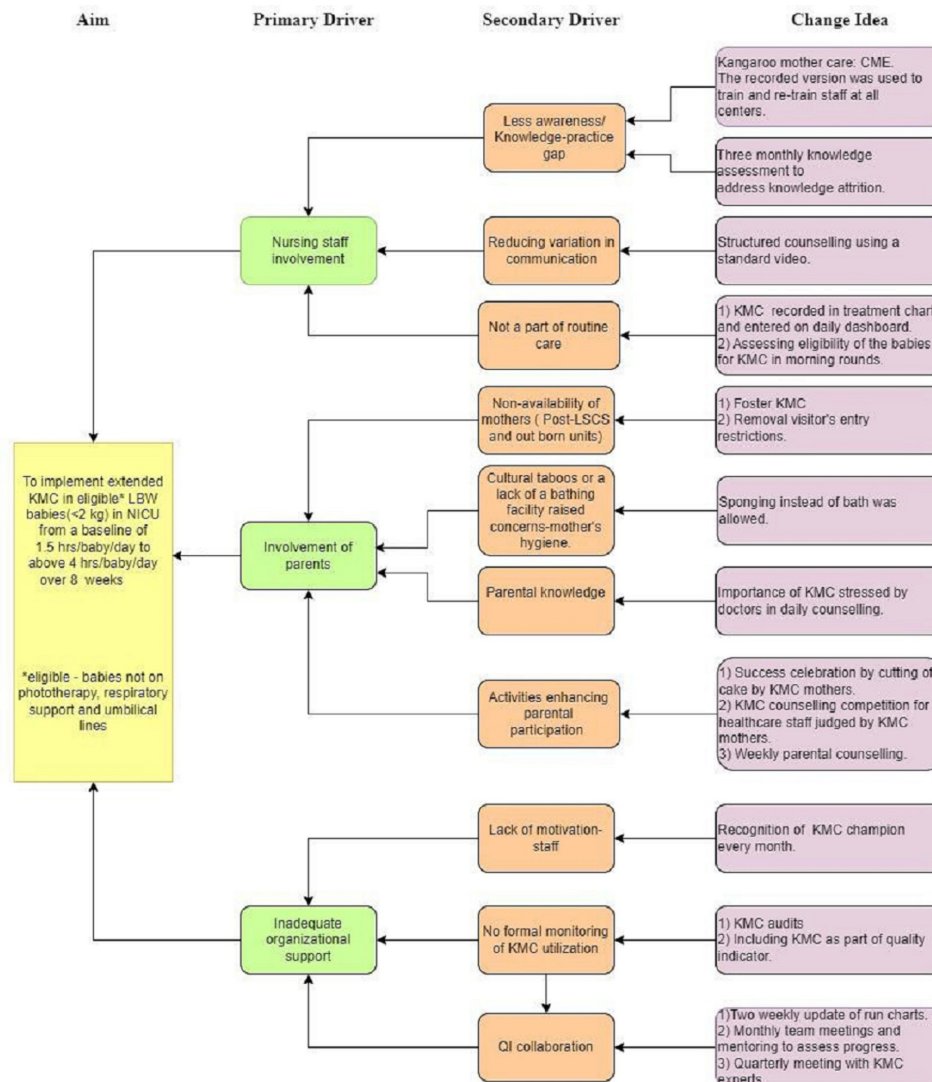


Figure 1 Driver diagram depicting key drivers and interventions. CME, Continuing medical education; KMC, Kangaroo mother care; LBW, low birth weight; LSCS, lower segment caesarean section; NICU, neonatal intensive care unit.

Figure 2 depicts the improvement of KMC rates over time as run charts. centre 1 (figure 2A) had a baseline KMC rate of 0.6 hour/baby/day (40 min). We identified a shift of 10 data points after the baseline period. We recalculated the median based on this and found the new median of 6.1. This shift suggested improvement with a bundled approach. We identified an additional shift of 10 data points after 18 weeks. We recalculated the median based on this and found the new median of 10.4. This shift suggested improvement with weekly parental sensitisation sessions. We identified an additional shift of 10 data points after 27 weeks. We recalculated the median based on this and found the new median of 14. This shift suggested improvement with recognising and rewarding nurses as KMC champions. Centre 2 (figure 2B) had a baseline KMC rate of 2.9 hours/baby/day. We identified two shifts in the run chart of centre 2 after baseline period and 18 weeks, corresponding to improvement with bundled approach and during sustenance phase with recognising and rewarding nurses as KMC champions (Centre 2

had done this strategy first). Centre 3 (figure 2C) was in the sustenance phase and ensured mentoring other centres. Centre 4 (figure 2D) had a baseline KMC rate as 1.7 hours/baby/day. We identified three shifts in the run chart of centre 4 after the baseline period, 12 weeks and 31 weeks corresponding to improvement with bundled approach, improvement with sustenance phase by weekly parental sensitisation sessions and recognising KMC champions respectively. Centre 5 (figure 2E) had a baseline KMC rate as 0.8 hours/baby/day. We identified two shifts in the run chart of centre 5 after the baseline period and after 16 weeks corresponding to bundled approach and sustenance phase respectively. Centre 6 (figure 2F) had a baseline KMC rate as 2.7 hours/baby/day. Similarly, we identified two shifts in the run chart of centre 6 after the baseline period and after 17 weeks corresponding to bundled approach and sustenance phase, respectively.

The components of the bundle and its compliance in each centre are summarised as table in online supplemental material.

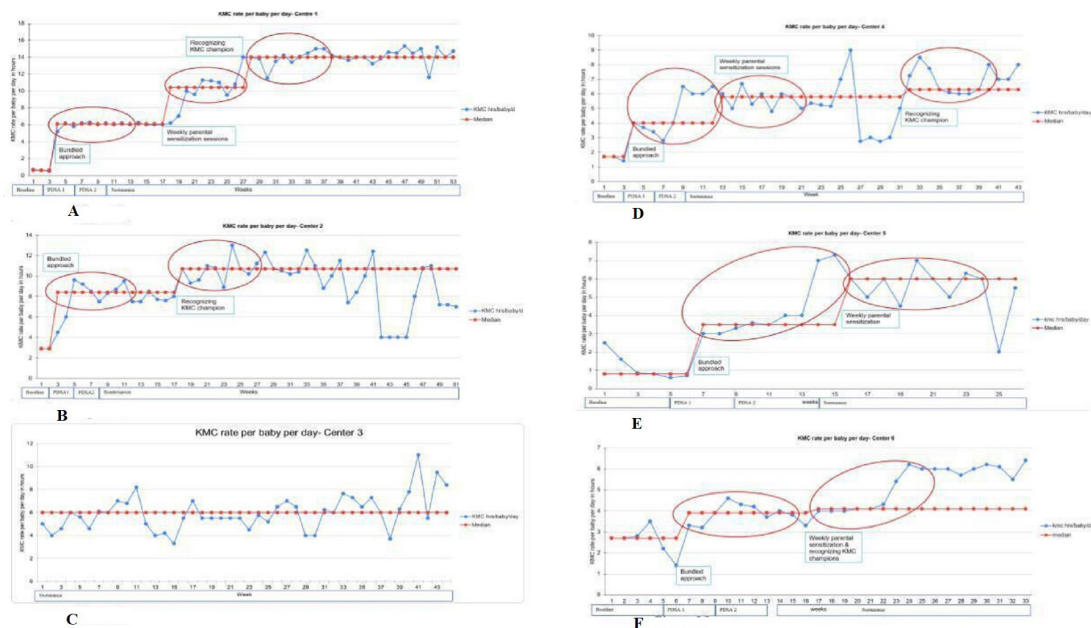


Figure 2 Run chart depicting KMC rate in hours per baby per day. (A) (centre 1), (B) (centre 2), (C) (centre 3), (D) (centre 4), (E) (centre 5), (F) (centre 6). The Oval shows a signal of shift. KMC, Kangaroo mother care; PDSA, plan-do-study-act.

Lessons and limitations

In NICUs, the healthcare professionals tend to focus predominantly on respiratory care and fluid management. Often the knowledge-implementation gap exists with developmentally supportive processes of stable growing LBW babies such as KMC. Poor utilisation of KMC has multifactorial reasons ranging from low nurses' awareness, staff shortage and inadequate support from leadership, to non-availability of mothers in outborn units, lack of awareness, challenges of accommodation or cultural practices from parents' side.^{8–10} The QI collaboration ensured addressing these multiple problems based on a common bundle approach across all six centres and also addressed few unique challenges of individual centres with team meetings.

One of the unique strategies of the collaboration was employing a bundled approach for implementation of KMC. Bundle is a package of evidence-based best practices that, when implemented collectively, improve the reliability of their delivery and maximise the patient outcomes.²³ Instead of the conventional approach of testing individual strategies in each PDSA cycle, bundled approach was tested in the first PDSA. The components of the bundle were derived from the previous QI experience of the mentoring team.¹⁶ The bundled approach reduced the implementation time across different centres from the previous 9 months to 8 weeks. Healthcare professionals training was an easier strategy employed without much need of resources. The initial training of centres happened on a live virtual platform. The recorded link helped to train nurses who missed the sessions due to leave or night shifts. To assess knowledge attrition after the training, the collaboration ensured 3-monthly assessments of nurses and retraining was done if the scores were less. Making KMC an integral part of daily prescriptions

of LBW neonates made sure KMC is reviewed each day in the rounds, improved communication among all healthcare professionals and ensured regular documentation in the patient case notes. The strategy of recognising 'KMC champions' monthly, made nurses feel encouraged and motivated. Parental awareness was ensured by weekly awareness sessions by nurses (Wednesdays). The daily dashboards, run charts and posters in a few centres served as visual reminders. Foster KMC was exceptionally successful in predominant outborn units and fathers showed equal enthusiasm for kangaroo care. Parental involvement through competitions and monthly success celebrations ensured integrated efforts to sustain KMC.

Although most of the strategies were similar across all centres, few strategies had to be implemented based on the local context. One centre did not have access to a mother's hygiene/bath. Sponging was allowed instead of bathing. This strategy was also employed if there was a cultural barrier for early bathing of mothers in the first few days. One centre had issues with a higher patient to nurse ratio. Housekeeping staff were motivated to drive KMC by motivating and helping mothers in picking for KMC or placing them back in warmer. One centre had issues with availability of KMC chairs and collaboration influence for early procurement of these special chairs was fruitful. One centre had issues with hesitation by female nurses to foster KMC by fathers. Continued success of KMC and peer counselling by other centres allayed the hesitation.

The collaborative model helped mutual learning between centres, served as a platform for sharing innovative ideas and understanding different ways of improving the predefined indicators. The root of the issue that the collaboratives seek to address is deficiencies in the clinical processes and organisational structure of the health system. The collaborative model involves multiple sites

working on the same issue concurrently, and the approach promotes learning from peers who are all experimenting with various ways to enhance shared indicators.^{11 12} Participation in QI collaborative activities may improve health professional's knowledge, problem-solving skills and attitude; teamwork; shared leadership and habits for improvement. Interaction across QI teams may generate normative pressure and opportunities for capacity building and peer recognition.²⁴ Shared experience of working as a part of the collaborative with regular mentoring seemed to improve the effective team functioning at each centre. Constant efforts were put through regular meetings by the collaborative team members to maintain the teams' motivation and to build and sustain their confidence. Bundled approach with regular training of nurses, staff encouragement, foster KMC and regular parental involvement were key in sustaining KMC. Majority of challenges faced were similar across different centres with few differences which we were able to overcome with strategies customised to each centre. The 2-weekly updates of run charts helped identify early dips and team meetings led by the mentoring team helped identify sudden change within the team and thus ensured sustenance. The monthly presentation by each team helped cross learning, gave a sense of peer pressure and also empowered them on KMC. The collaborative features such as having a standard change package, collaborative faculty (mentoring team), learning sessions interaction at the start of project at each centre, monthly conference calls, team initiated calls (whenever there is a sudden dip of KMC rate in 2-weekly data), site visits (three centres), written progress on monthly basis, collaborative extranet, etc were the key components which helped in the success.²⁵

Limitations

Major challenge faced by the collaborative was lack of funding to equip and support teams to manage data collection and handle the challenges. With more centres interested in joining the collaborative, designing standardised ways of implementation, tracking the data and sustaining will be a greater challenge. Different centres with variable patient groups, facilities, manpower and experiences warrant the need for innovative ideas to sustain KMC over a longer period of time. The babies on respiratory support were also given KMC but they were not part of data collection of the collaboration. Other components of KMC such as feeding and early discharge were also ensured. But formal data collection was not part of the collaboration.

This collaborative initiative paves way for the determined collaborations to design methods to explore KMC with other aspects of neonatal care and outcomes. It provides a great opportunity to weave KMC within the existing health system, and the collaboration initiative model can be an effective method of implementation to scale up the intervention. The findings from this implementation research project will provide inputs to policy makers to formulate KMC QI collaboration for state or

nationwide scaleup and thus resulting in achieving the goal of reducing neonatal mortality.

CONCLUSIONS

We were able to implement extended KMC across all six centres through bundling of raising nurses' awareness, simplifying documentation, making KMC as a prescribed intervention and promoting foster KMC. We could sustain by continuous parental involvement, developing local champions and low intensity training. Mentoring and regular motivation for each other through collaboration served as a backbone for continuous improvement. We believe our experience could be replicated in similar contexts across the developing world. Also, policy-makers could use this experience as a framework for larger state or nationwide collaborations.

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Contributors RM: designed data collection tool, data collection, assisted in data analysis, drafted initial manuscript. AK: data collection, assisted in data analysis, assisted in drafting the initial manuscript, critical inputs to the manuscript and approved the final manuscript. ASA: conceptualised the study, supervised data collection, data analysis, critical inputs to the manuscript, drafted the initial manuscript and guarantor. SKB: supervised data collection, assisted in drafting the initial manuscript, critical inputs to the manuscript and approved the manuscript. PV: supervised data collection, critical inputs to the manuscript and approved the final manuscript. DC, MJ, PR, DH, SNC, JP and HG: data collection, critical inputs to the manuscript and approved the final manuscript.

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REFERENCES

- Chawanpaiboon S, Vogel JP, Moller A-B, *et al*. Global, regional, and national estimates of levels of preterm birth in 2014: a systematic review and modelling analysis. *Lancet Glob Health* 2019;7:e37–46.
- United Nations Inter-agency Group for Child Mortality Estimation (UN IGME), WHO, World Bank Group and United Nations. Levels & trends in child mortality: report 2019, estimates developed by the United Nations inter-agency group for child mortality estimation [United Nations Children's Fund]. 2019. Available: <https://www.unicef.org/reports/levels-and-trends-child-mortality-report-2019> [Accessed 20 Jan 2023].
- Allotey J, Zamora J, Cheong-See F, *et al*. Cognitive, motor, behavioural and academic performances of children born preterm: a meta-analysis and systematic review involving 64 061 children. *BJOG* 2018;125:16–25.
- Liu L, Oza S, Hogan D, *et al*. Global, regional, and national causes of child mortality in 2000–13, with projections to inform Post-2015 priorities: an updated systematic analysis. *Lancet* 2015;385:430–40.
- World Health Organization. WHO recommendations on interventions to improve preterm birth outcomes. Geneva World Health Organization; 2015. Available: <https://www.who.int/publications/i/item/9789241508988> [Accessed 20 Jan 2023].
- Conde-Agudelo A, Diaz-Rossello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Cochrane Database Syst Rev* 2016;2016:CD002771.
- Charpak N, Tessier R, Ruiz JG, *et al*. Twenty-year follow-up of Kangaroo mother care versus traditional care. *Pediatrics* 2017;139:e20162063.
- Nimbalkar S, Sadhwani N. Implementation of Kangaroo mother care - challenges and solutions. *Indian Pediatr* 2019;56:725–9.
- Seidman G, Unnikrishnan S, Kenny E, *et al*. Barriers and Enablers of Kangaroo mother care practice: a systematic review. *PLoS One* 2015;10:e0125643.
- Mathias CT, Mianda S, Ginindza TG. Facilitating factors and barriers to accessibility and utilization of Kangaroo mother care service among parents of low birth weight infants in Mangochi district, Malawi: a qualitative study. *BMC Pediatr* 2020;20:355.
- Nadeem E, Olin SS, Hill LC, *et al*. Understanding the components of quality improvement collaboratives: a systematic literature review. *Milbank Q* 2013;91:354–94.
- Garcia-Elorrio E, Rowe SY, Teixeira ME, *et al*. The effectiveness of the quality improvement collaborative strategy in low- and middle-income countries: a systematic review and meta-analysis. *PLoS One* 2019;14:e0221919.
- Sharma D, Farahbakhsh N, Sharma S, *et al*. Role of Kangaroo mother care in growth and breastfeeding rates in very low birth weight (VLBW) neonates: a systematic review. *J Matern Fetal Neonatal Med* 2019;32:129–42.
- Joshi M, Sahoo T, Thukral A, *et al*. Improving duration of Kangaroo mother care in a tertiary-care neonatal unit: a quality improvement initiative. *Indian Pediatr* 2018;55:744–7.
- Arora P, Kommalur A, Devadas S, *et al*. Quality improvement initiative to improve the duration of Kangaroo mother care for twin preterm neonates born at a tertiary care hospital in resource-limited settings. *J Paediatr Child Health* 2021;57:1082–8.
- Ramachandrappa G, Somasekhara Aradhya A, Mercy L, *et al*. Sustaining prolonged Kangaroo mother care in stable low birthweight babies over 2 years in a predominant outborn unit: a quality improvement approach. *BMJ Open Qual* 2022;11:e001771.
- Jain H, Chandrasekaran I, Balakrishnan U, *et al*. Quality improvement initiative approach to increase the duration of Kangaroo mother care in a neonatal intensive care unit of a tertiary care Institute in South India during the COVID-19 pandemic. *J Pediatr Nurs* 2023;68:74–8.
- Jegannathan S, Natarajan M, Solaiappan M, *et al*. Quality improvement initiative to improve the duration of Kangaroo mother care in tertiary care neonatal unit of South India. *BMJ Open Qual* 2022;11:e001775.
- Joshi A, Londhe A, Joshi T, *et al*. Quality improvement in Kangaroo mother care: learning from a teaching hospital. *BMJ Open Qual* 2022;11:e001459.
- National Health Mission. Kangaroo mother care and optimal feeding of low birth weight infants: operational guidelines. 2014. Available: https://nhm.gov.in/images/pdf/programmes/child-health/guidelines/Operational_Guidelines-KMC_&Optimal_feeding_of_Low_Birth_Weight_Infants.pdf [Accessed 26 Jan 2023].
- Anhøj J. Diagnostic value of run chart analysis: using likelihood ratios to compare run chart rules on simulated data series. *PLoS One* 2015;10:e0121349.
- Ogrinc G, Davies L, Goodman D, *et al*. Squire 2.0 (standards for quality improvement reporting excellence): revised publication guidelines from a detailed consensus process. *BMJ Qual Saf* 2016;25:986–92.
- Resar R, Pronovost P, Haraden C, *et al*. Using a bundle approach to improve ventilator care processes and reduce ventilator-associated pneumonia. *Jt Comm J Qual Patient Saf* 2005;31:243–8.
- Zamboni K, Baker U, Tyagi M, *et al*. How and under what circumstances do quality improvement collaboratives lead to better outcomes? A systematic review. *Implementation Sci* 2020;15:27.
- Nembhard IM. Learning and improving in quality improvement collaboratives: which collaborative features do participants value most? *Health Serv Res* 2009;44:359–78.