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INTRODUCING QUALITY IMPROVEMENT TECHNIQUES TO MINIMIZE TIME AND ITS VARIATIONS FOR SURFACTANT REPLACEMENT THERAPY IN PRETERM INFANTS

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Abstract
In India, neonatal and perinatal outcomes exhibit significant variation, with some units achieving excellent results while others experience higher mortality and morbidity rates. Premature infants suffering from surfactant insufficiency due to poor lung development often develop respiratory distress syndrome (RDS), which can lead to acute pulmonary injury, neonatal death, or chronic lung disease if not promptly addressed with surfactant administration and assisted ventilation. This study investigates a quality improvement program implemented in intensive care settings to reduce surfactant receipt time and address key bottlenecks, ultimately improving neonatal survival. The objective is to assess the impact of timely surfactant administration through systematic quality improvement steps. The methodology involves three phases: observation to identify issues causing delays, three intervention cycles targeting enhanced communication, NICU preparation, prompt referral, and an evaluation phase to measure progress. Results show a significant reduction in surfactant receipt time after the interventions, demonstrating the positive impact of the Quality Improvement Program on neonatal health and outcomes. In conclusion, this study highlights the potential for other intensive care settings to adapt to similar changes, emphasizing training and sensitization of team members and a commitment to improvement to enhance neonatal survival.

INTRODUCTION:

Infants born prematurely with surfactant insufficiency due to poor lung development frequently have respiratory distress syndrome (RDS). In India, results of neonatal and perinatal outcomesvary widely, with some units achieving clinical outcomes comparable to the developed worldand others having higher death and morbidity rates than anticipated. Infants with respiratory distress syndrome benefit significantly from surfactant replacement treatment (SRT). Recently published studies, viz. interventional studies and meta-analyses conducted on the role of surfactants, have pointed out a few important findings. They have shown that surfactants help not only in reducing the incidence of broncho-pulmonary dysplasia after 28 days of therapy but also the risk of mortality.[1-3] The studies have also suggested that it is no longer necessary to administer costly drugs, thereby putting the newborn at risk of intubation.[4] The risk ofpulmonary air leak and the combined risk of death or BPD also increases.[2]

There are three main modalities of SRT therapy: prophylactic, early rescue (SRT introduced within

the first two hours of life) and late rescue (SRT introduced beyond the first two hours of birth).[2-3] Prophylactic use focuses on giving exogenous surfactant to newborns at risk of respiratory distress syndrome (RDS) to prevent the severity of the condition. Therefore, "selective prophylactic use of surfactant", which refers to administering exogenous surfactant to selective neonates like extreme preterm, is recommended.

Surfactant, when administered to infants with RDS who require assisted ventilation early on, minimizes the risk of acute pulmonary injury, neonatal death, or chronic lung disease. Acute pulmonary damage can be prevented if treatment begins immediately after the onset of symptoms.[5-6] "Quality improvement" (QI) is a systematic method of analyzing and enhancing performance. It emphasizes the reliability of integrating care systems with existing evidence and establishing best practices for the best possible results. Well-designed research needs to be implemented appropriately and efficiently. It is well-documented that Quality improvement can significantly enhance patient outcomes in neonatal intensive care.[7]

OBJECTIVE

To assess the impact and improvement as a result of timely administration of surfactant by applying systematic quality improvement steps

METHODOLOGY

The study setting was at a private hospital in the western part of India in Ahmedabad. From the recent clinical observations,it was identified that a significant proportion of neonates required surfactant replacement therapy but could not receive it within 2 hours of life, which is the best time limit to administer it for maximum benefit. This could be improved by taking necessary quality improvement steps from the labour room to the NICU. The NICU team used the HO point of care quality improvement model to address the challenge. A quality improvement team was formed and a fishbone analysis was carried out to identify the key issues related to delay in surfactant administration. Indicators to understand the effects of the QI were identified. A brief study was conducted to determine the before-after effect of reduced time needed to administer surfactant. The time the premature infants were delivered and received by the team was observed and recorded and after that, a decision related to the surfactant requirement or admission to NICU was taken. If the newborn required surfactant, the surfactant administration time was noted and recorded in the data collection sheet. If surfactant was administered in the NICU as an early rescue therapy, the time of patient arrival and when the SRT was completed were noted. A "Plan-Do-Study-Act cycle" was used to test and modify solutions for the issues. The fishbone diagram helped identify issues concerning workforce, material and methods. The process is shown in Figure 1.

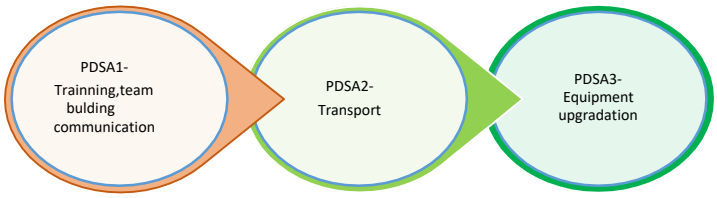


Figure 1 PDSA process cycle

The entire process of 7 months was divided into 3 phases. In the first phase, observation was carried out about the duration taken operationally to give surfactant therapy to the neonates.

Also, preparations related to the early administration of surfactant were done. If the neonate needed the surfactant early, it was first administered and shifted to the NICU forobservation afterwards; however, if the surfactant was not needed early, the surfactant was given if needed at the NICU, which was for two months. The second phase was an intervention stage of 3 months duration and the interventions were further divided into three cycles. In the first cycle, effective communication was carried out with the team and patients for the effective impact of the programme. In the second cycle,

X-ray intervention was carried out, which included the in-house installation of X-ray machines and sensitization of X-ray technicians so that there was no delay in administering surfactants at the NICU. The preparations related to referral were also carried out. An ambulance was kept on standby, with the orientationof the referral staff for early transfer and preventing delay in the same.
Along with this, preparations in the NICU were also carried out. The ambulance services were thereby strengthened. In the third cycle, NICU pre-preparation was strengthened. The respiratorysupport system at the NICU, which is a ventilator or a CPAP machine, was kept ready after pre-calibration and with its circuit to ensure availability before, during and or after the administration of SRT. After completing a 15-day cycle, a meeting was arranged to assess progress or any difficulties faced during the abovementioned process. The intervention focused on enhancement in the median time reduction of surfactant administration. In the thirdphase, viz. continuation phase (duration two months) of the study, the evaluation was carried out about the progress made after the intervention, and the practice was continued to evaluate and compare the result in conclusion. Before the commencement of the study, preparations related to the early administration of surfactant in the labour room and NICU were started. The capacity of the staff was built by training them.
Supportive instruments for administering surfactants, such as a surfactant kit, were used in the NICU. The contents included a pulse oximeter, a Rate monitor 5Fr 20cm tube, an AMBU bag, and an ET tube of sizes 2.5 F and 3.0 F. Supplies needed included a feeding tube of size 6Fr, a 3mL or 5mL suitable syringe (depending on the dose), alcohol wipes with 70% alcohol, a clean sheet or towel, a calculator, a tape measure, and emergency supplies including sterile scissors, a face mask, and a suction device.
At first, the baseline data was collected, which showed the median time of surfactantadministration as 1 hour 42 min. Out of a total of 13 babies admitted, 5 received surfactant after Two hours of life, one received at the labour room and one at around 2 hours. Several issues connected to policies, procedures, locations and individuals were tracked down, and the primary focus was ensuring that the baby received early surfactant. A total of 44 infants were enrolled forthe study after obtaining written consent from their caretakers.

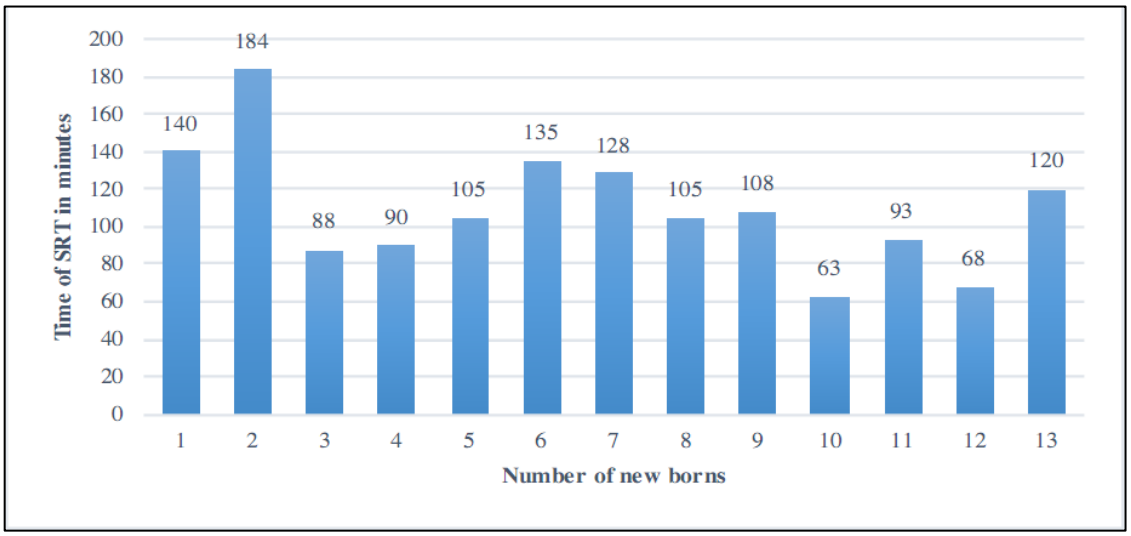
RESULTS

The data shown hereafter shows 44 infants enrolled in the study after consent. It can be seen from Table 1 that the mean duration in minutes for receiving surfactant is lower in the second and third phases as compared to the first phase. Graph 1 shows the results of the first phase, which included only observation of the timeduration elapsed before surfactant administration to the infants. The second phase of the graph shows the results of improvement in the timeliness of the surfactant administration by adapting quality improvement steps (Graph 2). Graph 3 shows further improvement in the timeliness of the surfactant administration to the neonates. The overall amount of time (in minutes) on each phase across all infants is shown in Graph 4, which included a total of 44 infants. The longest amount of time that a surfactant was administered was 184 minutes, while the shortest amount of time that a surfactant was administered was 15 minutes. As shown in Table 2, In the observational phase, not a single neonate received surfactant within 1 hour of birth, whereas during the second and third phases, the proportion of infants receiving thetherapy early was higher. The proportion was found to significantly increase going into the study's third phase, showing the intervention's effectiveness.

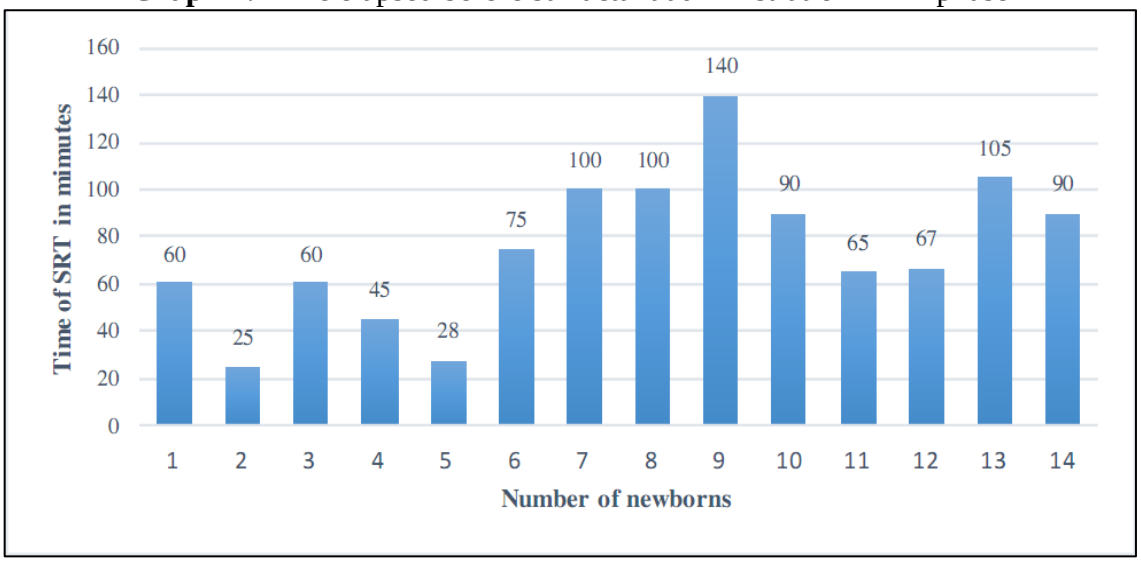
Table 1: Meantime duration required to receive surfactant therapy across the three phases

Phases with time duration (in minutes)	N	Minimum	Maximum	Mean	Std. Deviation
First Phase	13	63	184	109.7	43.129
Second Phase	14	28	140	74.07	33.313
Third Phase	17	24	75	53.94	15.805

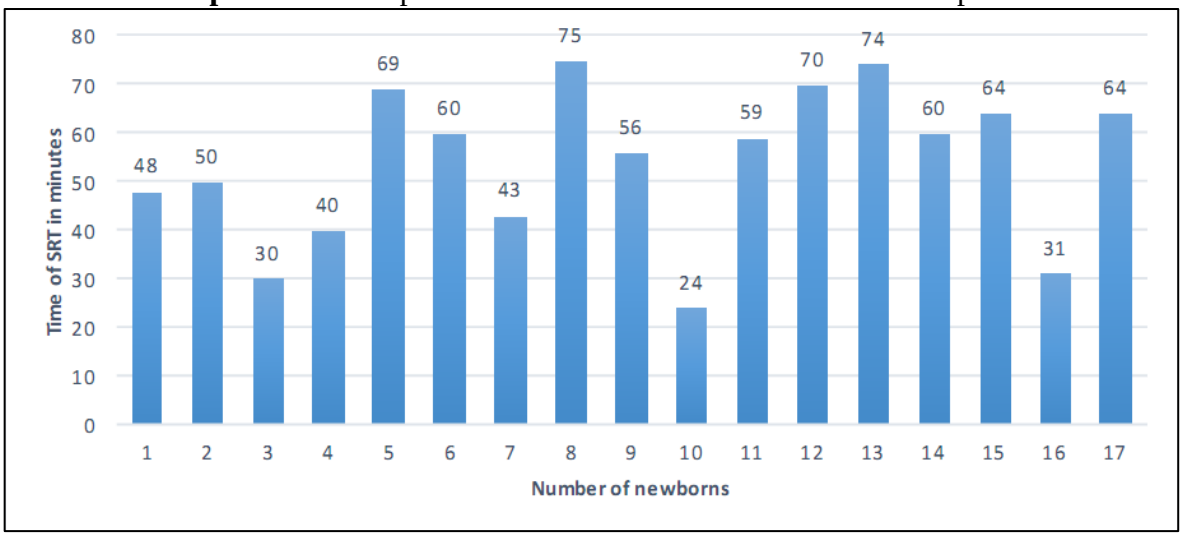
Graph 1: Time elapsed before surfactant administration in 1st phase



Graph 2: Time elapsed before surfactant administration in 2nd phase



Graph 3: Time elapsed before surfactant administration in 3rd phase



Graph 4: Line Graph of the total number of newborns and time of SRT in all phases

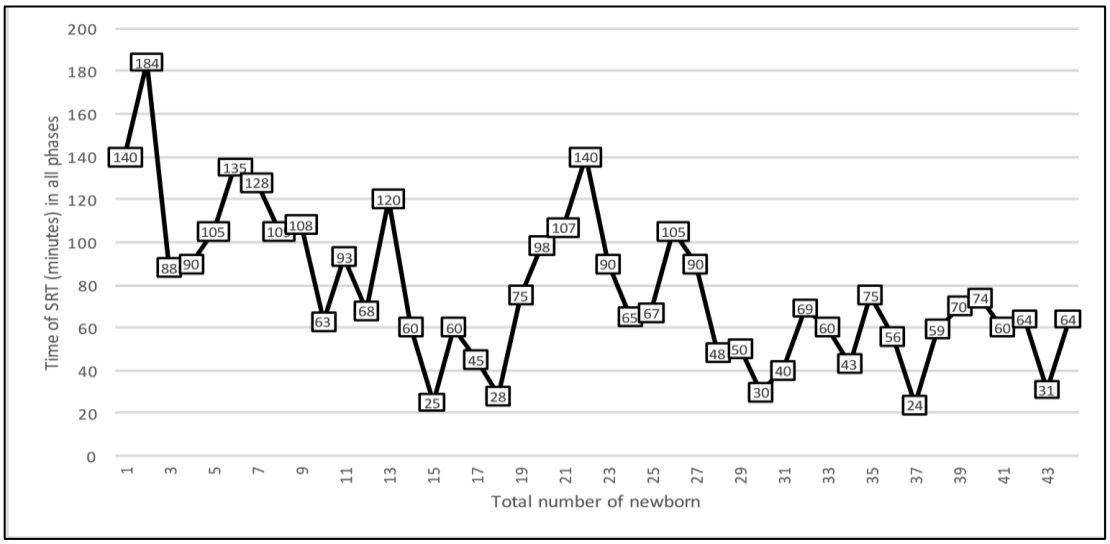


Table 2: Percentage of infants received early rescue surfactant in all phases

Phase of intervention	Within 2 hours	Within 1 hour
1	61%	0%
2	71%	21%
3	100%	58.80%

DISCUSSION

In the present study, a quality improvement programme was implemented. The programme was developed after carrying out a fishbone assessment of the key factors attributing to a delayed surfactant administration to neonates, which were commonly encountered. The study's key findings include: (a) Significant proportion of eligible newborns requiring surfactant within 2 hrs. of birth could not receive it in time, and the duration of the receipt of the therapy was high. (b) Implementing a Quality improvement programme and key interventions helped significantly reduce SRT and overall short-term and long-term respiratory morbidity incidence.It was therefore observed that the Quality improvement programme contributed to streamlining and reducing variability in the time duration for reception of the Surfactant therapy to the neonates in which it is indicated.

Studies related to neonatology and critical care have tested and used quality-improvement methods of a similar type.[8-10] Quality improvement programs are designed to tackle operational issues associated with delays in receiving Surfactant therapy. Curtis R et al.'s programs also indicate that such quality improvement initiatives enhance the operational management of clinical care in ICU, NICU, and related setups.[11]

This study has a few limitations. The lack of a control group could not delineate the direct impact of the quality improvement programme as it could also be due to certain other factors. It is also possible that the processimprovement used in the present study may not apply to other NICU settings. One of the major reasons for the programme's success included enthusiastic team members, including team leaders. Similar findings were also seen by Bookman L et al., who developed a similar QI program to reduce variation in Surfactant administration.[12]

CONCLUSION

Effective quality improvement programs rely on interdisciplinary teamwork. While the prospect of quality improvement might seem daunting, a step-wise approach ensures that it becomes a routine and integral part of the NICU. Leadership plays a crucial role in the success of both the overall program and individual improvement projects. Further research is necessary to identify cost-effective means of enhancing the quality of healthcare for critically ill newborns. The quality improvement program implemented in this project has been meticulously designed by a team of experts, with internal validation ensuring that deserving patients receive therapy within the recommended time

frame. Similar studies conducted in various parts of the country also support the efficacy of this intervention, underscoring the need for similar programs in NICU settings to enhance neonatal care. The evidence generated can be further strengthened by replicating studies with similar objectives, reinforcing the impact of quality improvement programs in specialized settings providing intensive care.

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