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Improving the longevity of intravenous cannulas in sick neonates admitted to NICU in a tertiary care centre: a quality improvement project

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ABSTRACT

Background Neonatal intravenous cannulation, especially in preterms, is more challenging than in children or adults. Placement of an intravenous cannula is painful and many cannulas need frequent changing due to complications. Each attempt at cannulation creates an entry for skin flora to cause systemic bacteraemia. This study was undertaken at a level III NICU. The team attempted to prolong the existing cannula longevity to reduce the frequency of intravenous cannulation thereby reducing handling and pain.

Objectives To improve the longevity of peripherally inserted intravenous cannula in sick neonates in NICU from the current 25.7 hours to 36 hours or more, over a span of 6 weeks.

Materials and methods The quality improvement (QI) team comprised resident doctors and staff nurses. A fishbone analysis was used to identify factors that affected the longevity of intravenous cannulas. Five WHYs technique was used to identify the cause behind early cannula removal. Both techniques identified the fixation technique used at the study centre for target intervention. Plan-Do-Study-Act cycles were planned to explore different fixation techniques to improve cannula longevity. The unpaired t-test and the χ^2 tests were applied to analyse statistical significance.

Results We achieved significant improvement in cannula longevity from 25.7 hours to 39.6 hours just by improving the fixation technique over 6 weeks with a p=0.0006.

Conclusions The QI study was successful and is adopted for routine practice. Such initiatives would greatly impact babies in low-resource settings and in transit.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Intravenous cannulation is a cause for pain and a potential risk of sepsis in neonates. More the number of cannulas needed, more the pain, more the risk of sepsis and more the expenditure of consumables and man-hours.

WHAT THIS STUDY ADDS

⇒ This study finds that good mechanical fixation alone can significantly improve cannula longevities. Although mechanical fixation improves longevities of all cannulas, maximum impact is seen on cannulas used for clear-fluid infusions.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The authors propose that improving mechanical fixation of cannulas would have great impact at low-resource facilities, especially in transit and referral.

INTRODUCTION

Neonatal intravenous cannulation, the most basic of procedures in NICU, required by almost all babies at some time during their NICU stay, is different from intravenous cannulation in children or adults. Preterm and low birthweight babies make insertion and maintaining of intravenous cannulas especially difficult. Frequent movement and smaller surface area for anchoring, lead to frequent dislodgement of inserted cannulas. This makes reinsertion unavoidable, necessary but painful procedure for neonates.

Every cannulation comes with pain and increased risk of sepsis.[1] and many cannulas get removed after occurrence of complications, most commonly infiltration.[2] Each attempt at cannulation creates a wound, a door for entry of skin-based bacteria, causing local cellulitis and even systemic bacteraemia[3] and neonatal sepsis—a leading cause of neonatal mortality.[4]

Peripheral intravenous cannulas are simple, inexpensive and convenient for short durations of intravenous therapy, against central lines or peripherally inserted central catheters (PICCs) which maybe left in situ longer. Changing of cannulas remains a problem, particularly in busy public hospitals.

The average life of intravenous cannulas varies across neonatal units. Studies show average longevities of intravenous cannulas between 20 and 40 hours[5] but the longevity of peripheral cannulas at the study centre

was 25.7 hours, far below average longevity documented at other centres.[6] This meant that neonates at the study centre needed changing of their cannulas daily (more frequently) and, therefore, needed more handling and endured greater pain.

Improvement in cannula longevity translates to reduction in handling of neonates, fewer pricks, lesser pain, fewer complications, faster recovery and discharge, reduction in workload for overworked resident doctors and staff nurses, and reducing the hospital's expenses on recannulation. The study centre, therefore, decided to improve its cannula longevity.

AIM STATEMENT

To improve the longevity of peripherally inserted intravenous cannulas in sick neonates admitted to NICU (Neonatal Intensive Care Unit) of this tertiary care unit from the current 25.7 hours to 36 hours or more, over a span of 6 weeks—between first week of January and second week of February 2022.

METHODS

This study was begun at a level III NICU, in western Maharashtra, India, in January 2022. The unit is staffed by resident doctors enrolled in a postgraduate training programme. The unit has a bed strength of 58, and a turnover of 200–250 babies per month, requiring an average insertion of 42 cannulas per day. This study was planned as a quality improvement (QI) project. Patients were not directly involved in designing, conducting, reporting or dissemination of any plans of this research.

A QI team was formed, with the following members and designated roles, as shown in table 1.

The cannula fixation technique in practice at the NICU was as follows:

Butterfly flap fixation

1. All equipment was collected in a sterile tray. After surgical handwashing, sterile gloves were donned by the resident doctor and the assisting staff nurse. The baby was given a sucrose-swab.
2. The chosen site was cleaned with three swabs—a spirit swab, a swab dipped in povidone-iodine and finally a spirit swab, allowing the area to air-dry after each application.
3. Cannula was inserted, keeping the device parallel to skin surface, to prevent a second puncture to the vessel.
4. Confirmation of cannula position was done by slowly flushing the cannula with 0.9% normal saline using a 1cc/2cc syringe. Smooth injection, causing no discolouration, pain or swelling confirmed the cannula being in situ.
5. A transparent sterile dressing was applied over the cannula, covering it from the point of insertion till the wings.
6. A strip of adhesive tape (Micropore) was crossed over the wings of the cannula. Another strip of adhesive tape was used to stabilise the cannula wings onto the skin (figure 1).

Micropore is a paper-based adhesive tape (1 inch wide), with a gentle glue, suitable for neonatal skin. However, the authors noticed that butterfly-flap fixation allowed a lot of movement of cannulas with the movement of the baby as shown in figure 1.

Fishbone analysis and five WHYs technique were used to formulate a list of factors that affected the longevity of intravenous cannulas, as summarised in figure 2.

The team concluded that achievement of better fixation of cannulas was the target of their QI project through PDSA (Plan-Do-Study-Act) cycles. At the end of each PDSA cycle, ideas were either Adapted, Adopted or Abandoned. The QI team had team meetings every week where team members celebrated little victories, analysed failures, troubleshot for problems and brainstormed for newer alternatives.

These cycles and their outcomes are summarised in table 2.

Table 1 The QI team member and their roles

No	Team member	No of members	Role
1.	Resident doctor	1	► Insertion of cannulas ► Documenting the date/time of insertion
2.	Staff nurses	2	► Assisting cannula insertion ► Administration of drugs and injectables ► Monitoring for cannula complications ► Recording time of removal of cannula
3.	Head nurse	1 (team leader)	► Ensuring smooth communication between members ► Planning team meetings
4.	Paediatric faculty of the medical college	1	► Providing technical input ► Ensuring administrative stability ► Ensuring supply of consumables

QI, quality iImprovement.

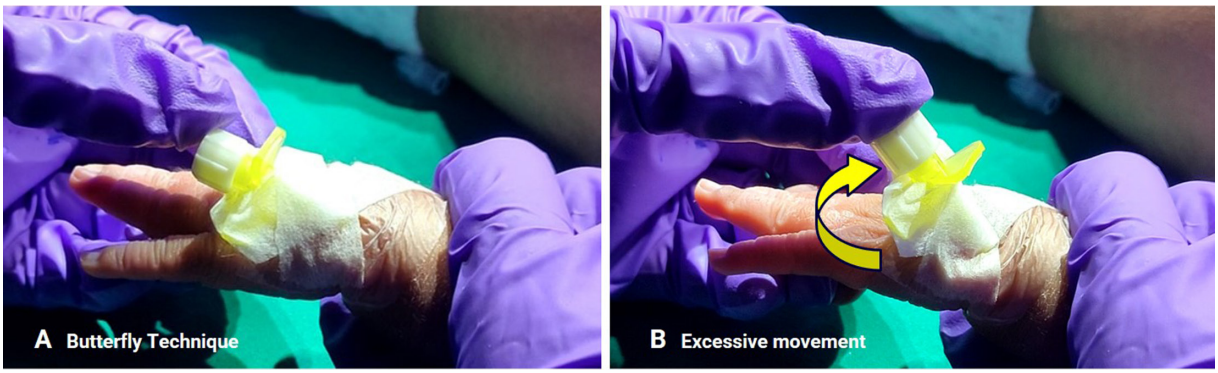

Figure 1 (A) Butterfly-flap fixation and (B) excessive movement of the inserted cannula.

A total of 139 cannulas were charted over 6 weeks (first week of January till second week of February 2022). Twelve inserted cannulas were excluded from analysis—all these cannulas were usable but had to be removed at the time of baby's transfer/death.

At the beginning of the study, the unit had an average life of intravenous cannula at 25.7 hours (recorded by averaging the longevities of 67 cannulas inserted in 20 randomly chosen neonates during the first week of the QI project, first week of January 2022). These 67 cannulas could have been inserted by anyone working in the NICU at that time and not necessarily the resident member of the QI-team—a measure to eliminate bias and to estimate the unit's true average longevity.

Between weeks 2 and 6 of QI, 60 cannulas were inserted only by the resident member of the QI team, to ensure all

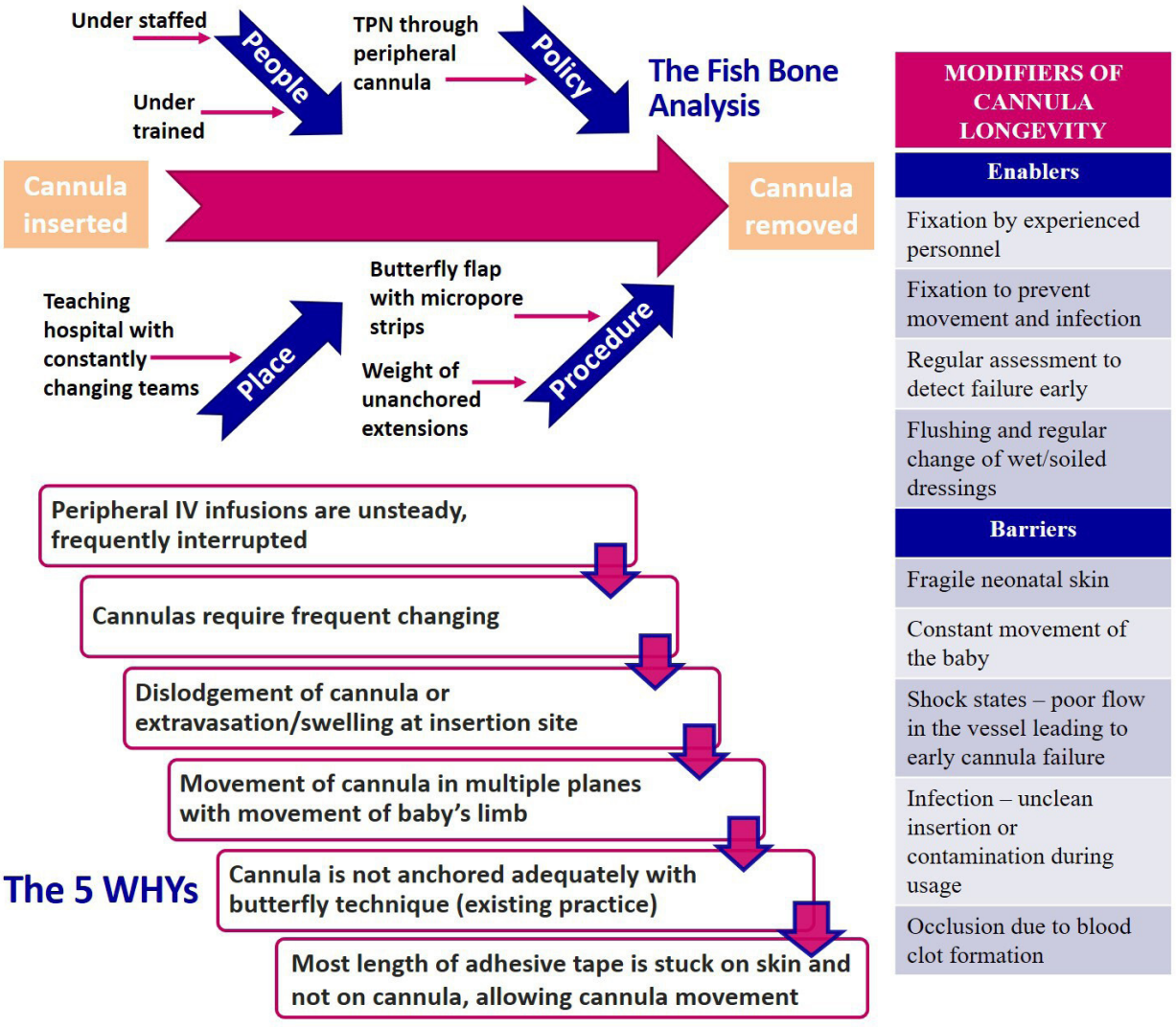

Figure 2 Fishbone analysis, five WHYs and modifiers of cannula longevity. IV, intravenous; TPN, total parenteral nutrition.

Table 2 The PDSA cycles (online supplemental file 1)

Sr. no.	QI week	PDSA idea (Idea with duration)	Study Merits	Limitations	ACT Outcome (discussed in weekly team meeting)
1	First	Baseline			Plan to try broader strips of Micropore on the butterfly flap
2	Second	Broader strips of Micropore on the butterfly flap (4 days)	Better fixation than narrower strips	Hub and wings did not get immobilised together	Idea of broader strips of Micropore on the butterfly flap— Abandoned Plan to try Fixomull to strap the limb with the splint/limb
3	Second	Strips of Fixomull to strap the limb with the splint/limb (3 days)	Better fixation, lesser skin peeling at the time of removal	Hub and wings did not get immobilised together	Idea of using Fixomull to strap the limb with the splint/limb— Abandoned Plan to try Tegaderm flaps on wings and hub
4	Third	Tegaderm (sterile transparent dressing) flaps on wings and hub (3 days)	Completely transparent seal, easier to monitor cannula complications Better anchoring of cannula	Difficult to apply—material folds on itself—lot of wastage of material	Tegaderm flaps on wings and hub proved difficult to be applied, material wastage was a concern—idea Adapted Fixomull was a better choice to be used in overlapping flaps to anchor the cannula wings.
5	Third fourth, fifth, sixth	Fixomull flaps on wings and hub (Tried for 1 week, successful, continued till the end)	Better anchoring of cannula, best by far		Fixomull flaps were a success—idea Adopted—continued for the remaining weeks Fixomull flaps continued for the remaining weeks Plan to add a compulsory 10 cm, three-way extension with the cannula and fixation of the same with the splint/limb
6	Fifth, sixth	Compulsory use of a 10 cm three-way extension with the cannula and fixation of the same with the splint/limb (tried for 1 week, successful, continued till the end)	No movement at the point of insertion due to movement of the infusion lines		End of fifth week Fixomull flaps continued for the remaining weeks Idea of adding a compulsory 10 cm, three-way extension with the cannula and fixation of the same with the splint/limb—Adopted Plan to try fixation without splints

Continued

Table 2 Continued

Sr. no.	QI week	PDSA idea (Idea with duration)	Study Merits	Study Limitations	ACT Outcome (discussed in weekly team meeting)
7	Sixth	Fixation without a splint (Tried for 1 week—unsuccessful Discontinued after 1 week)	More comfortable for the baby, reduction of weight on the limb	More movement of the limb allowed causing more frequent dislodgement of cannula Loss of area on which the 10 cm three-way extension could be anchored	Splints did not significantly change the cannula-longevity but having a splint gave additional surface area to anchor the 10 cm, 3-way extension line and prevented unnecessary application of adhesive tapes to the neonate's delicate skin. Hence omission of splints—Abandoned

PDSA, Plan-Do-Study-Act; QI, quality improvement.

cannulas analysed were inserted according to the decided protocol. All 60 cannulas were used to calculate longevities and for all statistical inferences of PDSA cycles.

The authors had originally planned for the sustenance phase to start immediately after the end of testing the PDSA cycles which however got delayed due to an unforeseen shortage of manpower in the unit. Sustainability was studied between April and October 2022. During this period, effectiveness of 'Fixomull-Fixation' was studied by averaging 30 randomly chosen cannulas every month, one cannula chosen every day for monitoring longevity.

All inserted cannulas were 24G plastic devices of various brands available in government supply. The unit had considered using 26G cannulas but rejected the idea after trying a few numbers due to poor quality of products available in supply.

Patient parameters recorded for each inserted cannula were sex, gestational age, weight at time of cannulation, content infused through cannula—namely total parenteral nutrition (TPN), clear fluids or others (blood products, antibiotics, bolus injections, inotropes), and whether cannula was usable at the time of removal or was removed due to dislodgement/extravasation. Respective cannula hours were calculated for each cannula.

The team finally decided on the following improvised technique for cannula insertion, as shown in figure 3.

Fixomull-Fixation

The first four steps (till figure 3A, figure 3B decribed by point 2 and 3 of decription of the Butterfly Flap Fixation) are identical to the procedure described earlier (figure 1).

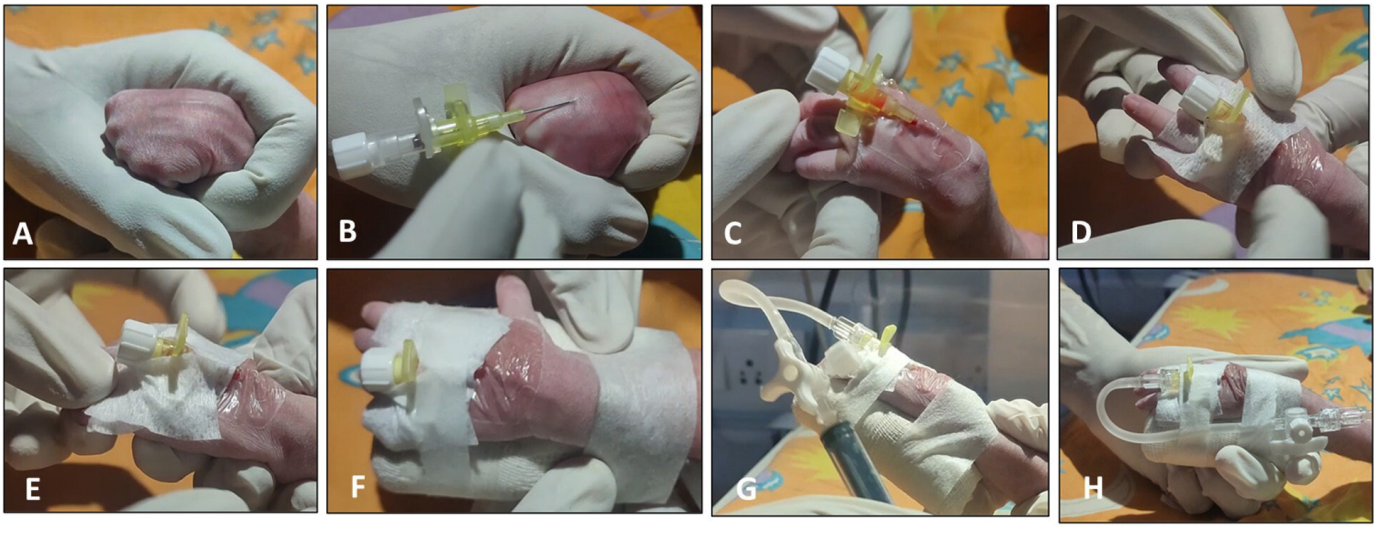

Figure 3 Technique of cannula fixation finally adopted by the unit at the end of PDSAs—called the 'Fixomull-Fixation' in this article and analysis. PDSA, Plan-Do-Study-Act. Parts A&B are corresponding to the 2nd and 3rd point in the description of the butterfly flap technique described previously. The suggested edit is as follows.The first four steps (till figure 3A, figure 3B) are identical to the procedure described for insertion with butterfly flap technique (figure 1).

5. A transparent sterile dressing is applied over the cannula covering it from the point of insertion till the wings (as shown in figure 3C).
6. Two pieces of quadrangular adhesive dressings (Fixomull) of size 3 cm×3 cm, are used to immobilise the wings of the cannula over the skin, overlapping over each other (as shown in figure 3D,E).
7. The point of insertion of the cannula is kept exposed for examination for any signs of extravasation or swelling. Fingertips are left exposed to monitor for any signs of vascular compromise.
8. A compulsory splint is applied to immobilise the joint over which cannula is inserted (as shown in figure 3F).
9. A compulsory 10 cm extension with a three-way stop cock is attached to the cannula and fixed to the splint (as shown in figure 3G,H).
10. An adhesive tape is applied over the extension tubing to prevent disconnection of extension from the cannula hub, and therefore, reduce any movement at the point of entry of the cannula into the lodging vein.

Fixomull is a cloth based woven adhesive dressing available in 10 cm×10 m.

Once the unit finalised the fixation technique, new batches of residents had to be trained for the same. This was accomplished in a compulsory orientation session taken for all newly joined at the NICU, with a video-clip of Fixomull-Fixation. New joiners were rotated with the previous team for a period of 1 week where they learnt fixation under supervision of the previously trained team. The unit continues to train new residents in this manner.

The unit protocol is to administer infusions through a syringe pump, using a 50cc/20cc syringe coupled with a 50 cm/100 cm extension line, attached to the 10 cm extension fixed with the cannula at the time of cannulation. For flushing cannulas, 0.9% normal saline is injected using a 1cc/2cc/5cc syringe. Saline is pushed slowly in a single push. In case of resistance, flushing is withheld and a second opinion is sought from another staff member. If the second opinion is 'difficult-flush', the cannula is replaced. The unit does not have a protocol on using heparin-lock on peripheral cannulas, only on central catheters.

The unit aimed to achieve an improvement in cannula longevity as the primary outcome. A secondary outcome that the unit aspired to achieve was reduction in total number of cannulas used and hence cutting down on number of pricks that a baby would require during NICU stay.

Unpaired t-test was applied to analyse statistical significance of Fixomull-Fixation. Various patient-specific parameters were individually studied to find their association with cannula longevity. A χ^2 test was used to determine how Fixomull-Fixation impacted reasons behind cannula removal.

RESULTS

The QI team achieved an increase in cannula longevity from existing 25.7 hours to 39.6 hours over a period of 6 weeks, that is, 50% increase in 6 weeks—first week of January–second week of February 2022. The maximum monthly average of cannula-longevity was documented at 42.1 hours (July 2022, sustenance phase). The change in fixation brought about an absolute increase in cannula longevity in all cannulas irrespective of baby's birthweight or gestational age or contents being infused through the cannula.

The authors attribute this result, to improved mechanical fixation of cannulas, which was statistically significant (p=0.0006 at 95% CI of −20.772 to −5.028).

The statistically significant categories of intravenous cannulas are discussed below. Figure 4 gives a graphical representation of the same.

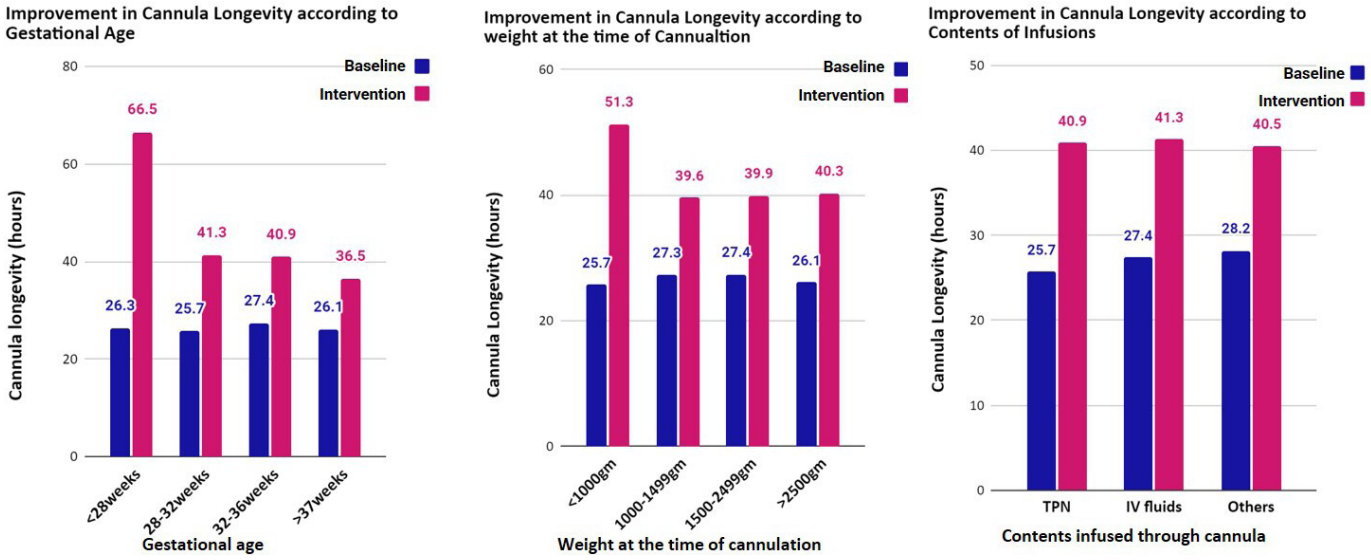

Figure 4 Improvement in cannula longevity. IV, intravenous; TPN, total parenteral nutrition.

- Maximum impact of Fixomull-Fixation was appreciated in cannulas used for infusing clear intravenous fluids. Longevity of these cannulas increased from 27.4 hours to 41.5 hours (p=0.0292 at 95% CI −26.239 to −1.561).
- In babies of birthweight < 1000 g, cannula longevity increased from 25.7 hours to 51.3 hours (p=0.0039 at 95% CI −42.399 to −8.801).
- In babies of gestational age < 28 weeks, cannula longevity increased from 26.6 hours to 66.5 hours (p=0.0101 at 95% CI −69.770 to −10.630).
- In babies of gestational-age 28–32 weeks, cannula longevity increased from 25.7 hours to 41.4 hours (p=0.0128 at 95% CI −27.774 to −3.426).

The most common reason behind removal of cannulas remained extravasation (76%). Other causes of removal were blockage (11%), leakage (4%) and end of cannula requirement (9%).

The patient demographics and impact of Fixomull-Fixation on cannula longevity are summarised in table 3. Its sustainability and trends of average cannula longevity over months following the QI study were as shown in figure 5.

Where, baseline longevities are average cannula longevities in first week of January 2022 and postintervention longevities are those documented at the end of week sixth week of the QI project. 'Intervention' is 'Fixomull-Fixation' defined earlier.

The unit achieved a near 50% increase in cannula longevities which translated to approximately 33% reduction in the number of cannulas required in the NICU. This translates to a 33% reduction in the number of pricks, and therefore, pain that a baby is subjected to during NICU stay. Also, longevities of all cannulas improved, irrespective of the contents infused through them.

Table 3 Demographics, number of cannulas (Num), average cannula longevities (ACL) and impact of intervention

		Baseline	With accepted intervention	Impact of Fixomull-Fixation (p value)	95% CIs (%increase)
Total patients		21	31		
Total cannulas	Num	67	60		
	ACL	25.7	39.6	**0.0006***	**−20.772 to −5.028***
<1000 g	Num	27 (40%)	7 (12%)	**0.0039***	**−42.399 to −8.801***
	ACL	25.7	51.3		
1000–1499 g	Num	19 (28%)	26 (43%)	0.1936	−30.968 to 6.368
	ACL	27.3	39.6		
1500–2499 g	Num	16 (24%)	23 (38%)	0.1921	−31.565 to 6.565
	ACL	27.4	39.9		
>2500 g	Num	5 (8%)	4 (7%)	0.3052	−44.497 to 16.097
	ACL	26.1	40.3		
<28 weeks	Num	21 (31%)	2 (3%)	0.0101	−69.770 to −10.630
	ACL	26.3	66.5		
28–32 weeks	Num	26 (39%)	33 (55%)	**0.0128***	**−27.774 to −3.426***
	ACL	25.7	41.3		
32–36 weeks	Num	13 (19%)	17 (29%)	0.1448	−32.880 to 5.880
	ACL	27.4	40.9		
>37 weeks	Num	7 (11%)	8 (13%)	0.2765	−29.977 to 9.177
	ACL	26.1	36.5		
TPN	Num	38 (58%)	8 (13%)	0.0699	−34.694 to 4.294
	ACL	25.7	40.9		
Itravenous fluids	Num	25 (36%)	38 (64%)	**0.0292***	**−26.239 to −1.561***
	ACL	27.4	41.3		
Others	Num	4 (6%)	14 (23%)	0.503	−50.057 to 25.457
	ACL	28.2	40.5		
Males	Num	36 (54%)	38 (64%)	**0.0009***	**−28.705 to −6.695**
Females	Num	31 (46%)	22 (36%)	**0.0455***	**−25.887 to −0.713**

*p value <0.05 at 95% confidence interval, implying statistical significance of the fixomull-fixation as an intervention
TPN, total parenteral nutrition.

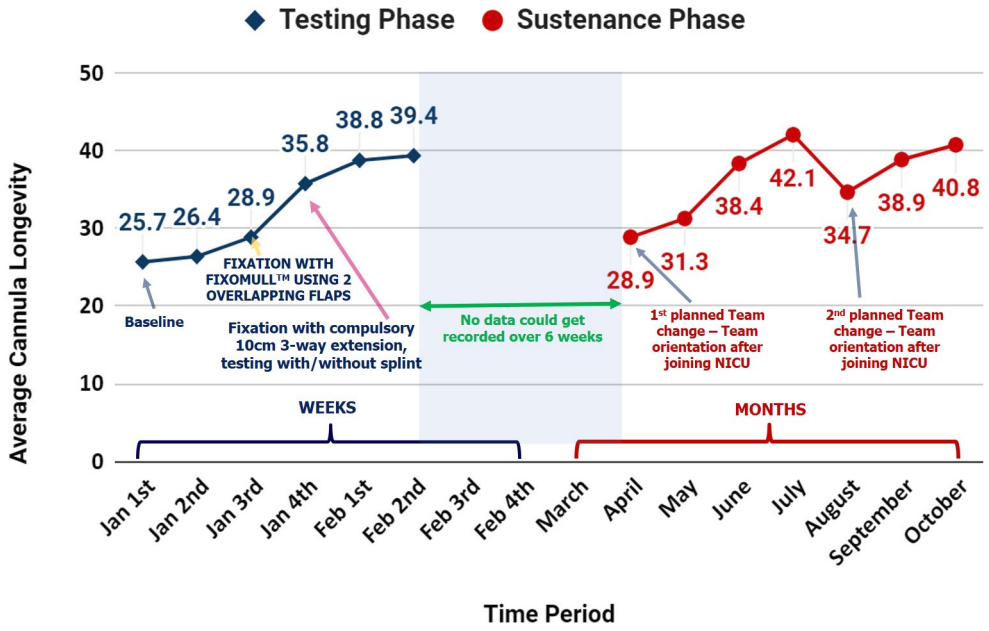

Figure 5 Trends of cannula longevity during the QI testing and sustenance phase. QI, quality iImprovement. NICU, Neonatal Intensive Care Unit.

DISCUSSION

This study has been undertaken and reported and according to the SQUIRE 2.0 (Standards of QUality Improvement Reporting Excellence 2.0) guidelines[7].

Mean longevities of cannulas used for various fluids (clear fluids, TPN, inotropes, blood products, antibiotics, etc), inserted in neonates of various gestational ages and birthweights improved individually, but not all of them were significant improvements.

The most common reason for removal of cannulas in the unit remained extravasation injury. This is a non-modifiable factor in any NICU with babies having fragile skin, thin and easily distensible subdermal tissues and thin walled, delicate blood vessels as demonstrated by Odom *et al*.[8] Cannulas used for clear intravenous fluids were found to have benefited the most from mechanical fixation when compared with cannulas used for TPN and other injectables. This was because clear infusions were least irritant to the neonatal blood vessels.

Cannulas used for TPN showed local inflammation and extravasation because of the high osmolarity of the infused fluid and many had to be removed though they hadn't been dislodged. This finding is also consistent with a study by Fessler and Rejrat,[9] which described the complication of venous lines with high osmolar solutions like TPN getting infused in neonatal ICUs. Administration of blood products, injectables such as antibiotics and electrolyte corrections given as short boluses left cannulas unused for long stretches of their indwelling time. This led to cannula blockage and flushing the cannula regularly with saline could not be adequately practiced in the unit. Usefulness of intermittent flushing in maintaining the patency of intravenous cannula as demonstrated by Uma *et al*[10] and a standard practice in many units, could not get consistently practised at the study centre.

The most significant impact of the Fixomull-Fixation came to be seen on cannulas infusing clear fluids. Statistically significant p values could be documented only for clear-fluid cannulas, because the number of cannulas in the baseline and during PDSAs was comparable for cannulas used for clear fluids only. However, baseline longevities of all cannulas and the absolute increase in average cannula longevities were, respectively, comparable for all cannulas included in the study. Therefore, this QI study infers that improving mechanical fixation of cannulas had a key role improving the longevities of intravenous cannulas, whatever be the choice of infusion.

Dalal *et al* demonstrated that splints have no effect on longevity of cannulas.[11] However, splinting cannulas remained a constant practice in this study. An advantage of using splints that the QI team found was that splints provided an additional surface for anchoring the 10 cm three-way extension, thereby reducing the direct strapping to the baby's limb, and therefore, making the assembly relatively more comfortable for the neonate.

The impact of mechanical stabilisation was best appreciated in neonates of 28–32 weeks gestation (with p=0.01) and less than 1000 g birthweight (with p=0.003). In babies <28 weeks of gestation, cannula longevities increased from 26.3 hours to 66.5 hours (2.5×increased longevity). These tiny infants are relatively less active than neonates of higher weights and greater gestational maturity. The authors infer from the study that anchoring cannulas firmly to the baby reduced movement of cannulas at the point of insertion and hence improved cannula longevities tremendously.

Sex of neonates had no impact on longevity of cannulas—Fixomull-Fixation was equally effective in male and female babies (with p=0.0009 and p=0.04, respectively).

An increase in cannula longevity from 25.7 hours to 39.6 hours translates approximately to one cannula a day to 2 cannulas in 3 days. This is a 33% reduction in the number of pricks that a baby must endure during the NICU stay. Documenting an improvement in pain outcomes or reduced duration of NICU stay due to lesser trauma/local site infection was beyond the scope of this QI study but is certainly an area of interest for the team.

At the time when the QI was in progress, the unit had been facing a shortage of manpower and was forced to reduce use of PICC lines due to a lack of personnel trained in inserting them. This led to an increased dependency on peripheral cannulas. Hence, the authors believe that the highest motivation to work on improving cannula-longevities came from a need becoming a necessity.

Planning and improvising fixation techniques was achieved in 6 weeks after which the unit laid down a written protocol for inserting and fixing intravenous cannulas. The entire staff was trained to insert and anchor cannulas according Fixomull Fixation method. Improvement in average longevity of intravenous cannulas was sustained over the coming months.

The only deterioration in cannula longevities was noted at the time of rotation of resident doctors in the NICU when trained teams were replaced by teams needing orientation. The QI team decided that future teams be oriented to Fixomull-Fixation a little ahead of their tenure in NICU since these rotations at the teaching institute are planned in advance.

Strengths

Fixomull-fixation is easy to replicate and sustain even in the face of changing teams which is inevitable in teaching hospitals. It led to near 50% increase in cannula longevity, therefore, substantially reducing the average number of cannula insertions required per day, bringing down the numbers of cannulas that the hospital procured.

The unit found Fixomull Fixation to be sustainable. The unit did not require any additional funding to carry out the QI or the sustenance phase. In fact, the unit reported an approximate reduction of 33% in the requirement of cannulas, compared with numbers required prior to the QI initiative. Although the unit did not undertake a formal cost analysis of the QI and sustenance periods, there is indirect evidence of the adopted practice being cost-effective.

Limitations

The unit noticed that administering TPN through peripheral cannulas led to a significantly greater number of extravasation injuries to the neonates. However, PICCs could not always be planned for all candidate babies, due to financial constraints and unavailability of personnel trained in inserting PICCs. The unit planned for its babies to be shifted to enteral nutrition more aggressively, in order to come down on the requirement of TPN and PICCs. Therefore, cannulas through which TPN was administered could not be compared reliably between cannulas having butterfly-flap fixation and Fixomull-Fixation

Once the unit is adequately trained in inserting PICCs, the authors would like to explore the possibility of achieving an even higher average longevity of intravenous cannulas, and reach a 60-hour or the ideal 72-hour target.[12] Further, the authors would also like to study any improvement in the numbers of grade 3/4 extravasations with Fixomull-Fixation, which was beyond the scope of this study.

CONCLUSIONS

Fixomull-Fixation was found to be more technically sound, with a simple learning curve and proved to be a sustainable practice. Better mechanical fixation of intravenous cannulas improved cannula longevity from 25.7 hours to 39.6 hours making the QI project a success. The unit achieved a near 50% increase in cannula longevities and a near 33% reduction in the total number of cannulations needed.

The study inferred that improvement in mechanical fixation did not prevent cannula complications arising due to the nature of fluid infused through cannulas or due to disuse of cannulas for a long time. Thus, mechanical fixation is an independent factor, modifying longevity of cannulas.

The authors also propose that improving mechanical fixation is likely to have a profound impact on peripheral centres and low-resource settings and particularly during transit in a referral chain, especially in India where there is a perpetual shortage of manpower trained to handle newborns in remotely located health facilities.

Contributors SV: Patient care, design of the PDSAs, analysis of data and documenting of results. CV: Critical review of the results and editing of the primary manuscript. RN: Patient care and overall monitoring of patient outcome in the NICU. RD: Patient care in NICU, critical review of the procedures undertaken and ensuring supply of comsumables in the NICU. AK: Guidance and critical review of final manuscript. There are no external contributors to this article besides the authors.

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Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained from parent(s)/guardian(s).

Ethics approval This study involves human participants and was approved by intavenous cannula insertion is a fundamental procedure in NICUs. The Initiative to improve the cannula longevity was undertaken as an organic process in the day-to-day fiontioning of the NICU with the materials already available in the unit and with the processes that the unit members were already familair with. It was only after the success of the initiaive and its adoption into everyday routine that the unit realised the further reaching impact of the intervention. Therfore, ther institutuinal ethics committe was not involved into the quality improvment initiative during planning or execution. Participants gave informed consent to participate in the study before taking part.

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Data availability statement All data relevant to the study are included in the article or uploaded as online supplemental information.

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