

THE IMPACT OF LEAN MANAGEMENT APPROACH IN REDUCING PERIPHERAL VENOUS LINE (PVL) RELATED INJURIES IN PICU: A QUALITY IMPROVEMENT PROJECT

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Background

Peripheral venous lines (PVLs) are the most frequently utilised vascular access devices in the Paediatric Intensive Care Unit (PICU), yet complications like infiltration and infection regularly compromise patient safety and escalate healthcare costs. Locally, a baseline review from January to March 2025 revealed that PVL-related injuries accounted for 4% of PICU admissions, with 4% of these cases being severe enough to require plastic surgery interventions. To address this urgent systemic risk, a Lean Management quality improvement project was initiated using the Plan–Do–Study–Act (PDSA) methodology. This initiative directly aligns with Malaysia's National Policy for Quality in Healthcare by focusing on optimising operational efficiency, minimising waste, and enhancing patient safety. Ultimately, the project targeted a bold 50% reduction in PICU PVL-related injuries within a tight three-month timeframe.



Figure 1

Methods

A Lean Six Sigma approach incorporating the Plan–Do–Study–Act (PDSA) cycle was utilised to analyse process inefficiencies and standardise care across the unit. During the Plan phase, a multidisciplinary stakeholder team was assembled to evaluate the clinic's medication administration workflow (Figure 2). A baseline audit of 27 infusions subsequently revealed critical system gaps, including a low 33% nursing compliance rate with recommended PVL care and an alarming 93% of smart pumps programmed with excessive dynamic pressure system (DPS) limits. To execute the Do phase and bridge these identified operational gaps, a comprehensive training kit was launched featuring lecture series, hands-on skill stations, and mandatory staff assessments (Figures 3, 4, 5).

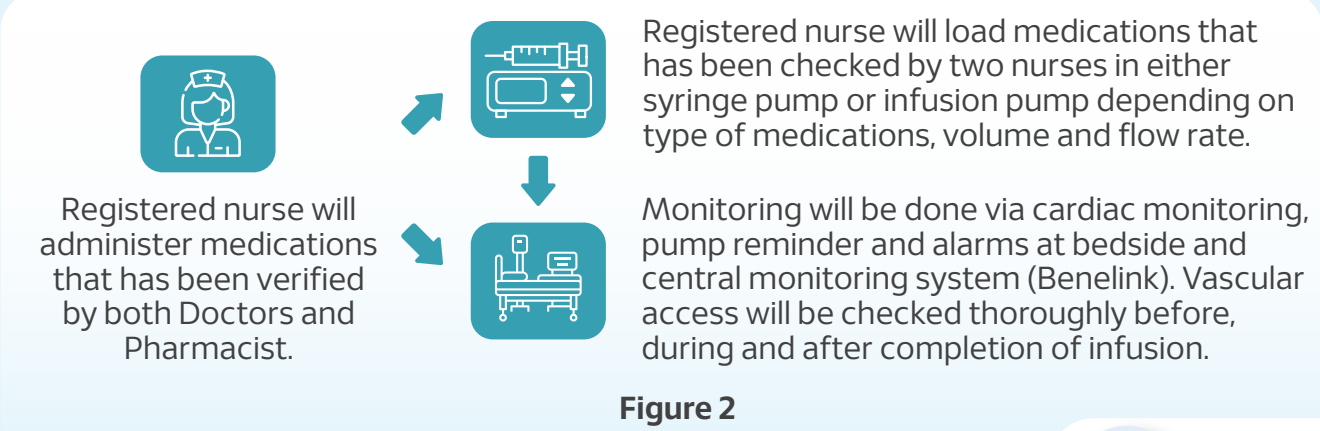


Figure 2

A formal RCA was conducted to study the underlying system failures, inspiring a four-pronged clinical intervention strategy (Figure 6).

- 1. Smart Pump Optimisation:** Developed a drug library with clinical pharmacists to reduce DPS limits to 300 mmHg, ensuring early occlusion detection (Figures 7, 8).
- 2. Standardised Protocol:** Formulated a standardised PVL Care Bundle utilising the Delphi Consensus methodology (Figure 9).
- 3. Visual Securement:** Introduced an enhanced taping technique to allow continuous visual assessment of the insertion site (Figure 10).
- 4. T.L.C. Monitoring Protocol:** Streamlined monitoring and documentation logs to guarantee strict clinical traceability (Figure 11).

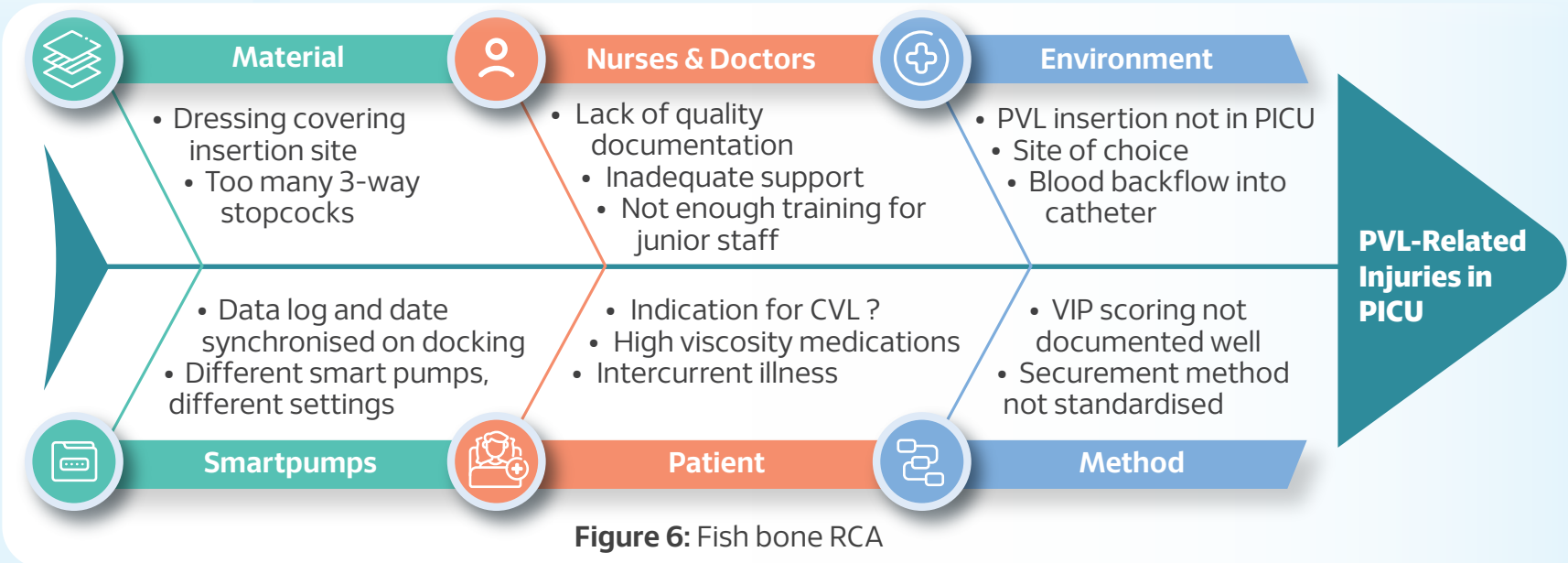


Figure 6: Fish bone RCA

Intervention 1: Smart Pump Optimisation

Built a customised smart pump drug library in a tandem with clinical pharmacists.



Figure 7: Drug Library



Figure 8: Dynamic Pressure System (DPS)

Intervention 2: The 8-Point PVL Care Bundle

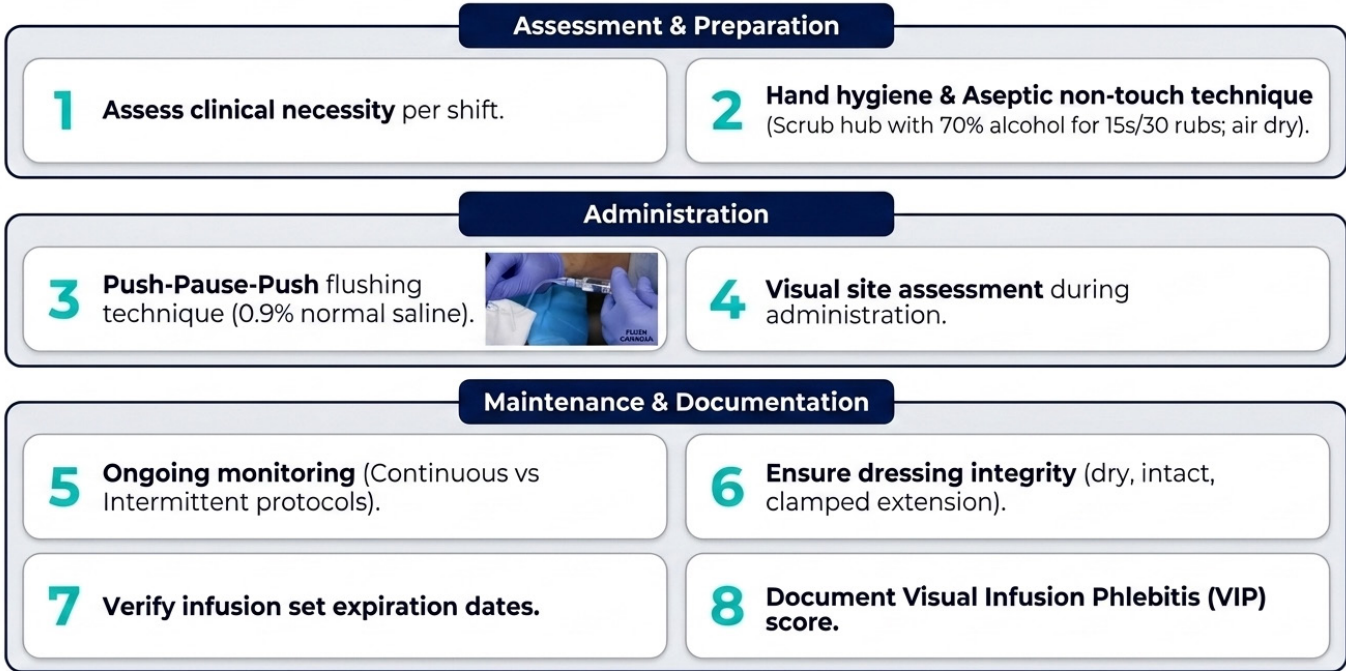
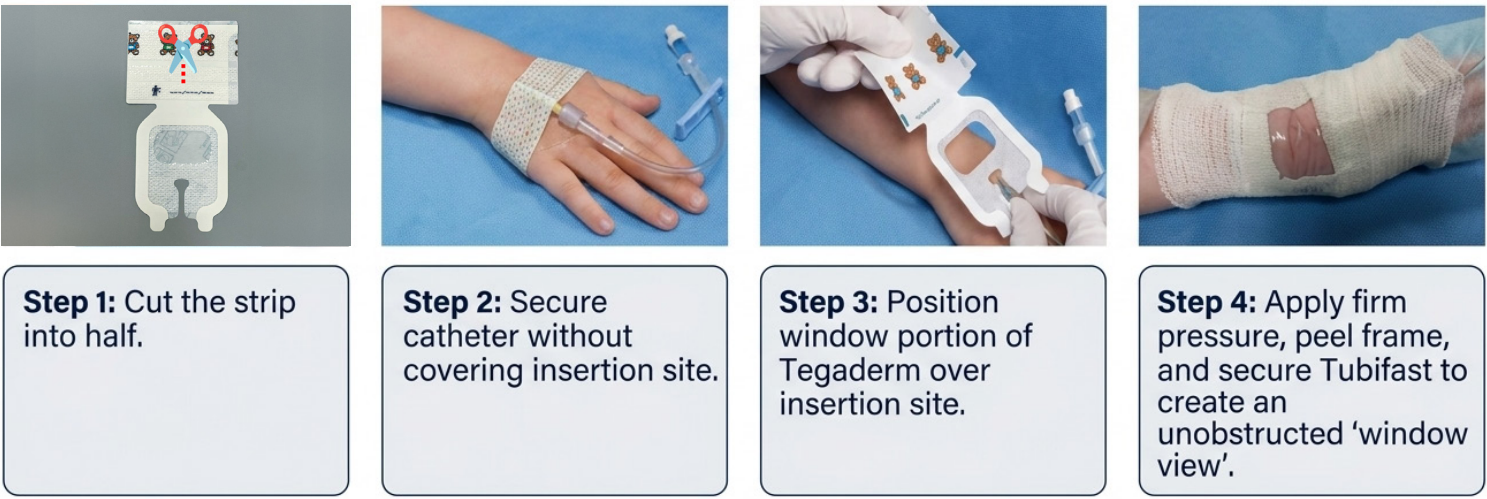


Figure 9: PVL Care Bundle through Delphi Consensus

Intervention 3: Enhanced Visual Securement



Traditional dressings obscured the insertion site. This modified technique guarantees 100% continuous visibility for early detection of phlebitis.

Figure 10: PVL Tegaderm Application

Intervention 4: The T.L.C Monitoring Protocol

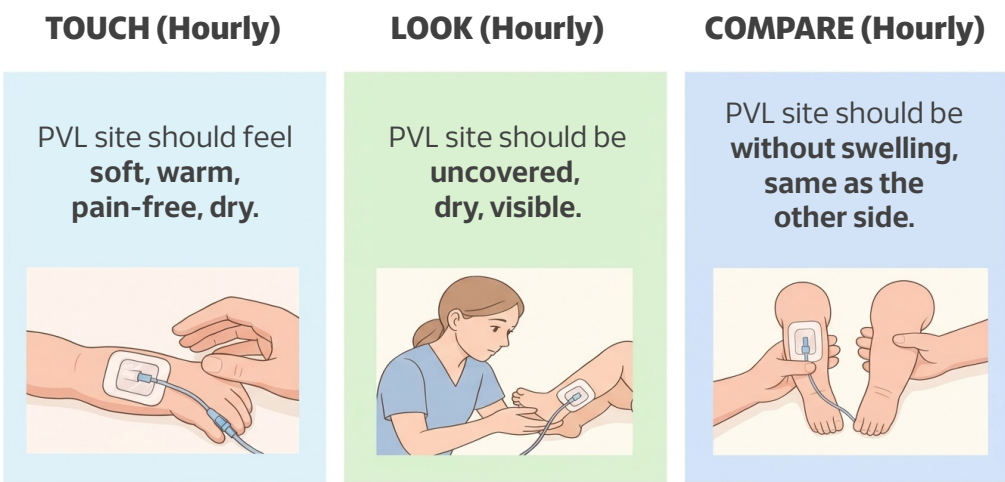


Figure 11: PVL monitoring using Touch, Look, Compare concept and document in the Vascular Device Chart.

Act and audit the process: Using the PDSA cycle, we developed and introduced continuous improvement (Kaizen) strategies. The second audit took place from June to August 2025.

Results

The post-intervention data demonstrated remarkable improvements across all clinical and operational metrics, culminating in a flawless 100% reduction in PVL-related injuries (Figure 12). Frontline clinical behaviours shifted significantly as nursing compliance with the standardised PVL care workflow soared from 33% to 100%. Concurrently, correct smart pump programming rose from a mere 7% to 100%, entirely eliminating medication administration and programming errors across the unit. Furthermore, staff clinical competency grew substantially, with 100% of the PICU team successfully passing the post-training assessments compared to 75% at baseline.

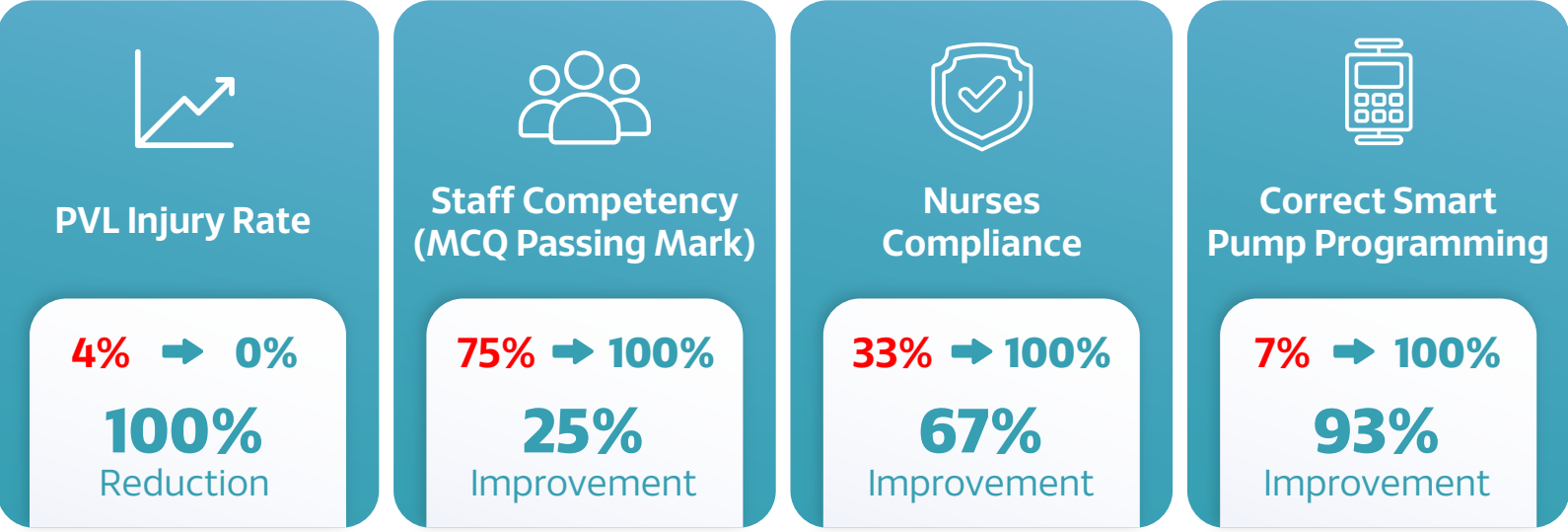


Figure 12

Conclusion

This initiative proves that a structured, data-driven Lean Management approach can eliminate preventable clinical injuries, reduce process waste, and curb avoidable healthcare costs. Engaging frontline staff directly fostered clinical ownership and a robust culture of safety. While the study is limited by a small sample size and a potential Hawthorne effect during observation, the outcomes underscore how targeted, localized interventions can yield profound hospital outcomes. Future efforts will focus on sustaining these metrics and scaling the framework hospital-wide to achieve long-term, scalable clinical excellence.

References:

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