An Observational Comparative Effectiveness Study of a Breakaway Device in Pediatric Peripheral and Central Venous Access

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Introduction

Peripheral venous catheters (PIVC) and central venous catheters (CVC) are widely used in pediatric care. Nearly half of all PIVCs fail before therapy completion due to mechanical complications such as dislodgement, infiltration, and phlebitis while similar forces contribute to CVC complications including line disruption, thrombosis, and infection. These failures interrupt therapy, increase cost and workload, and cause distress for pediatric patients. Breakaway devices address this by intentionally separating when a damaging force is place on the line; upon separation, valves close to prevent fluid loss, pump alarms are triggered, and prompt clinical response is enabled without catheter replacement. Despite their potential to reduce mechanical complications, evidence across pediatric populations remains limited.

Breakaway device Figure 1

Separated breakaway device

Methods

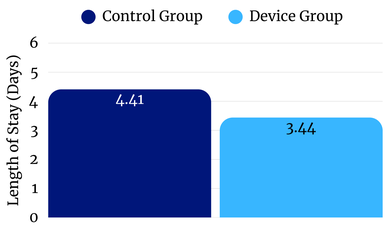
This pre-post observational clinical and economic study was conducted across three inpatient units at Cook Children's Medical Center, a 443 bed children's hospital from November-December 2025. Eligible patients were ≥2 weeks of age on all lines receiving continuous infusions. Unit nurses applied the breakaway device (SafeBreak, Lineus Medical) to enrolled patients. Outcomes for the intervention cohort (n=129) was compared against a retrospective control cohort (n=1,413) from the same units (August-November 2025).

The primary endpoint was IV complication rate; secondary endpoints were device separation rates, nursing time, hospital length of stay, and cost avoidance. Group differences were assessed using a two-proportion z-test and confirmed with a chi-square confirmation; complication subtypes were summarized descriptively. Economic outcomes were evaluated from the hospital perspective using IV restart supply costs, with net cost avoidance calculated after accounting for device acquisition costs.

Results

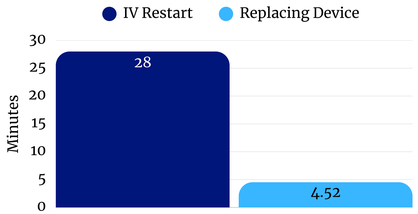
Summary of IV Complications on PIVCs			
Complication Type	**Control Group (n = 1413)**	**Device Group (n = 121)**	**Complication Rate Reduction**
Dislodgement	141 (10.0%)	3 (2.5%)	75.00%
Infiltration	70 (5.0%)	0 (0.0%)	100%
Phlebitis	144 (10.2%)	3 (2.5%)	75.50%
Leaking	142 (10.0%)	0 (0.0%)	100%
Occlusion	71 (5.0%)	0 (0.0%)	100%
Any complication	**568 (40.2%)**	**6 (5.0%)**	**87.60%**

Average Length of Stay



Average hospital stay was reduced by 0.96 days.

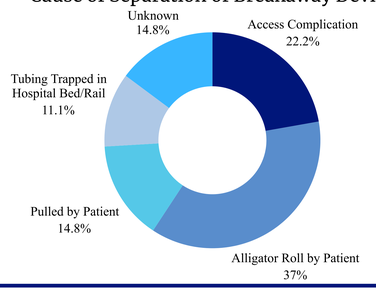
IV Restart and Device Replacement Times



Time to replace a breakaway device was 23 minutes less than the time to perform an IV restart

Projected Annual Cost-Benefit Analysis for 3 Trial Units	
Evaluation Period	48 days
PIV patients (device group)	$92
Historical complication rate	40.20%
Complication rate with device	5.00%
Annual device cost (at $5.50)	$5,060
Annual gross hard cost savings ($92/restart)	$29,831
Annual net cost savings	$24,771

Cause of Separation of Breakaway Device



Results

Control (n=1413) and intervention (n=129) cohorts were analyzed (n=121 PIVC, n=8 CVC), with similar baseline characteristics. The primary outcome shows PIVC complications of 40.2% in the control cohort versus 5.0% in the intervention cohort, representing a 87.6% relative reduction. Complications were observed exclusively among PIVC patients; no complications were recorded in the CVC subgroup. Secondary results included, 27 device separations (20.6%), with catheter integrity preserved in all cases. Of those separations 21 PIVCs (77.8%) and 6 CVCs (22.2%). Mean replacement time for the breakaway device (4.52) was 23 minutes shorter than IV restart (28 minutes) resulting in more than 80 nursing hours preserved. The most common causes of separation were alligator-roll (n = 10; 37.0%) with other causes less frequent. Active infusions were present in 22 separations events with no medication waste recorded. Gross cost savings for the units studies were approximately $29,831, with net hard cost avoidance of ~$24,771 after device costs. Nurse satisfaction was high (9.6/10 overall; 9.8/10 following separation events).

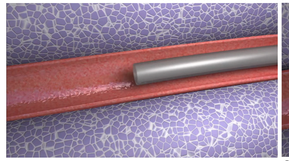
Conclusion

Implementation of a break-away device was associated with an 87.6% reduction in IV complications versus historical controls (p<0.001). Catheter integrity was preserved in 100% of separation events with no IV restarts or medication waste reported. These clinical benefits were accompanied by 0.96 day reduction in hospital length of stay, approximately 23 minutes of nursing time saved per separation event, and annualized net cost savings of $24,771. Collectively, these findings support breakaway devices as both a clinically effective and economically sound strategy in pediatric vascular access care.

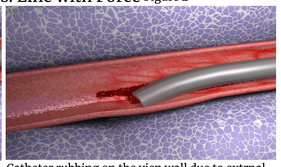
Dicussion

This is the first evaluations of a breakaway technology across peripheral venous access and central venous access in a pediatric population. Mechanical forces transmitted to the catheter tip contribute not only to dislodgement but also to complications across peripheral and central venous access such as phlebitis and infiltration. The observed separation rate of 20.2% exceeded prior randomized data (16.7%), likely reflecting reduced line awareness in pediatric patients. The control complication rate (40.2%) is consistent with previous meta-analytic estimates. Nursing satisfaction was high for both placement and post-separation replacement supporting feasibility and scalability. Limitations include a single-center design, use of retrospective historical control group, and limited data collections on central lines. Reduced IV complications and shorter length translate to meaningful cost savings, with direct implications for both patient outcomes and operational efficiency. These support consideration of breakaway devices as a systems-level intervention in vascular access, warranting further study to define their role in best practices.

IV Catheter Idle vs. Line with Force Figure 2



Catheter idle in vein



Catheter rubbing on the vien wall due to extrnal force

1. Helm, R.E., et al., Accepted but Unacceptable: Peripheral IV Catheter Failure. Journal of Infusion Nursing. 2016; 38(3): 189-203.
2. Panza, G., Steere, L. and Steinberg, A. (2022) 'A new force-activated separation device for the prevention of peripheral intravenous restarts', Journal of Infusion Nursing, 45(2), pp.74–80.