

A PEDIATRIC CARDIOVASCULAR INTENSIVE CARE UNIT STUDY: DEVICE IMPLEMENTATION

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INTRODUCTION

The placement of central venous lines (CVL) is common in managing critically ill pediatric patients. Inadvertent air bubbles in a line can lead to an air embolus within pulmonary circulation. Venous air embolus in children with right to left shunting lesions can lead to myocardial infarction, stroke and death. Additionally, children with congenital heart disease already have strokes at a higher rate than normal children. While many strokes are related to clots/procedures, some may be due to inadvertent air embolus and are thus a preventable harm.

METHODS

We analyzed the proportion of CVLs with air bubbles before and after implementation of anti-siphon valves in March 2016 and neutron caps in March 2017 within a 25 bed Pediatric Cardiovascular Intensive Care Unit (CVICU). Quality/Safety Analysts collected data during patient encounters and manually examined lines for the presence of air bubbles. The RE-AIM framework was used to analyze nursing adherence.

OBJECTIVES

- Aim 1 - Measure the proportion of central lines that contain air bubbles among a pediatric population
- Aim 2 - Compare air bubble prevalence on lines with and without ASVs among a pediatric population
- Aim 3 - Report the proportion of neurological events to air bubble occurrence

Table 1: Percentage of central venous lines with air bubbles

Cohort	Pre-initiative	Post-initiative	Difference	P-value
	% (no./total)	% (no./total)	(95% CI)	
All lines	18.0 (141/785)	8.0 (86/1075)	-10.0 (-13.2, -6.7)	<0.001
ASV only period		6.2 (38/615)	-11.8 (-15.2, -8.3)	<0.001
ASV and neutron cap period		10.4 (48/460)	-7.5 (-11.6, -3.5)	<0.001
STAT score 1 to 3	14.5 (20/138)	8.7 (26/298)	-5.8 (-13.0, 1.5)	0.098
STAT score 4 to 5	18.7 (121/647)	7.7 (60/777)	-11.0 (-14.7, -7.3)	<0.001
Among adherent lines		4.4 (33/742)	-13.5 (-16.7, -10.3)	<0.001
Among non-adherent lines		15.9 (53/333)	-2.0 (-7.0, 2.9)	0.460

RESULTS

Audits were performed on 1,860 lines from 104 patients between November 2015 and April 2018. Patients admitted before and after the quality improvement initiative were comparable with respect to demographics and clinical characteristics. The proportion of air bubbles decreased from 18.0% prior to the initiative to 8.0% following the introduction of ASVs ($p<0.001$). The post-initiative decrease was more prominent among the lines that had the devices in use, with rates of bubbles of 4.4% among adherent lines and 15.9% among non-adherent lines. The rate of potentially bubble related neurological events decreased from 4.8 events/1,000 patient days before the initiative to 1.8 after the initiative ($p=0.013$). The rate of nursing adherence to device use declined 1.56% per month.

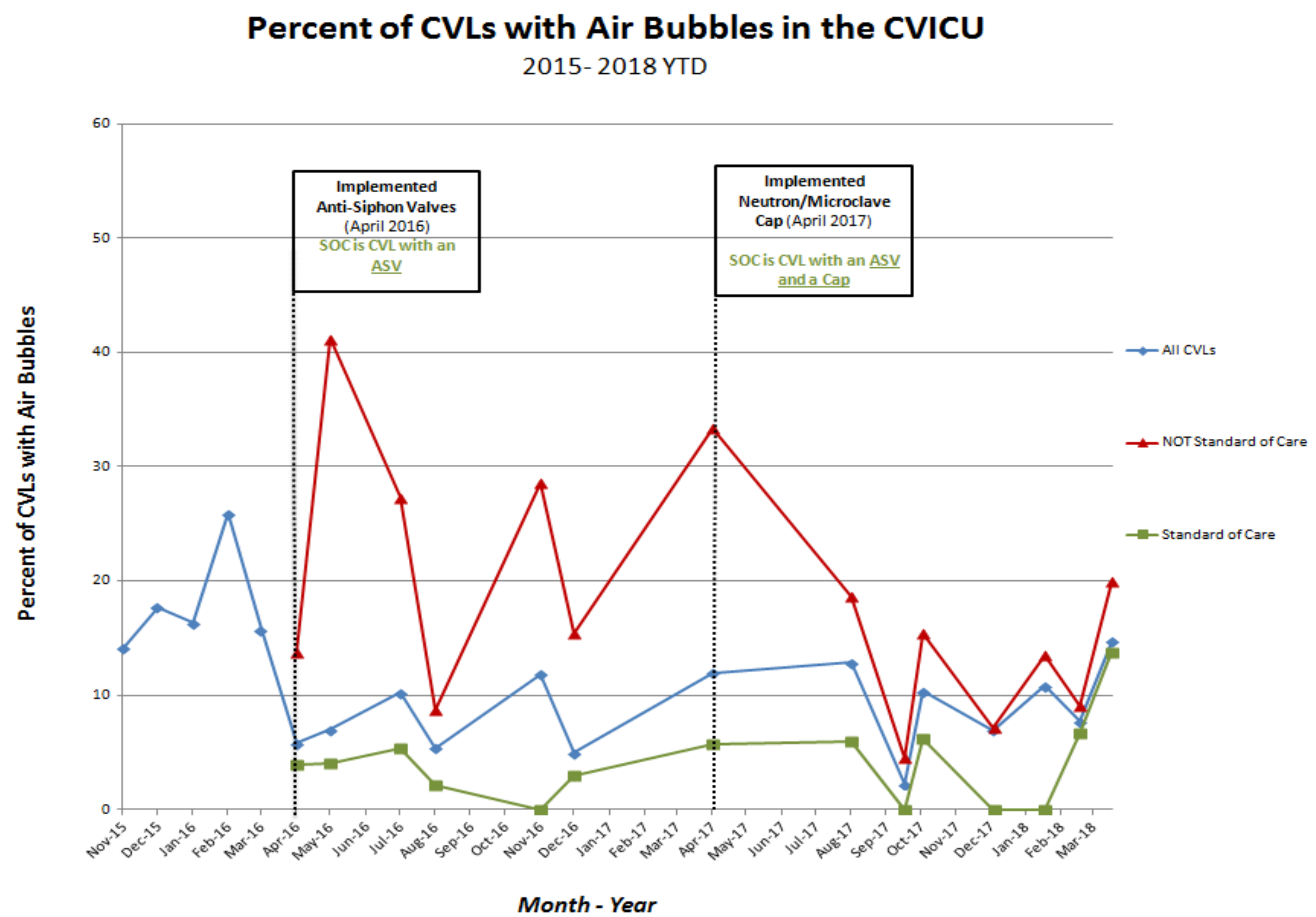
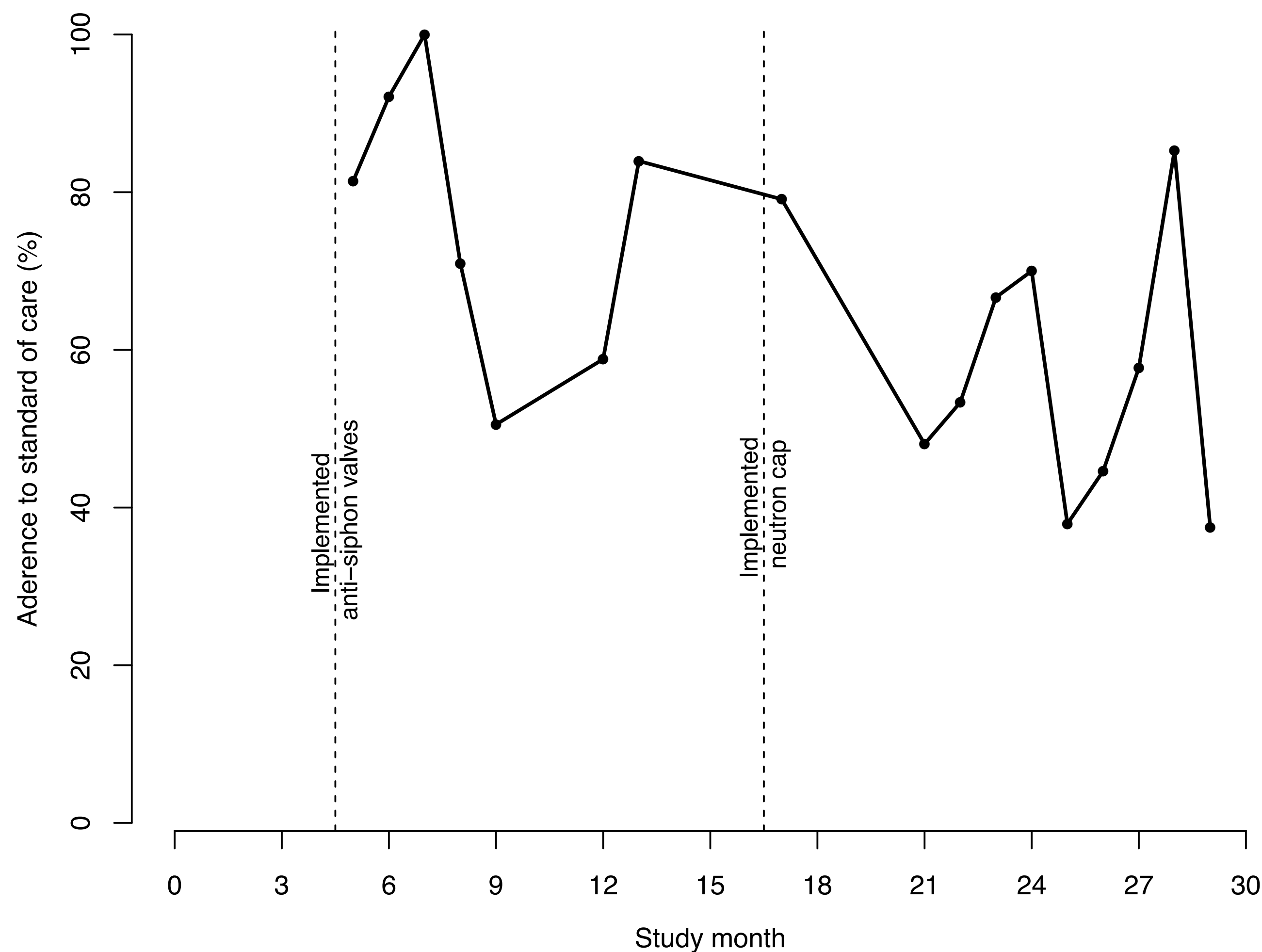


Table 2: Rates of neurological events per 1,000 patient days

Neurological event	Pre-initiative	Post-initiative	Ratio	P-value
	rate (no./patient days)	rate (no./patient days)	(95% CI)	
All	6.9 (10/1452)	1.8 (10/5479)	0.27 (0.11, 0.64)	0.003
Potentially bubble related	4.8 (7/1452)	1.3 (7/5479)	0.27 (0.09, 0.76)	0.013

Figure 2: Nursing adherence to standard of care overtime



CONCLUSION

The introduction of these devices reduced the frequency of air bubbles occurring in CVLs. Integrating these practices into standard care has the potential to decrease the number of neurological events among pediatric CVICU patients but is reliant on nursing staff adhering to standard of care practices.

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