Impact of Device Standardization to Prevent Hemodialysis Catheter Central Line-Associated Bloodstream Infections (HD-CLABSI) in a Large Healthcare System

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Background

- Large U.S. based healthcare system of 180+ hospitals
- Internal data identified one-third of CLABSI cases correlated to patients who also had a hemodialysis (HD) catheter
- HD catheter end caps protect lumens from non-dialysis care access. Products varied from gauze to generic end caps to antimicrobial impregnated end caps.

Objectives and Methods

Aim 1: Implement a Standardized HD Catheter Endcaps

- Supply chain sourced an antimicrobial barrier end cap specific for HD catheter lines. Product availability placed in location specific-dialysis and critical care units only. Tracked purchase data implied use.
- Phased implementation by geographic regions over 12 months included (i) user education: software training module, unit posters, hands on demonstrations and (ii) virtual coaching calls with unit leaders & educators. Adoption verification was by tracer observations.
- Full enterprise implementation occurred by end of 2022.

Aim 2: Impact Evaluation and Outcomes of Standardization

- CLABSI events were sourced from NHSN and abstracted by a centralized team. EHR nursing documented dialysis catheter identified HD sub-population of CLABSI cases.
- Return-on-investment [ROI] business plan based on harm avoided, CLABSI cost avoidance and product costs was developed for operational assessment.
- *R* statistical analysis on HD populations April 2021 – September 2023. Procedure and revenue codes and other financial data were also used to identify dialysis patients. Exclusions: Patients <18 years old, CLABSI present on admission and length of stay <3 days (not an HAI case).

Updated Results

Table 1.
Dialysis CLABSI Logistic Regression Results

Factor	Odds Ratio	95% Confidence Interval	p-value
Age (years)	1.00	0.99 - 1.00	0.144
Gender (Reference = female)	1.08	0.91 - 1.29	0.382
Triple dialysis catheter	0.97	0.78 - 1.20	0.767
Multiple catheters	**3.00**	2.45 - 3.68	**0.000**
Elixhauser Comorbidity Score	1.00	0.99 - 1.01	0.661
Renal Failure Type (Ref = acute)			
Chronic	0.91	0.71 - 1.17	0.474
Unknown	0.84	0.20 - 3.45	0.809
COVID-19	**1.76**	1.40 - 2.22	**0.000**
Skin Ulcer Present on Admission	**1.64**	1.32 - 2.04	**0.000**
BSI Present on Admission	**1.49**	1.23 - 1.80	**0.000**
Catheter Location (Ref = subclavian)			
Femoral	0.97	0.64 - 1.47	0.889
Neck	0.97	0.75 - 1.27	0.844
CHG Impregnated end cap	0.97	0.74 - 1.26	0.823

Notes: Estimates generated using logistic regression model;
Abbreviations: BSI = Blood Stream Infection; CHG = chlorhexidine gluconate

Table 2.
Sample Characteristics for Patients with Chlorhexidine Gluconate (CHG)-Impregnated End Caps vs. Non-CHG End Caps

	CHG-end Cap	No CHG-end cap	p-value
Number of patients (n =)	29,604	50,113	
CLABSI rate (%, n)	0.6% (169)	0.7% (352)	**0.029**
Average age (SD)	63.6 (14.8)	62.8 (14.7)	**< 0.001**
Male (%)	55.3% (16,384)	56.1% (28,095)	**0.046**
Triple-dialysis catheter (%)	26.1% (7,737)	30.6% (15,315)	**< 0.001**
Multiple catheters (%)	**18.8% (5,573)**	**20.9% (10,466)**	**< 0.001**
Severity on admission (%)			**< 0.001**
ICU	21.5% (6,352)	24.6% (12,320)	
None	65.3% (19,341)	63.0% (31,594)	
Mean Comorbidity Score (SD)	9.5% (17.7)	9.5% (17.8)	0.335
Renal Failure Type (%)			**< 0.001**
Acute	10.8% (3,201)	12.0% (6,010)	
Chronic	88.6% (26,240)	87.4% (43,803)	
COVID-19 (%)	**5.5% (1,631)**	**12.1% (6,074)**	**< 0.001**
Ulcer present on admission (%)	**12.3% (3,629)**	**13.8% (6,895)**	**< 0.001**
BSI present on admission (%)	**28.5% (8,428)**	**29.9% (14,964)**	**< 0.001**
Dialysis mode (%)			**< 0.001**
CRRT	3.9% (1,163)	3.4% (1,723)	
HD	91.8% (27,163)	90.8% (45,495)	
SLED	1.3% (378)	0.5% (242)	

Notes: Continuous variables compared using independent samples *t*-tests; differences in continuous variable compared using Pearson Chi-squared test; Abbreviations: CRRT = Continuous Renal Replacement Therapy; HD = Hemodialysis; SLED = Sustained Low-Efficiency Dialysis; BSI = Blood stream infection.

Figure 1.
Change in HD-CLABSI Rates (per 1,000 Dialysis Catheter Days) From Q2, 2021 to Q3, 2023

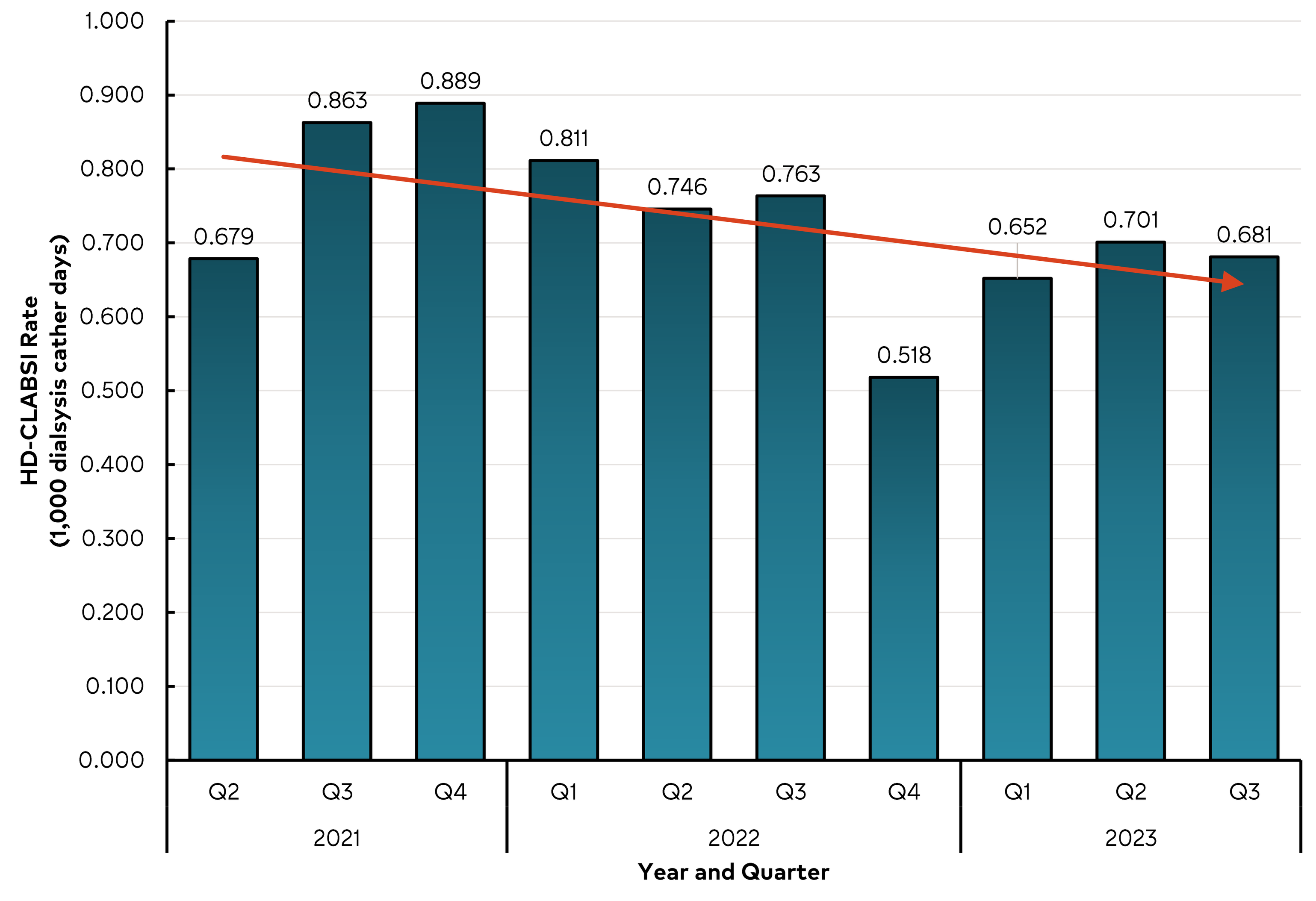
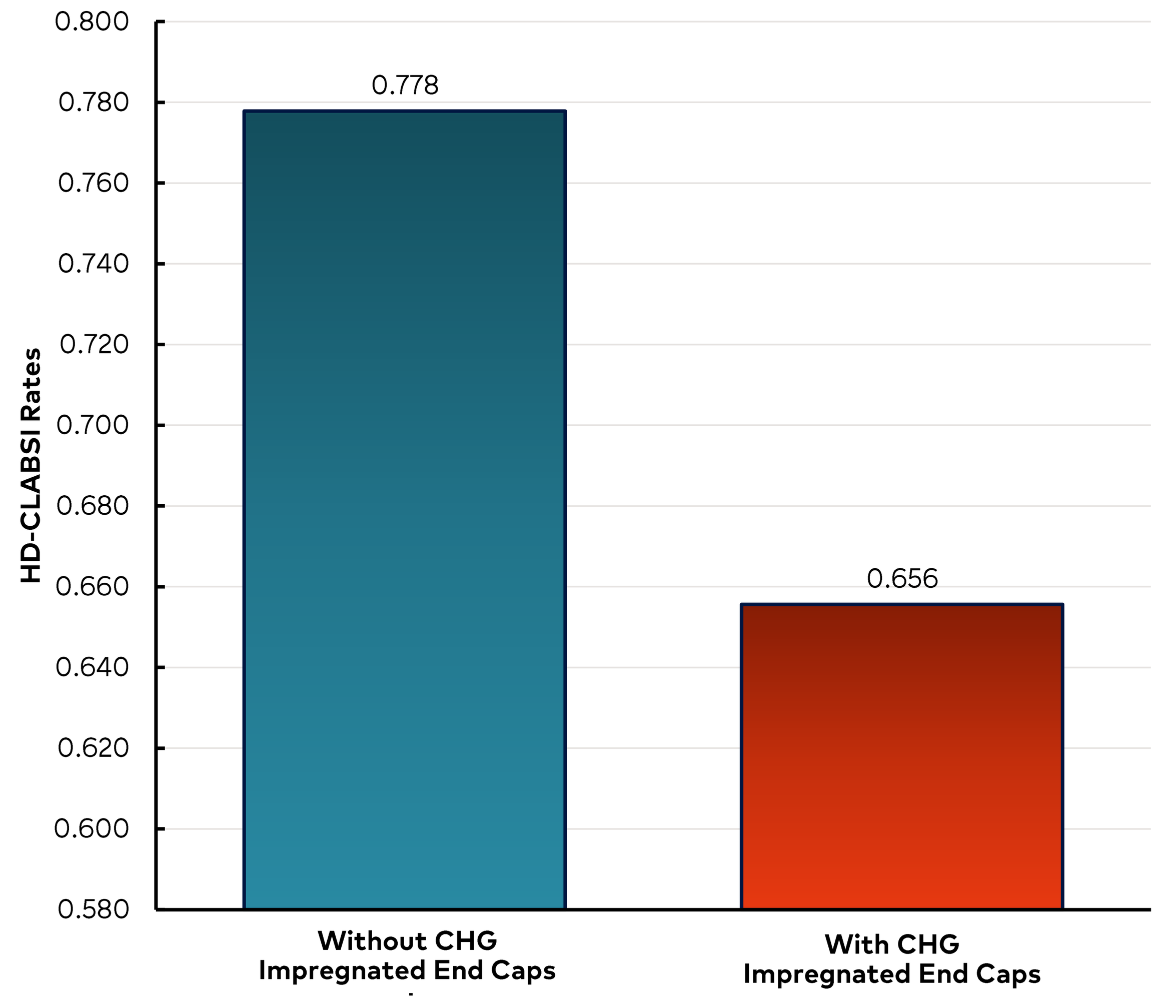


Figure 2:
Difference in HD-CLABSI Rates (per 1,000 dialysis catheter days) With and Without CHG Impregnated End Caps



Key Takeaways

- In Table 1, CHG-end cap use did not significantly impact overall HD-CLABSI reduction in a multifactor regression analysis. COVID infections peaked during early study periods.
- Table 2 shows that patients with CHG-end cap use had significant differences in clinical conditions, in part due to COVID infections and acuity.
- Figure 1 displays HD-CLABSI rates by quarter of pre- and post CHG-end cap use. Figure 2 shows dialysis CLABSI rates decreased by 16% with CHG-end cap use.
- Quarterly CHG-end cap purchases increased to a sustained volume in 3Q 2022 thru 2023.
- Post implementation HD-CLABSI cases were reviewed and identified 40% had clinical wounds/pressure injuries and 50% had clinical pneumonia which did not meet NHSN criteria for primary infection source.

Conclusion

- Device standardization decreased HD-CLABSI events via 1) ease of dialysis CVC identification; 2) increased staff accountability to avoid catheter use for care other than HD; 3) elimination of local solutions such as gauze and tape.
- HD-CLABSI rates decreased and event reduction met internal ROI goals. Analysis will continue to gain in post COVID epidemic peaks (CLABSI in COVID patients increased).
- Opportunities exist to reduce clinical conditions contributing to secondary bacteremia.

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