

Improving IV Connector Disinfection by Using Human Factors Engineering to Identify Effective, Nurse-Friendly Solutions

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Scientific Poster presented at

APIC 40th Annual Conference

June 8–10

Ft. Lauderdale, Florida

The presentation is designed to help clinicians:

- Identify risk factors for central line-associated bloodstream infections (CLABSI)
- Identify key evidence-based practices and technologies that can minimize CLABSIs and ideally sustain a zero CLABSI rate
- Create a culture of safety that supports 100% compliance with preventive practices

CLABSI risk factors include:

A. Skin organisms

- Endogenous (skin flora)
- Extrinsic (healthcare workers' hands, contaminated disinfectant)

B. Contaminated infusate

- Endogenous (fluid, medication)
- Extrinsic (introduced by manufacturer)

C. Contaminated catheter hub

- Endogenous (skin flora)
- Extrinsic (healthcare workers' hands)

A contaminated hub is an underrated risk factor not addressed by typical catheter maintenance bundles. Hospitals with above-zero CLABSI rates should consider disinfection cap use, as St. Joseph Mercy Hospital did.

One key to achieving zero CLABSIs is the proper interplay between technical interventions (evidence-based practices/technologies) and a culture of safety. Technical Interventions include the insertion bundle and the maintenance bundle covering assessment, site care, tubing, injection ports, and catheter entry.

Steps to achieving an effective culture of safety include:

- Educate staff on the science of safety
- Identify defects (staff safety assessment)
- Create non-punitive environment so staff feels comfortable reporting errors and near misses
- Learn from all defects, errors, and near misses
- Create processes to ensure that defects and errors never reach the patient

- Partner with senior executives
- Implement teamwork & communication tools

There are several important steps to achieving a zero CLABSI rate that involve going beyond CDC-recommended insertion & maintenance bundles. These include:

- CHG baths
- CHG dressings
- Disinfection caps
- Antibiotic-impregnated catheters



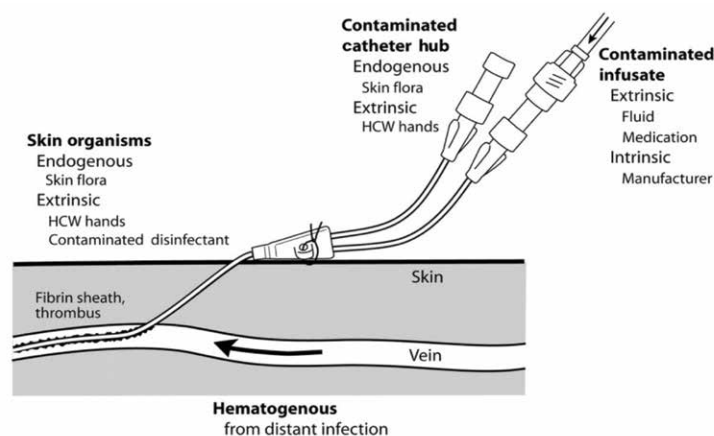
Disinfection cap with flush syringe

Example of Successful Intervention: Disinfection Cap

ISSUE

Our hospital examines every central line-associated bloodstream infection (CLABSI) for insights about prevention, as part of our “journey” to eliminate CLABSI. We uncovered inconsistency in nurses’ execution of the “scrub-the-hub” method for disinfecting intravenous therapy (IV) needleless connector/valve hubs. Scrubbing is a widely used protocol, but our analysis showed noncompliance due to the fast pace of nurses’ work. This increased CLABSI risk. The IV connector design also made adequate scrubbing difficult.

We sought a solution that, by incorporating human factors engineering (HFE), would make disinfection easier and more efficient for nurses.



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PROJECT

We identified a disinfection cap as a potential solution. The cap delivered continuous passive disinfection when left in place between line accesses; reached surfaces that scrubbing could not; and could be applied to tubing openings to create a closed system. We implemented it in our three ICUs in January 2011. In May 2012, we made available to nurses a new version in which the cap is held in a flush syringe plunger. This improves compliance by incorporating HFE, to make the cap even more readily available when the IV line is flushed.

RESULTS

Our ICU data since joining the Keystone ICU Project in 2004 show a steady decline in CLABSI rate. This declining infection rate is attributable to multiple interventions including insertion and line care bundles, chlorhexidine gluconate (CHG) bathing of patients, and CHG insertion-site dressing.

Since implementing the disinfection cap and then improving compliance with the cap-syringe combination, we have approached our goal of zero CLABSIs. After we experienced six straight months without CLABSIs in our ICUs, we implemented the cap-syringe combination hospital-wide in May 2012.

As of April, 2013, we have had zero CLABSIs in the previous 17 months in our three ICUs (and only 1 CLABSI in the past 23 months). The cap-syringe combination is used on all central and peripheral IV lines. Housewide, we've seen a 86% CLABSI reduction in the 11 months since implementation.

COST IMPACT

Besides the impact on patient safety, our hospital shows substantial cost savings associated with use of the disinfection cap and cap-syringe combination. In the period from May 2012 (when the devices were implemented housewide) to December 2012, we saved \$40,466 (avoided CLABSI treatment costs minus device acquisition costs). This is based on a calculation of \$11,700 treatment cost per CLABSI—a conservative figure that includes only hard costs from the pharmacy, laboratory, radiology, and central supply departments.

Patient Safety and Cost Impacts of Avoiding CLABSIs*

*All figures from St. Joseph Mercy Hospital

| | Cost (variable) of case w/o CLABSI | Cost (variable) of case involving CLABSI | Difference with CLABSI | Average Length-of-stay in case w/o CLABSI | Average Length-of-stay in case involving CLABSI | Difference with CLABSI |
|---------------|------------------------------------|--|------------------------|---|---|------------------------|
| Non-ICU units | \$4,383 | \$32,203 | Nearly 8x more | 3.91 | 36.06 | More than 9x more |
| ICUs | \$12,839 | \$45,085 | About 3.5x more | 8.1 | 49.44 | More than 6x more |

Mortality rate of ICU patients with CLABSIs: 44%

Keys to Continuous Improvement and Sustainability

- Measurement
- Learn from defects
- Review literature
- Tests of change

References

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2. Pronovost P et al (2010). BMJ; 340:309
3. Liptitz-Snyderman A, et al (2011). BMJ; 342:219
4. Wright M et al (2012) Amer J of Infection Control

Central-Line Associated Bloodstream Infection Rate:

Infections per 1000 line days

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|--------------------------------|------------------|------|------|------|-----------|--------------------|---|------------------|------|------|
| St. Joseph Mercy Hospital ICUs | 7.6 | 2.12 | 1.11 | 1.13 | 0.90 | 0.70 | 0.84 | 0.78 | 0.00 | 0.00 |
| # of infections | 31 | 13 | 8 | 8 | 7 | 5 | 6 | 6 | 0 | 0 |
| Interventions | Insertion bundle | | | | CHG baths | Maintenance bundle | CHG dressing, dialysis catheter education | Disinfection cap | | |

No CLABSIs in 17 months in all 3 ICUs

Last CLABSI:

MICU: May 2011

SICU: October 2011

CICU: June 2011

Central-Line Associated Bloodstream Infections:

Non-ICUs

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|-----------------|------------------|---------|--------------------|---|------|------------------|------|
| # of infections | Unknown | Unknown | 22 | 20 | 18 | 9 | 2 |
| Interventions | Insertion bundle | | Maintenance bundle | CHG dressing, dialysis catheter education | | Disinfection cap | |

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Disclosures:

- Consultant: Michigan Hospital Association Keystone Center
- Consultant: Missouri Center for Patient Safety
- Contracted consultant: Advancing Nursing, LLC
- Consulting services: Edward Lifesciences, Sage Products, Excelsior Medical