Central Line-Associated Bloodstream Infection: An Introduction

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

HRET
HEALTH RESEARCH & EDUCATIONAL TRUST
In Partnership with AHA

STRIVE
States Targeting Reduction in Infections via Engagement

Conflicts Of Interest

Grant/Contract Funding

- *Agency for Healthcare Research and Quality*
- *National Institute for Health*
- *National Institute for Aging*
- *Blue Cross Blue Shield Foundation of Michigan*
- *Veterans Health Administration*
- *Centers for Disease Control and Prevention*

Disclosure of Off-Label and/or investigative Uses

I will not discuss off label use and/or investigational use

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Learning Objectives

- Understand the impact, cost, morbidity and mortality of CLABSI
- Recognize that CLABSI is defined in different ways and there are multiple routes of developing CLABSI
- Describe technical and socioadaptive interventions to prevent CLABSI

What is a Central Venous Catheter?

- Intravascular device that terminates at or close to the heart or one of the great vessels
  - Nontunneled CVCs (subclavian, jugular, femoral)
  - Tunneled CVCs (Broviac, Hickman, Groshong)
  - Dialysis catheter (Quinton)
  - Peripherally inserted central catheters (PICCs)
  - Implanted ports (Permacath)
- Used increasingly to provide short-, medium- and long-term venous access in all settings

What is CLABSI?

- An infection that originates from or is related to a central venous catheter
- Two definitions: surveillance and clinical
- CDC/NHSN Surveillance Definition:
  - A laboratory confirmed infection where a CVC is in place for ≥2 calendar days prior to +ve culture and is also in place the day of or day prior to culture
  - Example: PICC placed June 1. Pt febrile June 3. PICC in place. Cultures positive for Staph Aureus: CLABSI
  - PICC placed June 2 and removed June 5. Pt febrile June 6. Cultures positive for Coag Neg Staph: CLABSI

Clinical Definition of CLABSI

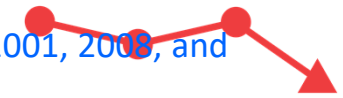
- CLABSI occurs when these 3 criteria exist:
  - Clinical signs of infection
    - E.g., fever, rigors, altered mental status, hypotension
  - No alternate source of bloodstream infection
  - Positive blood culture from a peripheral vein with any 1 of the following:
    - Catheter tip/segment culture that matches organism grown from blood;
    - At least 3-fold higher number of organisms grown from the catheter vs. peripheral blood culture on simultaneously drawn cultures
    - Growth from the catheter-drawn blood culture occurs at least 2 hours before growth of the same organism from a percutaneously-drawn blood culture

Burden of CLABSI

- Epidemiology of CLABSI is changing
  - 46% decrease in CLABSI since 2008-2013
  - An estimated 30,100 CLABSI occur in US hospitals on an annual basis
    - Prolongs hospital stay
    - Increase morbidity
    - Raises mortality: estimates 12-25%
- CDC estimates CLABSI cost ~ $16,550/episode

Centers for Disease Control and Prevention (CDC). (2015, January) Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-central line-associated Bloodstream Infection).

CDC. (2011, March). Vital signs: central line–associated blood stream infections—United States, 2001, 2008, and 2009. Morbidity and Mortality Weekly Report



Pathogenesis of CLABSI

- Based on route of entry of bacteria:
  - Extraluminal: Pathogens migrate along external surface of catheter from skin entry site
    - Often occurs within 7 days of insertion
  - Intraluminal: Hub contamination, migration along internal surface of catheter
    - More commonly occurs >7 days, intraluminal colonization
  - Hematogenous seeding from another source
  - Contaminated infusates (rare)

Risk Factors for CLABSI

- **Patient Characteristics**
  - Immune compromised host/neutropenic hosts
  - Severe skin burns or protein calorie malnutrition
  - Prolonged hospital stay prior to device placement

- **Provider Characteristics**
  - Emergent insertion
  - Excessive device manipulation
  - Improper site or dressing care
  - Nurse : patient staffing ratio (catheter hub care)
  - Failure to remove unnecessary devices

- **Device Characteristics**
  - Site of insertion
  - Number of lumens
  - Indication for use (total parenteral nutrition, chemotherapy)

Preventing CLABSI

- MHA Keystone Study:
  - State-wide initiative in Michigan to prevent CLABSI
  - 103 ICUs, launched Oct 2003
  - Made use of a “Bundle” of best practices

- What is a bundle?
  - Structured way of improving process of care and patient outcomes using a set of evidence-based interventions at the same time

- Keystone Bundle Intervention:
  - Hand hygiene prior to catheter insertion
  - Use of maximal sterile barrier precautions
  - Use of alcohol-containing chlorhexidine for skin antisepsis before insertion
  - Avoidance of the femoral site
  - Removal of unnecessary catheters as soon as possible

Pronovost P, Needham D, Berenholtz S, et al. NEJM. (2006); 355:2725-32.
Institute for Healthcare Improvement

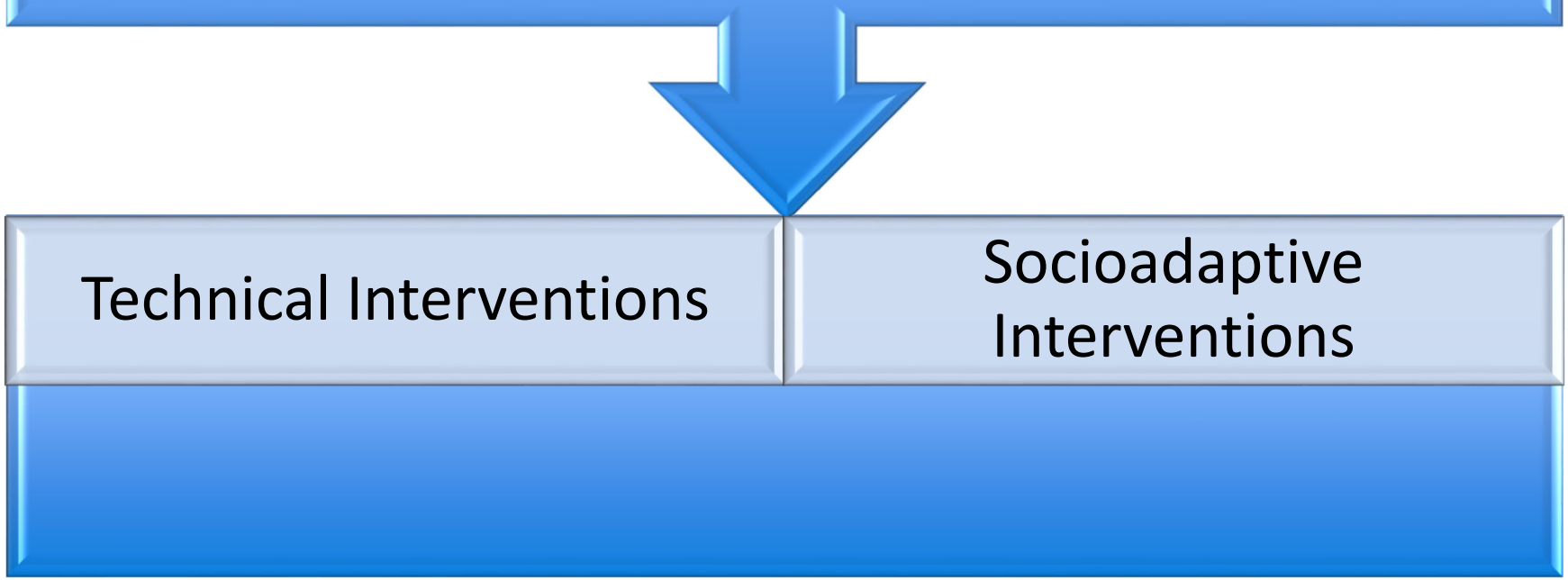
Keystone Study Decreased CLABSI Rates

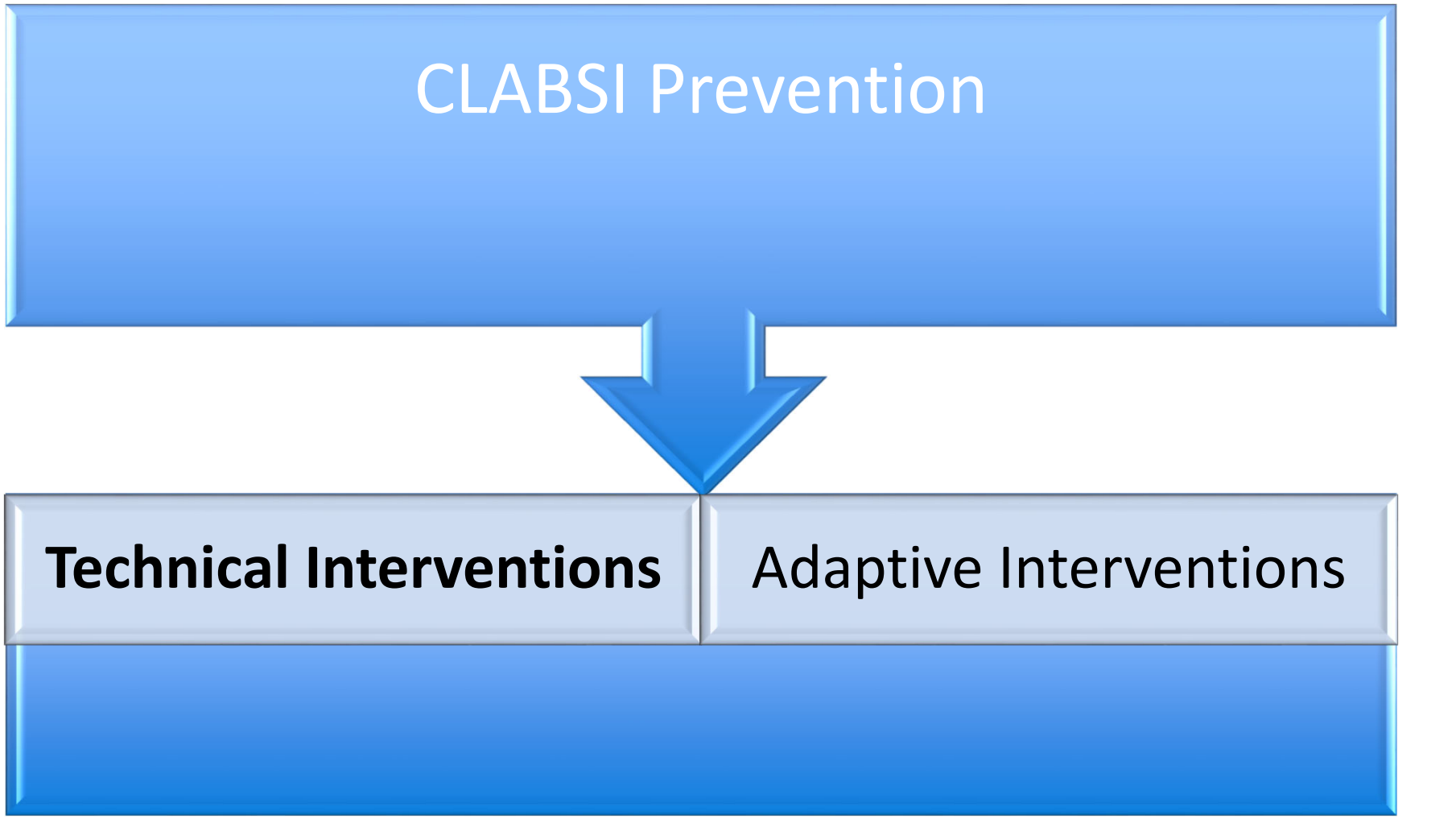
Table 3. Rates of Catheter-Related Bloodstream Infection from Baseline (before Implementation of the Study Intervention) to of Follow-up.*

Study Period	No. of ICUs	No. of Bloodstream Infections per 1000 Catheter-Days			
		Overall	Teaching Hospital	Nonteaching Hospital	<200 Beds
		median (interquartile range)			
Baseline	55	2.7 (0.6–4.8)	2.7 (1.3–4.7)	2.6 (0–4.9)	2.1 (0–3.0)
During implementation	96	1.6 (0–4.4)†	1.7 (0–4.5)	0 (0–3.5)	0 (0–5.8)
After implementation					
0–3 mo	96	0 (0–3.0)‡	1.3 (0–3.1)†	0 (0–1.6)†	0 (0–2.7)
4–6 mo	96	0 (0–2.7)‡	1.1 (0–3.6)†	0 (0–0)‡	0 (0–0)†
7–9 mo	95	0 (0–2.1)‡	0.8 (0–2.4)‡	0 (0–0)‡	0 (0–0)†
10–12 mo	90	0 (0–1.9)‡	0 (0–2.3)‡	0 (0–1.5)‡	0 (0–0)†
13–15 mo	85	0 (0–1.6)‡	0 (0–2.2)‡	0 (0–0)‡	0 (0–0)†
16–18 mo	70	0 (0–2.4)‡	0 (0–2.7)‡	0 (0–1.2)†	0 (0–0)†

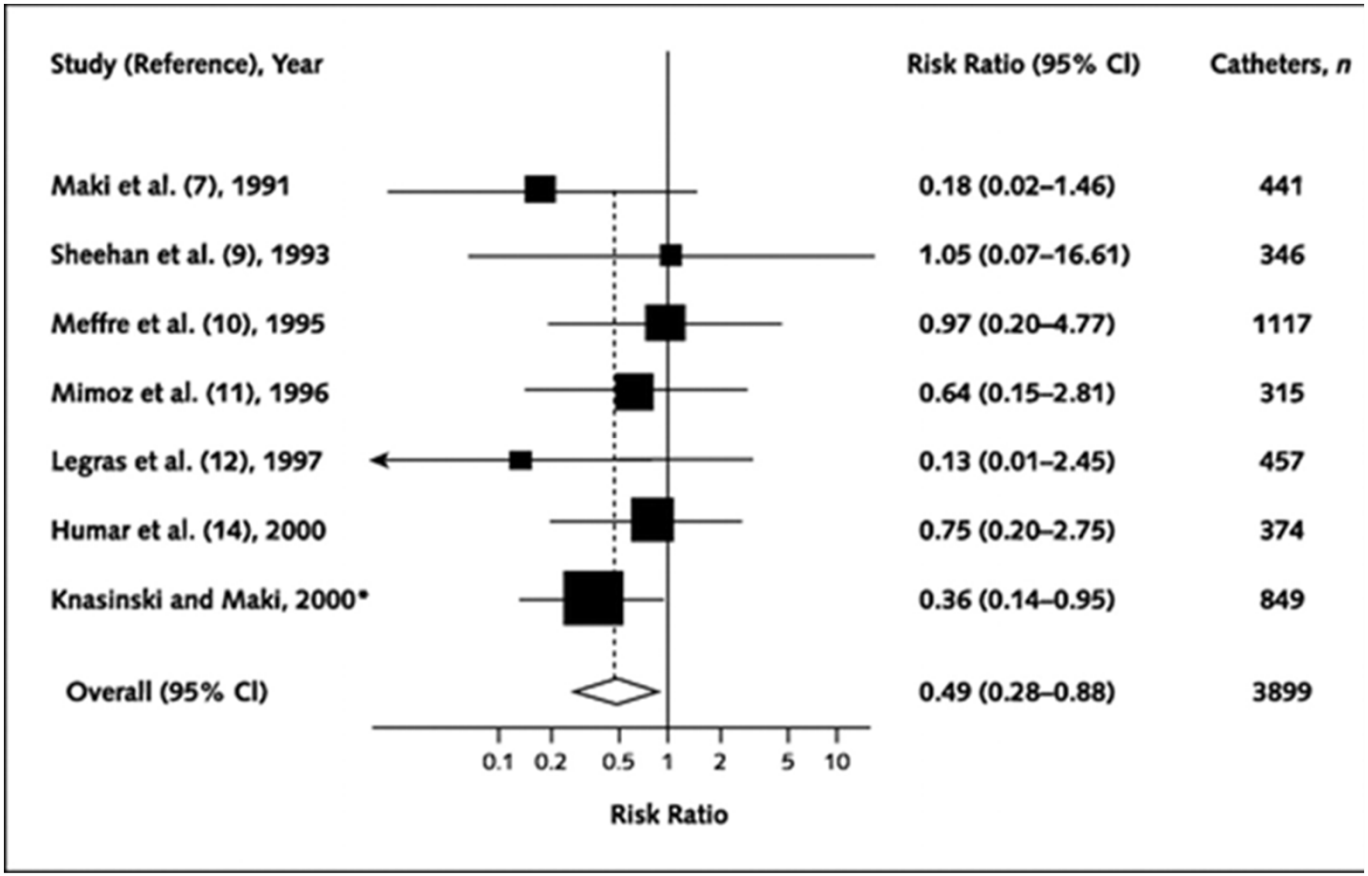
Pronovost P, Needham D, Berenholtz S, et al. NEJM. (2006); 355:2725-32.

CLABSI Prevention Bundles



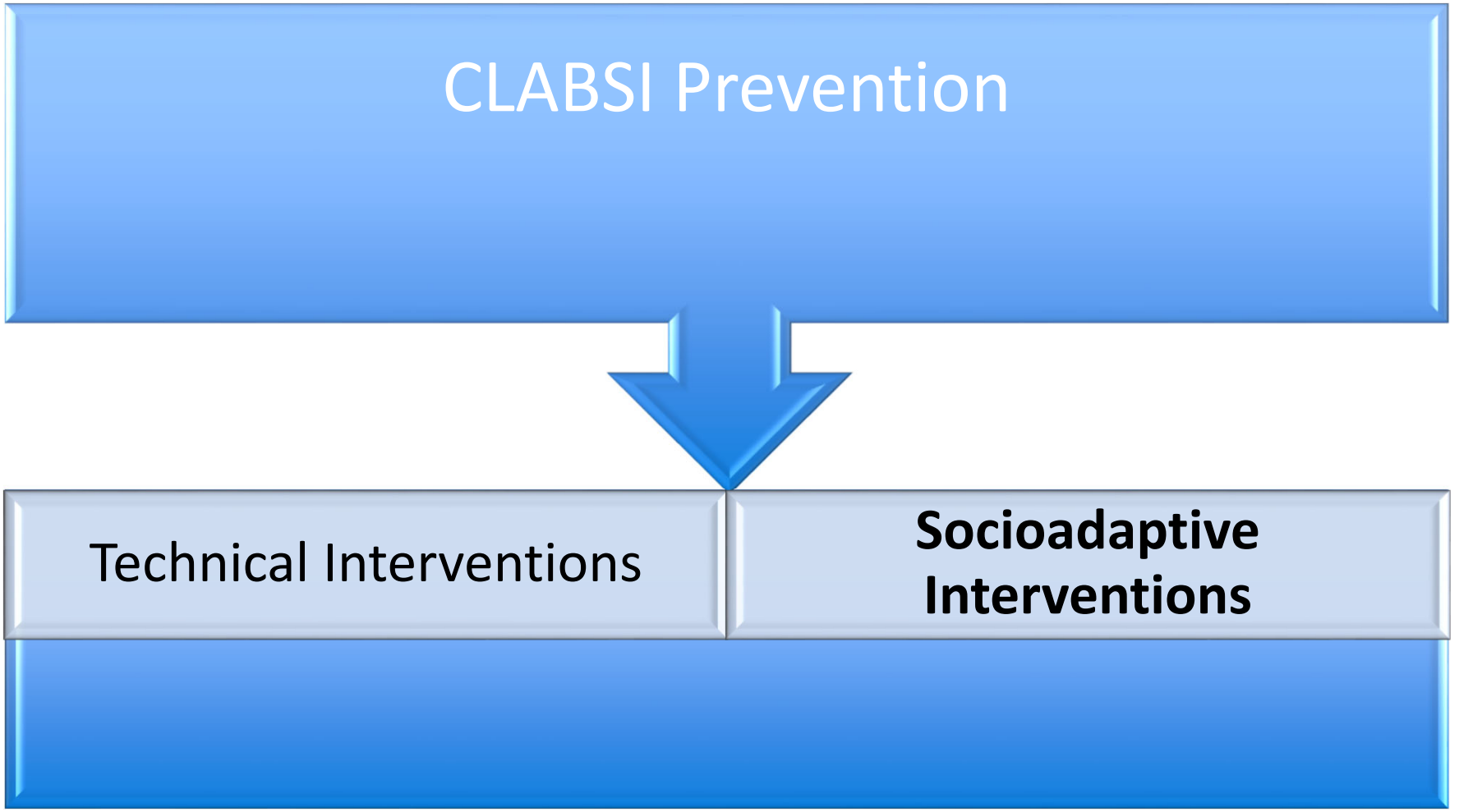

CLABSI Prevention
Technical Interventions
Adaptive Interventions

Evidence for Technical Element: Chlorhexidine



Meta-analysis: Among patients with CVC, chlorhexidine prep reduced risk of CRBSI by 49%

Chaiyakunapruk N, Veenstra DL, Lipsky BA, Saint S. Ann Intern Med (2002); 136(11):792-801.


CLABSI Prevention
Technical Interventions
Socioadaptive Interventions

Not just about having a bundle…

Socioadaptive Interventions include:

- Clinician education
- Designated Physician and Nursing Team Leader
- Central-line cart in each ICU
- Insertion Checklist
- Nurse empowerment to stop procedure if best practices not followed
- Adherence to best practices
- Feedback provided regarding rates of CLABSI to frontline staff

Socioadaptive Changes are Important

- Question: does adopting a bundle alone led to CLABSI prevention?
- In 250 hospitals, CLABSI rate was 2.1 per 1000 catheter days and 49% had a bundle policy
- CLABSI rates decreased only when units:
  - had a bundle policy
  - monitored compliance
  - **Demonstrated ≥ 95% compliance**

Furuya EY, Dick A, Perencevich EN, et al. Central Line Bundle Implementation in US intensive care units and impact on bloodstream infections. PLoS One (2011). 6(1):e15452.

Recommendations

- To improve CLABSI rates, first focus on known technical ‘active ingredients’
  - Alcohol containing chlorhexidine skin prep
  - Avoid femoral site
  - Maximal sterile barrier precautions

- Must also focus on socioadaptive elements
  - Measure and encourage compliance with bundle
  - Improve culture, communication and staff empowerment to improve outcomes

Chopra V, Shojania K. BMJ Qual Saf (2013); 22:93-96.

Summary

- Despite progress, CLABSI remains a costly, morbid and lethal condition
- Prevention of CLABSI should focus on both technical and socioadaptive elements
- Guidance using each of these strategies will be provided during the course of this quality improvement intervention

References

THANK YOU!