

**Technologic Innovations to Prevent Catheter-Related Bloodstream Infection**  
**Prof. Mark E. Rupp, University of Nebraska**  
**A Webber Training Teleclass**

# Technologic Innovations to Prevent Catheter-Related Bloodstream Infection

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Director, Infection Control & Epidemiology  
University of Nebraska Medical Center

Hosted by Bruce Gamage  
Provincial Infection Control Network of British Columbia

[www.webbertraining.com](http://www.webbertraining.com)

April 6, 2017



**Hosted by Bruce Gamage, Provincial Infection Control Network of British Columbia**  
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## Clinical Significance of CLA-BSI

- 78,000 central line-associated bloodstream infections (CLA-BSI) are estimated to occur yearly in United States hospitals and dialysis units.
- 2013 NHSN report from 4,567 US facilities, mean CLA-BSI rate in critical care units ranged from 0.0 – 3.0/1000 CVC d.
- CLA-BSI are associated with an estimated mortality rate of 12.3% and excess healthcare costs between \$7,288 and \$29,156 per episode.



Srinivasan A, et al. MMWR 60: 2011; CDC NHSN 2013 Data Summary; Umscheid CA, et al. Infect Control Hosp Epidemiol. 2011; 32:101-114. Scott RD. Division of Healthcare Quality Promotion, CDC, 2009.

3

International Nosocomial Infection Control Consortium (INICC) report, data summary of 43 countries for 2007-2012. Device-associated module



Rosenthal VD, et al. AJIC 2014

- **Countries Represented:** Argentina, Bolivia, Brazil, Bulgaria, China, Colombia, Costa Rica, Cuba, Cyprus, Dominican Republic, Ecuador, Egypt, El Salvador, Greece, Honduras, India, Iran, Saudi Arabia, Kosovo, Kuwait, Lebanon, Lithuania, Macedonia, Malaysia, Mexico, Mongolia, Morocco, Pakistan, Panama, Peru, Philippines, Poland, Puerto Rico, Romania, Russia, Serbia, Slovakia, Sudan, Thailand, Tunisia, Turkey, United Arab Emirates, Uruguay, Venezuela, Vietnam

Comparison of device-associated health care-associated infection rates per 1,000 device days in the ICUs of the INICC (2007-2012) and the U.S. NHSN (2012)

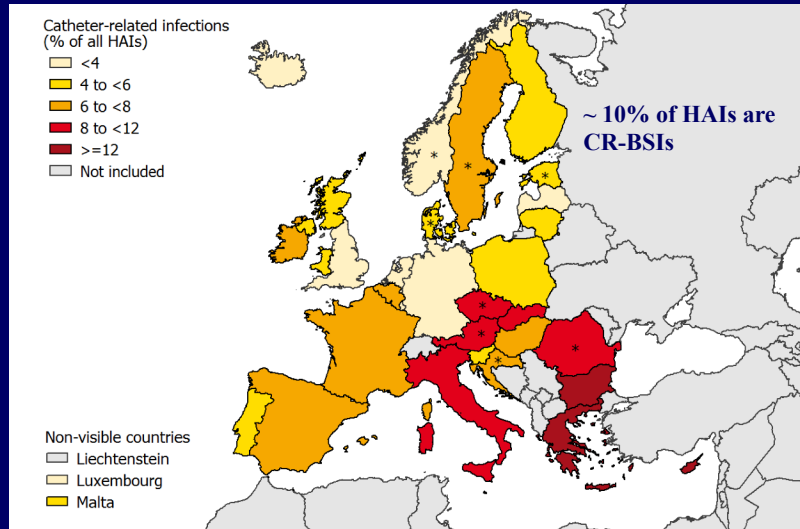
DA-HAI per Type of ICU	INICC 2007-2012 pooled mean (95% CI)	U.S. NHSN 2012 pooled mean (95% CI)
<b>Medical cardiac ICU</b>		
CLA-BSI	3.5 (3-3.9)	1.1 (0-1.1)
CAUTI	2.9 (1.6-4.4)	2.2 (2.0-2.3)
VAP	11.5 (10.5-12.5)	1.0 (0.8-1.1)
<b>Medical and surgical ICU</b>		
CLA-BSI	4.9 (4.8-5.1)	0.9 (0.9-1.0)
CAUTI	4.3 (4.2-5.8)	1.2 (1.2-1.3)
VAP	16.5 (16.1-16.8)	1.1 (1.0-1.2)
<b>Pediatric ICU</b>		
CLA-BSI	6.1 (3.7-6.5)	1.4 (1.3-1.6)
CAUTI	3.8 (5.1-6.1)	2.7 (2.5-3.0)
VAP	7.9 (7.4-8.4)	0.8 (0.6-0.9)
<b>Newborn ICU (1,501-2,500 g)</b>		
CLA-BSI	4.8 (3.3-6.1)	0.6 (0.5-0.8)
VAP	10.7 (8.4-13.4)	0.2 (0.1-0.5)

CAUTI, catheter-associated urinary tract infection; CI, confidence interval; CLA-BSI, central line-associated bloodstream infection; DA-HAI, device-associated health-care-associated infection; ICU, intensive care unit; INICC, International Nosocomial Infection Control Consortium; NHSN, National Healthcare Safety Network; VAP, ventilator-associated pneumonia.

4

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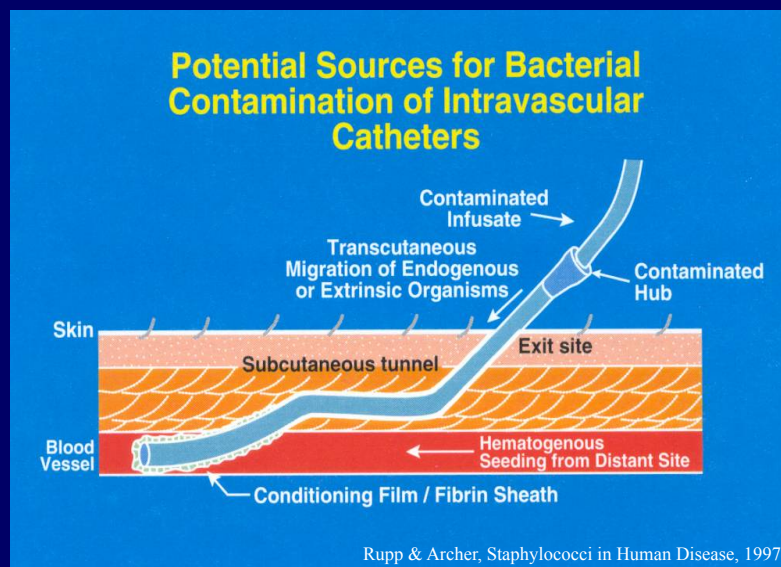
**Relative frequency of CR-BSI as a total of all HAIs by country (ECDC PPS 2011-2012)**



[http://ecdc.europa.eu/en/healthtopics/Healthcare-associated\\_infections/database](http://ecdc.europa.eu/en/healthtopics/Healthcare-associated_infections/database)

5

**Pathogenesis of CVC-Associated BSI**

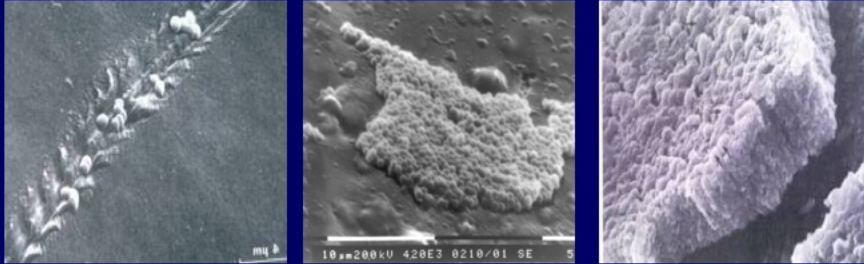


Rupp & Archer, Staphylococci in Human Disease, 1997

6

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## Pathogenesis of CVC-Associated BSI



Mature biofilm-associated infection with diverse population of cells including “persistor cells” is very difficult to eradicate with catheter in place

7

## Prevention of CR-BSI

### Practice Associated Interventions



8



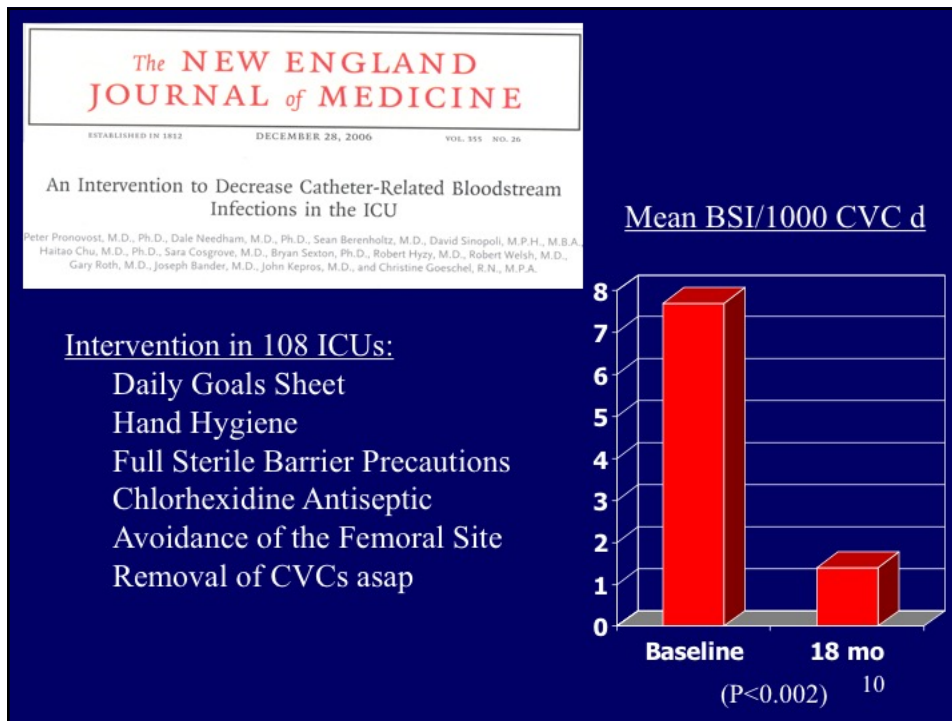
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## Practice Associated Interventions

- Education & Training
- Staffing Levels
- Insertion Procedures
  - Full Sterile Barriers & Checklist
- Post Insertion Care
  - Dressing Integrity
  - Aseptic Access Technique (scrub the hub)
  - Discontinuing unneeded catheters



9



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## Nebraska Medical Center CVC Insertion Kit



The Nebraska Medical Center, 98700 Nebraska Medical Center, Omaha, NE 68198-7600 PH: 402-559-4...

**Patient Information**

Name: [REDACTED] Sex: M DOB: 02/19/66  
 Race: [REDACTED] Ethnicity: [REDACTED]

**CVC Checklist (New insert)**

Order: [REDACTED] Date: 8/12/2014 8:28 AM  
 Provider: [REDACTED] Nurse: [REDACTED] Physician: [REDACTED] Registered Nurse: [REDACTED]

**Central Venous Catheter Checklist**

1. Indication for CVC?  **Yes**  **No**

2. Indication for CVC?  **Yes**  **No**

3. Indication for CVC?  **Yes**  **No**

4. Indication for CVC?  **Yes**  **No**

5. Indication for CVC?  **Yes**  **No**

6. Indication for CVC?  **Yes**  **No**

7. Indication for CVC?  **Yes**  **No**

8. Indication for CVC?  **Yes**  **No**

9. Indication for CVC?  **Yes**  **No**

10. Indication for CVC?  **Yes**  **No**

11. Indication for CVC?  **Yes**  **No**

12. Indication for CVC?  **Yes**  **No**

13. Indication for CVC?  **Yes**  **No**

14. Indication for CVC?  **Yes**  **No**

15. Indication for CVC?  **Yes**  **No**

16. Indication for CVC?  **Yes**  **No**

17. Indication for CVC?  **Yes**  **No**

18. Indication for CVC?  **Yes**  **No**

19. Indication for CVC?  **Yes**  **No**

20. Indication for CVC?  **Yes**  **No**

21. Indication for CVC?  **Yes**  **No**

22. Indication for CVC?  **Yes**  **No**

23. Indication for CVC?  **Yes**  **No**

24. Indication for CVC?  **Yes**  **No**

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83. Indication for CVC?  **Yes**  **No**

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87. Indication for CVC?  **Yes**  **No**

88. Indication for CVC?  **Yes**  **No**

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90. Indication for CVC?  **Yes**  **No**

91. Indication for CVC?  **Yes**  **No**

92. Indication for CVC?  **Yes**  **No**

93. Indication for CVC?  **Yes**  **No**

94. Indication for CVC?  **Yes**  **No**

95. Indication for CVC?  **Yes**  **No**

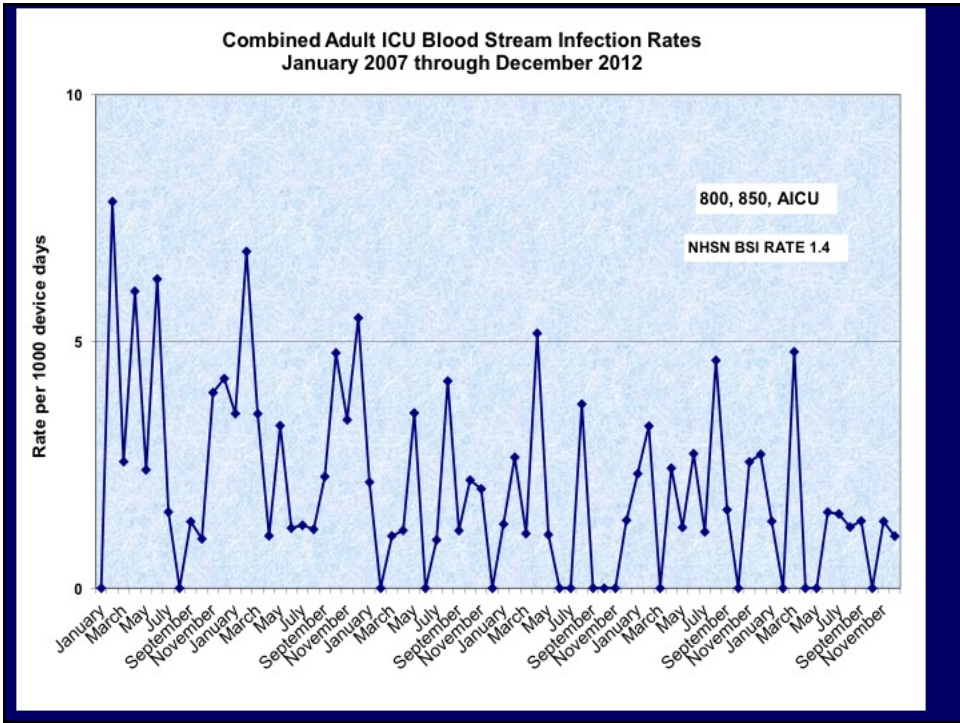
96. Indication for CVC?  **Yes**  **No**

97. Indication for CVC?  **Yes**  **No**

98. Indication for CVC?  **Yes**  **No**

99. Indication for CVC?  **Yes**  **No**

100. Indication for CVC?  **Yes**  **No**



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## Behavioral Change vs. Technology

"If you can choose between education and influencing human behavior or introduction of a gizmo, choose the gizmo everytime."

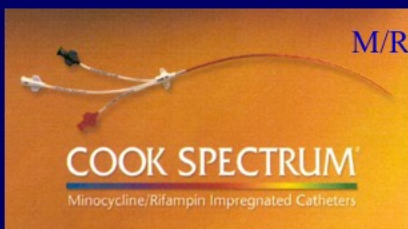
Bob Weinstein

15

## Commercially Available Antimicrobial Central Venous Catheters

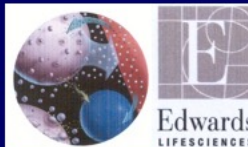


CHG/SS  
ARROWgard Blue PLUS<sup>®</sup>  
Central Venous Catheters



M/R

COOK SPECTRUM<sup>®</sup>  
Minocycline/Rifampin Impregnated Catheters



Silver/Platinum/  
Carbon (Silver  
Iontophoretic; Vantex)



Hydrocath Assure (BD)  
Benzalkonium  
AMC Thromboshield (Edwards)  
Benzalkonium Heparin



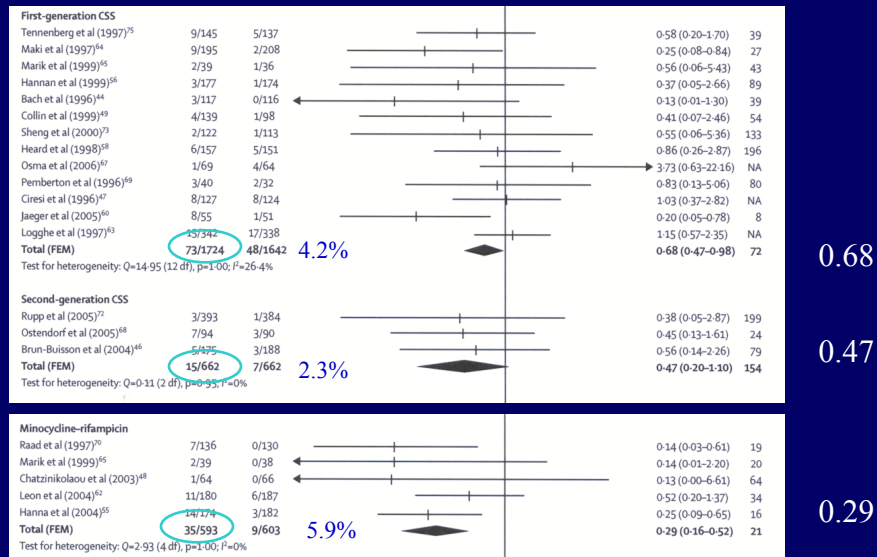
Multistar  
Miconazole/Rifampin  
(Vygon)

16



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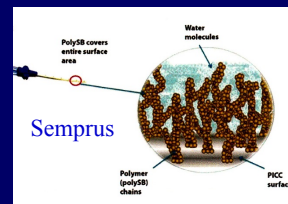
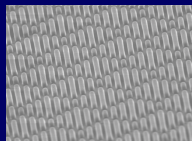
Do antimicrobial-coated catheters prevent BSI?



Casey AL, et al. Lancet ID, 2008

Novel Antimicrobial Coatings & CVCs

- 5-Fluorouracil
- Rifampin-Miconazole
- Silver Nanoparticles
- Chlorhexidine/Minocycline/Rifampin
- Gentian violet/Chlorhexidine
- Surface Pattern (Sharklet)
- Polymeric sulfobetaine (polySB)
- Heated CVCs



## Preservation of Dressing Integrity

- Dressing disruption is a major risk factor for catheter-related infections

Table 5. Association between dressing disruption and catheter colonization or infection (unadjusted and adjusted marginal Cox model)

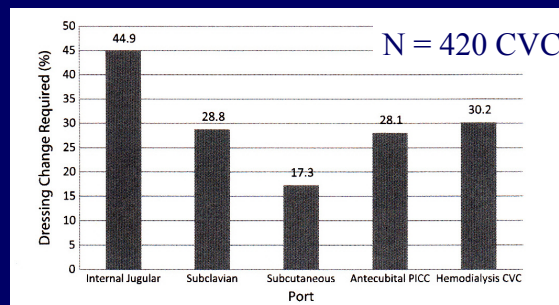
	Catheter Colonization $\geq 10^6$ colony-forming units/mL		Catheter-Related Bloodstream Infection		Major Catheter-Related Infection	
	HR (95% CI)	p	HR (95% CI)	p	HR (95% CI)	p
Unadjusted						
First	1.64 (1.13-2.39)	.01	3.15 (0.67-14.79)	.15	2.66 (0.50-14.26)	.25
Second disruption	1.52 (1.14-2.04)	.005	5.18 (1.85-14.48)	.002	4.31 (1.39-13.41)	.012
Final disruption	13.54 (10.17-18.04)	<.0001	14.90 (6.40-34.64)	<.0001	13.41 (5.17-34.75)	<.0001
Adjusted <sup>a</sup>						
First disruption	1.30 (0.90-1.87)	.16	2.65 (0.67-10.56)	.17	1.94 (0.50-7.48)	.33
Second disruption	1.16 (0.87-1.55)	.33	4.49 (1.71-11.79)	.002	3.26 (1.18-9.02)	.023
Final disruption <sup>a</sup>	13.99 (9.88-19.82)	<.0001	18.11 (5.66-57.88)	<.0001	12.51 (3.95-39.62)	<.0001

- The number of dressing disruptions was related to increased risk of colonization and bloodstream infection (P<0.001)

Timsit, et al. Crit Care Med 2012 19

### Hospital-wide assessment of compliance with central venous catheter dressing recommendations

Mark E. Rupp MD<sup>a,b,\*</sup>, Kyle Cassling BA<sup>a</sup>, Hayley Faber BS<sup>a</sup>, Elizabeth Lyden MS<sup>c</sup>, Kate Tyner RN<sup>b</sup>, Nedra Marion RN<sup>b</sup>, Trevor Van Schooneveld MD<sup>a,b</sup>



AJIC 2013

- On any given day approximately 31% of dressings were suboptimal and in need of change
- Reasons: 69% blood under dressing, 25.4% edge lift, 5.4% moisture under dressing

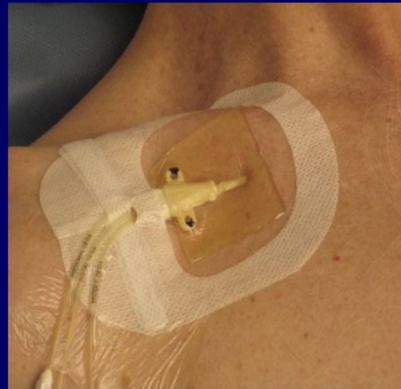
20

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## Chlorhexidine Impregnated CVC Dressings



“Biopatch”

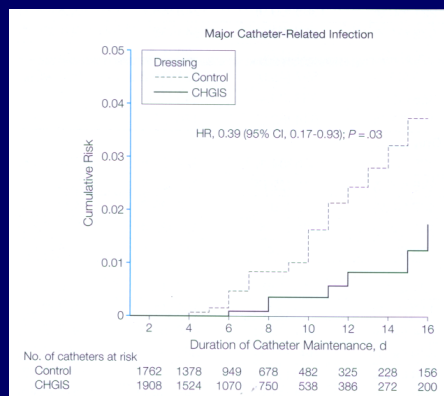


“Tegaderm CHG”

21

### Chlorhexidine-Impregnated Sponges and Less Frequent Dressing Changes for Prevention of Catheter-Related Infections in Critically Ill Adults A Randomized Controlled Trial

Timsit, et al. JAMA, 2009



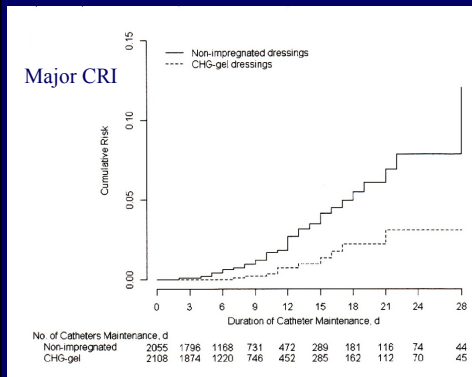
- CR-BSI: 1.4/1000 CVC d vs 0.4/1000 CVC d ( $P < 0.005$ )
- No significant difference between 3d and 7d dressing changes
- Full sterile barrier precautions used
- Site prep with 4% povidone-iodine soln & PI/Etoh

22

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**Randomized Controlled Trial of Chlorhexidine Dressing and Highly Adhesive Dressing for Preventing Catheter-related Infections in Critically Ill Adults**

Timsit, et al. Crit Care Med, 2013



- CR-BSI: 1.3/1000 CVC d vs 0.5/1000 CVC d (P= 0.02)
- Major-CRI: 2.1/1000 CVC d vs 0.7/1000 CVC d (P=0.0006)
- Highly adhesive dressings decreased dressing detachment rate (71.9% vs 64.3%; P<0.0001) but increased rate of colonization HR 1.65, 95%CI 1.21-2.26, P =0.0016)

23

**Scrub the Hub!**

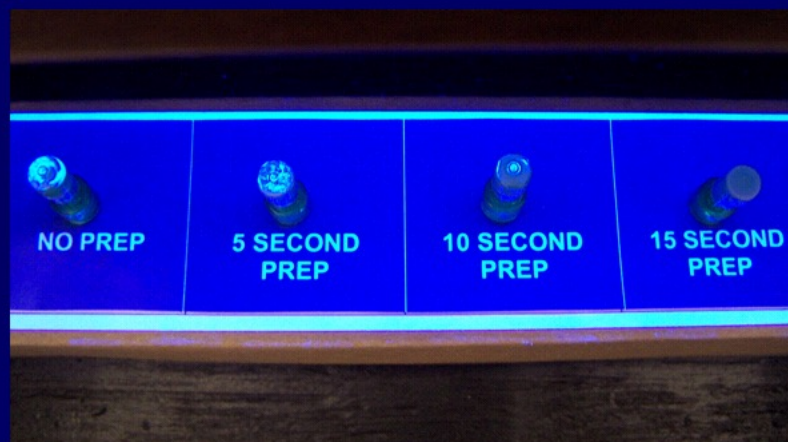


Figure: Courtesy Kristina Bryant, Kosair Children's Hosp

24



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**Not All Mechanical Valves are Created Equal**



**Needleless Connector Valves Linked to Increased CLA-BSI**



- Maragakis: ICHE, 2006
- Rupp: Clin Infect Dis, 2007
- Salgado: ICHE, 2007
- Field: ICHE, 2007
- Toscano: AJIC, 2009
- Jarvis: Clin Infect Dis, 2009

(Figure from Jarvis, Infect Control Today, 2010)

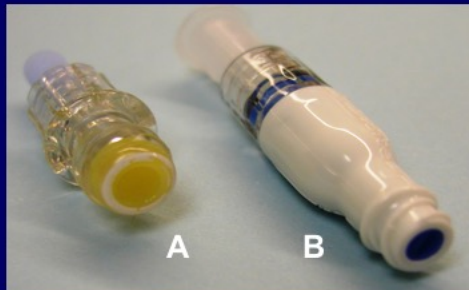
26

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## Outbreak of Bloodstream Infection Temporally Associated with the Use of an Intravascular Needleless Valve

Mark E. Rupp, Lee A. Sholtz, Dawn R. Jourdan, Nedra D. Marion, Laura K. Tyner, Paul D. Fey,  
Peter C. Iwen and James R. Anderson

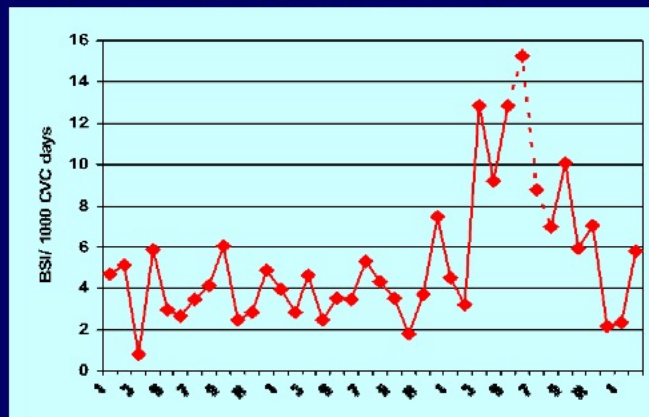
*Clin Infect Dis* 2007



A: Interlink IV Access  
System, Baxter  
B: SmartSite Plus,  
Alaris Medical  
Systems

27

## BSI Critical Care Units



8 critical care areas, 132 beds.  
Baseline: 38,250 CVC days, rate 3.87/1000 CVC d  
Outbreak: 10,340 CVC d, rate 10.64/1000 CVC d  
(2.82 fold increase) ( $p < 0.0001$ )  
Post removal: rate 5.59/1000 CVC d ( $p = 0.02$ )

28

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**Silver coated connector valves**

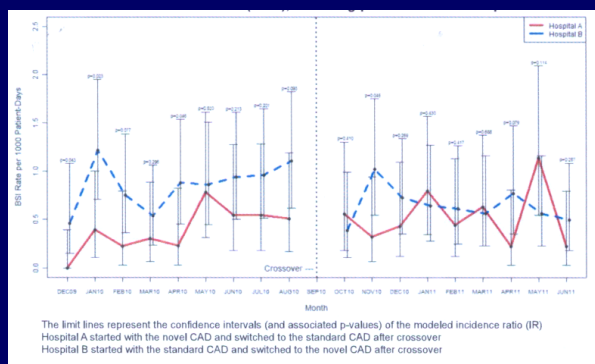


- 2 silver coated IV connector valves on the market. Very little clinical data re: effect on colonization of catheters or Bloodstream infection

29

**Comparison of a Novel Silver-Coated Needleless Connector and a Standard Needleless Connector for the Prevention Of CLA-BSI**

JT Jacob, et al. ICHE, 2015



CLA-BSI rate:  
 1.79/1000 CVC d vs  
 1.21/1000 CVC d  
 IR = 0.68 [95% CI  
 0.52-0.89] P = 0.005

30

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## Antiseptic Caps

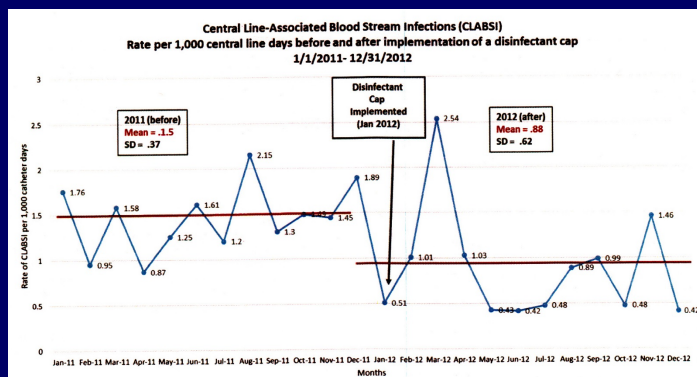


31

### Impact of universal disinfectant cap implementation on central line-associated bloodstream infections

Katreena Collette Merrill RN, PhD<sup>a,\*</sup>, Sharon Sumner RN, BS<sup>b</sup>,  
 Lorraine Linford RN, BS, CNSC<sup>c</sup>, Carrie Taylor RN, MS, CIC<sup>b</sup>,  
 Christopher Macintosh RN, BS<sup>d</sup>

AJIC, 2014



■ CLA-BSI decreased from 1.5/1000 CVC d to 0.88/1000 CVC d,  $p = 0.004$

32



# Technologic Innovations to Prevent Catheter-Related Bloodstream Infection

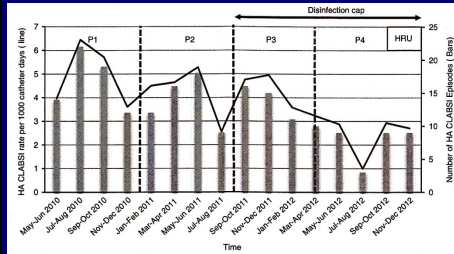
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#### Use of Disinfection Cap to Reduce Central-Line-Associated Bloodstream Infection and Blood Culture Contamination Among Hematology-Oncology Patients

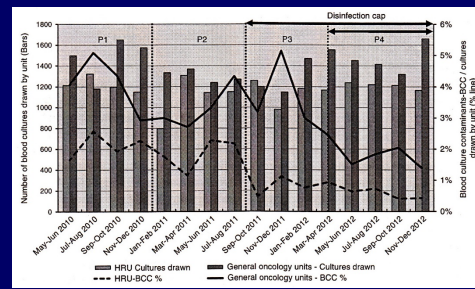
Mini Kamboj, MD;<sup>1,3,4</sup> Rachel Blair, MPH;<sup>1</sup> Natalie Bell, RN;<sup>1,2</sup> Crystal Son, MPH;<sup>1</sup> Yao-Ting Huang, MPH, PhD;<sup>3</sup> Mary Dowling, MSN, RN;<sup>2</sup> Allison Lipitz-Snyderman, PhD;<sup>2</sup> Janet Eagan, RN, MPH, CIC;<sup>1</sup> Kent Sepkowitz, MD<sup>1,3,4</sup>

ICHE, 2015



CLA-BSI in high-risk pts: Rate per 1000 CVC d: 4.93, 4.22, 4.47, 2.34 (P1-P4 respectively)

Blood culture contamination rate by CoNS



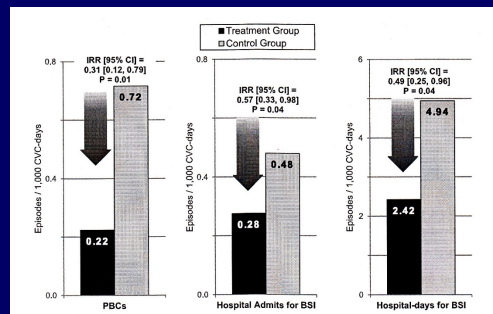
#### AJKD

Original Investigation

#### Dialysis Catheter-Related Bloodstream Infections: A Cluster-Randomized Trial of the ClearGuard HD Antimicrobial Barrier Cap

Jeffrey L. Hymes, MD;<sup>1</sup> Ann Mooney, MSN, RN, CNN;<sup>2</sup> Carly Van Zandt, MS;<sup>2</sup> Laune Lynch, PhD;<sup>3</sup> Robert Ziebol, BS;<sup>3</sup> and Douglas Killian, MBA<sup>3</sup>

- 12 month, prospective, cluster-randomized study in 40 HD units.
- 2470 pts; 350,000 CVC days
- 56% lower (+) Bld Cx rate (p=0.01)
- 40% decrease in hospital admissions for BSI (p=0.04); 31% less hospital days (p=NS)



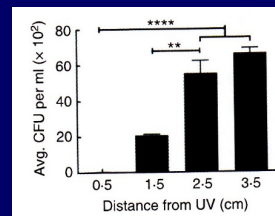
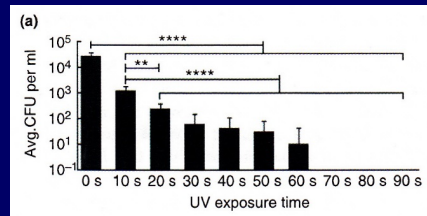
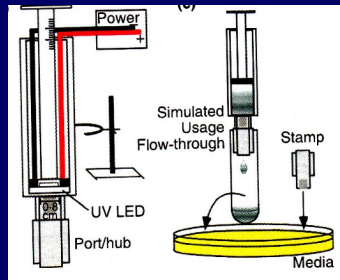
Results for last 6 months of the study

34

Technologic Innovations to Prevent Catheter-Related Bloodstream Infection  
 Prof. Mark E. Rupp, University of Nebraska  
 A Webber Training Teleclass

## UV light-emitting diode disinfection

Hutchens, et al. J Applied Micro, 2015



- 285 nm UV LED effectively disinfected needleless connectors with 60s exposure at 0.5 cm.

35

## Chlorhexidine Patient Bathing

Effectiveness of Chlorhexidine Bathing to Reduce Catheter-Associated Bloodstream Infections in Medical Intensive Care Unit Patients

Arch Intern Med 2007

Susan C. Bleasdale, MD; William E. Trick, MD; Ines M. Gonzalez, MD; Rosie D. Lyles, MD; Mary K. Hayden, MD; Robert A. Weinstein, MD

- Daily CHG baths in ICU patients decreased BSI from 16.8 to 6.4/1000 CVC d.

Effect of Daily Chlorhexidine Bathing on Hospital-Acquired Infection

NEJM 2013

Michael W. Climo, M.D., Deborah S. Yokoe, M.D., M.P.H., David K. Warren, M.D., Trish M. Perl, M.D., Maureen Bolon, M.D., Loreen A. Herwaldt, M.D., Robert A. Weinstein, M.D., Kent A. Sepkowitz, M.D., John A. Jernigan, M.D., Kakotan Sanogo, M.S., and Edward S. Wong, M.D.

- 28% decrease in bloodstream infections (P = 0.007)

Targeted versus Universal Decolonization to Prevent ICU Infection

NEJM 2013

Susan S. Huang, M.D., M.P.H., Edward Septimus, M.D., Ken Kleinman, Sc.D., Julia Moody, M.S., Jason Hickok, M.B.A., R.N., Taliser R. Avery, M.S., Julie Lankiewicz, M.P.H., Adrijana Gombosev, B.S., Leah Terpstra, B.A., Fallon Hartford, M.S., Mary K. Hayden, M.D., John A. Jernigan, M.D., Robert A. Weinstein, M.D., Victoria J. Fraser, M.D., Katherine Haffner-Reffer, B.S., Eric Cui, B.S., Rebecca E. Kaganov, B.A., Karen Lolans, B.S., Jonathan B. Perlin, M.D., Ph.D., and Richard Platt, M.D., for the CDC Prevention Epicenters Program and the AHRQ DECIDE Network and Healthcare-Associated Infections Program\*

- HR for BSI (intervention vs baseline): 0.99 vs 0.78 vs 0.56 (P = <0.001)

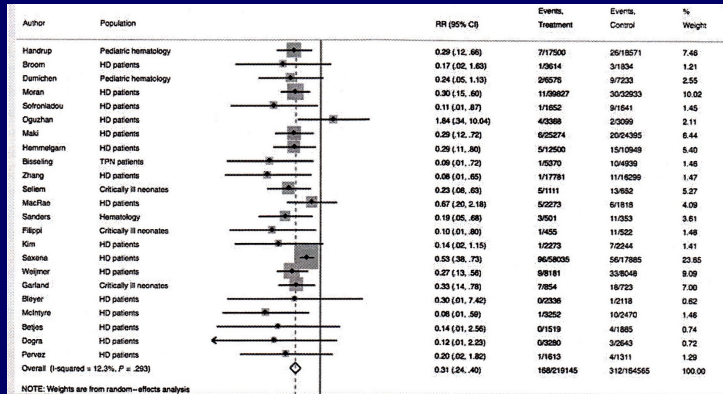
36

# Technologic Innovations to Prevent Catheter-Related Bloodstream Infection

## Prof. Mark E. Rupp, University of Nebraska

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## Anti-Infective Catheter Lock Solutions



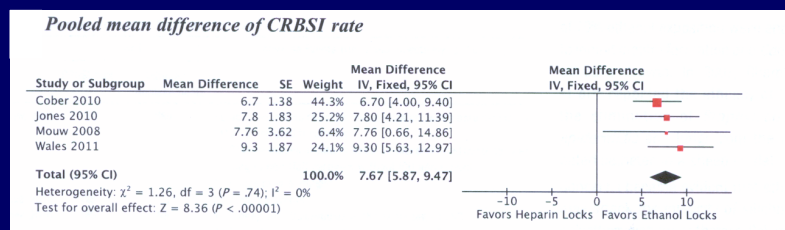
\* 23 studies, 2896 patients, 69% decrease in CLABSI  
 RR: 0.31 95CI (.24-.40)  
 \* 32% decrease in exit site infections  
 \* Mortality 16% decrease (NS)

Conclusion: Anti-Infective Lock solutions are useful in certain circumstances. Additional study to assess optimal solution (antibiotics, alcohol, taurolidine, trisodium citrate, EDTA, nitroglycerin, etc) and populations

Zacharioudakis, et al. CID, 2015 37

## Ethanol Locks to Prevent Catheter-Related Bloodstream Infections in Parenteral Nutrition: A Meta-Analysis

Oliveira C, et al. Pediatrics, 2012



- Risk ratio for CR-BSI: 0.19 (95% CI 0.12-0.32)
- Risk ratio for catheter replacement: 0.28 (95% CI 0.06-1.23)
- Rare Toxicity: Etoh assoc with clotting, dizziness, CVC mechanical compromise, protein ppt, etc.

38

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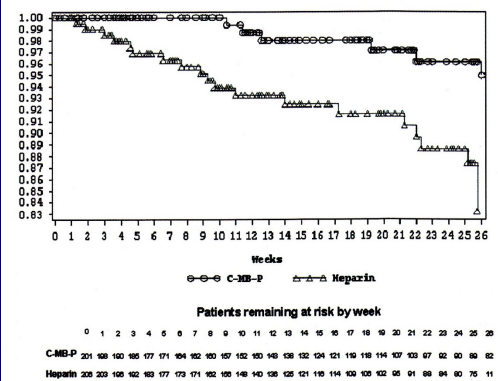
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A novel antimicrobial and antithrombotic lock solution for hemodialysis catheters: A multi-center, controlled, randomized trial\*

Dennis G. Maki, MD; Stephen R. Ash, MD; Roland K. Winger, BS, PE; Philip Lavin, PhD; for the AZEPTIC Trial Investigators

Crit Care Med 2011

The difference between the two groups is highly significant (P=0.0016 by log-rank test).



- Prospective, Randomized, Multi-Ctr trial
- 25 HD units, 407 pts, 50K CVC days
- 7% citrate, 0.15% methylene blue, 0.15% methylparaben, 0.015% propylparaben (C-MB-P)
- 0.82 vs 0.24 CRBSI/1000 CVC d; RR 0.29 (0.12-0.7, p = 0.005)

39

## Statewide Survey of Technologic CLA-BSI Prevention

- Nebraska statewide survey of hospitals (25 PPS/65 CAH)
- Response: 17 PPS (68%), 25 CAH (40%)

Technology	PPS (%)	CAH (%)
CHG Dressing	94	73
Antibiotic or Antiseptic CVC	47	31
Passive port disinfection	35	54
CHG bathing in ICU	65	8
CVC lock soln	17	12

Rupp et al. AJIC, 2016

40



## Scope of the Problem What about Peripheral IVs???

Yearly Use of Peripheral IVs



- Little systematic data regarding complications: infection, phlebitis, infiltration, extravasation

41

### The Risk of Bloodstream Infection in Adults With Different Intravascular Devices: A Systematic Review of 200 Published Prospective Studies

DENNIS G. MAKI, MD; DANIEL M. KLUGER, MD; AND CHRISTOPHER J. CRNICH, MD

Mayo Clin Proc, 2006

- Review of 110 studies, 10,910 catheters
- 0.1 BSI/100 devices; 0.5 (95% CI 0.2–0.7)/1000 device days
- 9 studies that required microbial concordance between catheter and blood culture: 0.6 BSI/1000 device d
- 1 per 1000 devices x 330 Million/2.25 attempts per successful IV start = 146,000 episodes of BSI

42

## Status of Vascular Access at the University of Nebraska Medical Center

- Series of point prevalence surveys in all units during summer 2015
- All units visited on at least 3 occasions
- 755 patients
  - 59 (8%) No vascular access
  - 414 (55%) peripheral IV only
  - 239 (32%) CVC only
  - 43 (6%) both CVC and PIV

Rupp ME. Unpublished Observations

43

## Peripheral IVs

Problems with securement



44

## Arterial Catheters & Dressings



45

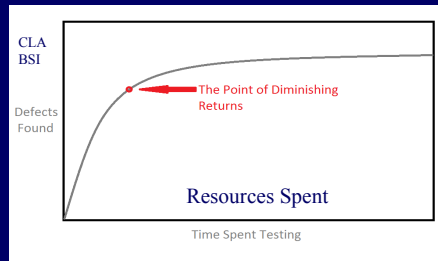
## Prevention of IV Catheter-Related Bloodstream Infection

- Practice Measures
  - Education and Training
  - Appropriate staffing
  - Insertion and Care Bundle
    - CHG skin prep
    - Sterile barrier precautions
    - Avoid femoral site
    - Scrub the hub
  - Removal of CVCs
- Technologic Innovations
  - Antimicrobial-Coated CVC
  - CHG impregnated dressings
  - CHG patient bathing
  - Catheter Flush/Lock soln
  - Antimicrobial-Coated Connectors
  - Antiseptic Caps

46

## Prevention of IV Catheter-Related Bloodstream Infection and "Getting to Zero"

- Cost Effectiveness
- Point of Diminishing Returns



47

## Questions & Comments





**Technologic Innovations to Prevent Catheter-Related Bloodstream Infection**  
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<a href="http://www.webbertraining.com/schedule1.php">www.webbertraining.com/schedule1.php</a>	
April 12, 2017	<p><i>(FREE ... WHO Teleclass - Europe)</i> <b><u>PRACTICAL STEPS TO DEVELOP AND SUSTAIN AN EFFECTIVE NATIONAL HAND HYGIENE PROGRAMME AND ITS IMPACT ON ANTIMICROBIAL RESISTANCE</u></b> Speaker: <b>Professor Lindsay Grayson</b>, World Health Organization, Melbourne, Australia</p> <p><i>Sponsored by the World Health Organization Infection Control Global Unit (<a href="http://www.who.int/gpsc/en">www.who.int/gpsc/en</a>)</i></p>
April 25, 2017	<p><i>(FREE European Teleclass ... Denver Russell Memorial Teleclass Lecture)</i> <b><u>DO'S AND DONT'S FOR HOSPITAL CLEANING</u></b> Speaker: <b>Dr. Stephanie Dancer</b>, Health Protection Scotland</p>
April 27, 2017	<p><b><u>COST ANALYSIS OF UNIVERSAL SCREENING VS. RISK FACTOR-BASED SCREENING FOR MRSA</u></b> Speaker: <b>Dr. Virginia Roth</b>, University of Ottawa</p>
May 5, 2017	<p><i>(FREE ... WHO Teleclass - Europe)</i> <b><u>SPECIAL LECTURE FOR 5 MAY</u></b> Speaker: <b>Prof. Didier Pittet</b>, World Health Organization, Geneva</p> <p><i>Sponsored by the World Health Organization Infection Control Global Unit (<a href="http://www.who.int/gpsc/en">www.who.int/gpsc/en</a>)</i></p>

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