Healthcare-Associated Infection Prevention Bundles – Preventing the Preventable
Dr. William Jarvis, Jason and Jarvis Inc.
A Webber Training Teleclass

Healthcare-Associated Infection Prevention Bundles: Preventing the Preventable

William R. Jarvis, M.D.
President, Jason and Jarvis Associates
www.jasonandjarvis.com

Hosted by Martin Kiernan
martin@webbertraining.com

Disclosure

Consultant to:

APIC, Bard, BD, J&J, Medscape, Teleflex, and CDC

Purpose

- Discuss the expanding horizon of infection prevention and control—Zero Tolerance.
- Provide an overview of selected healthcare-associated infections (HAIs), most of which are associated with medical devices.
- Illustrate how these HAIs cause morbidity and mortality.
- Illustrate how applying current infection prevention and control measures together with proper use of medical technology in bundles can markedly reduce these adverse patient events.

Urinary Tract Infections (UTIs)

Background

- Urinary tract infections (UTIs) often are the most common site of HAI.
- Most UTIs (80%) are associated with urinary catheterization.
- Approximately 25% of inpatients are catheterized.
- Each UTI:
  - Adds ~1 day of extra hospitalization
  - Costs ~$680.00

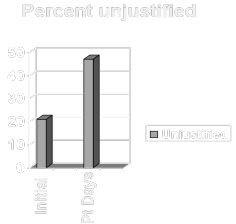
Overall, UTIs cause or contribute to ~7,450 deaths in U.S. hospitals each year.

UTI Prevention Rule: Make Sure the Patient Really Needs the Catheter

Appropriate indications

- Bladder outlet obstruction
- Incontinence and sacral wound
- Urine output monitored
- Patient's request (end-of-life)
- During or just after surgery

(Wong and Hooton - CDC 1983)



(Jain, Arch Int Med 1995)

Hosted by Martin Kiernan martin@webbertraining.com
www.webbertraining.com

Healthcare-Associated Infection Prevention Bundles – Preventing the Preventable
Dr. William Jarvis, Jason and Jarvis Inc.
A Webber Training Teleclass

Why are Catheters Used Inappropriately?

- Perhaps physicians "forget" that their patient has a urinary catheter.
- Study to determine the extent to which physicians are aware which of their inpatients have urinary catheters.
- Surveyed 56 medical teams at 4 sites; 256 providers completed the survey (response rate = 89%)

Saint S et al. Am J Med 2000

Urethral Catheters: Lost in Place?

Training Level	Proportion Unaware	95% CI
Medical Student	18%	8-32%
Intern	22%	13-34%
Resident	28%	20-38%
Attending	38%	28-45%

Saint S et al. Am J Med 2000

**** URINARY CATHETER REMINDER ****

Date: __ __ / __ __ / __ __

This patient has had an indwelling urethral catheter since __ __ / __ __ / __ __.

Please indicate below **EITHER** (1) that the catheter should be removed **OR** (2) that the catheter should be retained. If the catheter should be retained, please state **ALL** of the reasons that apply.

☐ Please discontinue indwelling urethral catheter; **OR**

☐ Please continue indwelling urethral catheter because patient requires indwelling catheterization for the following reasons (please check **all** that apply):

- ☐ Urinary retention
- ☐ Very close monitoring of urine output and patient unable to use urinal or bedpan
- ☐ Open wound in sacral or perineal area and patient has urinary incontinence
- ☐ Patient too ill or fatigued to use any other type of urinary collection strategy
- ☐ Patient had recent surgery
- ☐ Management of urinary incontinence on patient's request
- ☐ Other - please specify: _____

_____ _____

Physician's Signature Doctor Number

National Survey of UTI Prevention Practices

- **Study design**: Survey of non-federal hospitals with ICUs and >50 beds (N=600) and VA hospitals (N=119).
- **Results**: Response rate = 72%.

Practice	Per Cent Implementing
Monitor who is catheterized	44%
Monitor catheter duration	38%
Use antimicrobial/antiseptic catheters	30%
Use condom catheters	14%
Use catheter reminders	8%
Aim (ed vs. fed) use antiseptic catheters (30% vs. 14%; P=0.001)	

Saint S., et al., Clin Infect Dis. 2008;46:243-50.

Prevention of CA-UTI using Silver Alloy Catheters

- **Study design**: Meta-analysis of published literature.
- **Results**: Of 117 reports retrieved, **8 trials with a total of 2,355 patients satisfied inclusion criteria**. The summary OR for UTI was 0.59 (95% CI, 0.42 to 0.84) indicating a significant benefit in the patients receiving silver-coated catheters. A test of heterogeneity, indicated that the ORs varied significantly among studies: Silver alloy catheters (OR = 0.24; 95% CI, 0.11 to 0.52) were significantly more protective against bacteriuria than silver oxide.
- **Conclusion**: This meta-analysis found that silver alloy catheters are significantly more effective in preventing UTIs than are silver oxide catheters. Though silver alloy urinary catheters cost about $6 more than standard urinary catheters, they may be worth the extra cost.

Saint S. et al. Am J Med 1998;105:236-41.

The potential clinical and economic benefits of silver alloy urinary catheters in preventing UTIs

Study design: Decision model, performed from the healthcare payer's perspective, evaluated a simulated cohort of 1000 hospitalized patients on general medical, surgical, urologic, and ICU services requiring short-term urethral catheterization (2-10 days). Compared 2 catheterization strategies: silver alloy vs. standard (non-coated) urinary catheters. Outcomes included the incidence of symptomatic UTI, bacteremia and direct medical costs.

Conclusion: Using silver alloy catheters in hospitalized patients requiring short-term urinary catheterization reduces symptomatic UTI and bacteremia incidences, and likely produces cost savings compared with standard catheters.

Outcome	Non-coated Cath	Silver alloy cath	Decrease
SUTI	30	16	47%
BSI	4.5	2.5	44%
Cost	$20.87	$16.78	$4.09

Saint S., et el., Arch Intern Med 2001;161:1014-5.

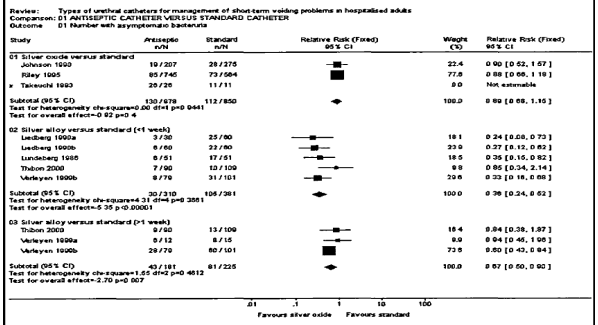
Hosted by Martin Kiernan martin@webbertraining.com
www.webbertraining.com

Healthcare-Associated Infection Prevention Bundles – Preventing the Preventable
Dr. William Jarvis, Jason and Jarvis Inc.
A Webber Training Teleclass

Silver Catheters: What Is The Evidence Base?

- To date, 11 comparative studies of and two meta-analyses of silver (the majority being the silver alloy urinary catheter) vs. non-coated Foley catheters have been conducted.
- In every comparative trial, the number of CA-UTIs has been decreased in the impregnated silver-coated catheter group compared to the non-coated catheter group.
- In some of these studies, the number of patients included has been small and thus a statistical significant decrease in CA-UTIs has not been documented (insufficient power). Nevertheless, in every study, a decrease in the rate of CA-UTI or CA-bacteruria has been documented.
- In both meta-analyses, combining a variety of studies to increase the power to detect a difference in efficacy of silver-coated catheters, the authors have concluded that the silver-alloy coated catheter is associated with a significant reduction in CA-UTI and CA-bacteruria.
- These data strongly support that silver alloy hydrogel impregnated urinary catheters can decrease the risk of CA-UTI or CA-bacteruria compared to non-coated catheters in patients who are to be catheterized for 3-7 days.

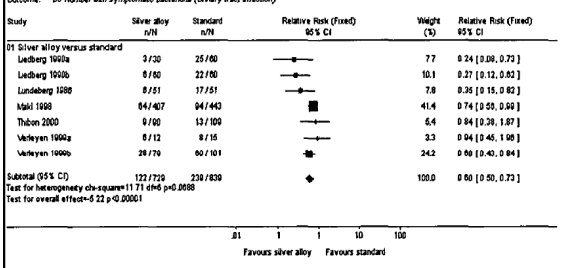
Meta-Analysis of CA-UTI Prevention-Silver Alloy Catheters



Brosnahan J. et al. Cochran Database Systematic Review 2004;(1):CD004013

Meta-Analysis of CA-UTI Prevention-Silver Alloy Catheters

01.03 Number with symptomatic bacteriuria (Urinary tract infection)



Brosnahan J. et al. Cochran Database Systematic Review 2004;(1):CD004013

CA-UTI Prevention Bundle

- Use urethral catheters only when necessary.
- Catheter inserters should be educated and competent.
- Use aseptic technique for catheter insertion and manipulation.
- Use a closed drainage system.
- Require a urinary catheter insertion indication/order and consider using an administrative urinary catheter "stop order" to limit inappropriate catheterization.
- Consider silver catheters in high-risk patients who require catheterization for 2-10 days.

PREVENTION POSSIBILITY: 20%-70%

Preventing Central Line-Associated Bloodstream Infections (CLA-BSIs)

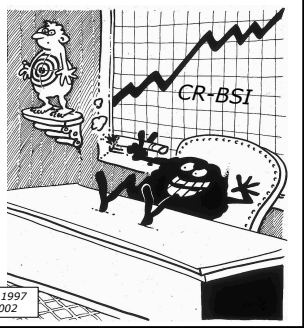
Impact of primary BSI

Crude mortality
10% to 40%

Attributable mortality
2% to 15%

Prolongation of hospitalization
5 to 20 days

Attributable cost
$34,000 to $56,000



Wey et al. Arch Intern Med 1988; Voss et al. Infection 1997
Pelz et al. J Int Care Med 2000; Blot et al. Am J Med 2002

Hosted by Martin Kiernan martin@webbertraining.com
www.webbertraining.com

Healthcare-Associated Infection Prevention Bundles – Preventing the Preventable
Dr. William Jarvis, Jason and Jarvis Inc.
A Webber Training Teleclass

Strategies to Prevent Central Line-Associated Bloodstream Infections (CLA-BSIs) in Acute Care Hospitals.

SUPPLEMENT ARTICLE: HICPAC/SHEA/APIC/IDSA PRACTICE RECOMMENDATION

Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals

PURPOSE

SECTION I: RATIONALE AND STATEMENTS OF CONCERN

Marschall J, et al. Infect Control Hosp Epidemiology 2008;29:S22-30.

SHEA Recommended Basic and Special Approaches for the Prevention of CLA-BSIs

Basic Practices		
Catheter Checklist	B- II	Catheter Insertion Bundle
Hand Hygiene	B- II	
Insertion site-Femoral	A- I	
Cart Kit	B- II	
Maximal Barrier Precautions	A- I	
Chlorhexidine (CHG) Skin Prep	A- I	
Special Approaches		
CHG Baths (ICU patients)	B- II	Catheter Maintenance Bundle
Impregnated Catheters	A- I	
BioPatch Disk	B- I	
Antimicrobial Locks	A- I	

Marschall J, et al. ICHE 2008;29:S22-30.

CDC HICPAC 2009 Draft IV Guideline

Guidelines for the Prevention of Intravascular Catheter-Related Infections

Prepared by

Naomi P. O'Grady, M.D.[1]
Mary Alexander, R.N.[2]
Lillian A. Burns, M.T., M.P.H., C.I.C.[3]
E. Patchen Dellinger, M.D.[4]
Jeffery Garland, M.D.[5]
Stephen O. Heard, M.D.[6]
Pamela A. Lipsett, M.D.[7]
Henry Masur, M.D.[1]
Leonard A. Mermel, D.O., Sc.M.[8]
Michele L. Pearson, M.D.[9]
Issam I. Raad, M.D.[10]
Adrienne Randolph, M.D., M.Sc.[11]
Mark E. Rupp, M.D.[12]
Sanjay Saint, M.D., M.P.H.[13]

1National Institutes of Health, Bethesda, Maryland
2Infusion Nurses Society, Norwood, Massachusetts
3Greenich Hospital, Greenwich, Connecticut
4University of Washington, Seattle, Washington
5Wheaton Franciscan Healthcare-St. Joseph, Milwaukee, Wisconsin
6 University of Massachusetts Medical School, Worcester, Massachusetts
7Johns Hopkins University School of Medicine, Baltimore, Maryland
8Warren Alpert Medical School of Brown University and Rhode Island Hospital, Providence, Rhode Island
9 Centers for Disease Control and Prevention, Atlanta, Georgia
10MD Anderson Cancer Center, Houston, Texas
11The Children's Hospital, Boston, Massachusetts
12University of Nebraska Medical Center, Omaha, Nebraska
13Ann Arbor VA Medical Center and University of Michigan, Ann Arbor, Michigan

CDC/HICPAC Draft Guidelines for the Prevention of Intravascular Catheter-Related Infections-2009

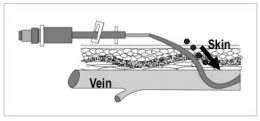
Major areas of emphasis include:

- 1) Educating and training healthcare personnel who insert and maintain catheters;
- 2) Using maximal sterile barrier precautions during CVC;
- 3) Using a ≥0.5% chlorhexidine (CHG)-based preparation for skin antisepsis;
- 4) Avoiding routine replacement of central venous catheters;
- 5) Using antiseptic/antibiotic impregnated short-term central venous catheters;
- 6) Using CHG-impregnated sponge dressings; and
- 6) Emphasize performance improvement by implementing bundled strategies, documenting and reporting rates of compliance rates with all components of the bundle as benchmarks for quality assurance and performance improvement.

http://www.cdc.gov/ncpdcid/pdf/Draft_BSI_guideline_v15_2FR.pdf

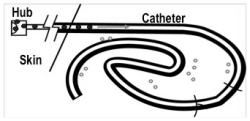
Microbial Source of CLA-BSI

EXTRALUMINAL COLONIZATION



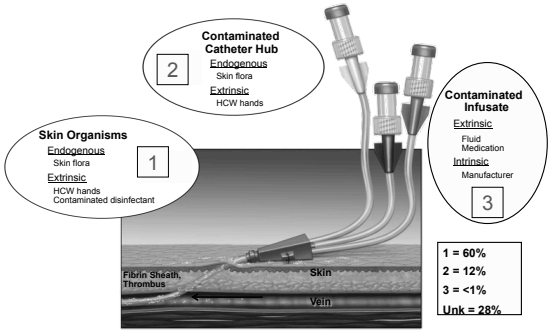
Extraluminal biofilm is the major source of CLA-BSI within the first week of catheterization in short-term catheters. Extraluminal biofilm is the major source of tunnel infections in long-term catheters.

INTRALUMINAL COLONIZATION



Intraluminal biofilm is the major source of CLA-BSI after 1 week in both short- and long-term catheters.

1. Ryder, MA. Catheter-Related Infections: It's All About Biofilm. *Topics in Advanced Practice Nursing eJournal.* 2005;5(3) ©2005 Medscape. Posted 08/18/2005 . http://www.medscape.com/viewarticle/508109



1. Safdar N, Maki DG. The pathogenesis of catheter-related bloodstream infection with noncuffed short-term central venous catheters. *Int Care Med.* 2004;30:62-67.

Hosted by Martin Kiernan martin@webbertraining.com
www.webbertraining.com

Evidence-Based Measures to Decrease the Risk of Infection During Insertion of the Intravascular Catheter: INSERTION BUNDLE

- Insert a catheter only when clinically essential.
- Use a catheter insertion check-list.
- Use a catheter insertion cart or kit.
- Hand hygiene.
- Chlorhexidine-alcohol skin antisepsis.
- Maximum barrier precautions.
- Select the correct catheter and insert in the correct location (Vessel Preservation; avoid femoral).

Basic Practices: Use a Checklist[1]

SHEA/IDSA Practice Recommendations

Basic Practices

Before Insertion

Action	Recommendation	Full Description	Implemented?
Educate healthcare personnel	A-II	Educate healthcare personnel involved in the insertion, care, and maintenance of CVCs about CLABSI prevention.	Yes__ No__

At Insertion

Action	Recommendation	Full Description	Implemented?
Use a checklist	B-II	Use a catheter checklist to ensure adherence to infection prevention practices at the time of CVC insertion.	Yes__ No__
Perform hand hygiene	B-II	Perform hand hygiene before catheter insertion or manipulation.	Yes__ No__
Avoid using femoral vein	A-I	Avoid using the femoral vein for central venous access in adult patients.	Yes__ No__
Use catheter cart or kit	B-II	Use an all-inclusive catheter cart or kit.	Yes__ No__
Use maximal barrier precautions	A-I	Use maximal sterile barrier precautions during CVC insertion.	Yes__ No__
Use CHG skin prep	A-I	Use a chlorhexidine-based antiseptic for skin preparation in patients older than 2 months of age.	Yes__ No__

After Insertion

Action	Recommendation	Full Description	Implemented?
Disinfect hubs, connectors, ports	B-II	Disinfect catheter hubs, needle-less connectors, and injection ports before accessing the catheter.	Yes__ No__
Remove nonessential catheters	A-II	Remove nonessential catheters.	Yes__ No__
Change transparent dressing every 5-7 days	A-I	For non-tunneled CVCs in adults and adolescents, change transparent dressings and perform site care with a chlorhexidine-based antiseptic every 5-7 days or more frequently if the dressing is soiled, loose, or damp; change gauze dressings every 2 days or more frequently if the dressing is soiled, loose, or damp.	Yes__ No__
Replace administration sets every 96 hours	A-II	Replace administration sets not used for blood products or lipids at intervals not longer than 96 hours.	Yes__ No__
Perform CLABSI surveillance	B-II	Perform surveillance for CLABSI	Yes__ No__
Use antimicrobial ointments on dialysis catheters	A-I	Use antimicrobial ointments for hemodialysis catheter insertion sites.	Yes__ No__

If CLABSI Rates Are Higher Than Institutional Goals

Special approaches for the prevention of CLABSI

Action	Recommendation	Full Description	Implemented?
Bathe ICU patient with CHG	B-II	Bathe ICU patients older than 2 months of age with a chlorhexidine preparation on a daily basis.	Yes__ No__
Use coated catheters	A-I	Use antiseptic- or antimicrobial-impregnated CVCs for adult patients.	Yes__ No__
Use CHG sponge dressing*	B-I	Use chlorhexidine-containing sponge dressings for CVCs in patients older than 2 months of age.	Yes__ No__
Use antimicrobial locks	A-I	Use antimicrobial locks for CVCs	Yes__ No__

* BioPatch® Protective Disk with CHG

1.Marschall J. et al., Strategies to prevent Central Line Associated Bloodstream Infections in Acute Care Hospitals. Infect Control Hospital Epidemiol 2008;29:S22-30

Developing a Physician Champion—Prevention Should Be The Focus of Clinicians, Not Just Infection Control Personnel.

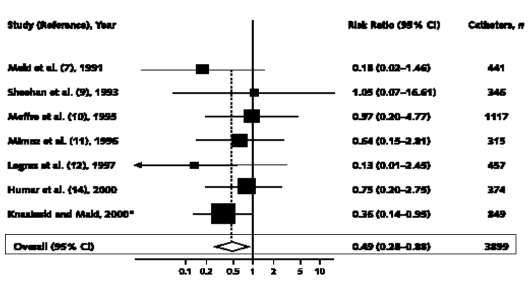
CENTRAL LINE INSERTION BUNDLE COMPLIANCE
By Doctors

DOCTOR	# of CL Insertions	Full Barrier Precautions	Hand Hygiene	Femoral Lines	Used Chloroprep	Used Betadine
A	21	16 (76%)	17 (81%)	6 (29%)	19 (91%)	6 (29%)
B	13	13 (100%)	13 (100%)	2 (15%)	9 (69%)	6 (46%)
C	8	3 (38%)	7 (88%)	0	7 (88%)	1 (22%)
D	6	6 (100%)	5 (83%)	0	4 (67%)	4 (67%)
E	4	4 (100%)	3 (75%)	0	3 (75%)	2 (50%)
F	3	2 (67%)	3 (100%)	0	1 (33%)	2 (67%)

Basic Practices: Use Catheter Cart or Kit [1]

1. Marschall J. et al., Strategies to prevent Central Line Associated Bloodstream Infections in Acute Care Hospitals. ICHE 2008;29:S22-30.

Chlorhexidine Compared with Povidone-Iodine Solution for Vascular Catheter–Site Care: A Meta-Analysis



Ann Intern Med. 2002;136:792-801.

Basic Practices: Use CHG Skin Prep[1]

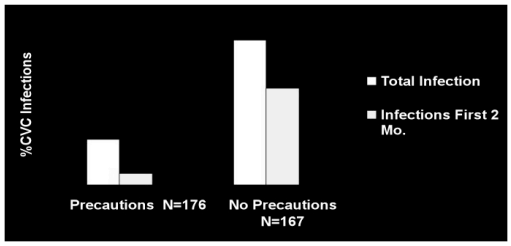
- Apply 30 seconds with friction
- Allow 30 seconds to dry

1. Marschall J. et al., Strategies to prevent Central Line Associated Bloodstream Infections in Acute Care Hospitals. Infect Control Hospital Epidemiol 2008;29:S22-30

30

Effect of Maximal Barrier Precautions during Insertion on CVC Infections

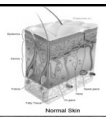
Raad et al, Infect Control Hosp Epidemiol, 1994



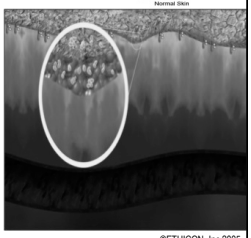
Evidence-Based Measures to Decrease the Risk of Infection During **Maintenance** of the Intravascular Catheter

- Minimize catheter site skin bioburden.
- Device selection
- Aseptic manipulation of catheter connectors-- Scrub the hub!
- Antibiotic/antiseptic lock
- Antimicrobial/antiseptic-impregnated-catheters

Microbiology of the Skin



- 80% of the resident bacteria exist within the first 5 layers of the stratum corneum
- 20% are found in biofilms within hair follicles and sebaceous glands
- Complete recolonization of the epidermis can occur within 18 hours of antiseptic application

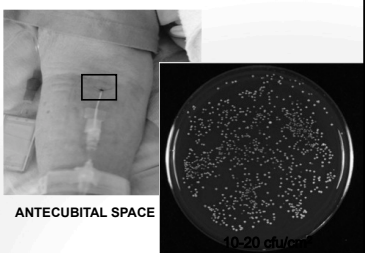


©ETHICON, Inc 2005

Ryder, MA. Catheter-Related Infections: It's All About Biofilm. *Topics in Advanced Practice Nursing eJournal.* 2005;5(3)
Posted 08/18/2005 . http://www.medscape.com/viewarticle/508109

Skin Microbial Density Catheter Entry Site Matters

- Skin surface microbial density varies at different body sites and between genders
- Normal microbial colony counts at the antecubital space are 10-20 CFU per cm^2

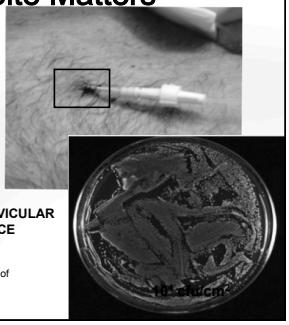


1. Ryder M. Evidence-based practice in the management of vascular access devices for home parenteral nutrition therapy.*JPEN.* 2006;30(1):S82-93.
Photo contributed by Marcia Ryder PhD MS RN

35

Skin Microbial Density Catheter Entry Site Matters

- Skin surface microbial density is highest on the skin at the femoral, jugular, and subclavian sites
- Normal microbial colony counts at the subclavicular space are 10^3-10^4 CFU per cm^2



1. Ryder M. Evidence-based practice in the management of vascular access devices for home parenteral nutrition therapy.*JPEN.* 2006;30(1):S82-93
Photo contributed by Marcia Ryder, PhD, MS, RN

36

Timsit's Randomized Controlled Trial:

Chlorhexidine-Impregnated Sponges and Less Frequent Dressing Changes for Prevention of Catheter-Related Infections in Critically Ill Adults

A Randomized Controlled Trial

Jean-François Timsit, MD, PhD
Carole Schwebel, MD, PhD
Lila Bouadma, MD
Arnaud Geffroy, MD
Maïté Garrouste-Orgeas, MD
Sebastian Pease, MD
Marie-Christine Herault, MD
Hakim Haouache, MD
Silvia Calvino-Gunther, RN
Brieuc Gestin, PhD
Laurence Armand-Lefevre, PharmD
Véronique Leflon, PharmD
Chantal Chaplain, PharmD
Adel Benali, MD
Adrien Francais, MSc
Christophe Adrie, MD, PhD
Jean-Ralph Zahar, MD
Marie Thuong, MD
Xavier Arrault, PharmD
Jacques Croize, PharmD
Jean-Christophe Lucet, MD, PhD
for the Dressing Study Group

Context Use of a chlorhexidine gluconate–impregnated sponge (CHGIS) in intravascular catheter dressings may reduce catheter-related infections (CRIs). Changing catheter dressings every 3 days may be more frequent than necessary.

Objective To assess superiority of CHGIS dressings regarding the rate of major CRIs (clinical sepsis with or without bloodstream infection) and noninferiority (less than 3% colonization-rate increase) of 7-day vs 3-day dressing changes.

Design, Setting, and Patients Assessor-blind, 2×2 factorial, randomized controlled trial conducted from December 2006 through June 2008 and recruiting patients from 7 intensive care units in 3 university and 2 general hospitals in France. Patients were adults (>18 years) expected to require an arterial catheter, central-vein catheter, or both inserted for 48 hours or longer.

Interventions Use of CHGIS vs standard dressings (controls). Scheduled change of unsoiled adherent dressings every 3 vs every 7 days, with immediate change of any soiled or leaking dressings.

Main Outcome Measures Major CRIs for comparison of CHGIS vs control dressings; colonization rate for comparison of 3- vs 7-day dressing changes.

Results Of 2095 eligible patients, 1636 (3778 catheters, 28 931 catheter-days) could be evaluated. The median duration of catheter insertion was 6 (interquartile range [IQR], 4-10) days. There was no interaction between the interventions. Use of CHGIS dressings decreased the rates of major CRIs (10/1953 [0.5%], 0.6 per 1000 catheter-days vs 19/1825 [1.1%], 1.4 per 1000 catheter-days; hazard ratio [HR], 0.39 [95% confidence interval (CI), 0.17-0.93]; P=.03) and catheter-related bloodstream infections (6/1953 catheters, 0.40 per 1000 catheter-days vs 17/1825 catheters, 1.3 per 1000 catheter-days; HR, 0.24 [95% CI, 0.09-0.65]). Use of CHGIS dressings was not associated with greater resistance of bacteria in skin samples at catheter removal. Severe CHGIS-associated contact dermatitis occurred in 8 patients (5.3 per 1000 catheters). Use of CHGIS dressings prevented 1 major CRI per 117 catheters. Catheter colonization rates were 142 of 1657 catheters (7.8%) in the 3-day group (10.4 per 1000 catheter-days) and 168 of 1828 catheters (8.6%) in the 7-day group (11.0 per 1000 catheter-days), a mean absolute difference of 0.8% (95% CI, −1.78% to 2.15%) (HR, 0.99; 95% CI, 0.77-1.28), indicating noninferiority of 7-day changes. The median number of dressing changes per catheter was 4 (IQR, 3-6) in the 3-day group and 3 (IQR, 2-5) in the 7-day group (P<.001).

Conclusions Use of CHGIS dressings with intravascular catheters in the intensive care unit reduced risk of infection even when background infection rates were low. Reducing the frequency of changing unsoiled adherent dressings from every 3 days to every 7 days modestly reduces the total number of dressing changes and appears safe.

Trial Registration clinicaltrials.gov Identifier: NCT00417235

JAMA. 2009;301(12):1231-1241 www.jama.com

PATIENTS ADMITTED TO THE INtensive care unit (ICU) usually require insertion of central venous catheters (CVCs). In Europe, the incidence density of CVC-related bloodstream infections ranges from 1 to 3.1 per 1000 patient-days.[1] In the United States, 15 million CVC-days are estimated to occur each year in ICU patients, as well as approximately 80 000

See also p 1285 and Patient Page.

Author Affiliations and the Members of the Dressing Study Group are listed at the end of this article.
Corresponding Author: Jean-François Timsit, MD, PhD, INSERM U823; University Joseph Fourier, Albert Bonniot Institute, 38076, Grenoble CEDEX, France (jftimsit@chu-grenoble.fr).
Caring for the Critically Ill Patient Section Editor: Derek C. Angus, MD, MPH, Contributing Editor, JAMA (angusdc@upmc.edu).

©2009 American Medical Association. All rights reserved. (Reprinted) JAMA, March 25, 2009—Vol 301, No. 12 1231

Results

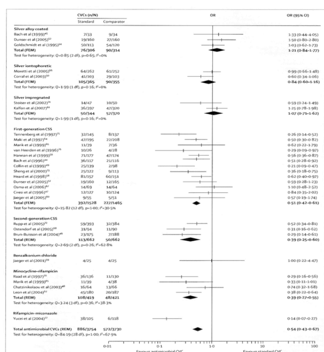
Table 3. Hazard Ratios in the Intention-To-Treat and Per-Protocol Analyses

	Dressing						Dressing Change Interval					
	Incidence, No./1000 Catheter-Days		ITT Analysis		Per-Protocol Analysis[a]		Incidence, No./1000 Catheter-Days		ITT Analysis		Per-Protocol Analysis[a]	
Variable	Control (n = 1825)	CHGIS (n = 1953)	HR (95% CI)	P Value	HR (95% CI)	P Value	3 d (n = 1815)	7 d (n = 1963)	HR (95% CI)	P Value	HR (95% CI)	P Value
Catheter colonization >10 CFUs/plate	15.8	6.3	0.36 (0.28-0.46)	<.001	0.35 (0.27-0.45)	<.001	10.4	11.0	0.99 (0.77-1.28)	.95	0.99 (0.77-1.28)	.95
Catheter-related bloodstream infection	1.3	0.4	0.24 (0.09-0.65)	.005	0.24 (0.09-0.63)	.004	0.7	0.9	1.26 (0.47-3.34)	.65	1.28 (0.48-3.40)	.62
Major catheter-related infection	1.4	0.6	0.39 (0.16-0.93)	.03	0.38 (0.16-0.92)	.03	0.9	1.1	1.16 (0.50-2.69)	.74	1.18 (0.51-2.73)	.70

Abbreviations: CFU, colony-forming unit; CHGIS, chlorhexidine gluconate–impregnated sponge; CI, confidence interval; HR, hazard ratio; ITT, intention-to-treat.
[a] Analysis adjusted on imbalanced parameters (ie, presence of ≥1 chronic disease for comparison of control and CHGIS groups).

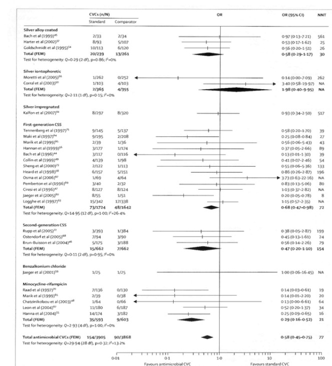
Timsit et al. *JAMA*. 2009;301:1231-1241.

Comparison of Antimicrobial vs. Standard CVC Colonization Rates



Casey A et al. Lancet 2008;8:763-776.

Comparison of Antimicrobial vs. Standard CVC CR-BSI Rates



Casey A et al. Lancet 2008;8:763-776.

Increased Bloodstream Infection (BSI) Rates Associated with Needleless Connectors

Author	SS Used	SS-BSI Rate*	MV Used	MV-BSI Rate*	P-value
Salgado[1]	Interlink	1.79	Smartsite	5.41	<0.001
Rupp[2]	Interlink	3.87	SmartSite Plus	10.43	<0.001
Fields[3]	Interlink	2.60	Clave/CLC2000	5.80	0.031
Jarvis[4]	Interlink/ needle	6.15	Ultrasite, Clearlink, Smartsite	9.49	<0.001
Toscano[5]	Needles	0.70	Clave	2.10	0.01

SS=Split Septum; MV=Mechanical Valve; Rate=BSI/1000 catheter days.
References: 1. ICHE 2007;35:648-8; 2. CID 2007;44:1408-14; 3. ICHE 2007;28:610-13; 4. CID 2009 (Dec 15); 5. AJIC 2009;37:327

Current SHEA or CDC Recommendations Regarding Neeleless Connectors

SHEA: Do not routinely use positive-pressure needleless connectors with mechanical valves before a thorough assessment of risks, benefits, and education regarding proper use (B-II).
Marschall J. et al., Infect Control Hosp Epidemiology 2008;29:S22-30.

CDC: When needleless systems are used, a split septum valve may be preferred over a mechanical valve due to increased risk of infection with some mechanical valves. Category II
http://wwwn.cdc.gov/publiccomments/comments/guidelines-for-the-prevention-of-intravascular-catheter-related-infections.aspx

Keystone Project

- **Study design**: Intervention cohort study in 108 Michigan Intensive care units (ICUs) over 18 months. Comparison of CVC-BSI rates before, during, and after intervention.
- **Results**: 103 ICUs. 1,981 months of ICU data and 375,757 catheter-days.

Median CVC-BSI Rates per 1,000 CVC-days

Baseline	3 Months	12-15 Months	16-18 Months	IRR
2.7	2	1.62	1.4	0.34

Conclusion: An evidence-based intervention resulted in a large and sustainable decrease (up to 66%) in CVC-BSI rates that was maintained for 18 months.

Pronovost P. et al NEJM 2006;355:2725-32

TABLE 2. Estimated annual number of central line–associated blood stream infections (CLABSIs), by health-care setting and year — United States, 2001, 2008, and 2009

Health-care setting	Year	No. of infections (upper and lower bound of sensitivity analysis)
Intensive-care units	2001	43,000 (27,000–67,000)
	2009	18,000 (12,000–28,000)
Inpatient wards	2009	23,000 (15,000–37,000)
Outpatient hemodialysis*	2008	37,000 (23,000–57,000)

*Case definitions approximate current definition of CLABSI according to the National Healthcare Safety Network.

CDC MMWR 2011:60:1-6.

Central Line-Associated Bloodstream Infections, United States, 2001, 2008, and 2009

- In 2009, an estimated 25,000 fewer CLA-BSIs.
- 58% reduction from 2001 to 2009.
- 6,000 lives saved.
- $414 million in potential excess healthcare costs in 2009.
- An estimated $1.8 billion cumulative excess healthcare costs since 2001.

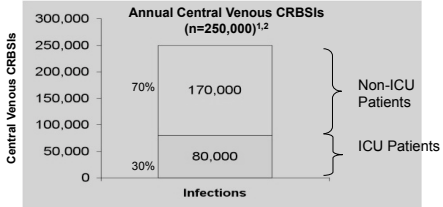
CDC MMWR 2011:60:1-6.

CLA-BSI Prevention Insertion and Maintenance Bundles

Insertion Bundle
Catheter checklist
Hand hygiene
Insertion site-Femoral
Cart kit
Maximal barrier precautions
Chlorhexidine (CHG) skin prep

Maintenance Bundle
Select the safest needleless connector
Scrub the hub (≥15 secs with CHG-alcohol or alcohol)
Antiseptic or antimicrobial-impregnated catheters
CHG-impregnated sponge (BioPatch)
Antimicrobial or antiseptic locks
CHG Baths (ICU patients) **Prevention Possibility: 70%-100%**

The Majority of CR-BSIs Occur Outside of the ICU



A significant opportunity exists to reduce CR-BSI incidence in non-ICU settings.

1. Mermel L, Farr B, Sheretz R. Guidelines for the management of intravascular catheter-related infections. *Clinical Infectious Diseases.* 2001;32:1249-1272.
2. Centers for Disease Control and Prevention. Guidelines for the prevention of intravascular catheter-related infections. *Morbidity Mortality Weekly Report.* 2002;51:1-29.

[1]Mermel, 2000 and CDC 2002

Ventilator-associated Pneumonia

Ventilator-associated Pneumonia (VAP) Background

- VAP is the most common healthcare-associated infection in critical care patients.
- Risk factors for VAP include age, chronic obstructive lung disease, trauma, gastric aspiration, duration ventilation, elevated gastric pH, etc.
- 10-20% of patients ventilated for >48 hrs will develop VAP.

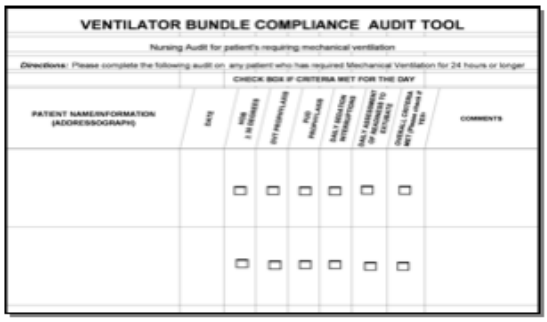
Impact of VAP

- Attributable extra ICU stay of 22 days.
- ICU patients developing VAP are twice as likely to die.
- Crude mortality rate 60%.
- Attributable mortality 27%-43%.
- Attributable cost $15,986

Safdar N et al CCM 2005;33:2184; Patel PJ et al SRCCM 2002;23:415-425; Hugonnet S et al ICHE 2004;25:1090-1096; Warren DK et al CCM 2003;31:1582-1583.

Ventilator Management Changes—The Bundle.

- Chlorhexadine on the unit
- Oral care product
- Sedation reduction vs. Sedation vacation
- Using deep vein thrombosis (DVT) and peptic ulcer disease (PUD) prophylaxis prevent risk for vent patients
- Using ventilator weaning protocol
- Continuous aspiration of subglottic secretions

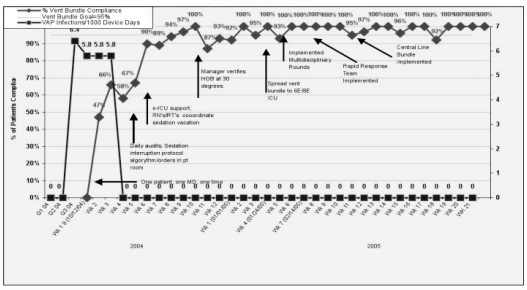


Oral Decontamination with CHG

- **Koeman M et al.** (AJRCCM 2006;173:1348-55): Randomized double blind placebo controlled trial (RCT): placebo vs. 2% CHG vs. 2% CHG/2% Colistin (CHG/COL) in patients ventilated for >48 hours. Results: The risk of VAP was decreased 65% with CHG (p=0.012) and decreased 55% for CHG/COL (p=0.003).
- **Tantipong H et al.** (ICHE 2008;29:131-6): RCT (2%CHG vs. Saline, 4 times per day). Results: VAP rate: CHG: 7 vs. Saline 21; p=.04.
- **Sona CS et al.** (JICM 2009;24:54-62): Pre- vs. Post-intervention observational study. Intervention: cleansing teeth with sodium monoflurophosphate paste and brush, rinse with water, then application of 0.12% CHG solution twice daily. Results: Pre-intervention: VAP rate per 1,000 vent-days: 5.2 vs. 2.4 in intervention period; p=0.04.

Data Feedback – New Way

Vent Bundle Compliance and VAP Infection Rates, Hospital A



Hosted by Martin Kiernan martin@webbertraining.com
www.webbertraining.com

Decreasing Ventilator-Associated Pneumonia in a Trauma Intensive Care Unit

- Study design: Prospective intervention. Pre-intervention VAP rates at the CDC's NNIS 90th percentile (22.3-32.7 VAP per 1000 ventilator-days). VAP bundle implemented with audits and weekly feedback to clinicians.
- Results: From November 2002 to June 2003, VAP stayed between 0 and 12.8 VAP per ventilator-days. The average cost of VAP was $50,000 per episode.

Cocanour CS et al. J Trauma 2006;61:122-9.

The Importance of Nursing Education

- **Study design**: European intensive care unit (ICU) nurses were tested on knowledge of evidence-based guidelines for preventing VAP. A validated multiple-choice questionnaire was distributed in 22 European countries from October 2006--March 2007.
- **Results**: There were 3329 questionnaires (response rate 69.1%). The average score was 45.1%.
  - 55% knew that the oral route is recommended for intubation;
  - 35% knew that ventilator circuits should be changed for each new patient;
  - 38% knew that heat and moisture exchangers were the recommended humidifier type, but only 21% knew that these should be changed once weekly;
  - 46% recommended closed suctioning systems; 18% knew that these must be changed for each new patient;
  - 51% recognized that subglottic secretion drainage reduced VAP;
  - 57% recognized that kinetic beds reduce VAP incidence; and
  - 85% knew that semi-recumbent positioning prevents VAP.

Labeau S. et al. J Hosp Infect. 2008;70:180-5.

Prevention of VAP

- Standard infection control practices (e.g., hand hygiene).
- Minimizing duration/intensity of sedation and device exposure.
- Positioning patient in semi-recumbent position (40 degree).
- Appropriate use of enteral feeding, antibiotics and selected medical devices.
- Use of sterile water for irrigation.
- Closed suction system.
- Mouth care—chlorhexidine mouth/teeth cleaning.

Safdar N et al CCM 2005;33:2184; Patel PJ et al SRCCM 2002;23:415-425; Hugonnet S et al ICHE 2004;25:1090-1096.

Prevention Possibility: 50%-100%

Surgical Site Infections

Major Surgery Antimicrobial Prophylaxis: Baseline Results from the National Surgical Infection Prevention Project (SIPP)

- Design: National retrospective cohort study (medical record review).
- Study population:
  - 2,965 hospitals
  - systematic random sample
  - 34,133 Medicare inpatients undergoing cardiac, vascular, colorectal, hip/knee and hysterectomy procedures from January 1-November 30, 2001.

Bratzler D et al. Arch Surg 2005;140:1066-7

SIPP Quality Indicators

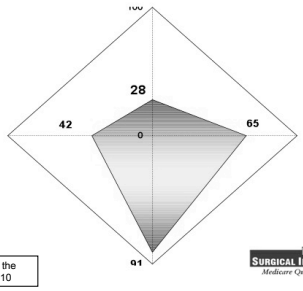
- Antimicrobial Prophylaxis (AP)
  - Correct AP
  - AP given at the correct time (within 1 hour)*
  - AP stopped correctly

***Because of the longer required infusion times, vancomycin or fluoroquinolones, when indicated for beta-lactam allergy, may be started within 2 hours before the incision.**

National Surgical Infection Prevention
Medicare Quality Improvement Project

Surgical Infection Prevention Project (SIPP):

National Performance – 4th Quarter, 2003



*Denominator for the aggregate is 5,210

National Surgical Infection Prevention
Medicare Quality Improvement Project

Preventing Surgical Site Infections in Nasal Carriers of *Staphylococcus aureus*

- **Background:** Nasal carriers of *Staphylococcus aureus* are at increased risk for healthcare–associated infections with this organism. Decolonization of nasal and extra-nasal sites on hospital admission may reduce this risk.
- **Methods:** A randomized, double-blind, placebo-controlled, multi-center trial at 3 university and 2 general hospitals in Holland from October 2005 through June 2007 assessing whether rapid identification of *S. aureus* nasal carriers by real-time polymerase-chain-reaction (PCR) assay, followed by treatment with mupirocin nasal ointment and chlorhexidine soap, reduces the risk of hospital-associated *S. aureus* infection.

Bode LGM et al., N Engl J Med 2010;362:9-17.

Preventing Surgical Site Infections in Nasal Carriers of *Staphylococcus aureus*

- **Results:** Of 6771 patients screened on admission, 1270 nasal swabs from 1251 (18.5%) patients were *S. aureus*-positive.
  - 917 patients enrolled in the intention-to-treat analysis, of whom 808 (88.1%) underwent a surgical procedure.
  - All the *S. aureus* strains identified on PCR assay were susceptible to methicillin and mupirocin.
  - The rate of *S. aureus* infection was 3.4% (17/504 patients) in the mupirocin–chlorhexidine group vs.7.7% (32/413 patients) in the placebo group (RR, 0.42; 95% CI, 0.23 to 0.75).
  - The effect of mupirocin–chlorhexidine treatment was most pronounced for deep surgical-site infections (RR, 0.21; 95% CI, 0.07 to 0.62).
  - The time to the onset of nosocomial infection was shorter in the placebo group than in the mupirocin–chlorhexidine group (P = 0.005).

Bode LGM et al., N Engl J Med 2010;362:9-17.

Preventing Surgical Site Infections in Nasal Carriers of *Staphylococcus aureus*

Table 2. Relative Risk of Hospital-Acquired *Staphylococcus aureus* Infection and Characteristics of Infections (Intention-to-Treat Analysis).

Variable	Mupirocin–Chlorhexidine (N = 504)	Placebo (N = 413)	Relative Risk (95% CI)*
	no. (%)		
S. aureus infection	17 (3.4)	32 (7.7)	0.42 (0.23–0.75)
Source of infection†			
Endogenous	12 (2.4)	25 (6.1)	0.39 (0.20–0.77)
Exogenous	4 (0.8)	6 (1.5)	0.55 (0.16–1.92)
Unknown	1 (0.2)	1 (0.2)	
Localization of infection			
Deep surgical site‡	4 (0.9)	16 (4.4)	0.21 (0.07–0.62)
Superficial surgical site‡	7 (1.6)	13 (3.5)	0.45 (0.18–1.11)
Lower respiratory tract	2 (0.4)	2 (0.5)	0.82 (0.12–5.78)
Urinary tract	1 (0.2)	0	
Bacteremia	1 (0.2)	1 (0.2)	
Soft tissue	2 (0.4)	0	

* Relative risks are for *S. aureus* infection in the mupirocin–chlorhexidine group.
† The source of the *S. aureus* infections was determined by comparing nasal strains with strains isolated from the infection site by pulsed-field gel electrophoresis.
‡ Data are for surgical patients only: 441 in the mupirocin–chlorhexidine group and 367 in the placebo group.

Bode LGM et al., N Engl J Med 2010;362:9-17.

SSI Prevention Bundle

- Correct antimicrobial prophylaxis (current drug, given at correct time and discontinued at the correct time).
- No hair shaving
- Glucose control (peri-operative)
- Normothermia (except cardiac surgery)
- Pre-op screening for *S. aureus* (or MRSA) and if positive, decolonize (mupiricin/CHG baths/vanco prophylaxis)

Prevention Possibility: 40-60%

Methicillin-resistant *Staphylococcus aureus* (MRSA) Infection Prevention

Healthcare-Associated Infection Prevention Bundles – Preventing the Preventable
Dr. William Jarvis, Jason and Jarvis Inc.
A Webber Training Teleclass

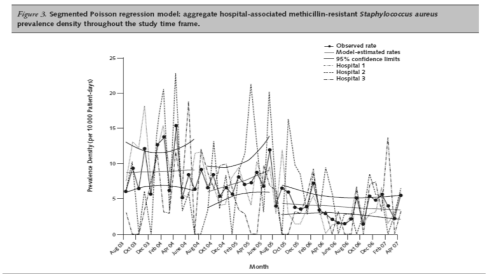
True Universal MRSA Screening Dramatically Reduces MRSA Infection Rates

Study Design: Observational, prospective interventional study with **universal screening** using MRSA-PCR on all admissions to three hospitals (total: 850 beds and 40,000 admissions per year) in Evanston, Ill.

- **Compared**: Passive surveillance (clinical detection-12m); Targeted surveillance cultures (clinical culture + high risk = ICU-12m); or Universal patient screening--21m.
- August 2005 to September 1, 2006.
- **Intervention**: Nasal screening. MRSA+ contact isolation, topical decolonization (mupricin).
- Poisson and segmented regression models used to compare prevalence density. Robicsek et al. Annals Intern Med 2008;148:409-418

~ 70% reduction in MRSA-HAIs

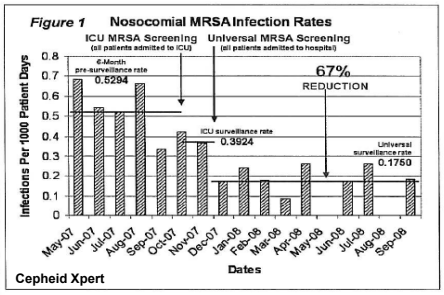
Robicsek et al., Annals Intern Med 2008



On average: 16 hour Turn Around Time (TAT) from collection to result

MRSA-HAIs: 67% reduction

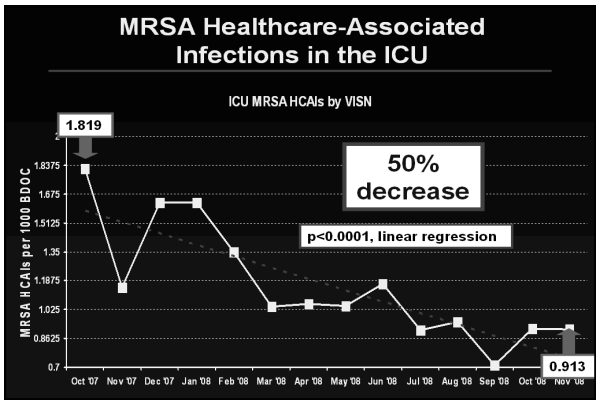
PARADA et al., SHEA 2009, abstract 205

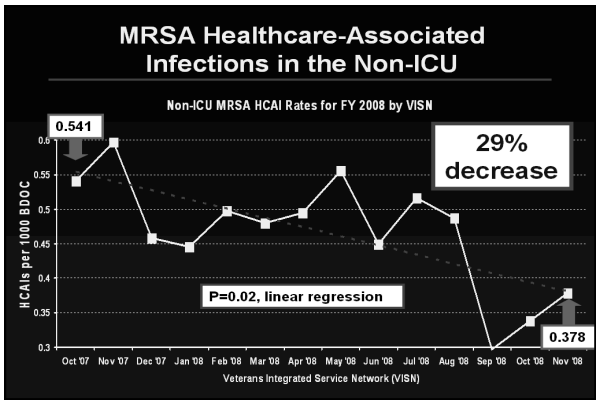


On average: 8 -12 hour TAT from collection to result

The Veteran's Hospital Administration (VHA) MRSA Control Program

- **The national initiative focuses on implementing the VHA MRSA Bundle which consists of four essential elements (ADI):**
- **Active Surveillance Testing [AST](Admission/Transfer/Discharge Swabbing)**
- **Hand Hygiene**
- **Contact Precautions**
- **Cultural Transformation (Leadership and Staff Engagement)**
- **Consistent use of the VHA MRSA Bundle had been shown to markedly reduce MRSA-related infections in the pilot facilities.**
- **Phase I: The VHA system began doing universal patient testing in 2006 at its approximately 150 hospitals in ICU patients.**
- **Phase II of the initiative began in March 2007 and was a national roll-out including all VHA medical facilities with all patients (ICU and non-ICU).**
- **MRSA prevalence on admission ranged from 5% to 22% (clinical culture 1-1.5%; AST 9%-12%).**





Hosted by Martin Kiernan martin@webbertraining.com
www.webbertraining.com

MRSA Prevention Bundle

- Screen high risk or all patients.
- Pre-operative screening of surgical implant patients; if MRSA-positive decolonize with intranasal mupiricin, CHG baths, and use vancomycin prophylaxis.
- Barrier precautions for MRSA positive patients.
- Hand hygiene
- Environmental cleaning

Prevention Possibility: ICU-50-75%; Hospital-wide: >25%; Surgical implant patients: nearly 100%

Conclusions

- Zero tolerance—trying to prevent all preventable healthcare-associated infections (HAIs)--is the new horizon for infection control.
- Benchmarking should be avoided with others or national databases. Compare your rate to your own rate (or zero) over time.
- Most HAI prevention interventions are low technology and not expensive.
- Implementation of evidence-based prevention interventions, including bundles with the latest technology, should be a high priority for all infection control personnel.
- We should all be striving to achieve a Zero Rate of preventable HAIs.

Thank you!