Chlorhexidine baths and central line associated bloodstream infections (CLABSIs)

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Disclosures

- Speaker for Sage Inc.

Outline

- Broad overview of chlorhexidine
- Bio-burden of patient's surfaces (fecal patina)
- Sources of CLABSIs
- Chlorhexidine baths for prevention of CLABSIs
  - Studies using impregnated cloths
  - Studies using liquid chlorhexidine
- Conclusions

Chlorhexidine gluconate

- Long acting topical antiseptic
- In use since 1954
- Water soluble
- Remains active for hours after application

Milstone AM, et al. Clin Infec Dis 2008; 46:274-81
Lio PA, Kaye E. Inf Dis Clin North Ame;

Chlorhexidine gluconate

- Binds to negatively charged bacterial cell wall, causing osmotic changes and finally destroying the organism
- Activity against:
  - Gram positive bacteria
  - Gram negative bacteria
  - Yeast
- No sporicidal activity

Milstone AM, et al. Clin Infec Dis 2008; 46:274-81
Lio PA, Kaye E. Inf Dis Clin North Ame;

Chlorhexidine gluconate

- For skin antisepsis:
  - Reduction of bacterial skin burden
  - Reduction of CLABSIs
  - Reduction of acquisition of certain resistant organisms
- Pre-operative bathing and scrub
- Impregnated devices (vascular catheters and dressings)
- Oropharynx antisepsis

Milstone AM, et al. Clin Infec Dis 2008; 46:274-81

Main uses of chlorhexidine baths

- To decrease CLABSIs
- To decrease acquisition of multidrug resistant organisms
- To decrease surgical site infections

Fecal patina

- Stool organisms do not remain in the stool but rather contaminate patient's skin and the environment
- This is known as fecal patina or fecal veneer

RA Weinstein. Crit Care Med 2012; 4: 1333-4
Beezhold DW, et al. Clin Infect Dis 1997; 24:704-6

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY SEPTEMBER 2012, VOL. 33, NO. 9

ORIGINAL ARTICLE

Relationship between Chlorhexidine Gluconate Skin Concentration and Microbial Density on the Skin of Critically Ill Patients Bathed Daily with Chlorhexidine Gluconate

Kyle J. Popovich, MD;[1,2] Rosie Lyles, MD;[2] Robert Hayes, BA;[1] Bala Hota, MD, MPH;[1,2] William Trick, MD;[2] Robert A. Weinstein, MD;[1,2] Mary K. Hayden, MD[1]

Popovich KJ, et al. Infect Control Hosp Epidemiol 2012; 33: 889-896

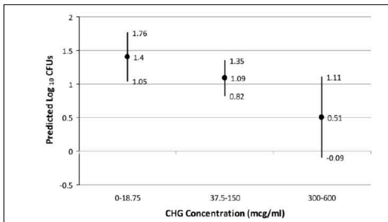
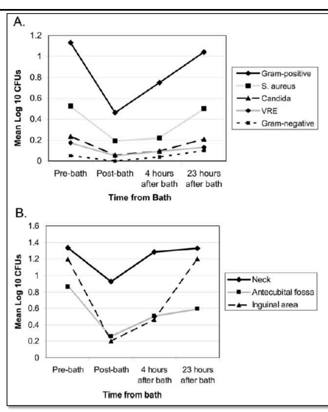


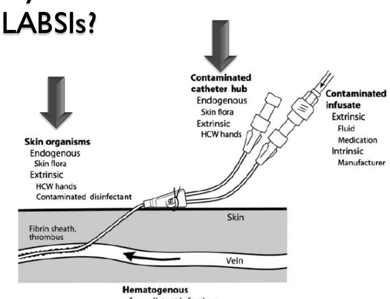
FIGURE 1. Correlation between chlorhexidine gluconate (CHG) concentration and predicted gram-positive colony counts (with 95% confidence limits) adjusted for patient and patient body site. CFU, colony-forming unit.

Popovich KJ, et al. Infect Control Hosp Epidemiol 2012; 33: 889-896



Popovich KJ, et al. Infect Control Hosp Epidemiol 2012; 33: 889-896

Why would chlorhexidine decrease CLABSIs?



Safdar N, Maki DG. Intensive Care Med 2004; 30:62-67

LETS REVIEW THE LITERATURE

We will divide the studies based on the preparation used:

- Chlorhexidine impregnated cloths
- Chlorhexidine solution

STUDIES USING CHLORHEXIDINE IMPREGNATED CLOTHS

ORIGINAL INVESTIGATION

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

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

(REPRINTED) ARCH INTERN MED/VOL 167 (NO. 19), OCT 22, 2007 WWW.ARCHINTERNMED.COM
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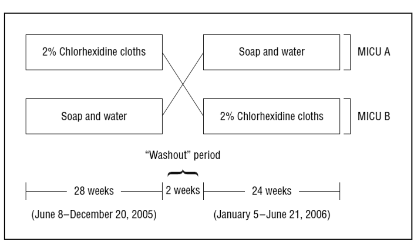


Bleasdale SC, et al Arch Int Med 2007; 19: 2073-2077

Table 2. Comparison of Incidence of Infection by Method of Bathing Patients and Infection Category

	Bathing Method					
	Soap and Water		2% CHG			
Infection Category	Events	Rate[a]	Events	Rate[a]	Difference (95% CI)	*P* Value
Primary BSI	22	10.4	9	4.1	6.3 (1.2 to 11)	.01
Contaminant	9	4.3	4	1.8	2.4 (–0.9 to 5.7)	.16
Clinical sepsis	9	4.2	16	7.2	–3.0 (–7.5 to 1.5)	.20
Urinary tract infection	17	8.0	13	5.9	2.1 (–2.8 to 7.1)	.41
Ventilator-associated pneumonia	15	6.8	18	7.8	–1.1 (–6.3 to 4.1)	.69
Secondary BSI	5	2.4	5	2.3	0 (–2.8 to 3.0)	.95
Clostridium difficile diarrhea	20	9.4	21	9.5	0 (–5.9 to 5.7)	.98

Abbreviations: BSI, bloodstream infection; CHG, chlorhexidine gluconate; CI, confidence interval.
[a] Rates are expressed per 1000 patient-days. There were 2119 patient-days in the soap and water arm and 2210 patient-days in the CHG arm.

Bleasdale SC, et al Arch Int Med 2007; 19: 2073-2077

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY OCTOBER 2009, VOL. 30, NO. 10

ORIGINAL ARTICLE

Effectiveness of Routine Patient Cleansing with Chlorhexidine Gluconate for Infection Prevention in the Medical Intensive Care Unit

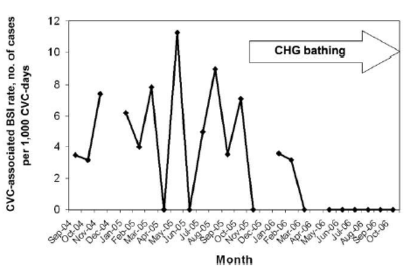
Kyle J. Popovich, MD; Bala Hota, MD, MPH; Robert Hayes, BA; Robert A. Weinstein, MD; Mary K. Hayden, MD

TABLE 1. Comparison of Nosocomial Infection Rates in the Medical Intensive Care Unit during 2 Study Periods

	Soap-and-water period		Chlorhexidine gluconate period		
Type of infection or culture	No. of cases	Rate	No. of cases	Rate	P
CVC-associated BSI	19	5.31[a]	2	0.69[a]	.006
Contaminated blood culture	47	6.99	23	4.1	.04
Secondary BSI	3	0.45	4	0.71	.48
CDI	6	0.89	2	0.36	.26
VAP	13	5.55[b]	10	6.33[b]	.76
UTI	20	2.97	13	2.32	.78
Clinical culture with drug-resistant bacteria					
Imi-res *A. baumannii*	7	1.04	2	0.36	.18
MRSA	11	1.63	8	1.43	.77
VRE	6	0.89	3	0.53	.47
Total	24	3.57	13	2.32	.21

NOTE. Rates are expressed as cases per 1,000 patient-days, unless otherwise indicated. There were 6,728 patient-days; 3,579 CVC-days; and 2,343 ventilator-days during the soap-and-water period. There were 5,610 patient-days; 2,880 CVC-days; and 1,581 ventilator-days during the chlorhexidine gluconate period. CDI, *Clostridium difficile* infection; Imi-res *A. baumannii*, imipenem-resistant *Acinetobacter baumannii;* MRSA, methicillin-resistant *Staphylococcus aureus;* UTI, urinary tract infection; VAP, Ventilator-associated pneumonia; VRE, vancomycin-resistant enterococci.
[a] Cases per 1,000 CVC-days.
[b] Cases per 1,000 ventilator-days.

Popovich KJ, et al. Infect Control Hosp Epidemiol 2009; 30:959-963



Popovich KJ, et al. Infect Control Hosp Epidemiol 2009; 30:959-963

Intensive Care Med (2010) 36:854–858
DOI 10.1007/s00134-010-1783-y

BRIEF REPORT

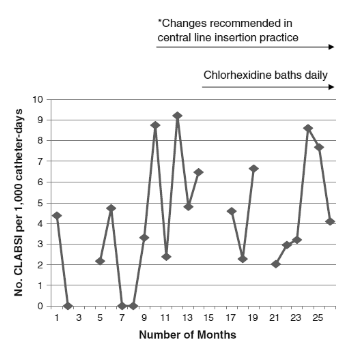
Kyle J. Popovich
Bala Hota
Robert Hayes
Robert A. Weinstein
Mary K. Hayden

Daily skin cleansing with chlorhexidine did not reduce the rate of central-line associated bloodstream infection in a surgical intensive care unit

Table 1 Comparison of nosocomial infection rates and rates of isolation of selected antibiotic-resistant bacteria in clinical cultures in the surgical intensive care unit during soap-and-water bathing and chlorhexidine gluconate bathing periods

Infection category	Soap-and-water bathing		Chlorhexidine bathing		*p* value
	Events	Rate	Events	Rate	
CLABSI	19	3.81[a]	17	4.6[a]	0.57
Contaminated blood culture	44	5.97	14	2.41	0.003
Secondary BSI	11	1.49	4	0.69	0.26
Clostridium difficile-associated diarrhea	4	0.54	3	0.52	0.95
Ventilator-associated pneumonia	48	13.64[b]	24	9.79[b]	0.18
Urinary tract Infection	19	2.58	20	3.45	0.20
Clinical cultures with resistant bacteria					
Total	13	1.76	12	2.07	0.69
Imipenem-resistant *A. baumannii*	5	0.68	1	0.17	0.21
Methicillin-resistant *S. aureus*	5	0.68	6	1.03	0.49
Vancomycin-resistant *Enterococcus spp.*	3	0.41	5	0.86	0.30

Popovich KJ, et al. Intensive Care Med 2010; 36:854-858



Popovich KJ, et al. Intensive Care Med 2010; 36:854-858

Effectiveness of stepwise interventions targeted to decrease central catheter-associated bloodstream infections*

L. Silvia Munoz-Price, MD; Cameron Dezfulian, MD; Mary Wyckoff, PhD, ACNP, BC, CCNS, FNP-BC, NNP, FAANP; Joshua D. Lenchus, DO; Mara Rosalsky, RN; David J. Birnbach, MD, MPH; Kristopher L. Arheart, EdD

Objective: Determine the impact of three stepwise interventions on the rate of central catheter-associated bloodstream infections.

Design: Quasi-experimental study.

Setting: Three surgical intensive care units (general surgery, trauma, and neurosurgery) at a 1500-bed county teaching hospital in the Miami metro area.

Patients: All consecutive central catheter-associated bloodstream infection cases as determined by the Infection Control Department.

Interventions: Three interventions aimed at catheter maintenance were implemented at different times in the units: chlorhexidine "scrub-the-hub," chlorhexidine daily baths, and daily nursing rounds aimed at assuring compliance with an intensive care unit goal-oriented checklist.

Measurements and Main Results: The primary outcome was the monthly intensive care unit rate of central catheter-associated bloodstream infections (infections per 1000 central catheter days). Over 33 months of follow-up (July 2008 to March 2011), we found decreased rates in each of the three intensive care units evaluated during the interventions, especially after implementation of chlorhexidine daily baths. Rates in unit A decreased from a rate of 8.6 to 0.5, unit B from 6.9 to 1.6, and unit C from 7.8 to 0.6. Secondary bloodstream infection rates remained unchanged throughout the observation period in units A and B; however, unit C had a decrease in its rates over time.

Conclusions: We report the progressive reduction of central catheter-associated bloodstream infection rates after the stepwise implementation of chlorhexidine "scrub-the-hub" and daily baths in surgical intensive care units, suggesting effectiveness of these interventions. (Crit Care Med 2012; 40:1464–1469)

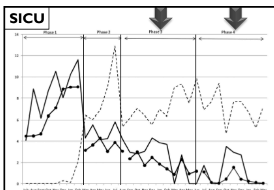
Key Words: central catheter-associated bloodstream infections; chlorhexidine; intensive care units

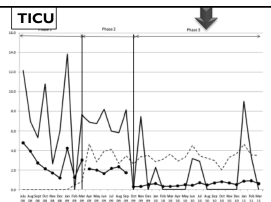
Munoz-Price LS, et al. Crit Care Med. 2012 May;40(5):1464-9.

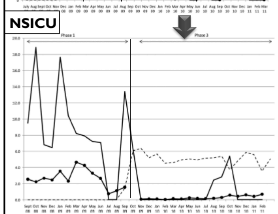
Phases

- Phase 1: Baseline
- Phase 2: Scrub-the hub (chlorhexidine gluconate for 15 sec)
- Phase 3: 2% chlorhexidine daily body baths AND scrub-the-hub
- Phase 4: Daily ICU nursing rounds AND 2% CHG AND scrub-the-hub

Munoz-Price LS, et al. Crit Care Med. 2012 May;40(5):1464-9.







LOOK ONLY AT THE SOLID LINE
(MONTHLY CLABSI RATES)

Munoz-Price LS, et al. Crit Care Med. 2012 May;40(5):1464-9.

ORIGINAL ARTICLE

Effect of Chlorhexidine Whole-Body Bathing on Hospital-Acquired Infections Among Trauma Patients

Heather L. Evans, MD, MS; Timothy H. Dellit, MD; Jeannie Chan, PharmD, MS; Avery B. Nathens, MD, PhD; Ronald V. Maier, MD; Joseph Cuschieri, MD

(REPRINTED) ARCH SURG/VOL 145 (NO. 3), MAR 2010 WWW.ARCHSURG.COM
240

Table 4. Comparison of Infection Incidence by Method of Bathing

Infection	No. (No. per 1000 Device-Days) Without Chlorhexidine	With Chlorhexidine[a]	Difference (95% CI)	P Value
CRBSI	15 (8.4)	4 (2.1)	6.2 (1.6 to 1.9)	.01
UTI	14 (7.1)	12 (6.5)	0.6 (−4.5 to 5.7)	.82
VAP	38 (21.6)	33 (16.9)	4.7 (−4.2 to 13.6)	.30
Secondary BSI	6 (3.0)	5 (2.5)	0.5 (−2.7 to 3.8)	.76

Abbreviations: BSI, bloodstream infection; CI, confidence interval; CRBSI, catheter-related bloodstream infection; UTI, urinary tract infection; VAP, ventilator-associated pneumonia.
[a] Administered in a washcloth as 2% chlorhexidine gluconate.

Evans HL, et al. Arch Surg 2010; 145: 240-246

Table 5. Causative Microorganisms in Catheter-Related Bloodstream Infections

Microorganism	No. of Cases Without Chlorhexidine (n=15)	With Chlorhexidine[a] (n=4)
Gram-positive bacteria		
Coagulase-negative *Staphylococcus* species	6	3
Bacillus species	1	0
Enterococcus species	1	0
Staphylococcus aureus	4	0
Gram-negative bacteria		
Escherichia coli	1	1
Klebsiella pneumoniae	1	0
Pseudomonas aeruginosa	1	0

[a] Administered in a washcloth as 2% chlorhexidine gluconate.

Evans HL, et al. Arch Surg 2010; 145: 240-246

CLINICAL RESEARCH STUDY

THE AMERICAN JOURNAL *of* MEDICINE®

Chlorhexidine Bathing to Reduce Central Venous Catheter-associated Bloodstream Infection: Impact and Sustainability

Marisa A. Montecalvo, MD,[a,b] Donna McKenna, MS,[a,b] Robert Yarrish, MD,[c] Lynda Mack, MSN,[a] George Maguire, MD,[d] Janet Haas, DNSc,[a,b] Lawrence DeLorenzo, MD,[d] Norine Dellarocco, MSN,[e] Barbara Savatteri, RN,[f] Addie Rosenthal, MS,[g] Anita Watson, RN,[h] Debra Spicehandler, MD,[g] Qiuhu Shi, PhD,[i] Paul Visintainer, PhD,[j] Gary P. Wormser, MD,[b]

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Table 2 Rates of Central Venous Catheter-associated Bloodstream Infection During the Pre-Intervention, Active Intervention, and Post-Intervention Periods

	Pre-Intervention			Active Intervention Chlorhexidine Bathing			Post-Intervention* Chlorhexidine Bathing		
Site	No. of Central Venous Catheter-associated Bloodstream Infections	Central Venous Catheter Days	Rate†	No. of Central Venous Catheter-associated Bloodstream Infections	Central Venous Catheter Days	Rate	No. of Central Venous Catheter-associated Bloodstream Infections	Central Venous Catheter Days	Rate
A	6	940	6.4	9	1772	5.1	14	2892	4.8
B	25	1688	14.8	14	2022	6.9	18	2755	6.5
C	6	717	8.4	0	646	0.0	2	909	2.2
D	2	205	9.8	0	397	0.0	3	299	10.0
E	4	1063	3.8	2	943	2.1	2	1457	1.4
F	3	655	4.6	0	686	0.0	0	976	0
Total	46	5268	8.7	25	6466	3.9	39	9288	4.2
Adjusted rate‡			6.4			2.6			2.9

*Post-intervention all sites continued chlorhexidine bathing; sites E and F had periods of bathing without chlorhexidine of 4 and 5 months, respectively.
†Rate = number of central venous catheter-associated bloodstream infections per 1000 central venous catheter days.
‡The central venous catheter-associated bloodstream infection rate is adjusted for total central venous catheter days, stratified by hospital and study period.

Montecalvo MA, et al. Am Journal Med 2012; 125:505-511

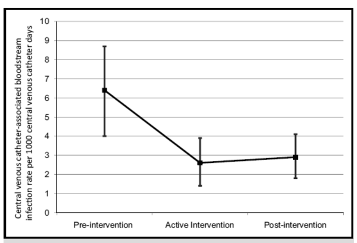

Figure 1 Adjusted rates of central venous catheter-associated bloodstream infection with limits of the 95% CI range for each point estimate.

Montecalvo MA, et al. Am Journal Med 2012; 125:505-511

STUDIES USING CHLORHEXIDINE SOLUTION

ELSEVIER

International Journal of Antimicrobial Agents 29 (2007) 536–543

INTERNATIONAL JOURNAL OF Antimicrobial Agents

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Topical antimicrobials in combination with admission screening and barrier precautions to control endemic methicillin-resistant *Staphylococcus aureus* in an Intensive Care Unit

Ian M. Gould[a,*], Fiona M. MacKenzie[a], Graeme MacLennan[b], Diane Pacitti[c], Emma J. Watson[a], David W. Noble[d]

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Received 1 November 2006; accepted 23 December 2006

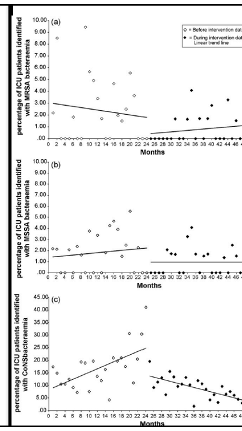


Fig. 2. Percentage of Intensive Care Unit (ICU) patients with (a) methicillin-resistant *Staphylococcus aureus* (MRSA) bacteraemia, (b) methicillin-susceptible *S. aureus* (MSSA) bacteraemia and (c) coagulase-negative staphylococci (CoNS) bacteraemia per month, before and during the intervention.

Gould IM, et al. Int Journal Antimicrobial Agents 2007; 29: 536-543

Continuing Medical Education Article

The effect of daily bathing with chlorhexidine on the acquisition of methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus*, and healthcare-associated bloodstream infections: Results of a quasi-experimental multicenter trial*

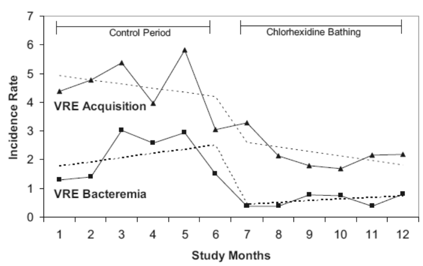
Michael W. Climo, MD; Kent A. Sepkowitz, MD; Gianna Zuccotti, MD, MPH; Victoria J. Fraser, MD; David K. Warren, MD; Trish M. Perl, MD, MSc; Kathleen Speck; John A. Jernigan, MD; Jaime R. Robles, PhD; Edward S. Wong, MD

Climo MW, et al. Crit Care Med 2009; 37:1858- 1865

Table 3. Time series analysis of the results of introduction of daily chlorhexidine bathing on the incidence of MRSA and VRE colonization and bacteremia

Outcome Measure	Incidence Rate as Modeled at End of Intervention in the Absence of Chlorhexidine Bathing[a]	Observed Incidence Rate at End of Intervention[b]	Change in Incidence Rate Attributable to Introduction of Chlorhexidine Bathing (% Change)[c]
MRSA incidence	2.59	1.93	−0.66 (25%)
MRSA bacteremia	<0.1	<0.1	0 (0)
VRE incidence	3.34	1.83	−1.51 (45%)
VRE bacteremia	3.38	0.74	−2.64 (78%)

Climo MW, et al. Crit Care Med 2009; 37:1858- 1865



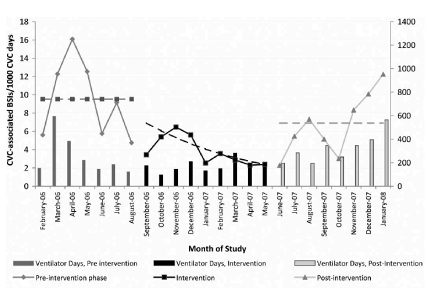
Climo MW, et al. Crit Care Med 2009; 37:1858- 1865

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY NOVEMBER 2009, VOL. 30, NO. 11

ORIGINAL ARTICLE

Prevention of Bloodstream Infections by Use of Daily Chlorhexidine Baths for Patients at a Long-Term Acute Care Hospital

L. Silvia Munoz-Price, MD; Bala Hota, MD, MPH; Alexander Stemer, MD; Robert A. Weinstein, MD



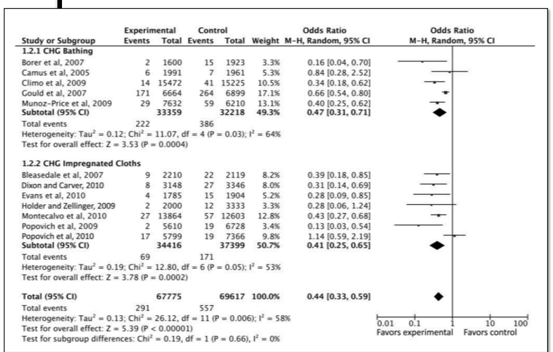
Munoz-Price LS, et al. Infect Control Hosp Epidemiol 2009; 30:1031-35

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY MARCH 2012, VOL. 33, NO. 3

ORIGINAL ARTICLE

The Efficacy of Daily Bathing with Chlorhexidine for Reducing Healthcare-Associated Bloodstream Infections: A Meta-analysis

John C. O'Horo, MD;[1] Germana L. M. Silva, MD;[2] L. Silvia Munoz-Price, MD;[3] Nasia Safdar, MD, PhD[4]



Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
1.2.1 CHG Bathing						
Borer et al, 2007	2	1600	15	1923	3.3%	0.16 [0.04, 0.70]
Camus et al, 2005	6	1991	7	1961	5.3%	0.84 [0.28, 2.52]
Climo et al, 2009	14	15472	41	15225	10.5%	0.34 [0.18, 0.62]
Gould et al, 2007	171	6664	264	6899	17.1%	0.66 [0.54, 0.80]
Munoz-Price et al, 2009	29	7632	59	6210	13.1%	0.40 [0.25, 0.62]
Subtotal (95% CI)		**33359**		**32218**	**49.3%**	**0.47 [0.31, 0.71]**
Total events	222		386			
Heterogeneity: $Tau^2 = 0.12$; $Chi^2 = 11.07$, df = 4 (P = 0.03); $I^2 = 64\%$						
Test for overall effect: Z = 3.53 (P = 0.0004)						
1.2.2 CHG Impregnated Cloths						
Bleasedale et al, 2007	9	2210	22	2119	8.2%	0.39 [0.18, 0.85]
Dixon and Carver, 2010	8	3148	27	3346	8.0%	0.31 [0.14, 0.69]
Evans et al, 2010	4	1785	15	1904	5.2%	0.28 [0.09, 0.85]
Holder and Zellinger, 2009	2	2000	12	3333	3.3%	0.28 [0.06, 1.24]
Montecalvo et al, 2010	27	13864	57	12603	12.8%	0.43 [0.27, 0.68]
Popovich et al, 2009	2	5610	19	6728	3.4%	0.13 [0.03, 0.54]
Popovich et al, 2010	17	5799	19	7366	9.8%	1.14 [0.59, 2.19]
Subtotal (95% CI)		**34416**		**37399**	**50.7%**	**0.41 [0.25, 0.65]**
Total events	69		171			
Heterogeneity: $Tau^2 = 0.19$; $Chi^2 = 12.80$, df = 6 (P = 0.05); $I^2 = 53\%$						
Test for overall effect: Z = 3.78 (P = 0.0002)						
Total (95% CI)		**67775**		**69617**	**100.0%**	**0.44 [0.33, 0.59]**
Total events	291		557			
Heterogeneity: $Tau^2 = 0.13$; $Chi^2 = 26.12$, df = 11 (P = 0.006); $I^2 = 58\%$						
Test for overall effect: Z = 5.39 (P < 0.00001)						
Test for subgroup differences: $Chi^2 = 0.19$, df = 1 (P = 0.66), $I^2 = 0\%$						

O'Horo JC, et al. Inf Control Hosp Epidemiol 2012; 33:257-267

IMPLEMENTATION OF CHLORHEXIDINE BATHS

- Remove all non-compatible products from the units (soaps, lotions, skin barriers, etc)
- In-service staff giving the baths
- Personally observe baths in a regular basis
- Quantify the usage of the product by the units

CHALLENGES DURING IMPLEMENTATION OF CHLORHEXIDINE

- Chlorhexidine doesn't foam
- Personnel perceives this lack of foaming as lack of cleaning
- Mixing with other products (soap and water) might happen at the bedside, especially with liquid preparations

Conclusions

- Chlorhexidine baths constitute a powerful tool to decrease CLABSIs
- Preparation of the inpatient units should be done before instituting chlorhexidine baths
- Frequent observations should occur after implementation in order to ensure compliance