Hot Topics in Infection Control

AMMI – CACMID 2014, Victoria, BC

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Welcome to the Westcoast

Disclosures: travel grant Ondine Biomedical Inc.

Outline

Surveillance

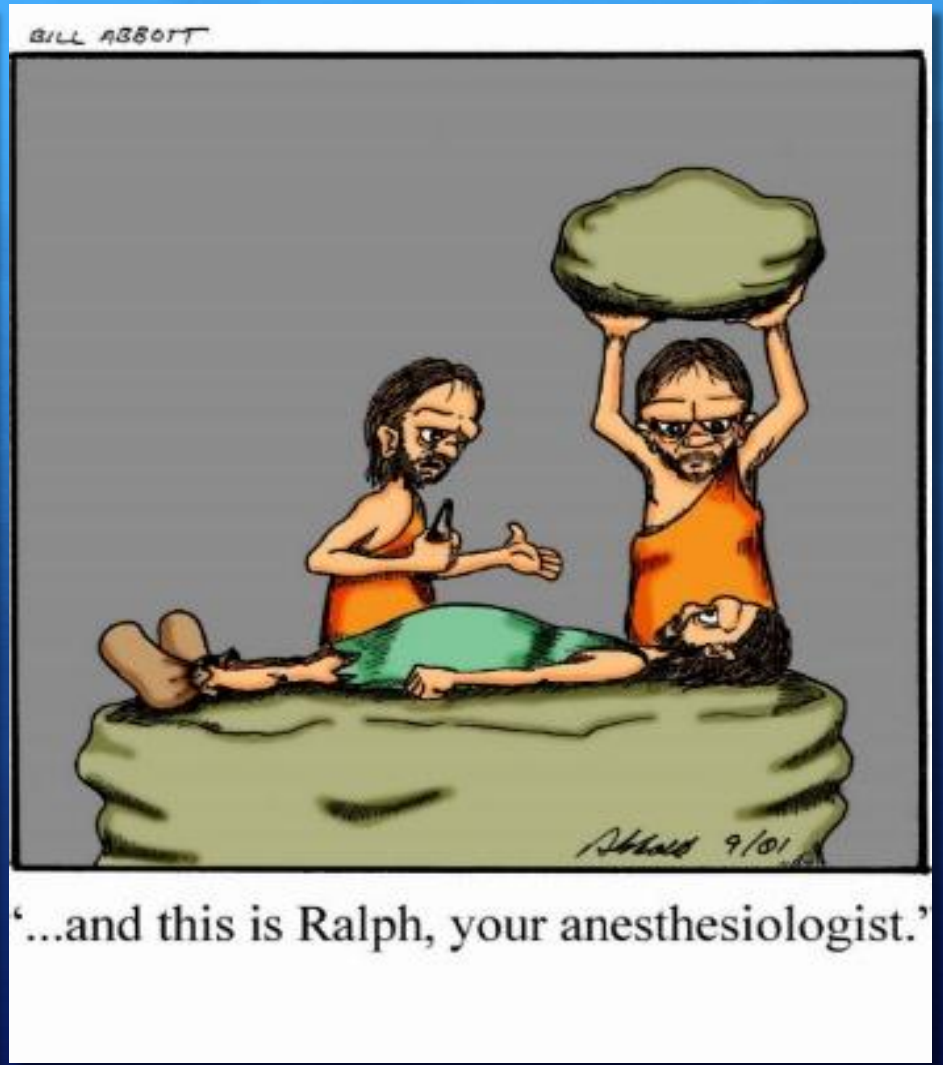
- Outbreaks Alerts
- Typing

IC Practices

- Gowning and Gloving
- Chlorhexidine Washing
- Presurgical Bundles

Environmental Hygiene

- Manual Cleaning
- Hydrogen Peroxide Vapor
- UVC disinfection
- Antimicrobial Surfaces



Old friends, New Faces

Ebola in Guinea

Plague in Madagascar

Dengue in SE Asia, South and Central America,

Polio in Afghanistan, Cameroon, Ethiopia, Kenya, Nigeria, Pakistan, Somalia, Syrian Arab Republic

MERS-CoV in KSA

CRE and CPO everywhere

H7N9 Appropriate paranoia

theguardian

News | Sport | Comment | Culture | Business | Money | Life & style

News › World news › Guinea

Fear and frustration as Guinea struggles to contain Ebola outbreak

Virus has claimed 84 lives and jumped borders to Sierra Leone and Liberia, raising concerns that it could sweep across region

Monica Mark in Lagos

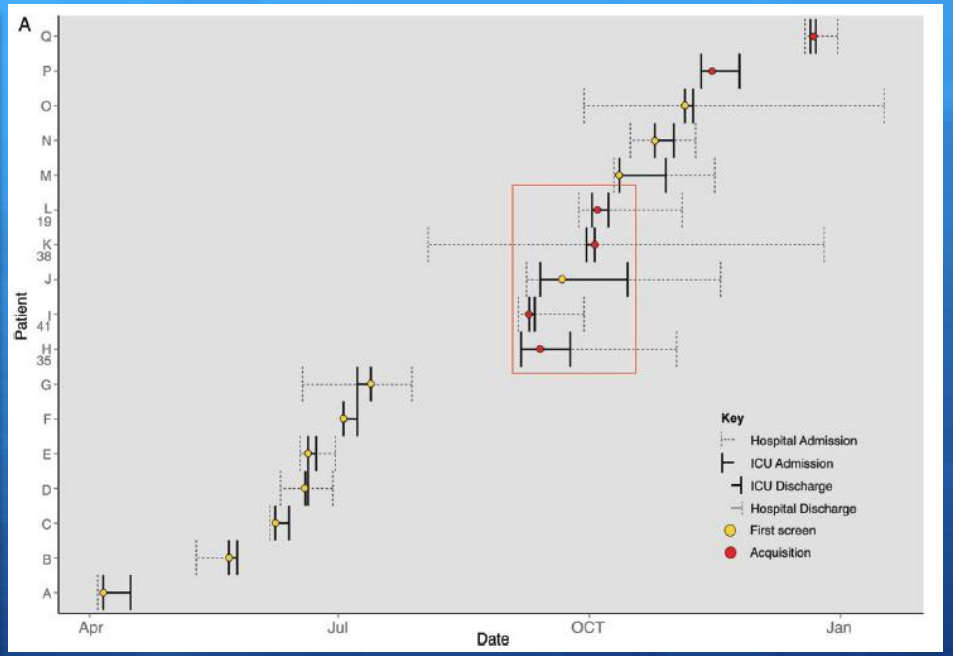
theguardian.com, Friday 4 April 2014 14.19 BST

Doctors without Borders carry a body on a stretcher at a centre for victims of the Ebola virus in Guekedou, Guinea. Photograph: Seyllou/AFP/Getty Images

Price, CID 2014

- Prospective 14 month MSSA/MRSA surveillance study in single ICU
- Whole Genome Sequencing vs Traditional epidemiologic definition + Spa typing
- 184/1109 pts had SA on admission, 44 new acquisitions during ICU stay, acquisitions

- **only 18.9% can be explained by patient-patient transmission.**



MAJOR ARTICLE

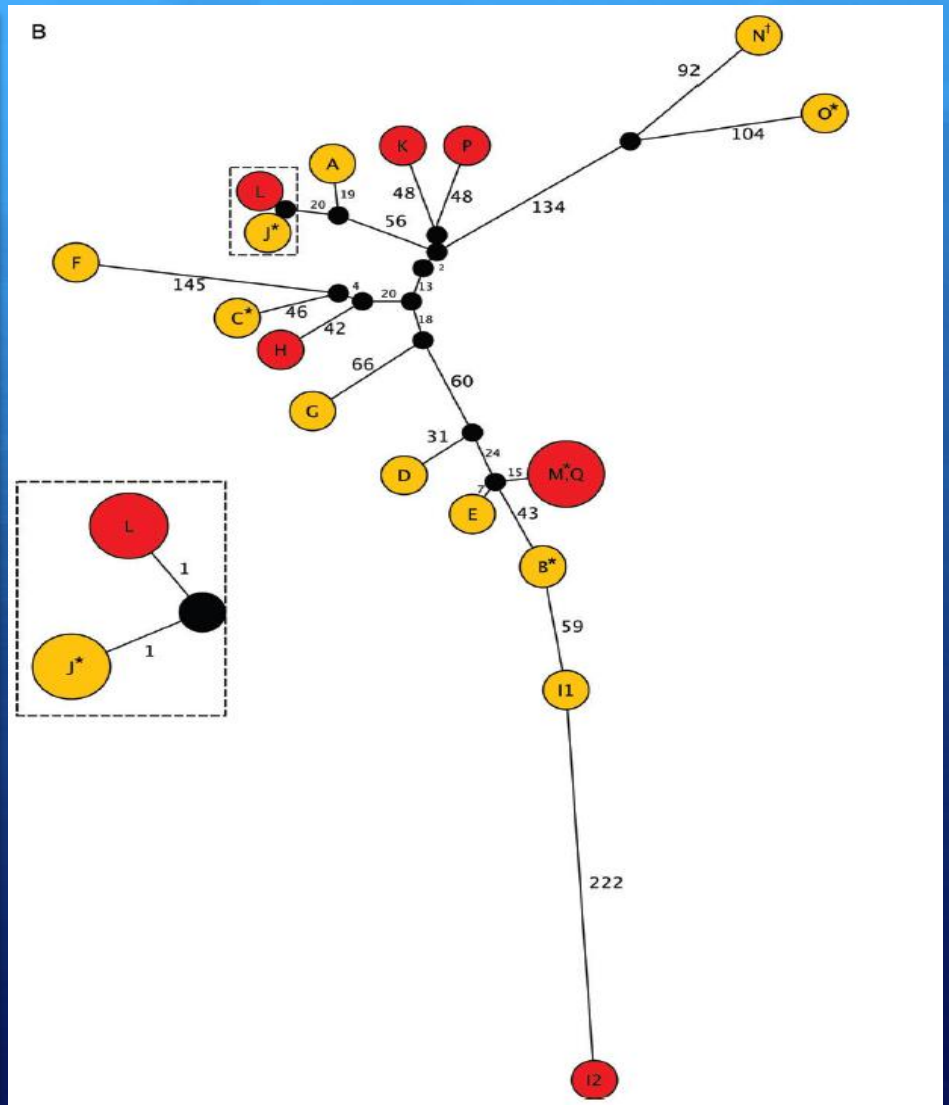
Whole-Genome Sequencing Shows That Patient-to-Patient Transmission Rarely Accounts for Acquisition of *Staphylococcus aureus* in an Intensive Care Unit

James R. Price,[1] Tanya Golubchik,[2] Kevin Cole,[3] Daniel J. Wilson,[4,5] Derrick W. Crook,[4,6] Guy E. Thwaites,[7] Rory Bowden,[5] A. Sarah Walker,[4,6] Timothy E. A. Peto,[4,6] John Paul,[1,3] and Martin J. Llewelyn[1,8]

Price, CID 2014

- Prospective 14 month MSSA/MRSA surveillance study in single ICU
- Whole Genome Sequencing vs Traditional epidemiologic definition + Spa typing
- 184/1109 pts had SA on admission, 44 new acquisitions during ICU stay, acquisitions

- **only 18.9% can be explained by patient-patient transmission.**



Eyre, NEJM 2013

Retrospective 3.6 year study, WGS comparison of 2377 *C.* difficile positive isolates from 4 hospitals

→1223 isolates sequenced (3:1 inpatients:outpatients)

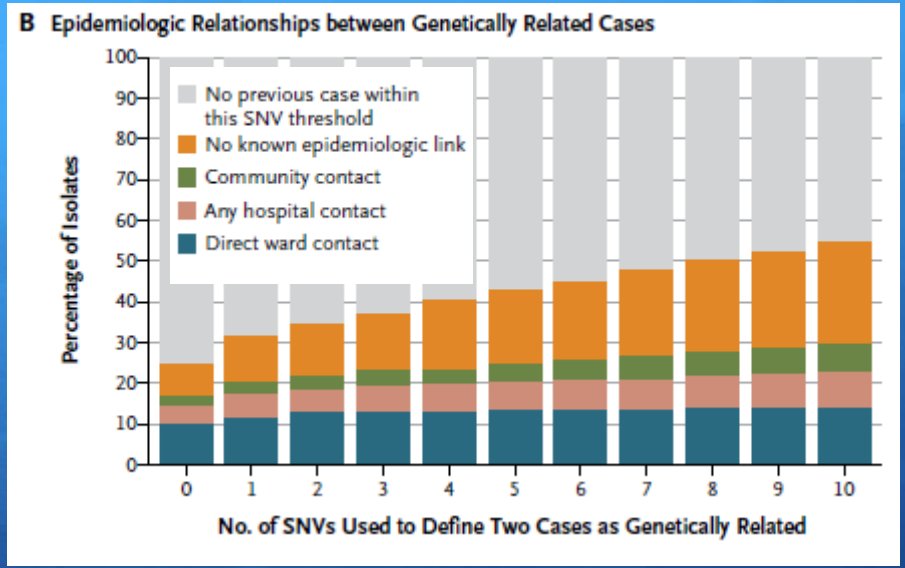
→**only 333 (35%) genetically related (≤ 2 SNV) from a previous case**

→**428 (45%) >10 SNVs = genetically unique**

→126 (13%) had ward contact

→29 (3%) had overlapping stay but not ward contact

→21 (2%) had both ward contact and overlapping stay



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 SEPTEMBER 26, 2013 VOL. 369 NO. 13

Diverse Sources of *C. difficile* Infection Identified on Whole-Genome Sequencing

David W. Eyre, B.M., B.Ch., Madeleine L. Cule, Ph.D., Daniel J. Wilson, D.Phil., David Griffiths, B.Sc., Alison Vaughan, B.Sc., Lily O'Connor, B.Sc., Camilla L.C. Ip, Ph.D., Tanya Golubchik, Ph.D., Elizabeth M. Batty, Ph.D., John M. Finney, B.Sc., David H. Wyllie, Ph.D., Xavier Didelot, D.Phil., Paolo Piazza, Ph.D., Rory Bowden, Ph.D., Kate E. Dingle, Ph.D., Rosalind M. Harding, Ph.D., Derrick W. Crook, M.B., B.Ch., Mark H. Wilcox, M.D., Tim E.A. Peto, D.Phil., and A. Sarah Walker, Ph.D.

Whole Genome Sequencing

WGS provides high level discrimination allowing for improved surveillance of transmission events

A minority of CDI transmission in a community in the UK is caused by symptomatic patients

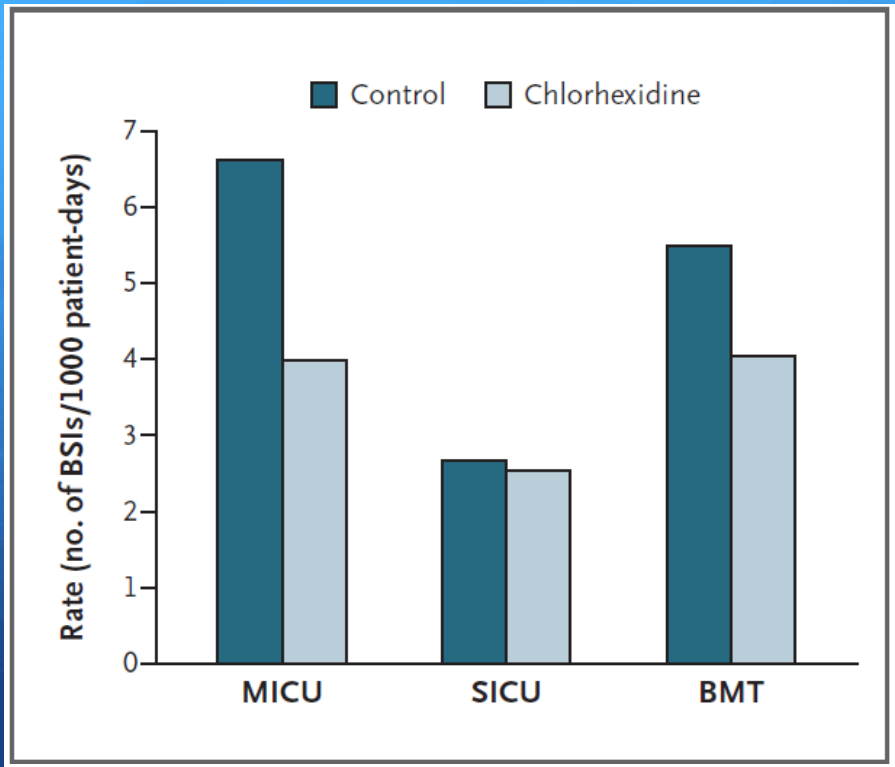
What is the contribution of other sources to CDI transmissions?

Vertical vs Horizontal Approaches

Covered extensively by E. Bryce and A. Mcgeer

Climo, NEJM 2013

- Multicenter, cluster-randomized, non-blinded crossover trial
- 9 ICUs/BMTU, 6 hospitals, 7727 patients
- Daily washing with CHG washcloths vs control washcloths
- **Daily CHG washing of adult patients in ICU reduced (1) MRDO acquisition and (2) BSI rates**
  - (1) MDRO acquisition (5.10 vs 6.60 cases/ 1000 pt days, P=0.03)
  - (2) BSI rate (4.78 vs 6.60 cases / 1000 pt days, p=0.007) driven by CNS reductions
- **did not detect MRSA or VRE high-level resistance to chlorhexidine**

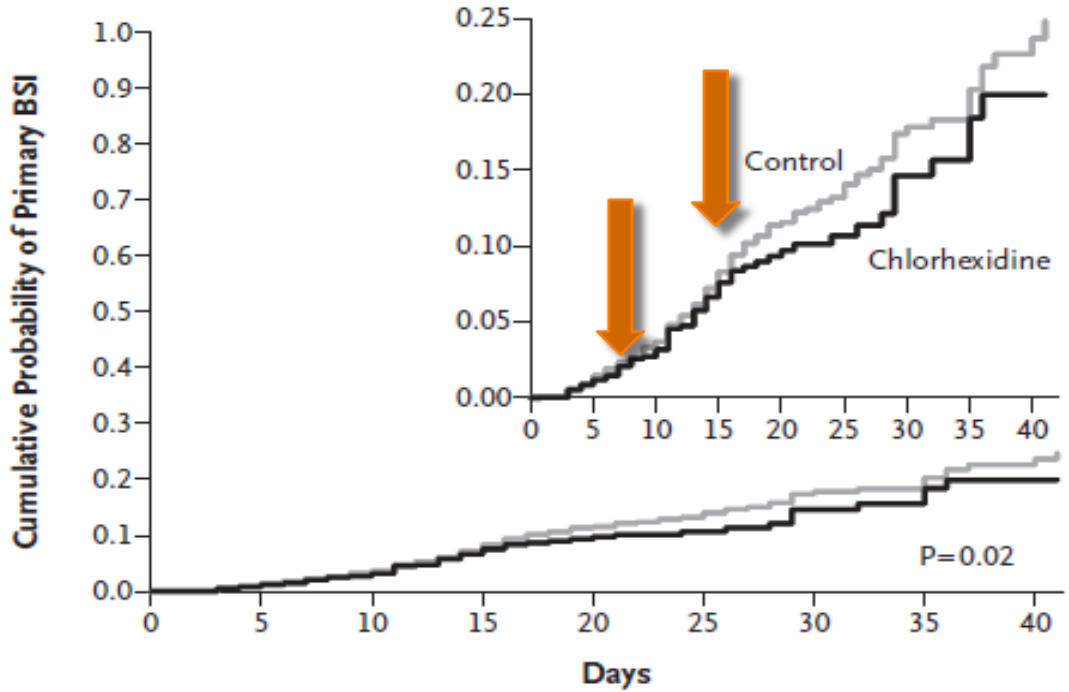


The NEW ENGLAND JOURNAL of MEDICINE

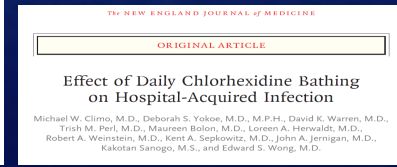
ORIGINAL ARTICLE

Effect of Daily Chlorhexidine Bathing on Hospital-Acquired Infection

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.



No. at Risk								
Control	1398	582	346	218	143	94	59	37
Chlorhexidine	1410	616	391	242	151	95	60	36
Total Cumulative No. of Primary BSIs								
Control	33	55	80	101	114	119	122	127
Chlorhexidine	26	44	64	73	75	80	83	84

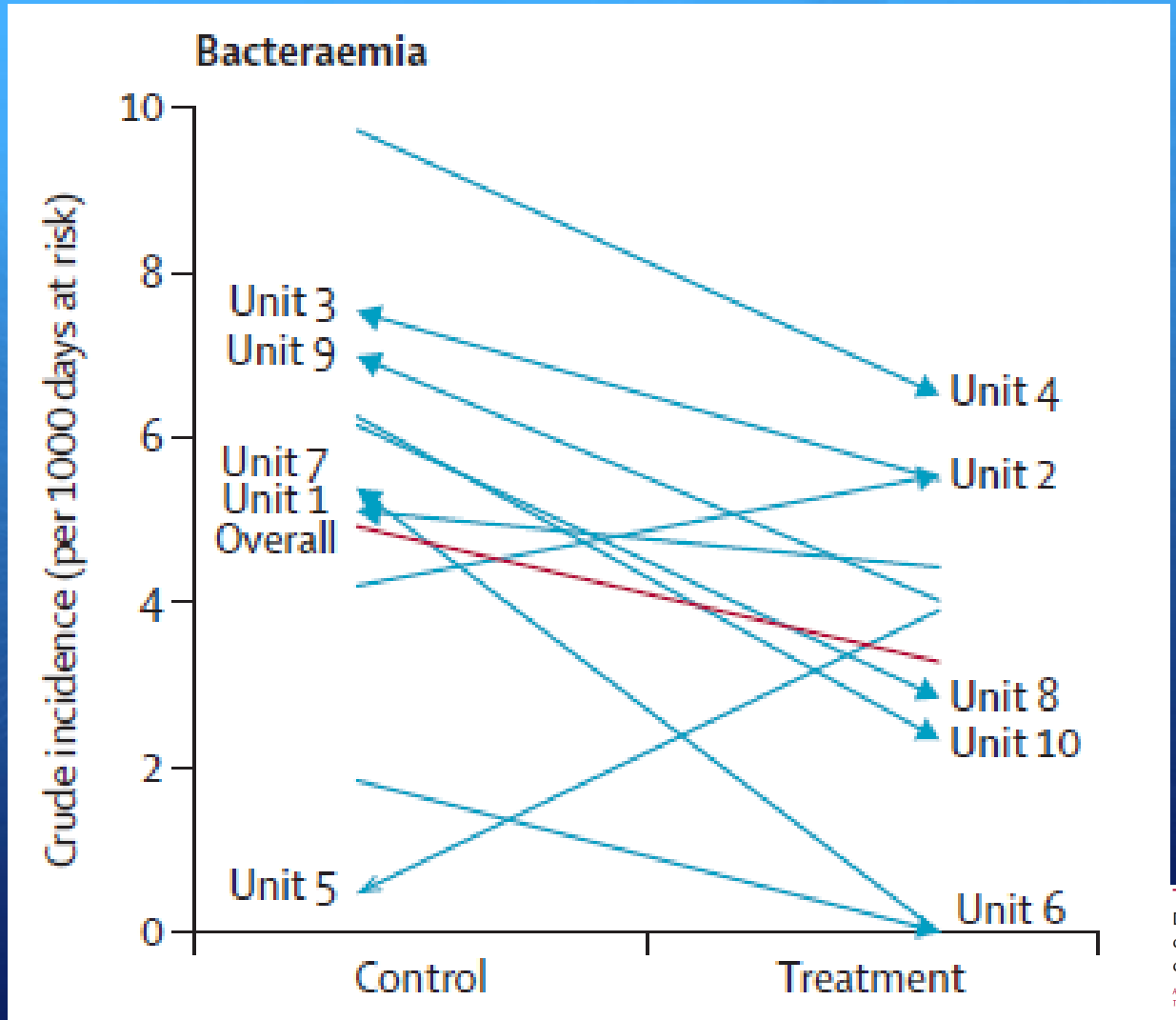


Milstone, SCRUB trial, Lancet 2013

- Non-blinded, cluster-randomized, cross-over trial
- 10 pediatric ICU, 5 hospitals, 1521 patients
- Daily CHG bathing vs soap and water
- **Daily CHG bathing in pediatric ICU decreased BSI rates**
- PP: CHG 3.28/1000 pt days vs Control 4.93/1000 pt days
- AE with CHG: 1.2 per 1000 pt days

Daily chlorhexidine bathing to reduce bacteraemia in critically ill children: a multicentre, cluster-randomised, crossover trial

Aaron M Milstone, Alexis Elward, Xiaoyan Song, Danielle M Zerr, Rachel Orscheln, Kathleen Speck, Daniel Obeng, Nicholas G Reich, Susan E Coffin, Trish M Perl, for the Pediatric SCRUB Trial Study Group



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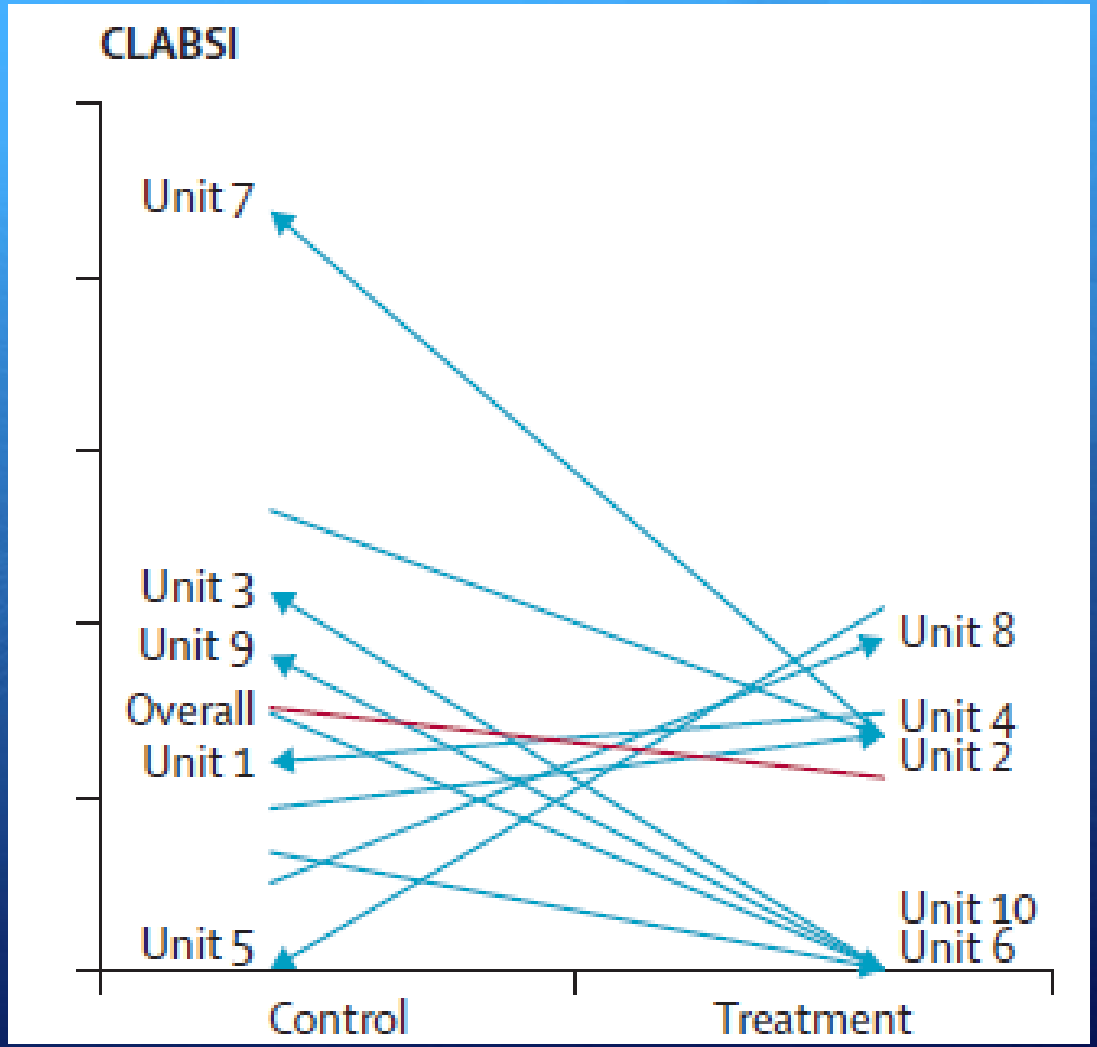

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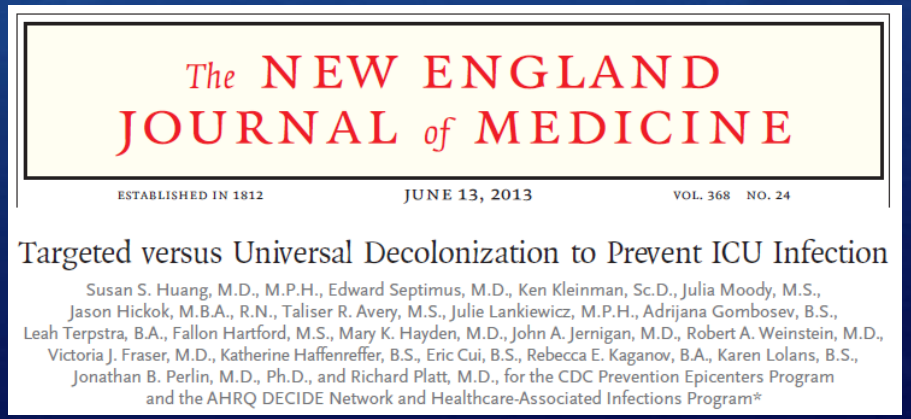
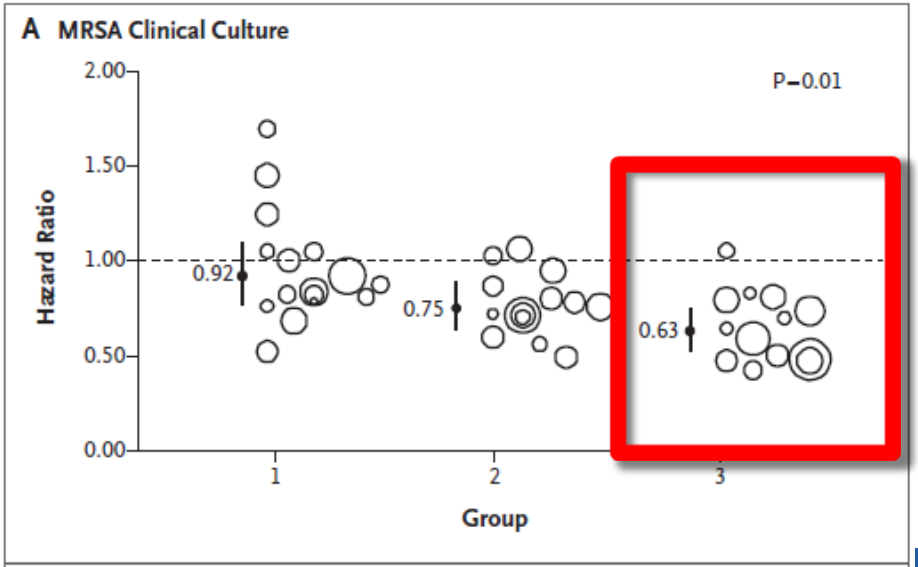
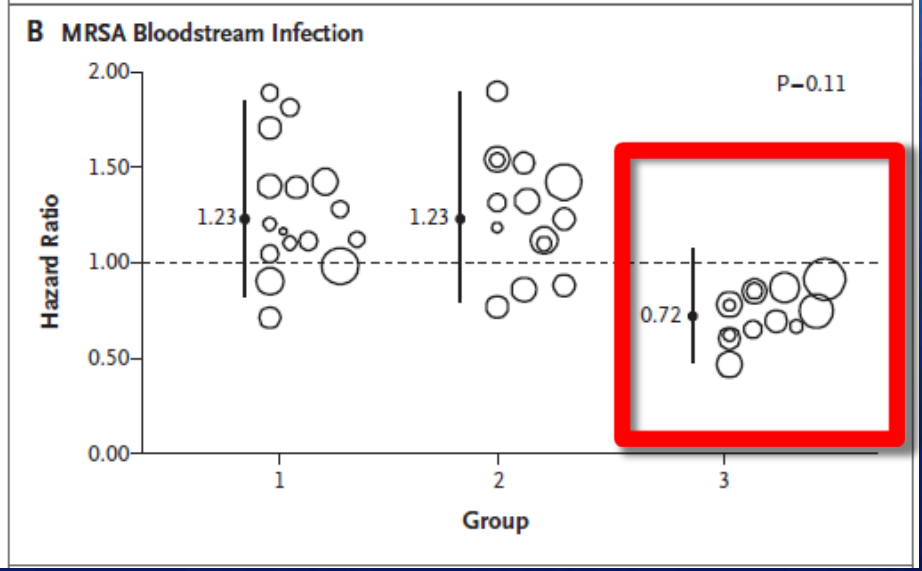
Huang, REDUCE MRSA trial, NEJM 2013

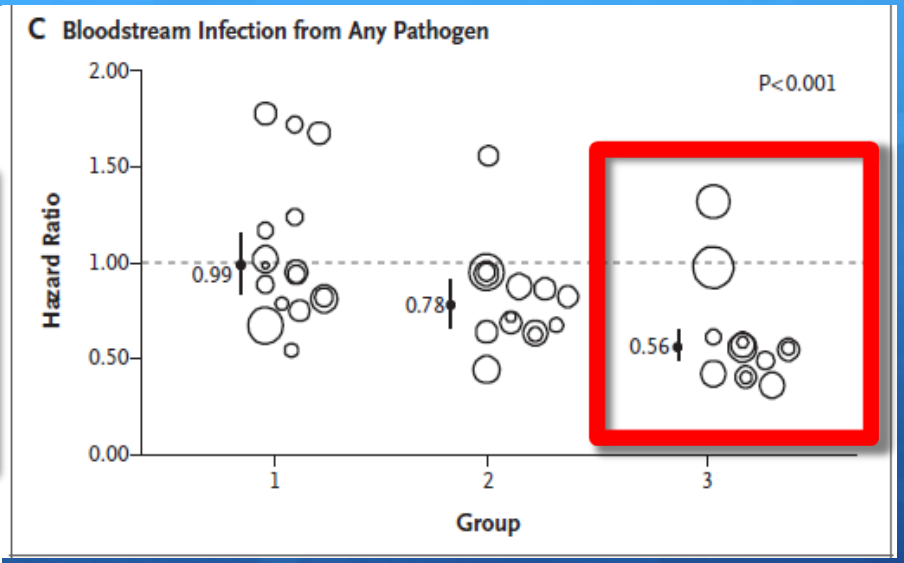
- Cluster-randomized trial
- 43 hospitals,ICU, 74,256 patients
- (1) MRSA screening + isolation vs (2) targeted decolonization vs (3) universal decolonization

- **Universal decolonization more effective than targeted decolonization or screening and isolation for reducing BSI and for MRSA acquisition**









The NEW ENGLAND JOURNAL of MEDICINE
ESTABLISHED IN 1812 JUNE 13, 2013 VOL. 368 NO. 24

Targeted versus Universal Decolonization to Prevent ICU Infection

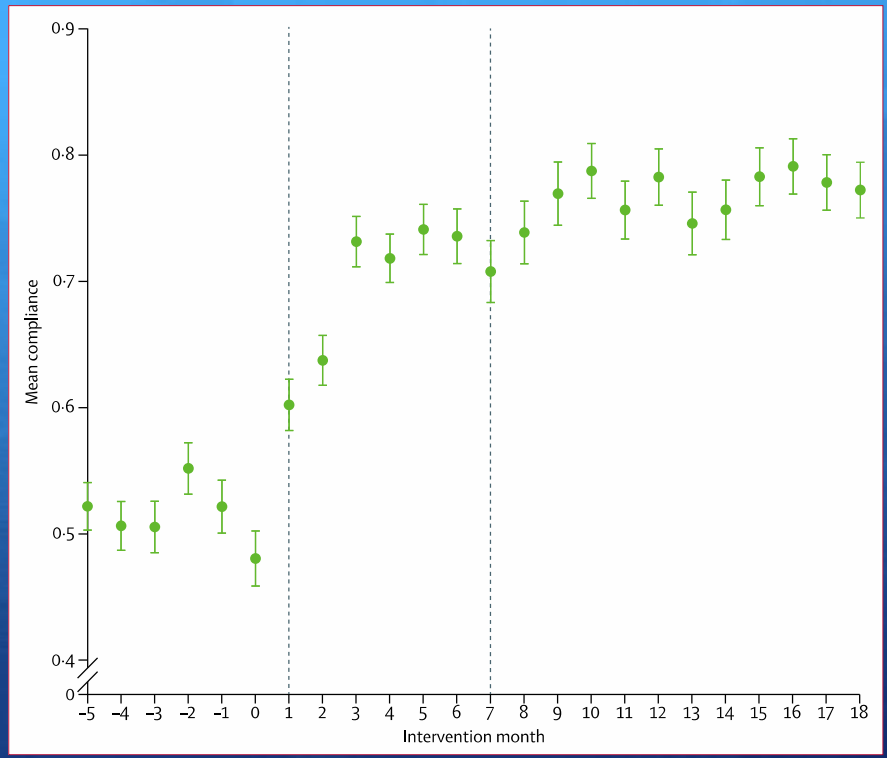
Susan S. Huang, M.D., M.P.H., Edward Septimus, M.D., Ken Kleinman, Sc.D., Julia Moody, M.S., Jason Hickok, M.B.A., R.N., Taliser R. Avery, M.S., Julie Lankiewicz, M.P.H., Adrijana Gombosev, B.S., Leah Terpstra, B.A., Fallon Hartford, M.S., Mary K. Hayden, M.D., John A. Jernigan, M.D., Robert A. Weinstein, M.D., Victoria J. Fraser, M.D., Katherine Haffenreffer, 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*

Derde, Lancet Inf Dis 2014

Multicenter, 13 adult ICUs, interrupted time series and cluster randomized trial

interrupted time series to assess: improved hand hygiene + chlorhexidine body washing → **decreased MRSA acquisition, but not VRE or HRE (highly resistant Enterobacteriaceae)**

cluster randomized trial to assess: PCR screening for MRSA,VRE + chromo HRE vs conventional chromo screening → **no difference in acquisition of AROs**

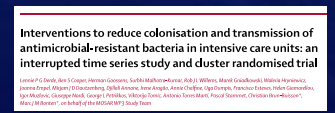


Interventions to reduce colonisation and transmission of antimicrobial-resistant bacteria in intensive care units: an interrupted time series study and cluster randomised trial

Lennie P G Derde, Ben S Cooper, Herman Goossens, Surbhi Malhotra-Kumar, Rob J L Willems, Marek Gniadkowski, Waleria Hryniewicz, Joanna Empel, Mirjam J D Dautzenberg, Djillali Annane, Irene Aragão, Annie Chalfine, Uga Dumpis, Francisco Esteves, Helen Giamarellou, Igor Muzlovic, Giuseppe Nardi, George L Petrikkos, Viktorija Tomic, Antonio Torres Martí, Pascal Stammet, Christian Brun-Buisson, Marc J M Bonten*, on behalf of the MOSAR WP3 Study Team*

	Antimicrobial-resistant bacteri
Phase 1 trend	1·014 (0·996–1·031; p=0·12)
Phase 2 step change	0·955 (0·676–1·348; p=0·79)
Phase 2 change in trend	0·976 (0·954–0·999; p=0·04)

MRSA	VRE	HRE
1·042 (1·010–1·075; p=0·01)	1·000 (0·971–1·030; p=0·99)	1·012 (0·992–1·032; p=0·25)
1·159 (0·654–2·053; p=0·61)	0·884 (0·481–1·626; p=0·69)	0·831 (0·559–1·235; p=0·36)
0·925 (0·890–0·962; p<0·001)	0·982 (0·945–1·020; p=0·36)	0·994 (0·968–1·021; p=0·66)



Chlorhexidine Washing

daily chlorhexidine washing in ICU (+/- mupirocin):

-decreases acquisition of MRSA-decreases BSI

-*more effective than targeted decolonization or screening and isolation

But:

-what about resistance? VRE? CRE?

-what about non-ICU wards?

Harris, JAMA 2013

- Cluster-randomized trial
- 20 hospitals, 20 ICUs, 26 180 patients
- Universal gloves and gowning vs usual care

- **Intervention did not decrease MRSA and VRE acquisition (1° endpoint)**
  - MRSA assessed alone was statistically significantly different

Original Investigation

Universal Glove and Gown Use and Acquisition of Antibiotic-Resistant Bacteria in the ICU
A Randomized Trial

Anthony D. Harris, MD, MPH; Lisa Pineles, MA; Beverly Belton, RN, MSN; J. Kristie Johnson, PhD; Michelle Shardell, PhD; Mark Loeb, MD, MSc; Robin Newhouse, RN, PhD; Louise Dembry, MD, MS, MBA; Barbara Braun, PhD; Eli N. Perencevich, MD, MS; Kendall K. Hall, MD, MS; Daniel J. Morgan, MD, MS; and the Benefits of Universal Glove and Gown (BUGG) Investigators

Table 2. Rates at Risk of Acquisition of Antibiotic-Resistant Bacteria per 1000 Patient-Days

	Intensive Care Units							
	Intervention			Control				
	No. of Acquisitions	Patient-Days at Risk	Mean Rate (95% CI)[a]	No. of Acquisitions	Patient-Days at Risk	Mean Rate (95% CI)[a]	Difference (95% CI)[b]	*P* Value[c]
Drug-Resistant Bacteria								
VRE or MRSA								
Study period	577	32 693.0	16.91 (14.09 to 20.28)	517	31 765.0	16.29 (13.48 to 19.68)		
Baseline	178	8684.0	21.35 (17.57 to 25.94)	176	9804.5	19.02 (14.20 to 25.49		
Change[d]			−4.47 (−9.34 to 0.45)			−2.74 (−6.98 to 1.51)	−1.71 (−6.15 to 2.73)	.57
VRE								
Study period	411	27 765.5	13.59 (10.26 to 17.99)	337	28 340.5	11.88 (8.65 to 16.33)		
Baseline	108	7691.5	15.18 (10.50 to 21.95)	122	8818.0	14.37 (10.31 to 20.02		
Change[d]			−1.60 (−7.18 to 3.98)			−2.48 (−5.53 to 0.56)	0.89 (−4.27 to 6.04)	.70
MRSA								
Study period	199	30 454.5	6.00 (4.63 to 7.78)	191	30 024.0	5.94 (4.59 to 7.67)		
Baseline	77	7841.0	10.03 (8.05 to 12.50)	59	9182.0	6.98 (4.50 to 10.83)		
Change[d]			−4.03 (−6.50 to −1.56)			−1.04 (−3.37 to 1.28)	−2.98 (−5.58 to −0.38)	.046

Table 3. Average Hand-Hygiene Compliance and Health Care Worker Visits per Hour

	Intensive Care Units							
	Intervention			Control				
	No. of Events	No. of Observations[a]	Mean (95% CI), %[b]	No. of Events	No. of Observations[a]	Mean (95% CI), %[b]	Mean Difference (95% CI), %[c]	*P* Value[d]
Hand-hygiene compliance, %								
Room entry	1563	2828	56.1 (47.2 to 66.7)	1644	3231	50.2 (41.4 to 60.9)	5.91 (−6.91 to 18.7)	.42
Room exit	027	2649	78.3 (72.1 to 85.0)	2080	3266	62.9 (54.4 to 72.8)	15.4 (8.99 to 21.8)	.02
Health care–worker visits	213	756.5	4.28 (3.95 to 4.64)	3775	716.5	5.24 (4.46 to 6.16)[e]	−0.96 (−1.71 to −0.21)	.02

Mehotra, ICHE 2013

Prospective cohort study, 528 patients

admission, day 3, 7, 14, discharge surveys

on discharge HCAHPS

20% perceived problem with care

contact precautions associated with perceived concerns with care (OR 2.05, 95% CI 1.31 - 3.21, p<0.01)

Universal gown/glove policy

An ICU policy requiring universal gowning and gloving:

-did not decrease MRSA *and* VRE acquisition

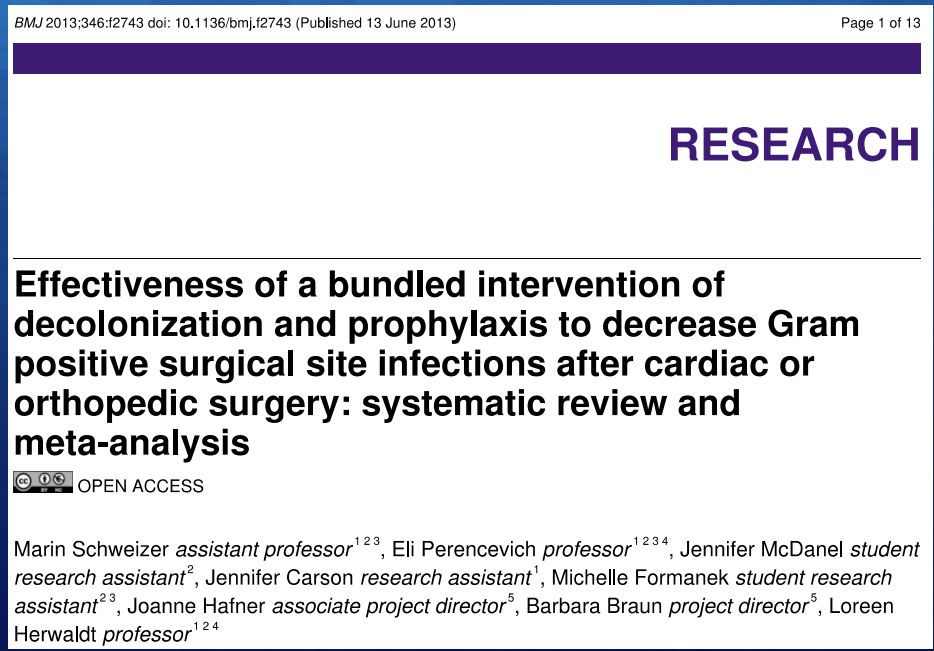
-impacted hand hygiene *after* patient contact, but not before

-decreased patient interaction, but (contrary to a previous study), adverse events was not SS different

Patients perceived problems with care when under contact precautions

Schweizer, BMJ 2013

- Meta-analysis of decolonization bundles to decrease SSI's in cardiac and orthopedic surgery
- 39 studies
- Nasal decolonization: 17 studies pooled RR 0.39 (95% CI 0.31-0.5)
- all patients decolonized RR 0.40 (95% CI 0.29 – 0.55)
- SA + patients decolonized RR 0.36 (95% CI 0.22 – 0.57)



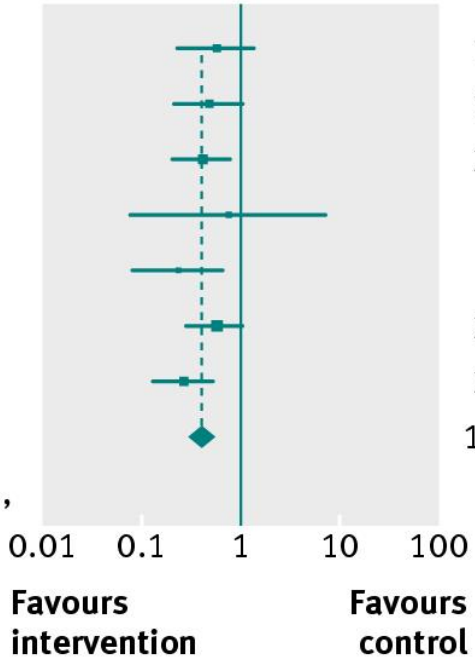
BMJ 2013;346:f2743 doi: 10.1136/bmj.f2743 (Published 13 June 2013)

RESEARCH

Effectiveness of a bundled intervention of decolonization and prophylaxis to decrease Gram positive surgical site infections after cardiac or orthopedic surgery: systematic review and meta-analysis

Marin Schweizer *assistant professor*[1 2 3], Eli Perencevich *professor*[1 2 3 4], Jennifer McDanel *student research assistant*[2], Jennifer Carson *research assistant*[1], Michelle Formanek *student research assistant*[2 3], Joanne Hafner *associate project director*[5], Barbara Braun *project director*[5], Loreen Herwaldt *professor*[1 2 4]

Study	No of events/total: Intervention	No of events/total: Control	Risk ratio (95% CI) M-H, random	Weight (%)	Risk ratio (95% CI) M-H, random
Jog 2008[56]	8/765	13/697		12.4	0.56 (0.23 to 1.34)
Acebedo 2009[60]	9/1072	16/909		14.4	0.48 (0.21 to 1.07)
Kim 2010[58]	13/7019	24/5293		20.9	0.41 (0.21 to 0.80)
Hadley 2010[62]	3/1644	1/414		1.9	0.76 (0.08 to 7.24)
Rao 2011[61]	5/1440	11/741		8.6	0.23 (0.08 to 0.67)
Sporer 2011[59]	18/3180	17/1693		21.8	0.56 (0.29 to 1.09)
Walsh 2011[57]	10/2496	42/2766		20.1	0.26 (0.13 to 0.52)
Total (95% CI)	66/17 616	124/12 513		100.0	0.41 (0.30 to 0.56)
Test for heterogeneity: τ^2=0.00, χ^2=4.50, df=6, P=0.61, I^2=0%					
Test for overall effect: z=5.65, P<0.001					




RESEARCH

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OPEN ACCESS

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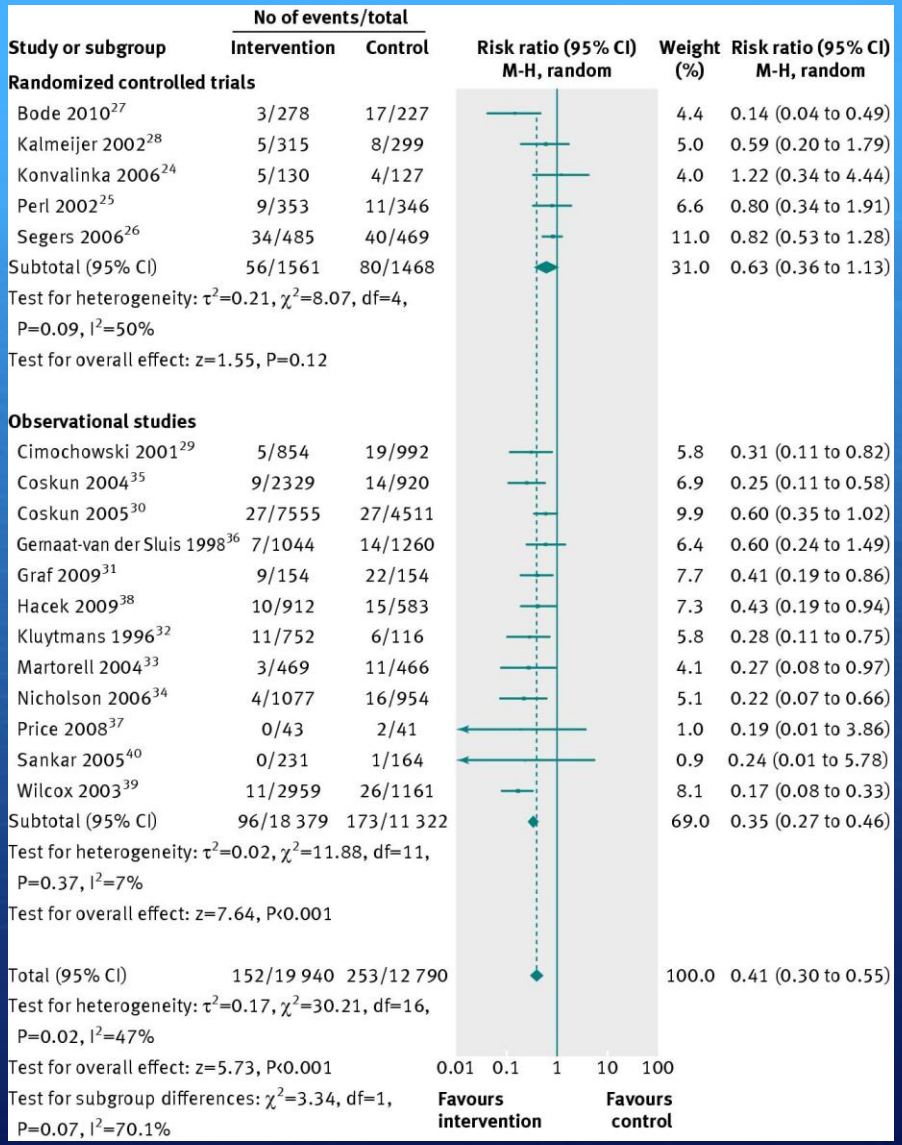
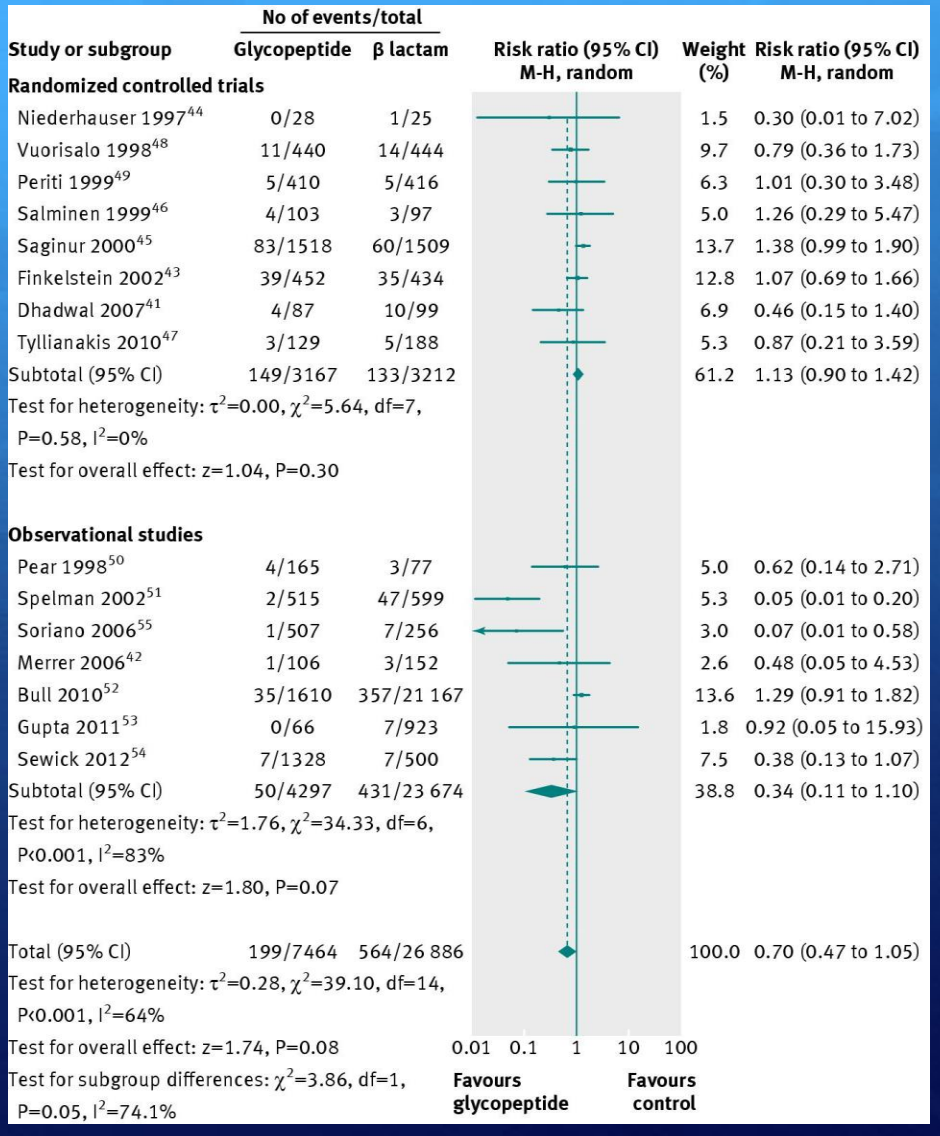
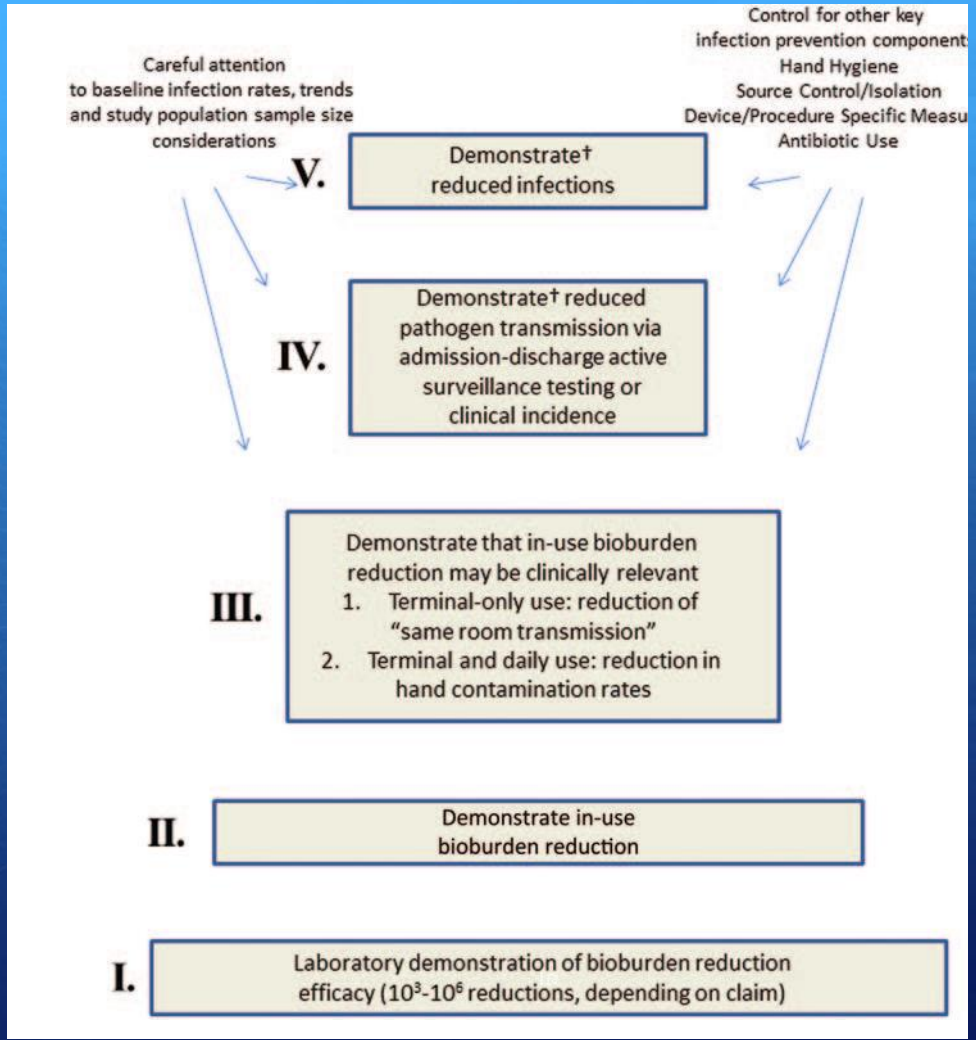

No of events/total
Study or subgroup
Intervention
Control
Risk ratio (95% CI) M-H, random
Weight (%)
Risk ratio (95% CI) M-H, random
Randomized controlled trials
Bode 2010[27] 3/278 17/227 4.4 0.14 (0.04 to 0.49)
Kalmeijer 2002[28] 5/315 8/299 5.0 0.59 (0.20 to 1.79)
Konvalinka 2006[24] 5/130 4/127 4.0 1.22 (0.34 to 4.44)
Perl 2002[25] 9/353 11/346 6.6 0.80 (0.34 to 1.91)
Segers 2006[26] 34/485 40/469 11.0 0.82 (0.53 to 1.28)
Subtotal (95% CI) 56/1561 80/1468 31.0 0.63 (0.36 to 1.13)
Test for heterogeneity: τ²=0.21, χ²=8.07, df=4, P=0.09, I²=50%
Test for overall effect: z=1.55, P=0.12
Observational studies
Cimochowski 2001[29] 5/854 19/992 5.8 0.31 (0.11 to 0.82)
Coskun 2004[35] 9/2329 14/920 6.9 0.25 (0.11 to 0.58)
Coskun 2005[30] 27/7555 27/4511 9.9 0.60 (0.35 to 1.02)
Gemaat-van der Sluis 1998[36] 7/1044 14/1260 6.4 0.60 (0.24 to 1.49)
Graf 2009[31] 9/154 22/154 7.7 0.41 (0.19 to 0.86)
Hacek 2009[38] 10/912 15/583 7.3 0.43 (0.19 to 0.94)
Kluytmans 1996[32] 11/752 6/116 5.8 0.28 (0.11 to 0.75)
Martorell 2004[33] 3/469 11/466 4.1 0.27 (0.08 to 0.97)
Nicholson 2006[34] 4/1077 16/954 5.1 0.22 (0.07 to 0.66)
Price 2008[37] 0/43 2/41 1.0 0.19 (0.01 to 3.86)
Sankar 2005[40] 0/231 1/164 0.9 0.24 (0.01 to 5.78)
Wilcox 2003[39] 11/2959 26/1161 8.1 0.17 (0.08 to 0.33)
Subtotal (95% CI) 96/18 379 173/11 322 69.0 0.35 (0.27 to 0.46)
Test for heterogeneity: τ²=0.02, χ²=11.88, df=11, P=0.37, I²=7%
Test for overall effect: z=7.64, P<0.001
Total (95% CI) 152/19 940 253/12 790 100.0 0.41 (0.30 to 0.55)
Test for heterogeneity: τ²=0.17, χ²=30.21, df=16, P=0.02, I²=47%
Test for overall effect: z=5.73, P<0.001
Test for subgroup differences: χ²=3.34, df=1, P=0.07, I²=70.1%
0.01 0.1 1 10 100
Favours intervention
Favours control


No of events/total
Study or subgroup
Glycopeptide
β lactam
Risk ratio (95% CI) M-H, random
Weight (%)
Risk ratio (95% CI) M-H, random
Randomized controlled trials
Niederhauser 1997[44] 0/28 1/25 1.5 0.30 (0.01 to 7.02)
Vuorisalo 1998[48] 11/440 14/444 9.7 0.79 (0.36 to 1.73)
Periti 1999[49] 5/410 5/416 6.3 1.01 (0.30 to 3.48)
Salminen 1999[46] 4/103 3/97 5.0 1.26 (0.29 to 5.47)
Saginur 2000[45] 83/1518 60/1509 13.7 1.38 (0.99 to 1.90)
Finkelstein 2002[43] 39/452 35/434 12.8 1.07 (0.69 to 1.66)
Dhadwal 2007[41] 4/87 10/99 6.9 0.46 (0.15 to 1.40)
Tyllianakis 2010[47] 3/129 5/188 5.3 0.87 (0.21 to 3.59)
Subtotal (95% CI) 149/3167 133/3212 61.2 1.13 (0.90 to 1.42)
Test for heterogeneity: τ²=0.00, χ²=5.64, df=7, P=0.58, I²=0%
Test for overall effect: z=1.04, P=0.30
Observational studies
Pear 1998[50] 4/165 3/77 5.0 0.62 (0.14 to 2.71)
Spelman 2002[51] 2/515 47/599 5.3 0.05 (0.01 to 0.20)
Soriano 2006[55] 1/507 7/256 3.0 0.07 (0.01 to 0.58)
Merrer 2006[42] 1/106 3/152 2.6 0.48 (0.05 to 4.53)
Bull 2010[52] 35/1610 357/21 167 13.6 1.29 (0.91 to 1.82)
Gupta 2011[53] 0/66 7/923 1.8 0.92 (0.05 to 15.93)
Sewick 2012[54] 7/1328 7/500 7.5 0.38 (0.13 to 1.07)
Subtotal (95% CI) 50/4297 431/23 674 38.8 0.34 (0.11 to 1.10)
Test for heterogeneity: τ²=1.76, χ²=34.33, df=6, P<0.001, I²=83%
Test for overall effect: z=1.80, P=0.07
Total (95% CI) 199/7464 564/26 886 100.0 0.70 (0.47 to 1.05)
Test for heterogeneity: τ²=0.28, χ²=39.10, df=14, P<0.001, I²=64%
Test for overall effect: z=1.74, P=0.08
Test for subgroup differences: χ²=3.86, df=1, P=0.05, I²=74.1%
0.01 0.1 1 10 100
Favours glycopeptide
Favours control

Environmental / Equipment Cleaning

Why is it important?



EDITORIAL COMMENTARY

Climbing the Evidentiary Hierarchy for Environmental Infection Control

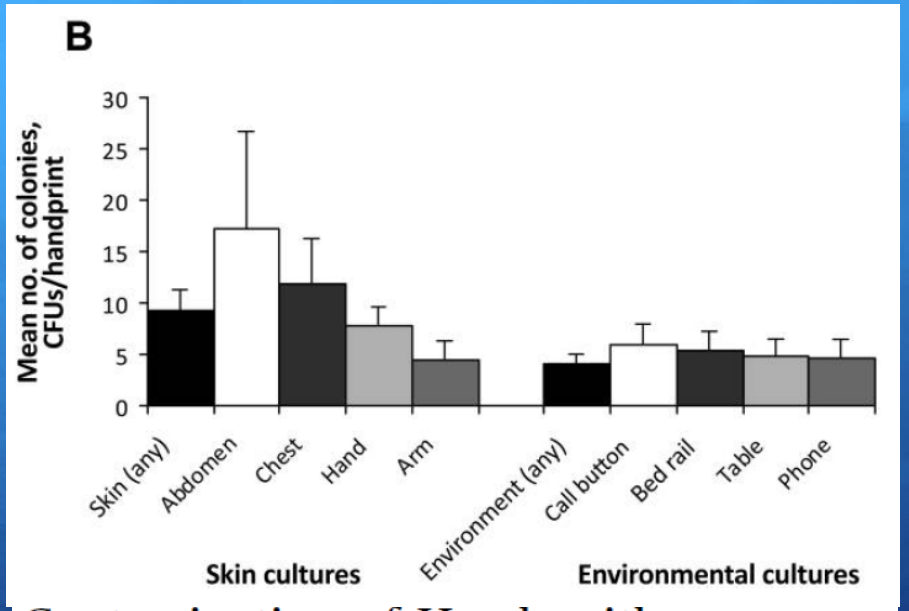
L. Clifford McDonald and Matthew Arduino

Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia

(See the Major Article by Passaretti et al, on pages 27–35.)

Stiefel, ICHE 2011

- Single center surveillance study of 40 MRSA colonized patients
- Compared acquisition of MRSA from examining an MRSA+ patient (4 sites) vs touching the patient's environment (4 sites)
- **Similar likelihood of acquiring MRSA from patient (40%) as the environment (45%)**



Contamination of Hands with Methicillin-Resistant *Staphylococcus aureus* after Contact with Environmental Surfaces and after Contact with the Skin of Colonized Patients

Usha Stiefel, MD;[1,2] Jennifer L. Cadnum, BS;[1] Brittany C. Eckstein, BS;[1] Dubert M. Guerrero, MD;[3] Mary Ann Tima, BS;[1] Curtis J. Donskey, MD[2,3]

Manian, ICHE 2011

- Convenience environmental surveillance of
- 312 rooms after C/D (clean/disinfection)
- 134 rooms after C/D + HP vapor
- 37 rooms after C/D + HP vapor + C/D
- **Manual cleaning is not sufficient: 26.6% of rooms had ≥ 1 ARO after C/D**
- **HP vapor was effective in eradicating ARO's from the environment**

ORIGINAL ARTICLE

Isolation of *Acinetobacter baumannii* Complex and Methicillin-Resistant *Staphylococcus aureus* from Hospital Rooms Following Terminal Cleaning and Disinfection: Can We Do Better?

Farrin A. Manian, MD, MPH;[1,2] Sandra Griesenauer, RN, MSN;[2] Diane Senkel, RN;[2] Janice M. Setzer, RN;[2] Sara A. Doll, RN;[2] Annie M. Perry, RN;[2] Michelle Wiechens, RN[2]

Otter, AJIC, 2013

Table 1
Survival of hospital pathogens on dry hospital surfaces

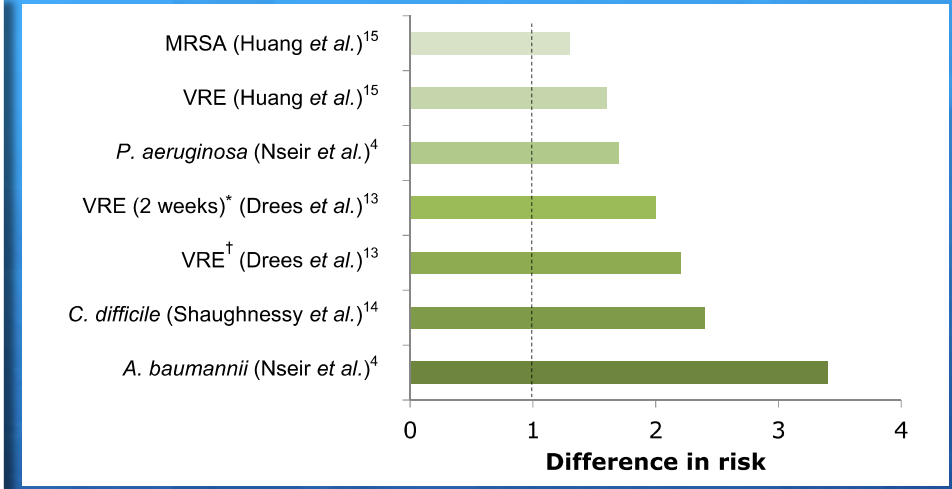
Organism	Survival time
Clostridium difficile (spores)	>5 Months
Acinetobacter spp	3 Days to 11 months[79]
Enterococcus spp including VRE	5 Days to >46 months[32]
Pseudomonas aeruginosa	6 Hours to 16 months
Klebsiella spp	2 Hours to >30 months
Staphylococcus aureus, including MRSA	7 Days to >12 months[80]
Norovirus (and feline calicivirus)	8 Hours to >2 weeks[81]

NOTE. Adapted from Kramer et al.[31]

Table 2
Transfer of pathogens from surfaces to the hands of health care personnel

Direct patient contact	Contact with environmental surfaces only
	52% of 44 HCP acquired VRE on their hands or gloves[10]
45% of 50 HCP acquired MRSA on their gloved hands[39]	40% of 50 HCP acquired MRSA on their gloved hands[39]
50% of 30 HCP acquired *Clostridium difficile* on their gloved hands[40]	50% of 30 HCP acquired *C difficile* on their gloved hands[40]
Compliance with hand hygiene: 80%[41]	Compliance with hand hygiene: 50%[41]

HCP, Health care personnel.



Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Original research article

Evidence that contaminated surfaces contribute to the transmission of hospital pathogens and an overview of strategies to address contaminated surfaces in hospital settings

Jonathan A. Otter PhD[a,b,*], Saber Yezli PhD[b], James A.G. Salkeld BSc[b], Gary L. French MD, FRCPath[a]

[a] *Centre for Clinical Infection and Diagnostics Research (CIDR), Department of Infectious Diseases, King's College London & Guy's and St. Thomas' NHS Foundation Trust, London, UK*
[b] *Bioquell, Andover, Hampshire, UK*

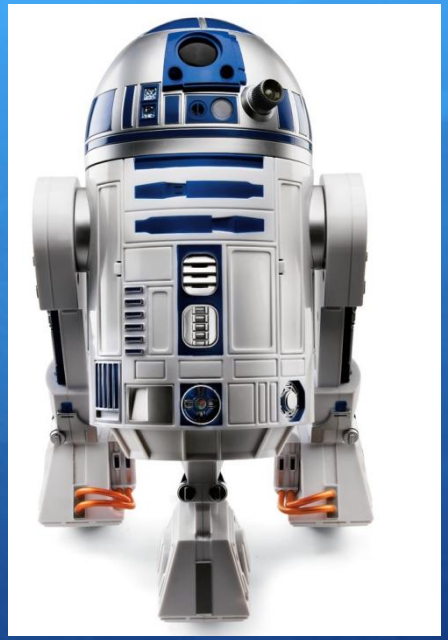
Passaretti, CID 2013

- Prospective cohort study, single center, 6 wards, 6350 patient admissions
- Standard cleaning vs standard cleaning + hydrogen peroxide vapor
- **Patients in HP vapor disinfected rooms had a reduction in VRE acquisition vs standard (2.4 /1000 pt days vs 11.6 /1000 pt days)**
- No difference in MRSA, MDR GNB, CDI

MAJOR ARTICLE

An Evaluation of Environmental Decontamination With Hydrogen Peroxide Vapor for Reducing the Risk of Patient Acquisition of Multidrug-Resistant Organisms

Catherine L. Passaretti,[1,2,3] Jonathan A. Otter,[4] Nicholas G. Reich,[5,6] Jessica Myers,[5] John Shepard,[1] Tracy Ross,[7] Karen C. Carroll,[7] Pam Lipsett,[8] and Trish M. Perl[1,2,5]



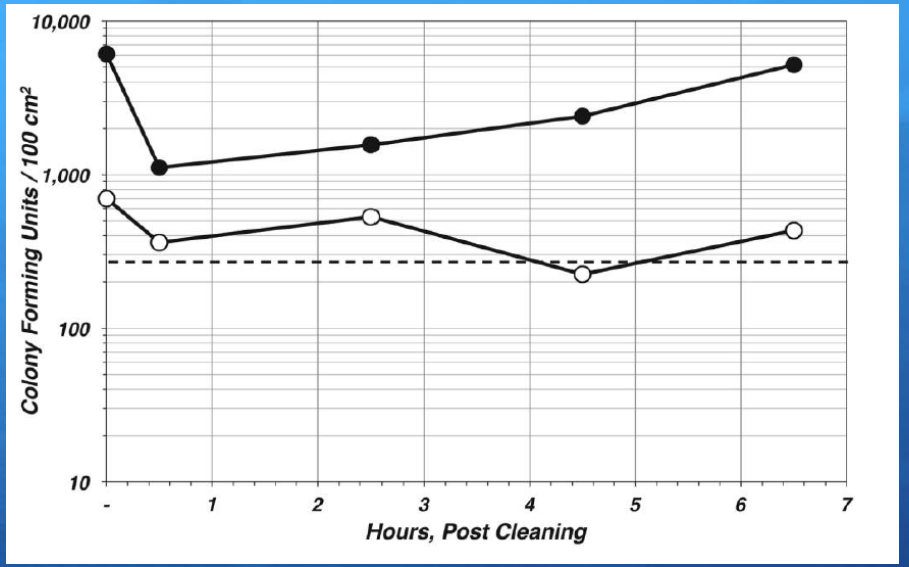
UV-C Machines and HAI's

D. Anderson at Duke, 9 hospitals, cluster-randomized trial with (1) TRU-D + bleach vs (2) TRU-D + quats vs (3) bleach only vs (4) quats only

Results pending…

Schmidt, ICHE 2013

- Prospective, unblinded, environmental surveillance study
- Single ICU, 3 Beds with copper bedrails vs 3 Beds with plastic bedrails sampled
- Sampled before clean, then serially after cleaning up to 7 hours
- Total of 75 observations for each
- **Manual cleaning did not reach benchmark**
- **Copper bedrails consistently limits the CFU of bacteria compared to plastic bedrails**



Copper Continuously Limits the Concentration of Bacteria Resident on Bed Rails within the Intensive Care Unit

Michael G. Schmidt, PhD;[1] Hubert H. Attaway III, MS;[1]
Sarah E. Fairey, BS;[1] Lisa L. Steed, PhD;[2]
Harold T. Michels, PhD;[3] Cassandra D. Salgado, MD, MS[4]

TABLE 1. Assessment of the Antimicrobial Activity of Copper to Control the Bacterial Burden between Cleanings with Virex 256

	Plastic bed rails		Copper bed rails		
Time point	Colony count, mean cfu/100 cm^2 (±SE)	Reduction, %	Colony count, mean cfu/100 cm^2 (±SE)	Reduction, %	*P*
Precleaning	6,102 ± 2,572		698 ± 368		.006
Hour 0.5	1,112 ± 802	82	362 ± 282	48	.069
Hour 2.5	1,560 ± 936	74	530 ± 530	24	.012
Hour 4.5	2,396 ± 1,502	61	224 ± 94	68	.013
Hour 6.5	5,198 ± 2,386	15	434 ± 236	38	.002

Copper Continuously Limits the Concentration of Bacteria Resident on Bed Rails within the Intensive Care Unit

Michael G. Schmidt, PhD;[1] Hubert H. Attaway III, MS;[1]
Sarah E. Fairey, BS;[1] Lisa L. Steed, PhD;[2]
Harold T. Michels, PhD;[3] Cassandra D. Salgado, MD, MS[4]

Salgado, ICHE 2013

- Non-blinded, randomized control trial
- 3 ICU's, 650 patients
- ICU rooms with copper clad surfaces (bed rails, overbed tables, IV poles, visitor arm chairs, +/- nurse button, computer peripherals) vs standard items
- **Patients in copper-clad ICU rooms had statistically significantly lower HAI / colonization with MRSA or VRE**

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY MAY 2013, VOL. 34, NO. 5

ORIGINAL ARTICLE

Copper Surfaces Reduce the Rate of Healthcare-Acquired Infections in the Intensive Care Unit

Cassandra D. Salgado, MD;[1] Kent A. Sepkowitz, MD;[2] Joseph F. John, MD;[3] J. Robert Cantey, MD;[1] Hubert H. Attaway, MS;[4] Katherine D. Freeman, DrPH;[5] Peter A. Sharpe, MBA;[6] Harold T. Michels, PhD;[7] Michael G. Schmidt, PhD[4]

TABLE 2. Distribution of Patients by Treatment Assignment for Primary and Secondary Outcomes

	Copper (n = 294)	Noncopper (n = 320)	Total	P
Primary outcome: new HAI or colonization				.020
No HAI or colonization	273 (92.86)	279 (87.19)	552 (89.90)	
HAI and/or colonization	21 (7.14)	41 (12.81)	62 (10.10)	
Secondary outcomes				
HAI only	10 (3.40)	26 (8.12)	36 (5.86)	.013
Colonization only	4 (1.36)	12 (3.75)	16 (2.61)	.063
ICU length of stay				.96
0–2 days	72 (24.49)	73 (22.81)	145 (23.62)	
3–4 days	95 (32.31)	108 (33.75)	203 (33.06)	
5–7 days	63 (21.43)	69 (21.56)	132 (21.50)	
>7 days	64 (21.77)	70 (21.88)	134 (21.82)	
Died in ICU	42 (14.29)	50 (15.63)	92 (14.98)	.64

Copper Surfaces Reduce the Rate of Healthcare-Acquired Infections in the Intensive Care Unit

Cassandra D. Salgado, MD;[1] Kent A. Sepkowitz, MD;[2] Joseph F. John, MD;[3] J. Robert Cantey, MD;[1] Hubert H. Attaway, MS;[4] Katherine D. Freeman, DrPH;[5] Peter A. Sharpe, MBA;[6] Harold T. Michels, PhD;[7] Michael G. Schmidt, PhD[4]

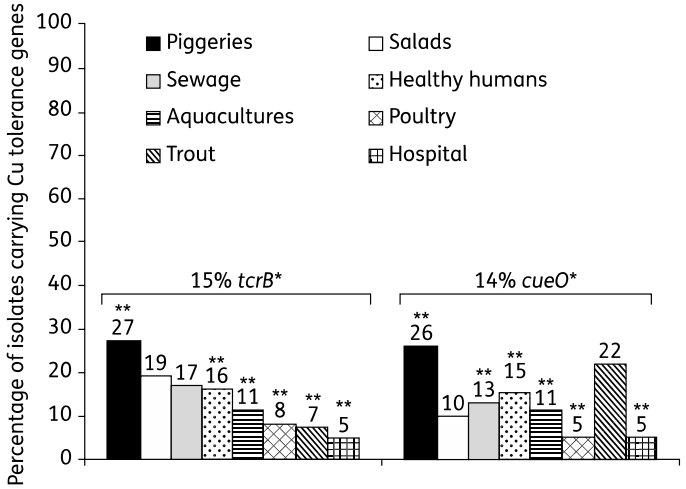
Silveria JAC 2014

Use of copper may select for Enterococcus with copper tolerance genes

these genes appear to be co-mediated with resistance to first line antibiotics

Prevalence of genes encoding Cu tolerance and epidemiological background

In this study, 348 *E. faecium*, 321 *E. faecalis*, 75 *E. hirae*, 29 *E. gallinarum*, 19 *E. casseliflavus*, 6 *E. durans* and 124 isolates that could



J Antimicrob Chemother 2014; **69**: 899–906
doi:10.1093/jac/dkt479 Advance Access publication 15 December 2013

Journal of Antimicrobial Chemotherapy

Co-transfer of resistance to high concentrations of copper and first-line antibiotics among *Enterococcus* from different origins (humans, animals, the environment and foods) and clonal lineages

Eduarda Silveira[1], Ana R. Freitas[1], Patrícia Antunes[1,2], Mariana Barros[1], Joana Campos[1], Teresa M. Coque[3–5], Luísa Peixe[1] and Carla Novais[1]*

[1]REQUIMTE, Laboratório de Microbiologia, Faculdade de Farmácia, Universidade do Porto, Porto, Portugal; [2]Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto, Porto, Portugal; [3]Servicio de Microbiologia, Hospital Ramón y Cajal, Instituto Ramón y Cajal de Investigación Sanitaria (IRYCIS), Madrid, Spain; [4]Centro de Investigación Biomédica en Red de Epidemiología y Salud Pública (CIBER-ESP), Madrid, Spain; [5]Unidad de Resistencia a Antibióticos y Virulencia Bacteriana asociada al Consejo Superior de Investigaciones Científicas (CSIC), Madrid, Spain

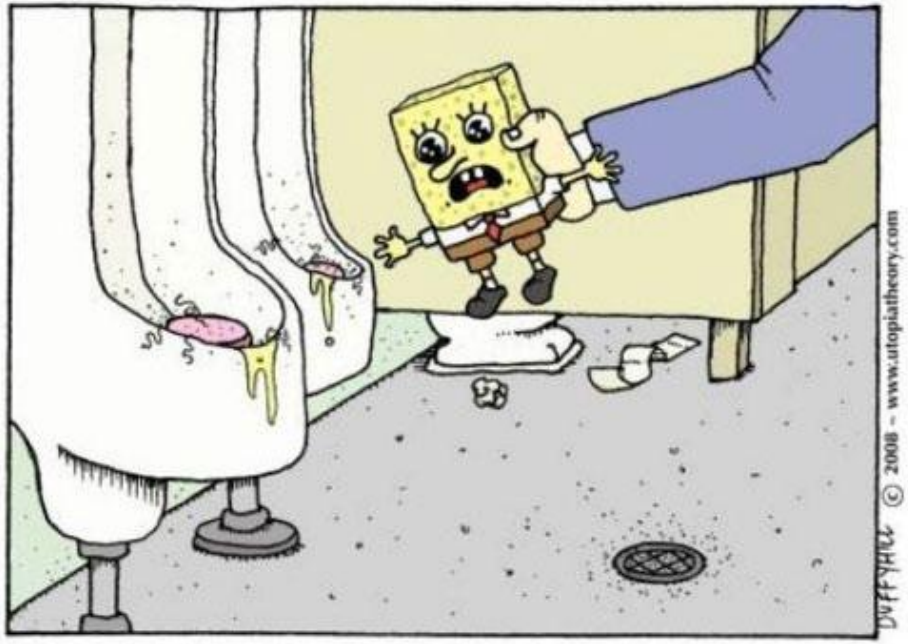
Environmental Cleaning

the patient environment contributes to acquisition of ARO's

manual cleaning is important but oftentimes suboptimal

technologies that may supplement manual cleaning: HP vapor, UVC, antimicrobial surfaces

important questions: can increased disinfection of high touch surfaces decrease HAI? How often should it be done? Is bioburden reduction enough or is eradication necessary?



After the cancellation of his show,
Sponge Bob was forced to take any job he could get...

Summary

- WGS may be the future of typing, improved discrimination
- Substantial genetic variability in MRSA, C. difficile points to sources we have yet to determine
- No one method is sufficient to prevent HAIs
- Ceiling for long-standing practices?
  - impact of gowning and gloving policies
- Emergence of decolonization as infection prevention
  - Chlorhexidine bathing
  - Pre-surgical decolonization
- Manual Cleaning isn't good enough
  - ARO's stick around the patient environment
  - the environment can transmit ARO's to HCW's
  - Evidence for environmental hygiene is improving
  - Technologies to supplement manual cleaning: HP vapor, UVC, antimicrobial surfaces

Marchetti, Rossiter J Med Econ 2013

- Previous CDC estimate: $28-45 billion in direct costs for HAI's in US hospitals
- This study updates those estimates and added *Indirect* costs
- **Total HAI societal costs $96-147 billion annually**

Table 1. Societal cost of hospital-acquired infections.

Category	Societal low	Societal high
Direct costs (Billions)		
Index hospitalization	$24.8	$53.9
Professional fees index hospitalization	$4.9	$13.2
Post-discharge outpatient	$0.2	$0.2
Readmission post-index hospitalization	$3.4	$4.0
Professional fees readmission	$0.7	$1.0
Post-discharge diagnosed infection	$0.3	$1.7
Sub-totals	$34.3	$74
Indirect costs		
Lost wages, incapacitation	$2.5	$3.9
Lost future wages, premature death	$59.1	$68.7
Sub-totals	$61.6	$72.6
Total societal costs		
Societal cost of illness	$96*	$147*

Original article

Economic burden of healthcare-associated infection in US acute care hospitals: societal perspective

Albert Marchetti
MedERA—Medical Education and Research Alliance, Linwood, NJ, USA, and UMDNJ—University of Medicine and Dentistry of New Jersey, Newark, NJ, USA

Richard Rossiter
MedERA—Medical Education and Research Alliance, Linwood, NJ, USA

DiBiase, ICHE 2014

- Dreaded "July effect"
- Assessed effect of new trainees in July at a tertiary care academic hospital
- Simple 3 month pre vs post July
- Outcome: ?difference in HAI?
- **Found no difference in overall HAI's – stop blaming the newbies!**

TABLE 1. Incidence of Selected and Overall Healthcare-Associated Infections (HAIs) for the Indicated Time Periods, 2010–2012

	Infection rate (95% CI)	
Infection	April–June	July–September
SSI	9.33 (8.10–10.69)	10.31 (9.02–11.73)
VAP	2.64 (1.85–3.65)	1.99 (1.29–2.94)
CLABSI	1.64 (1.34–1.98)	1.42 (1.14–1.73)
CAUTI	2.50 (2.06–3.01)	2.59 (2.14–3.11)
All HAIs	4.89 (4.58–5.23)	4.84 (4.52–5.16)

NOTE. CAUTI, catheter-related urinary tract infection; CI, confidence interval; CLABSI, central line–associated bloodstream infection; SSI, surgical site infection; VAP, ventilator-associated pneumonia.

July Effect: Impact of the Academic Year-End Changeover on the Incidence of Healthcare-Associated Infections

Lauren M. DiBiase, MS;[1] David J. Weber, MD, MPH;[1,2] Emily E. Sickbert-Bennett, PhD;[1,2] Clark Denniston, MD;[3] William A. Rutala, PhD, MPH[1,2]

Olson, J Econ Entomol 2013

- **Bed Bugs can survive below freezing temperatures**
- -16C x 80h or -20C x 48h is needed to achieve 100% kill

Thank You / Questions?

Thanks to Drs. E. Bryce, N. Rau, and E. Blondel-Hill, C. Lowe for their assistance