Friday 19th June 2015

Infection Prevention in the ICU – what works?

Dr Duncan Wyncoll, Guy's & St Thomas' NHS Foundation Trust, London, UK

Conflicts of Interest

In the last 5 years I have acted as consultant, or received honoraria/research grants from:

Astellas, Biovo, ConvaTec, Covidien, Eli Lilly, F&P, Iskus Health, J&J, Kimberly-Clark, Pfizer, Sage & Vygon

A comparison of ventilator-associated pneumonia rates as identified according to the National Healthcare Safety Network and American College of Chest Physicians criteria*

Lee P. Skrupky, PharmD; Kevin McConnell, MD; John Dallas, MD; Marin H. Kollef, MD

- 1 yr study of 2,060 ventilated patients
- 83 patients (4%) had VAP according to ACCP definition vs. 12 patients (0.6%) according to National Healthcare Safety Network criteria
- Equivalent to 8.5 vs. 1.2 per 1,000 vent days
- NHSN picked up 14.5% of clinical cases

Skrupky LP et al, *Crit Care Med 2012;* ***40:*** *281-4*

From VAP, to VAE, to VAC, to IVAC…

The CDC's New Surveillance Paradigm for Ventilator-Associated Events.

Concept	Name	Definition
New respiratory deterioration	Ventilator-associated condition (VAC)	≥2 Calendar days of stable or decreasing daily minimum positive end-expiratory pressure or daily minimum fraction of inspired oxygen, followed by a rise in daily minimum positive end-expiratory pressure of ≥3 cm of water or a rise in the daily minimum percentage of inspired oxygen by >20 points sustained for ≥2 calendar days
New respiratory deterioration with evidence of infection	Infection-related ventilator-associated complication (IVAC)	VAC plus a temperature of <36°C or >38°C or a leukocyte count of ≤4000 or ≥12,000 per cubic millimeter, plus one or more new antibiotics continued for at least 4 days within 2 calendar days before or after onset of a VAC, excluding the first 2 days of mechanical ventilation
New respiratory deterioration with possible evidence of pulmonary infection	Possible pneumonia	IVAC plus Gram's staining of endotracheal aspirate or bronchoalveolar lavage showing ≥25 neutrophils and ≤10 epithelial cells per low-power field, or a positive culture for a potentially pathogenic organism, within 2 calendar days before or after onset of a VAC, excluding the first 2 days of mechanical ventilation
New respiratory deterioration with probable evidence of pulmonary infection	Probable pneumonia	IVAC plus Gram's staining of endotracheal aspirate or bronchoalveolar lavage showing ≥25 neutrophils and ≤10 epithelial cells per low-power field, plus endotracheal aspirate with $\geq 10^5$ colony-forming units per milliliter or bronchoalveolar-lavage culture with $\geq 10^4$ colony-forming units per milliliter, or endotracheal-aspirate or bronchoalveolar-lavage semiquantitative equivalent, within 2 calendar days before or after onset of a VAC, excluding the first 2 days of mechanical ventilation

From VAP, to VAE, to VAC, to IVAC…

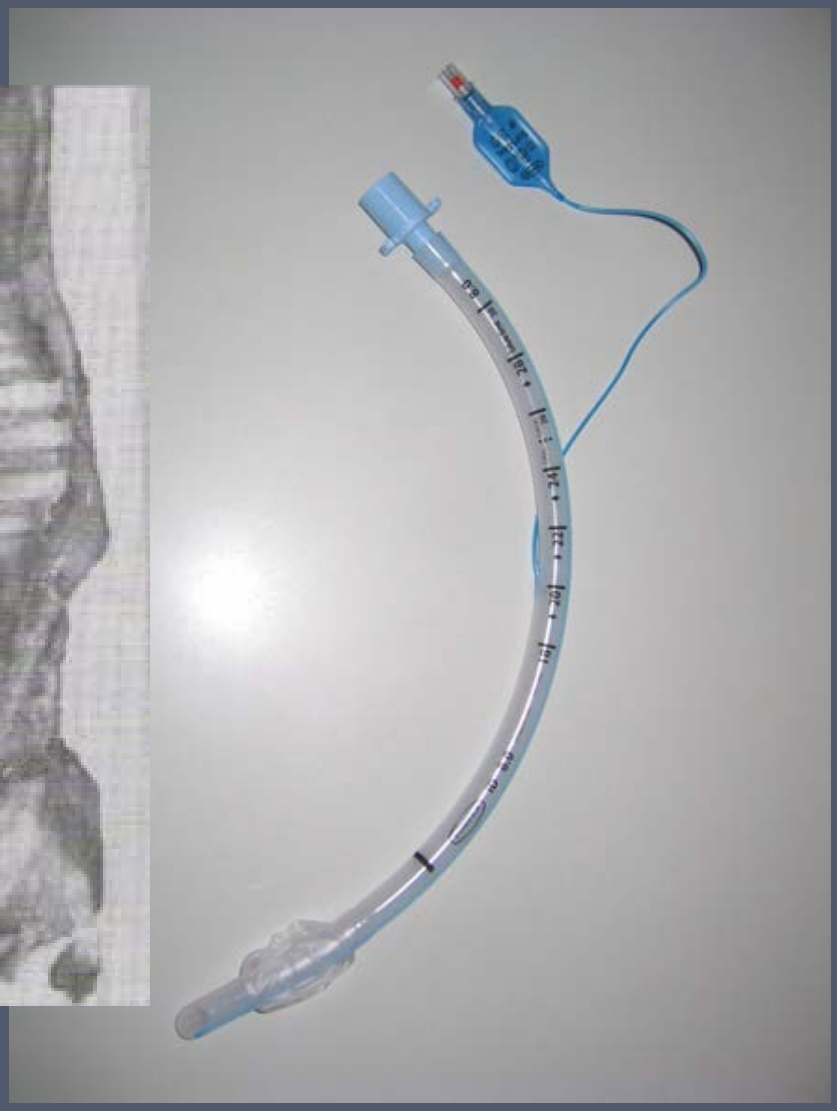
Infection-related ventilator-associated complication (IVAC)	VAC plus a temperature of <36°C or >38°C or a leukocyte count of ≤4000 or ≥12,000 per cubic millimeter, plus one or more new antibiotics continued for at least 4 days within 2 calendar days before or after onset of a VAC, excluding the first 2 days of mechanical ventilation

New definitions…

- Don't need radiology
- Don't necessarily need +ve micro
- Are linked to antibiotic use
- Highlights a problem some have chosen to ignore

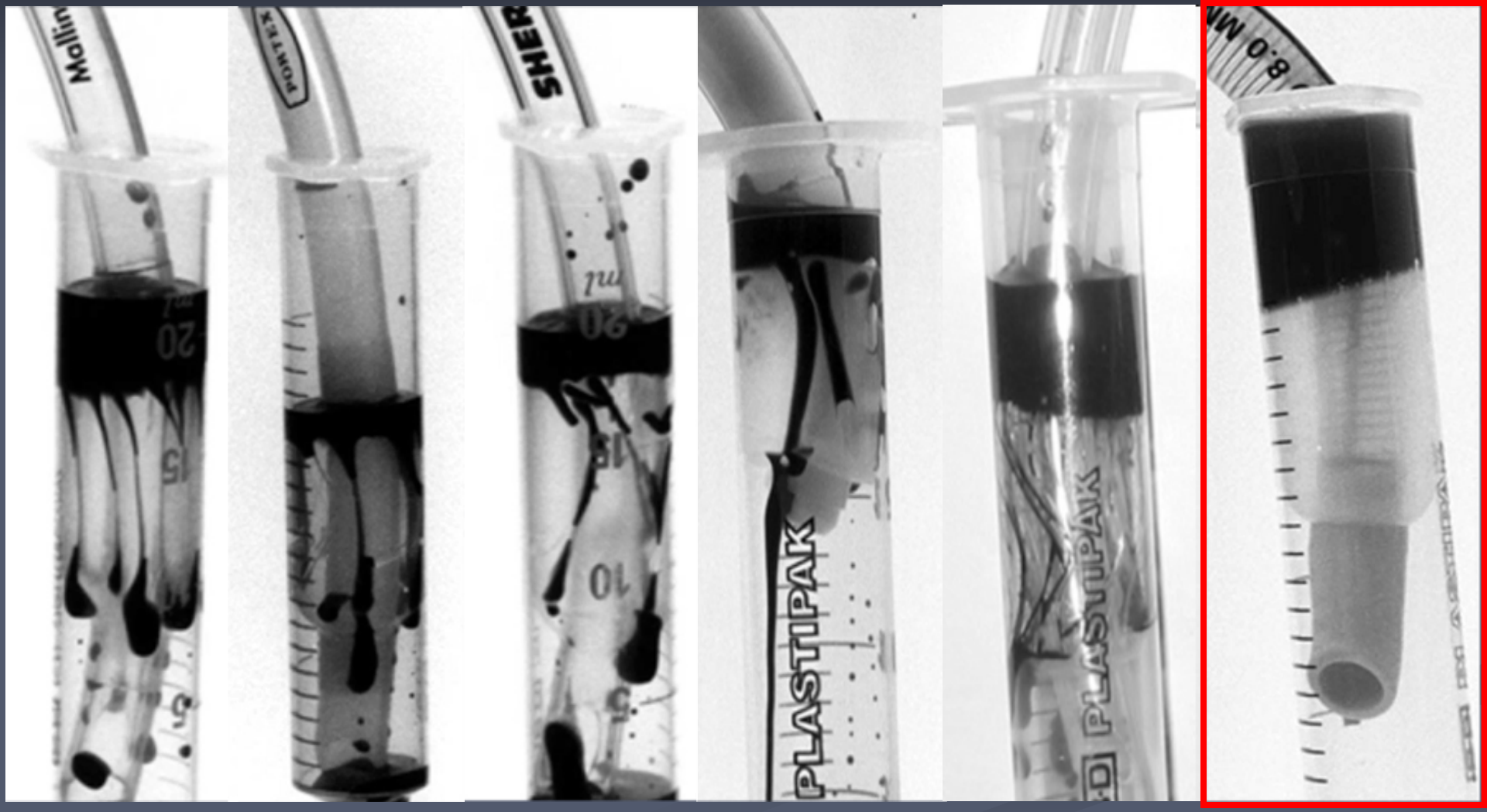
‘IVAC’ is an old & iatrogenic syndrome

1970 – 1980’s



Photographs courtesy of Dr Peter Young, King’s Lynn, UK

Almost Universal Failure with HVLP Cuffs



Zolfaghari PJ & Wyncoll DLA. *Crit Care 2011;* 15**:** 310

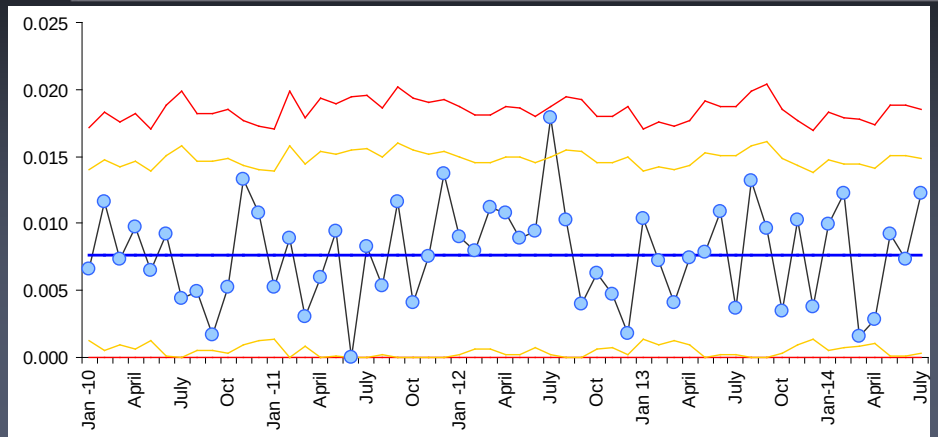
Pepsin – in the lungs!?

- Intra-tracheal pepsin used as marker for gastric aspiration in critically ill intubated patients
- >6,000 tracheal aspirates (360 patients)
- 89% of patients had pepsin detected at some stage
- Aspiration was the most significant independent risk factor for pneumonia

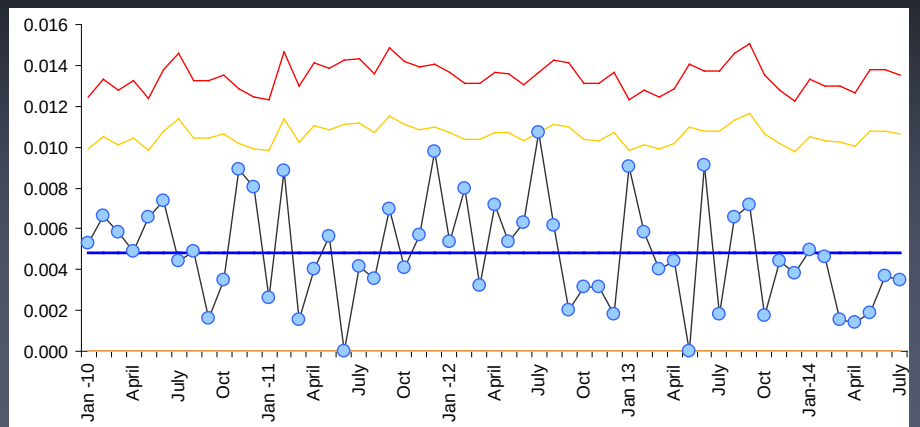
9/10 patients aspirate stomach contents

Methany NA et al, *Crit Care Med 2006;**34:**1007-15*

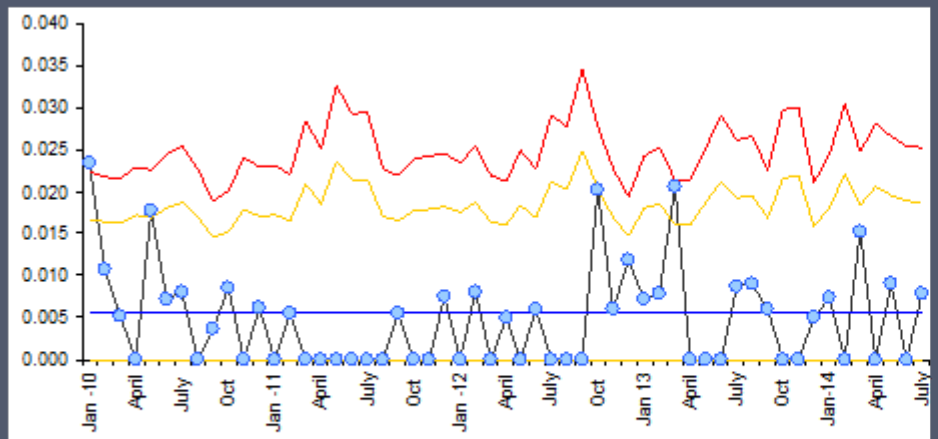
St Thomas' (upper pair), Guy's (lower pair)



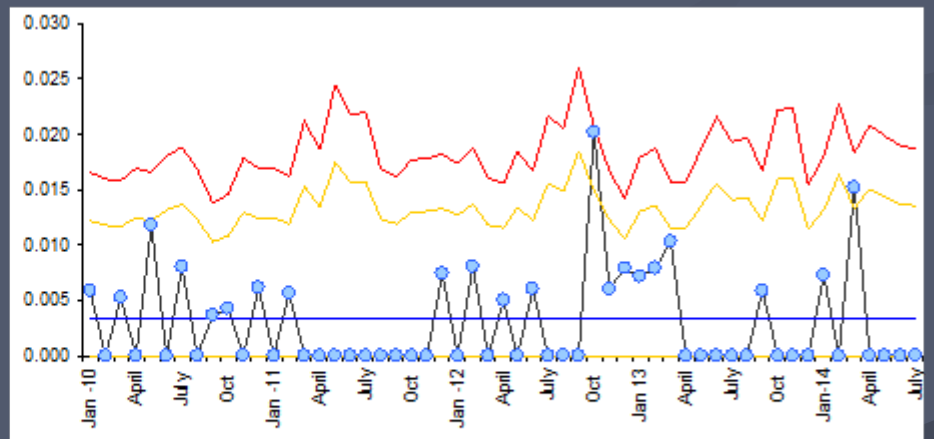
Clinical VAP



Micro +ve VAP



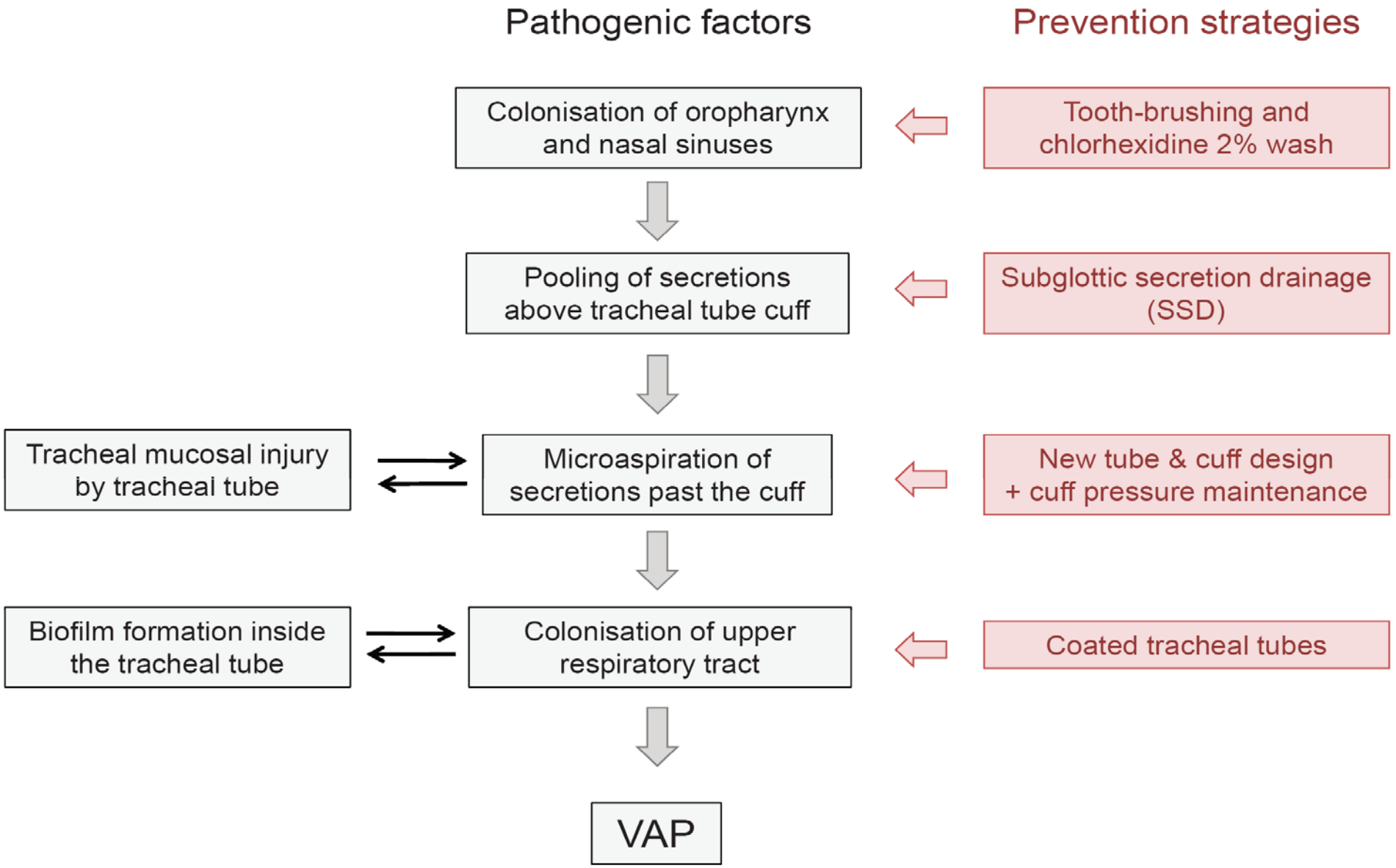
Clinical VAP



Micro +ve VAP

Same staff, same protocols, same kit – *different casemix*

VAP Prevention



Zolfaghari PJ & Wyncoll DLA. *Crit Care 2011;* 15**:** 310

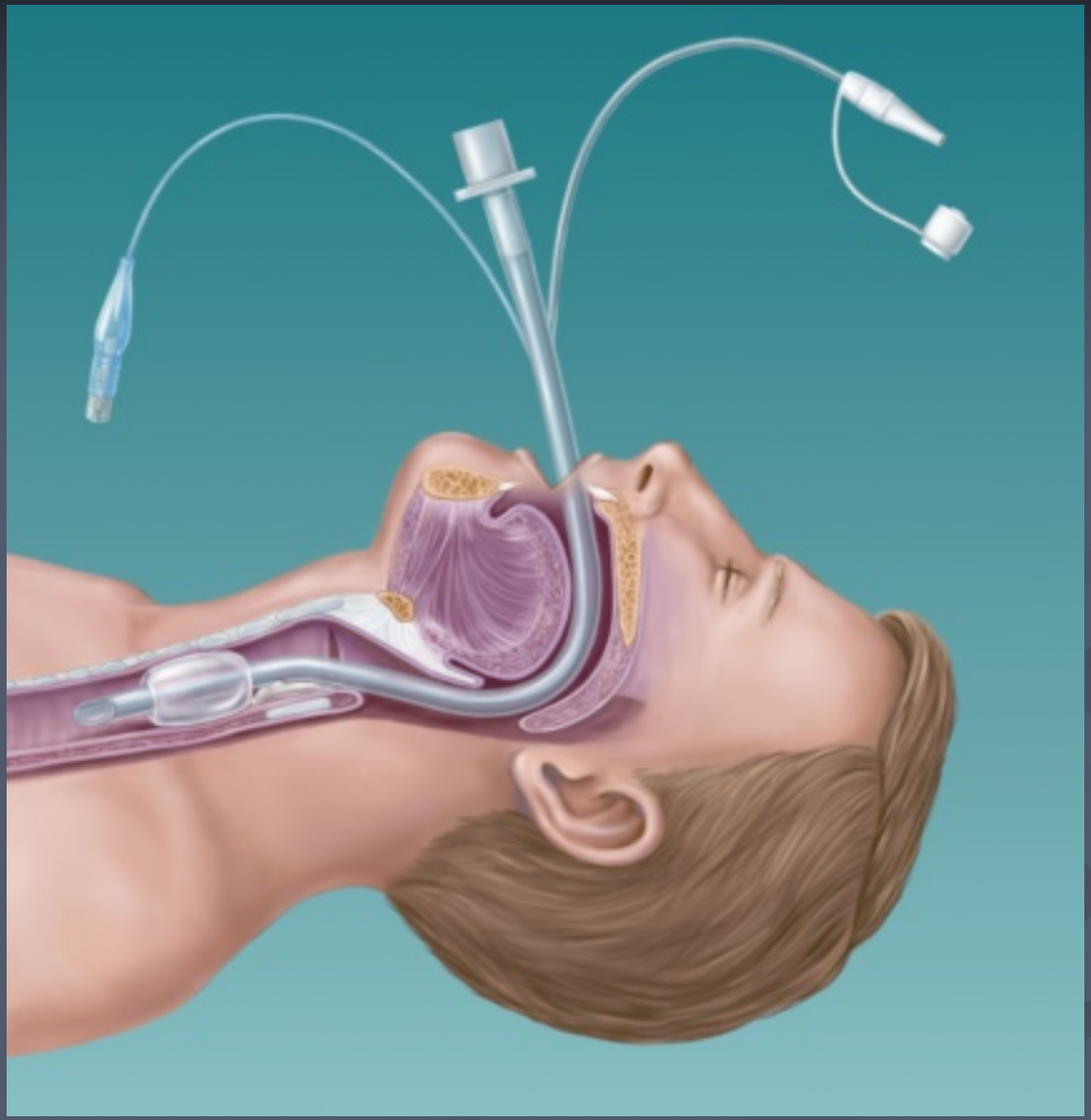
UK High Impact Intervention No 5 – 2011

(Care bundle to reduce VAP)

1. Elevation of the head of the bed
2. Sedation level assessment
3. Oral hygiene
4. Subglottic aspiration
5. Tracheal tube cuff pressure
6. Targeted stress ulcer prophylaxis

www.clean-safe-care.nhs.uk/index.php?pid=11#ventilation

Subglottic Secretion Drainage Tubes



Zolfaghari PJ & Wyncoll DLA. *Crit Care 2011;* 15**:** 310

Subglottic Secretion Drainage & VAP

Study or Subgroup	SSD Events	SSD Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI	Year
Mahul 1992	9	70	21	75	6.2%	0.46 [0.23, 0.93]	1992
Valles 1995	14	76	25	77	9.5%	0.57 [0.32, 1.01]	1995
Metz 1998	5	10	10	14	6.3%	0.70 [0.35, 1.41]	1998
Kollef 1999	8	160	15	183	4.5%	0.61 [0.27, 1.40]	1999
Bo 2000	8	35	15	33	6.1%	0.50 [0.25, 1.03]	2000
Smulders 2002	3	75	12	75	2.1%	0.25 [0.07, 0.85]	2002
Girou 2004	5	8	6	10	5.7%	1.04 [0.50, 2.18]	2004
Liu 2006	14	41	30	45	13.9%	0.51 [0.32, 0.82]	2006
Lorente 2007	11	140	31	140	7.4%	0.35 [0.19, 0.68]	2007
Yang 2008	12	48	20	43	9.1%	0.54 [0.30, 0.97]	2008
Bouza 2008	12	331	19	359	6.2%	0.69 [0.34, 1.39]	2008
Zheng 2008	9	30	16	31	7.5%	0.58 [0.31, 1.11]	2008
Lacherade 2010	25	169	42	164	15.6%	0.58 [0.37, 0.90]	2010
Total (95% CI)		**1193**		**1249**	**100.0%**	**0.55 [0.46, 0.66]**	
Total events	135		262				

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 7.78$, df = 12 (P = 0.80); $I^2 = 0\%$

Test for overall effect: Z = 6.57 (P < 0.00001)

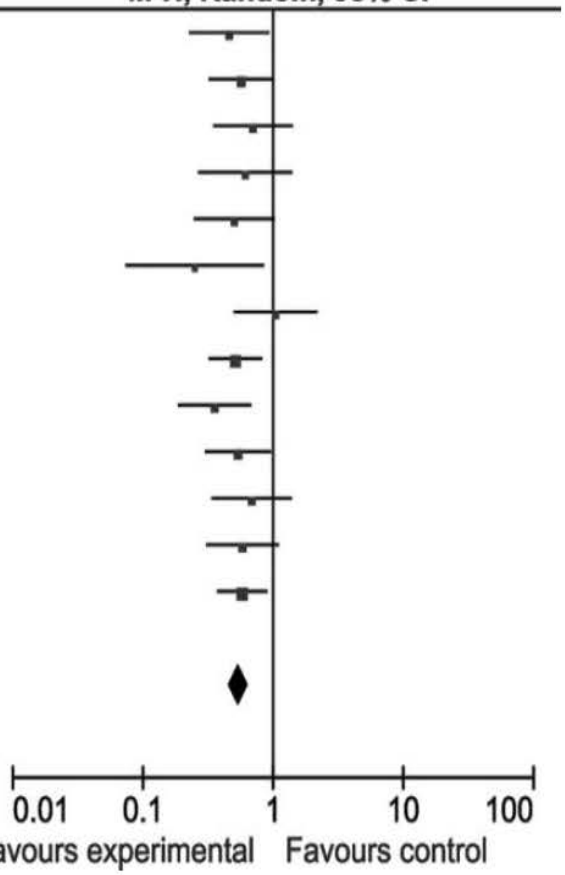
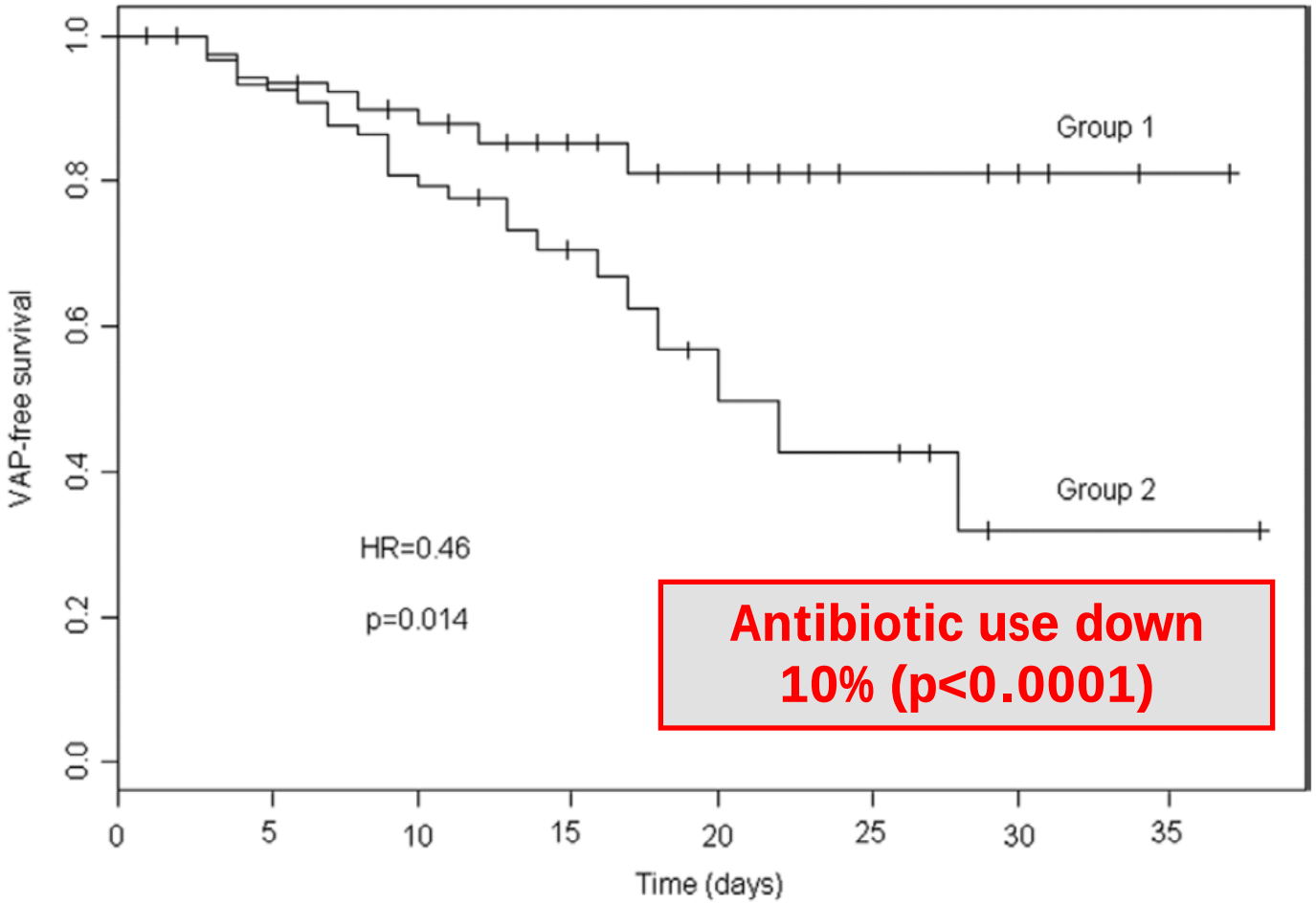


Figure 1. Rate of ventilator-associated pneumonia between groups with subglottic secretion and without subglottic secretion. *M-H*, Mantel-Henszel; *SSD*, subglottic secretion drainage; *CI*, confidence interval.

Muscedere J et al, *Crit Care Med 2011;* ***39:*** *1985-91*

Subglottic Secretion Drainage & VAP



Antibiotic use down 10% (p<0.0001)

Group 1								
At risk	170	107	45	22	17	6	3	1
New VAP cases	0	9	4	1	1	0	0	0
Group 2								
At risk	182	119	53	20	7	6	1	1
New VAP cases	0	11	11	4	4	1	1	0

Damas P et al, *Crit Care Med 2014*

Subglottic Secretion Drainage & VAP

Study or Subgroup	SSD Events	SSD Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI	Year
Mahul 1992	17	70	16	75	8.3%	1.14 [0.62, 2.07]	1992
Valles 1995	30	76	28	77	18.2%	1.09 [0.72, 1.63]	1995
Lorente 2007	26	140	32	140	14.1%	0.81 [0.51, 1.29]	2007
Zheng 2008	8	30	12	31	5.5%	0.69 [0.33, 1.44]	2008
Bouza 2008	22	331	23	359	9.4%	1.04 [0.59, 1.83]	2008
Lacherade 2010	71	169	65	164	44.6%	1.06 [0.82, 1.37]	2010
Total (95% CI)		**816**		**846**	**100.0%**	**1.01 [0.85, 1.20]**	
Total events	174		176				

Heterogeneity: Tau² = 0.00; Chi² = 2.30, df = 5 (P = 0.81); I² = 0%
Test for overall effect: Z = 0.06 (P = 0.95)

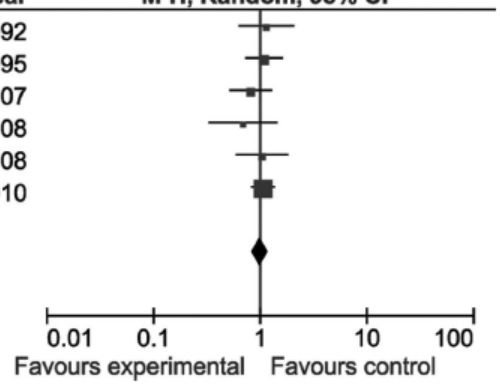


Figure 3. Intensive care unit mortality compared between patients receiving endotracheal tubes with subglot
Hensze

Study or Subgroup	SSD Mean	SSD SD	SSD Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI	Year
Valles 1995	19.4	4	76	22	2	77	19.5%	-2.60 [-3.60, -1.60]	1995
Kollef 1999	3.7	4.6	160	3.2	4.5	183	19.7%	0.50 [-0.47, 1.47]	1999
Smulders 2002	9.3	7.4	75	12.3	3.6	75	15.7%	-3.00 [-4.86, -1.14]	2002
Lorente 2007	14.1	17.9	140	15.5	19.9	140	6.9%	-1.40 [-5.83, 3.03]	2007
Bouza 2008	5.6	10.7	331	6.5	14.2	359	15.7%	-0.90 [-2.77, 0.97]	2008
Zheng 2008	9.3	2.9	30	12.3	5.7	31	14.0%	-3.00 [-5.26, -0.74]	2008
Lacherade 2010	15.9	14.4	169	15.7	20.4	164	8.4%	0.20 [-3.60, 4.00]	2010
Total (95% CI)			**981**			**1029**	**100.0%**	**-1.52 [-2.94, -0.11]**	

Heterogeneity: Tau² = 2.40; Chi² = 25.93, df = 6 (P = 0.0002); I² = 77%
Test for overall effect: Z = 2.11 (P = 0.03)

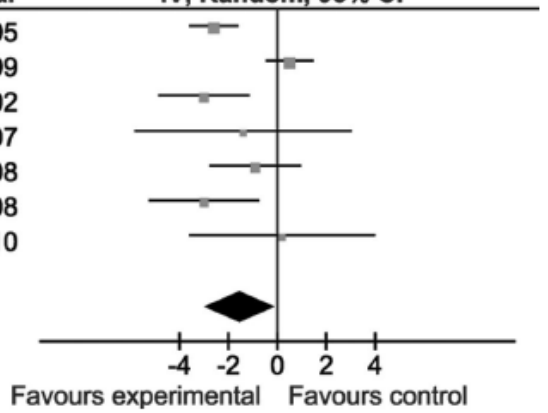


Figure 5. Intensive care unit length of stay compared between patients receiving endotracheal tubes with subglottic secretion drainage and standard endotracheal tubes. *IV*, inverse variance; *CI*, confidence interval; *M-H*, Mantel-Henszel; *SSD*, subglottic secretion drainage.

Muscedere J et al, *Crit Care Med 2011;* ***39:*** *1985-91*

Attributable mortality & VAP

Attributable mortality of ventilator-associated pneumonia: a meta-analysis of individual patient data from randomised prevention studies

Wilhelmina G Melsen, Maroeska M Rovers, Rolf H H Groenwold, Dennis C J J Bergmans, Christophe Camus, Torsten T Bauer, Ernst W Hanisch, Bengt Klarin, Mirelle Koeman, Wolfgang A Krueger, Jean-Claude Lacherade, Leonardo Lorente, Ziad A Memish, Lee E Morrow, Giuseppe Nardi, Christianne A van Nieuwenhoven, Grant E O'Keefe, George Nakos, Frank A Scannapieco, Philippe Seguin, Thomas Staudinger, Arzu Topeli, Miquel Ferrer, Marc J M Bonten

Interpretation The overall attributable mortality of ventilator-associated pneumonia is 13%, with higher rates for surgical patients and patients with a mid-range severity score at admission. Attributable mortality is mainly caused by prolonged exposure to the risk of dying due to increased length of ICU stay.

Melsen WG et al, *Lancet Infect Dis 2013;* ***13:*** *665-71*

Attributable mortality & VAP

Attributable mortality of ventilator-associated pneumonia: a meta-analysis of individual patient data from randomised prevention studies

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Increase LOS = Increase costs = Can't afford, taken home to die…

~£10

Covidien
Taperguard

Teleflex ISIS

~£10

~£8

Portex SACETT

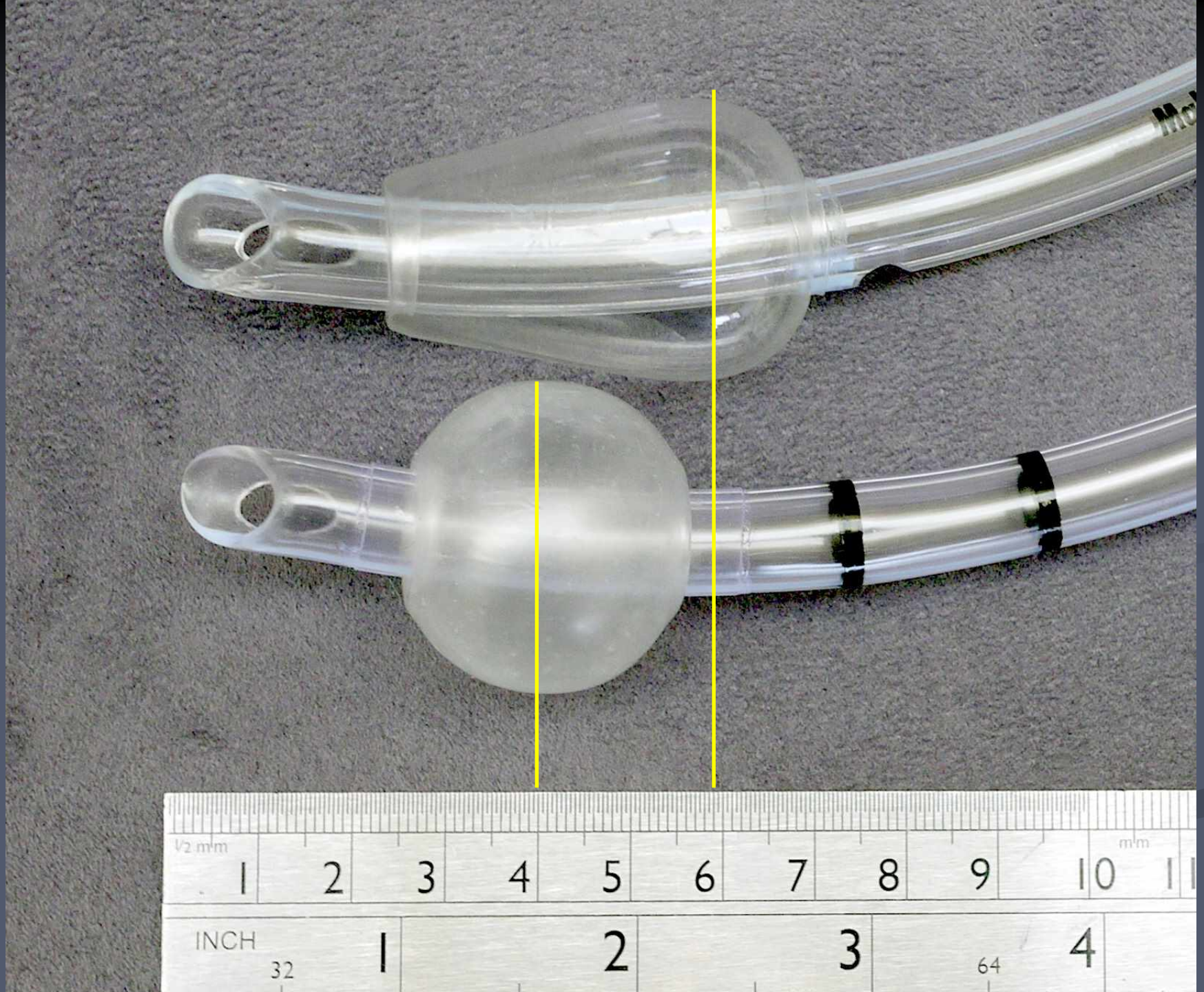
Subglottic Secretion Drainage Tubes

Kimberly-Clark

~£10

~£120

Young Lotrach


1 2 3 4 5 6 7 8 9 10
INCH
1
2
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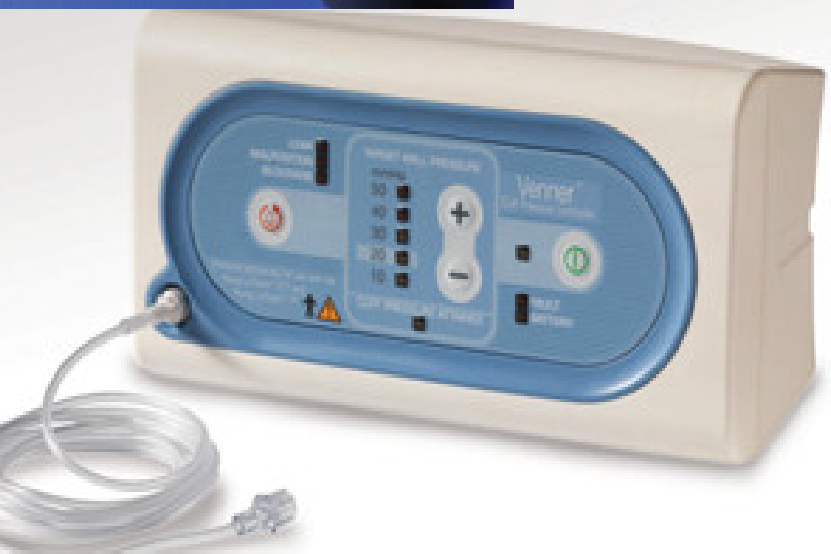
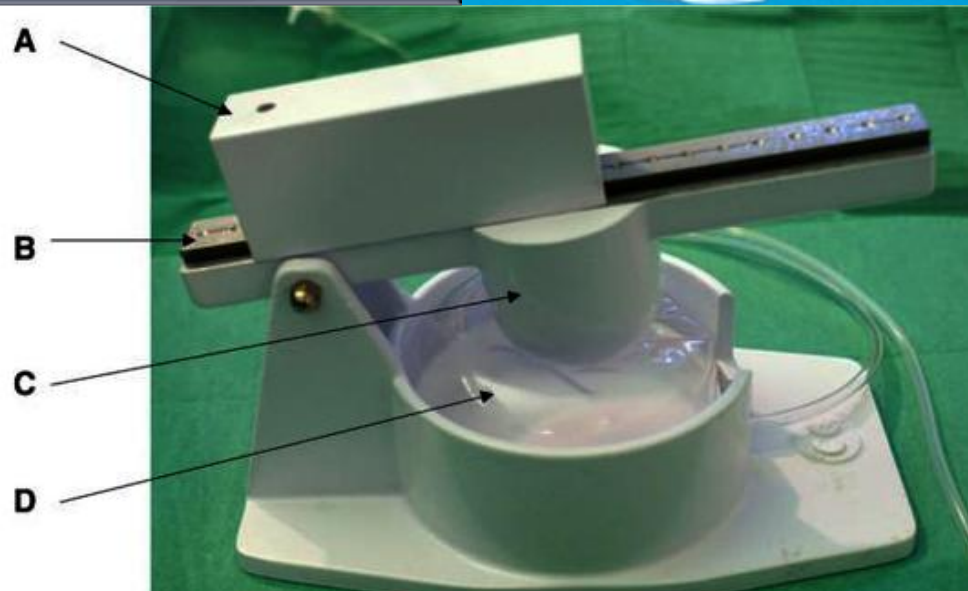
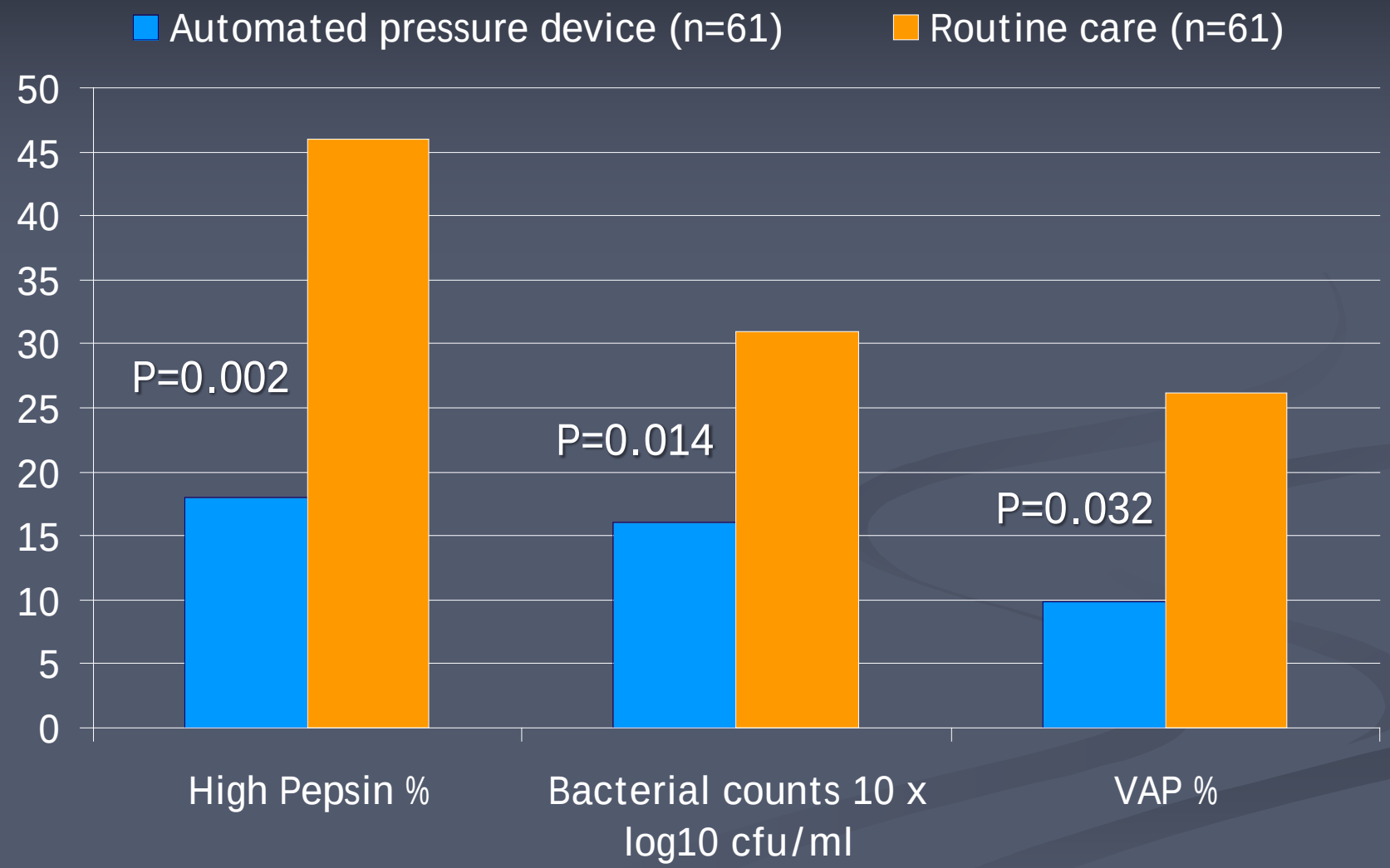
Cuff Pressure Controllers





Continuous Control of Tracheal Cuff Pressure & Micro-aspiration in the Critically Ill

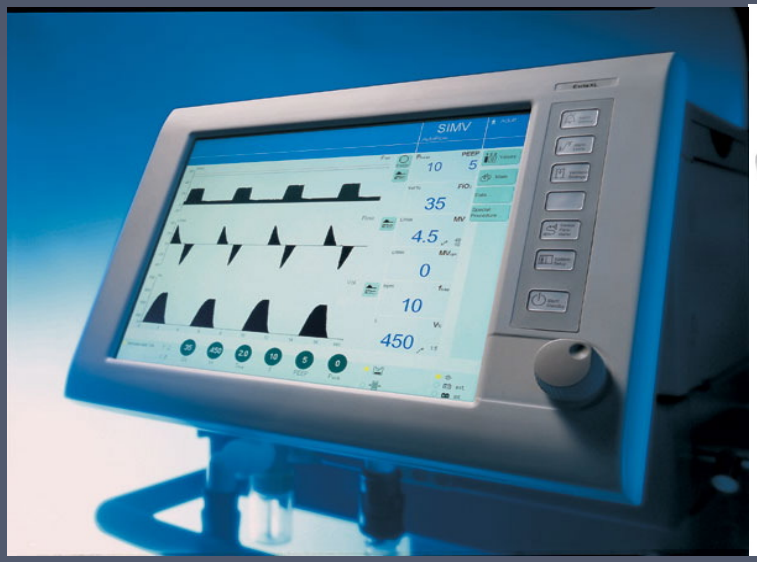


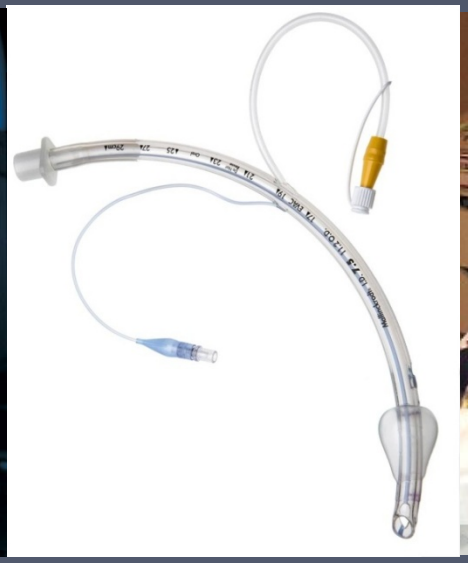
Nseir S et al, Am J Respir *Crit Care Med 2011; Epub August*

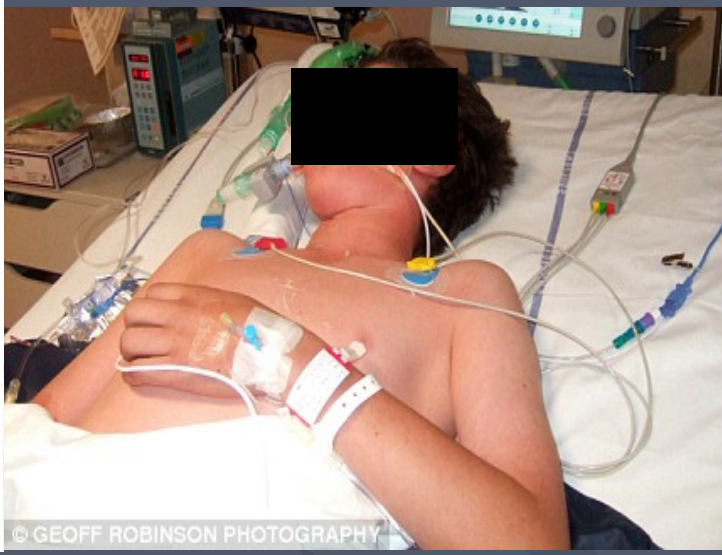
Published data & potential devices…

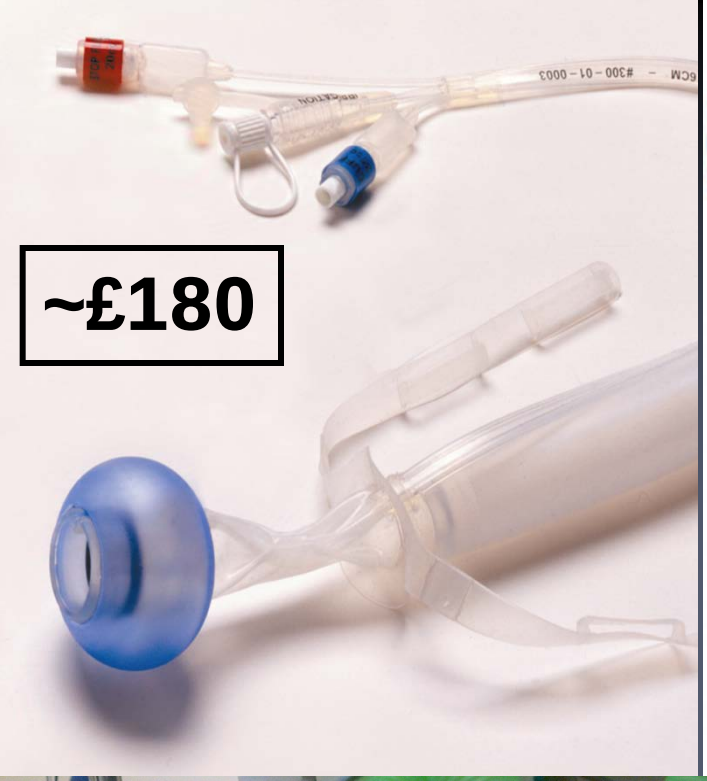
Author	*Valencia 2007*	*Nseir 2011*	*Lorente 2014*
Sample size	142	122	284
Device	'Homemade' device	'Nosten' Pneumatic	VBM Electronic
ET tube	Conical PVC, with no SSD	PVC, with no SSD	Tapered PVC (some with SSD)
Outcomes	**Clinical VAP** Early 29 % → 22% (ns) Late 15 % → 10% **Micro VAP** 15% both groups	**VAP** Suspected 39 % → 16 % Micro 26.2 % → 9.8 % (p=0.03)	**VAP** Micro 22 % → 11% Tracheo-bronchitis 6.7 % → 3.7%
Notes	2 ICUs >600 Eligible (75% excluded) No mention of ABX use	Single ICU Very few exclusions VAP was secondary outcome No mention of ABX use	Single ICU Pseudo-randomised Blinded expert panel No mention of ABX use

The Life Support System	The Interface	The Life
Value	~$1-15	$250,000 - 1,000,000
~$50,000		

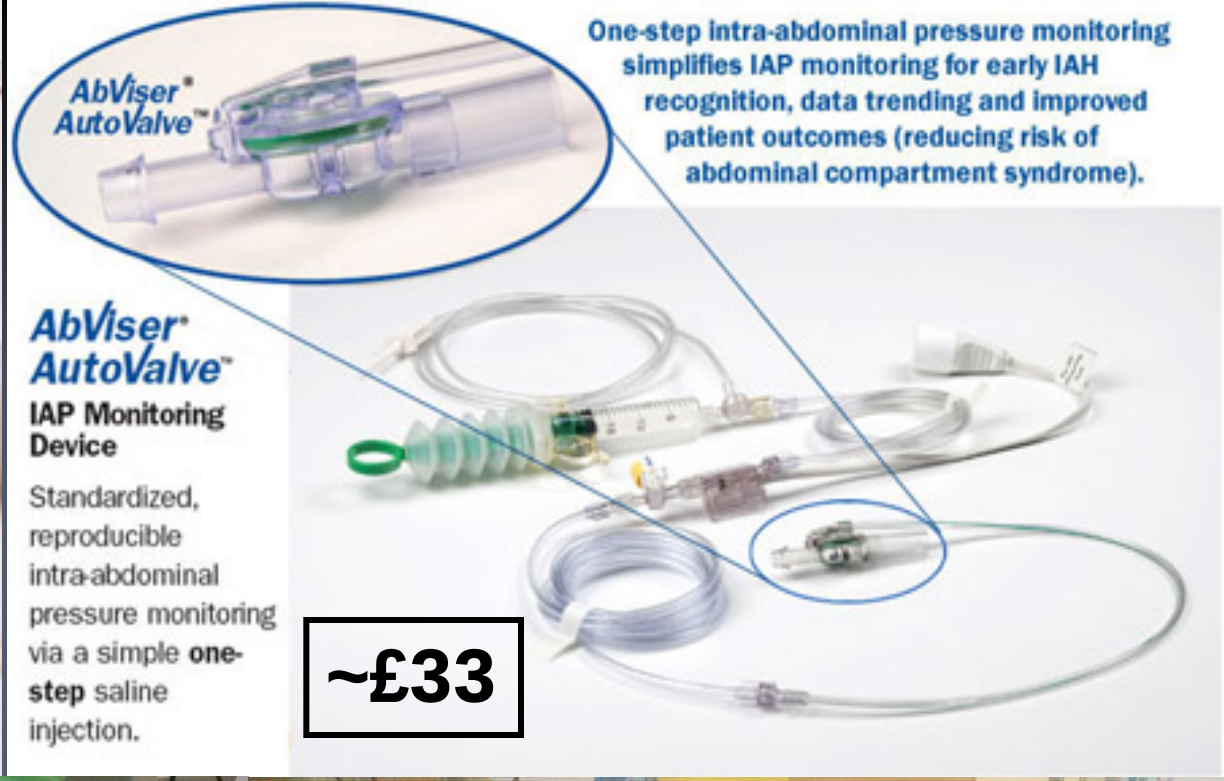






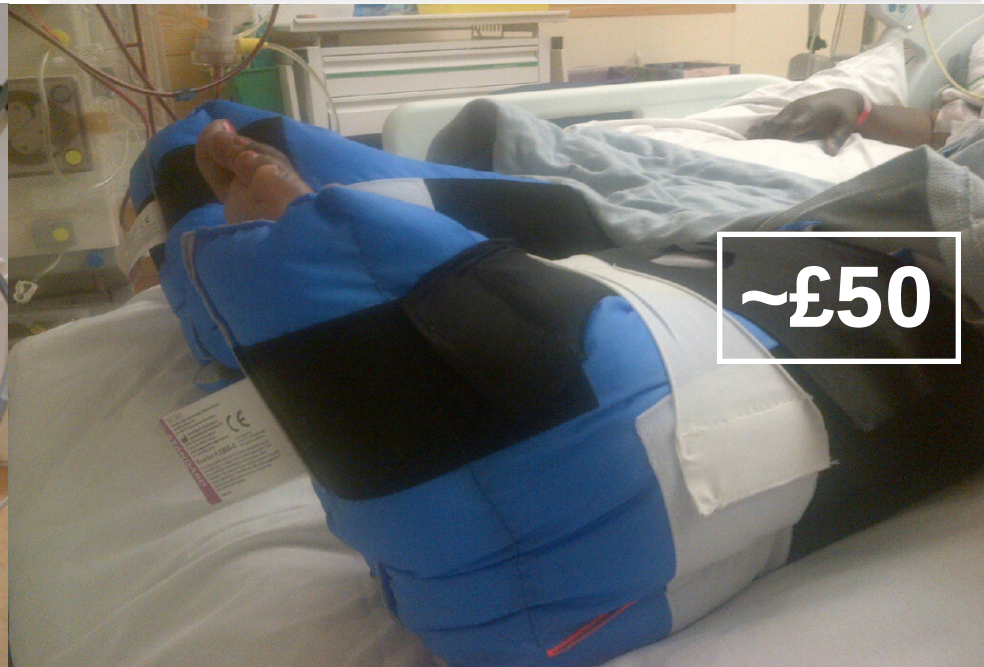


~£180


AbViser® AutoValve™
One-step intra-abdominal pressure monitoring simplifies IAP monitoring for early IAH recognition, data trending and improved patient outcomes (reducing risk of abdominal compartment syndrome).
AbViser® AutoValve™
IAP Monitoring Device
Standardized, reproducible intra-abdominal pressure monitoring via a simple one-step saline injection.

~£33

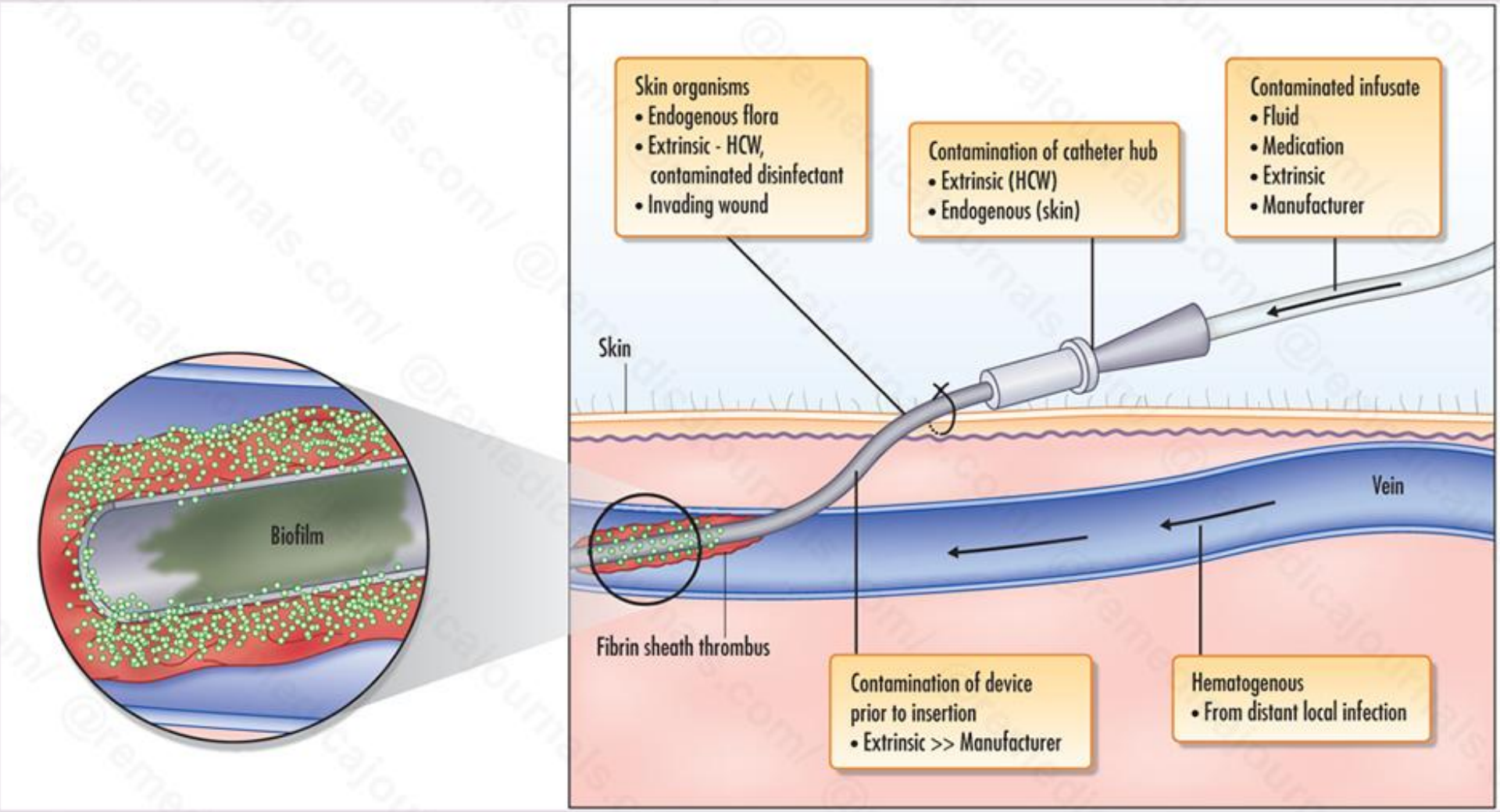
~£35



~£50

CRBSI: Pathogenesis

Figure 2. Diagram of an intravenous catheter with biofilm growth.

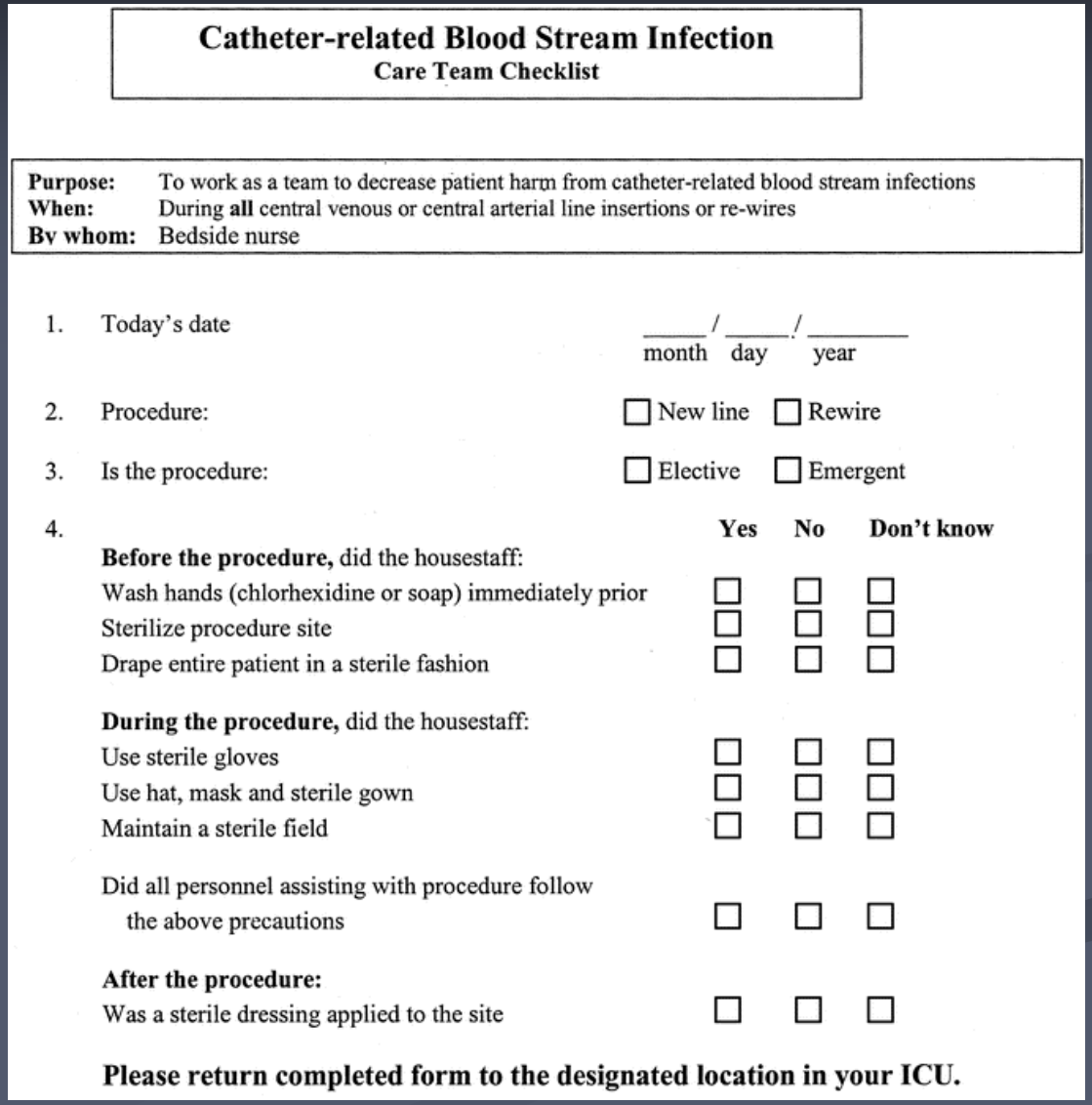


HCW: healthcare worker.

Eliminating CRBSI in the ICU

Interventions

1. Educational awareness
2. Creating a 'central catheter cart'
3. Can the catheter be removed?
4. Bedside insertion checklist
5. Empowering nurses to stop procedures



Catheter-related Blood Stream Infection
Care Team Checklist

Purpose: To work as a team to decrease patient harm from catheter-related blood stream infections
When: During **all** central venous or central arterial line insertions or re-wires
By whom: Bedside nurse

1. Today's date _____/_____/_____ (month / day / year)
2. Procedure: ☐ New line ☐ Rewire
3. Is the procedure: ☐ Elective ☐ Emergent
4.

	Yes	No	Don't know
Before the procedure, did the housestaff:			
Wash hands (chlorhexidine or soap) immediately prior	☐	☐	☐
Sterilize procedure site	☐	☐	☐
Drape entire patient in a sterile fashion	☐	☐	☐
During the procedure, did the housestaff:			
Use sterile gloves	☐	☐	☐
Use hat, mask and sterile gown	☐	☐	☐
Maintain a sterile field	☐	☐	☐
Did all personnel assisting with procedure follow the above precautions	☐	☐	☐
After the procedure:			
Was a sterile dressing applied to the site	☐	☐	☐

Please return completed form to the designated location in your ICU.

Berenholtz SM et al. *Crit Care Med* 2004; **32**: 2014-20

Can you match Michigan?

The NEW ENGLAND JOURNAL of MEDICINE

Table 3. Rates of Catheter-Related Bloodstream Infection from Baseline (before Implementation of the Study Intervention) to 18 Months of Follow-up.*

Study Period	No. of ICUs	No. of Bloodstream Infections per 1000 Catheter-Days				
		Overall	Teaching Hospital	Nonteaching Hospital	<200 Beds	≥200 Beds
		median (interquartile range)				
Baseline	55	2.7 (0.6–4.8)	2.7 (1.3–4.7)	2.6 (0–4.9)	2.1 (0–3.0)	2.7 (1.3–4.8)
During implementation	96	1.6 (0–4.4)†	1.7 (0–4.5)	0 (0–3.5)	0 (0–5.8)	1.7 (0–4.3)†
After implementation						
0– 3 mo	96	0 (0–3.0)‡	1.3 (0–3.1)†	0 (0–1.6)†	0 (0–2.7)	1.1 (0–3.1)‡
4–6 mo	96	0 (0–2.7)‡	1.1 (0–3.6)†	0 (0–0)‡	0 (0–0)†	0 (0–3.2)‡
7–9 mo	95	0 (0–2.1)‡	0.8 (0–2.4)‡	0 (0–0)‡	0 (0–0)†	0 (0–2.2)‡
10–12 mo	90	0 (0–1.9)‡	0 (0–2.3)‡	0 (0–1.5)‡	0 (0–0)†	0.2 (0–2.3)‡
13–15 mo	85	0 (0–1.6)‡	0 (0–2.2)‡	0 (0–0)‡	0 (0–0)†	0 (0–2.0)‡
16–18 mo	70	0 (0–2.4)‡	0 (0–2.7)‡	0 (0–1.2)†	0 (0–0)†	0 (0–2.6)‡

* Because the ICUs implemented the study intervention at different times, the total number of ICUs contributing data for each period varies. Of the 103 participating ICUs, 48 did not contribute baseline data. P values were calculated by the two-sample Wilcoxon rank-sum test.
† P≤0.05 for the comparison with the baseline (preimplementation) period.
‡ P≤0.002 for the comparison with the baseline (preimplementation) period.

Pronovost P et al. *N Engl J Med* 2006; **355**: 2725-32

‘Matching Michigan’: a 2-year stepped interventional programme to minimise central venous catheter-blood stream infections in intensive care units in England

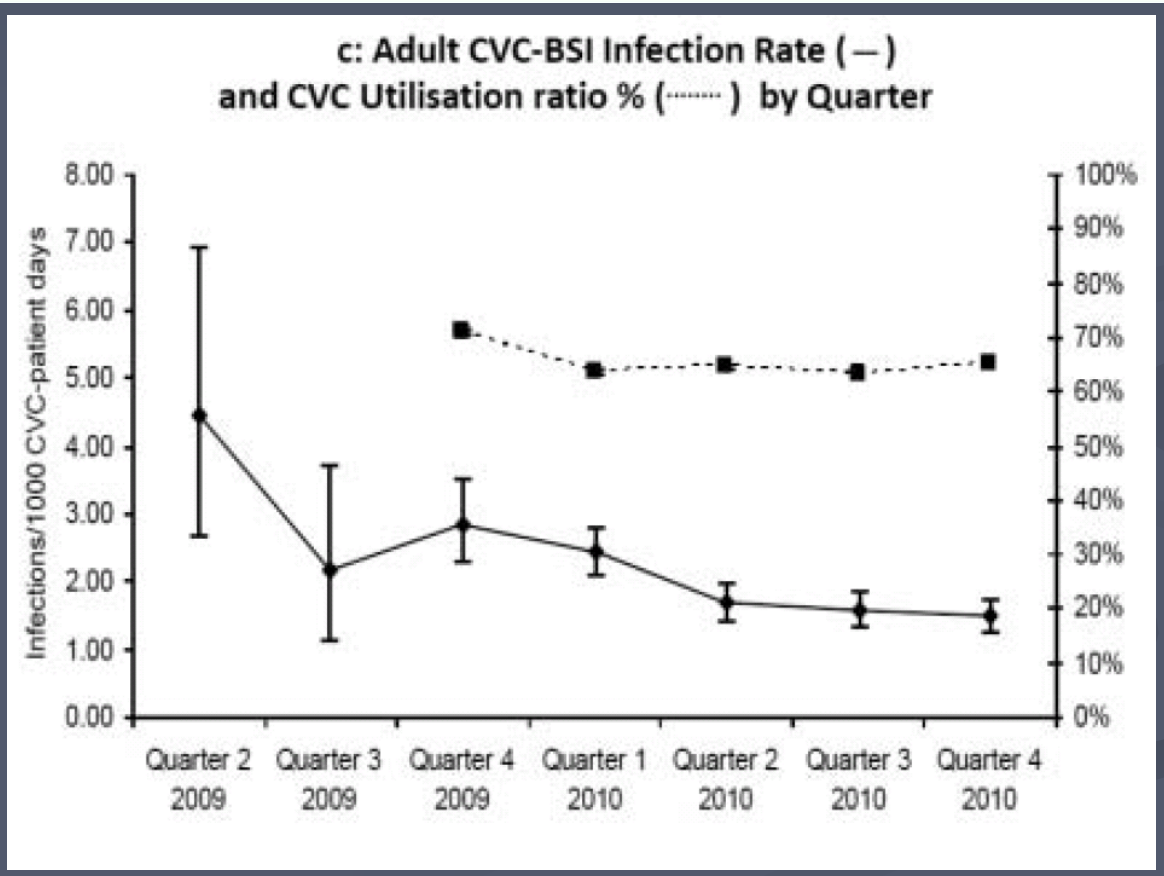
THE MATCHING MICHIGAN COLLABORATION & WRITING COMMITTEE

BMJ Quality & Safety Sept 2012

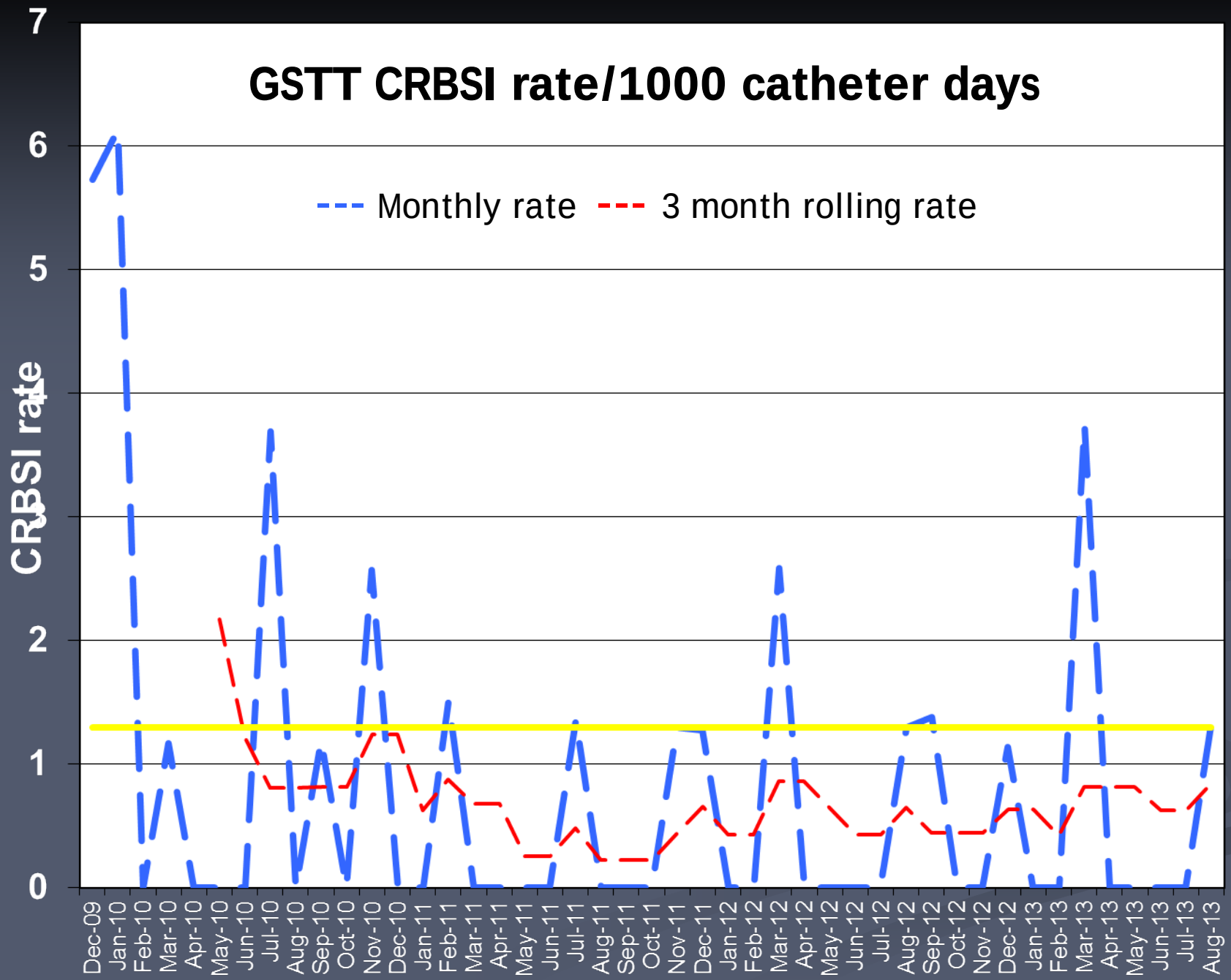
Table 5 1092 CVC-BSIs by infection classification and location

	Pre-ICU acquired			ICU acquired				
Infection classification	CVC associated	CVC related	Total pre-ICU	CVC associated	CVC related	Total in ICU	CVC-patient days	ICU CVC-BSI rate/1000 CVC-patient days
Adult	114	57	171	503	258	761	404252	1.88
Paediatric	28	9	37	84	39	123	34635	3.55
Total	142	66	208	587	297	884	438887	2.01

BSI, blood stream infection; CVC, central venous catheter; ICU, intensive care unit.



BMJ Quality & Safety Sept 2012


GSTT CRBSI rate/1000 catheter days
Monthly rate
3 month rolling rate
CRBSI rate
0
1
2
3
4
5
6
7
Dec-09
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
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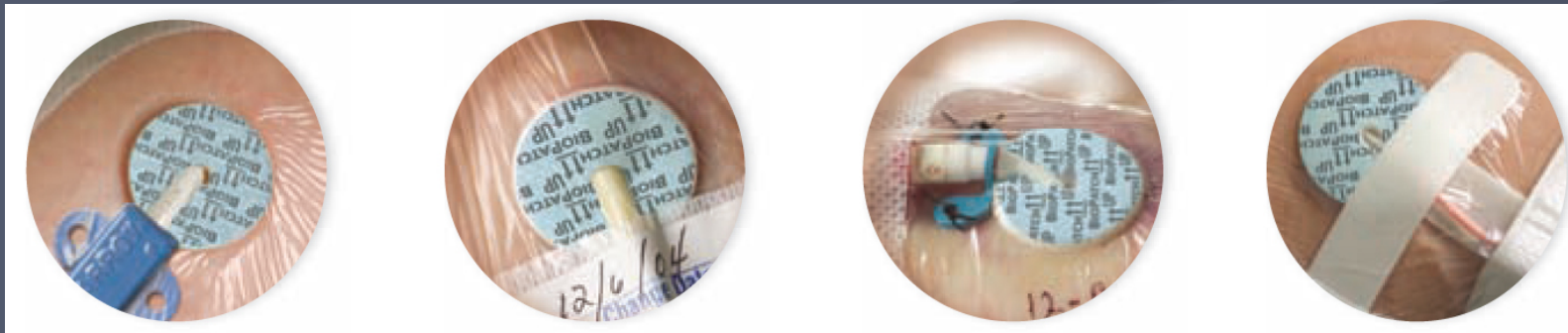
Jul-13
Aug-13

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

A Randomized Controlled Trial



entral Venous Catheters | Dialysis Catheters | Arterial Catheters | PICC Lines

Timsit J-FM et al. *JAMA* 2009; **301**: 1231-41

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

Variable	Dressing					
	Incidence, No./1000 Catheter-Days		ITT Analysis		Per-Protocol Analysis[a]	
	Control (n = 1825)	CHGIS (n = 1953)	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
Catheter-related bloodstream infection	1.3	0.4	0.24 (0.09-0.65)	.005	0.24 (0.09-0.63)	.004
Major catheter-related infection	1.4	0.6	0.39 (0.16-0.93)	.03	0.38 (0.16-0.92)	.03

Abbreviations: CFU, colony-forming unit; CHGIS, chlorhexidine gluconate–impregnated sponge; CI, co
[a] Analysis adjusted on imbalanced parameters (ie, presence of ≥1 chronic disease for comparison of

Timsit J-FM et al. *JAMA* 2009; **301**: 1231-41

epic3: National Evidence-Based Guidelines for Preventing HAIs

IVAD20

- Consider the use of a chlorhexidine-impregnated sponge dressing in adult patients with a CVC as a strategy to reduce CRBSI

New recommendation *Class B*

Journal of Hospital Infection January 2014

ORIGINAL INVESTIGATION

Chlorhexidine Gluconate to Cleanse Patients in a Medical Intensive Care Unit

The Effectiveness of Source Control to Reduce the Bioburden of Vancomycin-Resistant Enterococci

Michael O. Vernon, DrPH; Mary K. Hayden, MD; William E. Trick, MD; Robert A. Hayes, BSc; Donald W. Blom, RN; Robert A. Weinstein, MD; for the Chicago Antimicrobial Resistance Project (CARP)

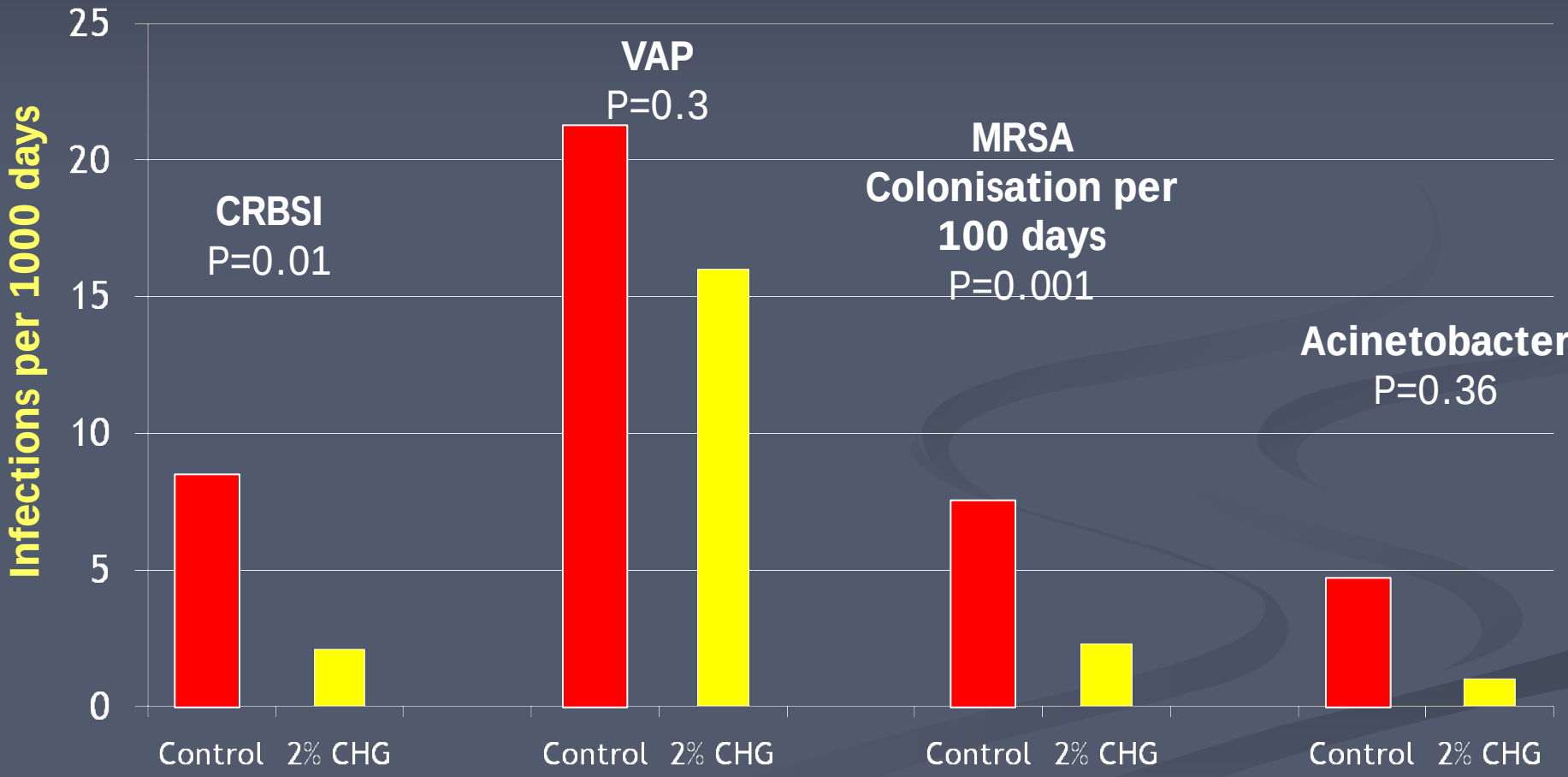
EDITORIAL

Universal Patient Disinfection as a Tool for Infection Control

Rub-A-Dub-Dub, No Need for a Tub

Effect of chlorhexidine whole-body bathing on HAIs among trauma patients

12 bed level 1 unit; 512 patients using 2% CHG washcloths



Evans HL et al, *Arch Surg 2010; 145: 240-6*

TABLE 3. Summary of Healthcare-Associated Bloodstream Infection (BSI) Incidence with Chlorhexidine and Comparator

48% reduction in BSI

Reference	No. of patients		No. of patient-days (or catheter-days for studies evaluating only CLABSI)		No. of healthcare-associated BSIs or CLABSIs	
	Treatment	Control	Treatment	Control	Treatment	Control
Bleasdale et al,[9] 2007[a]	391	445	2,210	2,119	9	22
Borer et al,[12] 2007[a]	320	329	1,600	1,923	2	15
Camus et al,[11] 2005	130	127	1,991	1,961	6	7
Climo et al,[8] 2009	2,650	2,670	15,423	15,993	14	41
Dixon and Carver,[22] 2010[a]	NR	NR	3,148	3,346	8	27
Evans et al,[17] 2010	286	253	1,785	1,904	4	15
Gould et al,[13] 2007	1,421	1,232	6,664	6,899	171	264
Holder and Zellinger,[14] 2009[a]	NR	NR	20,000	3,333	2	12
Montecalvo et al,[24] 2010[a]	1,832	1,808	13,864	12,603	2	12
Munoz-Price et al,[15] 2009[a]	405	340	7,632	6,210	29	59
Popovich et al,[16] 2009[a]	1,951	2,163	5,610	6,728	2	19
Popovich et al,[23] 2010[a]	1,387	1,938	5,799	7,366	17	19

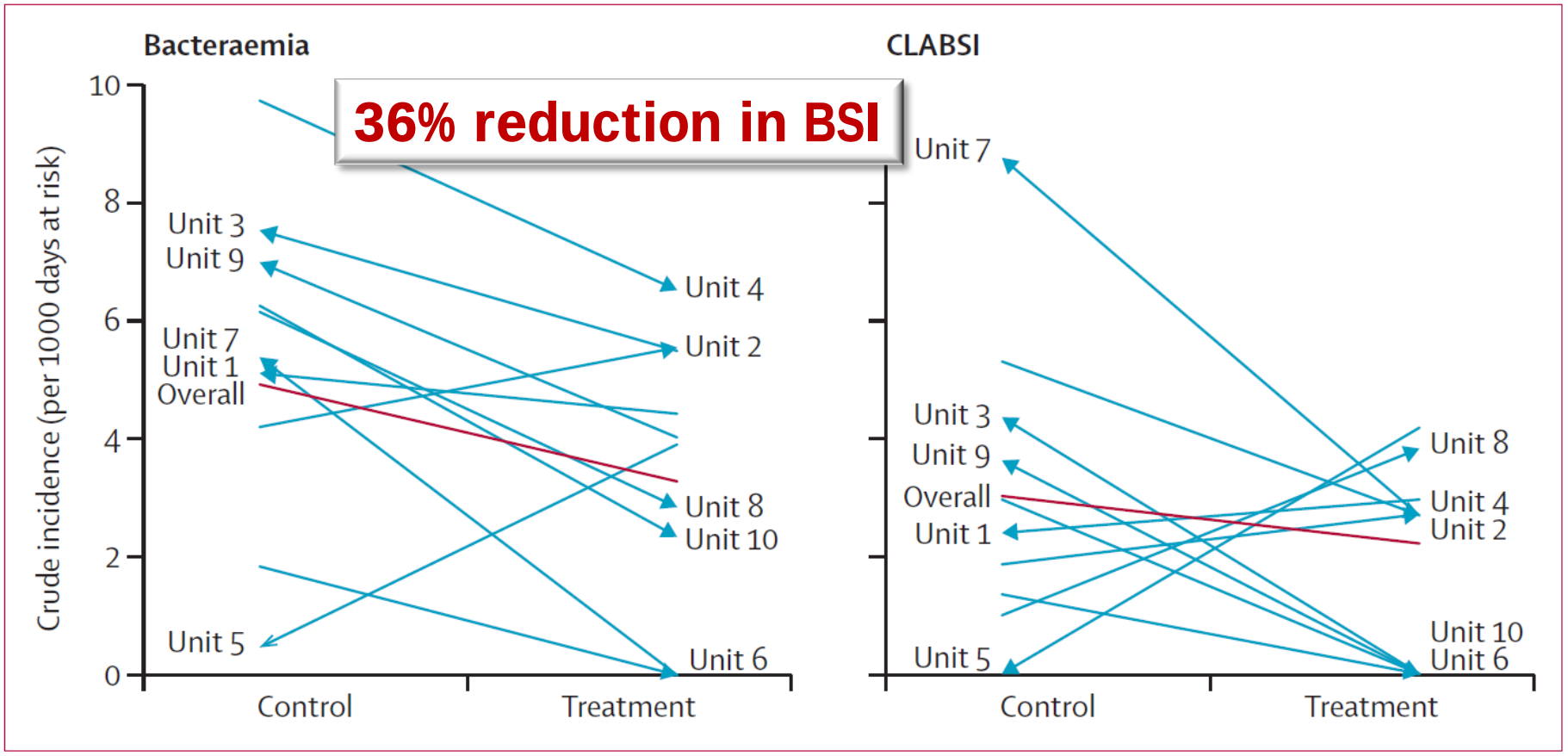
NOTE. CLABSI, central line–associated BSI; NR, not recorded.

[a] Studies that used CLABSI as their only end point.

O'Horo JC et al, *Infect Control Hosp Epid 2012; 33: 257-67*

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



Milstone AM et al, *Lancet 2013; Epub*

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.

Table 1. Characteristics of the Participating Study Units.*

Hospital	Unit	Mean No. of Monthly Admissions	Mean No. of Monthly Patient-Days	Mean Length of Stay	MRSA Prevalence	VRE Prevalence	Baseline Rate of Primary Bloodstream Infections†
		number (range)		*days*	*percent of admissions*		*no./1000 patient-days*
Group 1							
A	MICU	123.8 (114–142)	692.3 (504–773)	5.6	11.0	21.0	8.1
C	SICU	46.3 (31–59)	285.7 (251–314)	6.2	11.4	4.3	9.6
D	SICU 2	51.6 (32–71)	285.7 (227–338)	5.5	4.4	2.8	0
E	CSICU	85.3 (80–100)	425.9 (375–486)	5.0	6.6	8.3	0.4
F	BMT	41.8 (32–58)	786.3 (725–858)	18.8	2.4	21.6	5.5
Group 2							
B	MICU	111.6 (98–126)	598.8 (449–641)	5.4	21.8	21.0	3.1
C	MICU–CCU	55.8 (43–73)	299.1 (211–345)	5.4	16.1	9.7	8.5
D	SICU 1	62.3 (47–76)	316.3 (266–356)	5.1	10.8	8.2	2.2
E	MICU	72.7 (56–88)	467.1 (404–525)	6.4	23.3	27.9	8.7

Climo WC et al, *NEJM 2013; 368: 533-42*

Variable	Intervention Period	Control Period	P Value
No. of admissions	3970	3842	0.32
Total days of care	24,902	24,983	0.85
Central-catheter use (days)	13,425	13,049	0.14
Mean length of stay (days)	6.4	6.4	0.53
MRSA prevalence (%)	13.8	12.8	0.14
VRE prevalence (%)	16.3	15.1	0.24
MDRO acquisition			
No. of infections	127	165	0.03
Incidence rate (no./1000 patient-days)	5.10	6.60	
VRE acquisition			
No. of infections	80	107	0.05
Incidence rate (no./1000 patient-days)	3.21	4.28	
MRSA acquisition			
No. of infections	47	58	0.29
Incidence rate (no./1000 patient-days)	1.89	2.32	
Hospital-acquired bloodstream infection			
No. of infections	119	165	0.007
Incidence rate (no./1000 patient-days)	4.78	6.60	
Primary bloodstream infection			
No. of infections	90	131	0.006
Incidence rate (no.	3.61	5.24	
Central-catheter–associated bloodstream infection			
No. of infections	21	43	0.004
Incidence rate (no./1000 catheter-days)	1.55	3.30	

23% reduction in MDRO

25% reduction in VRE

19% reduction in MRSA

28% reduction in BSI

Climo WC et al, *NEJM 2013; 368: 533-42*

ORIGINAL ARTICLE

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 Fallon Hartford, M.S., Mary K. Hayden, M.D., John A. J Robert A. Weinstein, M.D., Victoria J. Fraser, M.D., Katherin Eric Cui, B.S., Rebecca E. Kaganov, B.A., Karen Lol Jonathan B. Perlin, M.D., Ph.D., and Richard Plat for the CDC Prevention Epicenters Program and the AHRQ and Healthcare-Associated Infections Progra

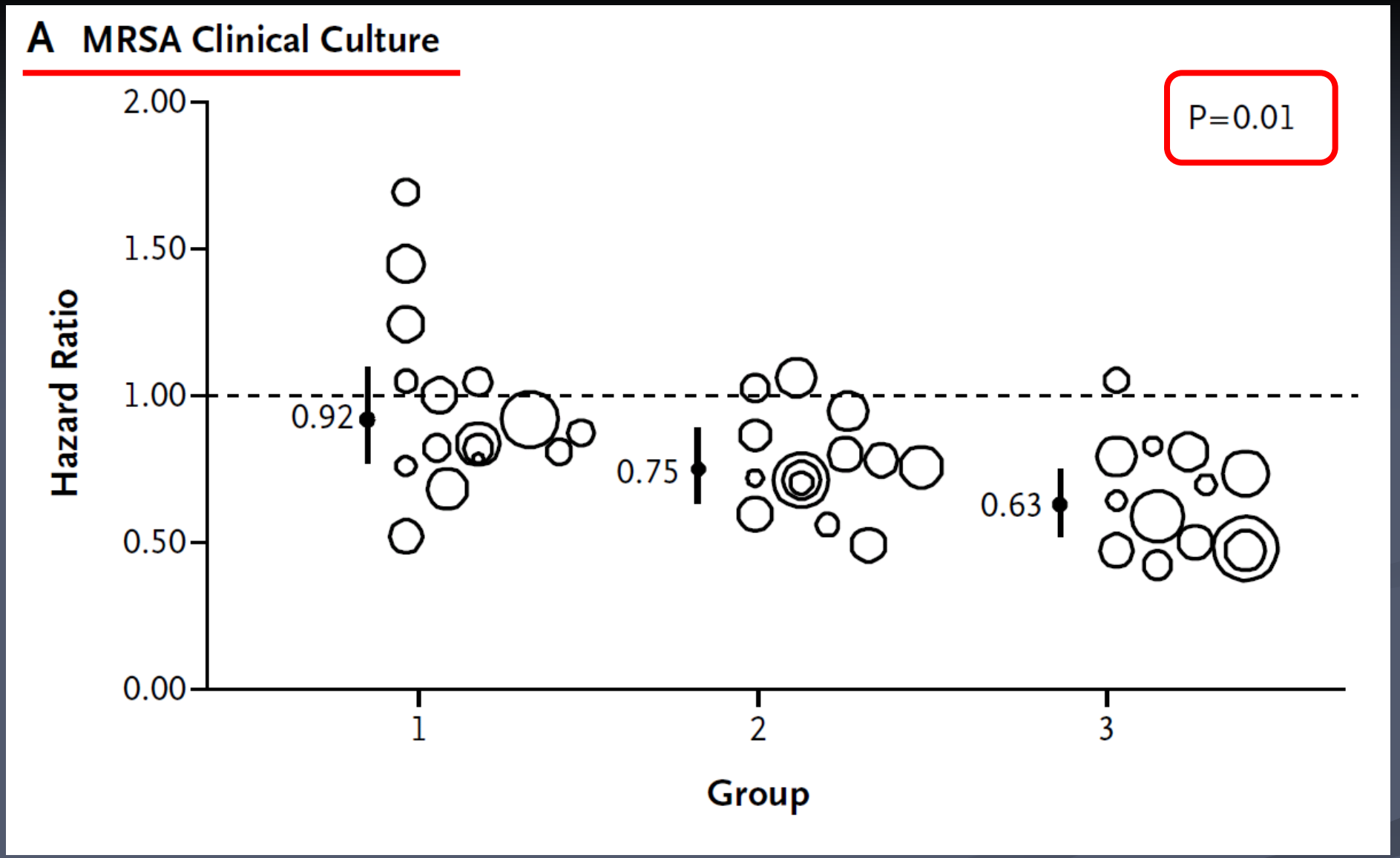
- 43 Hospitals, 74 ICUs, & 74,256 patients
- Screening & isolation, targeted decolonisation or universal decolonisation – Cluster RCT

Huang SS et al, *NEJM 2013; May 29 Epub*

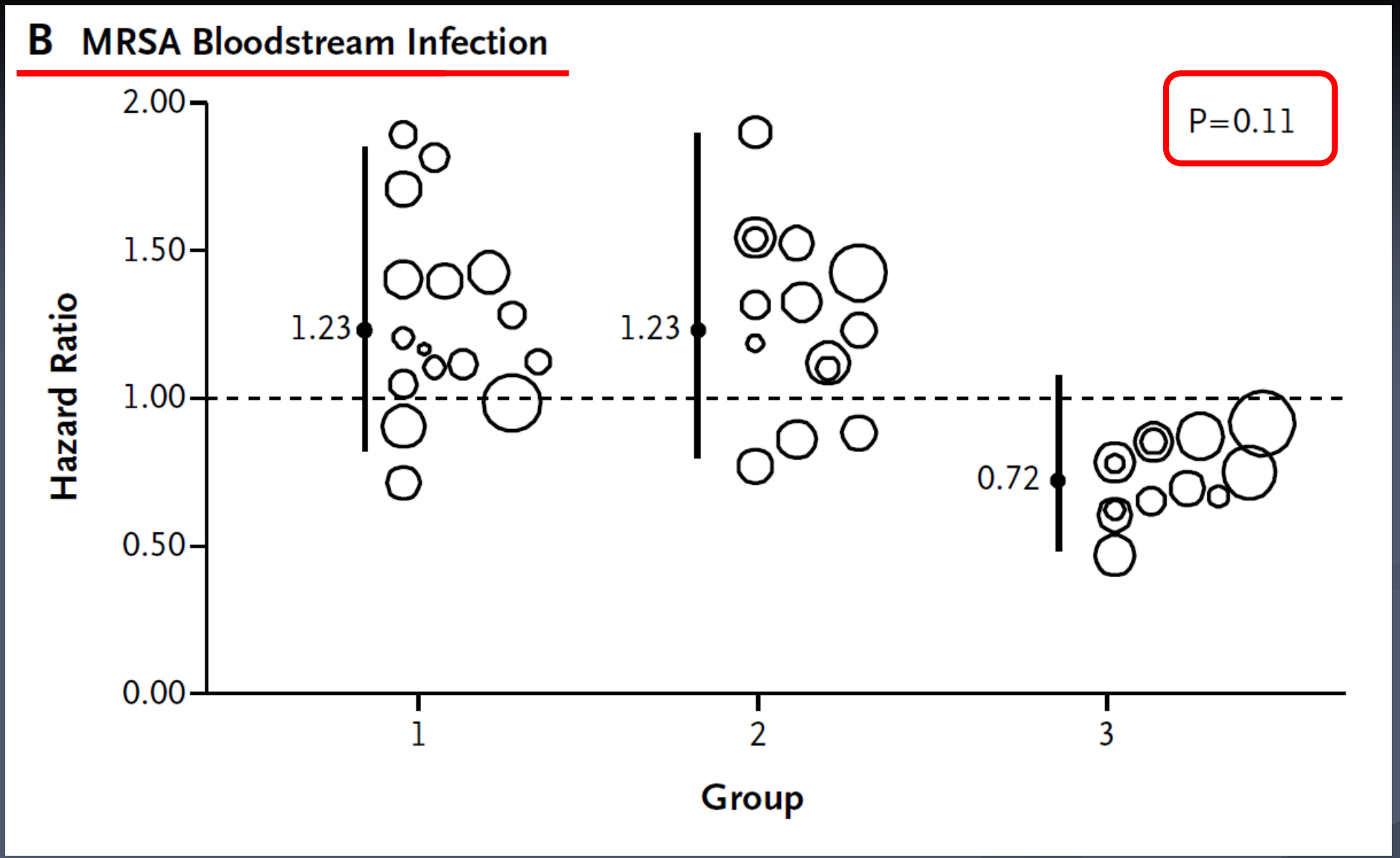
Table 1. Characteristics of the Intensive Care Unit (ICU) Population, According to Study Period and Group.*

Variable	12-Mo Baseline Period (N = 48,390)			18-Mo Intervention Period (N = 74,256)		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Admission with ICU stay (no.)	15,816	15,218	17,356	23,480	24,752	26,024
Attributable ICU patient-days (no.)	63,135	57,418	69,668	88,222	92,978	101,603
ICU type (no.)†						
Medical	3	5	5	3	5	5
Surgical	1	2	6	1	2	6
Mixed medical and surgical	19	14	18	19	15	17
Hospital stay (days)						
Median	7	7	8	7	7	7
Interquartile range	5–12	5–12	5–12	5–12	5–12	5–12
ICU stay (days)						
Median	3	3	3	3	3	3
Interquartile range	2–5	2–5	2–5	1–5	2–5	2–5
Age (yr)						
Median	65	66	65	65	66	65
Interquartile range	52–77	53–77	51–77	52–77	53–77	52–77

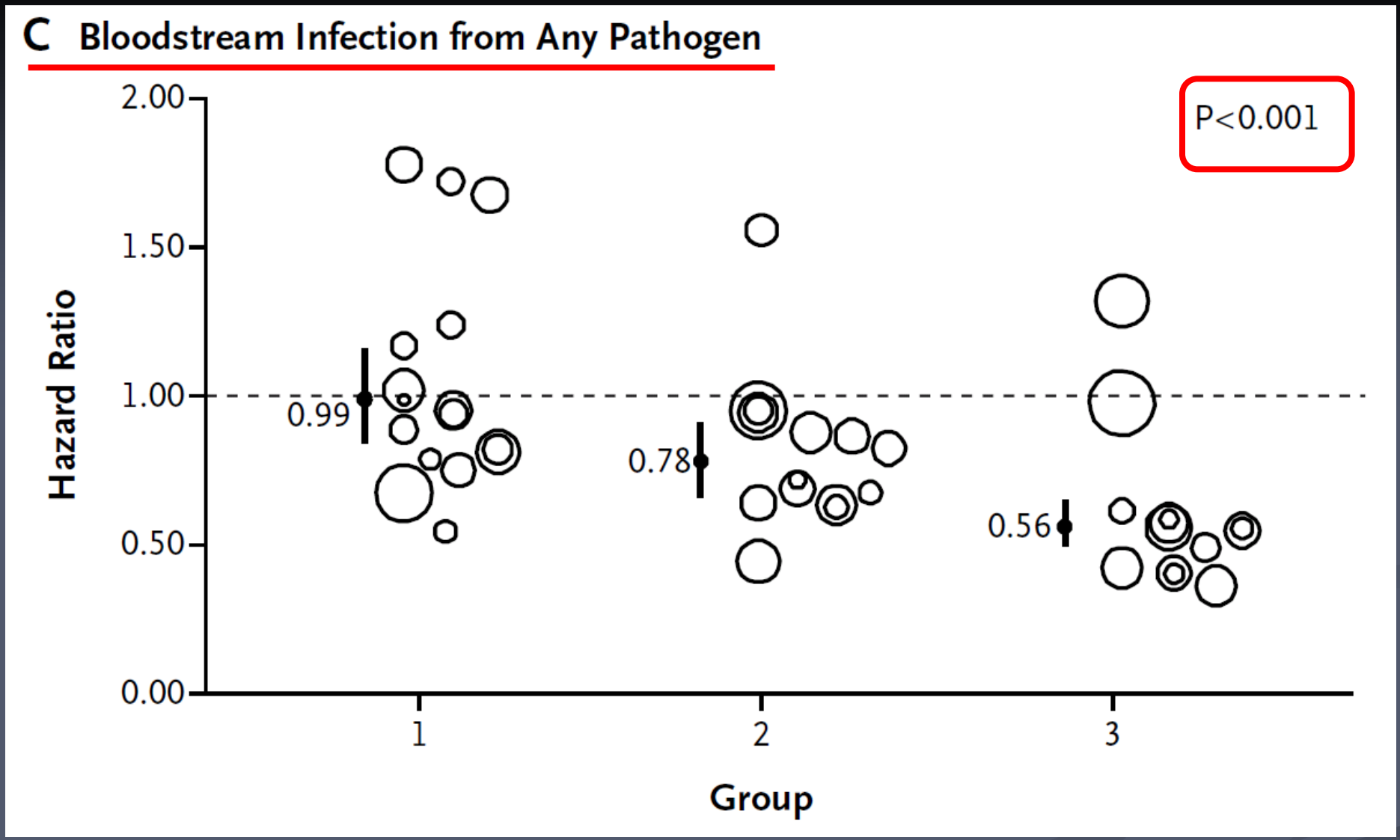
Huang SS et al, *NEJM 2013; May 29 Epub*



Huang SS et al, *NEJM 2013; May 29 Epub*



Huang SS et al, *NEJM 2013; May 29 Epub*

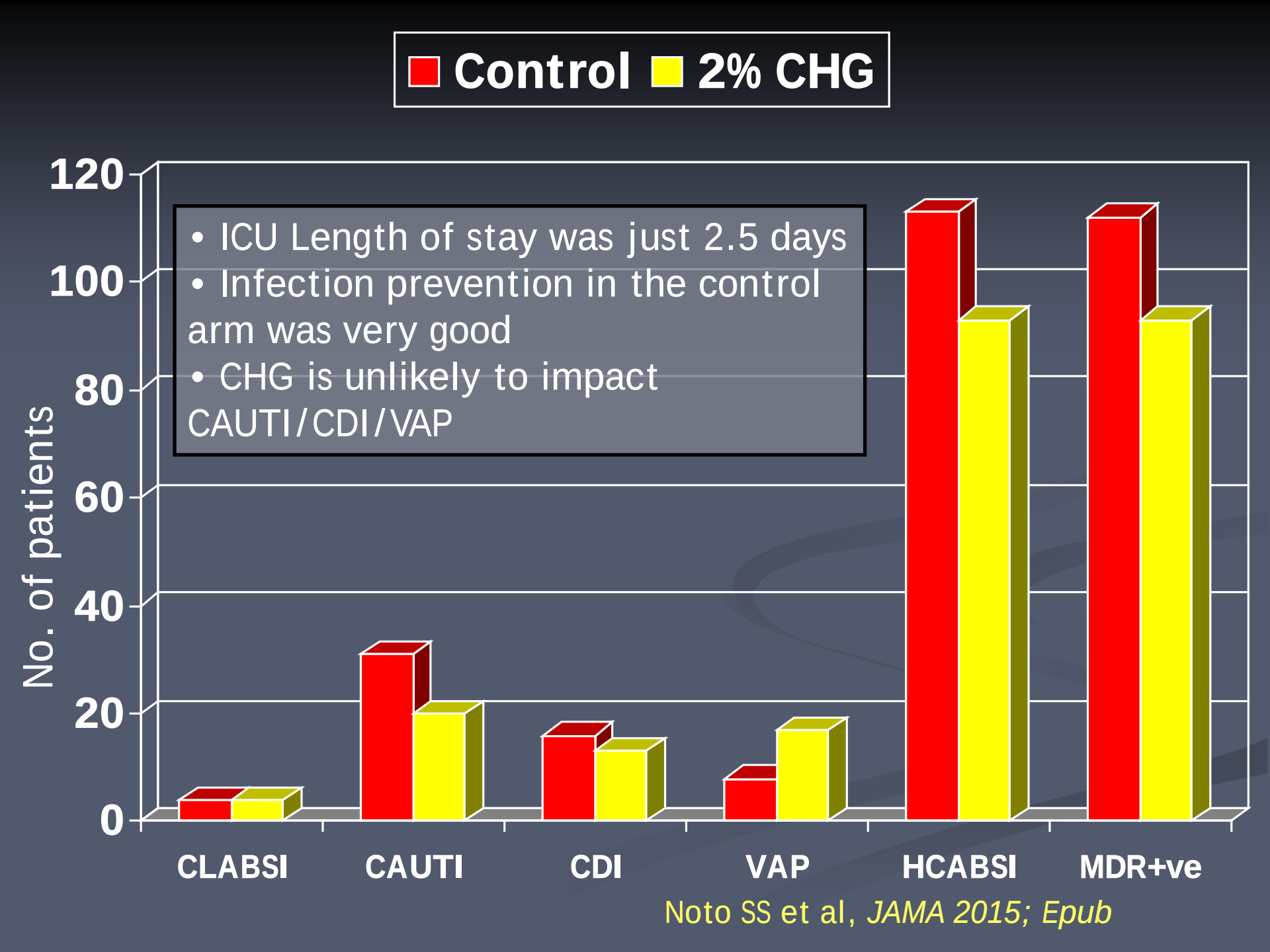


Huang SS et al, *NEJM 2013; May 29 Epub*

Advance pre-op 2% CHG reduces the incidence of surgical site infections in knee arthroplasty

Risk category	Compliance	Knees		
		Total joints operated	Number infected joints	Incidence (%)
Low	Non-compliant	256	4	1.6
	Compliant	52	0	0
Medium	Non-compliant	332	9	2.7
	Compliant	54	0	0
High	Non-compliant	123	9	7.3
	Compliant	30	0	0

Zyweil et al. *International Orthopedics* 2010 Epub



Noto SS et al, *JAMA 2015; Epub*

epic3: National Evidence-Based Guidelines for Preventing HAIs

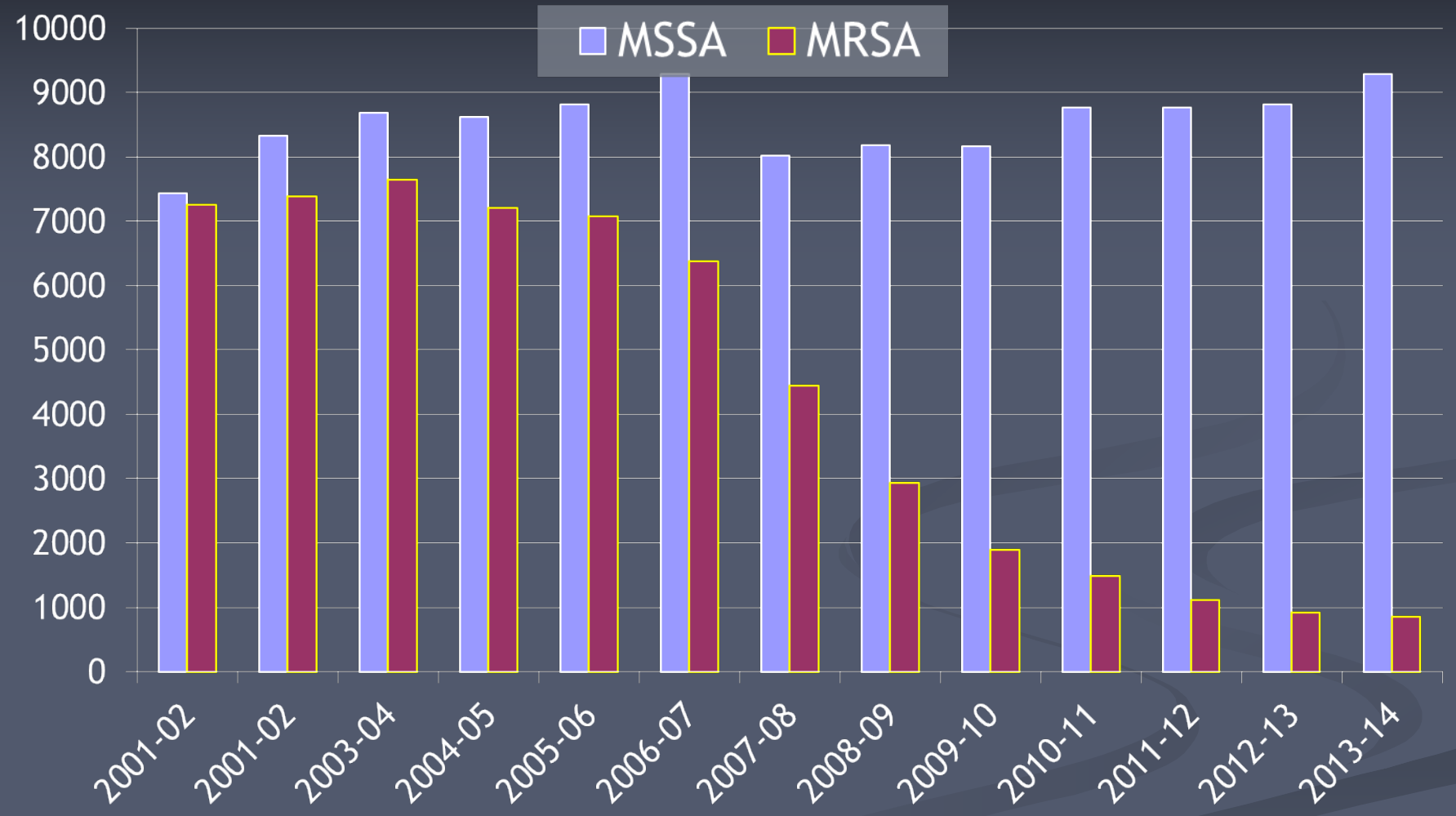
IVAD21

- Consider the use of daily cleansing with chlorhexidine in adult patients with a CVC as a strategy to reduce CRBSI

New recommendation *Class B*

Journal of Hospital Infection January 2014

MSSA/MRSA bacteraemia - 13 yrs of UK surveillance



- MRSA reporting **mandatory** since 2001
- MSSA reporting **voluntary** until 2011

hpa.org.uk

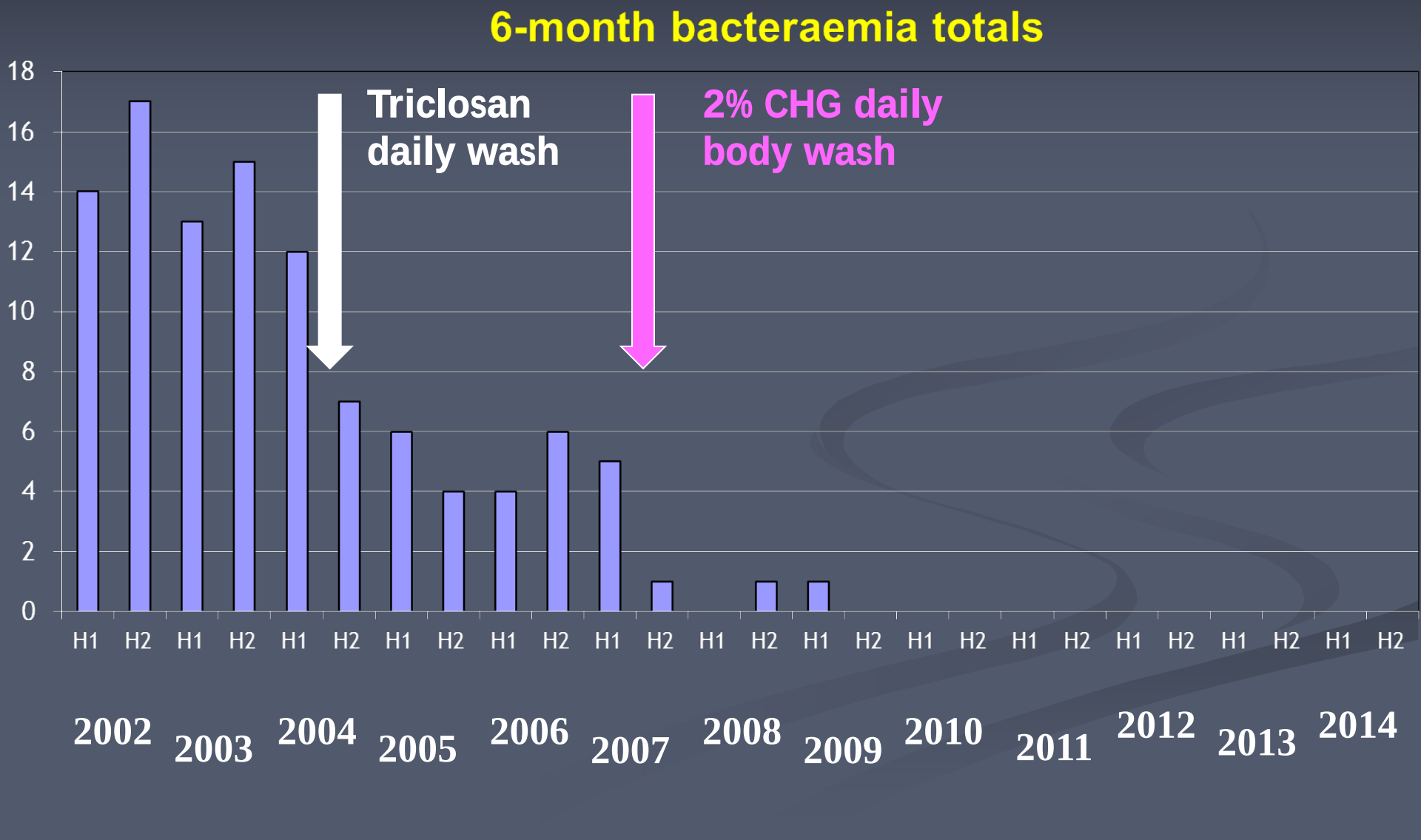
MRSA bacteraemia by NHS Trust 2003-4

Department of Health Mandatory Bacteraemia Surveillance Scheme - MRSA bacteraemia by NHS Trust: April 2003-March 2004

Specialist – ranked by MRSA rate in 2003/04

Trust Name	Number of MRSA bacteraemia reports	MRSA rate per 1000 bed days	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Guy's & St. Thomas' NHS Trust	166	0.45	0.39	0.53
Addenbrooke's NHS Trust	126	0.38	0.32	0.46
Hammersmith Hospitals NHS Trust	125	0.37	0.31	0.44
University Hospital Birmingham NHS Trust	123	0.35	0.29	0.42
King's College Hospital NHS Trust	107	0.35	0.29	0.42
North Staffordshire Hospital NHS Trust	135	0.35	0.29	0.41
Royal Free Hampstead NHS Trust	98	0.34	0.28	0.42
University College London Hospitals NHS Trust	85	0.32	0.26	0.40
Portsmouth Hospitals NHS Trust	105	0.32	0.26	0.39
Plymouth Hospitals NHS Trust	98	0.31	0.25	0.38
St. George's Healthcare NHS Trust	93	0.31	0.25	0.38
Oxford Radcliffe Hospitals NHS Trust	127	0.30	0.25	0.36
Brighton & Sussex University Hospitals NHS Trust	107	0.30	0.25	0.36
United Bristol Healthcare NHS Trust	86	0.28	0.22	0.34
St. Mary's NHS Trust	59	0.27	0.21	0.35
Queen's Medical Centre, Nottingham University Hospital NHS Trust	77	0.25	0.20	0.32
Salford Royal Hospitals NHS Trust	71	0.25	0.19	0.31
Leeds Teaching Hospitals NHS Trust	204	0.24	0.21	0.28
Hull & East Yorkshire Hospitals NHS Trust	102	0.24	0.20	0.29
Maidstone & Tunbridge Wells NHS Trust	58	0.23	0.17	0.29
Ashford & St Peter's Hospitals NHS Trust	44	0.23	0.17	0.31
Chelsea & Westminster Healthcare NHS Trust	38	0.22	0.16	0.31
Medway NHS Trust	48	0.22	0.16	0.30

MRSA bacteraemias - St Thomas' ICU



Checklists

- **F** – Feed
- **L** – Lines
  - Are they the source of infection?
  - Can they be removed?
- **A** – Analgesia/Awakening (sedation), Aperients & Angle of bed
- **T** – Thromboprophylaxis
- **H** – Hydration & Fluid Balance
- **U** – Ulcer prophylaxis
- **G** – Glucose control

The Aggregation Of Marginal Gains

The Learning Cycle

Infection Prevention in the ICU