Surveillance cultures: Can they help our decisions

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Questions about surveillance cultures

- Yes, No and When
- Colonization versus infection
- Prevention options
  - Isolation and barrier precautions
  - CHG
  - Peri-operative prophylaxis
  - Treatment

Why do surveillance cultures?

- Identifies an unknown reservoir or carrier
  - Organism of epidemiologic importance
  - Transmission in the setting of an outbreak
- Enhances infection control and or treatment interventions
- We have always done it

Rationale for active surveillance

- MRSA,VRE and MDR-GNR are an important part of the antimicrobial resistance problem
- Healthcare-Associated MRSA, VRE and MDR-GNR infections are expensive
- Outcomes for MRSA and VRE infection are worse than with infection with sensitive infections
- Healthcare facilities serve as amplifiers of MRSA, VRE and MDR-GNR transmission
- Multifaceted interventions that include active surveillance are often necessary to prevent MRSA and VRE transmission

Does contamination of a prior room increase the risk of acquisition?

Study	Pathogen	Likelihood of patient acquiring HCAI based on prior room occupancy
Martinez 2003[1]	VRE – cultured w/in room	2.6x
Huang 2006[2]	VRE – prior room occupant	1.6x
	MRSA – prior room occupant	1.3x
Drees 2008[3]	VRE – cultured w/in room	1.9x
	VRE – prior room occupant	2.2x
	VRE – prior room occupant w/in previous 2 weeks	2.0x
Shaughnessy 2011[4]	*C. difficile* – prior room occupant	2.4x
Nseir 2010[5]	*A. baumannii* – prior room occupant	3.8x
	P. aeruginosa – prior room occupant	2.1x

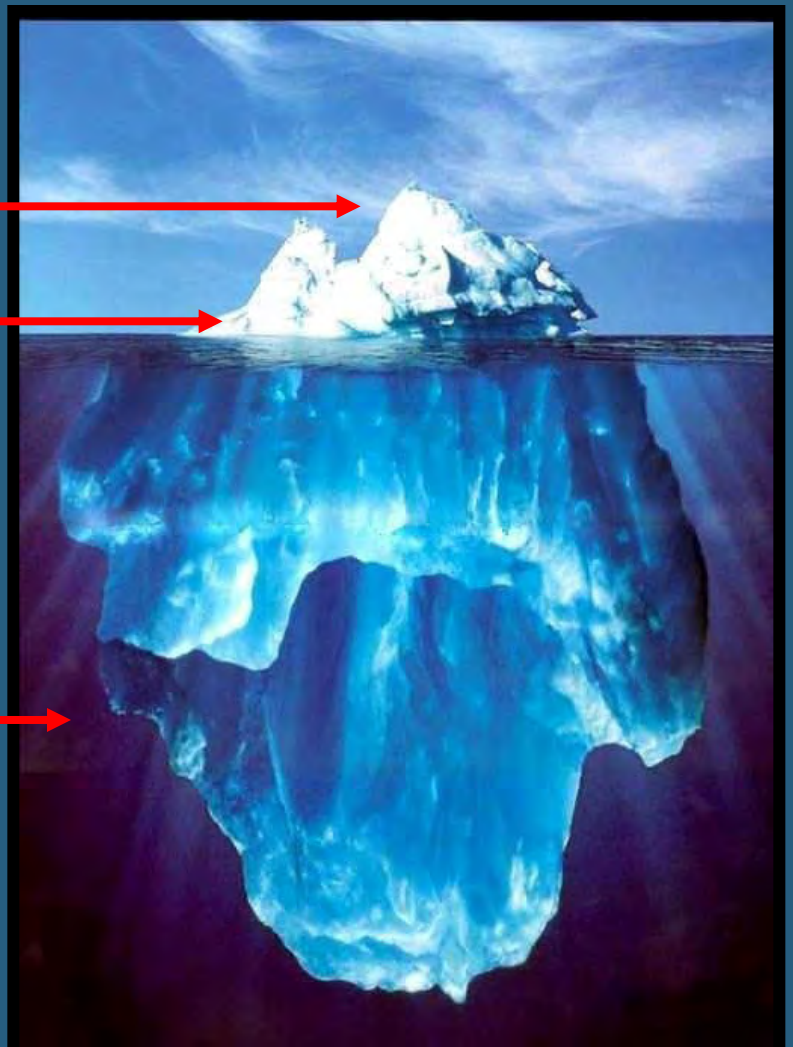
Martinez et al. Arch Intern Med 2003; 163: 1905-12.; Huang et al. Arch Intern Med 2006; 166: 1945-51; Drees et al. CID 2008; 46: 678-85; Shaughnessy. ICHE2011;32:201-206; Nseir et al. Clin Microbiol Infect 2010 (in press). *Slide from J Otter*

The rationale: “Iceberg” phenomenon

Clinical infection

Colonization detected by routine culture

Asymptomatic Colonization (reservoir)

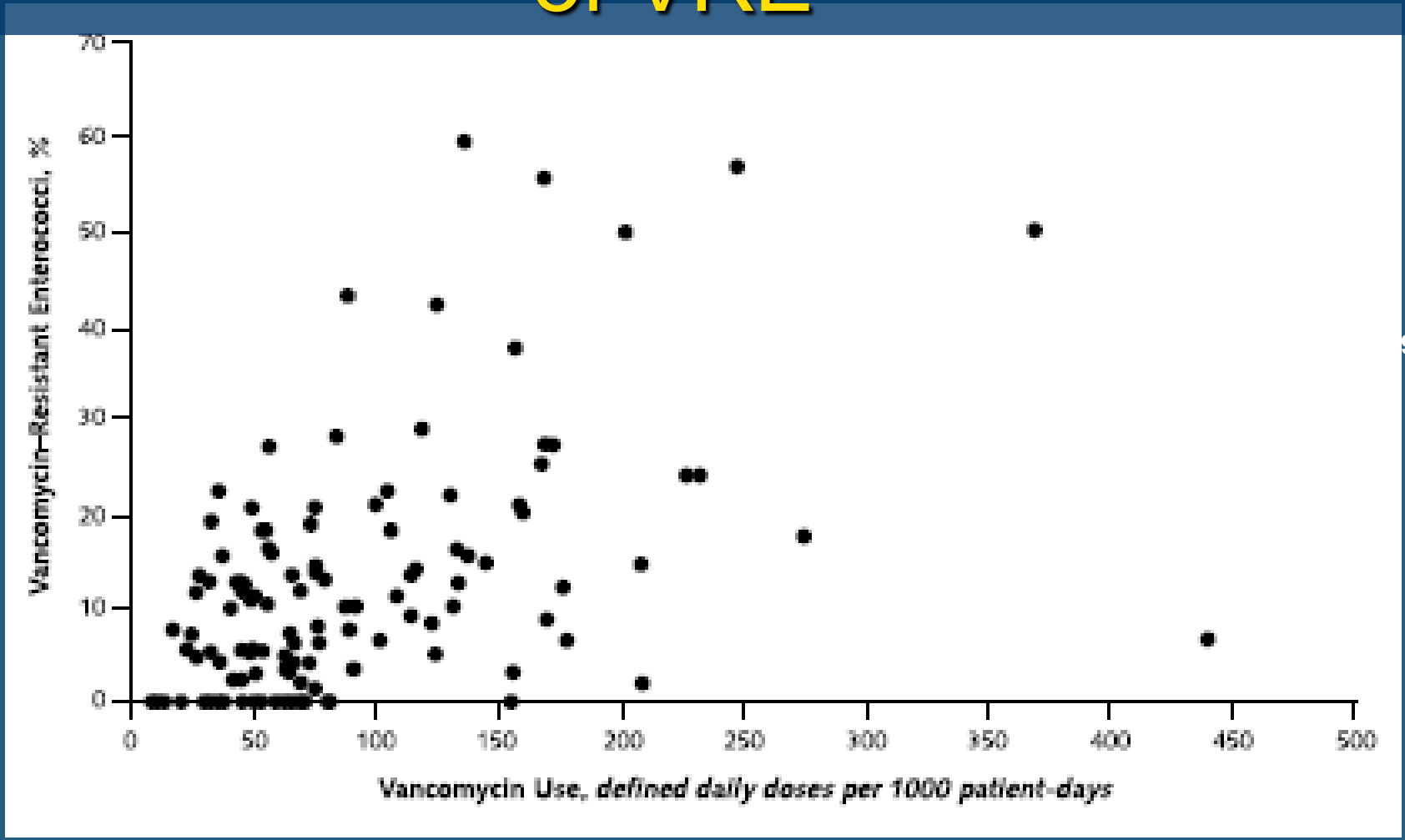


Who is colonized?

- Asymptomatic colonization >>> infection

- Ability to detect resistant bacteria depends on:
  1. Frequency of obtaining clinical cx's (ICU>floors)
  2. Sensitivity of site tested (nares, peri-rectal, stool, etc.)
  3. Sensitivity of laboratory methods used (routine cx, enrichment broth cx, molecular tests)
  4. Strategy chosen to identify patients

Higher rates of Vancomycin associated with increased prevalence of VRE



Fridkin SK. Ann Intern Med. 2001;135:175-183.

The role of active surveillance: VRE

Table 2. Estimated number of incident vancomycin-resistant enterococci (VRE) acquisitions and absolute number and proportion of cases prevented in 1 year with 3 competing infection-control strategies, after 1000 model simulations.

Infection control strategy	Average no. of incident VRE acquisitions	Estimated no. of incident cases of VRE colonization/infection prevented, compared with no surveillance strategy	Reduction of cases of VRE colonization/infection, compared with no surveillance strategy, %
No surveillance	118	…	…
Passive surveillance only	113	5	4.2
Active surveillance			
Patients isolated after culture results are determined to be positive	72.2	45.8	39
Immediate isolation and removal of patient after culture results are determined to be negative	41.1	76.9	65

NOTE. Each strategy is compared with a setting where no surveillance is in place.

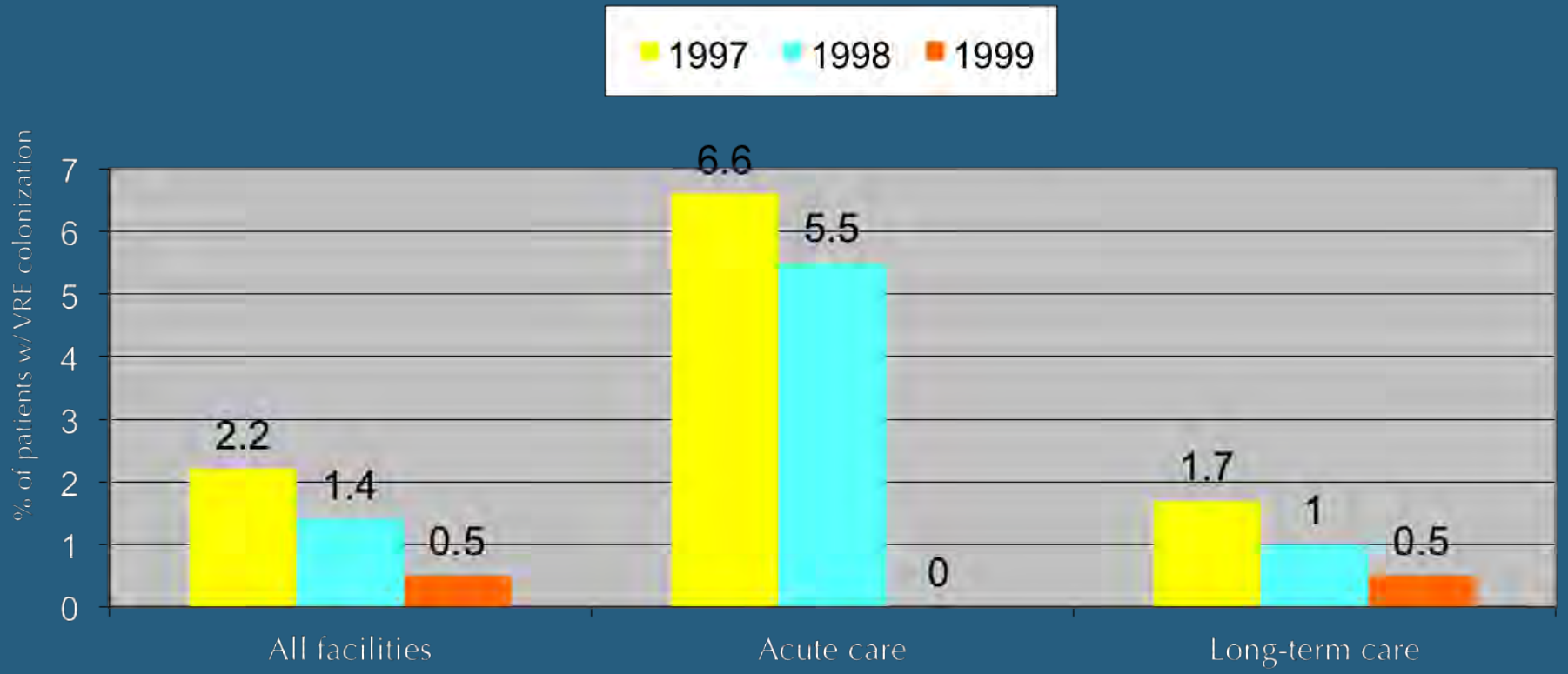
Perenchevich et al. Clin Infect Dis 2004;1108-15

Monoclonal transmission of HA-VRE bacteremia without active surveillance

	HOSPITAL A	HOSPITAL B
Beds (ICU)/ Yearly Admissions	700(68)/35K	683(96)/34K
VRE bacteremia rate/100K pt days	17.1	8.2
Mean Vancomycin DDD/1000 pt days/yr (range)	70.3 (64-81)	65.5 (49-72)
% pts affected by largest clonal types	30%	14.5%
% pts affected by 4 most predominate clonal types	75%	37%
Active surveillance & isolation	NO	YES

Price C. Clin Infect Dis 2003; 37:921–8

Active surveillance w/ isolation reduced/eliminated transmission of VRE in 32 health care facilities



1997 vs 1999 and trend for all 3 yrs highly significant ($p<0.001$)

Ostrowsky NEJM 2001 May 10;344(19):1427-33

Should VRE colonization impact antibiotic choices

- Data are limited
- In normal hosts, VRE colonization should not change antibiotic choice
- In liver and BMT transplant, VRE colonization can be considered in determination of empiric therapy if BSI suspected or in the presentation of severe sepsis until culture information available (48-72 hours), then d/c if no growth

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The MRSA iceberg

Multiple cx's were performed on 403 asymptomatic MRSA carriers found:

- 84% positive by initial anterior nares cx
- 38% by perineal cx
- 16% by groin cx
- 10% by axillae cx
- Nares + perineum cx = 93% sensitivity

- 3.4% had MRSA on admission, 19% developed infection
- 3.0% acquired MRSA after admission, 25% developed infection
- 21% had MSSA, 1.5% developed infection
- No colonization 75.4%, 2% developed infection

Coello R et al. Eur J Clin Microbiol Infect Dis, 1994; Sewell et al. Diagn Microbiol Infect Dis, 1993

Impact of ACS on identification of MRSA in ICUs

- Retrospective cohort study - 5 academic medical centers
- Outside of ASC, no change in infection control practices
- Admission prevalence- MRSA: 5-21%, an increase of 30-135%.
- 70% of MRSA carriers were identified by surveillance cultures.

Table 3. Average monthly incidence and prevalence measures across all intensive care unit (ICUs).

Measure	Excluding surveillance		Including surveillance		Added detection with surveillance (unit range)	P^b
	Estimate, % (ICU range)	ICU SD[a]	Estimate, % (ICU range)	ICU SD[a]		
Prevalence						
Admission prevalence	8 (2.2–15.9)	1.5–5.8	11.9 (4.5–20.6)	1.9–7.5	3.9 (2.3–5.6)	<.0001
Prevalence	13.4 (6.8–19.0)	2.4–7.1	17.5 (9.2–23.5)	3.3–8.7	4.1 (2.4–6.0)	<.0001
Prevalence density/1000 patient-days	2.9 (1.5–4.4)	0.6–1.4	3.8 (2.2–5.8)	0.6–1.7	0.9 (0.4–1.4)	<.0001
Incidence[c]						
Incidence	2.6 (1.4–5.3)	1.3–4.5	3.4 (2.4–5.7)	1.7–4.6	0.8 (0.2–2.3)	<.0001
Incidence density[d]	6.7 (3.2–16.5)	2.6–10.0	8.9 (4.0–18.2)	3.1–10.1	2.2 (0.6–6.2)	<.0001

[a] SDs were calculated across all monthly estimates from a given ICU. The range across all ICUs is shown.

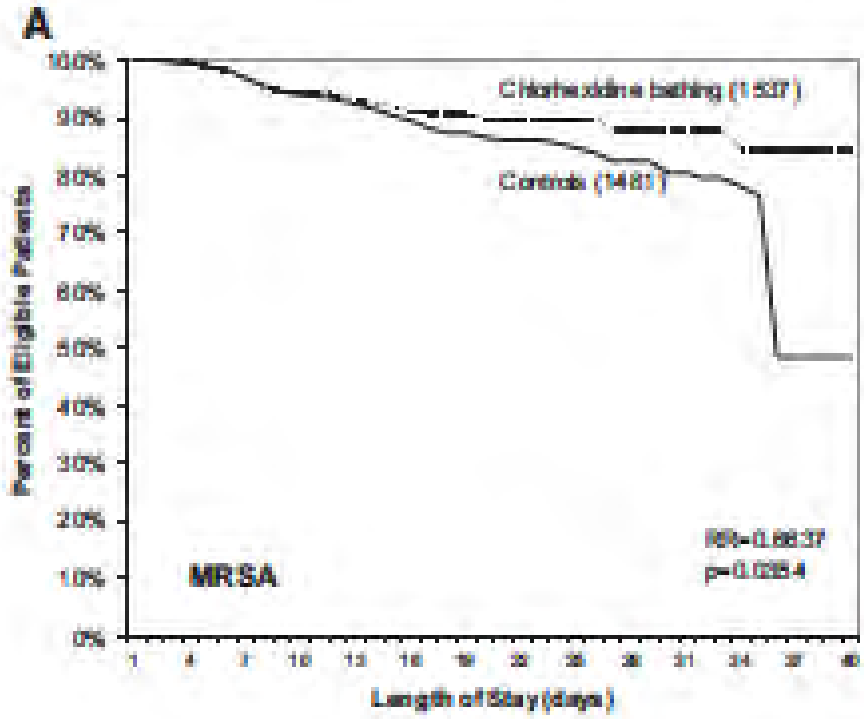
[b] Paired 2-tailed *t* test comparing monthly ICU estimates that include and exclude surveillance culture data.

[c] Similar results were found when the unit in which routine weekly surveillance was not performed was excluded (overall incidence, 2.4% without surveillance and 3.6% with surveillance [$P < .0001$]; overall incidence density, 9.3/1000 without surveillance and 7.1/1000 with surveillance [$P < .0001$]).

Huang et al 2007:JID 195:330-

Reduction in CABSI and MRSA with Use of Daily Chlorhexidine

- 6 ICUs, academic
- medical centers
- Cross over design
- Reduced MRSA incident coloniz -ations by 25% (2.5 1.93)



Number of subjects at risk	Day 5	10	15	20	25	30	35	40
Control	778	317	168	100	65	43	28	16
Intervention	817	317	161	103	58	41	24	17

Climo et al CCM 2009:37; 1858-65

Impact of daily bathing with CHG in ICU patients

- Multicenter, cluster-randomized, non blinded crossover trial
- 7727 patients bathed 2% CHG impregnated washcloths or nonmicrobial washcloths for 6 months
- Poisson regression analysis and incidence rates of MDROs and HAI bloodstream rates

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	

Climo M et al. NEJM. 2013;368:533

CHG skin decontamination in trauma

- Pro
  soa
  286
- Sin

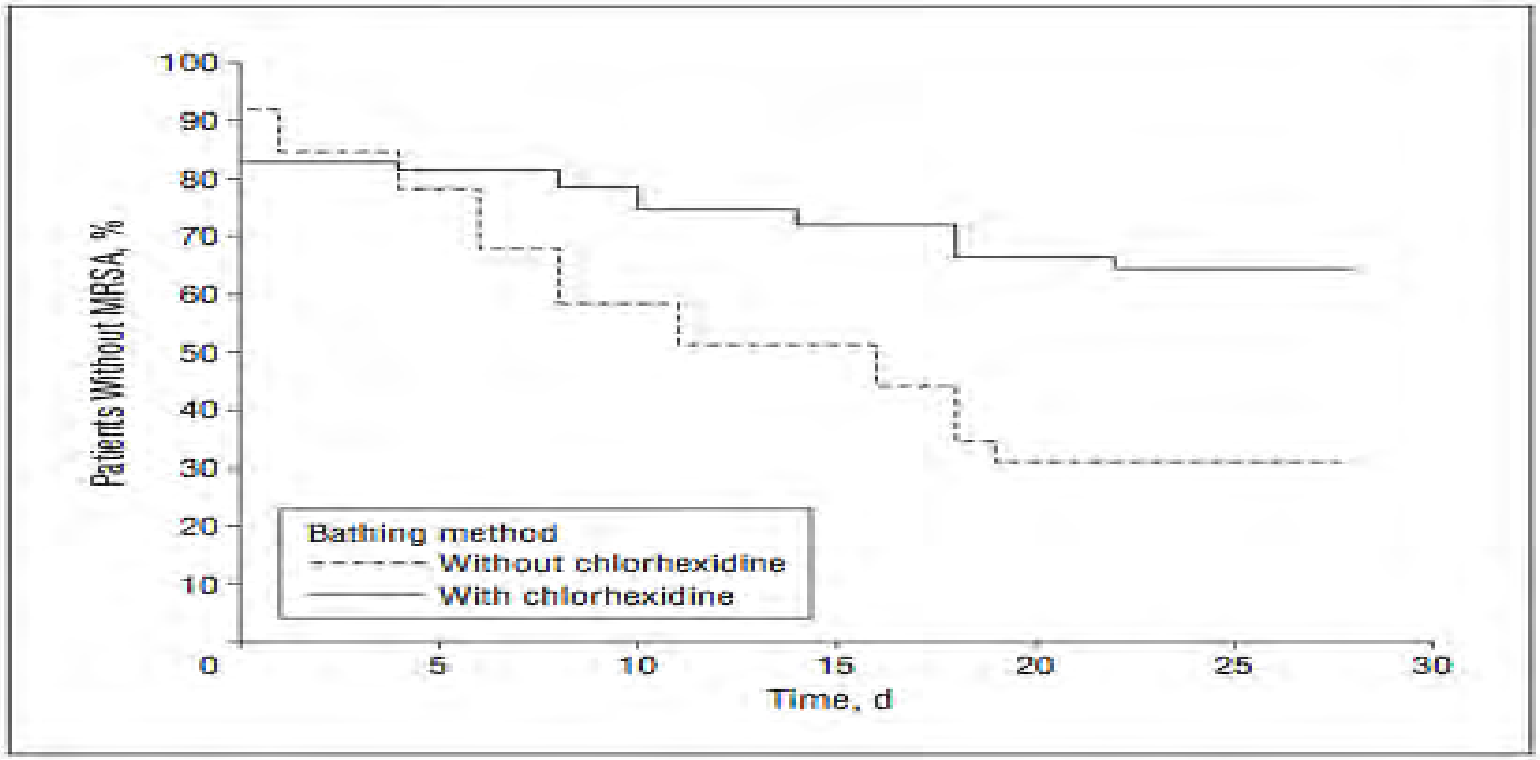


Table
by Met

Infectio				
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

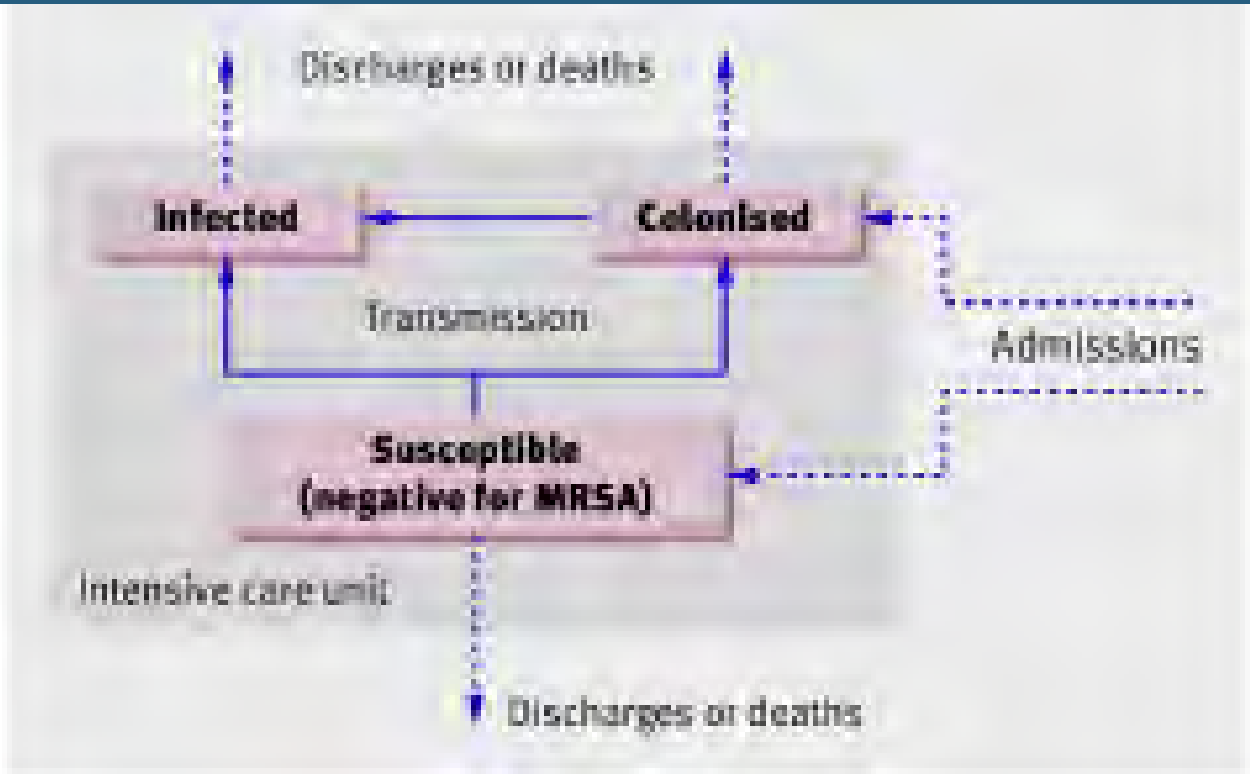
Abbreviations: BSI, bloodstream infection; CI, confidence interval;

Evans et al Arch Surg 2010:145 (3);240-6

Decolonization nationally: A cost effective approach

intensive care units

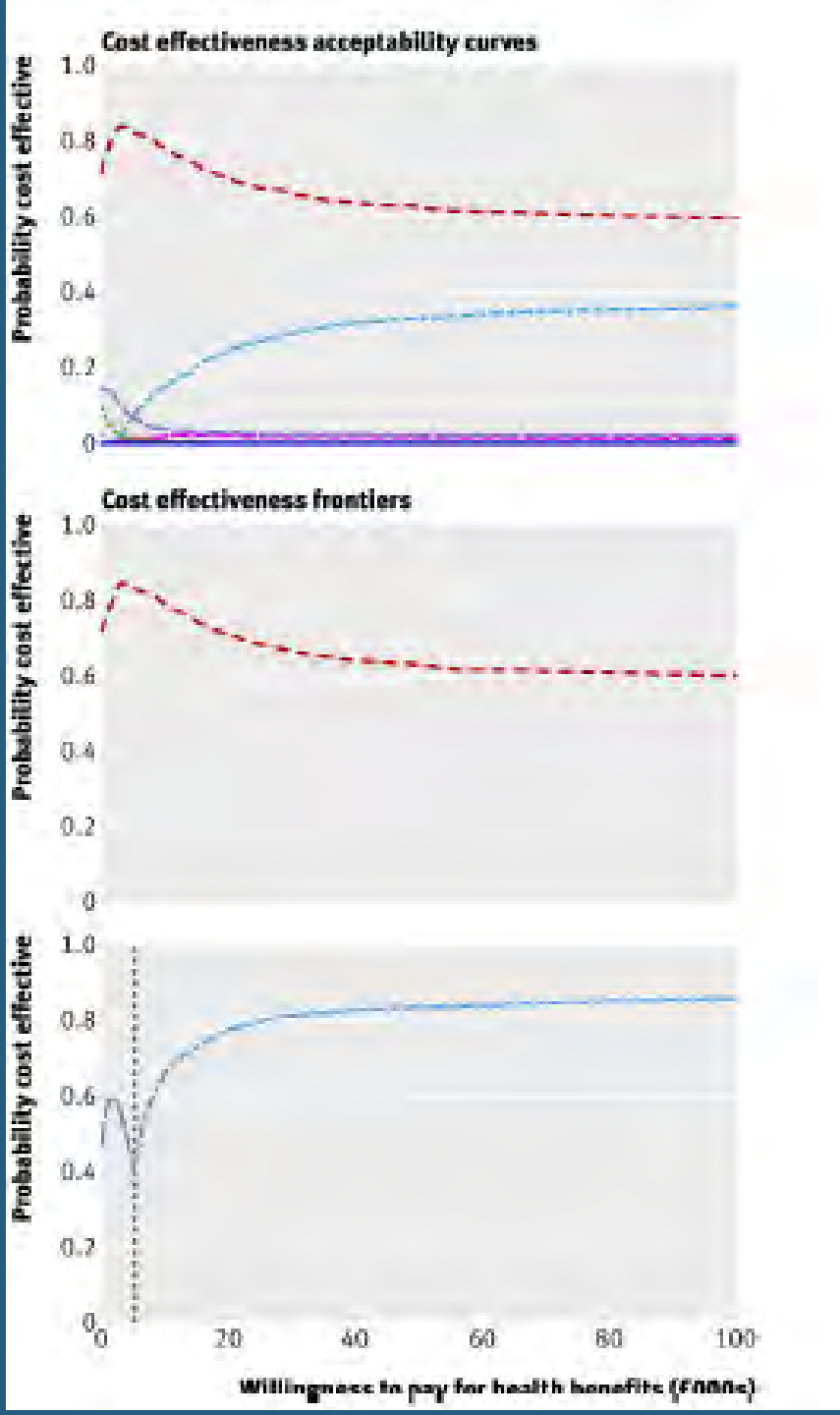
Screening	Screening method
No screening	Conventional culture of clini swabs only
No screening	Conventional culture of clini swabs only
No screening	Conventional culture of clini swabs only
All patients	Conventional culture
All patients on admission, and weekly thereafter	Conventional culture
	Chromogenic agar
	Polymerase chain reaction
High risk patients on admission, and weekly thereafter	Conventional culture
	Chromogenic agar



MRSA positive	On 48 hour result	Isolation or decolonisation (mupirocin)
MRSA positive	On 24 hour result (amended on 48 hour result)	Isolation†

Robatham et al, BMJ 2011; 343:1-13

Decolonization nationally: A cost effective approach



Robatham et al, BMJ 2011; 343:1-13

Decolonization nationally: A cost effective approach

- In an ICU decolonization is likely to be cost effective providing resistance is lacking
- Combining universal screening with decolonization is good value if untargeted screening is unacceptable
- Evidence is insufficient to support decolonization in low prevalence areas

Robatham et al, BMJ 2011; 343:1-13

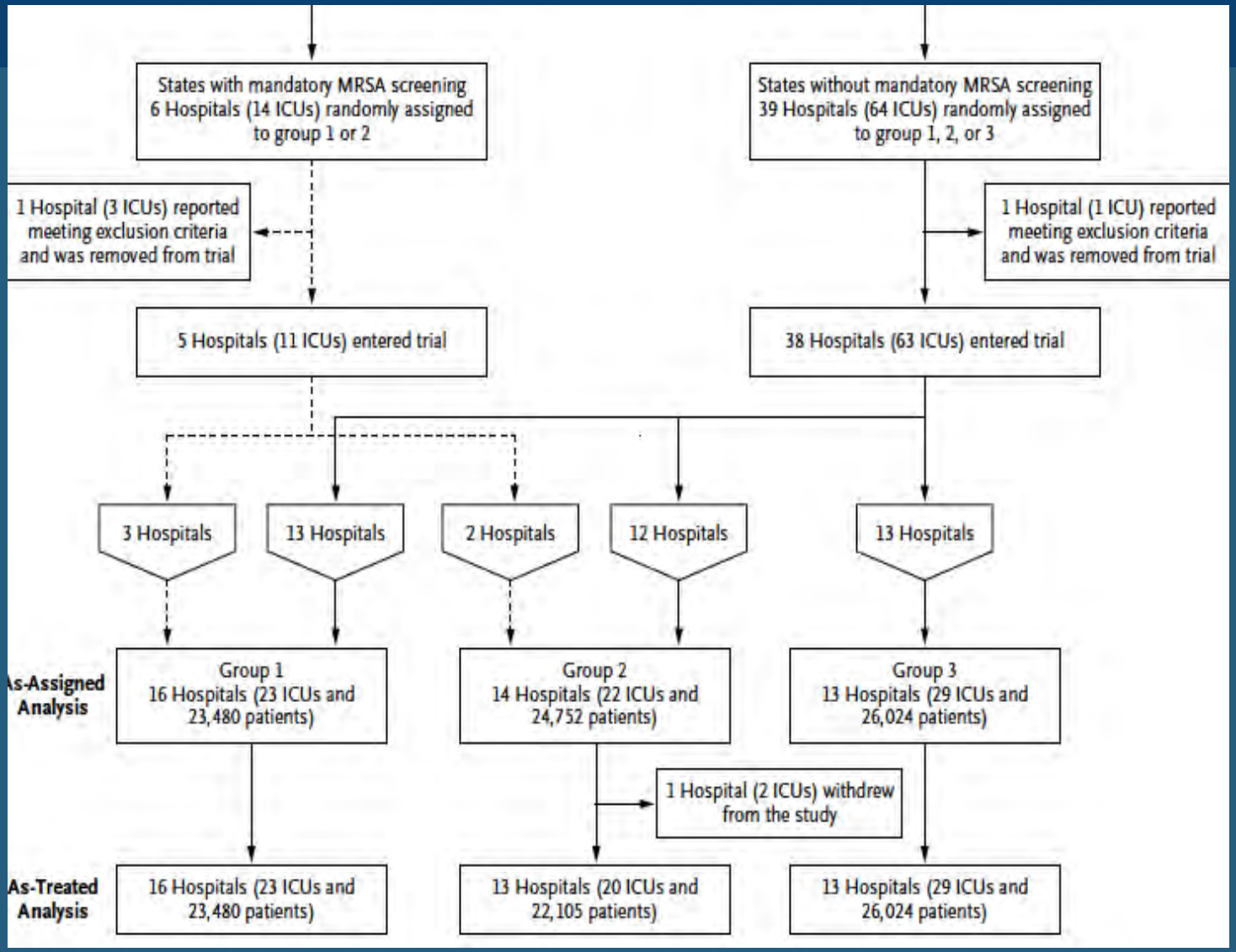
A national approach

Cluster randomized clinical trial in 74 ICUs comparing

- 1. MRSA screening and isolation
- 2. MRSA screening, isolation and decolonization (CHG and mupirocin) of carriers
- 3. MRSA screening, isolation and universal decolonization (CHG and mupirocin)
- Infection control policies standard; hospital and patient characteristics similar

Huang et al, NEJM 2013; 368:2255-65

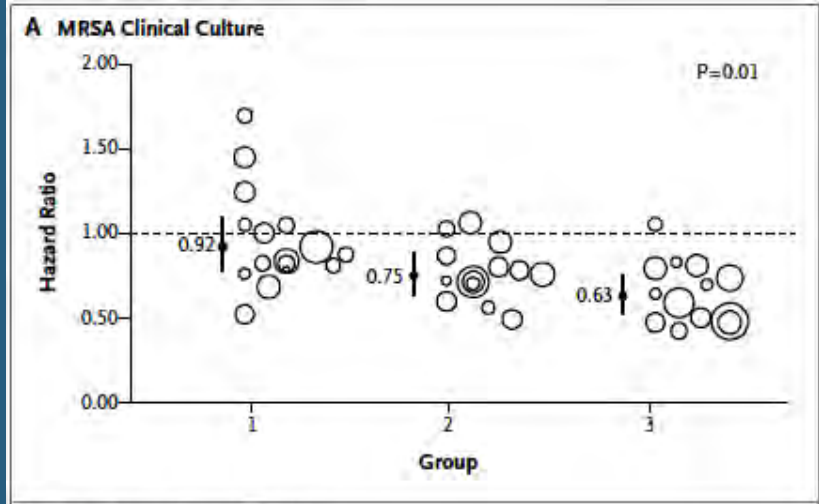
Decolonization nationally

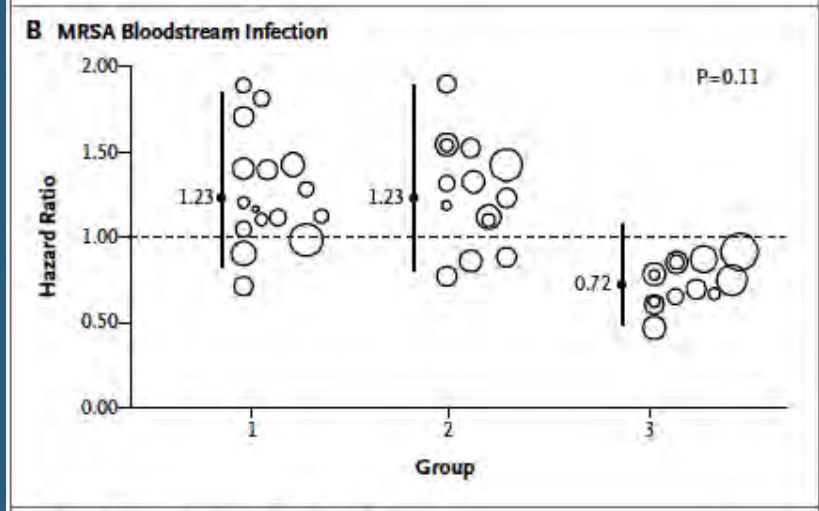


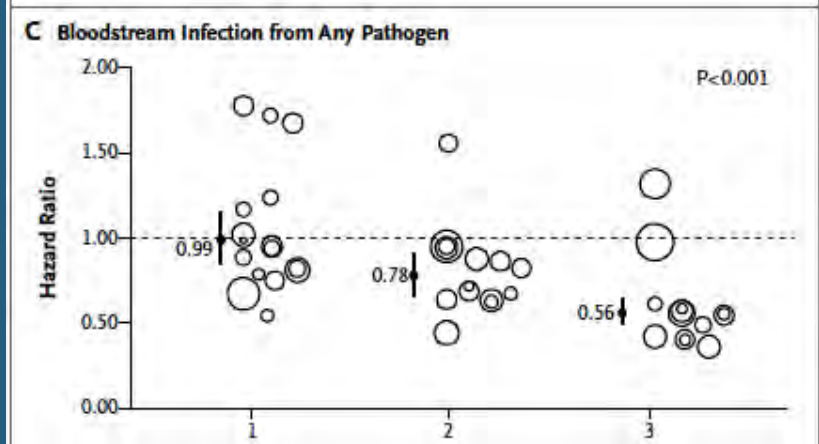
Huang et al, NEJM 2013; 368:2255-65

Decolonization nationally

- Routine universal decolonization in ICU patients was more effected than targeted screening and decolonization
- 1 BSI prevented for every 54 patients treated
- 7 adverse events related to CHG







Huang et al, NEJM 2013; 368:2255-65

The Limitation(s)

- Most sites were small hospitals
- No data on resistance to either mupirocin or CHG
- Compliance measured at 3 points by hospital nursing supervisors
- Only culture data was used; no definitions applied to laboratory information
- No information about the impact on transmission and guidance for infection prevention interventions such as isolation

Decolonization internationally

Three phased intervention in 13 ICUs

1. Baseline X 6 months
2. Improvement of hand hygiene and CHG bathing X 6 months
3. Cluster randomization of chromogenic versus rapid (PCR) screening for VRE, MRSA, and MDR-GNRs

Derde et al, Lancet 2013 (published on line Oct 23rd)

Decolonization internationally

	Antimicrobial-resistant bacteria	MRSA	VRE	HRE
Phase 1 trend	1·014 (0·996–1·031; p=0·12)	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)
Phase 2 step change	0·955 (0·676–1·348; p=0·79)	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)
Phase 2 change in trend	0·976 (0·954–0·999; p=0·04)	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)
Phase 3 step change	0·634 (0·349–1·153; p=0·14)	0·755 (0·252–2·257; p=0·62)	0·651 (0·209–2·031; p=0·46)	0·525 (0·263–1·048; p=0·07)
Phase 3 change in trend	1·015 (0·998–1·032; p=0·09)	1·057 (1·029–1·086; p<0·001)	1·015 (0·984–1·048; p=0·34)	0·991 (0·971–1·011; p=0·35)
Phase 3 step change (rapid vs conventional screening)	1·696 (1·090–2·638; p=0·02)	1·734 (0·768–3·916; p=0·19)	1·735 (0·711–4·234; p=0·23)	1·691 (1·012–2·828; p=0·05)
Phase 3 change in trend (rapid vs conventional screening)	0·996 (0·984–1·007; p=0·46)	0·985 (0·966–1·005; p=0·15)	0·993 (0·969–1·018; p=0·59)	1·000 (0·986–1·014; p=0·99)
Likelihood ratio test (rapid vs conventional screening)	p=0·06	p=0·34	p=0·47	p=0·10

Data are IRR (95% CI) unless stated otherwise. IRR<1 represents a decrease in acquisition, whereas IRR>1 represents an increase. Cluster effects were accounted for in the analyses, and potential confounding factors (sex, age, month, invasive devices, nurse-to-patient staffing ratio, location before ICU admission, reason for admission, APACHE/SAPS, hospital, and number of days-at-risk for acquisition) were fitted as covariates. MRSA=meticillin-resistant *Staphylococcus aureus*. VRE=vancomycin-resistant enterococci. HRE=highly resistant Enterobacteriaceae. IRR=incidence rate ratio. APACHE=Acute Physiology and Chronic Health Evaluation. SAPS=Simplified Acute Physiology Score.

Table 3: Weekly acquisition of any antimicrobial-resistant bacteria, MRSA, VRE, and HRE

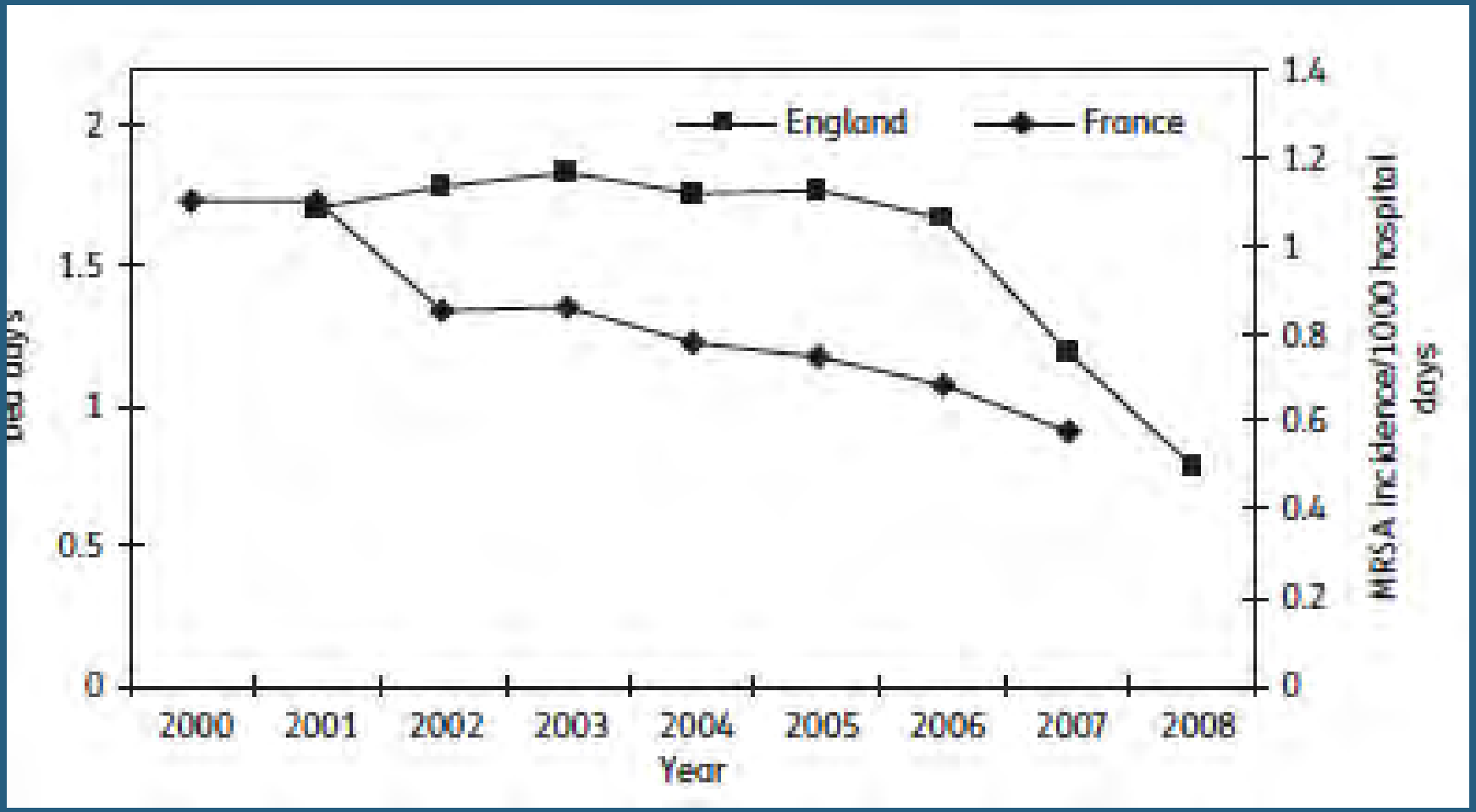
Derde et al, Lancet 2013 (published on line Oct 23rd)

Decolonization internationally: summary and limitations

- HH and CHG bathing not randomized in initial phases
- Not all patients screened on admission—selection bias
- An additional study that does not find screening adds to prevention of transmission

Derde et al, Lancet 2013 (published on line Oct 23rd)

The war of the roses continues



Edgeworth JAC 2011:S41-7

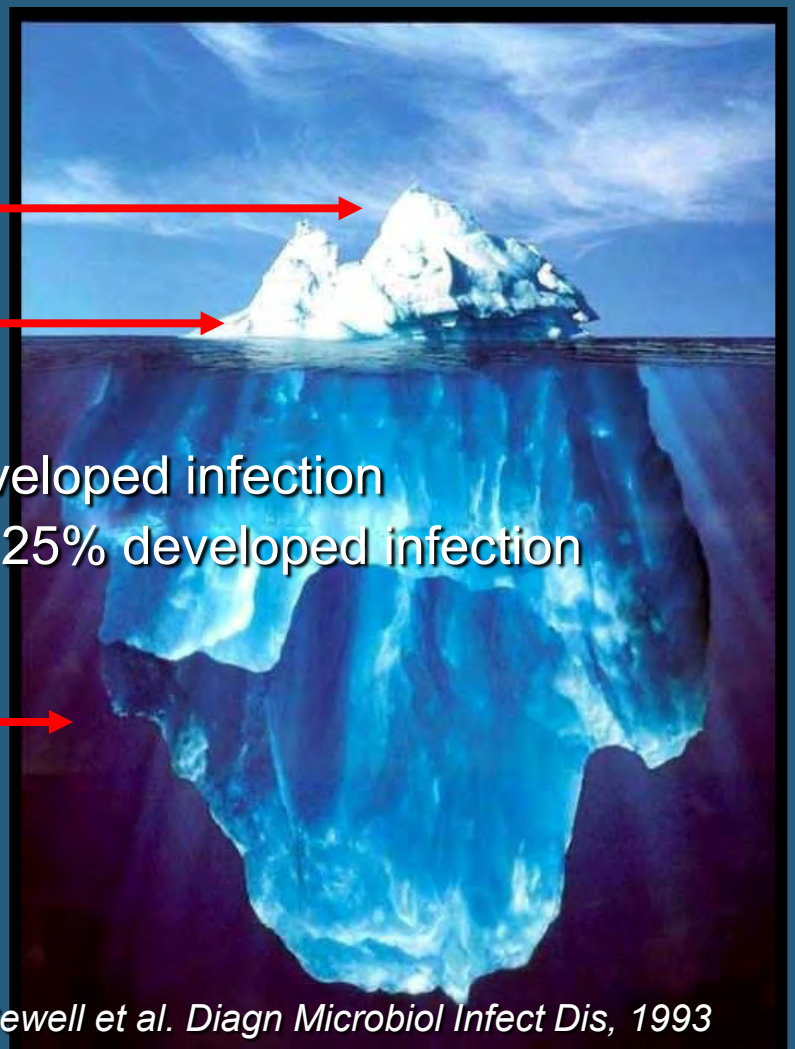
The rationale: "Iceberg" phenomenon

Clinical infection

Colonization detected by routine culture

- 3.4% w/ MRSA on admission, 19% developed infection
- 3.0% acquired MRSA after admission, 25% developed infection

Asymptomatic Colonization (reservoir)



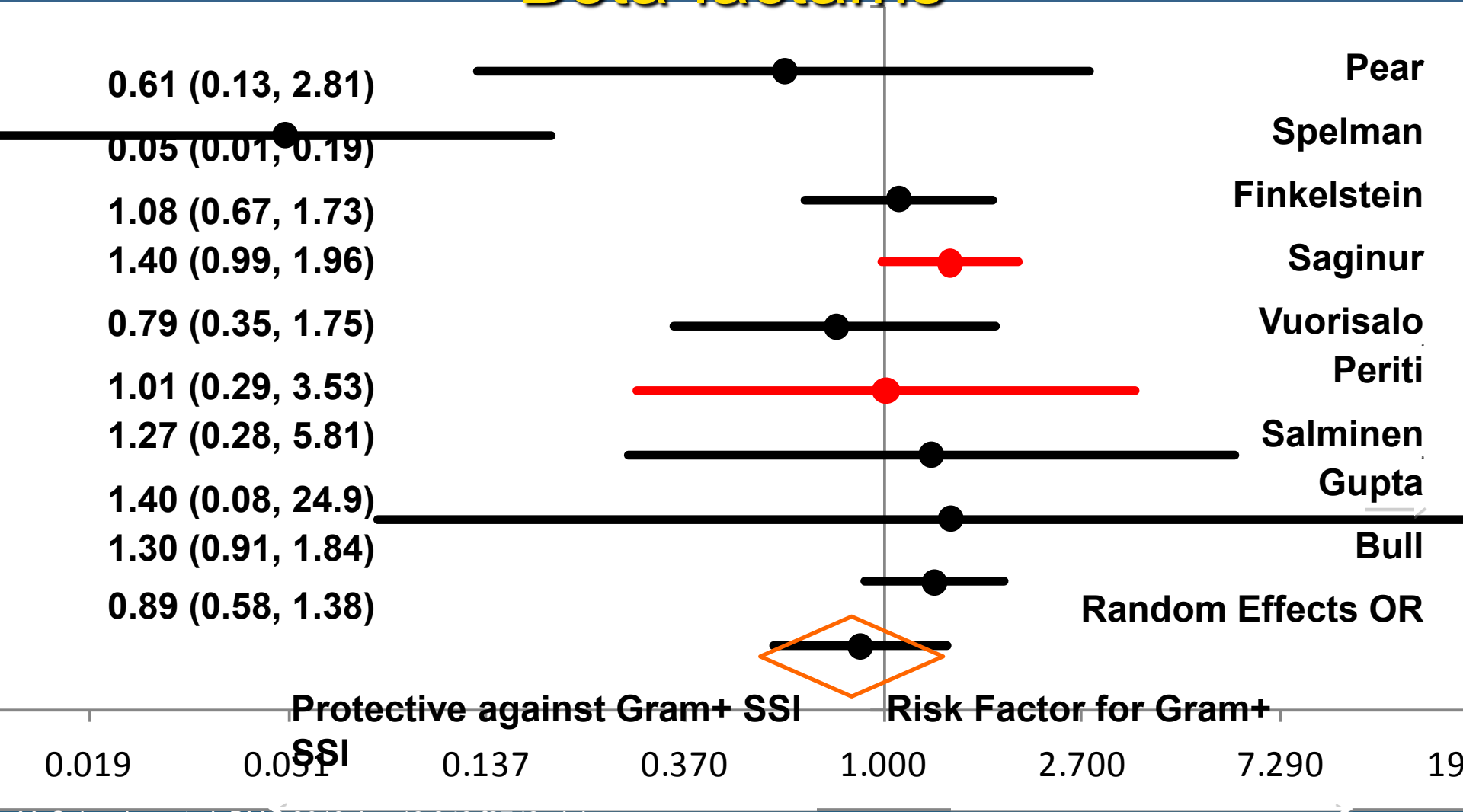
Coello R et al. Eur J Clin Microbiol Infect Dis, 1994; Sewell et al. Diagn Microbiol Infect Dis, 1993

Meta-analysis of Screening & Decolonization: MSSA & MRSA

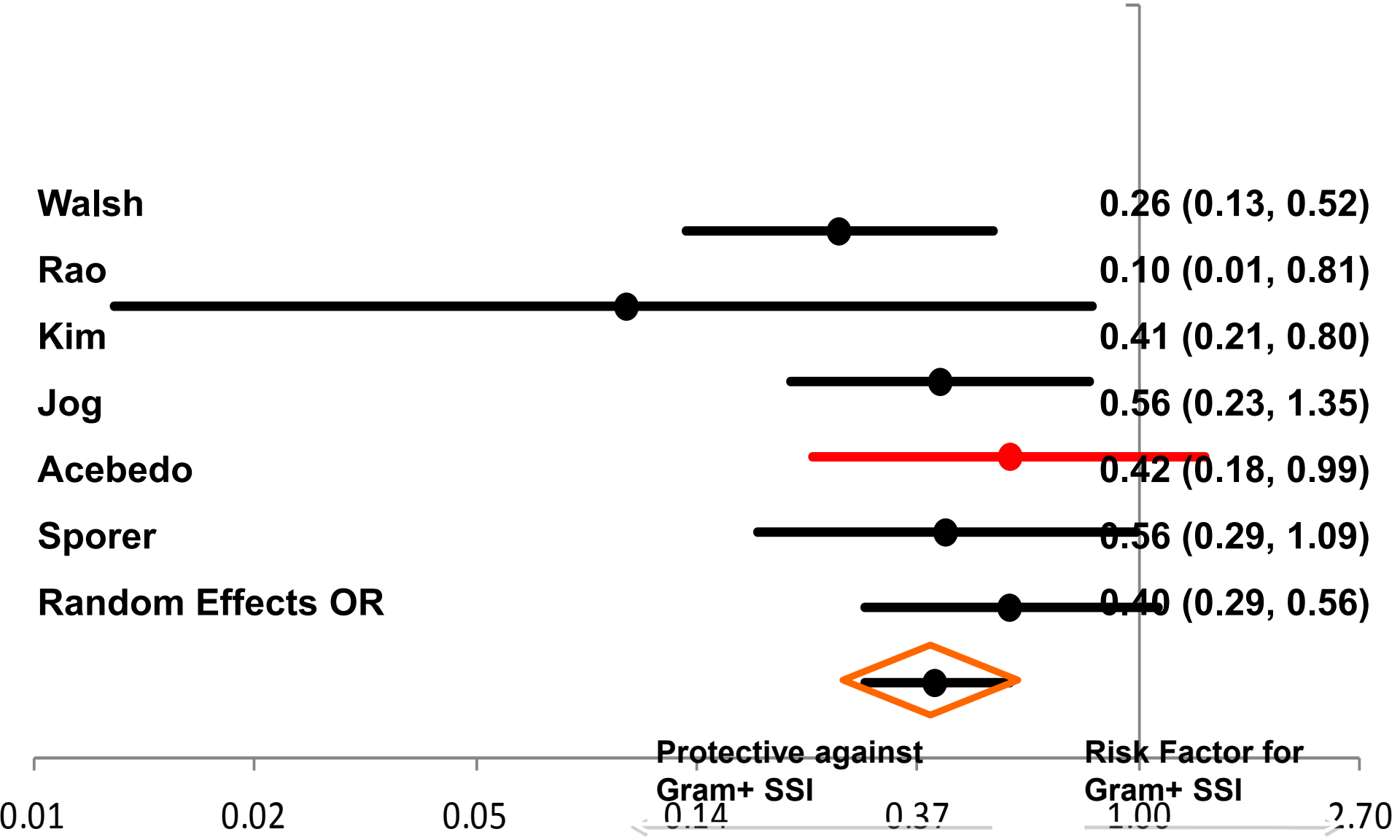
Analysis	Random Effects OR
Vancomycin vs. Glycopeptides	0.89 (0.58, 1.38)
Nasal decolonization: all patients	0.45 (0.32, 0.64)
Nasal decolonization: *S. aureus* carriers	0.39 (0.24, 0.65)
Decolonization + vancomycin of MRSA carriers	0.40 (0.29, 0.56)

M. Schweizer et al. BMJ. 2013 Jun 13;346:f2743. doi: 10.1136/bmj.f2743

Peri-operative prophylaxis: Glycopeptides vs. Beta-lactams

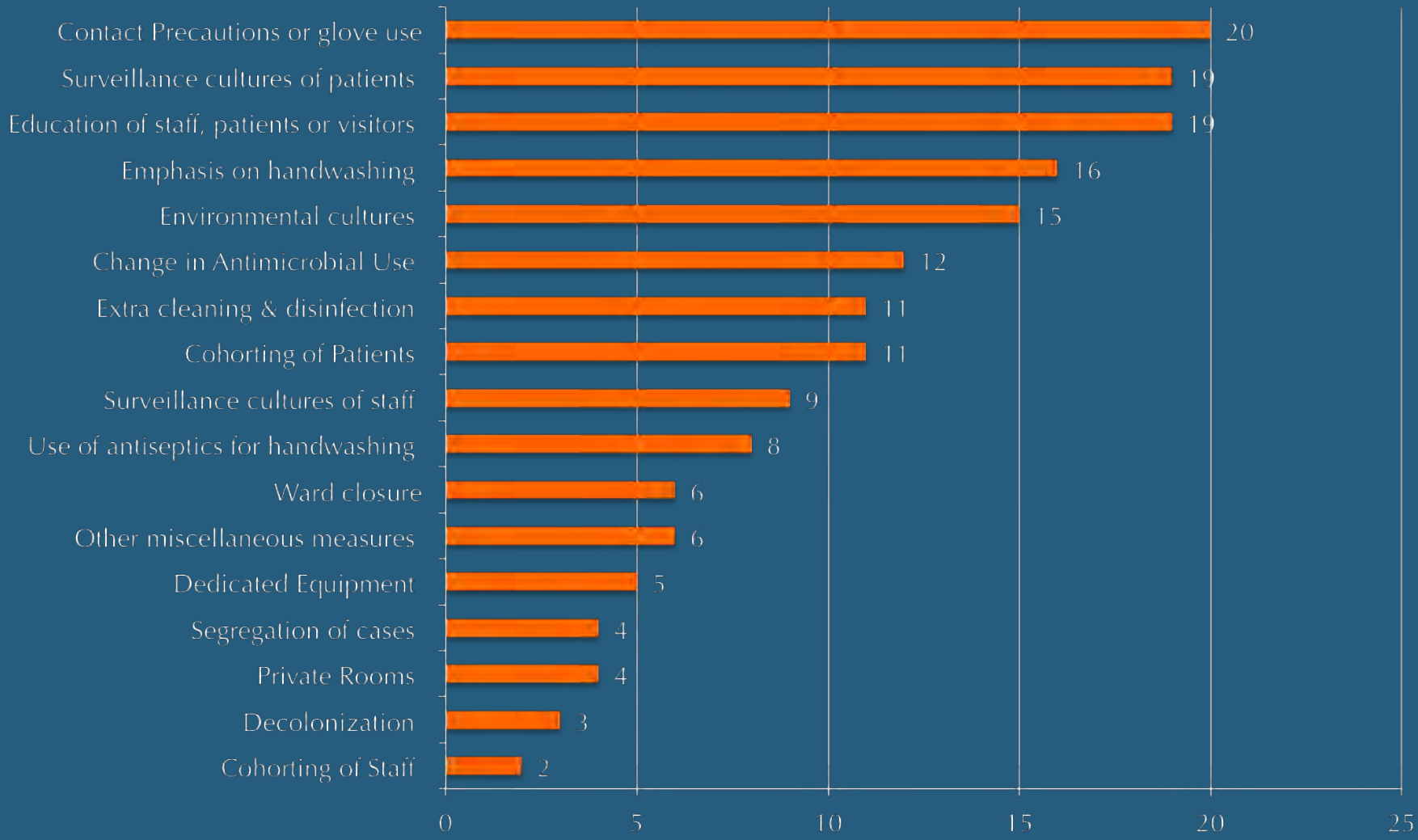


M. Schweizer et al. BMJ. 2013 Jun 13;346:f2743. doi: 10.1136/bmj.f2743



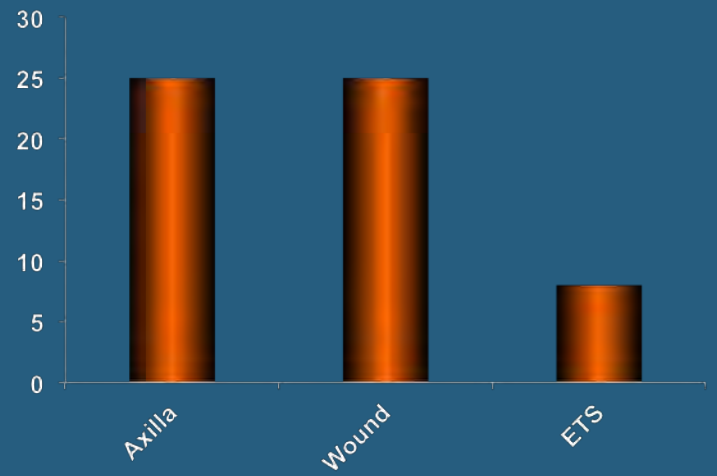
M. Schweizer et al. BMJ. 2013 Jun 13;346:f2743. doi: 10.1136/bmj.f2743

Control Measures for MDR-GNBs in Studies Performed in Healthcare Settings, 1982-2005



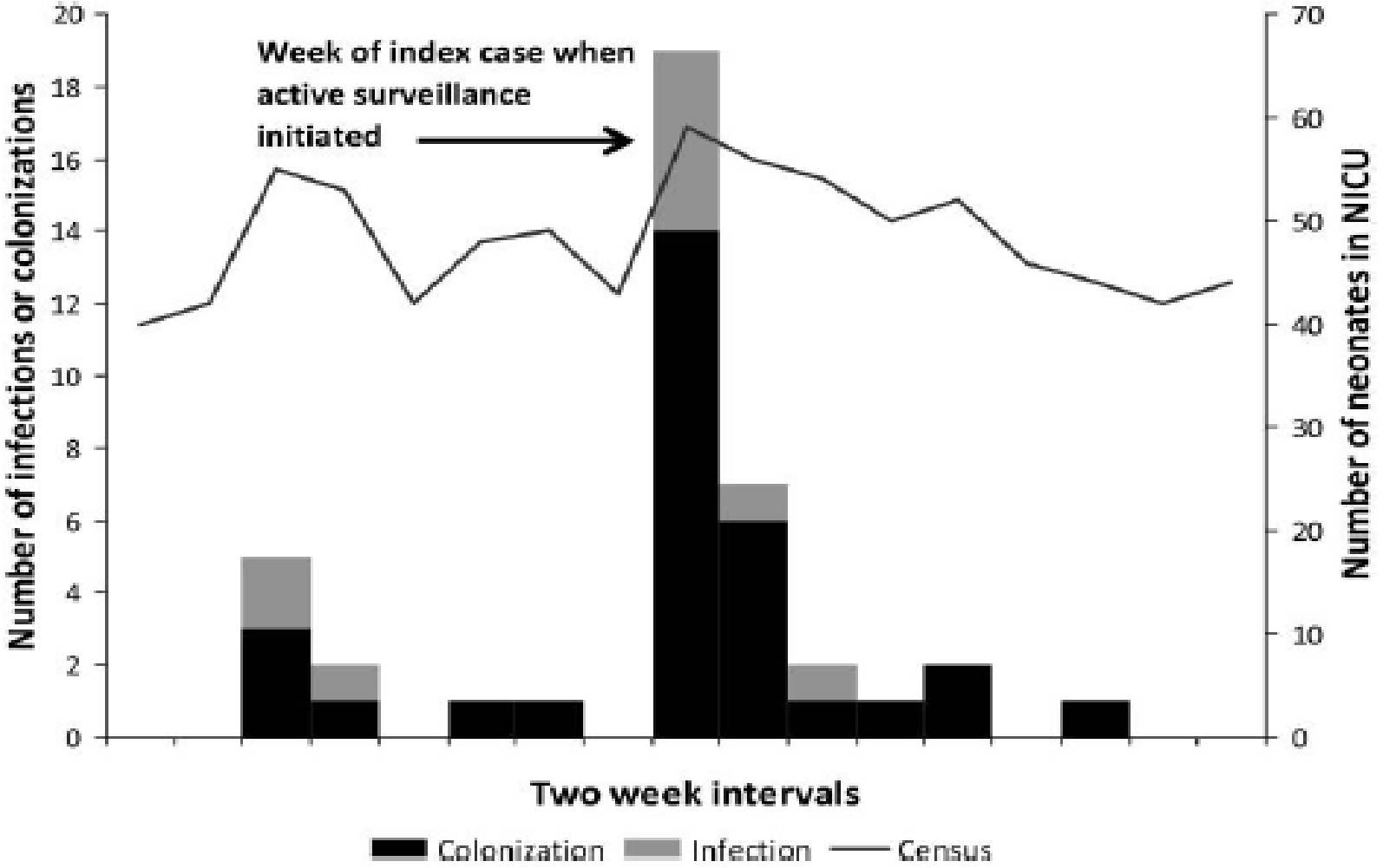
The Acinetobacter Iceberg

- 4-month prospective pilot study on 5 medical units at JHH
- Admission and weekly surveillance cultures for MDR-ACIN (Axilla, wound, sputum, endotracheal suction)
- 1601 admissions/transfers with 74%-94% compliance
- 7/1240 (0.006%) admission cultures and 5/470 (0.01%) weekly cultures grew MDR-ACIN
- 80% of patients with prior history had + culture



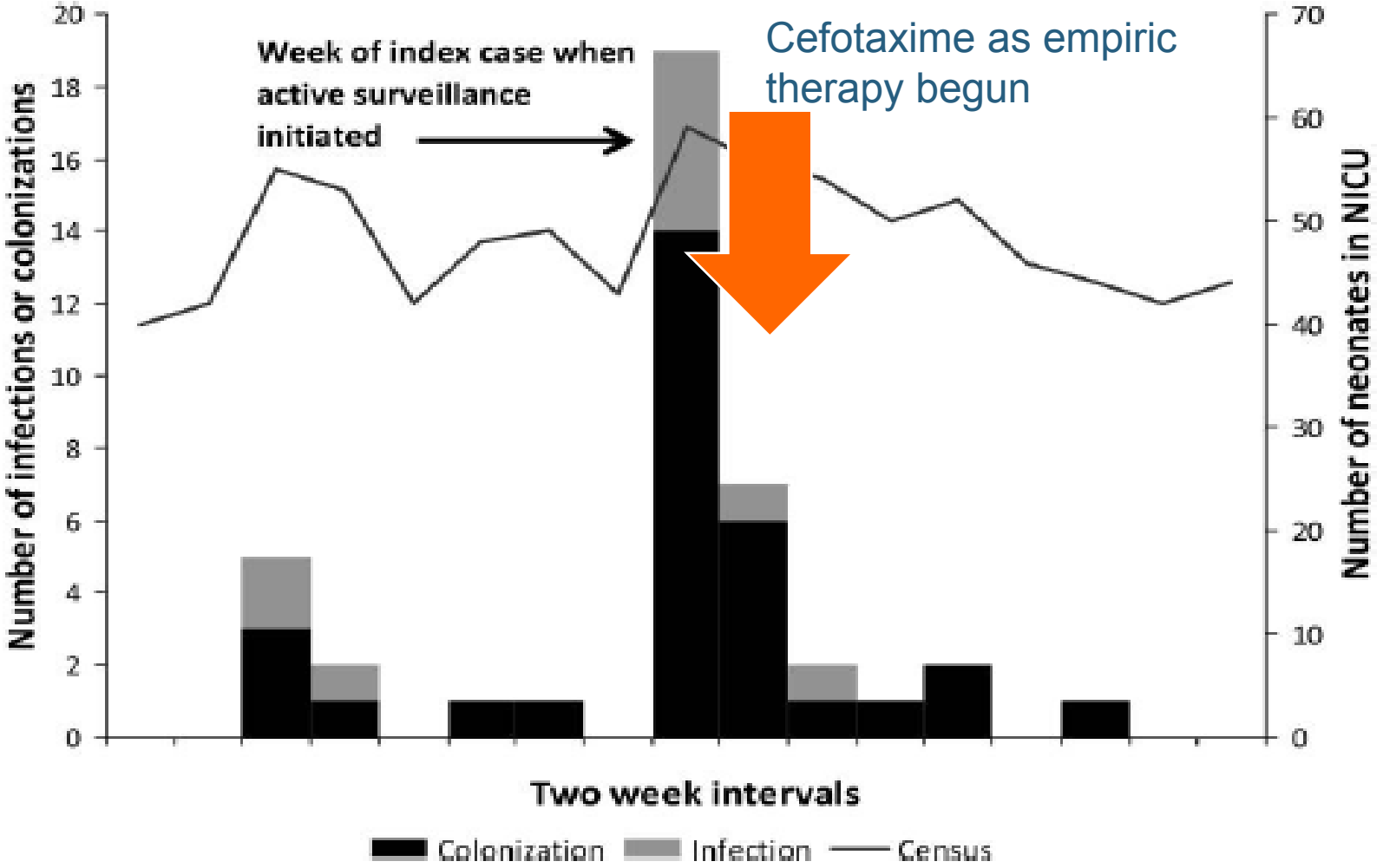
Maragakis , JAMA. 2006

ESBL Klebsiella in a NICU



Tamma et al ICHE 2012;33:631-4

ESBL Klebsiella in a NICU



Tamma et al ICHE 2012;33:631-4

Can We Identify These Cases?

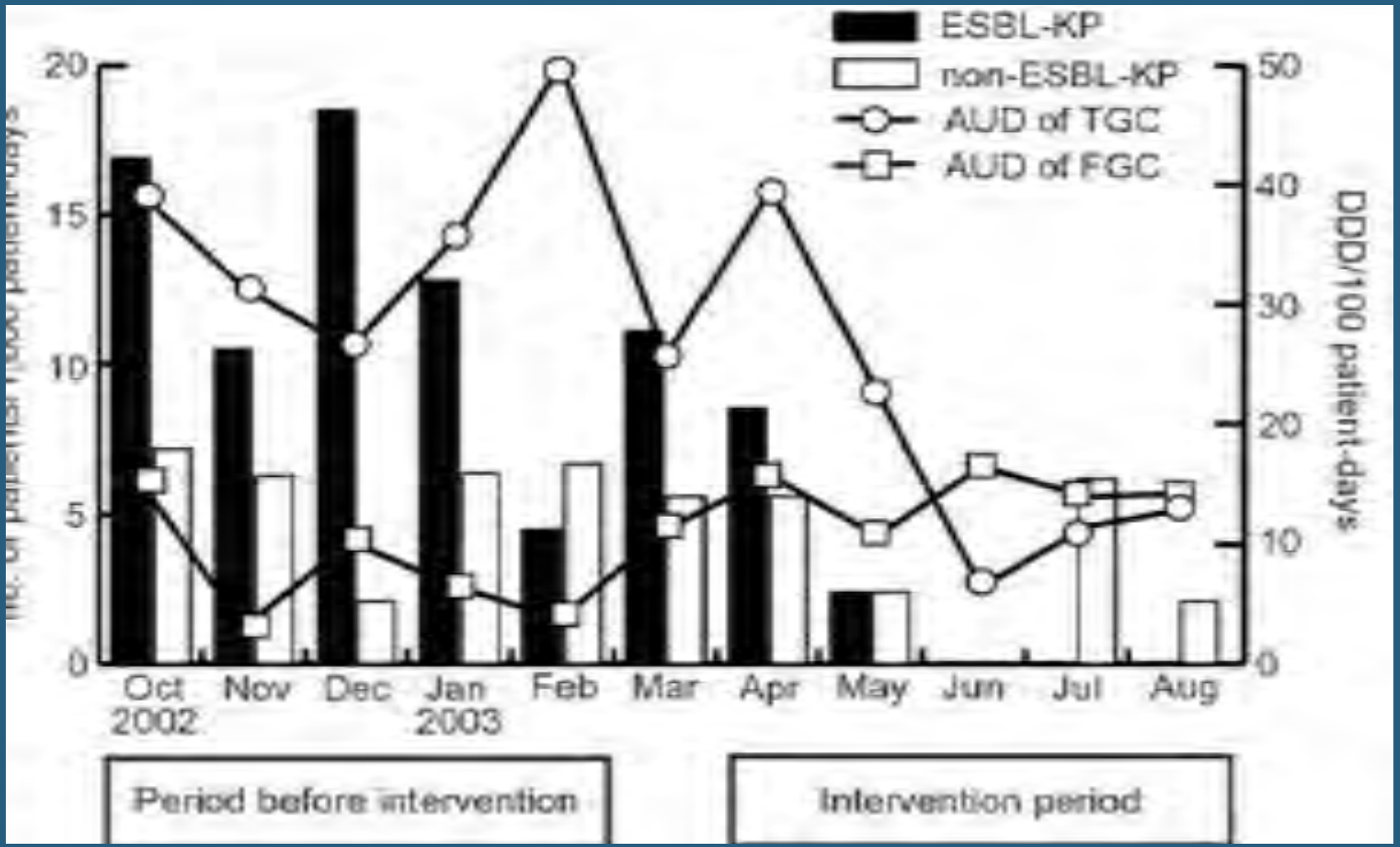
- Carriage of CTX-M found
  - 22% among patients with acute gastroenteritis
  - 7% among elderly Chinese

TABLE 1. Overview of the Different Colonization Patterns Detected in 133 Patients

Pattern	No. of patients (%)
1 colonization site	
Urine	32 (24.1)
Rectum	11 (8.3)
Groin	1 (0.7)
Throat	1 (0.7)
2 colonization sites	
Urine, rectum	38 (28.6)
Urine, groin	5 (3.8)
Urine, throat	1 (0.7)
Rectum, groin	6 (4.6)
Rectum, throat	1 (0.7)
Groin, throat	0 (0.0)
3 colonization sites	
Urine, rectum, groin	23 (17.3)
Urine, rectum, throat	2 (1.5)
Urine, groin, throat	1 (0.7)
Rectum, groin, throat	3 (2.3)
4 colonization sites	
Urine, rectum, groin, throat	8 (6.0)
Site totals	
Patients with colonization of the urine	110 (82.7)
Patients with colonization of the rectum	92 (69.2)
Patients with colonization of the groin	47 (35.3)
Patients with colonization of the throat	17 (12.8)

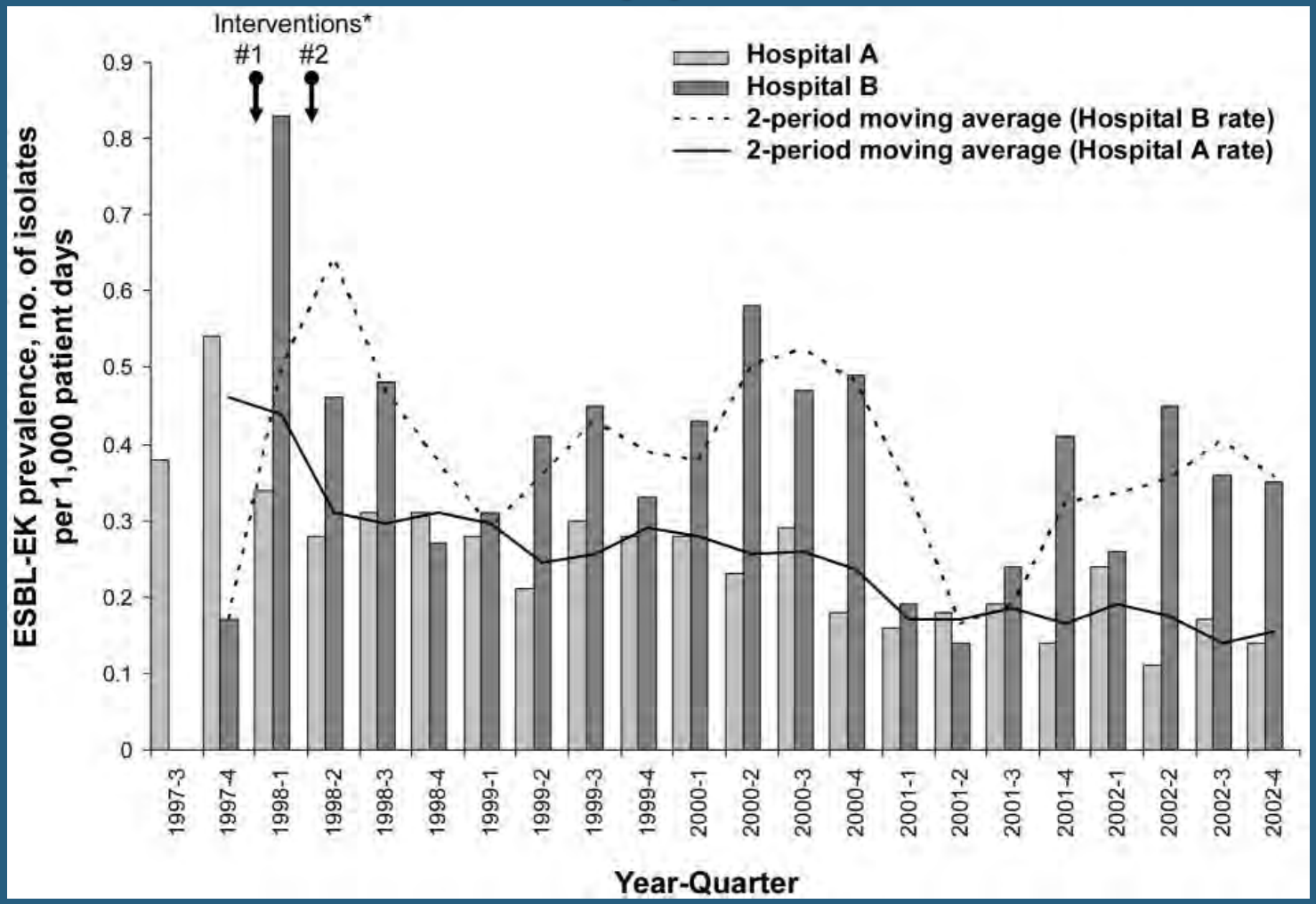
Tschudin-Sutter, et al. ICHE. 2012;33:1170-1; Muzaheed et al Indian J Med Res 2009; 129:599-602; Tian et al. Can J Microbiol 2008; 54:781-85

Reduced Use of 3rd Generation Cephalosporins Decreases the Acquisition of ESBL-Producing *K. pneumoniae*



Lee SO et al. Infect Control Hosp Epidemiol. 2004 Oct;25(10):832-7.

Impact of Antimicrobial Formulary Interventions on ESBL *E. coli* and *Klebsiella spp.*



Lipworth AD, et al. Infect Control Hosp Epidemiol. 2006;27:279-86.

Multivariate Analysis

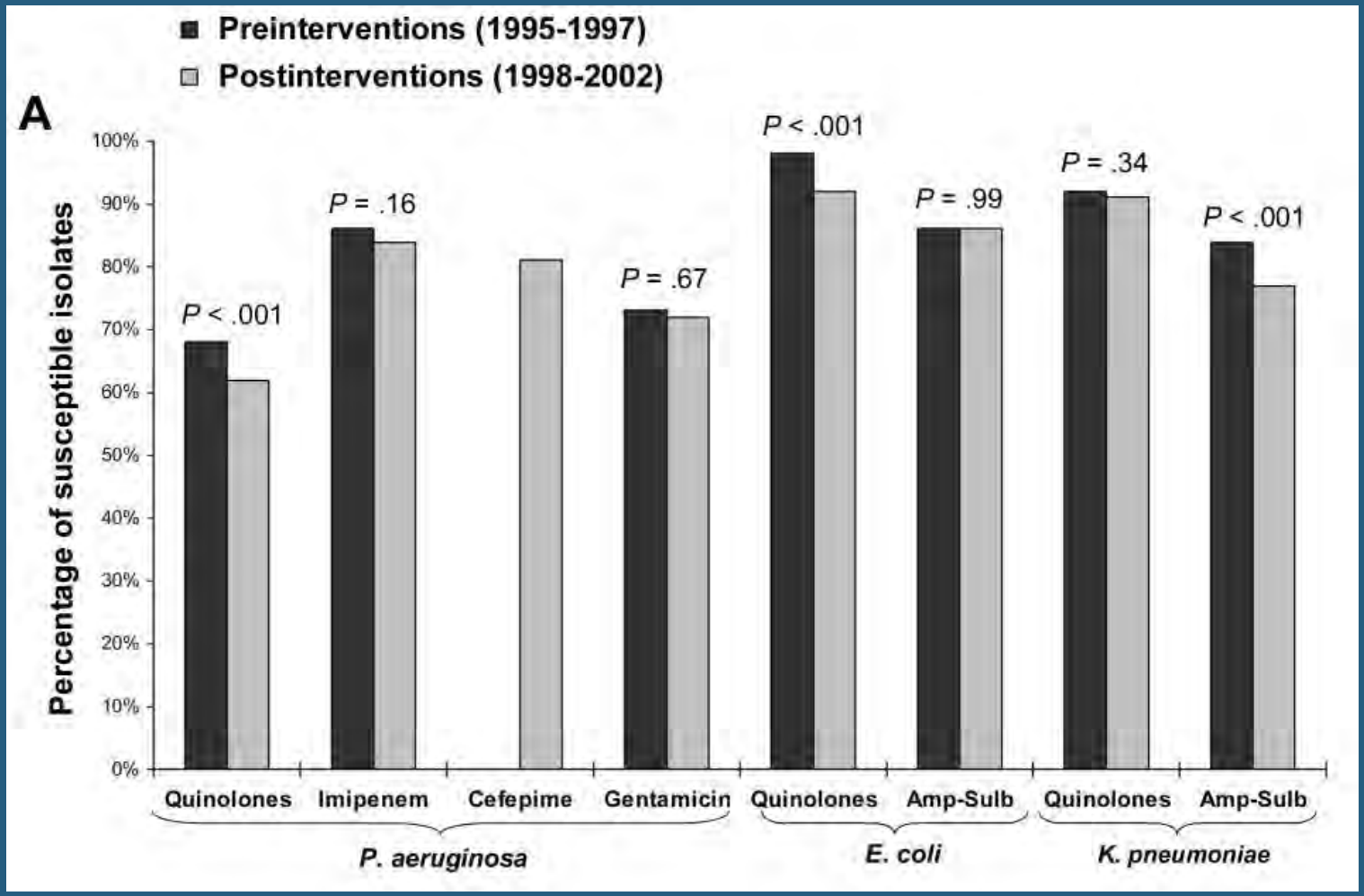
Variable	Unadjusted Odds Ratio (OR)	Adjusted OR (95% CI)	*P*
LTCF	8.72	3.77 (1.70–8.37)	.001
Age*	—	1.04 (1.01–1.06)	.002
Decubitus ulcer	3.43	4.13 (1.97–8.65)	<.001
Hospital duration	—	0.97 (0.94–0.98)	.005

*OR reflects the odds associated with each 1-year increase in age: this is equivalent to an OR of 1.44 (95% CI, 1.14–1.81) associated with a 10-year increase in age.

†Days from hospital admission until recovery of an extended-spectrum β-lactamase-producing isolate.

Lipworth AD, et al. *Infect Control Hosp Epidemiol*. 2006;27:279-86.

Changes in Antimicrobial Susceptibility After an Antimicrobial Intervention



Lipworth AD, et al. Infect Control Hosp Epidemiol. 2006;27:279-86.

Experience with KPC's

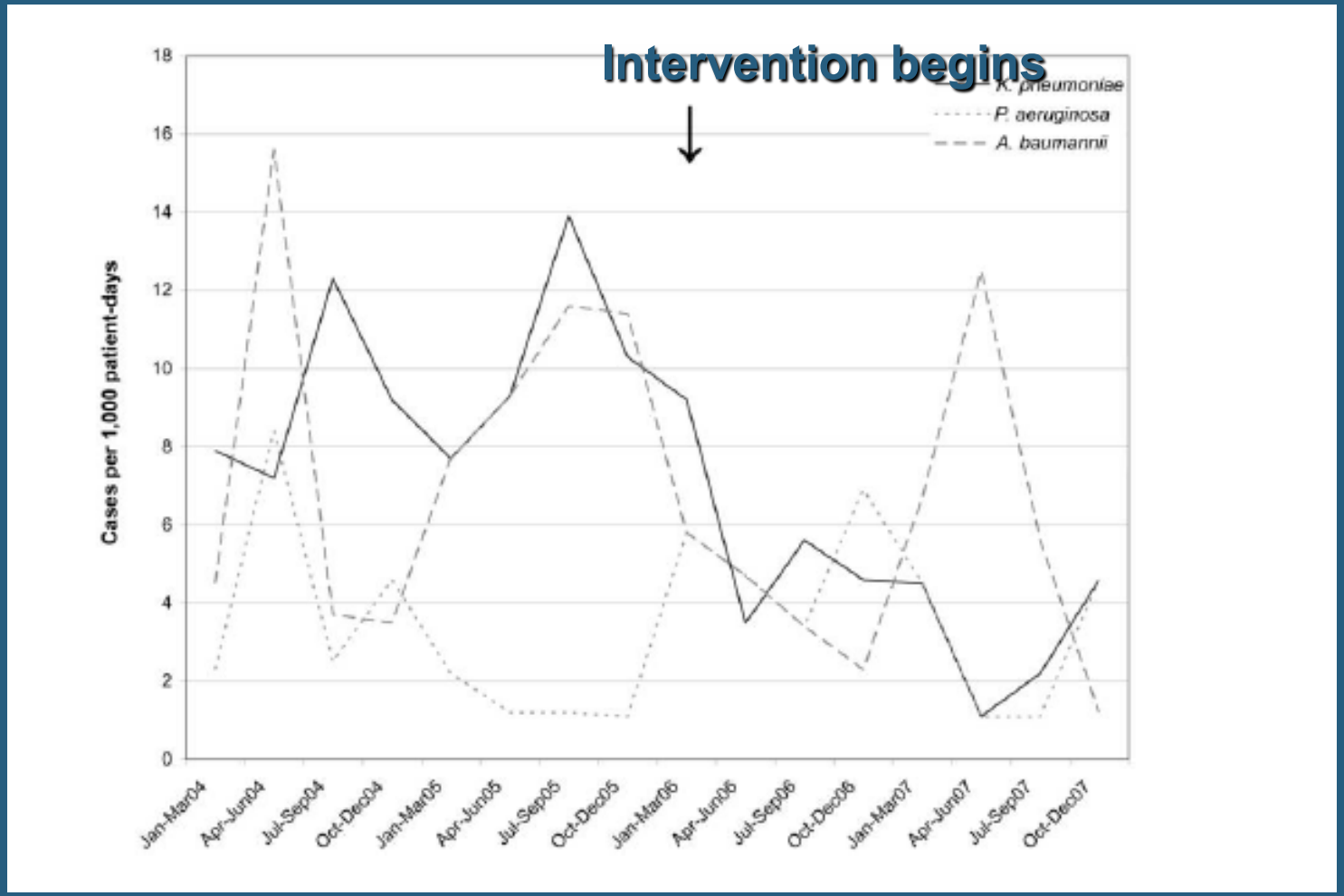
- Beginning 2006 in a 10 bed ICU all pts with KPC's, VRE, MRSA were

1) Placed in contact isolation
2) Cohorted in one end of the ICU
3) Compliance with hand hygiene and cleaning encouraged
4) Routine rectal swabs for KPCs implemented

- Mean number of patients per 1,000 pt days with KPC's decreased from 9.7 to 3.7 ($P<0.001$)

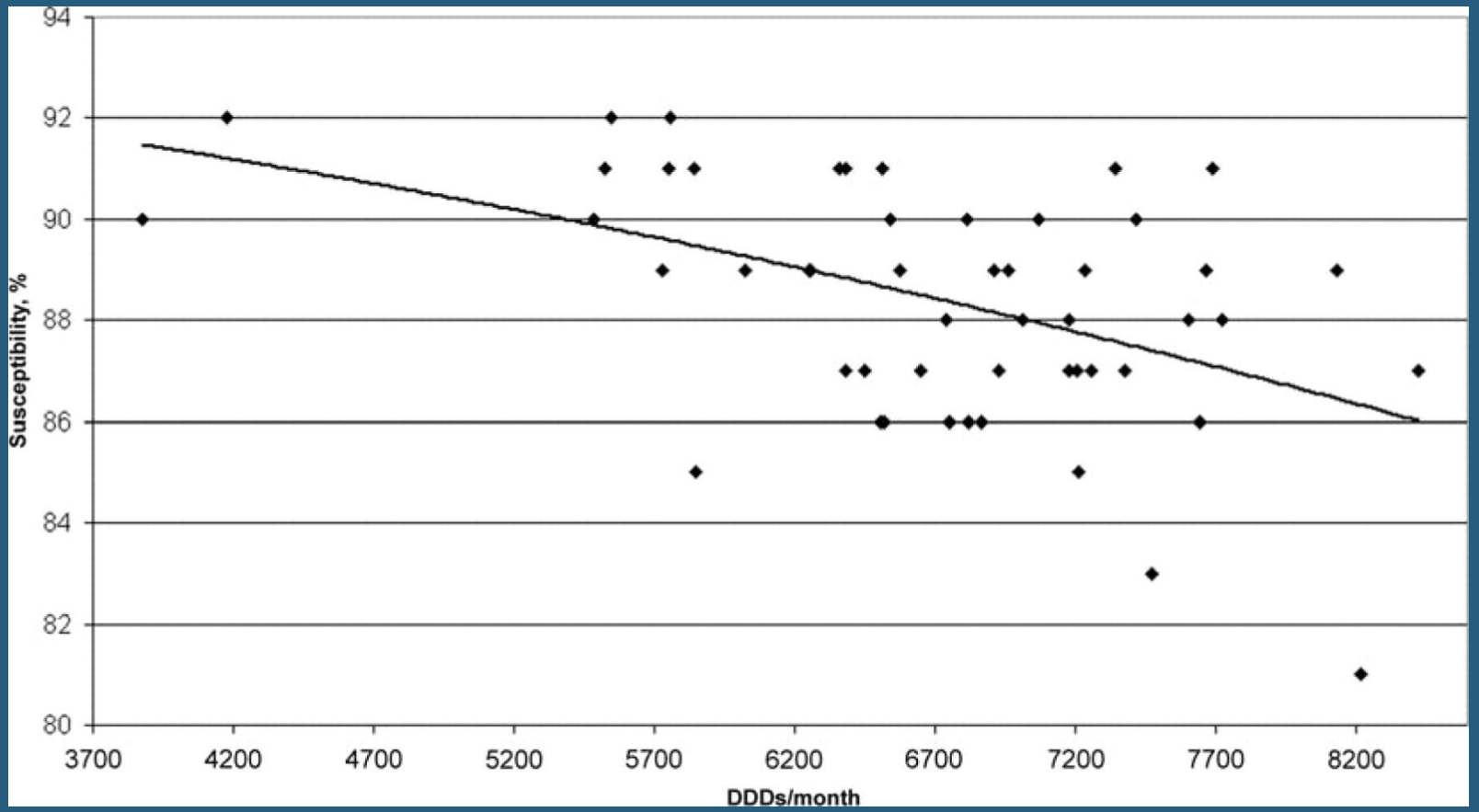
Kochar et al, ICHE 2009:33;447

Experience with KPC's



Kochar et al, ICHE 2009:33;447

Relationship Between Quinolone Consumption and Susceptibility of *Escherichia coli* Isolates from Urine Cultures to Quinolone



Gottesman B S et al. Clin Infect Dis. 2009;49:869-875

Summary

- Surveillance cultures
- In healthcare there is a high prevalence of « unrecognized » MDRO colonization-- the Iceberg. Colonization increases the risk of infection.
- For VRE and MRSA, surveillance cultures can facilitate appropriate precautions.
- MRSA in the preoperative patient—should be considered in peri-operative prophylaxis.
- VRE colonization may impact empiric therapy choices in high risk patients.
- In patients with surveillance cultures yeilding MDR-GNR, more information is needed before integrating them into clinical practice.

“There are risks and costs to a program of action. But they are far less than the long-range risks and costs of comfortable inaction”

John F. Kennedy

Free genius results in the capacity for evaluation of uncertain, hazardous, and conflicting information.

Winston Churchill