

Impact of routine surgical ward and intensive care unit admission surveillance cultures on hospital-wide nosocomial methicillin-resistant *Staphylococcus aureus* infections in a university hospital: an interrupted time-series analysis

Chaberny IF *et al.* *Journal of Antimicrobial Chemotherapy* (2008)  
62, 1422-1429

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# Background

- Approximately 32% (~90 million) and 0.8% (~2.3 million) of the US population is colonized with MSSA and MRSA respectively.

Kuehnert MJ et al. *Journal of Infectious Diseases* 2006; 193:172-9 Staphylococcal Disease Burden

- The proportion of healthcare associated staph infections that are due to MRSA has been increasing: 2% in 1974, 22% in 1995 and 64% in 2004

Klevens RM et al. *Clinical Infectious Diseases* 2006, 42:385-391

- MRSA acquisition is highly associated with subsequent infection in hospital
- Hospital-acquired MRSA infections are associated with increased morbidity and mortality, with prolongation of hospital stay and attributable and total direct costs.

## MRSA vs MSSA bacteremia

- increased risk of mortality with odds ratio of death 1.93
- increased attributable median length of stay 2 days
- median attributable hospital charge \$6,916

Cosgrove SE et al. *Infect Control Hosp Epidemiol* 2005; 26:53-9

## Observed Incidence Rates of Invasive Methicillin-Resistant *Staphylococcus aureus* (MRSA) by Active Bacterial Core Surveillance Site and Epidemiologic Classification, United States, 2005a

**Table 2.** Observed Incidence Rates of Invasive Methicillin-Resistant *Staphylococcus aureus* (MRSA) by Active Bacterial Core Surveillance Site and Epidemiologic Classification, United States, 2005<sup>a</sup>

Surveillance Site No. (Location) <sup>b</sup>	No. of Cases	Incidence per 100 000			Total
		Community-Associated	Health Care-Associated		
			Community-Onset	Hospital-Onset	
1 (Connecticut)	952	2.7	15.6	8.4	27.1
2 (Atlanta, GA, metropolitan area)	1165	5.1	16.7	10.3	33.0
3 (San Francisco, CA, Bay Area)	936	4.5	15.9	7.7	29.2
4 (Denver, CO, metropolitan area)	480	2.8	12.3	6.0	21.2
5 (Portland, OR, metropolitan area)	305	4.7	11.4	3.6	19.8
6 (Monroe County, NY)	307	2.7	22.2	16.8	41.9
7 (Baltimore City, MD)	742	29.7	62.9	19.7	116.7
8 (Davidson County, TN)	305	6.8	30.4	13.9	53.0
9 (Ramsey County, MN)	95	1.6	11.5	6.1	19.2

<sup>a</sup>Epidemiologic classification of disease consisted of health care-associated (either hospital-onset cases with a culture collected >48 h after hospital admission or community-onset cases with health care risk factors but a culture collected ≤48 h after hospital admission) and community-associated cases (no health care risk factors).

<sup>b</sup>Site numbers were assigned in descending order of population size.

**Klevens, R. M. et al. JAMA 2007;298:1763-1771.**

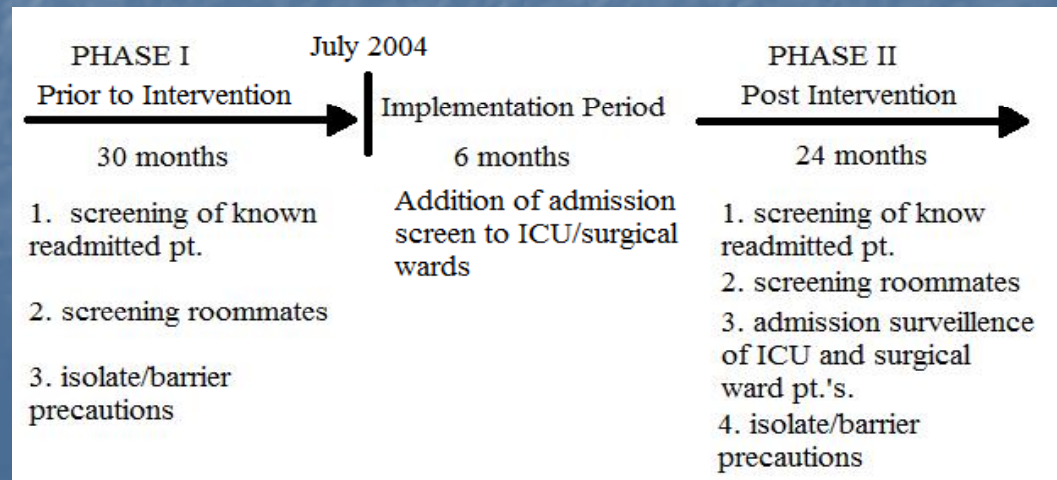
# “Tip of the Iceberg”

Clinically obvious infections represent only a small number of those colonized

- Admission cultures allow identification of unrecognized reservoir → appropriate barrier precautions and handwashing
- Several studies have shown reduction in ICU acquired nosocomial infections with admission screening

# Study Design

- Hypothesis/Goal: Admission screening on surgical wards and ICU's are effective in reducing the incidence of all MRSA infections and nosocomial MRSA infections
- Setting: 1400 bed university hospital with 129 intensive care medicine beds and 212 major surgical beds in Hannover, Germany.
- Participants : adults admitted to ICU's and surgical wards (ie trauma, visceral, CT, and vascular)
- Study Design: single center prospective quasi-experimental design via an analysis of an interrupted time series
- Quasi-experimental – experimental research selecting groups, upon which a variable is tested without any pre-selection randomization.
- Interrupted time series



# Data Collection/analysis

- MRSA positive - + clinical sample, + screening culture, or history of MRSA infection/colonization
  - every hospital stay was a separate case
- MRSA colonization – screening cultures without signs of infection
- MRSA infections – clinical signs/symptoms of infection with +sample
- Nosocomial MRSA infection – + clinical specimen/screening culture >48h from admission
- Analysis
  - Incident Densities
  - Segmented regression analysis

Table 1. Hospital demographics and incidence densities per 1000 pd of MRSA and of performed nares cultures, 2002–06

Parameter	2002	2003	2004	2005	2006
Hospital demographics					
no. of patients	40 225	39 129	44 647	46 785	48 338
no. of pd	391 516	385 842	401 015	396 863	412 440
length of stay (days)	8.9	8.9	8.4	8.0	8.0
MRSA patients/1000 pd					
MRSA patients/1000 pd	0.56	0.80	1.47	1.49	1.64
MRSA-infected patients/1000 pd	0.26	0.29	0.40	0.25	0.18
nosocomial MRSA-infected patients/1000 pd	0.11	0.19	0.23	0.13	0.10
nares cultures/1000 pd	2.3	4.7	11.6	18.6	20.4

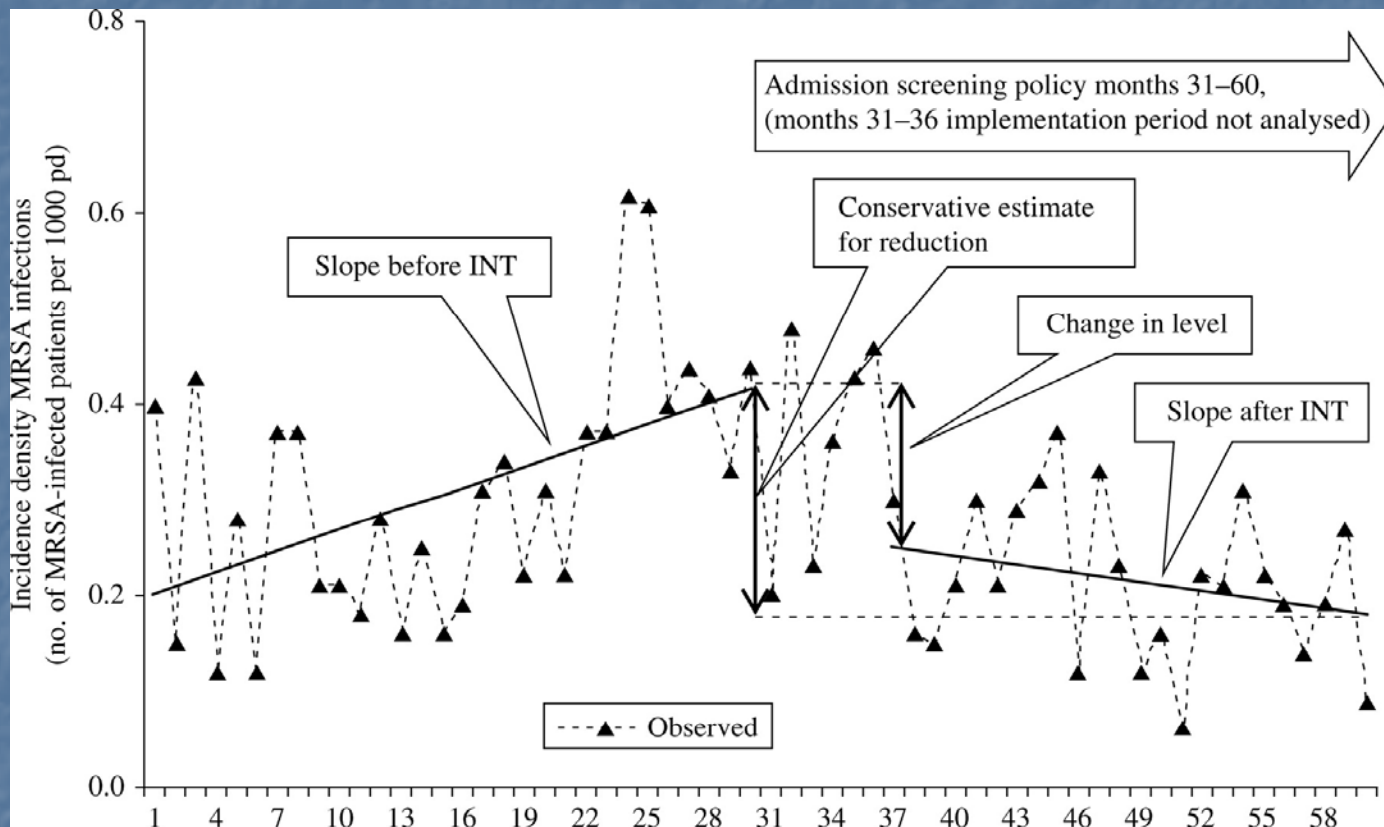
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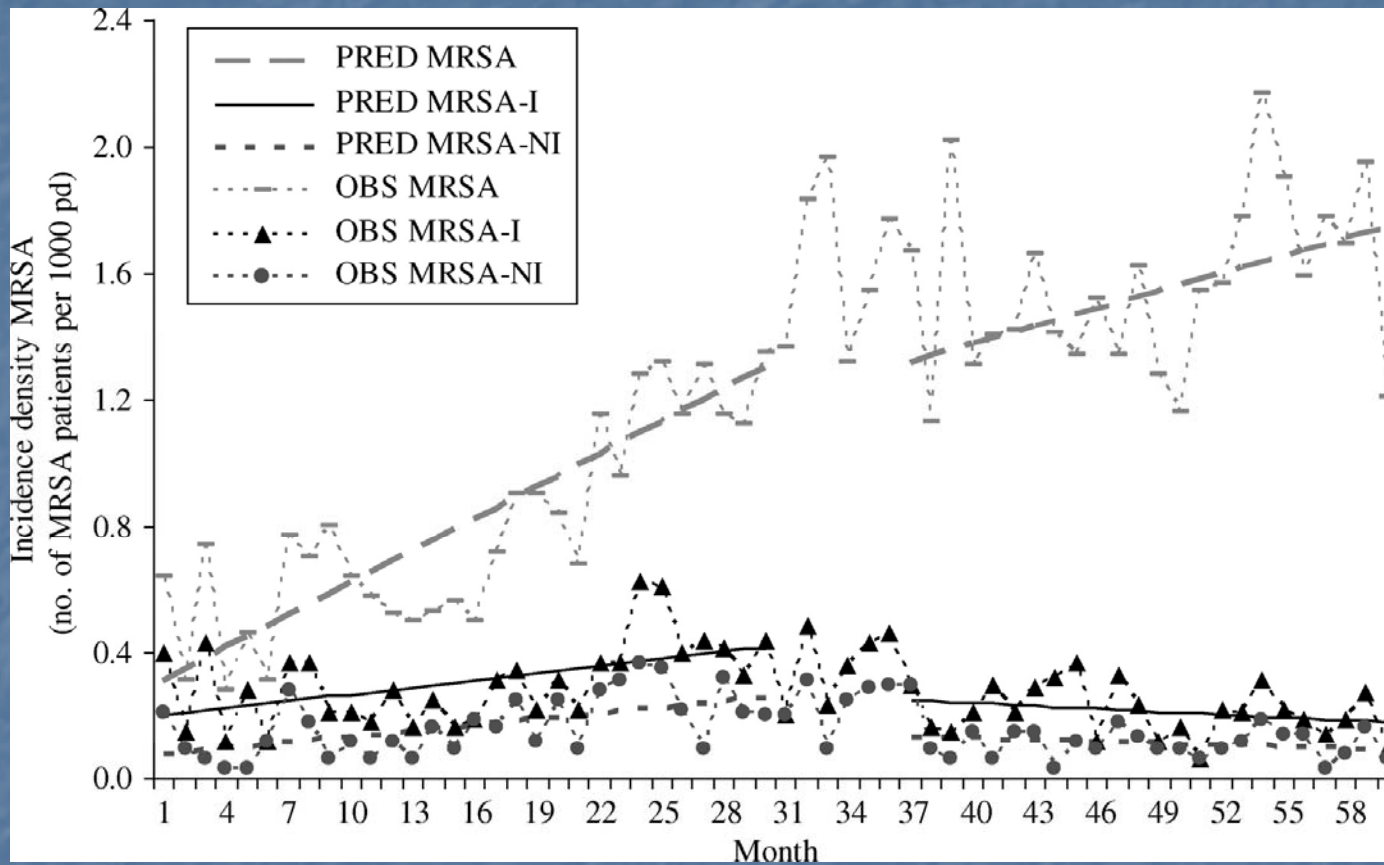
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**Changes in the hospital-wide incidence density of MRSA-infected patients/1000 pd 30 months before and 24 months after the intervention (INT = implementation admission screening for MRSA, 6 month implementation period)**



Chaberny, I. F. et al. *J. Antimicrob. Chemother.* 2008 62:1422-1429;  
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**Changes in the hospital-wide incidence densities of all MRSA patients, MRSA-infected patients and nosocomial MRSA-infected patients per 1000 pd 30 months before and 24 months after the intervention (INT = implementation admission screening for MRSA, 6 month implementation period)**



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Table 2. Results of segmented regression analysis of interrupted time series evaluating the impact of the admission screening policy on the incidence density of MRSA-infected patients, nosocomial MRSA-infected patients and MRSA-positive patients per 1000 pd in the whole hospital

Model coefficients	Coefficient	<i>P</i> value	95% confidence interval
<b>MRSA-infected patients</b>			
constant	0.195	<0.001	0.188–0.271
slope before INT	0.007	0.001	0.003–0.012
change in level after INT	–0.163	0.006	–0.276 to –0.050
change in slope after INT	–0.010	0.007	–0.018 to –0.003
<b>Nosocomial MRSA-infected patients</b>			
constant	0.073	0.011	0.017–0.129
slope before INT	0.006	<0.000	0.003–0.009
change in level after INT	–0.122	0.004	–0.204 to –0.040
change in slope after INT	–0.008	0.004	–0.013 to –0.003
<b>All MRSA patients (infected or colonized)</b>			
constant	0.281	0.001	0.119–0.444
slope before INT	0.034	<0.001	0.026–0.042
change in level after INT	NS		
change in slope after INT	–0.015	0.002	–0.032 to -0.001

## Conclusions

- Admission screening for MRSA in ICUs and surgical floors lowers the rate of hospital-wide MRSA infection and nosocomial MRSA infection

# Strengths of the Study

- Included a large number of patients and patient-days
- Each phase of the study was 2-2.5 years long, covering multiple seasons
- Alcohol availability and isolation practices similar to many other academic institutions (external validity)

## Threats to Internal Validity

- Phase 1 and 2 are separated in time--Could the results be due to other factors with a temporal relationship (e.g. change in antibiotic use)
- Phase 1 and 2 were of different durations. Start date for phase 2 appears arbitrary
- Study design is subject to maturation effect--perhaps the rates of MRSA would have decreased naturally as part of a cyclical process
- Difficulty in getting OSH records would overestimate the rate of nosocomial infection

## Threats to Internal Validity (2)

- Patient demographics are not accounted for, and can change over time
- Lack of patient demographics makes it difficult to judge external validity
- Readmits are counted multiple times in the design --> decreasing readmit rate (not accounted for) would show favorable results
- Determination of true MRSA infection was made by a single physician, without a protocol

## Threats to Internal Validity (3)

- Decreasing LOS would result in decreased risk for MRSA infection...or is decreased LOS the result of fewer MRSA infections?
- The existence of such a study could make the use of alcohol and isolation practices more frequent, thus confounding the effect of screening
- No audit of isolation practices or hand-washing procedures

## Further Discussion

External Validity: Can we apply this study to JHH?

--Beds: 1400 vs 950

--LOS > 8 vs 5.9

--Comparable # of annual discharges (~45,000)

--Study hospital focused on transplants

--Unknown patient demographics (age, IVDU, comorbidities)