

Implementing Surgical Site Infection Prevention Bundles Across Large Healthcare Systems

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- STOP SSI Study
 - Quantitative methods
 - Qualitative methods
 - Quantitative results
 - Qualitative results
- Summary & Conclusions

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STOP SSI: Introduction

- Our prior meta-analysis: a bundle of practices should decrease *S. aureus* SSIs significantly.
- The bundle elements were:
 - Screening patients' nares for *S. aureus*
 - Decolonizing carriers with intranasal mupirocin & chlorhexidine bathing
 - Using vancomycin & cefazolin for perioperative prophylaxis among MRSA carriers
- The effectiveness of the entire bundle had not been tested.

Schweizer ML, et al. *BMJ*. 2013;346:f2743

STOP SSI: Purpose

- To evaluate whether implementing an evidence-based bundle prevents *S. aureus* SSIs in patients undergoing cardiac operations or hip/knee arthroplasties (HA/KA)
- To identify facilitators of & barriers to implementation

STOP SSI: Eligibility Criteria

- A Hospital Corporation of America (HCA) hospital that performed the procedures of interest.
- The hospital had not incorporated all algorithm elements into its practice.
- The hospital could provide data on SSIs for ≥ 2 years preceding implementation.
- Staff from interested sites completed an electronic survey about current surgical infection prevention practices.

STOP SSI: Site Selection

- 45 HCA hospitals expressed interest
- 25 hospitals completed the electronic survey
 - 5 hospitals declined the invitation to participate
 - 1 hospital withdrew after a training session
- 1 hospital joined 1 month after the training session
- 20 hospitals participated in the quasi-experimental study

STOP SSI: Preliminary Training

- April 2012: 1½-day in-person meeting.
- Meeting objectives
 - Share detailed information about the protocol.
 - Build enthusiasm & relationships among sites & the leadership team.
 - Allow site liaisons to develop implementation plans for the multidisciplinary teams at their sites.
 - Allow liaisons interact face-to-face with the content experts & to ask the experts questions.

STOP SSI: Ongoing Support

- Created & updated a modular electronic procedure manual on HCA's intranet.
- Conducted frequent (biweekly, then monthly) interactive “coaching” webinars to:
 - Answer questions,
 - Disseminate study updates,
 - Allow sites to discuss challenges & share facilitating strategies,
 - Promote rapid implementation & “hardwiring” of the algorithm.
- Distributed frequently asked questions (FAQ) document & supported an electronic mailbox to facilitate communication.

STOP SSI: Activities

- Preparatory activities:
 - Establish processes for identifying patients,
 - Obtain necessary equipment & supplies,
 - Obtain local medical staff approval,
 - Establish a multidisciplinary implementation team & plans,
 - Organize & provide training materials for staff, patients, & physicians' offices,
 - Work with local information technology staff to ensure that study-specific charting screens were available.

STOP SSI: Activities

- Implementation activities:
 - Educate patients
 - Swab patients' nares
 - Provide mupirocin & chlorhexidine for carriers
- Maintenance activities:
 - Monitor 10–15 eligible cases/month to determine if the algorithm was applied consistently & documented in the electronic health record (EHR).
 - Submit audit forms & review results during one-on-one telephone calls between liaisons & project staff.

STOP SSI: Methods

- Pragmatic quasi-experimental effectiveness study
- Study population
 - 20 HCA affiliated hospitals
 - Adult patients having primary HA/KA or primary cardiac operations through median sternotomies

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STOP SSI: Exclusions

- Arthroplasty revisions, cardiac revisions, cardiac transplants, trans-apical valve implantations
- Patients with infections before their operations
- Pregnant women

- SSI surveillance:
 - Infection Preventionists (IPs) used the CDC NHSN SSI definitions & followed patients for 90 days postop.
 - An experienced IP validated 10% of SSIs.
- Primary outcome:
 - Rate of complex (deep incisional or organ/space) MSSA or MRSA SSIs

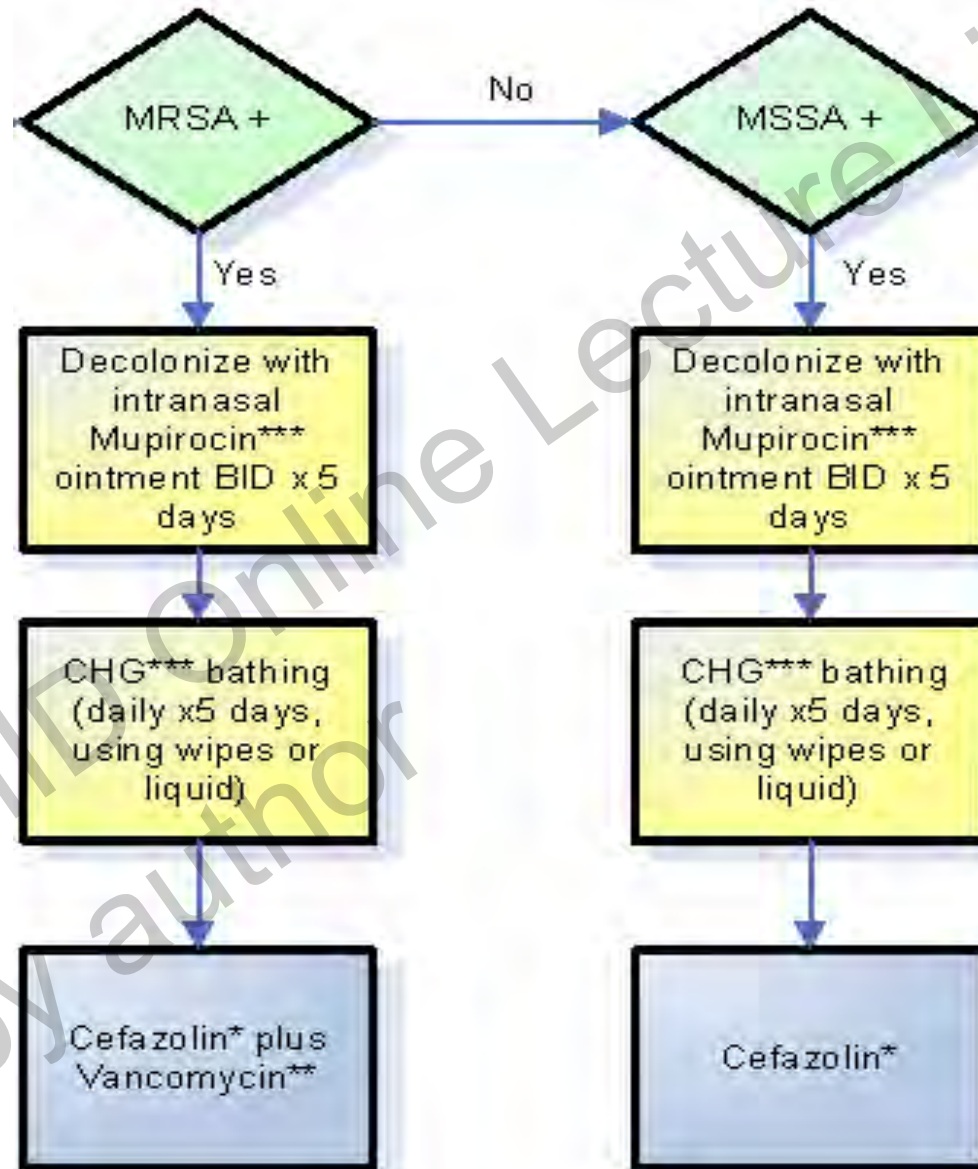
- Intention-to-treat analysis
- Analysis of SSI rates
 - Poisson regression to assess change in the monthly SSI rates
 - Used generalized estimating equations (GEE) to account for hospital-level clustering & temporal autocorrelation

- ## Analysis of Postop LOS & readmissions
- Postop LOS (log-transformed): Linear regression
 - Readmissions for SSIs: Logistic regression
 - Used GEE to accommodate patient-level confounders & hospital-level clustering effects

- Monthly coaching calls were recorded & transcribed.
- A qualitative research team:
 - Reviewed transcriptions & developed a coding structure based on thematic content.
 - Coded minutes using MAXQDA.
 - Created a report based on the coding analysis.

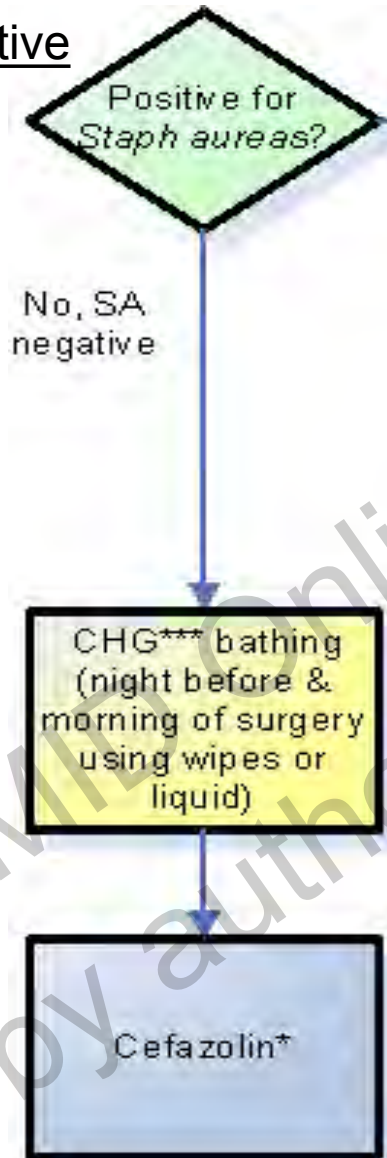
- At the end of the study, a focus group was conducted by video conference with study champions.
 - The report was presented to the champions.
 - The champions provided additional details & feedback on the report.
 - Comprehensive notes were recorded.
- Focus group notes were analyzed for additional thematic content.
- An analytic framework was used to organize thematic codes.

S. aureus Positive

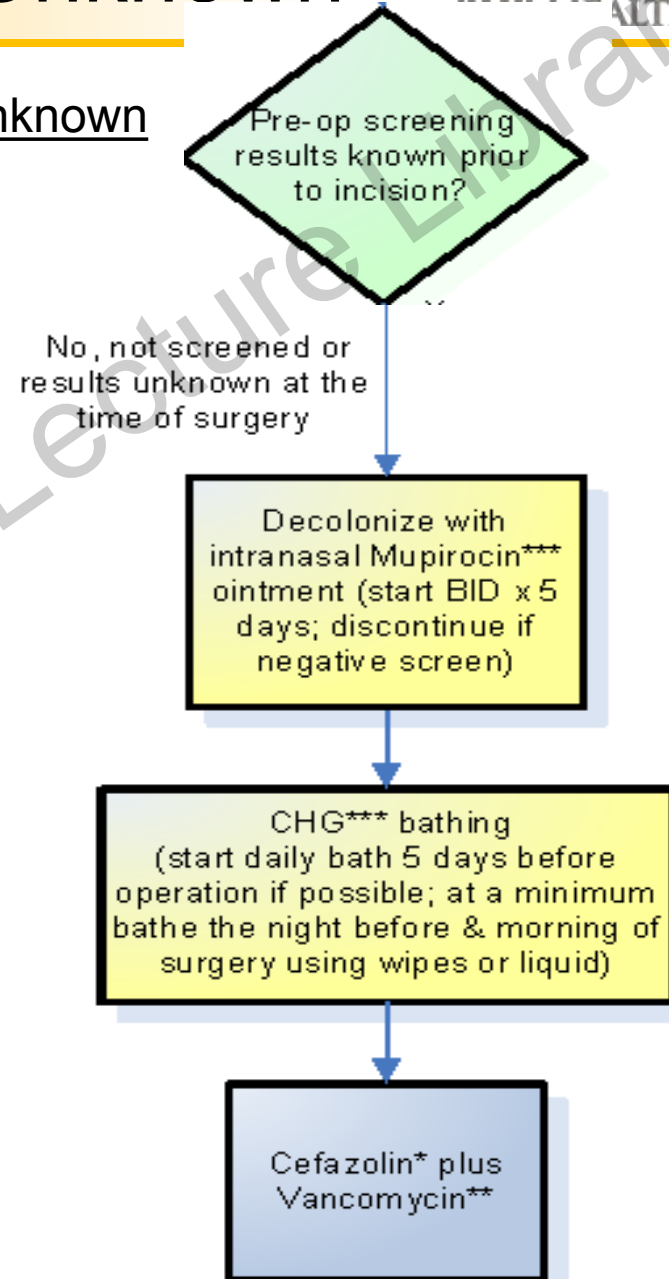


S. aureus Negative or Unknown

S. aureus Negative



Unknown



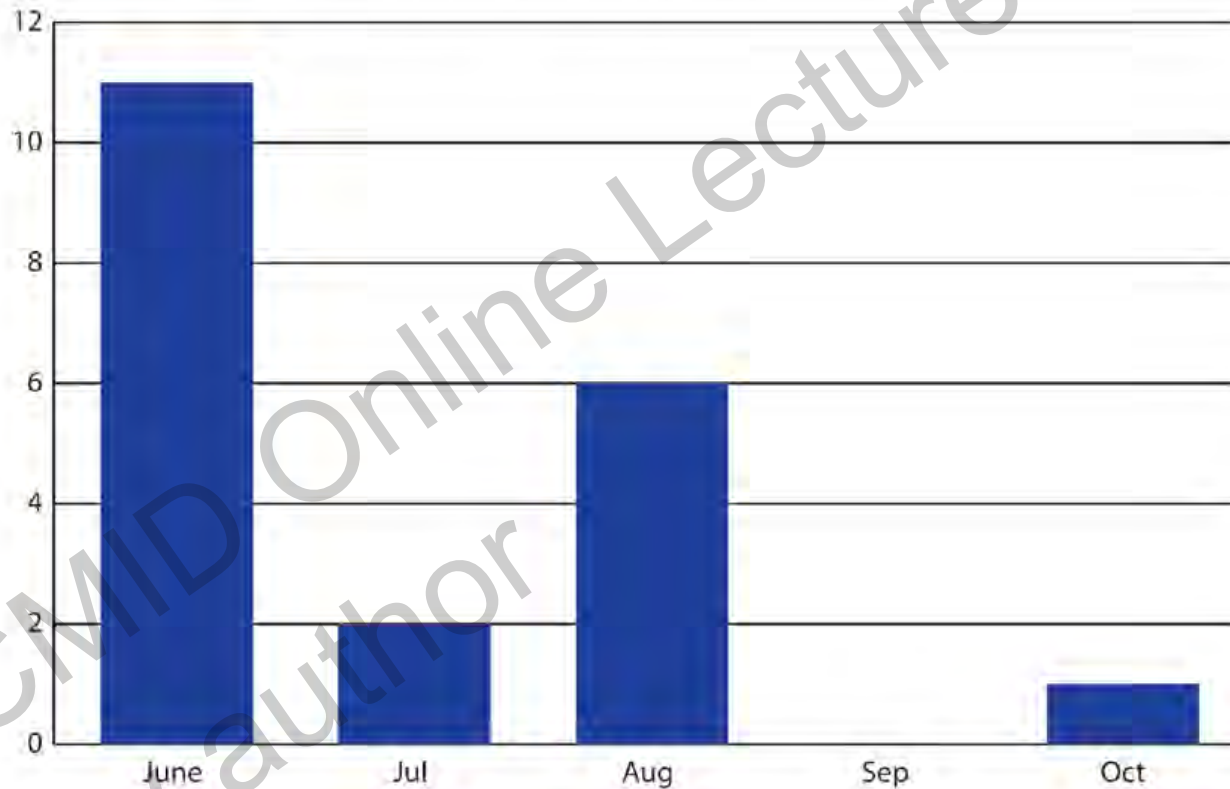
- MRSA screening: 20/20
- CHG bathing:
 - Scheduled operations: 20/20
 - Urgent/emergent operations: 13/20 (65%)
- Intranasal mupirocin:
 - Scheduled operations: 9/20 (45%)
 - Urgent/emergent: 6/20 (30%)

STOP SSI: Participation

- Hospitals & procedures:
 - Joint arthroplasties alone: 8 hospitals
 - Cardiac operations alone: 4 hospitals
 - Joint arthroplasties & cardiac procedures: 8 hospitals
- Median pre-intervention period: 39 months (range 39-43).
- Median intervention period: 21 months (range 14-22).
- One hospital stopped the intervention on March 31, 2013; 19 continued through March 31, 2014.

STOP SSI: Implementation

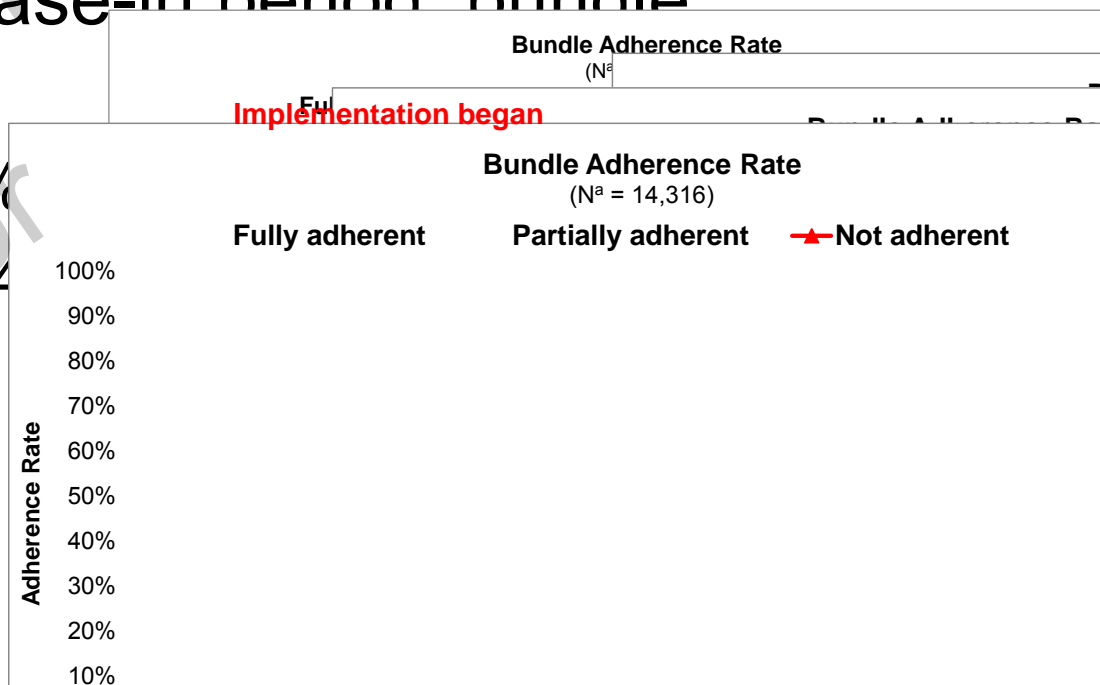
Number of hospitals ready to implement by the end of month*



2012

STOP SSI: Results

- 42,534 operations among 38,049 patients
 - Pre-intervention 28,218 operations
 - Intervention 14,316 operations
- Patients undergoing operations during both periods were similar.
- After a 3-month phase-in period, bundle adherence: 83%:
 - Fully adherent: 39%
 - Partially adherent: 44%
 - Not adherent: 17%



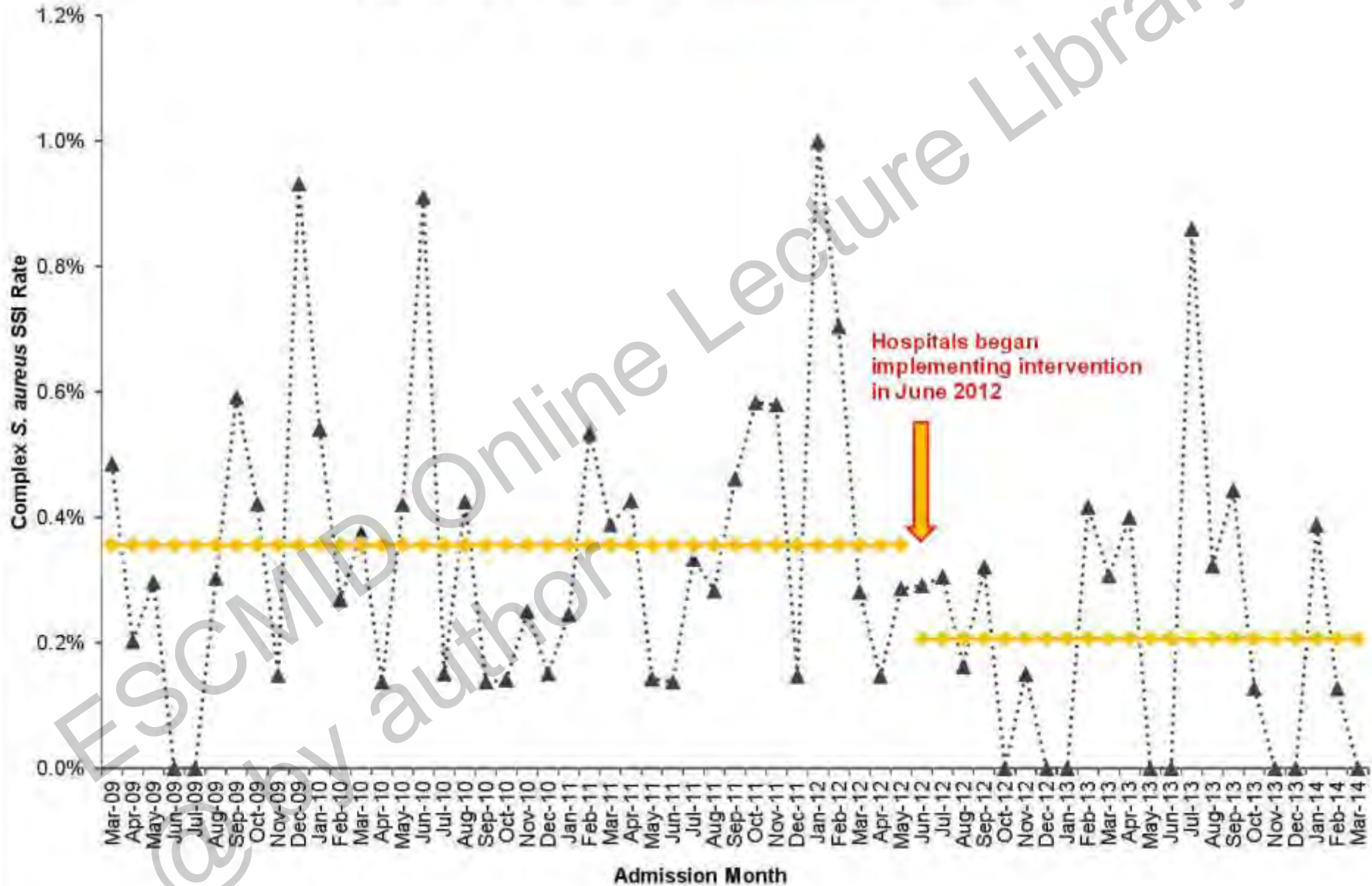
- Pooled rate of complex *S. aureus* SSIs:
Pre-Intervention 0.36% vs.
Intervention 0.20%
- Number of months with no complex *S. aureus* SSIs: Pre-intervention 2/39, 5.1%
vs. Intervention 8/22, 36.4%; **P = 0.006**
- The median rate & range became 0 by intervention month 4.

Results: Complex *S. aureus* SSIs

	Pre-Intervention	Intervention	Rate Ratio (95% CI)	P-value
Entire Cohort	28,218	14,316	0.58 (0.37, 0.92)	0.02
Hip/Knee	20,642	11,059	0.48 (0.29, 0.80)	0.005
Cardiac	7,576	3,257	0.86 (0.47, 1.57)	0.63

Complex *S. aureus* SSI Rate by Month

---▲--- Complex *S. aureus* SSI Rate —●— Poisson Regression Line



STOP SSI: Subgroup Analyses

- Scheduled operations: Rate ratio (RR) 0.55 (0.35, 0.86); **P = 0.009**
- Fully adherent: RR 0.26 (0.10, 0.69); **P = 0.007**
- Surgeon implemented at least some bundle elements: RR 0.54 (0.34, 0.88); **P = 0.01**
- Complex SSIs caused by any pathogen: RR 0.67 (0.44, 1.00); **P = 0.05**
- Gram negative SSIs: RR 0.86 (0.41, 1.75); P = 0.67

STOP SSI: Other Outcomes

- Postop LOS:
 - Median was 3 days for both periods
 - After adjustment: NS
- Readmissions for SSIs within 90 days
 - Pre-intervention vs. Intervention:
0.21% vs. 0.12%
 - After adjustment: OR = 0.58; NS
- Adverse events
 - 4 patients reported mild skin irritation after CHG bathing

STOP SSI: Early Barriers

- Delays in obtaining medical executive committee approval for new preoperative orders.
- Delays in obtaining surgeons' agreement to participate.
- Difficulty establishing reliable processes for screening & decolonizing patients who bypassed the usual pre-admission process:
 - Admitted through the emergency department for urgent/emergent procedures
 - Admitted on weekends or holidays.

STOP SSI: Qualitative Framework



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STOP SSI: Institutional Context: Healthcare Network

- Facilitators:
 - Corporate physician champion who had interacted with surgeons & local champions
 - Infrastructure & resources (e.g., centralized IRB & training, shared EHR, supply chain, prior implementation of MRSA screening)
 - Project team support (e.g., site visits)
- Barriers:
 - Time needed to resolve hospital-level barriers (e.g., developing order sets & reports in EHR)

STOP SSI: Organizational Context: Hospital

- Facilitators:
 - Establishing order sets in local EHRs
 - Educating & cross-training personnel
- Barriers:
 - Obtaining committee approval
 - Developing processes for urgent/emergent operations
 - Hardwiring practice across shifts
 - Documenting bundle adherence
 - Ensuring supplies were available

- Facilitators:
 - Strong local champion
 - Personalized education/training
- Barriers:
 - Resistance & autonomous decision making
 - Time constraints (e.g., documenting, auditing)

STOP SSI: Patterns of Interaction



- **Facilitators:**
 - Communication & partnerships among surgeons, clinics, & hospitals
 - Information technology used for alerting & documenting
 - Solutions (e.g., patient education material & checklists) shared during coaching calls)
- **Barriers:**
 - Priorities conflict
 - Decentralized offices
 - Complex communication channels among patients & providers, & among care sites
 - Demands of the healthcare network or hospital

Sufficient time & resources were needed for:

- Information technology staff to develop standardized orders & documentation in the EHR to facilitate adherence monitoring & data collection.
- Educators to develop educational materials & conduct initial & ongoing training for all staff, including those on all shifts, new staff, & temporary staff.
- Project liaisons to develop systems that allow staff in different departments to coordinate new activities.
- Providers to consider & adopt practice changes.

- Implementation of the SSI prevention bundle:
 - Was associated with significantly lower rates of complex *S. aureus* SSIs in the total cohort & in the hip/knee arthroplasty group.
 - Was not associated with an increase in gram negative SSIs.
- Use of the full bundle was associated with significantly lower rates of complex *S. aureus* SSIs.

STOP SSI: Bundle Summary

- The complexity of the bundle (intervention) may have affected adherence rates.
- The bundle is relatively simple to maintain because it does not require expensive technology or additional staff.

STOP SSI: Study Limitations

- SSI surveillance varied among hospitals.
- May not be generalizable to large academic health centers or to hospitals without strong infrastructures for quality improvement.
- Neither patients nor facilities were randomized
 - Regression to the mean is unlikely because we compared rates over a long time period
 - Seasonal effects are unlikely:
 - No evidence of long-term trends or seasonal effects
 - Rolling implementation reduced the bias

STOP SSI: Qualitative Summary

- Some barriers & facilitators were shared among hospitals.
- Combinations of barriers & facilitators differed among hospitals.
- Hospitals & staff differed in their capacity to overcome barriers.
- Strong local champions & a corporate physician champion helped overcome barriers.

Collaborators

- **University of Iowa**

- MA Ward
- H-Y Chiang
- DJ Diekema
- ML Schweizer
- JE Cavanaugh
- EN Perencevich

- **HCA**

- J Moody
- J Hickok
- JB Perlin
- E Septimus
- Staff from 20 HCA hospitals

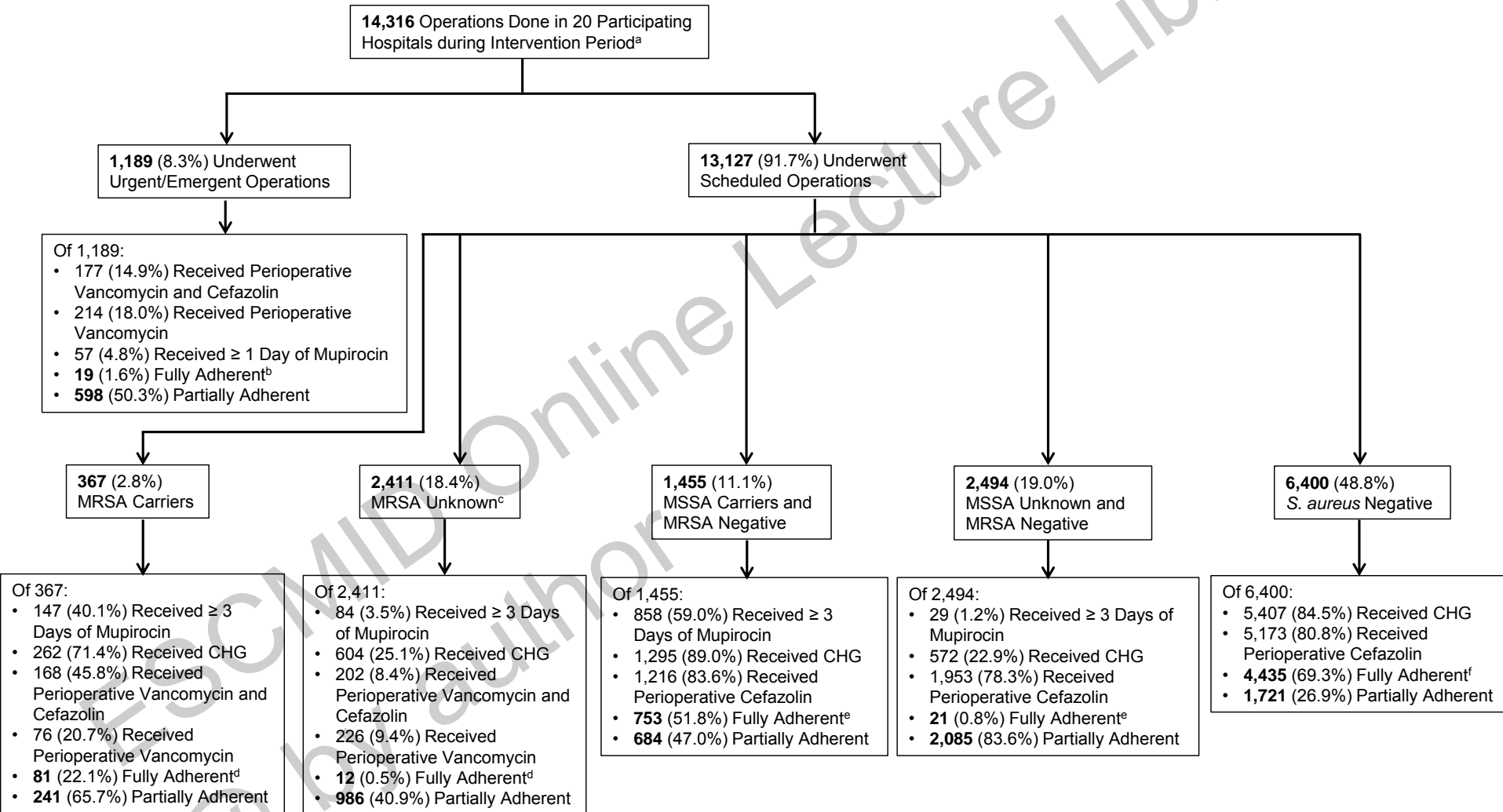
- **TJC**

- B Braun
- J Hafner
- CL Richards

Thank you!

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Number of Patients Receiving Each Bundle Component



Bundle Adherence Definition

	Scheduled			Urgent/Emergent
	MRSA + or ?	MRSA -	MRSA -	Not Screened
	Any MSSA Status	MSSA + or ?	MSSA -	
Full Adherence	Received CHG bathing, mupirocin for ≥ 3 days, and vancomycin plus cefazolin*	Received CHG bathing, mupirocin for ≥ 3 days, and cefazolin*	Received CHG bathing and cefazolin*	Received CHG bathing, mupirocin for ≥ 1 day, and vancomycin plus cefazolin*
Partial Adherence	Received CHG bathing, any mupirocin, or vancomycin or vancomycin plus cefazolin*	Received CHG bathing, any mupirocin, or cefazolin*	Received CHG bathing or cefazolin*	Received CHG bathing, any mupirocin, or vancomycin or vancomycin plus cefazolin*
No Adherence	Did not receive CHG bathing, mupirocin, or vancomycin or vancomycin plus cefazolin*	Did not receive CHG bathing, mupirocin, or cefazolin*	Received neither CHG bathing nor cefazolin*	Did not receive CHG bathing, mupirocin, or vancomycin or vancomycin plus cefazolin*

* Cefazolin can be replaced by cefuroxime