# Surgical Site Infection (SSI)


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**The Lancet Conference,**
**Healthcare-Associated Infection**
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# Declaration

The views expressed are in a personal capacity & do not necessarily reflect those of my employers.

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# Overview

- Background
- Definitions
- How, what & when to count SSI
- Specific challenges
- Aspects of prevention

## SSI are common

**14.5% of all HCAI in UK/Ireland**

*J Hosp Infect* 2008; 61: 230-248

**20m surgical procedures in US annually, 2.8% get SSI**

*Surg Infect* 2002; 3: S9-21

## SSI are costly

**Median hospital charges x2 greater for *S. aureus* SSI**

*Infect Control Hosp Epidemiol* 2004; 25: 461-467

# Public Reporting & Performance Indicators

## HICPAC

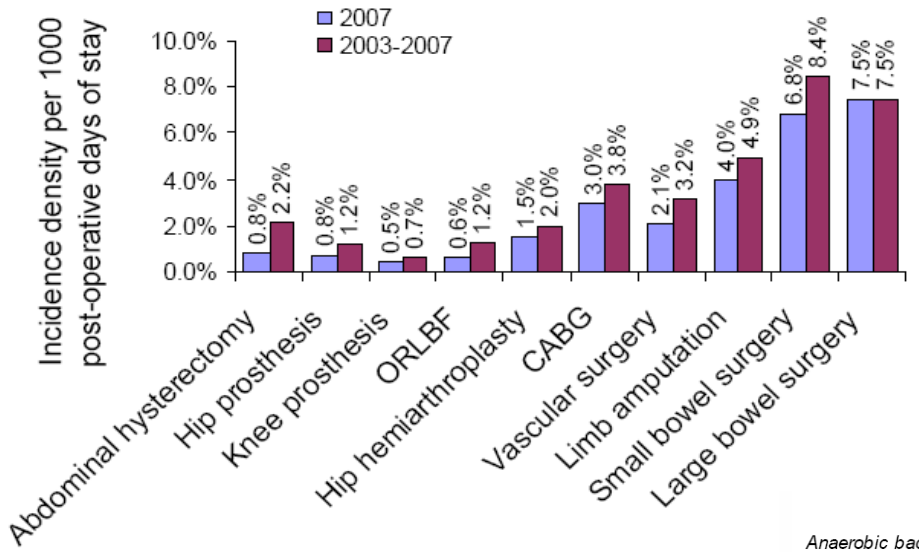
**SSI associated with cost, morbidity & mortality**
**Prevention guidelines exist**

## 100,000 Lives Campaign/Surgical Care Improvement Project

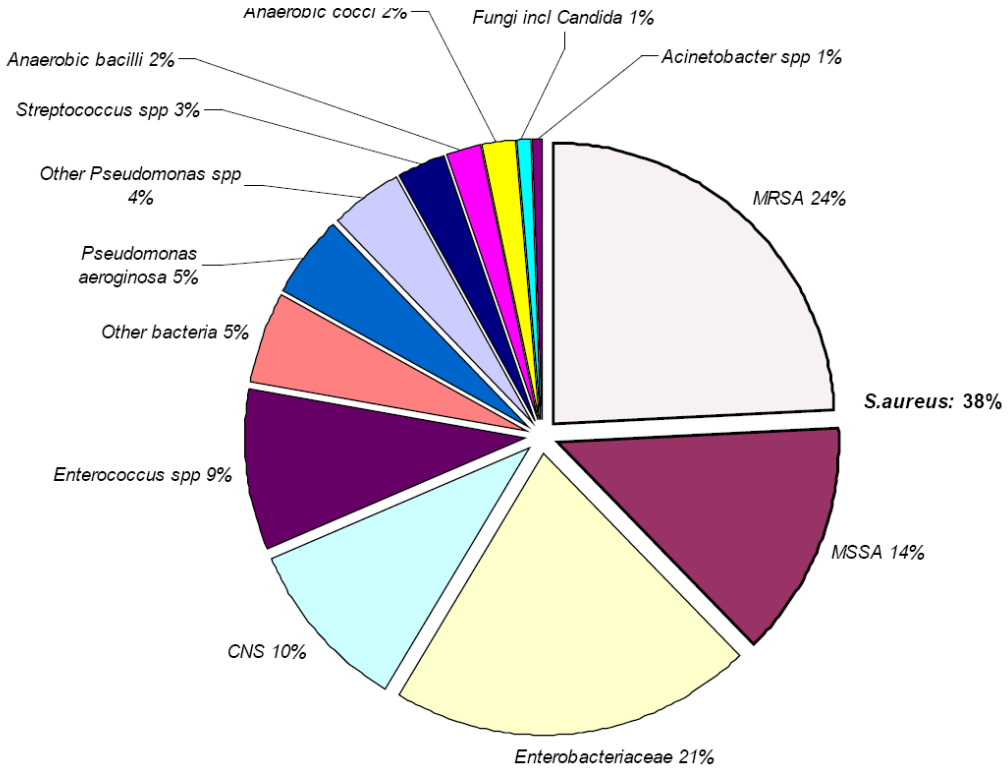
**SSI amenable to interventions**

*Am J Infect Control* 2005; 217-26
*JAMA* 200; 295: 324-327
*Clin Microbiol Infect* 2008; 14: 892-894

Figure 29: Incidence density
(per 1000 days of post operative stay)




**Health Protection Agency, 2008**



# Definitions

"Infection may be in the eye of the beholder"

- Signs & symptoms
- Microbiology
- Intention to treat

# Internal Comparisons

| | | 1982-89 | '90-97 |
|---|---|---|---|
| General surgery | 20,272 | 5.1% | 5.9% |
| Vascular | 9,105 | 8.1% | 5.0% |
| Neurosurgery | 12,830 | 2.3% | 3.6% |
| Total | 57,335 | 4.5% | 4.5% |

*Infect Control Hosp Epidemiol* 2002; 23; 36-40

# Different Definitions-I

**Cruise & Food** - presence of pus, too insensitive

**CDC** - three levels

i) Superficial incisional (skin & subcutaneous)

ii) Deep incisional (fascia & muscle)

iii) Organ or space (joint, peritoneum - too open to interpretation

**NI NSS** - UK modification of CDC & excludes the need for surgeon's diagnosis

# Different Definitions - II

**ASEPSIS** - quantified score developed in UCH, originally for cardiac surgery

≤ 5 post-operative days & at 2 months

**ACHS - Australian Council**

i) ≤ 30 days of procedure

ii) Pus

iii) Positive culture

iv) Medical diagnosis

# What to count?

**Too much & the data set may be complex or too extensive to analyse**

**Too little & the data does not allow for comparisons & risk stratification**

# Ideal Surveillance System

1. Meaningful definitions
2. Consistent interpretation of classified criteria
3. Applicability
4. Detection after discharge
5. Precision to detect small absolute difference
6. Adjustment for risk
7. Reasonable cost

*Emerg Infect Dis* 2001; 7: 212-6

# Missing Data

- 11 sites
- 5,400 procedures
- 4 core procedures
- CDC definitions

Table II Observed responses and missing values (%) for dependent core data set questions

| Field | Observations | Missing (%) |
|---|---|---|
| Type of infection | 97 | 33 (25.4) |
| Date of infection | 98 | 32 (24.6) |
| Criteria used for identifying SSI | 98 | 32 (24.6) |
| Duration of procedure | 5193 | 212 (3.9) |
| Patient risk index | 5029 | 376 (7.0) |
| Antibiotic-loaded cement[a] | 2529 | 2649 (53.2) |

SSI, surgical site infection.
[a] One hospital did not collect this information.

*J Hosp Infect* 2005; 60: 202-212

# Risk Factors

Age

Underlying illness

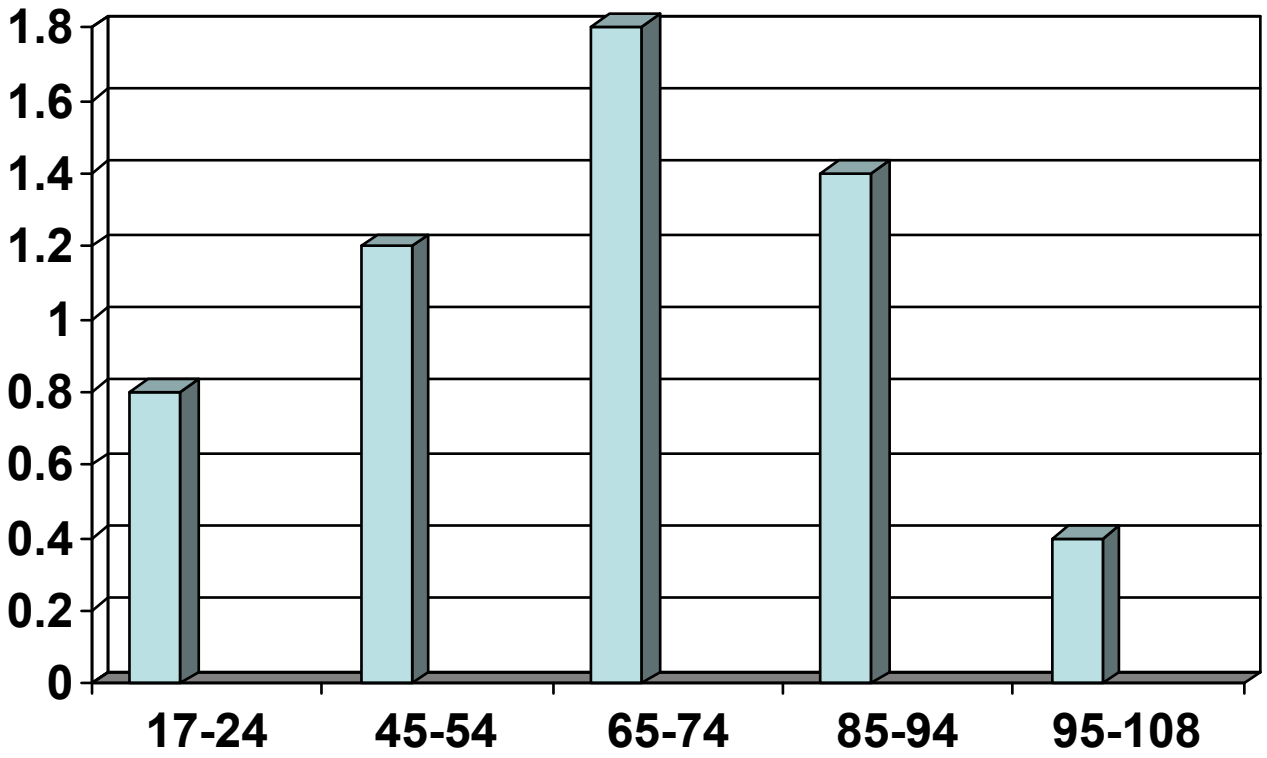
Obesity

Smoking

Wound classification

Site & complexity of procedure

# Age & SSI Rate




*J Infect Dis* 2005; 191: 1056-62

# Risk Factors for SSI (General Surgery)

| Variable | %Deep | % Superficial | P value |
|---|---|---|---|
| Low albumin | 51 | 24 | 0.001 |
| Low haemoglobin | 39 | 17 | 0.001 |
| Blood loss (>0.5L) | 25 | 15 | 0.095 |
| Excess alcohol | 12 | 31 | 0.004 |
| Previous operation | 67 | 47 | 0.006 |

*Surgery* 2008; 144: 496-503

# Standardised Infection Ratio

$$\frac{\text{Observed Number}}{\text{Expected Number (NNIS)}}$$

| Procedure | Rate | SIR |
|---|---|---|
| Appendectomy | 3.3 | 1.3 |
| Colon | 5.9 | 1.0 |
| Limb amputation | 11.2 | 3.0 |
| Total (4,431) | 4.3 | 2.3 |

*Am J Infect Control* 2003; 31: 274-9

# SENIC *versus* NNIS Index

| SENIC | NNIS |
| --- | --- |
| Contaminated wound | Contaminated wound |
| Discharge diagnoses | Anaesthetist score |
| Duration of surgery | Duration of surgery |
| Abdominal surgery | |

**Δ SENIC index had higher predictive power**

*Infect Control Hosp Epidemiol* 2000; 21: 633-638

# Assessment of Site & Complexity of Procedure

- ASA preoperative assessment 3,4 or 5
- Operation classified as contaminated or dirty/infected
- Operation lasting > 7 hours

*NNIS/NICE*

# What About After Hospital Discharge?

1. Data from existing IT systems, e.g. pharmacy
2. Direct observation by healthcare professional
3. Telephone interviews
4. Patient questionnaire

# In-Patient *versus* Post-Discharge Diagnosis

| | Superficial | Deep | Organ/ Space | Total |
|---|---|---|---|---|
| During hospitalisation | 149 | 14 | 5 | 168 |
| Post discharge | 122 | 57 | 32 | 216 |
| Re-admission | 28 | 39 | 26 | 93 |
| Follow-up | 19 | 2 | 2 | 23 |
| OPD + questionnaire | 64 | 7 | 2 | 73 |

*Infect Control Hosp Epidemiol* 2006; 27: 1324-1329

# Post-Discharge (PDS), The Netherlands

| | SSI Rate | % SSI PDS |
|---|---|---|
| Recommended PDS | 3.7 | 43 |
| Other active PDS | 3.2 | 30 |
| Passive PDS | 3.1 | 25 |

Recommended - surgical review & agreed definitions

Other active - review of medical records

Passive - re-admission

*Infect Control Hosp Epidemiol* 2006; 27: 809-816

# Special Challenges

**Laparoscopic *versus* open procedures**

**Cardiac, changing**

**Orthopaedic**

# Laparoscopic & Open Repair of Perforated Peptic Ulcer

- 8 studies
- 2.5%(L) *versus* 6.9 (0)
- Statistical difference
- Little statistical heterogeneity

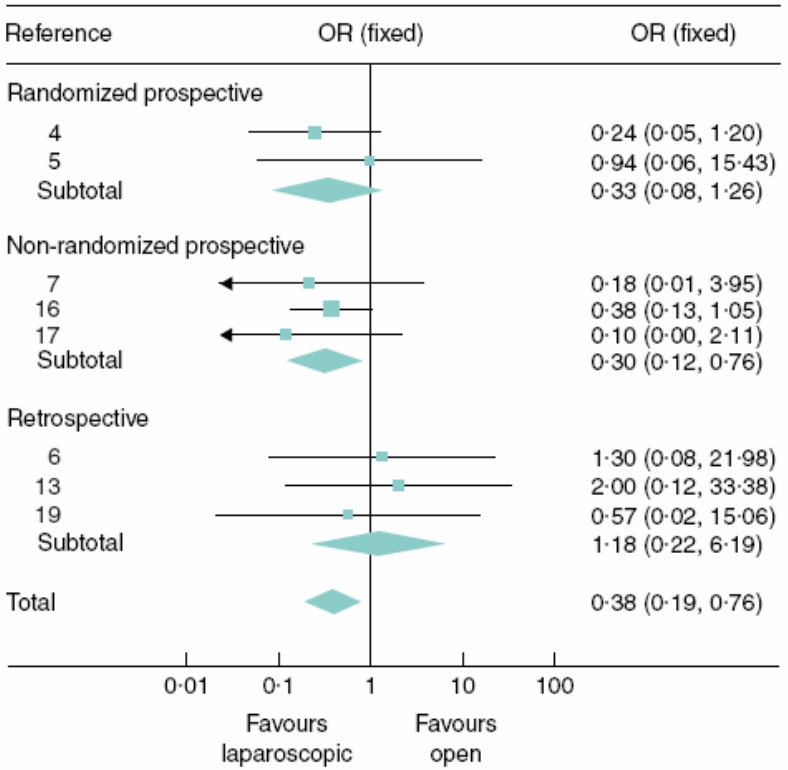



**Fig. 10** Analysis of wound infection rates. Odds ratios (ORs) are shown with 95 per cent confidence intervals

*Br J Surg* 2005; 92: 1195-1207

# Minimally Invasive Surgery

**Table II** Category of theatre ventilation for gastrointestinal minimally invasive surgical procedures

| Theatre ventilation facility | Type of hospital (and number replying) | Number of procedure types in gastrointestinal category[a] | Percentage within theatre category[b] |
|---|---|---|---|
| Non-ventilated room | DGH (36) | 166 | 27.9 |
| | University/referral (15) | 61 | 18.5 |
| Treatment room with ventilation | DGH (47) | 231 | 38.9 |
| | University/referral (28) | 133 | 40.3 |
| Operating theatre with conventional ventilation <20 air changes per hour | DGH (18) | 62 | 10.4 |
| | University/referral (12) | 43 | 13.0 |
| Operating theatre with conventional ventilation >20 air changes per hour | DGH (39) | 135 | 22.7 |
| | University/referral (25) | 93 | 28.2 |

*J Hosp Infect* 2005; 61: 112-22

# Aetiology of SSI in Cardiac Surgery

| | Superficial | Mediastinatis | Total |
|---|---|---|---|
| *Enterobacteriacae* | 3 | 4 | 7 (18.4%) |
| *S. aureus* | 4 | 8 | 12 (31.6%) |
| CNS | 6 | 3 | 9 (23.7%) |
| Undetermined | 7 | 3 | 10 (26.3%) |

*Infect Control Hosp Epidemiol* 2005; 26: 466-472

# Orthopaedic Surveillance, HPA

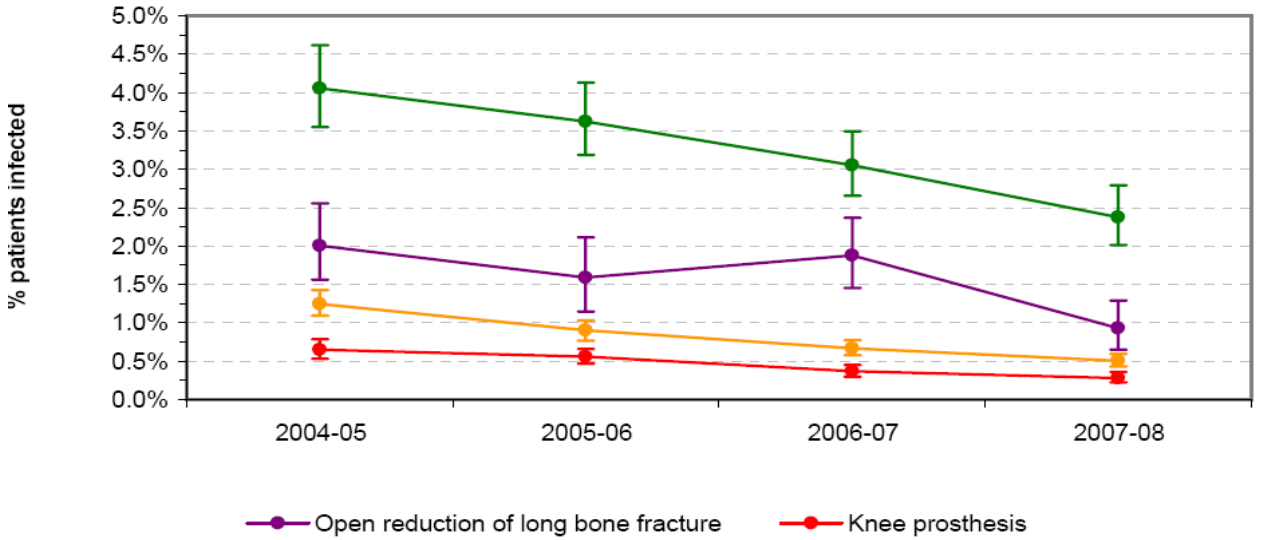
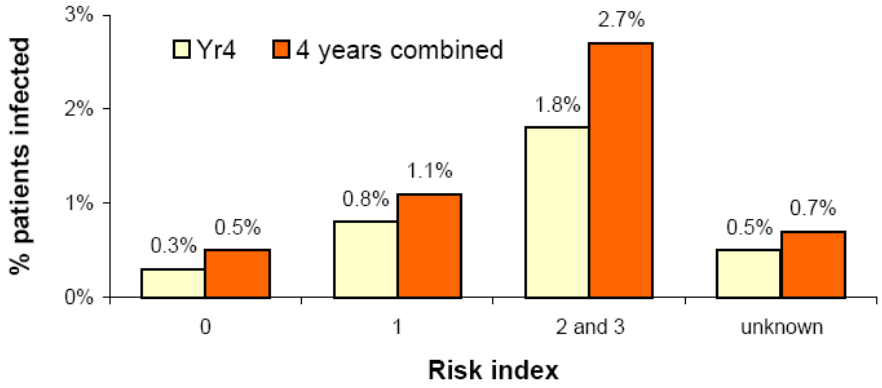



Figure 4: Cumulative incidence of SSI in hip prosthesis by risk index for year 4 (2007/08) and all four years combined (2004/05 – 2007/08)

**Hip prosthesis**



# Hip Arthroplasty

- Dutch network (PREZIES), 60% coverage
- Includes PDS with registration card completed by surgery
- 2.2% of SSIs for hip arthroplasties, 5.3% for replacements, head of femur
- 1 in 5 SSI detected after discharge
- High volume associated with reduced SSI

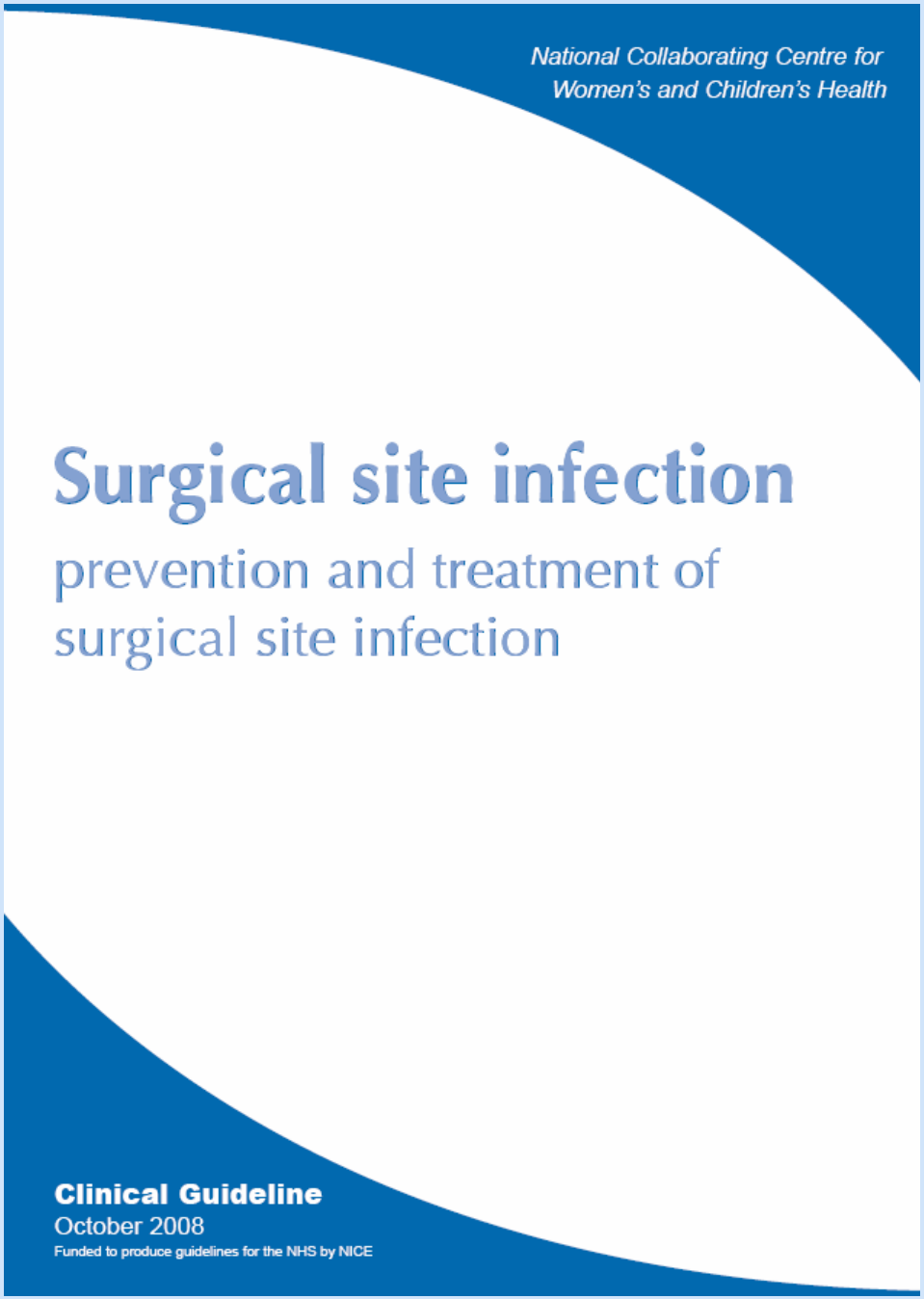
*Infect Control Hosp Epidemiol 2005; 26: 434-441*

# Preventing SSI

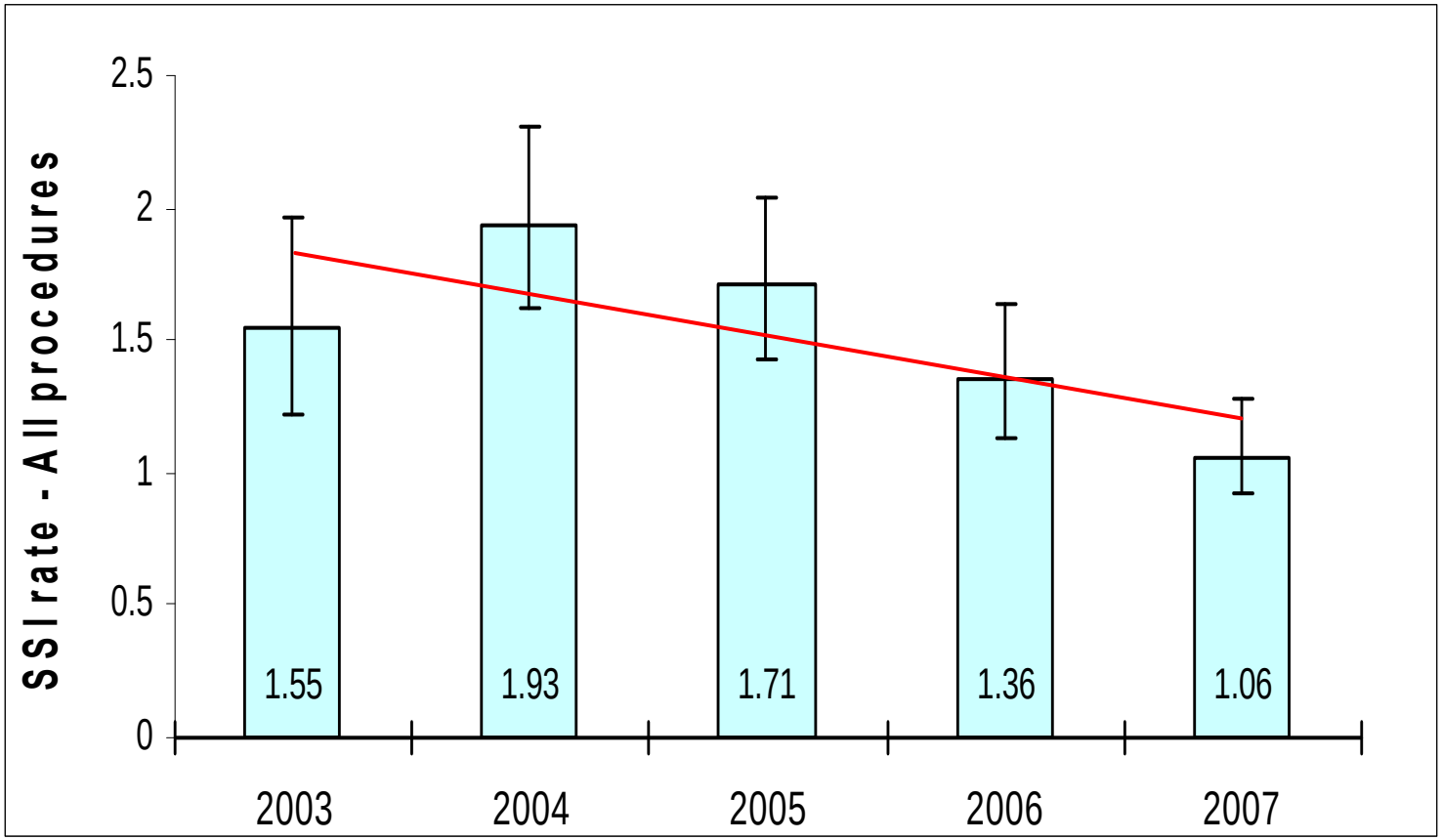
## SHEA/IDSA Practice Recommendations

1. Antimicrobial prophylaxis
2. Do not remove hair or use clipping/depilatory agent
3. Blood glucose levels
4. Feedback rates of SSI
5. Equipment/operating theatre practices

*Infect Control Hosp Epidemiol* 2008; 29:S51-S61

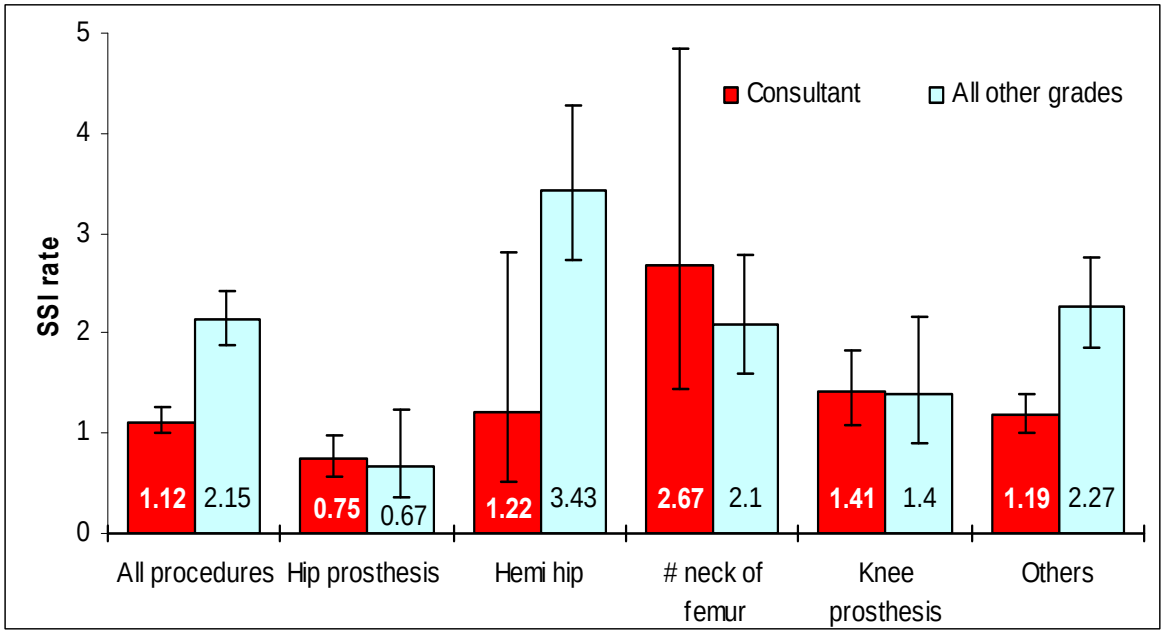

National Collaborating Centre for
Women's and Children's Health
Surgical site infection
prevention and treatment of
surgical site infection
Clinical Guideline
October 2008
Funded to produce guidelines for the NHS by NICE

# Knowledge Effects Change

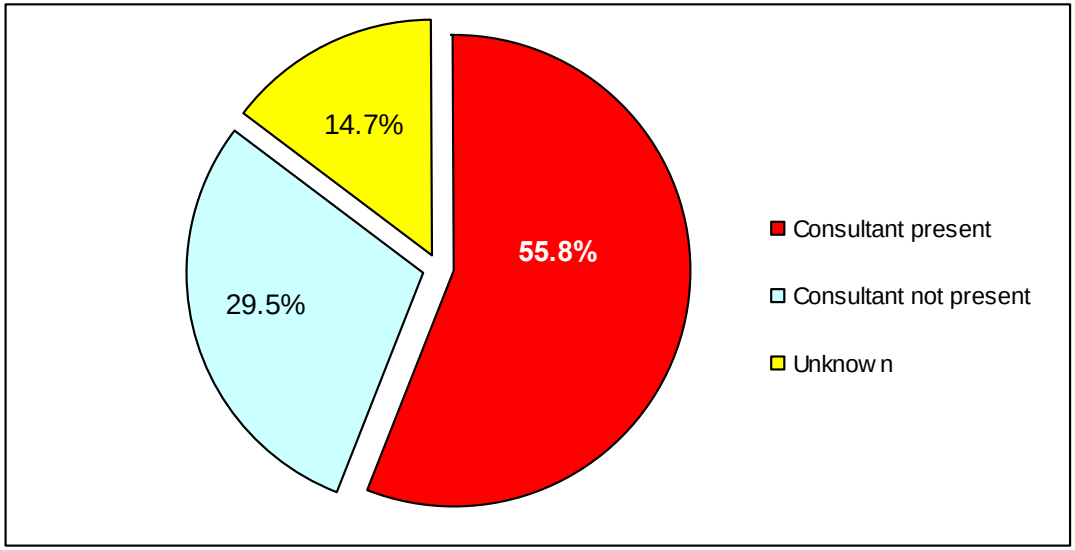



**HISC, Belfast, 2007**

# Who Does the Operation?




**HISC Report of Orthopaedic SSI, 2007**



# Blood Glucose Control, SSI & Hepato-Biliary Pancreatic Surgery

| Risk Factor | Odds Ratio | p |
|---|---|---|
| No. of anastomoses | | |
| 0 | 1 | |
| 1,2 | 3.8 | <0.01 |
| 3 | 6.5 | <0.001 |
| Post-operative glucose control | | |
| Good | 1.0 | |
| Poor | 6.6 | <0.001 |
| Organ | | |
| Liver | 1.0 | |
| Bile duct | 5.9 | <0.001 |
| Pancreas | 3.7 | <0.05 |

*J Hosp Infect* 2008; 68: 230-233

# Oxygen & SSI Rates

**Supplemental 80% $F_1O_2$ during & for 6 hours after major colorectal surgery reduced SSI by 2**

*J Am Med Assoc* 2005; 294: 203-42

**"Defending the status quo (low oxygen tensions) by demanding the perfect study …..may be missing a quality improvement opportunity"**

*J Am Med Assoc* 2005; 294: 2091-2

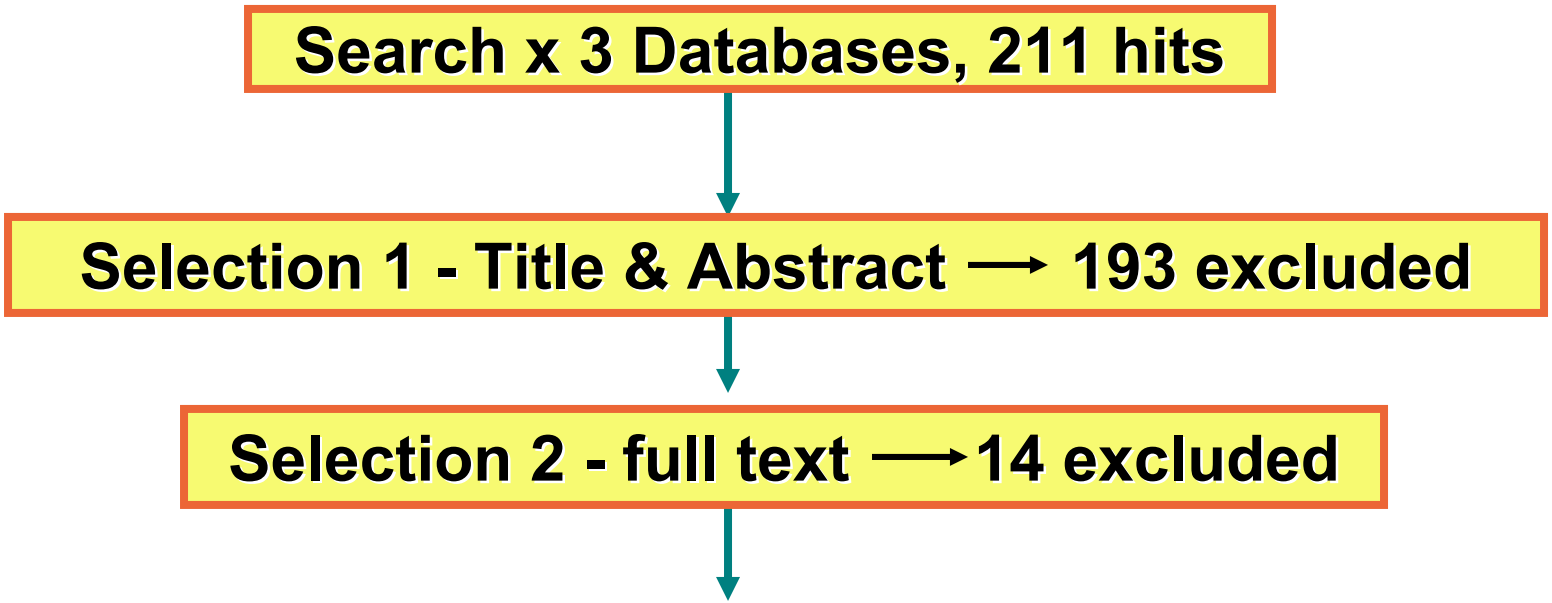
# Principles of Antimicrobial Prophylaxis

"*Infusion of the 1st dose should begin within 60 min of the significant incision (120 min for IV vancomycin & quinolones)*

"*….. antimicrobial prophylaxis is unnecessary after wound closure or upon termination of an endoscopic procedure.*"

*J Urology* 2008; 179: 1379-1390

# Mupirocin & *S. aureus* Infections




*J Antimicrobial Chemother* 2008; 61: 254-261

# Mupirocin & *S. aureus* Infections

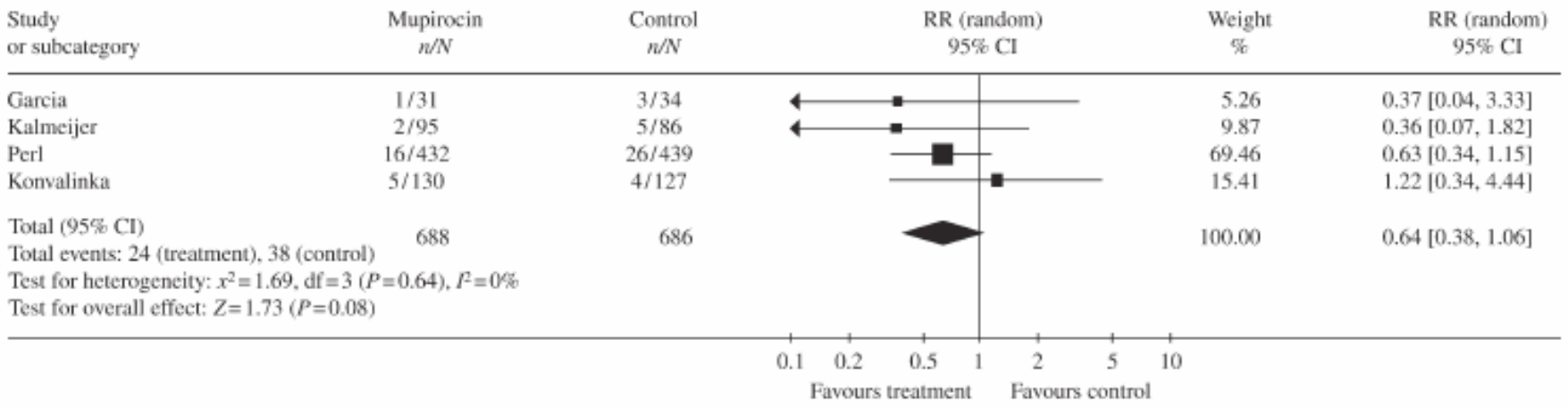



**Figure 3.** *S. aureus* SSIs among surgical patients with *S. aureus* nasal carriage.

**Of 686 mupirocin-treated patients with *S. aureus* nasal carriage, there were 25 *S. aureus* infections (3.6%) compared with 46 (6.7%) infection in control patients (p=0.02)**

*J Antimicrob Chemother* 2008; 61: 254-261

# Healthcare Bundle for SSIs
## Derived from NICE

### Pre-Operative
**e.g. hair removal,**
**staff theatre wear**
**antibiotic prophylaxis**

### Intra-Operative
**e.g. hand decontamination**
**antiseptic skin preparation**
**wound irrigation**

### Post-Operative
**e.g. changing dressings**
**topical antimicrobial agents**
**debridement**

# Conclusions

1. SSI rates will be used as a measure of healthcare quality
2. Surveillance methodologies must use agreed methods that allow for complexity & specialisation
3. A practical but effective approach to post-discharge surveillance is required
4. Prevention is achieved through a multi-faceted and multi-disciplinary approach, including care bundles


Thank You