

## 15-14 Surgical Site Infections

### 13 Timing of Antimicrobial Prophylaxis and the Risk of Surgical Site Infections: Results from the Trial to Reduce Antimicrobial Prophylaxis Errors (TRAPE)

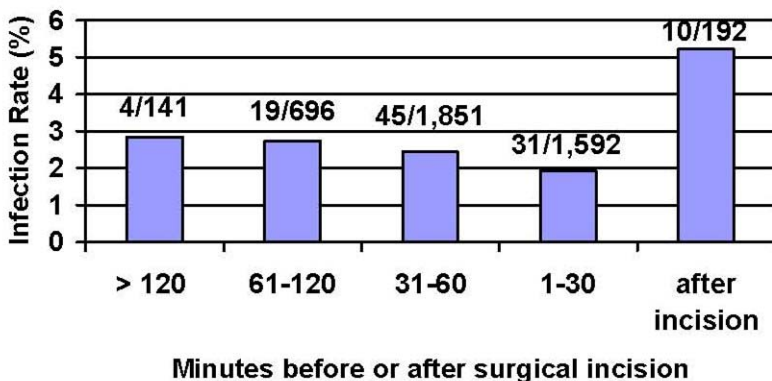
**James P. Steinberg, MD<sup>1</sup>**, Barbara I. Braun, PhD<sup>2</sup>, Bryan P. Simmons, MD<sup>3</sup>, Linda Kusek, RN, MPH<sup>2</sup>, Andrew J. Bush, PhD<sup>4</sup>, Michele R. Bozikis, MPH<sup>2</sup>, John P. Burke, MD<sup>5</sup>, Stephen Kritchevsky, PhD<sup>6</sup>.  
<sup>1</sup>Emory University School of Medicine, Atlanta, GA, USA, <sup>2</sup>Joint Commission, Oakbrook Terrace, IL, USA, <sup>3</sup>Methodist Health System, Memphis, TN, USA, <sup>4</sup>University of Tennessee, Memphis, TN, USA, <sup>5</sup>LDS Hospital, Salt Lake City, UT, USA, <sup>6</sup>Wake Forest University School of Medicine, Winston-Salem, NC, USA.

**Background:** Current national initiatives devoted to appropriate timing and duration of surgical antimicrobial prophylaxis (AMP) should be supported by additional evidence that appropriate timing is effective for preventing surgical site infections (SSIs). Because SSIs are generally low frequency events, multi-center studies are well suited for examining this relationship.

**Objective:** To assess the relationship between timing of AMP and SSI risk.

**Methods:** During 2003 and 2005, 44 hospitals participating in the TRAPE study prospectively obtained information on AMP for randomly selected cardiac, hip/knee arthroplasty and hysterectomy cases. Twenty-nine hospitals that used NNIS definitions for their routine SSI surveillance participated in this ancillary study and reviewed their infection records for SSIs in patients included in the TRAPE study. A de-identified, standardized case report form was completed for SSI cases. Stratified analysis and conditional logistic regression were used to relate SSI risk to AMP timing.

**Results:** SSI occurred in 109 (2.44%) of 4472 surgical procedures. 81% of patients received appropriately timed preoperative AMP according to current guidelines. There was a progressive increase in the infection rate as the interval from time of antibiotic administration to incision increased; highest SSI rate occurred when prophylaxis was given following incision ( $p < 0.05$  compared to 1-30 minute interval).



Stratifying data to account for the longer administration time for vancomycin (V) compared with other (O) agents, the SSI rate was 2.07% (38/1832) for preoperatively administering V  $\leq 1$  hr or O  $\leq 0.5$  hr, 2.38% (43/1804) for V 1-2 hr or O 0.5-1hr and 3.35% (28/836) for all other times ( $p$ -overall = 0.18). When patients receiving V were omitted from analysis, the impact of timing was clearer with SSI rates of 1.62% (22/1360) for O  $\leq 0.5$  hr, 2.40% (38/1584) for O 0.5-1 hr, and 3.55% (28/781) for all other times (overall  $p = 0.02$ ). Intraoperative re-dosing reduced SSI rates for procedures  $\geq 4$  hours duration only when the preoperative dose was given appropriately; SSI rate was 2.43% (5/206) with and 5.60% (36/643) without re-dosing ( $p = 0.06$ ).

**Conclusions:** These data confirm and extend previous observations and show a consistent relationship between the timing of AMP and SSI rates. The lowest rate occurred when AMP was given  $\leq 30$  minutes prior to incision. Intraoperative re-dosing reduced the SSI rate in operations lasting  $\geq 4$  hrs. While

preoperative dosing was appropriately timed in 81% of cases, intraoperative re-dosing was given in only 24% of long operations.

Acknowledgements: TRAPE was supported by AHRQ Grant R01HS11331.

#### **14 Decrease in Leg Surgical Site Infection Rate by Switching from Open Vein to Endoscopic Vein Harvesting During Coronary Artery Bypass Graft Surgery**

**Carlos Torres-Viera, MD, MPH<sup>1</sup>**, Patricia Reagan, PhD<sup>2</sup>, Louise-Marie Dembry, MD<sup>1</sup>.

<sup>1</sup>Yale-New Haven Hospital, Yale University, New Haven, CT, USA, <sup>2</sup>Yale-New Haven Hospital, New Haven, CT, USA.

Background: Saphenous veins remain the most commonly harvested conduit for revascularization in cardiac surgery. Vein harvesting is usually performed by a longitudinal lower extremity incision (open leg harvesting). Complications of this technique, including superficial and deep infections, have been reported to occur in 1 to 24 % of patients. Some investigators have reported that the use of endoscopic vein harvesting reduces these infectious complications.

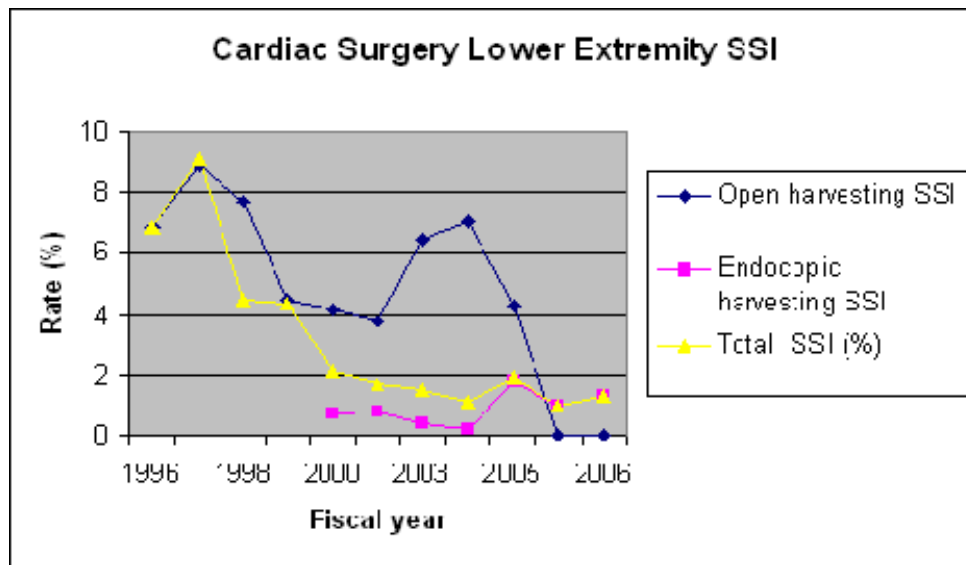
Objective: To compare the leg surgical-site-infection (SSI) rate before and after the implementation of an endoscopic technique for saphenous vein harvesting.

Methods: Surveillance program of cardiac surgery SSI at Yale-New Haven Hospital from 1996 to the present. The surveillance methodology employed follows CDC recommendations: all patients having coronary artery bypass graft (CABG) surgery are followed prospectively for 30 days post-surgery for evidence of SSI; in-house by a Hospital Epidemiology Technician; post discharge surveillance forms are sent to the attending surgeons' offices for completion. Endoscopic saphenous vein harvesting was initiated in June of 1999.

Results: On average 616 cardiac surgeries that require saphenous vein harvesting are performed yearly. Until June of 1999 saphenous vein harvesting was performed exclusively by open incision. The rate of lower extremity surgical site infection before institution of endoscopic harvesting in June 1999 was 4.5 % (range between 1996 to 1999 was 8.9to 4.5 %). During the first year of implementation of endoscopic harvesting, 60 % of the saphenous vein harvesting was performed endoscopically and the rate of infection dropped to 2.1 % (0.7 % for endoscopic harvesting vs. 4.2 % for open leg incision harvesting) and continued to remain low during the following years with a rate of 1.3 % during the year 2006 (99 % endoscopic harvesting). This represents a 71 % decrease in the infection rate. No significant changes in timing of antibiotic prophylaxis or hair removal methods were introduced during this period.

Conclusions: These data demonstrate that endoscopic saphenous vein harvesting decreases the rate of

lower extremity wound infections associated with coronary artery bypass surgery.



### 15 Surgical Site Infection Surveillance in The Netherlands and the Predictive Power of the National Nosocomial Infection Surveillance (NNIS) Risk Index as compared to Routinely Collected Alternative Determinants

Marten Kivi<sup>1</sup>, Judith Manniën<sup>1</sup>, Jan C. Wille<sup>2</sup>, Susan van den Hof<sup>1</sup>.

<sup>1</sup>National Institute for Public Health and the Environment, Bilthoven, The Netherlands, <sup>2</sup>Dutch Institute for Healthcare Improvement, CBO, Utrecht, The Netherlands.

**Background:** The surgical site infection (SSI) component of the Dutch nosocomial infection surveillance system (PREZIES) covers 67 of the 98 (68%) hospitals in The Netherlands. Per hospital, the observed procedure-specific SSI rate is compared with the expected rate. This expected risk is based on the national SSI risk per patient given its NNIS risk index, which consists of the American Society of Anesthesiologists physical status classification, the wound contamination class and the duration of surgery.

**Objective:** We aimed to improve the comparison of SSI occurrence between hospitals by estimating the predictive power of additional SSI determinants as routinely collected within PREZIES.

**Methods:** We used SSI surveillance data from PREZIES in 1996-2004. Data on 11 putative risk factors and SSI occurrence regarding 19 surgical procedure groups with at least 50 SSI were analyzed. Variables with a p-value < 0.2 in univariate analyses were selected for multivariate logistic regression analyses, using backward elimination. Per surgical procedure group, the predictive power of the new model was compared to that of the model based on the NNIS risk index, by testing the area under the receiver operating characteristic (ROC) curves.

**Results:** The 19 procedure groups comprised 93,511 procedures and 3,494 SSIs. The most common determinants in the new models were the three NNIS index components, annual number of the procedure performed, age, pre-operative duration of hospitalization, and hospital type. The area under the ROC curve varied from 0.51 to 0.66 for the models based on the NNIS index, and from 0.57 to 0.71 for the new models. Nine models predicted SSI better (p<0.05) than the NNIS index, and 10 models were equivalent of which 4 used fewer predictors than three as used in the NNIS index. The calculated expected number of SSI per surgical procedure did not differ much between the NNIS index and new models.

**Conclusions:** Our results show that for some surgical procedures SSI occurrence is better predicted by customized models than by one universal model based on the NNIS risk index. However, even with this

relatively large data set comprising 11 potential risk factors, the predictive power for SSI is still not optimal and the practical relevance of the increase in predictive power is marginal.

**16 Pan celtic Surveillance of Surgical Site Infection (SSI) of Orthopaedic Procedures: results of two years collaborative work across three countries**

**Jacqueline S. Reilly, PhD<sup>1</sup>**, Ed T. M. Smyth<sup>2</sup>, Anthony J. Howard<sup>3</sup>, Gerard McIlvenny<sup>2</sup>, Daffyd Williams<sup>3</sup>, Eleri Davies<sup>3</sup>, Geraldine Reid<sup>2</sup>.

<sup>1</sup>Health Protection Scotland, Glasgow, United Kingdom, <sup>2</sup>HISC, Belfast, United Kingdom, <sup>3</sup>WHAIP, Cardiff, United Kingdom.

Background: Northern Ireland, Scotland and Wales have collaborated over the last 2 years to develop orthopaedic SSI surveillance.

Objective: To determine incidence rates of surgical site infection in the three countries and enable data to be used for national and international comparisons.

Methods: CDC definitions for SSI were used for; total hip replacement (THR), total knee replacement (TKR), open reduction of fracture of the trochanteric region of the femur that requires internal fixation (ORTF) and hemiarthroplasty of the hip (HA). Information was collected by clinical staff with support provided by infection control teams. HISC collated the data for the three surveillance centres.

Results: Data on 35,197 operations from the four categories of orthopaedic procedures were collected by hospitals in Scotland, Wales and Northern Ireland between 2003 and September 2005. In the calendar year 2005 data on 17,781 orthopaedic procedures were collected.

The SSI rates in 2005 were as follows: (SSI rate 95% confidence intervals):

- Hip prosthesis 1.8 (1.5 - 2.1)
- Hemiarthroplasty of hip 2.8 (2.2 - 3.6)
- # neck of femur 2.1 (1.6 - 2.8)
- Knee prosthesis 2.2 (1.9 - 2.6)

The SSI rate for hemiarthroplasty of the hip was significantly higher than the SSI rate for hip prosthesis ( $p < 0.001$ ). Two-thirds of emergency procedures (66.3%) were performed within a day of admission. The SSI rate of 2.7% for emergency procedures was significantly higher than the SSI rate of 1.9% for elective procedures ( $p < 0.003$ ). Consultant surgeons performed the majority of hip and knee prosthesis. Specialist registrars performed the majority of hemiarthroplasty of hip and # neck of femur procedures. Consultant surgeons had a significantly lower SSI rate (1.9%) than surgeons' in training did (junior surgeon grades SSI rate 2.5%) ( $p < 0.02$ ). Of all procedures, 85% were performed by a consultant or a consultant was present in the theatre suite.

There was a greater risk of developing an SSI in orthopaedic patients with a preoperative stay of four or more days. Patients who developed SSI stayed in hospital 5 days more than patients who did not develop an SSI, i.e. procedure to discharge was 7 days without SSI and 12 SSI (2003 - 2005).

Conclusions: This valuable dataset has informed orthopaedic practice in these three countries. These data set permit the calculation of risk-adjusted SSI rates, allowing comparisons between countries, hospitals and within a hospital over time. The use of CDC definitions permits international comparisons of these data. Collaboration of this kind can be used as a template for other areas of SSI surveillance and the pan celtic group are collaborating on caesarean section procedures from this year.

**17 An Alternative Scoring System to Predict Risk for Surgical Site Infection Complicating Coronary Artery Bypass Graft Surgery**

**Nadia D. Friedman, MBBS<sup>1</sup>**, Ann L. Bull<sup>1</sup>, Philip L. Russo<sup>1</sup>, Karin Leder<sup>2</sup>, Chris Reid<sup>2</sup>, Baki Billah<sup>2</sup>, Silvana Marasco<sup>3</sup>, Emma McBryde<sup>1</sup>, Michael J. Richards<sup>1</sup>.

<sup>1</sup>VICNISS, Melbourne, Australia, <sup>2</sup>Monash University, Melbourne, Australia, <sup>3</sup>Alfred Hospital, Melbourne, Australia.

Background: The National Nosocomial Infection Surveillance (NNIS) System of risk adjustment performs poorly at predicting risk of surgical site infection (SSI) complicating coronary artery bypass graft (CABG) surgery.

Objective: To analyze the risk factors for SSI complicating CABG surgery and to create an alternative SSI risk score.

Methods: Prospective cohort study of patients undergoing CABG surgery over 27 months in Victoria, Australia. SSI data from the VICNISS co-ordinating centre for hospital-acquired infections were matched with risk factor data from the Australasian Society of Cardio Thoracic Surgeons. An alternative SSI risk score was created based on the results of multivariate analysis and compared with the NNIS method of risk adjustment.

Results: 4633 patients (93%) were matched from the 2 systems databases. There were 286 SSI and 62 were deep or organ space sternal SSI (deep sternal SSI rate 1.33%). Univariate analysis revealed that diabetes mellitus, body mass index (BMI)>35, and blood transfusion were risk factors for all types of SSI complicating CABG. Six multivariate analysis models were created to examine either pre-operative factors alone or combined with operative factors. All models revealed diabetes and BMI $\geq$ 30 as risk factors for SSI complicating CABG. A new pre-operative scoring system was devised to predict sternal SSI, which counted one point for diabetes, one point for BMI  $\geq$ 30 < 35 and a third point for BMI  $\geq$ 35. Each point in the scoring system represented approximately a doubling of risk of SSI. The new scoring system performed better than the NNIS risk index at predicting SSI.

Conclusions: A new weighted scoring system based on pre-operative risk factors was created to predict sternal SSI risk following CABG. The new scoring system out-performed the NNIS risk index. Future studies are needed to validate this risk score.

### **18 Using an Electronic Anesthesia Record Keeping System (ARKS) to Facilitate Reporting of Timing of Antimicrobial Prophylaxis (AP) with Outcomes in Patients Undergoing Surgery**

**Steven M. Gordon, MD**, Brain Parker, MD, Susan Vitagliano, RN, Tom Fraser, MD, Steve Schmitt, MD, Cynthia Fatica, RN, Alan Siperstein, Mary Bertin, Joan Kowalczyk, Linda Madison, Surgical Infection Prevention Team Cleveland Clinic.  
Cleveland Clinic Foundation, Cleveland, OH, USA.

Background: Appropriate timing of AP ( $\leq$  60 minutes from administration to surgical incision) is a key component of the Surgical Infection Project of CMS.

Objective: We report on using an electronic anesthesia record keeping system (ARKS) to facilitate the measurement and reporting capabilities of AP before surgery.

#### **Methods:**

ARKS was launched in all of the operating theatres throughout the Cleveland Clinic in January of 2006. AP administration is the responsibility of anesthesiologists and we created a specific step in documenting induction phase in ARKS which serves a reminder to administer antibiotics prior to incision. Data for AP was downloaded for all cardiac, colorectal, gynecological, vascular and orthopedic surgeries for which antibiotics were indicated from Jan 1 through September 30, 2006 (the study period). Targeted SSI surveillance was performed by ICPs using CDC definitions for cardiac, prosthetic joint (primary and revision), and spine surgeries during the study period.

Results: A total of 88% (4310/4997) patients received appropriate AP during the study period with a mean timing of 37.5 minutes [gynecology 93% (399/427); cardiac 89% (2384/2679), colorectal surgery 89% (640/720); orthopedics 87% (819/946); and vascular surgery 66% (148/225). A total of 116 SSI were identified: cardiac surgery 2.3 per 100 procedures [63 SSI]; spine surgery 3.6 per 100 procedures spine [42 SSI]; prosthetic joints 0.9 per 100 procedures [11 SSI]. AP was appropriate in 76% of these 116

SSIs. SSI in cardiac Patients with SSI following cardiac surgery were more likely to have inappropriate AP timing than those without SSI (79% [13/63] vs. 89% [282/2616] 2-tailed P=.05).

Conclusions: Electronic anesthesia record keeping facilitated monitoring of AP in surgery and was associated with higher risk of SSI after cardiac surgery. We report cases of SSI with AP to surgeons to identify possible missed opportunities for SSI prevention. We plan to begin anesthesia specific report anesthesia specific rates of appropriate timing of AP as a method to improve our adherence to appropriate AP in surgery.