

## Surveillance

### 221. Catheter-Associated Urinary Tract Infection Rates in 88 Intensive Care Units of 18 Developing Countries. Findings of the International Nosocomial Infection Control Consortium (INICC)

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**Objective:** To determine the rate, microorganism profile, bacterial resistance, extra length of stay (LOS) and extra mortality of catheter-associated urinary tract infection (CAUTI) in 88 intensive care units (ICUs) of hospital members of the INICC in Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, India, Kosovo, Lebanon, Macedonia, Mexico, Morocco, Nigeria, Peru, Philippines, El Salvador, Turkey and Uruguay.

**Methods:** An open label, prospective cohort, active healthcare-associated infection surveillance study was conducted on adult and pediatric patients admitted to 88 tertiary-care ICUs of 46 cities in 18 countries. Rates of device-associated infections (DAI) were recorded through applying the definitions provided by CDC-NNIS system. The protocol, forms, and methodology of outcome surveillance implemented were developed by INICC. The data collection was performed in the participating ICUs. Data uploading and data analysis were conducted at INICC headquarters on proprietary software.

Results: From 01/02 to 12/07, we enrolled 42,505 patients, representing 270,854 bed days. The overall CAUTI rate in all the ICUs combined was 6.48 per 1000 device days; stratified by type of ICU the CAUTI rate per 1000 device days was: in the Medical-Surgical ICUs rate was 6.61; in the Coronary Units 6.41; in the Medical ICUs 9.63; in the Surgical ICUs rate 4.53; in the Trauma ICUs 5.15; in the Neuro-Surgical ICUs 8.29; in the Cardio-Surgical ICUs 1.02; and in the Pediatric ICUs 3.98. Overall 25.7% of all CAUTI were caused by *Candida* sp; 20.5% by *E. coli*-37.7% were resistant to third generation cephalosporins and 30.0% were Quinolones-resistant; 13.6% by *Pseudomonas* sp. (60.3% of which were resistant to Ciprofloxacin, 32.7% to Imipenem, and 58.1% to Piperacilin); 11.9% by *Klebsiella* sp. (62.8% of which were resistant to third generation cephalosporins); 4.5% by *Enterobacter* sp. (80.0% of which were resistant to third generation cephalosporins and 4.3% to Carbapenem); 3.7% by *Proteus mirabilis*; 4.8% by *Enterococcus* sp.; 3.7% by *Staphylococcus aureus* (66.0% of which were MRSA ); 2.2% by *Coagulase-negative-staphylococci* (43.8% of which were resistant to methicillin). The LOS of patients without DAI was 4.9 days; the LOS of patients with CAUTI was 14.06 days (RR, 2.92), representing 9.17 extra days. A total of 5,901 out of 38,613 (15.3%) patients without any DAI died; 203 out of 567 patients (35.6%) with CAUTI died, the extra mortality of CAUTI being 20.5% (RR, 2.34, 95% CI, 2.04 - 2.69, P, 0.0001).

Conclusions: This study has identified that the CAUTI rate is high, increasing 9 extra days the length of stay, and it has also identified that CAUTI is significantly associated with higher mortality.

## **222. Natural History of *Staphylococcus aureus* Colonization In An Intensive Care Unit That Does Not Use Contact Precautions For Colonized Patients**

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Background: Many hospitals place patients (pts) who are colonized or infected with methicillin-resistant *Staphylococcus aureus* (MRSA) on contact precautions to control transmission. Although this measure has been part of successful control of outbreaks, its impact on controlling endemic MRSA is unknown. With the trend toward surveillance cultures for MRSA, more asymptomatic colonized pts are identified. The effectiveness of placing these pts on contact precautions is less studied.

Objective: In a hospital that does not place colonized pts on contact precautions, we evaluated the natural history of SA colonization in an intensive care unit (ICU).

Methods: We collected nasal swabs from pts on admission and discharge in our 26 bed medical/surgical ICU over 1 month. Specimens were cultured and susceptibility testing was performed for all SA isolates. During ICU stay, pts were managed according to hospital infection control policies, which require contact precautions for pts who have uncontrolled secretions, open wounds, or uncontained diarrhea, regardless of pathogen. We calculated rates of SA colonization on admission and discharge, and compared the rates of acquisition and clearance of colonization. We

also performed active surveillance for infections due to SA, and reviewed results of hand hygiene observations conducted by the infection control program.

Results: 142 pts were admitted to the ICU in one month. We collected admission cultures from 119 pts (84%), and discharge cultures from 85 (65%) of 130 pts who survived to be discharged. Both admission and discharge cultures were available from 83 (64%). For these pts, median length of stay was 3 d (range 1-47 d); median age was 67 y (range 21-90 y). On admission, 31(26%) of 119 pts were colonized with SA; 11 with MRSA. At discharge, 19 pts (23%) were colonized with SA; 8 with MRSA. Of the 83 pts with both admission and discharge cultures, 5 (8%) who were culture negative on admission developed SA colonization during their ICU stay: 3 with MRSA and 2 with MSSA. Eight pts (38%) who were colonized at admission had negative cultures at discharge: 4 cleared MRSA colonization and 4 cleared MSSA colonization. The proportion of pts who cleared colonization was significantly higher than the proportion who acquired colonization ( $p=0.003$ ). No pts in the ICU developed an infection due to SA during this month. Hand hygiene compliance in the ICU was 71%.

Conclusions: In this setting, where contact precautions are not used with SA-colonized pts, pts were significantly more likely to clear SA colonization than to acquire it during an ICU stay. This may reflect the often transient nature of SA colonization. Though additional data are necessary to confirm these preliminary findings, these results suggest that knowledge of colonization status and use of contact precautions for colonized pts may not be required to control SA in an ICU setting.

### **223. Do Seasonal Variations Of Nosocomial Infections Exist?**

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Background: Several infectious diseases are known to have a seasonal variation in their incidence but it is not clear, if these differences have to be considered for evaluating surveillance data of nosocomial infections.

Objective: To investigate seasonal influences for the most important nosocomial infections and their causing pathogens.

Methods: The data from the surveillance components for ICU patients (ICU-KISS) and operated patients (OP-KISS) of the German Nosocomial Infection Surveillance System (KISS) between January 1997 and December 2006 were considered for the analysis.

Infection rates (infections/1000 patient days for ICU-KISS or infections/100 patients for OP-KISS) for the winter period (December - February) and the summer period (June - August) as well as the resulting incidence density ratio (IDR) for ICU-KISS or risk ratio (RR) for OP-KISS were calculated. As test of independence two-sided p values were calculated using mid-p exact method for IDR's and Fisher's exact test for RR's.

Results: A total of data from 694 185 ICU patients from 401 ICUs and 267 537 operated patients from 382 departments were analyzed. The results for the 4 most important infection types and some pathogens with a significant difference are shown in table 1.

Conclusions: Minor seasonal variations do exist but it seems not to be necessary to consider these differences for evaluation of surveillance data.

KISS component	Infection type / Infection with pathogen	n	Infection rate summer months	Infection rate winter months	IDR / RR	p
ICU-KISS	Pneumonia	10637	4.34	4.13	1.050	<0.05
	UTI	5248	2.09	2.10	0.995	0.86
	BSI	3107	1.36	1.10	1.235	<0.05
	<i>P. aeruginosa</i>	2717	1.16	1.00	1.152	<0.05
	CNS	1861	0.82	0.66	1.252	<0.05
	<i>Enterobacter spp.</i>	1372	0.62	0.47	1.313	<0.05
OP-KISS	SSI / 100 patients	5215	2.17	1.81	1.199	<0.05

#### 224. A Creutzfeldt-Jakob Disease (CJD) Lookback Program in Veterans Health Administration (VHA) Facilities

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Background: CJD is a rare human neurodegenerative disease with a general annual rate of 3.4 cases/million in those >50 years of age. The median rate of CJD diagnosis in the total VHA inpatient population from 1996 to 2007, the majority of whom were >50 years old, was 2.72 cases/million (ICD-9 code 046.1). Iatrogenic transmission of the CJD prion agent by blood or blood products is theoretically possible. In 1994, national withdrawals of blood products and plasma derivatives were initiated after a ten-gallon volunteer blood donor subsequently died of CJD.

Objective: Patients at VHA facilities were among those nationwide who had received plasma derivatives prior to the withdrawals; these patients are followed over time to assess occurrence of CJD.

Methods: A VHA CJD lookback program was initiated in 1995 and VHA facilities identified patients who had received the products prior to withdrawal. The withdrawals covered plasma derivatives given to VHA patients from 1992 to 1997. Basic data for these patients, such as vital status, date and cause of death, and CJD

diagnosis, are collected periodically from the facilities. The most recent data collection was in 2007. Patients with "unknown" status in the 2007 survey results were cross-referenced with an online Social Security Death Index (SSDI) to determine if they were recorded as deceased. This report is a summary of data collected thus far in the lookback.

Results: 1615 patients treated at 68 VHA facilities nationwide had received the products prior to withdrawal. Of those patients, 649 (40%) who were not yet reported as deceased remained for the 2007 lookback. Follow-up data were reported in 2007 for 84% (543/649) of patients: 350 patients were alive and 193 patients were deceased. 48 of the 106 patients lost to follow-up were identified as deceased using the SSDI. Therefore, vital data are available for 96% of lookback patients (1557/1615). Cause of death data were reported for 37% of all deceased lookback patients (450/1207). One patient in the 2007 lookback had an unconfirmed diagnosis of CJD, 13 years after receiving the withdrawn product (albumin). This patient died one year after the presumed CJD diagnosis.

Conclusions: VHA was the largest healthcare organization to initiate a lookback of patients who had received the withdrawn plasma derivatives. Statistical analyses are problematic for the incidence of a rare disease in a population, especially when diagnosis is unconfirmed by histopathology (a common issue with CJD) and incubation period of the agent is unknown. While a firm conclusion here is impossible, large data sets such as this can be useful as another element in elucidating the risk of blood transmission of CJD.

## **225. Validation of Algorithms for Surveillance of Primary Nosocomial Bloodstream Infections (PN-BSIs)**

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Background: Traditional surveillance requires infection control professionals (ICPs) to review patients' medical records, microbiology data, results of other tests, and data on antimicrobial use to identify patients with primary nosocomial PN-BSIs. A study, sponsored by the Centers for Disease Control and Prevention (CDC), suggested that computer algorithms applied to information stored in hospital databases could approximate results of ICPs' surveillance, thereby increasing efficiency. Such an algorithm could also standardize surveillance by removing human judgment.

Objective: This study compared the accuracy of surveillance for PN-BSIs done by 2 computer algorithms and that done by ICPs.

Methods: ICPs and the 2 algorithms independently classified 1224 positive blood cultures obtained from 890 patients between 7/1/2004 and 12/31/2005. The algorithms classified the blood cultures by asking the following questions: 1) polymicrobial (yes/no); 2) duplicate (yes/no); 3) secondary BSI (S-BSI; yes/no) 4) primary BSI (yes/no). Cultures meeting secondary or primary criteria were classified as either nosocomial or community acquired. The principal investigator created a database of all positive blood cultures assessed by either the ICPs or one of the algorithms as a PN-BSI and he determined which of the ICPs' assessments agreed

with the algorithms' assessments and which did not. A trained research assistant assessed each episode to determine which met CDC's criteria for PN-BSI; an ICP validated the assessments to determine the reason for any discrepancies between the ICPs' and the algorithms' assessments.

Results: The ICPs and/or the algorithms classified 490 blood cultures as PN-BSIs, of which 381 (77.8%) met the CDC's definition. Of the 109 cultures that were misclassified as PN-BSI, the ICPs misclassified 17 (15.6%) and the algorithms misclassified 92 (84.4%). The ICPs were correct in 466 (95.1%) cases. They misclassified 17 (3.5%) positive cultures as PN-BSI, and they missed 7 PN-BSI ( $7/381 = 1.8\%$ ). In contrast, both algorithms were correct in 176 (35.9%) cases and one or the other algorithm was correct in 31 (6.3%). Of the 381 blood cultures from PN-BSI, the ICPs and both algorithms assessed 170 (44.6%) as PN-BSIs, the ICPs alone assessed 177 (46.5%) as PN-BSIs, the ICPs and one of the algorithms assessed 27 (7.1%) as PN-BSI, and the algorithms alone assessed 7 (1.8%) as PN-BSIs. The algorithms frequently misclassified: PN-BSIs related to treatment early during hospitalization as community acquired, polymicrobial PN-BSIs and coagulase-negative staphylococcal PN-BSIs as contaminants, PN-BSIs as S-BSIs, and S-BSIs as primary.

Conclusions: The algorithms are neither sensitive nor specific enough to replace surveillance done by ICPs at our hospital. Future studies should determine if changing programming or increasing the information assessed can improve the algorithms' performance.

## **226. Effectiveness of Outcome Surveillance for Reducing Ventilator Associated Pneumonia and Overall Device Associated Infection Rates in a Hospital in Cuba. Findings of the International Nosocomial Infection Control Consortium (INICC)**

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Objective: To determine the effect of outcome surveillance (intervention) on the rate of ventilator-associated pneumonia (VAP) per device days and overall device-associated infection (DAI) per 100 discharged patients in one intensive care unit (ICU) of Havana, Cuba.

Methods: An open label, prospective cohort, active DAI surveillance, sequential study was conducted on adult patients admitted to a tertiary-care ICU. The protocol, forms, and methodology implemented were developed by the INICC. The data collection was performed in the participating ICU. Data uploading and data analysis were conducted at the INICC headquarters on proprietary software. Rates of DAI were recorded through applying the definitions provided by CDC-NNIS system. Infection control guidelines were applied during intervention phase.

The VAP rate per device days and overall DAI rates per 100 discharged days during baseline and intervention phases were compared.

Results: From 1/2007 to 10/2007, 235 adult ICU patients were enrolled, 108 in the baseline period (01/07 to 05/07) and 127 in the intervention period (06/07 to 10/07).

Patient's characteristics were similar over the two periods (Patient gender, P= 0.4711; Age, P= 0.4939; Diabetes, P= 0.3544; Hypertension, P= 0.1330; Coronary Insufficiency, P= 0.9601; Cardiac Surgery, P = 0.3564; COPD, P= 0.3298; Renal Impairment, P= 0.7054; Hepatic Failure, P = 0.8425; Abdominal Surgery, P= 0.5496; Thoracic Surgery, P= 0.2438; Trauma, P= 0.8711 and Stroke, P = 0.0536) The rate of VAP per 1,000 ventilator days during the intervention period was significantly lower than during the baseline period (43.5 vs. 9.2, RR = 0.21, 95% CI = 0.06 - 0.77, P = 0.0092).

Finally, the rate of DAI per 100 patients during the intervention period was significantly lower than during the baseline period (15.7% vs. 3.9% DAIs per discharged patient, RR = 0.25, 95% CI = 0.09 - 0.68, P = 0.0032).

Conclusions: Outcome surveillance resulted in a significant reduction of the VAP rate per 1,000 ventilator days and the overall DAI per 100 discharged patients.

## **227. Comparison of Northern Ireland and the Republic of Ireland Results from the Hospital Infection Society Prevalence Survey of Healthcare-Associated Infection 2006**

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Background: As part of the Third Hospital Infection Society's Healthcare Associated Infection (HCAI) Prevalence Survey of the United Kingdom and Ireland, HCAI point prevalence surveys were carried out during 2006 in the Republic of Ireland (RoI) and Northern Ireland (NI).

Objective: To explore the potential benefits of comparing results from two countries that employed similar methodologies and identical definitions of infection.

Methods: Information regarding participation in the survey was sent to hospitals in Summer 2005. The survey was organised by the Northern Ireland Healthcare-associated Infection Surveillance Centre and the Health Protection Surveillance Centre, Dublin, Ireland and funded by the respective Departments of Health.

Infection prevention & control staff across NI (with the help of a regional co-ordinator) and RoI, completed the survey between February and May 2006. In addition, dedicated data collectors were used in the RoI. Data was collected for all types of HCAI and included specific questions regarding MRSA and *Clostridium difficile*. Standardised methods and training were used and the CDC definitions of infection were employed. Questionnaires were processed employing optical mark reader technology (OMR)

Results: Forty-four acute adult hospitals in the RoI and fifteen in NI participated in the survey that resulted in a total of 11,185 patients being surveyed (RoI 7,541 and NI 3,644 patients). The overall HCAI prevalence was 4.9 and 5.4 in the RoI and NI respectively. There was no significant difference in prevalence rates of HCAI, device related HCAI or HCAI associated with bloodstream infection but there was a difference in MRSA-related HCAI ( $p=0.02$ ), between the two countries. There were significantly more urinary tract infections and *C. difficile* infections recorded in NI ( $p=0.002$  and  $p<0.001$ ). HCAIs were more prevalent in patients over aged 65 years and in the intensive care unit in both countries. HCAIs were also more prevalent if patients were mechanically ventilated, had recent non-implant surgery (RoI) or had more recorded HCAI risk factors.

Conclusions: This is the first time that HCAI prevalence rates have been directly compared between the RoI and NI. By closely examining similarities and differences between HCAI prevalence rates in both countries it is hoped that this will influence healthcare planning and at the same time reassure the public that HCAI is important and that measures are being taken to combat it.

## **228. Automated Surveillance To Detect An Influenza Epidemic: Which Respiratory Syndrome Should We Monitor?**

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Background: Syndromic surveillance systems (SSS) seek early detection of infectious diseases outbreaks by focusing on pre-diagnostic symptoms. We do not yet know which respiratory syndrome should be monitored for a SSS to discover an influenza epidemic as soon as possible.

Objective: To compare the delay and workload required to detect an influenza epidemic using a SSS that targets either (1) all cases of influenza-like illness (ILI) or (2) only those ILI cases that are febrile.

Methods: Using an explicit definition of ILI, we reviewed the electronic medical record (EMR) of 15,377 outpatient encounters at the Veterans Administration (VA) system. Found ILI cases served as a reference to develop ILI case-detection algorithms (CDAs) that utilized combinations of structured EMR data and text analyses of clinical notes. We recreated historical background case count time series by applying the most successful CDAs to EMR data from the Baltimore VA. We injected factitious influenza cases to CDA-specific backgrounds using an age-

structured modeled influenza epidemic and then used a modified CUSUM statistic daily for 50 days to detect the outbreak. This injection/prospective-surveillance cycle was repeated each week of the study year. To distinguish between true- and background-positive alarms, the daily statistics were performed on paired background + injection vs. background-only time series. We then computed two benchmarks: 1) the average "Detection Delay", from the time of each injection to the first true-positive alarm; 2) the "Workload", defined as the yearly number of cases included in all the background-positive alarms. We compared these benchmarks for simulated SSS optimized to target either ILI, or Febrile-ILI cases.

Results: The CDAs that minimized both Detection Delay and Workload were those that maximized specificity (>99%) and positive predictive value (PPV) (35-54%) and yet retained a sensitivity of 69-100%. Compared to the "respiratory" ICD-9 codeset used by CDC's "BioSense" SSS, the best ILI CDA decreased Detection Delay from 38 to 30 days, and Workload from 2397 to 483 cases/year. The best Febrile-ILI-targeted CDA further reduced Delay to 27 days and Workload to 121 cases/year.

Conclusions: Case detection methods that take advantage of information from the full EMR and that focus only on those ILI cases that are febrile can lower both the delay and the workload required to detect an influenza epidemic in the community.

## **229. Surveillance for Laboratory-Confirmed Influenza in Adults Hospitalized in Canadian Acute-Care Hospitals**

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Background: Seasonal influenza remains a substantial cause of morbidity and mortality, and a significant contributor to hospital costs during influenza season. The burden of illness associated with seasonal influenza on adult in-patients has not been described, to date, in Canada. In this context, the Canadian Nosocomial Infection Surveillance Program (CNISP) performed a prospective surveillance in adults hospitalized in Canadian acute-care hospitals during the 2007 influenza season.

Objectives: To describe the epidemiology of influenza-associated illness in adults admitted to Canadian acute care facilities and the infection control measures used for these patients.

Methods: Laboratory-based surveillance for influenza-associated illness was performed in 15 CNISP hospitals between November 1, 2006 and April 30, 2007. Eligible cases were in-patients  $\geq 16$  years of age with a laboratory test (EIA, DFA, PCR or culture) positive for influenza. Cases were defined as hospital acquired (HA) if symptom onset was  $>96$  hours after hospital admission, or if they were re-admitted  $<96$  hours post-discharge. Chart review was performed to determine the infection control measures that were used during the hospitalization.

Results: A total of 173 cases of influenza were identified (165, 95% influenza A; 8, 5% influenza B). Mean age was 66 yrs (range 16-98 yrs), 90 (52%) were male. 129 (75%) cases were community acquired (CA). The incidence of CA influenza was 1.07 per 1,000 admissions (range 0.20 to 2.30 per 1,000 admissions). The 44 HA cases occurred in 7 hospitals, 22 (50%) were part of the 3 identified influenza outbreaks. The rate of HA influenza was 3.87 per 100,000 patient days (range 0.00 to 15.53). Of the 173 cases of influenza, 15 (9%) required ICU admission, 11 (6%) required intubation/mechanical ventilation, and 14 (8%) died within 30 days of symptom onset. Most (122, 71 %) diagnosed cases were managed in droplet or droplet contact precautions in addition to routine practices, which for 79 (46%) included a private room. Additional precautions were not initiated, at any time, for the remaining 51 (29%) patients. Among the patients on precautions, gloves were used when providing care to 59 (48%) patients, gowns for 78 (64%) patients, surgical masks for 62 (51%) patients, and goggles for 59 (48%). N95 respirators or equivalents were used for 28 (23%) patients.

Conclusions: Both CA and HA influenza are relatively common during influenza season. However, over a quarter of the patients identified with influenza were not treated with the appropriate infection control measures. In this report, seasonal influenza has been shown to have a significant rate of serious complications and death.

### **230. Preparing Infection Control Professionals for Mandatory Reporting of Hospital Acquired Infections is Necessary for Improving Surveillance Validity**

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Background: Virginia mandated reporting of central line associated bloodstream infections (CL-BSIs) in adult ICU patients effective July 1, 2008. All hospitals were required to join the National Healthcare Safety Network (NHSN) to standardize surveillance methodology and reporting. However, of Virginia's 94 acute care hospitals, only 3 hospitals and 2 health systems were active NHSN members. APIC-VA established a task force to educate the membership regarding NHSN surveillance methods.

Objective: To determine the accuracy of ICPs in detecting CL-BSIs using simulated cases.

Methods: An initial education session was held in Spring 2007, which included an overview of NHSN, review of surveillance definitions and case studies to illustrate application of definitions. More than ¾ of the facilities were represented at the session. A second session was held in Fall 2007 using case presentations with a pretest before further education and a post-test after review of definitions and scenarios.

Results: Eight scenarios were reviewed by 59 participants. The overall rate of accuracy for identification of CL-BSI was 70% (328/471). Accuracy for the first set of 4 cases ranged from 44% to 92%. After a detailed discussion and review of definitions, 87% accuracy was demonstrated for an additional 4 scenarios. However, one of the cases had an incorrect response rate of 60%. Common problems noted included experienced ICPs not strictly adhering to the definitions and over interpretation of data.

Conclusions: The pretest/post test format led to an overall improvement in correctly identifying ICU CL-BSIs. States considering mandatory reporting should plan for education of ICPs to improve the accuracy of case detection, thereby improving the validity of the reported data.

### **231. Comparison of CHROMagar MRSA Culture and BD GeneOhm MRSA PCR Assay for Screening of Methicillin-Resistant *Staphylococcus aureus* Colonization**

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Background: Universal screening of inpatients has been advocated by some as part of hospital based methicillin-resistant *Staphylococcus aureus* (MRSA) control strategies. Optimal methods of detecting MRSA colonization remain obscure. At our institution, the median length of stay is 3 days (mean 4.7 days). Therefore, the ideal screening tool would not only need to be sensitive but must also be timely.

Objective: This study compares culture of direct patient swabs on CHROMagar MRSA vs. PCR using the BD GeneOhm MRSA assay. Additionally, we investigated the effect of anatomic sample site, duration of culture, and use of culture enrichment on identifying patients colonized with MRSA.

Methods: A cross-sectional sample of 118 patients (59 floor and 59 ICU) were swabbed separately at nares, axillary, and perianal sites. Samples were concurrently plated on CHROMagar and subjected to BD GeneOhm MRSA PCR. Swab samples were then subjected to 24-hour broth enrichment, followed by plating on CHROMagar. Cultures were read at 24 and 48 hours after plating.

Results: Comparing patient rates of detection with PCR (23.8%) using all three anatomical sites, the patient rates of detection with CHROMagar were: 21.8% ( $p=0.5$ ) and 16.8% ( $p=0.016$ ) by broth enriched/CHROMagar at 72 and 48 hours respectively, and 13.9% ( $p=0.002$ ) and 10.9% ( $p<0.001$ ) by non-enriched/CHROMagar at 48 and 24 hours, respectively. Using PCR screening from all three anatomical sites (nares, axilla, and perianal) as the gold standard, the sensitivity of screening the nares alone is 83.3% for PCR, 70.8% for broth enriched/CHROMagar at 72 hours, and 58.3% for non-enriched/CHROMagar at 48 hours. For optimal detection, all techniques required swab samples taken from multiple sites. Using PCR, MRSA was detected in 19.8% of patient nares, 8.9% of axillary, and 10.9% of perianal sites. All culture positive patients were detected by PCR. Rates of detection were not significantly different with respect to age, gender, unit, or length of stay.

Conclusions: PCR using the BD GeneOhm MRSA assay is a more sensitive and timely methodology than CHROMagar for detection of MRSA colonization. In addition, the data suggest a need for multi-site sampling strategies. Further research is required regarding the issues of cost/benefit, targeted screening, and utility of interventions prior to use as a universal screening tool.

### **232. Implementing a Hospital-wide Methicillin-resistant *Staphylococcus aureus* (MRSA) Active Surveillance Program**

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Background: MRSA is a major cause of hospital-acquired infections (HAI). Early identification and isolation of MRSA reservoirs has been associated with decreased MRSA transmission. ASC and isolation of MRSA positive patients has been used to reduce MRSA HAI in the ICU setting. Some US hospitals are now adding hospital-wide ASC to strategies for reducing MRSA HAIs. In 01/04, Park Nicollet-Methodist Hospital initiated an ASC program for all patients admitted to the ICU. By end of 2004, the number of MRSA HAIs in the ICU was 55% lower than at the end of 2003. At the same time, our hospital-wide MRSA HAI rate did not change. Therefore, 2007 the ASC program was expanded to include admissions to all inpatient care units.

Objective: To identify and isolate patients colonized with MRSA as part of our efforts to eliminate MRSA HAI.

Methods: Beginning in March of 2007, the anterior nares of all patients admitted to the hospital were tested for MRSA using standard CHROMager® culture methods. Results were available at 18-48 hours. Patients who tested positive were placed in contact isolation. MRSA HAI were defined using CDC criteria and identified by review of microbiological and clinical data. MRSA HAI rates were calculated as the number of cases per 10,000 patient-days.

Results: ASC were collected on 89% of eligible patients. ASC identified an average of 51 cases of new MRSA colonization per month, representing a 2.7% increase over patients with previously known history of MRSA infection or colonization. At baseline (2005) and 2006 we experienced 31 and 25 MRSA HAI respectively. After ASC program implementation in 2007 we experienced 16 MRSA HAI. The rate of MRSA HAI pre-intervention was 2.55 per 10,000 patient-days. In the first 9 months post-intervention our rate fell to 1.66 per 10,000 patient-days. When evaluated by analysis of means, this improvement does not yet reach statistical significance. The cost of culture collection and processing was approximately \$14,500.00 per month.

Conclusions: Our program evaluation describes early results of a hospital-wide ASC program. While we have not yet achieved statistically significant improvements we have reduced the actual number of MRSA HAIs in our system. We have achieved these results without preemptive isolation or rapid MRSA testing and have learned much about the issues surrounding implementation of an ASC program.

### **233. Developing the Colorado Health Facility Acquired Infections Report**

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**Background:** Health facility acquired infections (HAI) are a growing concern among healthcare consumers, purchasers, and workers. Consumer demand for public reporting of HAI continues to increase and policy-makers across the nation have recognized this demand. This pressure has led 20 states to pass laws requiring mandatory reporting of HAI since 2004. In June of 2006 the Colorado General Assembly passed the Hospital-Acquired Infections Disclosure Act. This bill mandates hospitals, hospital units, ambulatory surgery centers (ASC), and dialysis treatment centers report HAI data as a condition of their state licensure and the Colorado Department of Public Health and Environment (CDPHE) must produce an annual report disclosing the results.

**Objective:** To describe the process used by Colorado to develop a HAI report.

**Methods:** An advisory committee was appointed by CDPHE to provide oversight in selecting clinical procedures, assuring quality and accuracy of the data, and developing the reports. The committee consists of representatives from a public hospital, private hospital, physician with healthcare epidemiology or infection control (IC) expertise, four IC practitioners, medical statistician, health consumer, health insurer, and purchaser of health insurance. The committee met monthly during 2007 and 2008.

**Results:** The committee was required by the legislation to focus on HAI in 3 clinical areas: cardiac surgery, orthopedic surgery, and central-lines. The initial metrics for surgical site infections (SSI) focus on coronary artery bypass grafts and total or partial hip and knee arthroplasty. These surgeries were chosen because they are high volume procedures performed at many health facilities and can be expensive for healthcare payers. In addition, SSI from these operations are easily detected and reported, prevented by following standardized protocols, and have a devastating impact on a patient's quality of life. Central line associated blood stream infections are reported for neonatal intensive care units (ICUs) broken down by ICU level and birth weight and 6 types of adult ICUs. Reporting by specific unit and birth weight allows for a fairer comparison between hospitals by adjusting for different patient types and risk factors. All data entry is through the CDC's National Healthcare Safety Network (NHSN) internet-based surveillance system. CDPHE has been educating the health facilities on their roles and responsibilities with this new reporting system.

**Conclusions:** Developing a statewide reporting structure is a significant undertaking. Challenges include difficulties with NHSN training and enrollment, inability for ASCs to enroll in NHSN, limited funds to educate health facilities, and lack of resources to ensure the accuracy and completeness of the data. Future enhancements are tracking the organism that caused the infection, selecting metrics relevant to hemodialysis centers and ASCs, and adding 2 new measures in 2008.

### **234. Are Hospital Acquired Infection Surveillance Programs Effective in Smaller Hospitals?**

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Background: Since 2004, the VICNISS hospital-acquired infection surveillance program has been implemented in 91 smaller (<100 acute care beds) hospitals. The Infection Control (IC) nurses in these hospitals have collected optional or required data for 1. Process indicator surveillance modules- Surgical antibiotic prophylaxis (SAP), Health care worker and measles/hepatitis B vaccination, and Peripheral venous catheter use and 2. Outcome indicator surveillance modules- Methicillin-resistant *staphylococcus aureus* (MRSA) infections, Bloodstream infections, Occupational exposures (OE), Outpatient hemodialysis events and Surgical site infections.

Objective: To determine if the VICNISS smaller hospital surveillance program had over time achieved its objectives- increased compliance with 'best practice' processes and reduced outcome (usually infection) rates. There was no published evidence that these objectives had been achieved elsewhere in smaller hospitals.

Method: For some modules, regression modelling was used to analyze the relationship between the data collected over different time intervals.

Results: The statistically significant changes are outlined in Tables 1 and 2. For the SAP module (Table 1), 15 of the 28 participating hospitals collected enough data to qualify for the regression analysis.

Table 1: SAP module: Hospital level data

Objective	Description	Hospital	Odds Ratio	95% confidence interval	p value
Choice	'Concordant' (according to Australian Therapeutic Guidelines) or 'Adequate' classification	A	0.35	0.15- 0.86	0.02
		B	0.34	0.14 - 0.81	0.02
		C	2.22	1.21 - 4.06	0.01
		D	1.79	1.20 - 2.66	0.00
Timing	Antibiotic administered within 2 hours prior to surgical incision	E	0.14	0.35 - 0.58	0.01
		F	2.78	1.52 - 5.11	0.00
		B	0.25	0.64 - 0.98	0.00
		G	0.30	0.01 - 0.14	0.00
Duration	Antibiotic ceased within 24 hours post surgery.	A	0.23	0.07 - 0.78	0.02

Table 2: Outcome Indicator modules: Group level data

Objective	Aggregate category	Incident Rate Ratio	95% confidence interval	p value
MRSA infections present on admission or detected <48 hours post admission	All 91 hospitals	1.06	1.00- 1.11	0.04
	All 55 sub-group A hospitals*	1.20	1.06- 1.35	0.00
Parenteral OEs	All 55 sub-group A hospitals*	1.23	1.04 - 1.46	0.02
Non-parenteral OEs	All 91 hospitals	1.07	1.00 - 1.15	0.05

\* Sub-group A hospitals had between 1 and 14 acute beds.

Conclusions: The VICNISS smaller hospital surveillance program had been useful in establishing baseline surveillance data. Over the relatively short time it had been implemented, limited statistically significant improvement however was demonstrated for its defined objectives. It is unknown if this will change over an extended time period and if any factors outside the influence of the program (for example, IC resources) have affected or might affect the extent to which the objectives are achieved.

### **235. A Pilot Investigation of the Stability of Statistically Significant Events generated by BioSense**

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Background: BioSense1 is a public health surveillance tool that incorporates data associated with hospital visits and includes administrative data and elements from the electronic medical record. We define signal stability as the persistence of either the presence or absence of a statistical significant event (SSE). Quantifying the certainty of SSEs to reduce the workload required for investigation of false alarms will improve the quality of BioSense data for infection control and public health users.

Objective: To evaluate stability of BioSense-generated SSEs and determine their impact on alert interpretation.

Methods: From 10/25/2007 to 11/15/2007, we examined the BioSense report at Denver Health prospectively every workday, and recorded the "lag", where lag was calculated as number of days between visit date and record date. We recorded information on presence/absence of SSEs and the associated visit counts, stratified by syndrome group and patient class defined by BioSense. We considered an SSE present when both the count and rate were statistically significant using the W2 analysis and recurrence interval of 100 days<sup>1</sup>. Descriptive statistics were used to compare signal stability between different groups. We excluded potential SSEs followed-up for less than 7 days from index visit date for this analysis.

Results: During the 3 week evaluation period, 66 categories of potential SSEs were noted on each of the 14 days of observation. We observed a total of 8 SSEs, 5 from emergency visits and 3 from inpatient visits. The majority of these alerts (7 out of 8), which were all generated by the Chief Complaint / Reason for Admission (CC/RA), showed up on the next business day. Three of these alerts disappeared within a week of their first appearances. The only SSE in the Final Diagnosis category did not show up until 9 days later. Four alerts were considered "marginally stable" because they were consistent over the whole observation period.

Conclusion: In this preliminary study, 4 out of 8 (50%) of the SSEs were inconsistent with their initial values when observed on a later date. Though SSEs from CC/RA were deemed more timely than Final Diagnosis, they were also more unstable in the sense that 3/7 of them disappeared within a week of the index event. SSEs from Final Diagnosis tended to provide greater data stability and have a higher certainty (fewer false alarms), at the price of timeliness. To further explore these relationships and the infection control and public health significance we will expand our analysis to another institution. Biosurveillance and the meaning of signals should be investigated in the context of clinical situations to maximize their utility in studying important public health events.

References: 1. CDC. BioSense Real-Time Hospital Data User Guide, version 2.11 (November 2007).  
[http://www.cdc.gov/biosense/files/CDC\\_BioSense\\_BioSense\\_Hospital\\_Data\\_User\\_Guide\\_V2.11.doc](http://www.cdc.gov/biosense/files/CDC_BioSense_BioSense_Hospital_Data_User_Guide_V2.11.doc)

### **236. Notifiable Disease Reporting: Can an Electronic Biosurveillance System Help?**

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Background: Communicable diseases, especially without laboratory confirmation, are underreported. Our goals were to determine primary varicella (chickenpox) reporting rates, describe common clinical presentations, and assess case capture of an electronic biosurveillance system (BioSense).

Objective: To determine the accuracy of BioSense in identifying a proxy of a disease syndrome (varicella-variola) that could be associated with a public health event of importance and to determine whether these surveillance systems could be used to report diseases of public health interest.

Methods: Two healthcare systems located in Denver, CO and Baltimore, MD reviewed all outpatient varicella visits (ICD-9 code=052) between 1/1/06-8/31/07. Both sites evaluated probable or confirmed cases that met the Centers for Disease Control and Prevention (CDC) definition to determine whether they were captured by BioSense in its rash sub-syndrome as it was implemented (9/15/06- 8/31/07). Demographic, chief complaint, exam, lab, radiology, prescribing, and vaccination data were

recorded. In Colorado, cases of varicella are reportable and identified cases were compared to reports received by the Colorado Department of Public Health and Environment (CDPHE) during the same time period. Only varicella deaths are reportable in Maryland.

Results: 165 potential varicella cases were detected by ICD-9 codes and 45 were excluded after chart review. Among 120 varicella cases, 50% were male, average age = 11 years, of Caucasian (57%), African-American (30%), and Hispanic (11%) ethnicity. Most (88%) had no laboratory, radiology, and serology tests ordered. These studies were ordered in only 8%, 3%, and 5%, respectively. 13% had fever (>38°C) on intake. 38% reported or had documented prior varicella vaccine. Common chief complaints were rash (59%), "chickenpox" (23%), fever (8%), and itching (4%). 74% were prescribed medications, including antihistamines (36%), APAP or ibuprofen (23%), acyclovir (16%), oral antibiotics (13%), and anti-itch topicals (10%). During the BioSense implementation period (9/15/06- 8/31/07), only 11% of cases in Colorado were captured through physician reporting to CDPHE. No cases were reported in Maryland. Varicella comprised 0.7% of all visits classified as a rash sub-syndrome in BioSense with an attack rate of 1 per 2.9 x 10<sup>4</sup> patients. BioSense captured 49/67 of varicella cases (73%) during the evaluation period.

Conclusions: Biosense detected ¾ of varicella cases and more than were reported using current public reporting methods. Capturing clinical data using the electronic chief complaint combined with ICD-9 code is a relatively robust syndromic surveillance strategy and may be a vehicle to improve case reporting. Biosurveillance creates opportunities to monitor routine and unexpected disease when confirmatory laboratory test are unlikely to be obtained (e.g., smallpox).

### **237. Comparison of Traditional Infection Prevention and Control Data with Biosurveillance Using ILI and Respiratory Viruses as Proxies**

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Background: Traditionally, health care institutions rely on laboratory diagnostics to track infectious and communicable diseases. The utility of syndromic surveillance based on final diagnosis and chief complaint in health care settings has not been studied. BioSense (BioS) is a national biosurveillance system utilizing clinical information to identify and manage public health significant events.

Objective: To examine whether trends for (ILI) determined by BioS are similar to traditional lab-confirmed (LC) surveillance methods that identify influenza and RSV, and to evaluate whether BioS can detect ILI cases identified by LC surveillance methods.

Methods: One of BioS's sites, Johns Hopkins Hospital, has an active hospital epidemiology and infection control (HEIC) program which encourages nasopharyngeal aspirate testing for all patients with respiratory syndromes, and captures patients with ≥1 specimens positive for ILI to monitor seasonal trends. BioS

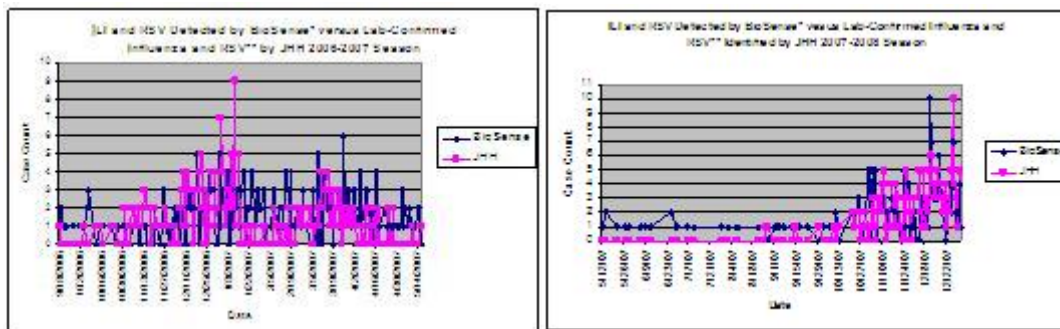
detects ILI cases based on a real-time message containing chief complaint(s) and discharge ICD-9 diagnoses. The '06-'07 and '07-'08 influenza seasons served as "gold-standard" and were compared to BioS trends prospectively. Because BioS allows hospitals to identify individual patients binned into ILI syndromes, these patients and those with LC influenza and RSV were compared to determine if BioS captured these cases. The ILI binned cases' chief complaint and final diagnosis were also reviewed for binning accuracy.

Results: The two surveillance systems identified similar trends for ILI (Figures 1 & 2). For the 2006-2007 season, 330 cases were detected by laboratory tests, BioS identified 328 (Figure 1). 139 (42%) cases were detected by both surveillance systems. Since the beginning of the 2007-2008 Flu Season, 177 LC ILI have been identified. BioS has reported 143 cases (Figure 2). Of the 177 LC ILI cases, BioS reported 98 (56%).

Conclusions: Traditional surveillance and BioS's syndromic surveillance system had a high correlation in both respiratory virus seasons. Importantly, after reviewing chief complaint and final diagnosis in the influenza like syndromes used by the BioS surveillance system, both syndromes identified true cases of respiratory viral disease. The results demonstrate that syndromic surveillance data may be a useful proxy when rapid testing is not available or used.

\* BioS defines cases based on chief complaint/reason for admit, and final diagnosis.

\*\* Surveillance for Influenza and RSV at JHH is lab based.



### 238. Hand Hygiene Compliance in 84 ICUs of 16 Countries. Findings of the International Nosocomial Infection Control Consortium (INICC)

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Objective: To evaluate the hand hygiene compliance (HHC) so as to find differences among stratum.

Methods: One health care worker per intensive care unit (ICU) observed the HHC of health care Workers (HCW) before patient contact at 84 ICUs of 57 hospitals in 16 countries (Argentina, Brazil, Colombia, Costa Rica, India, Kosovo, Lebanon, Macedonia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, El Salvador and Turkey), and filled the obtained information on a specially designed table. We analyzed the differences using Chi square test.

Results: From 08/98 to 11/07 (10 years) we observed 85,203 patient contacts. The overall HHC rate before patient contact was 55.0%.

	Variable	HH Compliance	Comparison	RR; 95% CI; P Value
Gender	Women (W)	57.4%	W vs M	RR, 1.17; CI 95%, 1.15 - 1.21; P value, 0.0001
	Men (M)	49.0%		
HCW	Nurses (NS)	58.3%	Ns vs Ph	RR, 1.11; CI 95%, 1.09-1.14; P value: 0.0001
	Physicians (PH)	52.3%	Ph vs AS	RR, 1.17; CI 95%, 1.13-1.21; P value: 0.0001.
	Ancillary Staff (AS)	44.8%	Ns vs AS	RR, 1.30; CI 95%, 1.27-1.34; P value: 0.0001
Procedure	Invasive (I)	58.2%	I vs NI	RR, 1.09; CI 95%, 1.06-1.11; P value, 0.0001
	Non-invasive (NI)	53.6%		
Unit	New born ICU (NB)	67.7%	Nb vs Ad	RR, 1.24. 95% CI 1.20 - 1.29, P value 0.0001
	Adult ICU (Ad)	54.4%	Ad vs Pe	RR, 1.02, 95% CI 0.96 - 1.10, P value 0.5000,
	Pediatric ICU (Pe)	55.7%	Nb vs Pe	RR, 1.22, 95% CI 1.12 - 1.31, P value 0.0001.
Work Shift	Morning (MWS)	55.2%	MWS vs AWS	RR, 1.03; CI 95%, 1.01-1.05; P value, 0.0119

	Afternoon (AWS)	53.7%	MWS vs NWS	RR, 1.03; CI 95%, 1.01-1.05; P value, 0.0169.
	Night (NWS)	56.8%	AWS vs NWS	RR, 1.06; CI 95%, 1.03-1.08; P value, 0.0001.

Conclusions: At the INICC hospitals members, we found a higher HHC rate in NS compared to PH, in NS compared to AS, in PH compared to AS, in women compared to men, in MWS compared AWS, in MWS compared to NWS, in AWS compared to NWS, in invasive contact compared to Non invasive contact, and in New Born ICUs compared to Adult and Pediatric ICUs.

### **239. Effect of 10 Years of Surveillance on the Incidence of Surgical Site Infections (SSI) in the Netherlands**

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Background: SSIs continue to present a major proportion of adverse events in surgical patients. Many countries have established national surveillance systems, which aim to reduce the patients' risk of infection.

Objectives: Evaluation of the time-trend in SSI rate for five frequently-performed surgical procedures in the Netherlands, between 1996 and 2006.

Methods: Hospitals that participated for at least three consecutive years in the Dutch PREZIES surveillance network were included, and CDC definitions for SSIs were used.

Hospitals receive a feedback report per surgical procedure, including crude and expected SSI rates, which are usually spread and discussed in the hospital with involved personnel. Per surgical procedure, the association between SSI rate and surveillance year was estimated by odds ratios, which were obtained by logistic regression and adjusted for confounders and method of postdischarge surveillance. Superficial and deep SSIs were analyzed together. A random coefficient model (multilevel logistic modelling) was used to adjust the risk estimates for random variation among hospitals.

Results: Among the five surgical procedures, the number of included surveillance years varied between 6 and 10 years, the number of hospitals between 19 and 34, the number of procedures between 3,031 and 31,407, the number of SSIs between 249 and 766, and the overall SSI rate between 1.6% and 12.2%. The results of the multilevel logistic modelling are presented in the Table. A non-significant increase in SSI rate was found for mastectomies. A significant decrease in SSI rate of 6% per surveillance year occurred for total hip prosthesis, indicating a 60% decrease after 10 years. And decreasing trends in SSI rate per 1-year increase in surveillance time appeared of 6% for replacement of the head of the femur, of 8% for colectomy, and of 3% for knee prosthesis, although statistically not significant.

Conclusions: For one of the five surgical procedures the decreasing trend in SSI rate was statistically significant and three procedures showed a non-significant decreasing trend, which are encouraging results. The decreasing trends are most likely a result of an improvement in the quality of care; probably caused by changes in infection control in the hospitals. This study showed that an active surveillance system might be an effective strategy to reduce the SSI incidence. Feedback of infection rates to hospital staff can make them more aware of infection risk and willing to work more-disciplined. Additional interventions might further decrease the SSI rate, and sustaining control efforts are necessary to maintain a low SSI level.

Table. Results of multilevel logistic regression analysis.  
Odds ratio (OR) with 95% confidence interval (95% CI) and p-value of change in SSI rate **per 1-year increase** in surveillance time to operation.

	<b>OR (95% CI)</b>	<i>P</i>
Mastectomy <sup>1</sup>	1.04 (0.96-1.08)	0.46
Colectomy <sup>2</sup>	0.92 (0.83-1.02)	0.10
Replacement of the head of the femur <sup>3</sup>	0.94 (0.88-1.00)	0.07
Total hip prosthesis <sup>4</sup>	0.94 (0.90-0.98)	0.01
Knee prosthesis <sup>5</sup>	0.97 (0.91-1.03)	0.32

<sup>1</sup> Adjusted for: postdischarge surveillance (PDS), age, duration of surgery, gender

<sup>2</sup> Adjusted for: PDS, ASA classification, wound contamination class, duration of surgery, duration of preoperative hospitalization, emergency procedure

<sup>3</sup> Adjusted for: PDS

<sup>4</sup> Adjusted for: PDS, age, ASA classification, duration of preoperative hospitalization, wound contamination class, duration of surgery

<sup>5</sup> Adjusted for: PDS, university-affiliated hospital, duration of surgery, gender, age

## 240. Predictors of Failure to Clear Multi-Drug Resistant Organisms

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Background: Infections caused by multi-drug resistant organisms (MDRO's) have become increasingly prevalent during the past several years. Placement of patients colonized or infected by these organisms in contact precautions has been an effective method to limit spread. Surveillance protocols to assess clearance have been proposed but untested in determining long term clearance of MDRO's. If culture negativity over time is demonstrated, many hospitals remove these patients from contact precautions to improve bed utilization and eliminate the need to "isolate" these patients.

Objective: To evaluate predictors of failure to eradicate MDRO's in patients who initially cleared but subsequently become re-infected with the same MDRO.

Methods: A retrospective matched 1:2 case-control study of patients in contact precautions for MDRO's with prior clearance of the organism by defined protocol but with subsequent re-infection or relapse, compared with patients in contact precautions for MDRO's with persistent culture negativity. Controls were matched by gender and age. Patients were removed from contact precautions if site of original infection/colonization became negative and surveillance cultures remained negative.

Results: A total of 300 patients were included in the study (100 cases, 200 controls). There were no significant differences in site of admission (home vs. nursing home), neurologic disease, chronic cardiopulmonary diseases, vascular disease or presence of controlled diabetes mellitus between cases and controls. The presence of a chronic wound [HR, 3.7(CI 1.4-9.4;p- 0.005), hyperglycemia [HR, 1.0 (CI 1.010-1.018;p- 0.0014)], indwelling devices [HR, 4.5 (CI 2.1-9.5; p<0.0001)], and chronic kidney disease [HR, 2.7 (CI 1.2-6.4;p-0.015)] were associated with failure to clear MDRO. Subsequent antibiotic exposure at clearance was strongly associated with culture negativity [HR, 0.1(CI 0.035-0.385; p-0.0004)].

Conclusions: A paucity of information exists on when to discontinue contact precautions for patients with MDRO's. Contact precautions add significantly to hospital costs, interfere with clinical care, and result in increased anxiety and depression scores in patients. Removal of patients from contact precautions as soon as microbiologic and clinical cure is achieved is ideal. Our study suggests that "relapsers" may not be infrequent and occur especially in patients that continue to require indwelling devices, have non-healing wounds, uncontrolled hyperglycemia, and chronic kidney disease. Surveillance cultures for clearance should not be obtained while patients are receiving antibiotics. These patients should best be cared for in contact precautions during their hospital stay and possible future admissions if the risk factors remain unchanged.

#### **241. Surveillance Practices for Central Line Associated-Bloodstream Infections (CLA-BSI) in Utah Prior to Mandatory Reporting**

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Background: Increasing numbers of states have mandated reporting of healthcare-associated infections (HAI). Inter-hospital comparisons are hindered by traditional surveillance using subjective CDC criteria. Standardized objective surveillance will change infection control professional (ICP) practice and ICP input should be sought in the development and implementation of these surveillance methods.

Objectives: To survey baseline surveillance practices and prevention measures for CLA-BSI across Utah prior to mandatory reporting.

Methods: A web-based on-line survey was designed by the Utah multidisciplinary advisory panel for HAI comprised of representatives from the Utah Department of Health (UDOH), Utah Hospital Association, and ICPs from all major Utah healthcare systems. Questions focused on surveillance practices for and prevention of healthcare associated CLA-BSI. A cover letter was sent to encourage infection control managers of all hospitals in Utah to complete the voluntary survey. The survey was distributed Feb 2006 and data compiled April 2006. An administrative rule for confidential reporting of ICU acquired CLA-BSI to the UDOH became effective Jan 2008.

Results: Infection control managers from 16/16 urban and 5/6 rural hospitals with at least 4 intensive care beds required to report ICU acquired CLA-BSI completed the survey for a response rate of 95%. Survey results summarized in the table below led ICPs on the advisory panel to develop and recommend an objective manual algorithm for state-wide CLA-BSI reporting.

Baseline survey results	Urban (n=16)	Rural (n=5)
Demographics		
Hospital beds, range (med)	80-520 (198)	39-86 (48)
ICU beds, range (med)	7-68 (17)	4-10 (6)
ICP resource utilization		
ICP FTE for HAI surveillance/100 beds, range (med)	0.1-0.4 (0.2)	0.4-1.5 (0.6)
Proportion surveillance for CLA-BSI, range (med)	2 - 33% (10%)	2 - 20% (8%)
ICP practices for CLA-BSI		
Access to electronic line list of patients, no. (%)	12 (75%)	3 (60%)
Manual review of paper chart, no. (%)	8 (50%)	3 (60%)
Use physician diagnosis, no. (%)	6 (38%)	3 (60%)
> 1 culture of skin commensals to call infection, no. (%)	11 (69%)	4 (80%)
Report CLA-BSI as rate, no. (%)	12 (75%)	1 (20%)
Facility Prevention measures		
Track insertion processes, no. (%)	9 (56%)	2 (40%)
Use standard form to track insertion, no. (%)	7 (44%)	2 (40%)

Conclusions: Variation in ICP practices and resources for CLA-BSI surveillance prior to initiation of mandatory reporting was identified between Utah hospitals. Awareness of this variation led to ICP acceptance of definitions using only objective criteria as well as intensive ICP involvement in the development and implementation of a standardized objective surveillance system. Evaluation will include tracking changes in ICP time dedicated to surveillance, assessing ICP acceptance, and looking at how ICP roles may change especially as related to quality improvement processes.

#### **242. Can Mortality Be Lowered by Switching from an Open to a Closed Infusion System?**

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Objective: Examine mortality rates using open (burette, glass, semi-rigid plastic) and closed (fully collapsible plastic) infusion systems.

Methods: Four prospective cohort, active healthcare-associated infection surveillance, sequential studies of 15 ICUs in Argentina, Brazil, Mexico, and Italy were analyzed. Studies used identical protocol and methodology. Mortality for open versus closed infusion systems varied by country. To provide a more robust sample size, country datasets were pooled to investigate these differences. Recursive partitioning was performed during the open infusion system phase identified subject characteristics affecting mortality. Ten strata were identified based on severity of illness, age, ICU stay and prior infection and country. Open versus closed infusion system phase data were analyzed for each strata using Chi-square test. Mortality was analyzed using Cochran-Mantel-Haenszel.

Results: From Aug 99-Feb 06, 4,373 adult-ICU patients with CVC  $\geq$ 24 hours were enrolled. Country-specific mortality for open and closed infusion system phases, respectively, were: Argentina 42% vs 37% (RR=0.89, 95%CI=0.76-1.04, P=0.15), Brazil 19% vs 16% (RR=0.85, 95%CI=0.66-1.10, P=0.22), Mexico 23% vs 16% (RR=0.69, 95%CI=0.54-0.88, P=0.002), and Italy 4% vs 5% (RR=1.29, 95%CI=0.77-2.17, P=0.33). Patient characteristics were similar across all studies. Five strata showed lower mortality for closed system; 3 strata comprising seriously ill patients showed significance (RR= 1.3-1.5) and 2 trending (RR=1.1-1.2). Three strata were comparable. One stratum (5% of data) showed lower mortality but not significance (RR=0.8) for open phase. One stratum had small sample size. Adjusting for strata, overall mortality was significantly lower in closed versus open infusion systems, 17%, 22%, respectively (P=0.003).

Conclusions: In this pooled analysis, despite differences among the 4 countries, closed infusion systems (fully collapsible plastic) had lower mortality than open infusion systems (burette, glass, semi-rigid plastic).

### **243. Early Lessons on a Targeted Whole Hospital Active Surveillance**

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Background: To our knowledge there have been no published studies that have assessed active surveillance programs outside ICU populations. Even with aggressive infection control interventions in ICU populations, lack of control programs in general medical and surgical wards likely contributes to the spread of MRSA in hospitals. The aim of this study was to assess a targeted active surveillance program in the non-ICU setting of a tertiary care hospital.

Methods: In February 2007, we began performing targeted active surveillance for MRSA among patients admitted to the University of Maryland Medical Center. Patients were asked two questions as part of a nursing intake triage admission form: 1) Have you been admitted to any healthcare facility in the last 12 months? and 2) Do you have a skin infection (i.g. boil, abscess, spider bite, cellulitis) at this time? Those who answered "yes" to either question were "targeted" as "high risk" and had

a surveillance nasal culture obtained for MRSA. A research nurse used a real-time informatics system to monitor each admission to assess whether the questions were asked and whether the swabs were being collected. Swabs were obtained by the floor nurses and processed by a PCR MRSA assay. Turn-around times were calculated from hospital admission to final result being completed. Patients identified as MRSA positive were placed on contact isolation precautions.

Results: From February 1, 2007 to November 30, 2007 (9 months) there were 4617 admissions of greater than a 6-hour length of stay. Of those admissions, 364 (8%) patients were already known MRSA positive so were not swabbed. 62% answered "yes" to either one or both of the intake questions, were not known to be MRSA positive, thus were classified as "high-risk" and targeted for MRSA surveillance swabs. 233 (10%) of 2258 obtained swabs were positive for MRSA. Of the group that answered "yes" to either question and were not already known to be MRSA positive, 45% of swabs were completed by 24 hours, 61% by 36 hours, 72% by 48 hours, 81% by 72 hours, and 87% by 120 hours.

Conclusions: We described the mechanics of implementing a targeted whole hospital MRSA active surveillance program. We also determined that the targeted program seems effective in terms of the high prevalence of "high risk" patients who are MRSA positive. Despite having a highly sophisticated method to monitor turn-around time of the microbiological analyses, the real life turn-around time is still longer than ideal. An in depth cost-effectiveness study still needs to be performed.

#### **244. Using Electronic Health Data as Predictors of Surgical site Infections**

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Background: Surveillance for healthcare-associated infections requires significant time and expenditure of resources by infection control practitioners (ICPs). Development of algorithms using electronic healthcare data for detection of infections has the potential to significantly improve efficiency and accuracy of infection control surveillance.

Objective: Determine which retrospectively collected electronic data may have potential to predict the presence of SSIs without requiring additional ICP time and resources.

Methods: Patients (>18 years, prisoners excluded) undergoing colon, hysterectomy, and knee replacement surgeries from July 1, 2003 to June 30, 2005 at OSU Medical Center (OSUMC) were identified from specific surgical procedure codes. Patients within this group having SSIs, based on CDC/NNIS criteria, were previously identified as part of routine IC surveillance. Electronic health data on each patient (presence of any one of 4 secondary ICD-9-CM infection codes [998.5, 998.51, 998.59, 996.66], presence of an antibiotic order >48 hours after procedure, culture ordered after procedure, and presence of positive culture after procedure) were obtained from querying the OSUMC Information Warehouse. No additional ICP time or resources were required to obtain these data.

Results: There were 1134 surgical patients identified with 44 SSIs previously reported. Preliminary analysis demonstrated that among patients with SSIs, 36/44 had infection codes, 23/44 had an antibiotic order, 32/44 had cultures obtained, and 31/44 had positive cultures. Among patients without infections, 120/1090 had infection codes, 812/1090 had an antibiotic order, 49/1090 had cultures obtained, and 19/1090 had positive culture. Upon multivariate logistic regression, presence of a positive culture and infection code and were the best predictors of SSI (OR 35.19,  $p < 0.0001$ ; OR 5.89,  $p < 0.0001$ ; respectively). Presence of a culture order was also a predictor in a separate model (OR 11.80,  $p < 0.0001$ ). The positive and negative predictive values of the first model were 0.53 and 0.98, respectively. The positive and negative predictive values of the second model were 0.53 and 0.97, respectively. Presence of an antibiotic order did not discriminate SSIs in this data set.

Conclusions: The presence of a positive culture or culture order and secondary infection code was most often associated with an SSI previously identified using CDC/NNIS criteria. Quantitative antibiotic exposure, rather than the mere presence of an order, may be more discriminatory for the presence of an SSI. Electronic data elements examined in this study can be prospectively validated in algorithm form to determine how well they identify true SSIs. Negative predictive values from the two models are high enough to suggest adequate discrimination for screening. Thus, algorithms with electronic health data collected independent of ICPs may be useful to detect SSIs.

#### **245. Successful Implementation of a National Surveillance System for Surgical Site Infections in Norway**

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Background: Nosocomial infections (NI), including surgical site infections (SSI), lead to increased morbidity and mortality. Calculating costs and burden of NI is difficult because of lack of good surveillance data. In 2005, after extensive pilot testing, a new mandatory national surveillance system, NOIS, was introduced by regulation in Norway.

Objective: Norwegian hospitals have prioritized implementing computer-based systems for data extraction from electronic patient journals. This is a description of the new system and the first findings.

Methods: Standard methods and definitions (CDC/HELICS) were used. Surveillance data was collected on all patients who underwent one of five surgical procedures during a 3-month period in 2005 and in 2006. Patients were followed for 30 days after surgery, including post-discharge. Hospitals collected data locally and transferred anonymized datasets to the national database. We calculated incidence proportions of infections in total and in subgroups and analyzed data in order to identify factors that are associated with infection.

Results: Among 6132 patients from 38 (30 in 2005) hospitals, 92% were followed for 30 days after surgery. 81% of the infections were discovered post-discharge. In 2006, the incidence proportion was 6.5% (95% CI 5.7%-7.3%) in total (9.1% for Caesarean section, 4.4% for hip replacement, 4.4%, for coronary artery bypass

graft, 6.1% for appendectomy and 8.7% for cholecystectomy). Higher scores on the US NNIS risk index appear to increase the risk of infection following all five procedures. The use of antibiotic prophylaxis and whether the surgery was elective or acute also influences the risk of infection.

Conclusions: It is possible to introduce mandatory, nationwide surveillance of SSI in hospitals and to gather quality national data with post discharge surveillance. To correctly measure the burden of disease, good post-discharge surveillance is vital.

#### **246. Validating and Evaluating the Accuracy of Syndromic Binning in a Biosurveillance System, BioSense**

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Background: BioSense is a syndromic surveillance system that captures data components from electronic patient records (EPR) and ICD9 diagnostic codes to generate real-time data on epidemiologically significant events. Its method is similar to RODS' classifier CoCo which uses chief complaint. BioSense uses chief complaint and final diagnosis to bin into 11 syndromes with sub-syndromes and statistically determine if a particular syndrome/sub-syndrome has increased over baseline.

Objective: To evaluate the validity and accuracy of the "syndromic binning" and to measure the number of days between BioSense's reporting of a statistical anomaly (SA) to chart availability, allowing validation of the signal generated by BioSense.

Methods: During October 2007, the BioSense application (BSA) at Johns Hopkins Hospital (JHH) was examined daily for the presence of SAs. The BSA was set at W2 100 day recurrence interval. SAs reporting a high count and increased rate per 1000 patient visit were recorded. Individual patient and visit identification number correlating with each SA were identified. Charts were reviewed from JHH's EPR to determine whether the patient was binned into an appropriate syndrome using the patient's signs, symptoms, and final diagnosis. The percentage binned correctly was calculated using the number of charts reviewed for each SA. The date the SA was reported in BioSense and date of chart review were also recorded. The number of days between the report of the SA and case validation was determined by the day the SA was reported in BioSense to the day the case was reviewed.

Results: 101 cases were classified into BioSense syndromes resulting in 9 SAs. 2 anomalies were botulism-like (12%); 3 fever (32%); 1 hemorrhagic (7%); 1 Neurological (21%); 1 Rash (7%) and 1 Respiratory (21%). Of the 9 SAs reported only 4 (44%) remained in the system on November 1, 2007. Of the 9 SAs, the correct case binning percentages per SA were as follows; Botulism-like (2) 25% and 0%, Fever (3) 90%, 77% and 71%, Hemorrhagic (1) 86%, Neurological (1) 72%, Rash (1) 100%, and Respiratory (1) 83%. For case validity, 29 of the 101 (29%)

charts were available for review 11-17 days after the SA was reported. (Figure1). At this time data are not available for 10 patients.

Conclusions: Preliminary analysis shows anomalies at a hospital level can be unstable. However, BioSense binning was appropriate for most syndromes. While this study is a pilot project and limited in size, the quality of data may be a function of the penetration of the electronic medical record into an institution and how the record is integrated into medical care. Validation and additional study are needed to understand how syndromic surveillance can be used in healthcare settings. #

