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Tuberculosis (TB) Exposure of Patients and Healthcare Workers (HCW) by an Infected Healthcare Worker. *J.A. SELLICK, M.A.HARING, D. STUBEUSZ, D. GRIFFEN, A. SULLIVAN–FROHM, R. STRICOF. Buffalo General Health System, Buffalo, NY and New York State Department of Health (NYSDOH), Albany and Buffalo, NY.

Four nursing employees from a short stay surgical/procedure unit were found to be tuberculin skin test (TST) converters (purified protein derivitive, Tubersol®, Connaught) on routine screening in 8/97. Reviow of unit logs and lab records for the prior several months revealed no apparent source of infection. Interviews with staff members revealed that a nurse's aide, previously known to be PPD positive, had been ill with cough for weeks. She was diagnosed with active, cavitary TB on 8/29/97. One additional HCW from the unit converted on repeat testing in 11/97. 15 other HCWs from the unit had negative TSTs as did 56 other HCWs who intermittently visited the unit. All HCWs who converted had closc contact with the index case. With assistance from NYSDOH, pts who may have been exposed to the source in Jun–Aug/97 were notified. Letters (with educational materials) were sent to pts and their physicians advising TSTs (Mantoux, PPD) with results to be sent to NYSDOH. A telephone hotline also was made available; 144 calls were received. 873 pts were notified and 369 (42.3%) had TST results sent to NYSDOH. 15 pts (4.1%) had positive TSTs. None had clinical or Xray evidence of active TB, and many had other possible TB exposures in the past. Pts exposed June/mid–July had similar positive TST rates to those exposed mid–July/August (4.8 *vs* 2.5%, χ^2= 0.569, p=0.45.) Assuming that the index case HCW was likely to be more infectious over time, higher infection rates would be expected for individuals exposed later. This was not the case: TST positivity rates were higher, though not statistically significant, early in the exposure period. Evaluation/follow–up of this outbreak was time and cost intensive, but it appears that only HCWs with close contact to the source converted TSTs.

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RISK OF TUBERCULIN SKIN TEST (TST) CONVERSION AMONG MEDICAL STUDENTS (MS) TRAINING AT AN INNER-CITY HOSPITAL IN A HIGH INCIDENCE AREA. HM Blumberg*, MA Welsh, MJ Sotir, J Wyndham, JA Shulman. Emory Univ. School of Medicine & Grady Memorial Hospital (GMH), Atlanta, GA.

The resurgence of TB in the U.S. has highlighted the risk of occupational exposure. The risk for MS has been incompletely defined, especially in the non-outbreak setting. We assessed rates of and risk factors for TST conversion among Emory MS as well as the prevalence of a positive TST at baseline testing following implementation of expanded infection control measures at GMH. MS spend ~70% of their clinical rotations at this public inner-city hospital which cares for ~200 TB patients per year. TST was required every 6 months beginning in 9/92 for MS on clinical rotations (i.e. 3rd and 4th years). Additional testing was implemented at the time of med school entry beginning with the Class of 1997 (9/93) and at the start of the 2nd year beginning with the Class of 1998 (9/95). All TSTs were placed by the Emory student health clinic and read at 48-72 hrs there or by an attending physician. A positive TST was induration ≥ 10mm. A TST conversion was defined as a positive test following a documented negative test. The prevalence of a positive TST at baseline was 10.5% (84 of 800 MS in the classes of 1994-2000 had a positive baseline test). Risk factors for a baseline positive test included non-white race [37 (17.8%) of 208 vs. 44 (7.9%) of 563; P<.001], birth outside of the US [40 (33.1%) of 122 vs. 42 (6.5%) of 651; P<.001) but not gender or age. Multivariate analysis revealed foreign birth was associated with having a baseline positive TST (OR=6.24 [95% CI, 3.56-10.94] P<0.001). Over the 1847.4 person-years worked, 14 (2.0%) of 716 susceptible MS converted their TST, yielding a conversion rate of 0.76 per 100 person-years. Foreign born MS had a significantly higher conversion rate than U.S. born MS, 2.93 vs. 0.50 per 100 person-years (RR=5.91 [95% CI, 2.05-17.02], P<0.001). Multivariate analysis of risk factors for conversion indicated foreign birth (RR=6.34 [95% CI 1.99-20.26], P=0.002) and age (P=0.02) were associated with conversion but race was not. The conversion rate for 3rd and 4th year MS was 1.34 per 100 person-years worked; foreign born MS had a higher rate then U.S. born MS (4.96 vs. 0.94 TST conversions per 100 person-years; RR=5.26 [95% CI, 1.26-22.01], P<0.01). In summary, U.S. born MS had a relatively low rate of TST conversion during medical school despite working in a high incidence area.

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Risk Factors for Nosocomial Multi-Drug Resistant Tuberculosis (MDRTB) Due to *M. bovis*. *ANGEL ASENSIO, JAVIER COBO, JOSE CAÑON, JESUS OLIVA and ANTONIO GUERRERO, Hosp. Ramón y Cajal and Univ. de Alcalá. Madrid, Spain.

We have reported and outbreak of MDRTB-*M. bovis* in our hospital during 1994. In a previous case-control study we demonstrated nosocomial transmission since the exposition to a MDRTB case in the same ward of the hospital was an independent factor for development of MDRTB. Nevertheless, in our experience only a minority of the patients exposed to MDRTB in a ward became ill. To detect risk factors for development of MDRTB after nosocomial exposition in HIV infected patients we performed a case control study. Case patients were 19 HIV infected patients with MDRTB acquired after exposition (at least one day in the same ward) to a MDRTB patient. Control patients were 31 randomly selected HIV infected patients with nosocomial exposition to MDRTB cases that did not become ill during the follow-up (48 months). We did not detect differences between both groups respect to age, sex, risk factor for HIV, sputum induction, aerosolized pentamidine treatment, clinical stage of disease, isolation of the source patient, length of exposition and number of source cases to whom the patient had been exposed. We found differences between both groups for the following variables : ward in which occurred the exposition, exposition to index case, exposition being in individual room and CD4 cell count. After control of confounding by multiple logistic regression three variables remained associated to develop MDRTB : exposition to index case (OR 9.5 , CI 2.0-44.3; p=.004), exposition being in individual room (OR 0.1, CI 0.01-1.03; p =.052), and less than 50 CD4 cells/mm^3(OR 5.1, CI 1.1-24.7; p=.042). The risk of development of MDRTB after exposition depends on the grade of immunosupresion expresesed by a low CD4 cell count. The index case seems to have been more contagious. Hospitalization in ún individual room would.had protector effect for acquisition of MDRTB.

4

The sensitivity of a third AFB smear after two previously negative smears in detecting patients with active pulmonary tuberculosis. MARY-CLAIRE ROGHMANN, ANWAR SIDDIQUI, MARTHA CONLON AND TRISH PERL. VA Maryland Health Care System (VA), University of Maryland Medical System (UMMS) and the Johns Hopkins Hospital (JHH), Baltimore, MD

Three negative acid-fast bacilli (AFB) smears on expectorated sputum (ES) are needed to discontinue isolation for a patient for whom tuberculosis (TB) is being excluded at the VA and UMMS while only two induced sputa (IS) are required at JHH. Operationally the third ES is the most difficult to acquire since cough is usually diminished after three days of hospitalization. We performed this study to determine the sensitivity of a third AFB smear after two previously negative smears. All patients (n=118) with active pulmonary TB diagnosed at three urban medical centers (VA,UMMS,JHH) from 1990 to the present were included in the study. Microbiology and infection control records were reviewed to determine the date of the first positive culture for *M. tuberculosis*. AFB smears on all respiratory specimens: ES, IS, and bronchoalveolar lavage (BAL) subsequent to the day that culture was taken, but prior to therapy, were reviewed. AFB smears were screened by fluorescent microscopy using a fluorochrome stain.

Source	Number Positive	Number evaluable patients	Sensitivity	95% Confidence Interval
First ES	47	86	55%	44-65%
Second ES in which first ES negative	1	18	5%	0-27%
Third ES in which first two ES negative	0	7	0%	0-40%
One BAL	3	21	14%	3-36%
One IS	4	11	36%	11-69%

Our results, though limited by sample size, suggest that the second and third AFB smear in a patient with one or two prior negative smears adds little to detecting patients with active TB. The sensitivity of BAL and IS cannot be compared to that of ES because IS and BAL were performed on patients who could not produce ES. Given the low prevalence of active tuberculosis is our patient population (e.g. 6 TB patients per year for a 200-bed acute care hospital), isolating patients until a third smear is obtained is unlikely to be cost-effective.

5

Pseudo-Outbreak of *Mycobacterium tuberculosis* Associated With Laboratory Processing Contamination. *CINDY M. GROSS, CAROL A. STAMILIO, ROBERT L. SAUTTER, ROBERT J. KANTOR AND LISA S. TKATCH, PinnacleHealth System, Harrisburg, PA.

Between March 15, 1997 and May 17, 1997 the PinnacleHealth System (PHS) microbiology department notified the infection control department of five patients whose acid fast bacilli respiratory cultures had grown *Mycobacterium tuberculosis (Mtb)*. One specimen was smear positive and this patient had a typical presentation of pulmonary tuberculosis (Ptb). The identification of *Mtb* in five different patients in a short time span was unusual. Case review did not suggest a common source exposure. Three of the five patients were referred to the Pennsylvania Department of Health (PaDOH) for continuum of care. Consultation with the PaDOH infectious disease physician revealed that two of these patients had clinical presentations that were not consistent with Ptb (negative PPD, negative chest radiograph). Contact investigation resulted in no PPD converters among their family or close contacts. Further investigation disclosed that the actual laboratory processing of the five specimens took place within a five day period. The smear positive specimen was the first processed. Infection control consulted with the PHS microbiologist to determine if the specimen processing procedure could have led to cross contamination. The microbiologist determined that bottles of phosphate buffer utilized in processing could last for several days until depleted. It was possible that the buffer had become contaminated during the processing of the smear positive specimen. In support of this hypothesis, all isolates possessed a common antibiogram (resistance to streptomycin only). DNA analysis confirmed matching fingerprints. Attending physicians were notified that cross contamination may have occurred and the microbiology department began to aliquot the buffer and discard all unused reagents daily. Although it is possible that all five patients were infected with *Mtb*, there is strong support for the hypothesis that cross contamination occurred during processing. A vigilant tuberculosis program and effective interdisciplinary communication will facilitate timely discovery of similar situations. The importance of correlating laboratory test results with clinical presentation should not be underestimated.

6

Drug Resistant Tuberculosis (DRTB) at a NYC Hospital Center - Emergence of MDRTB in Patients Without Typical Risk Factors? *BARBARA SMITH, ELOISA SANTOS, MARY ELLEN GILLIGAN, GEORGE MCKINLEY, MICHAEL LANGE and EMILIA MIA SORDILLO. St. Luke's-Roosevelt Hospital Center and Columbia University College of Physicians and Surgeons, New York, NY.

In the early 1990s, major risk factors for DRTB at our Hospital Center were HIV infection, prior hospitalization, homelessness, or prior TB. To identify whether these characteristics remain the dominant risk factors, we reviewed all DRTB cases from January 1996 through October 1997.

24 Patients (age, 8-87 years; M:F = 19:5) had DRTB; 10 isolates were resistant to streptomycin (S) only, 3 to isoniazid (I) only, 3 to rifampin (R) only, 2 to both I /R, one to both I/S, and 5 (20%) to both I/R and at least 1 other drug (MDRTB). Overall, 10 DRTB cases (42%) were HIV seropositive (HIV+), 5 were HIV seronegative (HIV-), and 9 refused testing. Of the non-HIV+ cases, 4* were foreign born, 2* were physicians (*one foreign born), and one had repeated hospitalizations for sickle cell disease. None were homeless. Of the 5 cases with MDRTB, only 1 was HIV+; 3 were HIV-, and 1 (not tested) was elderly and without known HIV risk factors. No MDRTB patients were foreign born, had prior TB or prior hospitalizations, or were homeless, although 2 patients had lived in congregate settings. Thus, in contrast to most cases of DRTB, the majority of current MDRTB cases did not have "typical" risk factors. We emphasize that MDRTB must be considered for all patients until susceptibility tests are available.

7

Central Venous Catheter (CVC) - Associated Blood Stream Infection (BSI) in Canadian Intensive Care Units (ICUs) D.L. HOLTON [1], J. CONLY [2*], S. PATON [3], J. EMBREE [4], G. TAYLOR [5], W. THOMPSON [6], CANADIAN HOSPITAL EPIDEMIOLOGY COMMITTEE (CHEC), CANADIAN NOSOCOMIAL INFECTION SURVEILLANCE PROGRAM.
[1]Medical Epidemiologist, [2]Toronto Hospital, [3]Toronto, Health Canada, [4]Health Sciences Centre, Winnipeg, [5]Capital Health Authority, Edmonton, [6]Moncton Hospital, Moncton.

The rate of CVC-associated BSIs occurring in Canadian ICUs and risk factors associated with BSIs were studied in a 6 month active prospective surveillance and case-control study that occurred in CHEC facilities. 3,696 CVCs (2,531 patients) were enrolled. 182 BSIs were reported; 73.2% caused by coagulase negative Staphylococcus. Pooled mean rates of CVC-associated BSIs per 1,000 CVC days were 6.9 in adult, 6.8 in pediatric, 5.0 in neonatal ICUs and 16.1 for burn patients. 15.3% of enrolled patients died. BSI or not removing an infected CVC were associated with death. The type of organism causing the BSI did not affect outcome (i.e., death) or response to BSI (therapy). Risk factors associated with BSIs included-Surveillance study: CVCs impregnated with antimicrobial substances or using needles to enter the tubing; in both the surveillance and case control studies: Duration of CVC insertion or using the CVC to administer antimicrobial therapy or TPN; case-control study: > 2lumens, receiving chemotherapy or high dose steroids, a tracheotomy or a wound other than a clean wound. Impregnated CVCs or use of needles to enter the tubing system were not factors. Factors not associated with BSIs included anatomical site of CVC insertion (when umbilical CVCs excluded), complications during CVC insertion, using the CVC for hemo-dialysis, WBC count, serum albumin, age or intubation.

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Antiinfective Efficacy of Central Venous Catheters Impregnated with Minocycline and Rifampin VS Chlorhexidine Gluconate and Silver Sulfadiazine: A Prospective, Randomized, Multicenter Clinical Trial
R DAROUICHE,* I RAAD, S HEARD, K RAND, N KHARDORI, R HARRIS, S BJORNSON, G MAYHALL, Baylor College of Medicine, Houston, TX, Univ of Texas MD Anderson Cancer Center, Univ of Massachusetts, Univ of Florida, Southern Illinois Univ, Univ of Cincinnati, and Univ of Texas Medical Branch.
Central venous catheters (CVC) coated either with minocycline and rifampin (M/R) or with chlorhexidine gluconate and silver sulfadiazine (CG/SS) were recently reported to reduce the rates of both catheter colonization (CC) and catheter-related bloodstream infection (CRBSI) and to allow cost savings (*Ann Intern Med, 1997;127:257-274*). We undertook this large, prospective, randomized, multicenter clinical trial to compare the rates of CC and CRBSI between CVC impregnated with M/R vs CG/SS. Adult patients requiring triple lumen polyurethane CVC were randomized to receive CVC impregnated with either M/R or CG/SS. The subcutaneous and tip segments of removed catheters were cultured using both roll-plate and sonication techniques. Of a total of 865 inserted CVC, 738 (85.3%) were cultured and considered evaluable (356 CVC impregnated with M/R vs 382 CVC impregnated with CG/SS). Patients and CVC in the two groups were comparable for clinical characteristics and risk factors predisposing to infection. CVC impregnated with M/R were three-fold less likely to be colonized ($\geq$ 15 cfu by roll plate and/or $\geq$ 1,000 cfu by sonication) than CVC impregnated with CG/SS (28/356 = 7.9% vs 87/382 = 22.8%; $p < 0.0001$) and were twelve-fold less likely to produce CRBSI (1/356 = 0.3% vs 13/382 = 3.4%; $p < 0.002$). No adverse effects were observed from either CVC. We conclude that the antiinfective efficacy of CVC impregnated with M/R is significantly superior to that of CVC impregnated with CG/SS.

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Optimal Frequency of Changing Intravenous Administration Sets (IVAS): Is it Safe to Prolong Duration of Use Beyond 3 Days (3D)?
ISSAM RAAD,* HEND HANNA, DEBORAH RICHARDSON, DIMA ABI-SAID, ABEER AWAD, AMIN ALRAHWAN, CAROL BIVINS, ASMA KHAN, GEORGEANNE MANSOUR and RAY HACHEM,. The University of Texas M. D. Anderson Cancer Center, Houston, TX.

Several studies have demonstrated that the replacement of IVAS every 72 hours is safe and cost-beneficial. However, the safety of a longer duration of use of IVAS for 4-7 days (4-7D) has not been evaluated. In a prospective, randomized study, 511 patients were randomized to have their IVAS replaced within 3D or 4-7D. At the time of IVAS removal, 5-10 ml of infusate were collected through the tubing, vortexed for 30 seconds and cultured quantitatively. Colonization was defined as $\geq$100 CFU/ml of infusate and infusion-related bloodstream infection (IRBSI) was defined as isolation of the same organism from a contaminated or colonized IVAS and peripheral blood culture with no other apparent non infusion-related source for the bloodstream infection. The two groups were comparable in terms of agents given through IVAS and patient and catheter characteristics. Intent to treat analysis demonstrated a trend towards a higher colonization frequency in the 4-7D group of 5/232 (2.1%) vs. 1/280 (0.4%) in the 3D group (P=0.1). In addition, there were three episodes of IRBSI, all of which occurred in the 4-7D group (P=0.09). However, when the 84 patients who received total parenteral nutrition (TPN), blood transfusions (BT), or interleukin-2 (IL2) through the IVAS were excluded, the two groups had a comparable rate of colonization [1/240 (0.4%)for 3D vs. 1/188 (0.5%) for 4-7D] and no IRBSI were observed in either group. In conclusion, our data suggest that prolonging the duration of placement of IVAS beyond 72 hours may be safe and cost beneficial for patients who are not receiving TPN, BT or IL2.

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A Novel Silver-Hydrogel-Impregnated Indwelling Urinary Catheter Reduces CAUTIs: A Prospective Double-blind Trial.
*D.G. MAKI, V. KNASINSKI, K. HALVORSON, P.A. TAMBYAH, University of Wisconsin, Madison, WI.

Catheter-associated urinary tract infections (CAUTIs) are extremely common, accounting for 40% of all nosocomial infections and comprising perhaps the most important reservoir of antibiotic-resistant nosocomial organisms in hospitals and nursing homes. Little progress has been made in controlling these infections over the last 35 years. Studies of silver-oxide catheters were very disappointing. We have studied in a large prospective, double-blind randomized trial a novel catheter with a hydrophilic silver-hydrogel coating (C.R. Bard, Inc.) which inhibits microbial adherence to the catheter surface; the nonmedicated control silicone catheter was indiscernible from the study catheter. Overall, 852 newly-catheterized patients were prospectively studied; quantitative cultures were obtained at insertion and daily thereafter from the sampling port and collection bag. Patients in the two groups were very similar demographically, in mean APACHE II scores and other risk factors for CAUTI. The overall incidence of CAUTI was 21.2% in the control group and 15.4% in patients with a silver-hydrogel catheter (RR 0.72, 95% CI 0.68-0.84, P=0.03). The antiseptic catheter was most effective in preventing CAUTI caused by enterococci, CNS and Candida (P<0.01), but had little effect on CAUTIs caused by gram-negative bacilli. The silver-hydrogel catheter was well tolerated, and there were no differences in quantitative urine leukocyte counts in noninfected patients in the two groups. We conclude that the novel silver-hydrogel catheter studied provides substantial protection against CAUTI caused by skin organisms that most frequently gain access extraluminally -- gram-positive cocci and yeasts -- but is marginally effective against GNRs that more frequently gain access intraluminally, and is a major advance for prevention of CAUTI *without* selecting for resistant organisms.

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Randomized Cross-over Study of Silver-coated Urinary Catheters in Hospitalized Patients. *TB KARCHMER, CA MUTO, EG CAGE, BA STRAIN, and BM FARR University of Virginia Health Sciences Center, Charlottesville, VA.

Background: Catheter-associated urinary tract infections (UTI_c) account for 40% of nosocomial infections. Nosocomial UTI cause bacteremia in 2% - 4% of patients with a case fatality rate between 13% and 30%. The overall mortality of patients with UTI_c is nearly three times higher than for nonbacteriuric patients. Nosocomial UTI_c can result in morbidity and mortality as well as increased length of hospital stay. Silver has bactericidal qualities, is non-toxic and is effective in other settings, such as controlling burn wound infections. Two randomized studies involving mostly male post-surgical patients not receiving antibiotics found decreased rates of bacteriuria in patients with silver-coated (SC) latex foley catheters. Three other studies showed conflicting results with a different SC catheter. Methods: We conducted a 12 month cross-over study comparing rates of UTI_c in patients with SC latex foleys (Bard, Covington, GA) and those having uncoated latex catheters. Hospital wards were randomly divided into two groups. Group I was stocked with the SC foley while group II used uncoated catheters. After six months, group I switched to uncoated catheters and group II to SC catheters. A cost-benefit anlaysis was conducted using estimates of the excess cost per UTI from the CDC of $680 (MMWR, 1992, 41:783) and from a U.of Utah study of $3,803 (both in 1992 dollars). The price of all urinary catheters and components was obtained from the manufacturer. The number of foley-related products was enumerated from a hospital computer database. Results: Total rates of UTI_c for the year prior to the study were 0.93 infections per 100 patients and 2.20 infections per 1000 patient-days. 338 UTI_c occurred among 27,878 patients using 13,902 foleys during the study period. Thirteen UTI_c (3.8%) were complicated by secondary bacteremia. The relative risk of UTI_c per 1000 pt-days was 0.81 (95% CI, 0.65 to 0.99, p = 0.054) based on randomization to SC catheters compared to uncoated catheters and 0.52 (95% CI, 0.41 to 0.65, $p < 10^{-7}$) based upon actual catheter usage. The relative risk for UTI_c per 1000 catheter-days in ICU patients using SC foleys was 0.53 (95% CI, 0.35 to 0. 78, p = 0.0011). Annual savings to the hospital from using SC foleys ranged from $8,400 to $671,000 in cost-benefit analysis. Conclusion: The risk of UTI_c declined by 19% on wards randomized to SC foleys and by 48% when the SC catheter was actually used, which appeared to offer significant cost benefit.

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Description of an Infection Control Course for House Officers (HO) and Medical Students (MS). RJ SHERERTZ, DM WESTBROOK, KS GLEDHILL, SA STREED. Wake Forest University/Baptist Medical Center, Winston-Salem, NC

In June 1996, all new HO (124) and rising third year MS (102) participated in a one day course aimed at achieving better standardization of existing infection control practices. HO and MS were instructed in isolation and handwashing, arterial puncture, insertion of peripheral venous catheters and urinary catheters, phlebotomy, blood draws through lines, and lumbar puncture; only HO were instructed in insertion of arterial lines and central lines. All instruction, except the isolation and handwashing required hands-on participation by the HO and MS. Each HO was required to estimate the number of procedures they had done prior to the course. Notably 10 – 15% of HO had never previously performed a lumbar puncture, inserted a central line or inserted a peripheral line. As a measure of the effectiveness of the course the frequency of using full size sterile drapes for central line insertion was monitored and surveillance of central line related and associated infection was performed.The baseline frequency of full sterile drape use in the year prior to the course was about 30%; it increased to >90% in four subsequent surveys during a 6 month period following the course. The prospectively determined ICU central line infection rate for the year preceding the course was 4.55/1000 patient days versus 3.35/1000 patient days for the year after the course (P<.03). The apparent 26% reduction in our central line infection rate suggests that standardization of our infection control practices through a course, may be a cost-effective way to decrease infection control-related adverse outcomes.

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Vancomycin-resistant enterococci (VRE) in ICU: transmission dynamics, persistence and the impact of infection control programs.

M. BONTEN*, D. AUSTIN, S. SLAUGHTER, R.M. ANDERSON, R.A. WEINSTEIN, Univ Hosp Maastricht, The Netherlands; Wellcome Trust Centre for the Epidemiol of Infect Dis, Oxford, UK; Cook County Hosp and Rush Medical School, Chicago, IL.

Colonization with VRE is endemic in many U.S. hospitals, especially in ICUs. Endemicity persists because of the continuous admittance of colonized patients and cross-acquisition of VRE on the ward, as a result of lapses in compliance with infection control measures. In addition, antibiotic use may stimulate acquisition of VRE colonization. Based on epidemiological data from studies performed in Cook County Hospital (Ann Intern Med 96;125:448 and Lancet 96;348:1615), we created a mathematical framework, based on vector-borne diseases (Ross-MacDonald equations). The actual endemic prevalence of VRE was 36% ± 17, admission prevalence 15%, compliance with handwashing 50% ± 10 and the proportion of patient-days with 3rd generation cephalosporins and/or vancomycin use was 55%. Using these data, the model facilitates quantitative definition of the relative impacts of different infection control processes (handwashing, cohorting of staff-patient contacts and control of antibiotics) and generates criteria for control or eradication of VRE. Multiple computer simulations showed excellent agreement between model predictions and the observed pattern. Our model shows that the endemic prevalence of VRE will increase with an increase in the admission prevalence, that VRE prevalence decreases linearly in response to improved handwashing compliance, that the response to staff-patient cohorting is quadratic, and that the benefit of reduced antibiotic use is optimal when the endemic prevalence still is low.

This is the first theoretical framework of transmission dynamics of an ICU-pathogen which is based on epidemiological data. Once VRE endemicity has been established, cohorting of staff-patient contacts is likely to be the most effective control measure. The level of compliance with infection control measures needed for effective control depends on the endemic prevalence, but is likely to exceed generally published compliance rates.

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Independent Risks for Vancomycin-Resistant *Enterococcus faecium* in Hemodialysis Patients.

T GARRISON*, P TRAYNOR, D WINDUS, S LU, C BULLINER, L MUNDY, Barnes-Jewish Hosp. & Wash U. Sch of Med, St. Louis, MO.

Focused surveillance for enteric vancomycin-resistant *Enterococcus faecium* (VREF) began on 4/28/97 due to rising rates of VREF on our Acute Dialysis (AD) unit. Enteric VREF screening occurred on admission and weekly. Contact isolation for VREF was required. The AD unit was cleaned nightly with quaternary ammonium salt disinfectant using a 5 minute dwell time. The objective of this study is to determine independent risks for enteric VREF. Drug exposure was categorized by spectrum of activity on intestinal flora: If a pt received 1 or multiple drugs in an antimicrobial class, it was counted as a positive exposure. Results: Over 30 weeks, VREF was detected in 44/264 (16%) pts, of whom 25 (57%) were Caucasian, 23 (52%) were women and the mean age was 58 (range 19-93). Demographics were not different for the 220 non-VREF pts. The mean length of accumulative hospital exposure (LOE) prior to VREF acquisition was 26.9 days (median 20). The total number of antimicrobial drug exposures per VREF pt was 3.7 and 2.8 for non-VREF pts. Exposure to anaerobic agents (OR 3.89; CI 1.96 - 7.12; p< 0.0001) and exposure to antifungals (OR 3.48; CI 1.69 -7.17; p< 0.001) was significantly more common in VREF pts, while exposures to gram positive antimicrobials (OR 2.16; CI 0.63 - 7.41 p=0.22), gram negative agents (OR 2.85; CI 0.08 - 9.69; p=0.09) and cephalosporins (OR 2.29; CI 0.85 - 6.13; p=0.09) were not. Exposure to medications suppressing gastric acid secretion occurred in 40/44 (91%) VREF pts (OR 3.02; CI 1.03 - 8.37; p=0.04). Multivariate analysis identified LOE (OR 1.02; CI 1.02 - 1.04; p=0.042) and exposure to anaerobic agents (OR 2.78; CI 1.26 - 6.12; p=0.014) as independent predictors for VREF. Conclusion: AD pts are at risk for acquisition of enteric VREF through cumulative exposure to the nosocomial environment and to anaerobic agents. We suggest contact isolation for VREF pts, thorough cleaning of the environment and further evaluation of anti-anaerobic drug impact upon gastrointestinal flora.

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A Meta-Analysis of the Association Between Vancomycin Treatment (VT) and Vancomycin Resistant Enterococci (VRE).

*YEHUDA CARMELI AND CHARLES HUSKINS, Beth-Israel Deaconess Medical Center, Children's Hospital, and Harvard Medical School, Boston, Massachusetts.

Numerous studies have examined the association of VT and VRE with variable results. **Methods:** We searched published reports and abstracts and identified US studies comparing VT among patients with VRE and concurrent controls. Ecological studies of vancomycin use and VRE were not included. We examined sources of heterogeneity in these studies in regard to the definition of cases and controls and adjustment for length of hospital stay (LOS). The DerSimonian & Laird model was used to determine the pooled odds ratios (OR) and 95% CI for the association of VT and VRE. Heterogeneity was defined by the Q statistic, p<0.05. **Results:** All 18 studies included were case-control studies. Only 50% found a significant association, but all found an OR >1. The pooled OR for the 18 studies was 4.6 (3-6.9). There was significant heterogeneity among the results. Ten studies that identified cases by surveillance cultures had a lower pooled OR (3.24; 1.64-6.4) than 8 studies that identified cases by clinical cultures (7.45; 4.3-12.9). The latter 8 studies showed significant heterogeneity: 4 studies used controls with vancomycin-sensitive enterococcal (VSE) infection and had a higher pooled OR (10.67; 4.9-23.1) than 4 studies that used controls with no enterococcal infection (3.67; 1.4-9.5). After excluding the 4 studies using VSE controls, no heterogeneity (p = 0.5) was found among the results of the remaining 14 studies, irrespective of case definition; their pooled OR was 2.93 (2.1-4.1). Only 4 of these 14 studies adjusted for LOS by statistical methods or matching. After adjustment for LOS, these studies had a pooled OR that was much lower and not significant (1.26; 0.7-2.5). **Conclusions:** Initial examination of the 18 studies pointed to a strong association between VT and VRE. However, there was substantial heterogeneity in the results, attributable mostly to different definitions of controls and adjustment for LOS. A subgroup of studies that adjusted for LOS showed only a weak and non-significant association. Because the likelihood of VT and VRE both increase with longer LOS, lack of adjustment for LOS overestimates their association. The results of this study may not apply to the ecological impact of vancomycin use on the spread of VRE.

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Vancomycin Use in a University Medical Center: Effect of a "Vancomycin Continuation Form".

*MARTIN E. EVANS, ERIC T. MILLHEIM and ROBERT P. RAPP, University of Kentucky Schools of Medicine and Pharmacy, Lexington, KY

We previously analyzed vancomycin use of in our 461-bed tertiary care hospital and found that only 35% of the orders written were consistent with HICPAC guidelines (Evans and Kortas, *Infect Control Hosp Epidemiol*, 1996;17:356-359). In July 1997, we instituted a policy that allowed physicians to prescribe the drug, but required them to complete a "vancomycin continuation form" if they wished to continue the drug beyond 72 hours. The form required physicians to document that use conformed to HICPAC guidelines. If use was not consistent with guidelines, if the drug was not approved by infectious diseases, or if no form was completed, the drug was automatically stopped. A clinical pharmacist and infectious diseases specialist monitored the use of vancomycin prospectively and interacted with prescribers when indicated. No educational efforts were undertaken before institution of the form. Vancomycin use fell from a mean of 1,542(±421)gm/month in the 6 months before institution of the form to 682(±205)gm/mo after institution of the form (p<.05, signed-rank test), and expenditures fell from $7,578(±1,739)/mo to $3,661(±1,271)/mo (p<.05). This represented a savings of >$23,000 in the first six months of the program. The percent of drug use judged appropriate after 72 h rose to 98%, however, the number of orders initially meeting HICPAC criteria did not increase. Inappropriate one time use for surgical prophylaxis and renal dialysis patients was most problematic. A "vancomycin continuation form" monitored continuously by clinical pharmacists and infectious disease clinicians can decrease use and save money. Educational efforts may be required, however, to increase initial compliance with HICPAC guidelines.

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Impact of Clinical Practice Guidelines (CPGs) on Vancomycin (VANC) use in Adult Intensive Care Units (ICUs) at U.S. Hospitals.

SK FRIDKIN*, JR EDWARDS, SC PICHETTE, ER PRYOR, JE MCGOWAN Jr., DH CULVER, FC TENOVER, RP GAYNES, and Intensive Care Antimicrobial Resistance Epidemiology (ICARE) Hospitals, CDC and Rollins School of Public Health, Emory University, Atlanta, GA.

To examine intravenous VANC use and antimicrobial control policies, we analyzed data collected prospectively during 1996-97 from 108 adult ICUs representing 41 U.S. hospitals participating in ICARE. VANC use was analyzed as no. of defined daily doses/1000 ICU-patient-days (DDD). In November 1997, 38 hospitals completed surveys describing formularies, mechanisms to optimize the use of antibiotics, and details of infectious disease CPGs (i.e., diagnosis-based, criteria for appropriate use, method of dissemination). The median VANC use was lowest in coronary (25.6, p=.001) and highest in surgical (87.6) ICUs (p=0.003) compared to other ICUs. Factors associated with high VANC use included no. of hospital beds (Spearman correlation coefficient [r]=0.34, p<.001), rate of *S. aureus* resistant to methicillin (MRSA) (r=0.34, p<.001) and rate of central line-associated bloodstream infection (r=0.26, p=0.01). average length of stay (r=0.20, p=.04), but not rate of nosocomial pneumonia or urinary tract infection. Of 38 hospitals reporting antimicrobial control policies for VANC, neither approval requirements (n=6), automatic stop orders (n=24), antibiotic order forms (n=8), or pharmacists participating in clinical rounds (n=19) was associated with less VANC use. However, those ICUs with CPGs placed in patients' charts had significantly less VANC use (median 59 vs 99 DDD, p=.05) than other ICUs. We performed multiple linear regression modeling to examine the above factors and found MRSA rate, ICU type, bloodstream infection rate, hospital size, and CPGs placed in patients' chart to be independently important. Therefore, controlling for the the above factors, CPGs placed in patient's charts was associated with significantly less VANC use. In summary, ICU characteristics must be controlled for when comparing VANC use between different ICUs. Efforts to improve VANC use should focus not only on the use of CPGs, but also the method of dissemination of CPGs.

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European Vancomycin-Resistant-Enterococci (VRE) Prevalence.

MA SCHOUTEN*, JAA HOOGKAMP-KORSTANJE, CJM BARTELS, HJGR ROELOFS-WILLEMSE, YJM PETERS, A VOSS. University Hospital St Radboud, Nijmegen, The Netherlands.

We determined the pan-European occurrence of VRE by conducting a prevalence study in 49 hospitals representing 25 different European countries, Israel and Turkey. During the first quarter of 1997, each participating laboratory was asked to collect a maximum of 100 consecutive clinical isolates, presumptively identified as *Enterococcus* species by the local standard methods. So far, 1967 strains from Austria, Belgium, Bulgaria, Croatia, Czechoslovakia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Russia, Spain, and Sweden have been evaluated (identification and MIC determination) in our laboratory. Species identification was performed in an MIC system using 10 biochemical reactions. Susceptibility to currently used and investigational antibiotics, including glycopeptides, quinolones, and ß-lactams was performed according to NCCLS standards. Isolates were from the urogenital tract (51%), digestive tract (21%), skin (11%), respiratory tract (5%), blood (4%), and other sites (8%). Most isolates derived from adults (80%), with equal distribution among males and females. 75% of the patients were hospitalised (intensive care 20%, ward 80%), 25% came from the out-patients department. Only a few patients (3.3%) received documented glycopeptide therapy during the study period. Identification yielded *Enterococcus faecalis* 81%, *Enterococcus faecium* 15%, other enterococcal species 4%. The overall VRE prevalence was 1.2% (out-patients 0.8%, hospitalised patients 1.3%), ranging from 0% to 7.6%. From the 24 VRE strains isolated so far, 7 VRE strains originated from one center. Since four of these strains furthermore came from the same unit (hematology) an outbreak was suggested. Excluding this center, the pan-European prevalence of VRE in the countries evaluated until now is less than 1%.

Conclusion: at this moment VRE prevalence among clinical isolates in Europe is low, in the hospitalised patients as well as in out-patients.

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19 Healthcare Worker Handwashing Rates On High Risk Wards. *CA MUTO, MG SISTROM, BM FARR. University of Virginia Health System, Charlottesville, VA.

Handwashing has been advocated as an infection control measure for 150 years. Bryan et al reviewed the results of 18 studies and concluded that hand hygiene may influence nosocomial infection rates and deserves attention. Larson reviewed 37 studies published between 1989 and 1994 and found that healthcare workers washed their hands only about half the time. Some have advocated the use of 70% alcohol for disinfection of hands because this is more rapid than soap and water handwashing and thus may have better compliance. A major perceived disadvantage of alcohol hand products has been its drying effect on the skin, but incorporation of a moisturizing agent has been reported to result in alcohol being better tolerated than soap and water handwashing. An informal evaluation of user preferences for 6 commercially available alcohol hand products was conducted. The product selected by most users as most pleasing to their hands was chosen for use in a study of handwashing rates on 2 wards at high risk for nosocomial infection and spread of antimicrobial resistant pathogens. Compliance measured by unobtrusive observers during 126 opportunities on these 2 wards one month before introduction of the alcohol was 60%. Physicians were most compliant with 83% washing followed by nurses (60%), technicians (56%), and housekeepers (36%). Dispensers were then placed by the door in every room on these 2 units and an informational/motivational campaign was waged during the first week of their use emphasizing that the alcohol was effective and required less time to use. Prolink Hand Sanitizer dispensers (GoJo Industries, Akron, OH) were used containing 62% ethyl alcohol with water, isopropyl alcohol, and emollients propylene glycol and isopropyl myristate. After one month of use and following a change of rotations by medical staff, compliance was again measured. Overall hand cleansing declined to 52% of 114 opportunities to wash. Nurses were most compliant with a rate of 67%, followed by technicians (57%), physicians (29%), and housekeepers (25%). The physicians' rate changed significantly, declining by more than half. Overall, the alcohol product was used in only 16% of handwashing opportunities (31% of all cases in which hands were cleansed). We conclude that simply placing dispensers containing a rapidly acting hand cleansing product by hospital room doors and providing a brief educational and motivational campaign was ineffective. An ongoing educational/motivational campaign is now being planned with further observations of compliance.

20 **Intensity of Patient Care Is a Major Factor for Noncompliance with Handwashing**

Didier PITTET*, Philippe MOUROUGA, Thomas V. PERNEGER, and the members of the Infection Control Program. University Hospitals of Geneva, Switzerland.

Context : Transmission of microorganisms by hands of health care workers is the main source of cross infection in hospitals, and can be effectively prevented by handwashing.

Objective : To determine factors associated with noncompliance with handwashing during routine patient care in a teaching hospital.

Observed events : 2834 opportunities for handwashing observed over 2 weeks in preselected hospital wards. Structured observations concerned nurses (66%), physicians (10%), nursing assistants (13%) and other personnel (11%).

Main outcome measure : Compliance with handwashing practices.

Results : The average compliance with hanwashing was 48 percent. In multivariate analysis, noncompliance varied by type of staff (nurses performed significantly better than other groups) and by hospital ward (compared with internal medicine, intensive care units fared worse (odds ratio (OR) 1.6, 95% confidence interval (CIs) 1.3-2.1). In addition, noncompliance was worse during procedures with a high risk of contamination (OR 1.7, CIs 1.4-2.1), and with increasing intensity of patient care: compared with 0-20 opportunities for handwashing per hour of care, 21-40, OR 1.6, CIs 1.3-2.1; 41-60, OR 2.5, CIs 1.9-3.2; >60, OR 2.2, CIs 1.6-3.0). Finally, compliance improved on week-ends (OR 0.5, CIs 0.4-0.7).

Conclusions : This study confirmed modest levels of compliance with handwashing in a Swiss teaching hospital. Compliance varied by hospital ward and by type of health care worker, which suggests that targeted educational programs may improve the situation. Importantly, compliance was lower when intensity of care was high, suggesting that reductions in health care personnel may have a negative impact on the quality of patient care.

21 Surveillance of Handwashing Episodes in Adult Intensive Care Units by Measuring an Index of Soap and Paper Towel Consumption Correlated with Handwashing Frequency. *MARVIN J. BITTNER, EUGENE C. RICH and KAY L. RYSCHON. VA Medical Center, Creighton University, and University of Nebraska Medical Center, Omaha, NE.

In reducing nosocomial infections and the transmission of multi-drug-resistant organisms, handwashing (HW) is the most important single measure; but HW compliance is maintained at high levels only with sustained monitoring and feedback. Because direct monitoring is labor-intensive, we sought to develop an index of how frequently handwashing episodes (HWE) occur. We did so using indirect measurements that are inexpensive enough to allow indefinitely sustained monitoring and feedback. An observer counted HWE in an 8-bed medical intensive care unit (MICU) open ward with 5 sinks for 10 four-hour daytime observation periods encompassing 409 HWE. Similar observations were made in a 9-bed surgical intensive care unit (SICU) open ward with 3 sinks for 7 periods encompassing 350 HWE. The observer also measured soap dispenser weight, paper towel weight, and paper towel stack height at the beginning and end of each period. Mean HWE per occupied bed per hour was 2.92 with a standard deviation of 0.77 for MICU (3.35 ± 0.70 for SICU). Correlation (r^2) with HWE was 0.45 for soap consumption, 0.91 for paper towel weight, and 0.77 for paper towel height for MICU (0.84, 0.65, and 0.49 for SICU). Using stepwise multivariate linear regression in SPSS, count of HWE was used as the dependent variable. This equation was developed for MICU: HWE = 0.0914 x towel weight change in gm + 0.0601 x soap used in gm. (Coefficients for SICU: 0.0406, 0.276) For the model, r^2 was 0.97 (0.98 for SICU), which was better than that for each variable measured separately. For each model, $p < 0.0001$. Readily obtained measurements of soap and towel consumption provide reliable, valid estimates of handwashing episodes in an intensive care unit. These measurements show promise for the construction of an index of handwashing episodes. Indirect measurements of handwashing frequency show potential for an inexpensive system of handwashing surveillance useful for providing feedback on handwashing.

22 **Handwashing Compliance by Health Care Workers: The Impact of an Education and Patient Awareness Program.** *WERNER E. BISCHOFF, TAMMY M. REYNOLDS, CURTIS N. SESSLER, MICHAEL B. EDMOND and RICHARD P. WENZEL, Medical College of Virginia, Campus of Virginia Commonwealth University, Richmond, VA

The efficacy of handwashing (hw) procedures to prevent infections has been clearly demonstrated. However, under routine conditions the hw-compliance of health care workers (HCWs) remains unacceptably low. The goal of this study was to investigate the efficacy of an education and patient awareness program. The hw-compliance was measured in two ICUs (medical ICU [MICU] 12 beds; cardiac surg. ICU [CSICU] 10 beds) and one general medical ward (27 beds). Direct observations were undertaken for 40hrs in each ICU and counting devices were mounted on soap (s) and chlorhexidine (c) dispensers in all three units. After six weeks without intervention an educational program was introduced in both ICUs (6 in-services/ICU) and patient awareness flyers were distributed initially to all patients on the general medical ward and then every new admission. This was followed by a second six week period. Without intervention HCWs washed their hands prior to and after defined events in 9% and 22% (MICU) and 3% and 13% (CSICU), respectively. After education the hw-rates indicated a slightly higher compliance (MICU: 14%/25%; CSICU: 6%/13%). Similiar results could be found using the counting devices (MICU: before 129[s] and 17[c]/pat.day; after 142[s] and 24[c]/pat.day; CSICU: before 109/pat.day[s]; after 93/pat.day[s]). In the general medical ward the baseline compliance was 34/pat.day(s) and 4/pat.day(c). After flyers were distributed, there was no increase in soap utilization (30/pat.day[s]; 5/pat.day[c]). Both interventions failed to improve hw-compliance rates. A fast and safe hw-device with easy access could be a solution for this problem. The efficacy of patient awareness flyers is probably limited by health conditions and the low socioeconomic status of many patients. Utilization of such flyers alone proved to be insufficient in generating the social pressure on HCWs to wash their hands.

23 Dynamics of Hand Contamination during Routine Patient Care.

Didier PITTET*, Sasi DHARAN, Thomas V. PERNEGER, and the members of the Infection Control Program. University Hospitals of Geneva (HCUG), 1211 Geneva 14

Background: Transmission of microorganisms by the hands of health care workers (HCWs) is the main route of spread of nosocomial infections.

Objective: To study the dynamics of bacterial contamination of the hands of HCWs during routine patient care in a large teaching hospital.

Methods: Structured observations of 417 episodes of care were conducted by trained, external observers. Each observation period started after a hand cleansing procedure and ended when the HCW proceeded to clean his/her hands or at the end of a coherent episode of care. At the end of each period of observation, an imprint of the five fingerprints of the HCW's dominant hand was taken on and bacterial colony counts were quantified. Regression methods were used to model the intensity of bacterial contamination as a function of predictor variables: method of hand cleansing, use of gloves during patient care, duration and type of care, and the hospital ward.

Results: Bacterial contamination increased linearly with time on ungloved hands during patient care (on average: 16 cfu per min, 95% confidence interval 11-21). Patient care activities independently and significantly (all $p < 0.05$) associated with higher contamination levels were direct patient contact, respiratory care, handling of body fluid secretions, and rupture in the sequence of care. Contamination levels varied with hospital location, the medical rehabilitation ward having higher rates than other wards. Finally, simple handwashing before patient care, without effective hand antisepsis, was also associated with higher colony counts ($p=0.03$).

Conclusions: Both the duration and type of patient care influence hand contamination. Furthermore, as hand antisepsis was superior to handwashing, intervention trials should explore the role of systematic hand antisepsis to reduce cross-transmission in hospitals.

24 Glove Leakage Rates as a Function of Latex Content and Brand: Caveat Emptor. *MG SISTROM, CA MUTO, J NEAL, BA STRAIN, BM FARR. University of Virginia Health System, Charlottesville, VA.

When the CDC advocated Universal Precautions in 1987, studies were conducted to determine optimal gloves for use as barriers against bloodborne pathogens. Multiple studies showed that sterile surgical gloves were significantly less likely to leak than nonsterile exam gloves and latex gloves were less likely to leak than vinyl gloves (JAMA 1993; 270:350; ArchIntMed 1989). Glove use increased from 1 billion pairs per year in the US in 1987 to 10 billion pairs in 1996 with latex gloves accounting for a large majority. Between 1988 and 1995 there were more than 1,600 reports to the FDA of allergic reactions to latex containing products including 23 deaths. Due to concern about the risk of allergic reactions and concern that increased use of latex gloves resulted in increased rates of sensitization, NIOSH published an alert in 6/97 suggesting the use of nonlatex gloves for activities unlikely to involve contact with infectious materials and the use of powder free latex gloves with reduced latex protein content if latex gloves were chosen for protection against potentially infectious materials. We purchased and tested 15 different glove types using the ASTM standard test method for detection of holes in medical gloves (ASTM D 5151-92) which involved mounting the glove on a plastic tube (38cm long,6cm outer diameter,5cm inner diameter) pouring 1 liter of tapwater into the glove and visually inspecting the glove for 2 minutes. Half of the gloves were tested straight from the package and half after a standard manipulation developed by Korniewicz et al (JClinMicro 1990; 28:787). 9 sterile surgical glove types (5 high powder, high latex, 2 low latex, and two nonlatex) and 7 exam glove types (2 high powder, high latex, 2 lowlatex, and 3 nonlatex) were tested (total=2,859 gloves). Leakage rates were greater for exam than surgical gloves, and for manipulated vs. unused gloves for both surgical and exam gloves. High latex surgical gloves from all manufacturers provided an excellent barrier, but significant differences were observed among low latex surgical gloves (leakage rates of 1% vs 12% after manipulation) and all types of exam gloves(leakage rates ranging from 0% to 29% after manipulation). We conclude that FDA approval should not be interpreted as suggesting equality of different manufacturers' products. Some nonpowder and lowlatex gloves may provide an effective barrier for preventing exposure to bloodborne pathogens.

25 Gram-Negative Bacteremia: Incidence, Antimicrobial Resistance and Impact at a large Teaching Hospital.

S. HARBARTH', P. ROHNER, R. AUCKENTHALER, E. SAFRAN, P. SUDRE, D. PITTET
Geneva University Hospitals, 1211 Geneva 14, Switzerland.

Background: Analysis of the incidence and resistance patterns of Gram-negative bacteremia (GNB) in hospitals with number of related hospital deaths provides meaningful estimates of the impact of these infections.

Objectives: To characterize the rates, secular trends, antibiotic susceptibilities and impact of bacteremia due to Gram-negative (GN) organisms at a large teaching hospital.

Methods: 6-year retrospective cohort study including all patients with GNB between 1989 and 1994. Trends were analyzed using linear regression analysis. Survival analysis used a multivariate Cox-proportional hazard model.

Results: 1,766 patients had 1,835 episodes of GNB; 61% were community-acquired. Overall incidence of GNB increased linearly (r_s=.90, P=.014) from 7.07 episodes per 1,000 admissions in 1989 to 8.32 episodes per 1,000 admissions in 1994. After adjustement for the number of blood cultures drawn per year, this trend was no longer significant (r_s=.22, P=.68). Leading pathogens were: *E. coli* (48% of all GNB isolates), *Klebsiella* spp (13%), and *P. aeruginosa* (10%). 321 patients with GNB died (18%). The crude in-hospital mortality in patients with GNB decreased significantly from 20% in 1989 to 16% in 1994 (r_s=.94, P=.005) and was markedly lower in patients without GNB (2.5%). Factors independently associated with an increased hazard of death after GNB were: intensive-care acquired infection (hazard ratio [HR] 1.53, 95% confidence interval [CI] 1.14-2.05), older age (66 to 79 y: HR 1.81, 95% CI 1.27-2.56), infection due to *Klebsiella* spp (HR 1.66, 95% CI 1.15-2.40) or *P. aeruginosa* (HR 1.56, 95% CI 1.07-2.27), and polymicrobial infection (HR 1.59; 95% CI 1.15-2.20). Multiresistance in GN bloodstream isolates was not associated with an increased risk for death.

Conclusions: The overall incidence of GNB is increasing at our institution due to a detection bias (increased number of blood cultures). The crude mortality of GNB is decreasing, but the population-attributable risk for death due to GNB is significant and remained unchanged over the period of the study.

26 Epidemiology of *Pseudomonas aeruginosa* Infections in Northern France.

*B GRANDBASTIEN, C CATTOEN, Y BERROUANE, D DESCAMPS, L BOUILLET, B COIGNARD, T LEVENT, MICROBIOLOGY NETWORK, ASSOCIATION REGIONALE des CLIN (ARECLIN), Tourcoing, France.

Introduction: A prevalence survey showed that *Pseudomonas aeruginosa* (PSA), causing 13.5% of nosocomial infections, was as frequent as *Staphylococcus aureus* in northern France. To further study PSA epidemiology, a laboratory-based regional network has been initiated. We describe here the results of the first 6-month study.

Material and methods: 25 hospital-affiliated microbiology laboratories conducted an incidence study in spring and then in fall 1996. Data were collected for non repeat isolates from diagnostic specimens only, and included patient data, specimen, serotype, and antibiogram. Numbers of beds (b) and admisssions were used to calculate incidence rates (IR). Results: 2 755 non repeat isolates from 2172 patients were identified, giving IR of 39.6/100 b and 12.0/1000 admissions. Rates varied greatly between institutions (median: 33/100 b; Q_1: 28.3, Q_3: 46.1) and between types of units with 452.8/ 100 intensive care b, 42/100 surgery b, 48.6/100 medicine b, and 13.6/100 extended care b. In addition, in hospitals with less than 300 b and in those with 300 to 500 b, the rates were 45.1 and 40.4/100 b respectively. In larger hospitals , the rate was 67.9 /100 b. The most frequent infection was pneumonia (IR, 12.6/100 b). Isolates were resistant to ticarcillin (TIC) in 26% of cases, ceftazidime (CAZ) in 8.1%, imipenem (IPM) in 15.5%, amikacin in 17%, and ciprofloxacin in 36.8%. 10.3 isolates /100 b were resistant to TIC, 3.2/100 b to CAZ. Resistance rate to 1 antibiotic among TIC, CAZ and IPM was 13.4/100 b.

Conclusion: This study confirmed the importance of PSA in the region. Moreover, it helped organize isolation of patients and provides a rationale for antibiotic policies in each institution. Given the frequence of patient transfers between hospitals, this project will serve to coordinate control measures region-wide.

27 Gram-Negative Bacteremia (GNB) in a Hemodialysis Unit Traced to Probable Drain Port Contamination, Maryland.

*SUSAN A. WANG, RACHEL B. LEVINE, LORETTA A. CARSON, MATTHEW J. ARDUINO, TERESA KILLAR, F. GREGORY GRILLO, WILLIAM R. JARVIS, MICHELE L. PEARSON, CDC, Atlanta, GA

In the United States, approximately 236,000 patients undergo hemodialysis annually; bacteremia is a leading cause of hemodialysis-related morbidity and mortality. From December 1996 through January 1997 (study period), 10 GNBs occurred among patients at one hemodialysis center in Maryland. To identify risk factors, we conducted a cohort study, reviewed infection control practices and water system and dialysis machine (COBE Centrysystem 3, GAMBRO Healthcare) maintenance and disinfection procedures, and performed cultures of the water and dialysis machines, including the waste-handling option (WHO). The WHO is a drain port solely designed to dispose of saline used to flush the dialyzer before patient use. During the study period, 94 patients received dialysis on 27 machines; 10 (11%) of the patients had GNBs. Pathogens causing the GNBs included *Enterobacter cloacae* (n=6), *Pseudomonas aeruginosa* (n=4), and *Escherichia coli* (n=2); two patients had polymicrobial bacteremia. Factors associated with GNBs included receiving dialysis via a central venous catheter (CVC) rather than via an A-V shunt (10/31 vs 0/53, RR undefined, p<0.001), or dialysis on any of three particular dialysis machines (7/20 vs 3/64, RR=7, p=0.001). Several dialysis machines grew *E. cloacae*, *P. aeruginosa*, or both organisms. WHO valves, which prevent backflow from the drain to dialysis bloodlines, were faulty in 8/26 (31%) machines, including 2/3 machines epidemiologically linked to case-patients. Pulsed-field gel electrophoresis patterns of available dialysis machine and patient *E. cloacae* isolates were identical. Our study suggests that WHO ports with incompetent valves and resultant backflow may be a source of cross-contamination of dialysis bloodlines and patients' CVCs. Replacement of faulty WHO valves and enhanced disinfection of dialysis machines ended the outbreak.

28 Computerized Monitoring of Antibiotic-Resistance Complemented by Molecular Typing: Detection and Investigation of an Outbreak of Antibiotic-Resistant *Pseudomonas aeruginosa*.

*Y. CARMELI, D. LICHTENBERG, A. KARCHMER, M. SAMORE. Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA.

Using automatic computerized monitoring of antibiotic resistant pathogens we detected a 3 fold increase in the incidence of ciprofloxacin-resistant *Pseudomonas aeruginosa* (CR-Pa). The isolation rate of CR-Pa increased from a rate of 2.5 to 7.5 cases per 1000 hospital admissions. An initial epidemiologic investigation identified a high frequency of antecedent treatment with fluoroquinolones in patients from whom CR-Pa was isolated. To find whether this increase in ciprofloxacin resistance is related to nosocomial transmission or related solely to the antibiotic treatment molecular typing of CR-Pa was performed simultaneously with the epidemiological study. Pulse field gel electrophoresis (PFGE), revealed two groups of CR-Pa: Group 1- sharing a common PFGE pattern were resistant both to ciprofloxacin and to gentamicin (CGR-Pa), and Group 2- isolates were ciprofloxacin-resistant and susceptible to gentamicin and had each unique PFGE pattern. Using these data we modified the case definition to patient from which CGR-Pa was isolated; 22 cases and 58 controls were identified between 3/3/97 and 7/7/97. During the 8 month prior to this outbreak only 4 out of 88 patients with *P. aeruginosa* had CGR-Pa (OR 8, p<0.001). The case control study identified two risk factors: Isolation of *P. aeruginosa* from a wound (OR 13, p<0.001), and having the podiatry service as the admitting or consulting service (OR 9, p<0.001). We cultured the hands of the podiatry team, the equipment and solutions used by the team for wound care. CGR-Pa of the same PFGE pattern was cultured from saline solution used by the podiatry service for wound care. A non-sterile bottle was filled with sterile saline solution and was carried in a bag during rounds to wet wound dressing. The bottle was used for four month for the care of multiple patients and was refilled with sterile saline when needed. After discontinuing this practice and using a unique sterile solution bottle for each patient the outbreak subsided.

29 An Unusual Source of *Pseudomonas aeruginosa* (PA) Infections in a Neonatal Intensive Care Unit (NICU).

GAIL POTTER-BYNOE, ANNE ZAWACKI, CHRISTINE PSOTA, ANN MACONE, DONALD GOLDMANN and *EDWARD O'ROURKE, Children's Hospital and Harvard Medical School, Boston, MA

During a 6-week period in 1997, 4 ventilated neonates in our NICU developed fatal PA pneumonia with secondary bloodstream infection (BSI). Two cases occurred despite comprehensive traditional outbreak control, so the unit was closed while investigation continued. Historical data indicated that PA was occasionally isolated from NICU patients, but prior to this outbreak serious PA infection was rare. A case was initially defined as any NICU patient with a positive PA culture during the outbreak or in the prior 12 months. Sixteen patients were identified: 6 with BSI, 2 with eye infection, 1 with wound infection and 7 with respiratory or GI colonization. The investigation included environmental assessment, policy and procedure review, clinical practice observation, prospective screening of patients and personnel for PA colonization, and a case-control study. Microbiologic sampling included PA cultures of the environment (7/181 positive) and semi-quantitative broth rinse cultures of health care workers' (HCWs) hands before beginning work on the day of culture (5/178 positive). Genotyping by pulse-field gel electrophoresis (PFGE) was done on all available PA isolates, including 5 of 6 patients with BSI. All 5 BSI isolates were identical as were the PA isolates from a single HCW (hands and external auditory canal) and from a ventilator flow sensor that had been cleaned but not disinfected. All other isolates were unrelated genotypes. The case-control study of 5 BSI patients and 10 controls matched on birthweight, NICU exposure and quarter of year revealed no statistically significant risk factors. However, 5/5 cases vs. 7/10 controls were ventilated, and 4/5 cases vs. 4/10 controls had been cared for by the HCW with the identical PA strain. The HCW was a swimmer who recalled bouts of mild, intermittent otitis externa prior to and during the outbreak. The HCW was treated and cleared of PA and no further cases of PA infection or colonization with the implicated genotype have occurred. The HCW with chronic intermittent otitis externa was the probable source for this cluster of infections.

30 *P. aeruginosa* infections in neurosurgical patients after cerebral ventricular catheter placement.

WE TRICK*, JI TOKARS, CM KIOSKI, BM YEN, GD CAGE, WR JARVIS. Hospital Infections Program, Centers for Disease Control and Prevention (CDC) and Arizona Department of Health Services (ADHS).

P. aeruginosa is a rare but sometimes lethal cause of postoperative meningitis. During August 8-October 22, 1997 (epidemic period), eight neurosurgery patients at Hospital X developed *P. aeruginosa* cerebral ventriculitis. All had percutaneous external ventricular catheters (EVCs) to monitor intracranial cerebrospinal fluid (CSF) pressure. A case-patient was defined as any patient with *P. aeruginosa* culture-positive CSF during the epidemic period. We determined background rates of *P. aeruginosa* ventriculitis, and then performed a cohort study of all patients who had EVCs placed at Hospital X during the epidemic period. Pulsed-field gel electrophoresis (PFGE) was performed on all isolates. Among patients with an EVC during January 1 to October 22, 1997, *P. aeruginosa* was isolated from CSF significantly more often in the epidemic than pre-epidemic periods (8/61 [13.1%] vs 2/131 [1.5%] , p=0.002). In the cohort, ventriculitis was significantly more likely after EVC placement in the operating-room (OR) than in other units (8/24 vs 0/22, p=0.004). When analysis was limited to those with EVCs placed in the OR, we found that contact with one healthcare worker (HCW) was statistically significant (7/13 vs 0/8, p=0.02), but cultures of this HCW were negative. No other factors, including OR or intensive-care unit exposures, were implicated as the cause of this outbreak. However, EVC placement technique differed for EVCs placed in the OR (little hair was removed, preventing application of an occlusive dressing) vs other hospital units (more hair was removed, and an occlusive dressing applied). Of seven case-patients, four had negative CSF surveillance cultures after EVC placement, and before the culture-positive CSF specimen was obtained. Antimicrobial therapy successfully eradicated *P. aeruginosa* from CSF in all case-patients. All isolates had indistinguishable PFGE patterns. These data suggest that patient-to-patient transmission of *P. aeruginosa* resulted in contamination, and subsequent invasion of catheter insertion-sites in patients without occlusive dressings. Application of an occlusive barrier dressing may be necessary to prevent ventriculitis in patients with EVCs.

31 Control of Hepatitis B Among Health Care Workers in the Czech Republic. SEPKOWITZ KA*, HELCL J, CÁSTKOVÁ J, BENEŠ Č, DeHOVITZ JA. National Institute of Public Health, Prague; Memorial Sloan-Kettering Cancer Center, NY; SUNY Health Science Center, Brooklyn, NY.

Objective: To determine the effect of an active vaccination program on rates of occupational hepatitis B among HCW's in the Czech Republic from 1980 to 1995.

Methods: The Czech Republic has 10 million persons, of whom 200,000 (2%) are HCW's, similar to the proportion in the US (2.4%). Health records for what is now the Czech Republic were maintained separately and distinctly during the years the area was part of Czechoslovakia (through January, 1993). Rates of occupationally-acquired hepatitis B among HCW's, including job-specific rates, have been tracked since 1980. In 1983, vaccination of all "high risk" HCW's became mandatory. In addition, disposable needles became widely available. Vaccination schedules have varied according to availability of products and of national resources. "High risk" HCW's comprise 20% of the health care workforce and include dialysis workers, internal medicine ward employees, and surgeons.

Results: Between 1982 and 1995, rates per 100,000 population decreased sharply:

	1982	1995
All HCW's	174	17
"High Risk" HCW's	587	23
General population > 15 y	27	7

Conclusions: Introduction of mandatory hepatitis B vaccination for HCW's in the Czech Republic has resulted in a dramatic decrease in occupational morbidity. This was accomplished despite (1) profound changes in government and (2) comparatively low per capita health care expenditures, relative to the US.

32 Hepatitis C (HCV) Infection in Health Care Workers (HCWs) Following Percutaneous Exposures to HCV Positive Sources. *ABIGAIL V. VEEDER, KATHLEEN STELLRECHT, ALWIN STEINMANN, KAREN PUTNAM, WILLIAM CALDWELL, and RICHARD A. VENEZIA, Albany Medical Center, Albany, New York

HCWs are at risk for acquiring bloodborne pathogens from an occupational exposure. In 1996, 114 of 134 percutaneous needle stick exposures from known sources at our hospital met the CDC high risk exposure definition of breaking the skin with a device visibly contaminated with blood. Of the 114 source patients, 9 of 96 (10%) tested for anti-HCV antibodies were positive. The HIV status of the 9 were 3 unknown, 3 positive, and 3 negative. None were symptomatic with HCV however liver function tests were elevated in 4 source patients. The 9 exposed HCWs were sero-negative for HCV at baseline testing. At 6 weeks post exposure, 2 HCWs were positive for HCV RNA. HCW A presented with vomiting, jaundice, dark urine, fever, and an alanine aminotransferase (ALT) level of 870 IU/L. The exposure was a deep puncture with a lancet from an HIV negative source with normal ALTs and asymptomatic for hepatitis. Further follow-up was not provided by our hospital. HCW B's exposure was a moderate puncture with an IV stylet from an HIV positive source who had a slightly elevated ALT (70 IU/L) but was asymptomatic. HCW B was noted to have an elevated ALT (132 IU/L) but asymptomatic at the 6 week follow up exam for HIV prophylaxis. HCV viral load in HCW B peaked at 8 weeks post-exposure, before falling to undetectable levels at 6 months. Although asymptomatic, ALT levels paralleled viral loads and peaked (1,287 IU/L) at 13 weeks post exposure. Three months after apparent resolution of infection, HCV and elevated ALTs were again detected. α-interferon therapy was begun at 10 months post exposure and HCV became undetectable with normal ALTs after 12 weeks. Based on these 2 cases and the high rate of HCV infection following high risk exposures, follow up HCV testing in exposed HCWs may be beneficial at 6 weeks post exposure instead of the current recommendation of 3 months.

33 Accidental Blood Exposures: A 2-Year Survey in 60 French Hospitals ARNAUD P. TARANTOLA, MD* for the CCLIN/GERES Accidental Blood Exposure Surveillance Network

From January 1, 1995, to December 31, 1996, a needlestick surveillance network was implemented to determine the frequency and trends of accidental blood exposures (ABE). Method: 60 hospitals staffed by 60,000 health care workers (HCWs) were surveyed. ABEs were documented by occupational physicians using a standardized questionnaire completed in collaboration with the injured HCW. Results: From January 1995 to December 1996, 4,206 ABEs were documented. Most injured HCWs were practicing or student nurses (60%), nurses' aides (17%) or physicians (10%). Seventy-seven percent of ABEs were needlestick injuries. The first cause of ABE was blood sampling (19%, 808 ABEs). Fifty-eight percent (2454) of ABEs occurred after completion of the procedure. Needle disposal in safety containers was associated with 10% (447) of ABEs. Source patient HIV serostatus was known in 33% (1412) of cases. One hundred and forty-seven (3,5%) of ABEs involved HIV-infected patients. Post-exposure chemoprophylaxis was advised in 168 (4%) cases and initiated in 88 (3.5%) cases. Source patient HBV or HCV serostatus was known in 769 (18%) and 861 (20.5%) of cases, respectively. Patients were Hepatitis B Virus antigen (HBsAg) and Hepatitis C Virus (HCV) carriers in 1.2% (52) and 3.4% (143) of cases, respectively. Twenty-one percent (888) of ABEs could have been avoided if universal precautions had been observed. We gathered complementary data on hospitals which offer safety catheters (number and type of catheter used). Results and trends for 1997 will be presented (ongoing analysis of an additional 2,000 ABEs), including HIV post-exposure chemoprophylaxis. Conclusion : The availability of effective HIV chemoprophylaxis should not discourage efforts to improve universal precautions observance which remains an effective way of protecting HCWs against HIV, HBV, HCV and other blood-borne pathogens. In 1998, the impact of recommendations regarding safety devices and post-exposure HIV chemoprophylaxis will be further evaluated based on the surveillance network data.

34 Potentially Preventable Occupational Percutaneous Injuries (PIs) Resulting in Human Immunodeficiency Virus (HIV) Postexposure Prophylaxis (PEP). *SCOTT CAMPBELL, PAMELA SRIVASTAVA, DENISE CARDO, and the NaSH Surveillance Group. Centers for Disease Control and Prevention (CDC), Atlanta, GA.

Although postexposure management is an important element in workplace safety, preventing blood exposures is the primary means of preventing occupationally-acquired HIV infection. To evaluate the preventability of PIs for which HIV PEP was prescribed, we assessed the circumstances, including the device type, the procedure for which the device was used or intended, and the injury mechanisms, of PIs reported to the National Surveillance System for Hospital Health Care Workers (NaSH). During June 1995 - September 1997, the six hospitals in NaSH reported 1,388 PIs; 218 (16%) resulted in the exposed health care worker (HCW) taking HIV PEP. These injuries involved 153 hollow-bore needles (70 syringe needles, 48 winged needles, 14 intravenous [IV] stylets, 9 phlebotomy needles, and 12 other hollow-bore needles), 29 suture needles, 17 scalpels, and 19 other sharps. At least 108 (50%) PIs could be classified as potentially preventable because they occurred during the disposal of a device, during clean-up, during the use of a hollow-bore needle that could be replaced by available safety devices, or during recapping. The 65 PIs that were disposal-related occurred while placing the device in the disposal container (22), while in transit to the container (13), during clean-up (16), or because the device was left in an unusual location (14). An additional 38 exposures occurred during or immediately after the use of hollow-bore needles and may have been prevented by safety devices. These included 15 needles used for manipulating IV lines, 7 syringes for subcutaneous injections, 6 winged steel needles for phlebotomy, and 6 IV stylets. Recapping was involved in 5 injuries. Zidovudine (ZDV) and lamiduvine (3TC) together were prescribed for 58 (56%) of the HCWs who experienced potentially preventable injuries; triple-drug combinations including a protease inhibitor, for 27 (26%); and ZDV alone, for 18 (17%). The specific PEP drugs were not described in five cases. Estimated cost of the prescribed regimens for these potentially preventable exposures was approximately $61,000. The considerable cost of PEP therapy could be offset by preventing injuries by providing HCWs with safety devices and appropriate training.

35 EFFICACY OF A "SAFETY" WINGED STEEL NEEDLE IN PREVENTING PERCUTANEOUS INJURIES (PIS) IN HEALTHCARE WORKERS.
*MERYL H. MENDELSON, ROBIN SOLOMON, EILEEN BAILEY, LIN CHEN , and DEBORAH MCCARTHY,
THE MOUNT SINAI SCHOOL OF MEDICINE, NEW YORK, NEW YORK

Winged steel needles (WSNs) have been reported to cause a significant number of PIs from hollow bore needles used in phlebotomy procedures; and are considered high risk for bloodborne pathogen transmission in healthcare workers (HCWS) . We evaluated a "safety" WSN (SafetyLok, BD) at an 1100 bed urban teaching hospital comparing PI rates during a baseline period (I, 9/1/95-8/31/96) to a study period (II, 7/1/97-11/30/97). "Safety" WSNs were implemented hospital-wide; all conventional WSNs were removed from inpatient and outpatient units. PIs were tracked using the NASH exposure form (CDC), a survey of sharps disposal boxes was performed to assess usage and activation rates, and product evaluations were distributed. The injury rate due to WSNs during period I was 11.6/100,000 WSNs (46 injuries; 396,612 conventional WSNs); compared to 5.2/100,000 during period II (10 injuries; 194,195 "safety" WSNs; 55% reduction, p<.05). Distribution of injuries due to "safety" WSNs were as follows: 5 WSN/vacutainer holder, 5 WSN/syringe; 6 occurred during the procedure prior to "safety" mechanism activation, 4 after procedure (HCW failed to activate mechanism); 9 were of moderated depth, and 1 was superficial. A survey of 660 disposed WSNs during period II revealed 633 "safety" WSNs and 37 conventional WSNs. 83% (515/623) "safety" WSNs had been activated. A review of 466 product evaluations (70% RN s, 13% MD s/ PA s, and 12% care associates) showed the following responses: 75% attended formal training, 80% minimal or no training was needed, 82% very easy or easy to use, 82% procedural performance time unchanged or decreased, 53% activated mechanism >75% procedures, and 77% preferred (64%)/no opinion (13%) re: preference for "safety" vs. conventional WSN. In conclusion, a "safety" WSN (SafetyLok, BD) was shown to significantly reduce PIs secondary to WSNs. HCWs require minimal training. Compliance with activation needs to be routinely stressed.

36 Assessment of the Nature and Frequency of Blood Contacts Among Home Healthcare Workers. *ELISE M. JOCHIMSEN, CINDY BOYER, DEMIE LYONS, ALLISON MCGEER, MARGARET MCARTHUR, MAXINE ARMSTRONG-EVANS, PENNY MCKIBBEN, and DENISE CARDO, Hospital Infections Program, CDC, Atlanta, GA, the Cleveland Clinic Foundation, Cleveland, OH, Mikalix & Company, Boston, MA, and Mt. Sinai and Princess Margaret Hospitals, Toronto, Canada.

Over 450,000 healthcare workers (HCWs) are currently employed by home healthcare agencies in the United States and Canada. Transmission of bloodborne pathogens is a serious concern whenever HCWs are providing care to patients, but little is known about the nature and frequency of occupational blood contact among home HCWs. To assess rates of blood contact and needlestick injury for HCWs in the home setting, we conducted surveillance of blood contacts among workers, employed by 11 home healthcare agencies in the United States and Canada, who provide home infusion therapy and/or perform procedures using hollow-bore needles and other sharp instruments. From August 1996 through June 1997, 548 HCWs recorded information about procedures performed and blood contacts sustained during each of their home visits for a 2-4 week period. Information was provided for 33,606 home visits. Fifty-three blood contacts (48 cutaneous contacts and five needlestick injuries) occurred during 14,744 visits during which procedures with potential for blood contact were performed, for a blood contact rate of 3.6 per 1,000 procedure-visits. Procedures with potential for blood contact included 8,129 procedures with sharp instruments, 5,517 bloody dressing changes, and 4,594 intravenous line injections using needleless devices; more than one procedure was performed during some visits. Of the cutaneous blood contacts, 42 (88%) were to non-gloved hands. Needlestick injuries were associated with the following procedures: implanted port access using a Huber needle (N=2), subcutaneous injection (N=1), phlebotomy (N=1), and fingerstick for glucose monitoring (N=1). Because data were not collected for a longer period and underreporting of exposures was not assessed, we do not know how representative these data are for all home HCWs. The majority of cutaneous blood contacts may have been prevented by glove use.

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Procedure-specific importance of risk factors for surgical site infections in a national surveillance network in the Netherlands.

*EVELINE GEUBBELS, JOKE MINTJES-DE GROOT, ANNETTE DE BOER, JAN MAARTEN VAN DEN BERG
Nat. Institute of Public Health and the Environment, Bilthoven and Nat. Organization for Quality Assurance in Hospitals, Utrecht, the Netherlands.

From June 1996 until May 1997 one third (38) of all Dutch hospitals participated in a national surveillance system on surgical site infection (SSI) and known risk factors. We investigated the relative importance of risk factors for all patients in the study (n=18,063) and separately for patients who underwent mastectomy (n=685), open reduction of a femur fracture (n=768), replacement of the femurhead (n=508) and total hip prosthesis (n=3490). The cumulative incidence of SSI for all procedures was 3.1%, for the separate procedures 4.7%, 4.2%, 6.5% and 2.8% respectively. The median postoperative length of stay was 8, 7, 15, 15 and 13 days respectively. In a multivariate *model including all procedures, the strongest risk factors for SSI were wound* contamination class of 3-4 (OR 3.3) and age 45-64 yrs (OR 1.7), 65-74 yrs (OR 2.1), ≥75 yrs (OR 2.9). The ORs for patients with an ASA-score over 2, procedures longer than 105 minutes and preoperative stay over 2 days were about 1.5. ORs for sex, antibiotic prophylaxis and acute surgery were close to 1 and not statistically significant. For the specific procedures however, the relative importance of these risk factors was quite different. ASA-score was an important risk factor for both mastectomy (OR 5.8) and open reduction of femur fracture (OR 2.5), but not for the replacement of the femurhead (OR 1.1, ns.) and total hip (OR 1.6, ns.). Similarly, the duration of the procedure appeared to be associated with infection for mastectomy (OR 3.3) and total hip (OR 1.7), but not for open reduction of femur fracture (OR 1.6, ns.) and replacement of femurhead (OR 1.5, ns.). None of the other risk factors were statistically significant when multivariately analysed per surgical procedure. We concluded that the type of procedure is a risk factor possibly outweighing other risk factors. Knowledge of the relative importance of risk factors for separate procedures is needed to design specific preventive measures.

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Sternal Surgical Site Infections Following Coronary Artery Bypass Graft (CABG) Surgery: Risk Factors and Outcome Analysis. *SUSAN M. CONTE, RONALD I. COWAN, PAMELA R. PARKER, ROSLYN A. YOMTOVIAN, ROBERT A. SALATA, University Hospitals of Cleveland, Cleveland, OH.

More than 650,000 CABG surgeries are performed annually in the United States. Major infectious complications such as mediastinitis are associated with significant morbidity, mortality and increased costs. Due to a perceived increase in sternal wound infections at our institution, we examined infections for two periods of time, 1993-94, and 1995-96. At our 850 bed tertiary teaching hospital, 555 CABGs were performed in 1993-94, for which the surgical site infection rate was 2.34% while 795 CABGs were performed in 1995-96 with an infection rate of 3.52%. An 18 month retrospective case-control study was performed to ascertain risk factors for sternal surgical site (SSS) infections. Controls were matched by age and date of surgery. Patient demographics; pre, peri, and postoperative issues; clinical features; antibiotic use and outcomes were reviewed. Post-operative features that predicated SSS infection in 15 patients included leukocytosis ($p<0.001$), persistent drainage ($p<0.001$), evidence of osteomyelitis ($p<0.001$) and an unstable sternum ($p=0.05$). 12 of the 15 infections were caused by 7 organisms including coagulase-negative staphylococci (33%), *S. aureus* (17%), gram-negative enterics (50%) and mixed infection (8%). Three infections were culture negative. Multivariate analysis showed frequency of blood product administration ($p<0.001$, OR 16.9) and timing of prophylactic antibiotics ($p=0.046$) predicted development of SSS infections. No correlation occurred with the type of blood products administered. None of the infected patients received prophylactic antibiotics optimally 31-60 minutes prior to the procedure. Infected patients had increased length of stay ($p=0.027$), increased length in Intensive Care ($p=0.042$), increased readmission rate ($p<0.001$) and higher hospitalization costs ($p=0.057$). Recognition of risk factors and consequences of SSS infections are critical elements in reducing rates. The role of transfusions in decreasing immune response and increasing susceptibility to infection will be further examined. Prophylactic antibiotics will be optimally administered to improve patient outcomes.

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Surgical site infection surveillance by means of post-discharge telephone interviews. P. ORENSTEIN, N. BA, DIA, CIC., B. AMIHOD, N., DNA, CIC N. CONSOLACION, N. BSCN., AND *M.A. MILLER, MSc, M.D., FRCPC., SMBD-Jewish General Hospital, Montreal, Canada.

The SMBD-JGH is a 638-bed tertiary care hospital. On April 1, 1995, the Infection Prevention and Control unit (IPCU) initiated a focused surgical nosocomial surveillance program (SNSP). Surgeries selected for surveillance were high volume and high risk. Healthcare restructuring that resulted in shortened length-of-stay (LOS) necessitated post-discharge (PD) follow-up for obtaining accurate surgical site infection (SSI) surveillance data. Various methods which failed to yield complete SSI data included: incident reports, mailed patient questionnaires, surgeon self-reporting and local clinic reporting. We therefore decided to evaluate telephone interviews (TI) done one month PD with subsequent surgeon verification as a means of SSI surveillance for Coronary Artery Bypass Grafts (CABG) surgery.

Methods: A TI consisted of a 1-page questionnaire upon contacting the patient 30 days PD. Those patients unable to be contacted included long distance numbers, no answer after 3 attempts, and/or incorrect numbers.

Results: For a 15-month period (08/01/96-10/31/97), 429 CABG were performed, of which 331 (77.2%) patients were contacted via TI. 112 of 331 (34%) patients were unable to be contacted. Of the remaining 219, 10 (4.6%) patients were deceased and 26 (11.9%) reported possible SSI of which 3 were previously identified by routine SNSP. The surgeon confirmed only 4 (15.4%) patient-reported SSI. Therefore, TI alone added an additional 10.5% to the SSI rate obtained by routine SNSP, whereas TI with surgeon confirmation added only 1.8% to the SSI rate. In addition, the authors will present the TI program (questionnaire, time requirements) and a comparison of nosocomial infection data obtained from in-hospital surveillance, physicians and the TI program. Although TI was the most labour intensive method, it produced the most complete data (i.e. high sensitivity) but required further confirmation (i.e. low specificity), and may not be feasible in all settings.

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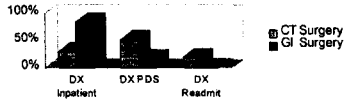
Should Post Discharge Surveillance (PDS) be Applied to all Surgeries? JEFFREY E. TOPAL*, PATRICIA REAGAN-CIRINCIONE, SHIRLEY HANNAN, DOROTHY MAZON, LOUISE M. DEMBRY, and WALTER J. HIERHOLZER, JR, Yale-New Haven Hospital, New Haven, CT.

Yale-New Haven Hospital is a 824 bed tertiary care center with 21,000 surgeries/year. High volume/high risk surgical procedures are targeted for surgical site infection (SSI) surveillance. The utility of PDS in case finding of SSI's was investigated for 2 types of surgeries: cardiothoracic (CT) and large bowel gastrointestinal surgery (GI). Standard definitions of SSI per published CDC criteria were used. 30 days following surgery, SSI surveillance forms were sent to the attending surgeons for completion. If a patient was still hospitalized at day 30, Hospital Epidemiology reviewed the medical record for the presence/absence of an SSI. All readmissions within 30 days of surgery were evaluated for an SSI. 1422 CT surgery patients (9/95-8/96) and 220 large bowel GI surgery patients (2/96-1/97) were followed by PDS. Overall response rates by CT and GI surgeons for completion of PDS forms were 85% and 90% respectively.



PDS identified 51% of CT SSI's and 71% of all leg infections (e.g. saphenous vein graft site infections). Inpatient surveillance and readmission surveillance identified 29% and 20% of all CT SSI's, respectively. In contrast, only 18% of the GI SSI's were identified by PDS; the remainder (82%) were identified during the initial inpatient stay. Thus, the utility of PDS is dependent on the type of surgery performed. In the era of limited resources, PDS should be targeted to those surgeries where its utility has been clearly established by prospective study.

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Predictive Value of Patient Self-Assessment of Wound Healing Following Discharge After Open Heart Surgery and Subsequent Emergency Department Visits and Hospital Readmissions. *MONICA WEBER, STEVEN M. GORDON, IRENE MCNAMARA, and DELOS COSGROVE III, The Cleveland Clinic Foundation, Cleveland, Ohio.

The incidence of readmission within 30 days after open heart surgery at our institution in 1996 was almost 18% of which approximately 10% were due to problems with wound healing. In an attempt to identify patients at high risk for wound complications after discharge we implemented a call back program for all 2,964 patients discharged from our institution following open heart surgery in 1996. Trained personnel conducted telephone interviews of patients at 7 days and 30 days after discharge which included a self-assessment of all surgical wounds (normal vs other than normal) and any emergency room visits and/or hospital readmissions within 30 days of hospital discharge. At 7 days following hospital discharge, 85% (2,515) of patients undergoing open heart surgery were contacted by telephone and 13.2% of patients (393) reported a problem with wound healing. Patients reporting wound problems within 7 days of discharge did not have a significantly higher rate of hospital readmissions than patients not reporting wound problems (5% vs 3.6%), but did have a significantly higher incidence of emergency room visits within 7 *days of discharge (13.4% vs 6.4%, p=0.001, RR= 1.9, 95% CI:1.5-2.5). At 30 days following* hospital discharge, 88.5% (2,623) patients were contacted by telephone and 8.7% (228) reported a problem with wound healing. Patients reporting wound problems between 8 and 30 days of discharge did not have a significantly higher incidence of emergency room visits than patients not reporting wound problems (12.2% vs 11.4%) but did have a higher incidence of readmission between 8 and 30 days of discharge (15.8% vs 9.4%, RR=1.6 95%CI: 1.2-2.3, P=0.002). We conclude patient self-assessment of abnormal surgical wound healing within 7 and 30 days after hospital discharge from open heart surgery may be associated with an increased rate of emergency room visits and readmissions within 30 days of discharge from open heart surgery. Prompt assessment of patients reporting wound problems in wound clinic may be one intervention to reduce the emergency room visits and hospital readmissions in these patients.

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Accuracy of Nosocomial Infection (NI) Surveillance as Performed by Infection Control (IC) or Quality Improvement (QI) Personnel. RJ SHERERTZ, SA STREED, KS GLEDHILL, K HAMPTON, AJ KOONTZ. Wake Forest University/Baptist Medical Center, Winston-Salem, NC

Recently the Joint Commission for the Accreditation of Hospitals Organization (JCAHO) beta-tested 8 quality assurance indicators, one of them being NI surveillance in intensive care unit (ICU) patients. Our QI group elected to perform this ICU surveillance, so it was decided to compare their efforts with our on-going IC surveillance. During a one year period 988 possible NI were identified by one or both groups using the same CDC NI surveillance criteria; 200 possible NI were identified by both IC and QI, 521 by IC but not QI, 267 by QI but not IC. It was assumed that NI identified by both IC and QI were valid and then the mismatch groups were further evaluated. Forty NI were randomly selected from the group only identified by IC – 10 surgical site, 10 lower respiratory tract, 10 urinary tract, and 10 primary bloodstream; another 40 NI were similarly selected from the group only identified by QI. These 80 cases were reviewed blindly by two senior IC practitioners (ICP) who had not previously participated in the surveillance of these NI; agreement by both ICP was required to define a valid NI. Using this definition IC correctly identified 79% of the NI (31/39 – 1 case was accidentally unmasked during review) and QI 38% (15/40 – P=.0002). The frequency of false positives was 15% for IC and 20% for QI and the frequency of false negatives was 13% for IC and 58% for QI. At our institution NI surveillance was more accurately performed by IC than QI, and subsequently no further NI surveillance was performed by QI.

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Cryptic Methicillin-Resistant *Staphylococcus aureus* (MRSA) Carried by Health Care Workers Is Representing a Possible Source of Infection of Patients.

*SILJA ADENA, GÜNTER KAMPF and HENNING RÜDEN, Institute of Hygiene of the Free University of Berlin, Germany

In a case of a nosocomial MRSA-infection the source of the strain is often unknown. Up to 80% of health care workers (HCW) on intensive care units (ICU) carry *Staphylococcus aureus* in the nasopharnyx with a small percentage being methicillin-resistant. An isolate may be methicillin-susceptible (MSSA) despite the presence of the mecA gene („cryptic" MRSA). The objective of this study was to determine the proportion of cryptic MRSA carried by HCW from ICUs and to describe the possible induction of mecA gene carrying MSSA into MRSA in vitro. Thereby a new source of MRSA-infection might be elucidated. During a period of twelve months HCW of ICUs from an university hospital and an orthopedic hospital (n=313) were screened for nasal and oropharyngeal carriage of *S. aureus* after a MRSA-infection of a patient was diagnosed. The species was identified using an agglutination test (Staphaurex Plus). Resistance to oxacillin was determined by disk diffusion (1 µg oxacillin) and oxacillin broth screening test (2 mg/l). Presence of the mecA gene was determined by PCR; clonal identity of isolates was investigated by pulsed-field gel electrophoresis (PFGE) and compared to MRSA isolates from two patients treated during this time. Induction of phenotypic resistance was attempted *in vitro* in cryptic MRSA isolates by exposure to oxacillin (256 mg/l) at 37°C for two days. MRSA was found in 0.6% (2/313) of the HCW. The overall MSSA carrier rate was 33.5% (105/313); 5.7% (6/105) were found to be mecA gene positive. MecA gene positive MSSA showed a minimal inhibition concentration (MIC) of 0.5 mg/l Oxacillin. Phenotypic resistance (MIC ≥ 32 mg/l) was successfully induced in 67% (4/6) of the cryptic MRSA. The PFGE pattern of one MRSA-isolate (patient) was identical to the PFGE pattern of one cryptic MRSA isolate (HCW). (1) MecA gene positive MSSA isolates are much more frequently found among HCW than MRSA. (2) MRSA resistance of mecA gene positive MSSA can be induced by exposure to oxacillin and (3) may therefore represent a substantial risk for patients. (4) Screening of HCW for cryptic MRSA may be therefore helpful in outbreaks where a source cannot be found.

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Value of Pre-Operative Screening for Staphylococci and Use of Broad–spectrum Antimicrobial Prophylaxis in Open Heart Surgery

Patients in a Veterans Affairs Medical Center. *J.A. SELLICK, R. NANGIA, E. WATSON, H. HAMEER. Veterans Affairs Western New York Healthcare System and SUNY at Buffalo, Buffalo, NY.

A series of patients with *Staphylococcus aureus* (SA) surgical site infections (SSI) following open heart surgery (OHS) prompted two major changes in the OHS program at the Buffalo/VAWNYHS ~5 yr ago. First, all OHS pts have preoperative nasal and throat swab cultures and sputum cultures to screen for SA. Second, all OHS pts receive perioperative antimicrobial prophylaxis with ceftriaxone (CRO)+vancomycin (VAN). The appearance of vancomycin resistant enterococci and the need for cost–effective programs prompted review of both changes in 1996. Records of 87 pts having OHS between 10/1/95 and 4/19/96 were reviewed and 2 (operative death, incomplete records) were excluded. Among 85 pts, there were no sternotomy wound SSI and 11 episodes of SSI or cellulitis of the vein donor wound. 5 were due to methicillin susceptible SA (MSSA), one to methicillin resistant SA (MRSA), one to *Proteus/Serratia/Enterococcus* and 4 had no or negative cultures. 5 of the 11 pts with SSI had nasal swabs (+) for MSSA but only 2/5 had SSI due to MSSA. None had MSSA in throat swabs and 2/5 also had MSSA in sputum. None of the 11 had MRSA from any swab. Among 74 uninfected pts, 15 (11 nose, 2 throat, 4 sputum) had swabs (+) for MSSA. One had a swab pos for MRSA. Having a (+) swab did not correlate with having SSI due to SA (p=0.6, Fisher's Exact test) and the postive predictive value of a (+) swab was only 9.5%. 82/85 pts received CRO and 79/85 received VAN. All pts with SSI got CRO and all pts with SSI due to SA got VAN. We conclude that pre–operative screening for SA at this facility appears unjustified. Likewise, CRO+VAN appears unnecessary and may not be more effective than a 1st or 2nd generation cephalosporin. Revised protocols will be developed using these data.

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Methicillin-resistant Staphylococcus aureus (MRSA) and Antimicrobial Use in Belgian Hospitals.

NATASHA S. CROWCROFT, OLIVIER RONVEAUX, DOMINIQUE L. MONNET, RAF MERTENS, Scientific Institute of Public Health - Louis Pasteur, Brussels Belgium and National Centre for Hospital Hygiene, Statens Serum Institut, Copenhagen, Denmark.

The links between antimicrobial use and MRSA are complex. We investigated the relationship between the incidence of MRSA and the use of different classes of antimicrobials using data from 50 Belgian hospitals. The number of new nosocomial MRSA colonised or infected patients in 1994 and 1995 was obtained from the national MRSA surveillance programme. We used Pearson correlation coefficients to compare this information with antimicrobial use data from the National Institute for Sickness and Disability Insurance. Relationships between different classes of antimicrobials were evaluated in a correlation matrix. MRSA incidence, antimicrobial use and potential confounding factors were included in a multiple linear regression analysis. The use of a number of different classes of antimicrobials was interrelated. In the multivariate analysis, the incidence of nosocomial MRSA increased with increasing use of ceftazidime and cefsulodin (p=0.0003), broad spectrum penicillins with beta-lactamase (p=0.02) and quinolones (p=0.005). No association was found between MRSA incidence and total antimicrobial use. Advice for preventing and controlling MRSA has focused on hygiene measures and precautions to avoid cross-transmission. Further evidence is needed, through studies such as this one, on the role of antimicrobial pressure in generating MRSA.

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Usefulness of a Commercially Available Software Package for Fingerprinting Isolates of Methicillin Resistant *Staphylococcus aureus* (MRSA)

*G PETERS, B HARMER, R LANNIGAN, M A JOHN, London Health Sciences Centre and University of Western Ontario, London, Ontario.

Pulsed Field Gel Electrophoresis (PFGE) is one of the most widely used techniques for fingerprinting of bacteria for epidemiological purposes. Some limitations to this technique still exist however; differences in electrophoresis can complicate comparison of DNA banding patterns, so that reliable comparison of two or more isolates may require that they be run on the same gel. Also, as the number of strains typed increases, a large database of DNA banding patterns may accumulate, making visual comparisons to match isolates more difficult. For two years we have used a commercially available software package for the analysis, storage and retrieval of DNA patterns obtained by PFGE on MRSA isolates. All MRSA isolates from our institution and referred in isolates were typed by PFGE, following digestion of cellular DNA with *Sma* I. RFL patterns were recorded by a scanner linked to a computer and stored as bitmap image files. Tracks were processed using the software package to "normalize" the gels, using reference patterns run on each gel and realigning test tracks to these standard patterns. Strains were classified as identical, sub-types of strains, or different strains using published criteria. Over the two year period 45 distinct strains or sub-types of strains were identified and entered into the database. Newly run isolates were then compared with this library using the software. The system was able to reliably identify the same isolate run on different gels as being the identical strain. Comparison of new isolates with the library entries identified the correct strain types with no errors. Searching of the library with a sub-type of a strain always identified the "parent" strain correctly, although the specific sub-type was sometimes only given as second or third choice if differences are small. We find that this system allows us to easily and reliably compare strains run at different times and also to maintain a reference library of historical isolates to which the computer can match new isolates.

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Twice Monthly Nasal Mupirocin (MUP) Maintenance Regimen (MR) After Eradication of *S. aureus* (SA) Nasal Carriage in Peritoneal Dialysis (PD) Patients.

*J. MYLOTTE State Univ. of New York at Buffalo and Erie County Medical Center, Buffalo, NY.

Background: SA Peritonitis (Per) and exit site infections (ESI) are common in PD patients. Eradication of SA nasal carriage reduces the rate of these infections but recolonization occurs unless a MR is used. Topical application of MUP successfully eradicates nasal SA carriage in PD patients and several MRs have been studied. A concern has been development of resistance to MUP. The minimum amount of nasal MUP necessary to maintain PD patients free of nasal SA carriage remains uncertain. Objective: To determine if twice monthly MUP applications to the nares of PD patients (after an initial eradication regimen) will maintain them free of SA nasal carriage. Design: Prospective, open, nonblinded study. Methods: Nasal cultures for SA were performed monthly in all PD patients from April 1996 to November 1997. After informed consent was obtained, carriers were treated with an eradication regimen (MUP to nares BID for 5 days) and then a MR (MUP BID for one day twice monthly). Rates of infection are reported as # of infections per 100 dialysis months. Results: 18 patients have been enrolled; 13 remain in the study. 3 patients had one follow-up nasal culture positive for SA but none developed infection. 4 patients developed SA infection but were not recolonized with SA. Mean (± SD) # months free of SA nasal carriage was 6.1 ± 5.6 (median, 3.5; range, 1-16). The overall infection rate (Per plus ESI), Per rate, and SA Per rate showed no significant change; the ESI rate significantly decreased (P = .03) but the SA ESI rate showed only a downward trend (P = .20). The % infections caused by SA in the study population did not change significantly during the study period. Conclusions: After eradication of nasal carriage, the twice monthly MUP MR was successful in keeping most PD patients free of carriage for an average of 6 months. There was a significant decrease in the ESI rate overall as but this was due only in part to a decline in the SA ESI rate. The overall number of episodes of SA infection of all types did not significantly change. MUP susceptibility testing of SA isolates has not been done but the twice monthly MUP regimen may reduce the risk of resistance developing.

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Determination of a Screening Method for Glycopeptide-Intermediate *Staphylococcus aureus* (GISA) and Other Staphylococci Using Mueller-Hinton Agar.

S. K. HUBERT, C. D. STEWARD, F. C. TENOVER, *J. E. MCGOWAN, JR., Emory Univ. and CDC, Atlanta, GA.

Recently, isolates of *Staphylococcus aureus* with decreased susceptibility to glycopeptide antimicrobial agents, such as vancomycin and teicoplanin, have emerged in the United States. Currently, Brain-Heart Infusion Agar (BHIA) supplemented with 6 µg/ml of vancomycin is the standardized screening method for vancomycin-resistant enterococci (VRE). However, no method exists to screen for glycopeptide-intermediate *S. aureus* (GISA) or other staphylococci. For this study, thirteen well-characterized isolates of staphylococci (9 *S. aureus*, 3 *S. epidermidis*, and 1 *S. haemolyticus*) with broth microdilution MICs ranging from 2-8 µg/ml for vancomycin were tested. These isolates included the Michigan, New Jersey, and Japan strains of *S. aureus* characterized at the CDC. Mueller-Hinton Agar (MHA) was chosen as the test medium because it readily supports the growth of staphylococci, is well standardized, commercially available, and easily prepared. The isolates were tested against two lots each of five different manufacturers of MHA (Accumedia, BBL, Difco, Oxoid, and Remel) supplemented with 3, 4, 5, or 6 µg/ml of vancomycin. In addition, the isolates were tested on standard BHIA VRE screen plates. All test plates were incubated at 37° C and read at 24 and 48 hours for the presence or absence of growth. The isolates with known decreased susceptibility to vancomycin grew consistently on all lots from all manufacturers of MHA supplemented with 5 µg/ml of vancomycin, while all susceptible staphylococci failed to grow. Breakthrough growth of susceptible isolates occurred on plates with 3 and 4 µg/ml of vancomycin with some media lots. Most isolates with MICs of 8 µg/ml did not grow on MHA plates containing 6 µg/ml of vancomycin from certain manufacturers. Based on the results of this study, MHA supplemented with 5 µg/ml of vancomycin should be effective for screening GISA isolates in the clinical microbiology laboratory or other settings.

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Nosocomial Infection Surveillance Results in a Newborn Nursery: 1995-1997. *B COIGNARD, N KACET, A LISKA, MO HUSSON, P LEQUIEN, B GRANDBASTIEN. Lille University Hospital, Lille, France.

Introduction: The newborn nursery of the University Hospital of Lille introduced nosocomial infection (NI) surveillance in June, 1995. The study objectives were to measure NI incidence, to identify risk factors for NI, to monitor antibiotic use, and to increase awareness of staff. We present here the results of the first 2-year study. Methods: The surveillance is a clinical, active, continuous, and prospective process. Indicators include incidence densities (ID). Results: 1837 infants were admitted, accounting for 31903 patient days (ptd). 1006 (55%) were hospitalized during their first week (wk) of life. Among these, the median gestational age was 34 wk (range: 23-44), median birthweight was 1970 g (range: 470-5000). 671 (37%) infants stayed at least once in the intensive care unit (ICU) for 7959 ptd. 569 (31%) required mechanical ventilation (v) for 5533 v days, and 690 (38%) needed central vascular catheter (cvc) for 11501 cvc days. 250 infants developed 350 NI, of which 151 (43%) were severe (pneumonia, bacteremia, enterocolitis, and meningitis). The overall ID was 11/1000 ptd $_{IC95}$ [10-12] whereas in the ICU, the ID was 14/1000 ptd $_{IC95}$ [12-16]. The most frequent NI sites were conjunctivitis (27%), primary bacteremia (20%), gastrointestinal tract infections (13%), pneumonia (12%), catheter-associated bacteremia (11%), mucocutaneous infections (9%). ID of catheter-associated bacteremia was 3/1000 cvc days $_{IC95}$ [2-4] and that of pneumonia was 4/1000 v days $_{IC95}$ [2-6]. In 19% of NI, no organism was isolated. The remaining 282 NI were related to 310 organisms with Gram-positive cocci (53%) and *Staphylococcus epidermidis* (33%), Gram-negative bacilli (20%), viruses (18%), and yeast (7%). When tested, resistance to methicillin among *S. epidermidis* isolates was 72%. Median time before the first NI was 22 days. NI, accounting for 43% of the 16505 treatment days, were the major reason for antibiotic use. Plotting monthly ID over time showed neither significant trend nor noticeable peak. Among infants hospitalized during their first wk of life, ID were higher if gestational age was less than 33 wk (14 versus 9/1000 ptd, p<0.001) or if weight was less or equal than 1500 g (15 versus 9/1000 ptd, p<0,001).

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An Outbreak of *Serratia marcescens* (SM) Conjunctivitis in a Neonatal Care Unit (NCU): Genotypic Link to an Environmental Source. C.CARLYN[1]*, J. SIMMONDS[2], S. KONDRACKI[2], D. SCHOONMAKER[1], R.GALLO[2], D. MORSE[1] Wadsworth Center[1], Bureau of Communicable Diseases, NYSDOH[2], Albany, APIC, Past President Mid-Hudson, NY[2].

We used pulsed-field gel electrophoresis (PFGE) to investigate an outbreak of SM conjunctivitis occurring on 2 NCUs in a 280 bed hospital in NYS in 1997. Because SM can spread rapidly, cause morbidity and mortality and remain endemic in a NCU for a prolonged period, an epidemiologic investigation was conducted to identify cases, describe risk factors, determine the source and implement control measures. A retrospective cohort study of all 161 infants born during the period (5 culture confirmed and 156 noncases) showed prematurity (RR=124.8), respiratory distress (RR=67.6), low birth weight (RR= 58.9), sepsis (RR=46.8), pre-eclampsia (RR=35.1), residence in NCU A (RR=22.8) and history of cesarean section (RR=8.4) to be potential statistically significant risk factors for SM infection. Case numbers were too small to perform multivariate analysis. PFGE of 27 SM isolates showed 9 types and 3 subtypes. Ten isolates from 4 of the infant cases and 3 of 4 isolates from the nursery A sink had the same PFGE pattern suggesting a common source. The sink specimen revealed 2 PFGE types; disclosing the outbreak pattern only when several like colonies were sampled. A fifth infant's isolate from nursery B, 7 other NCU environmental isolates and 5 isolates from patients not linked to the outbreak had patterns distinct from the case strain. Intervention included replacing the sink, altering a bath practice, antibiotic treatment of cases, and closing and cleaning the unit. The outbreak was terminated at 30 days. This study demonstrates the need to sample morphologically identical colonies from an environmental source likely to be populated with a mixture of organisms when cross-contamination is suspected. It is one of the first reports of a neonatal outbreak by SM limited to conjunctivitis involving infants who were modestly immune suppressed where early recognition of a genotypic link coupled with control measures may have averted a more serious situation.

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Cystic Fibrosis (CF) Patients (Pts) Do Not Contaminate Their Environment During Exercise. *LOREEN HERWALDT, LINDA BOYKEN, RICHARD AHRENS. Departments of Internal Medicine and Pediatrics, Univ. of Iowa, Iowa City, IA, USA.

Cardiac rehabilitation staff in our hospital questioned whether it was safe for CF pts to use common exercise equipment. Therefore, we conducted this study to determine whether CF pts contaminated the environment with viable organisms when they exercised. We studied 15 CF pts who were admitted for treatment of acute pulmonary exacerbations. We cultured their hands before and after exercise, the pulse oximeter and the handles of the exercise equipment before and after each pt exercised, the air 36" from each pt's mouth during maximal exercise and while the pt was coughing, and the physical therapists' hands before and after each pt exercised. Quantitative sputum cultures were obtained during routine clinic visits and during exacerbations. Organisms present at >10^6 CFU/ml were stored. *P aeruginosa* (PA) and *S aureus* (SA) isolates were typed by pulsed field gel electrophoresis (PFGE). Isolates were considered to be identical if all bands matched, subtypes if 1-3 bands differed, and different strains if >3 bands differed. Of 15 pts, 10 were male. The median age was 27 years. On admission, the pts carried: classical PA (CPA) [n = 4], mucoid PA (MPA) [n = 7], CPA and MPA [n = 3], and CPA and SA [n = 1]. All environmental cultures were negative for PA and SA except 3 air cultures. Two air cultures from pts who were coughing each had 1 colony of MPA. PFGE revealed that these isolates matched those the pts had in their sputum specimens. One air culture grew 1 colony of a mucoid *Pseudomonas* species not found in the pt's sputum. One post-exercise hand culture had 1 colony of MPA but this isolate did not yield an interpretable PFGE pattern. One pre-exercise hand culture grew 82 colonies of SA and 1 physical therapist had >300 colonies of SA on her hands after a pt exercised but neither of these organisms were found in the pt's sputum. Unrelated pts did not share strains. CF pts admitted for acute pulmonary exacerbations did not contaminate the environment with their PA or SA strains while exercising. Our data indicate that physical therapy departments do not need special infection control precautions for CF pts who are infected with PA or SA and that CF pts can use common exercise equipment.

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Decreasing Bloodstream Infection Rates in Very Low Birthweight Infants withTopical Ointment Therapy M. WALLACE, MS*,CIC, S. LINDADO, RN, BSN, A. BEDRICK, MD, C. MORAVEC, MD, S. NIETO, RN, BA Franklin Square Hospital Center, Baltimore, MD

Objective: To examine the effects of a preservative-free, petrolatum topical ointment on bloodstream infection rates in a neonatal intensive care unit. **Design:** Sequential, prospective study using a continuous quality improvement approach. **Methods:** CDC definitions for nosocomial bloodstream infection (BSI) in <1 year infants were used. Rates of bacteremia were expressed as the number of bacteremias per 1000 patient days. **Setting:** A 21 bed Level III neonatal intensive care unit (NICU) in a community teaching hospital. **Patients:** All infants less than 1500 grams (n=94) admitted between December 1994 and February 1997. **Interventions:** Numerous interventions were instituted to reduce endemic BSI. These measures included gloving for all infants under 1500 grams, using chlorhexidine as a skin antiseptic prior to intravenous line placement, maximal barrier precautions for central line insertion, the use of a dedicated IV access cart, and increased emphasis on handwashing. Despite these measures, the endemic BSI rate did not decrease significantly. Starting in May, 1996 twice daily application of Aquafor ointment was instituted. The ointment was applied to the entire body except the face and scalp. **Results:** After instituting the use of Aquafor, BSI rates decreased from 12.7 BSI/1000 patient days (12/94 to 4/96) to 5.4 BSI/1000 patient days (p< .02). Treated infants had decreased skin breakdown and no adverse reactions to the ointment **Conclusion:** Topical ointment can decrease the risk of BSI among very low birthweight infants. We propose that topical ointment improves neonatal skin integrity, and enhances the premature infants non-immune defenses to infection.

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Aquaphor as a Source of Colonization and Subsequent Bloodstream Infections Among Very Low Birthrate Neonates. *KEITH M. RAMSEY, SUSAN G. MALONE, PAUL D. FEY, MARK E. RUPP, BETH GLOVER, CHARLES R. HAMM, JR., FABIEN G. EYAL. University of South Alabama, Mobile, AL, and University of Nebraska Medical Center, Omaha, NE.

Blood stream infections (BSI) are the most frequent site of nosocomial infection among neonates in High-risk nurseries (HRN). Coagulase-negative Staphylococci (CONS) are the most common etiologic agents responsible for BSI associated with umbilical or central venous catheters. In 1997, physicians in the HRN reported a shift in the epidemiology of overall infections and specifically BSI to predominantly gram-negative organisms among infants < 1000 gms. Ongoing surveillance utilizing the National Nosocomial Infection Survey (NNIS) detected significant increases in BSI per 1000 day to 19.8 (range 21.1-72.6) or p<0.01 over the NNIS rate of 12.9, despite no increases in device utilization. A retrospective survey suggested Aquaphor solutions (utilized to decrease insensible losses only among the < 1000 gm infants) as a potential source of contamination. A prospective study detected colonization of Aquaphor solutions with CONS and gram-negative organisms, which were followed by BSIs with the corresponding organisms among six neonates. The bacterial isolates recovered from the bloodstream and the Aquaphor were compared by analysis of *Sma*I restriction fragment length polymorphism pattern by pulsed-field gel electrophoresis and shown to be identical or closely related. A change in the procedure of the use of Aquaphor solutions resulted in both a decrease in BSIs, and a return of CONS as the predominant organism causing BSIs in the < 1000 gm neonates. We conclude: (1) Aquaphor solutions may represent a new source of infection among infants < 1000 gms; (2) Daily preparation and subsequent discarding of the Aquaphor solutions effectively eliminated this source of subsequent BSIs.

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Successful Control of an Outbreak due to Vancomycin-Resistant Enterococci in a Neonatal Intensive Care Unit. M.E. RUPP*, N. MARION, P.D. FEY, P.C. IWEN, D.L. BOLAM, C.M. OVERFELT, L. CHAPMAN. The University of Nebraska Medical Center, Omaha, Nebraska.

Although the prevalence of vancomycin-resistant enterococci (VRE) is increasing, there is relatively little experience with VRE in neonates. At our institution we have encountered VRE in adult patients since 1993, but had not observed VRE in neonates. In Sept 1997 we experienced a VRE outbreak in a 34-bed neonatal intensive care unit (NICU). The outbreak strain was *Enterococcus faecium* with a *Van*B phenotype. The isolates also exhibited high-level resistance to ampicillin and aminoglycosides. From 9/5/97 to 10/1/97, 25 neonates became colonized with VRE. No neonate experienced an invasive infection. Colonized neonates were cohorted, and strict barrier precautions, including handwashing with an antiseptic soap and use of gowns and gloves, were instituted. Weekly patient colonization prevalence surveys and environmental contamination surveys were performed. Environmental decontamination was performed TID. VRE isolates were characterized by PFGE analysis of *Sma*I RFLP patterns. In response to the control measures, the weekly VRE neonatal colonization prevalence declined as follows: 41%, 59%, 41%, 21%, 17%, 17%, 15%, and 0%. The weekly VRE environmental prevalence declined as follows: 8%, 4%, 8%, and 0%. Within 6 weeks of institution of control measures, no additional VRE colonized neonates or positive environmental cultures were identified. A VRE surveillance program was instituted which has subsequently identified 3 colonized neonates. Isolation measures and decontamination procedures were promptly used and secondary spread was prevented. We conclude that epidemic VRE can be controlled in specific areas of an institution with endemic VRE. Surveillance systems can serve as "early warning" systems to prevent additional VRE outbreaks.

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Seasonal Variation of *Acinetobacter* spp. Infections Reported to the National Nosocomial Infection Surveillance (NNIS) System:1987-1996. *L.C. MCDONALD, S.N. BANERJEE, W.R. JARVIS and NISS. Hospital Infections Program, Centers for Disease Control and Prevention, Atlanta, GA.

Increased reports of outbreaks caused by *Acinetobacter* spp. (ACN) suggest infections due to these pathogens are increasing. It is unknown whether this increase represents reporting bias; there are alarming reports of multidrug resistance in ACN. NNIS data for 1974-77 suggested that ACN infections occurred at a steady annual rate with an unexplained seasonal increase in the number of infections during summer months. To determine whether ACN infections have increased over the past 10 years and whether infections continue to have a pronounced seasonal variation, we reviewed ACN infections reported to NNIS during 1987-96. During this period, 2,650 nosocomial ACN infections were reported by NNIS hospitals, which performed hospital-wide surveillance on 5,519,936 patients. With a mean of 5 infections (range 4.0-6.1) per 10,000 discharges, there was no upward trend over the past 10 years in the rate of ACN infections overall, or by major infection sites: bloodstream (BSI), mean 0.7, range 0.6-0.9; urinary tract (UTI), 0.9, 0.6-1.3; surgical site (SSI), 0.6, 0.4-1.0; and pneumonia (PNE), 1.7, 1.3-2.1. However, the rate of ACN infections increased sharply in late summer months throughout this period; seasonal variation is demonstrated by comparing rates for July-October with remaining months for ACN infections overall (6.3 vs 4.1, p<0.001) and all major infection sites: BSI (1.0 vs 0.6, p<0.001), UTI (1.3 vs 0.7, p<0.001), SSI (0.8 vs 0.5, p<0.001), and PNE (2.0 vs 1.6, p<0.001). Additional studies of this seasonal variation examining potential risk factors such as weather conditions, hospital ventilation systems, and water supply may result in control measures to prevent seasonal increases in ACN infections.

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An Investigation of the Relationship of Colonizing and Infecting Nosocomial *Acinetobacter anitratus* Isolates. *GIANNA ZUCCOTTI and BRIAN P. CURRIE, Albert Einstein College of Medicine and Montefiore Medical Center, Bronx, NY.

A. anitratus has emerged as an important nosocomial pathogen in many hospitals. An understanding of the risk factors associated with *A. anitratus* colonization and infection and the relationship between colonizing and infecting isolates could provide guidance for developing effective interventional infection control strategies. In order to investigate these issues, 67 patients were randomly chosen from all hospitalized patients that had any culture positive for *A. anitratus* during 6/1/95 to 9/30/97 at our hospital. Chart review using CDC NNIS criteria for nosocomial infection identified 32 patients with *A. anitratus* infection and 35 with *A. anitratus* colonization. The anatomic site of infection or colonization was very similar for infected and colonized patients (pneumonia/sputum col - 53.2%/71.5%; UTI/urinary col - 15.7%/14.3%; wound inf/wound col - 3.2%/8.6%). All patient isolates were PFGE strain-typed and subjected to antibiotic sensitivity testing. Multiple antibiotic resistance was defined as sensitive to ≤2 antibiotics. 60% of colonizing and 65.6% of infecting isolates were determined to be multiple antibiotic resistant. 2 PFGE patterns were shared by 51.5% of colonizing and 52.7% of infecting isolates. The remaining isolates were determined to be genetically unique. Case-control analysis indicated that infected patients were no more likely than colonized patients to have been on mechanical ventilatory support, to have had tracheostomy placement, to have undergone prior endoscopy or to have received prior broad spectrum antibiotic therapy. Infected patients were more likely to have been in an ICU setting (MICU, SICU, PCU and CCU) than colonized patients (O.R. = 3.2, P = 0.04). This suggests that infection is related to severity of underlying illness. These data suggest that colonizing isolates can be a reservoir for *A. anitratus* infection, that there is no evidence for differences in virulence among *A. anitratus* strains and that the progression of *A. anitratus* colonization to infection is most likely determined by host factors.

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Occurrence of *Acinetobacter* genomic species in patients, the environment, and on hands of staff of an ICU: a two-years' ecological study. *ALEXANDRA T. BERNARDS, LENIE DIJKSHOORN, TANNY J.K. VAN DER REYDEN and CEES P.A. VAN BOVEN, Leiden University Medical Centre, Leiden, The Netherlands.

Acinetobacter is a nosocomial pathogen of increasing importance. The genus comprises at least 18 genomic species (gen. sp.) of which *A. baumannii* is most often encountered in hospital outbreaks. Little is known of the occurrence of the various genomic species in the hospital environment. A two-year study was undertaken to investigate the occurrence of *Acinetobacter* in an ICU of a Dutch hospital. Patients, the environment, and hands of staff were sampled at three monthly intervals. Clinical isolates from patients were also included. Isolates were identified using amplified ribosomal DNA restriction analysis (ARDRA), and comparatively typed using cell envelope protein profiling and PCR fingerprinting with primers M13 core and DAF4. A total of 460 isolates were obtained, 37 from clinical patient samples, 86 from patient surveillance samples, 243 from environmental sites, and 18 from hands of staff. One outbreak occurred, caused by a strain of genomic species 13TU, lasting five months. During the non-outbreak period, nine different genomic species were found in patient clinical samples, none predominating. *A. baumannii*, gen. sp. 3 and 13TU (*Acb*-complex) were found in the environment only when patients colonized with them were present. *A. johnsonii* and *A. lwoffii* were found on patients' skin sites and in the environment, mostly in dry sources. A variety of strain types were found among the latter two species none of which predominated. *A. junii*, and gen. sp. 10 and 11 were predominantly found in the environment and occasionally in patients. These three genomic species each comprised one predominating strain type, present throughout the study period. Gen. sp. 10 and 11 were most often found in wet sites. It is concluded that acinetobacters are omnipresent in the hospital, but that the genomic species vary with regard to their ecological niche. Since the genomic species of the *Acb*-complex were clearly patient-associated, it is likely that outbreaks follow introduction of strains by patients and do not originate from the hospital environment.

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A Nosocomial Outbreak of Acinetobacter baumanii in a University Hospital. RANA CHAKRABORTY*, BART HOLLAND, EILEEN FINERTY, KEISHNI FERNANDO, SHAHEEN TIMMAPURI, DENNIS DIAWATAN, DAFER AL-HADDADIN, UMD/New Jersey Medical School, Newark, New Jersey

OBJECTIVES: To identify possible risk factors associated with the nosocomial acquisition of Acinetobacter baumanii (Ab) during a hospital outbreak and to evaluate effectiveness of infection control measures in containing its spread. **DESIGN:** A retrospective case-controlled study involved reviewing medical, infection control and microbiology records of patients in whom Ab had been isolated from clinical specimens. Case patients were compared with a non-infected, non-colonized control group hospitalized in similar clinical settings at the time of the outbreak. Results were expressed as the mean +/- SD. Differences in characteristics between the two groups were tested by chi square and t-tests. **RESULTS:** Between October 1996 and June 1997, 73 patients were colonized or infected with Ab. Forty-seven were identified from September to December, Ab was detected in a further 26 patients from March to June 1997. A total of 170 specimens grew Ab. Seventy-one percent of cultures (120/170) were found in surgical units. Eighty-six isolates (51%) were from the sputum and respiratory tract, 36 from the urine (21%), and 30 (17%) from wound and abscess sites. Only 8 were blood isolates. Minimal inhibitory concentrations (MICs) showed that 34% of patients (25/73) at some point harbored Imipenen-resistant Ab. Factors associated with the acquisition of Ab included prolonged length of stay (mean of 45.5 days vs. 15.7 days in Ab positive (+) and Ab negative (-) patients, respectively), use of central catheters (p=0.0003), total parenteral nutrition (p=0.001) mechanical ventilation and tracheostomy (p=0.00005). Other risk factors included multiple and prolonged use of antibiotics (p=0.000001 for each). Multi-drug resistant Ab was isolated from 10 specimens with the same banding pattern by pulse-field gel electrophoresis (PGFE) in surgical intensive care unit (SICU) in-patients, suggesting cross contamination. Use of standard infection control measures were effective in controlling the outbreaks in both medical and surgical floors, with only sporadic cases occurring. **CONCLUSION:** 1) Ab is becoming an important and common nosocomial pathogen. 2) Infection and colonization appears most often in surgical units. 3) Multi-drug resistant Ab was frequently isolated. 4) Risk factors associated with the outbreaks were mostly related to prolonged hospital stay in debilitated patients requiring intensive acute medical care. 5) The mode of spread of Ab was facilitated by personnel.

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Molecular Epidemiology of Multiple Antibiotic Resistant (MAR) *Acinetobacter anitratus* Isolates at a Single Hospital. *GIANNA ZUCCOTTI and BRIAN P. CURRIE, Albert Einstein College of Medicine and Montefiore Medical Center, Bronx, NY.

Isolates from 75 patients randomly chosen from among 105 patients hospitalized at our institution with any positive culture for *A. anitratus* from 6/1/95 to 9/30/97 were analyzed. 93 isolates were subjected to PFGE typing and antibiotic sensitivity testing (MAR isolates were defined as sensitive to ≤ 2 antibiotics). PFGE typing identified 32 patterns and 64% of patients were infected or colonized with MAR strains. 2 PFGE patterns accounted for 73% of patients with MAR isolates and defined 2 temporally distinct patient clusters that had not been previously detected (12 Type A - Jan-July 1995 and 23 Type B - 8/96-8/97). Chart review of 67/75 patients and case-control analysis indicated the recovery of both MAR Type A and B strains was strongly associated with prior broad spectrum antibiotic use. In addition, MAR Type A strains were more likely to come from patients who shared geographically and temporally overlapping hospitalization experiences than among controls (O.R. = 33, P = .003). The likely spread of MAR Type A isolates by horizontal transmission was further supported by the fact that these isolates were no longer recovered after the initiation of contact isolation precautions in 1995 of all patients with MAR *A. anitratus* isolates. In contrast, MAR Type B isolates occurred in spite of continued contact isolation precautions. The recovery of MAR Type B isolates was not associated with overlapping hospital experiences with other MAR Type B patients, but there seemed to be a trend for MAR Type B isolate recovery to be associated with previous exposure to the MICU environment (O.R. = 5.5, P = .07). This study documents two sequential clonal outbreaks of MAR *A. anitratus* at a single institution, one sustained by horizontal transmission and another apparently sustained by patient exposure to an environmental reservoir in the MICU, and suggests that MAR *A. anitratus* control in a hospital may potentially require a variety of interventions including antibiotic control activities, the interruption of horizontal transmission and the identification of potential environmental reservoirs.

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Standardization of PCR-based Fingerprinting of Nosocomial Pathogens: Prospects of the Exchange of Digital Typing Data.

HAJO GRUNDMANN[1]*; KEVIN J TOWNER[2], MARC STRUELENS[3] and the Acinetobacter Study Group[4]. [1] University Hospital Freiburg, Germany; [2] University Hospital Nottingham,UK; [3] Hospital Erasme Bruxelles, Belgium; [4] L. DIJKSHOORN, P. GERNER-SMIDT, M. MAHER, H. SEIFERT, M. VANEECHOUTTE.

Aims: DNA fingerprinting based on PCR (AP-PCR, RAPD, rep-PCR, ERIC-PCR) is increasingly used in descriptive hospital epidemiology. The reproducibility of patterns between different laboratories however, has been repeatedly called into question. We investigated if strict standardization of protocols, reagents, and data analysis generated sufficient reproducible typing results that would enable unequivocal strain identification and digital data exchange between different laboratories.

Methods: Seven laboratories in six European countries examined (in duplicate) 40 isolates belonging to the *Acinetobacter calcoaceticus-baumannii* complex using four different PCR protocols. The primers were M13, DAF4, ERIC, REP1+REP2. Reproducibility was assessed in three ways: (i) by isolate groupings determined independently by each participant, (ii) centrally, by parallel analysis of the actual PCR products generated by the individual laboratories using sequencing gels and automated laser flourescence (ALF) analysis, and (iii) by comparing the digital ALF data generated independently for the duplicates in two different laboratories after exchange via electronic mail.

Results: The epidemiological conclusions reached by the participating laboratories were substantially correct, with 96.4% of the total isolate groupings agreeing with the consensus view. High resolution ALF analysis of the independently generated PCR products grouped between 96.4 and 98.9% (depending on the primer used) of all isolates correctly and the pattern similarity of isogenic isolates ranged between 83.3 and 86.6%. The pattern similarity of the duplicate PCR products analysed independently by ALF in two laboratories varied between 75.7 and 83.8%.

Conclusion: It was concluded that independently produced PCR fingerprint patterns can be obtained reproducibly for *Acinetobacter* spp. if standardized protocols and quality controlled reagents are used and that digital exchange of typing data via internet may become feasible once agreement on equipment, standards and data format has been reached.

61 Epidemiology of Penicillin Resistant Pneumococci (PRP) in Erie County, New York. M.L.STOCK, *M.D. ANTALEK, J.L. FROST, D. TRISTRAM, J.A.SELLICK. SUNY at Buffalo, Millard Fillmore Health System, Mercy Hospital, Buffalo General Health System, Childrens Hospital of Buffalo, Buffalo, NY.

PRP (penicillin MIC≥0.1μg/ml) have become an increasingly important problem in the US. This study was done to estimate the local occurrence of PRP.The laboratories of 7 Buffalo/suburban hospitals saved all clinical specimens of pneumococci in January/February 1997. Isolates were sent to a central lab where identity was confirmed and susceptibility to penicillin and other agents was determined by E–test. 89 isolates were obtained and 21 (23.6%) were PRP. The 21 PRP were very resistant to other commonly used antibiotics: TMP/SMX 43%, ceftizoxime 43%, erythromycin 38%, azithromycin 38% and cefprozil 19%. These all were significantly higher than for penicillin susceptible strains. No PRP were rifampin or vancomycin resistant. Clinical data were obtained on 63 patients including 14 with PRP. There were no statistically significant differences between PRP and susceptible pneumococci for the following: specimen source, whether the specimen was from a polymicrobial infection, source patient demographics (location, age, gender) or source patient clinical profile (underlying illness, prior hospitalization, need for intensive care/mechanical ventilation, mortality.) PRP source patients were more likely (64 *vs* 27%, RR=3.26, 95%CI=1.25, 8.46) than those with susceptible pneumococci to previously have received antibiotics. While this study was limited in time and scope, it showed that during the first two months of 1997, the proportion of pneumococci which were PRP and the levels of resistance of PRP to other agents was higher than generally acknowledged in the Buffalo area. The presence of PRP and their overall susceptibility profile will likely drive changes in antibiotic use toward newer agents. However, excessive use of these and other agents likely will foster further resistance to them.

62 Unusual risk factors for Group B streptococcal (GBS) bacteremia among non-pregnant adults in a community hospital cohort. *WEHBEH WEHBEH, SORANA SEGAL-MAURER, JANICE BURNS, JAMES J. RAHAL JR, The New York Hospital Medical Center of Queens, Flushing, New York.

Invasive Group B streptococcal (GBS) infection is a common cause of serious disease among neonates and pre/post-partum females. However, a recent increase has occurred in the incidence of invasive GBS infection in non-pregnant adults associated with increased morbidity and mortality. We undertook a three year, retrospective review of GBS bacteremias at our 487-bed university-affiliated community hospital, excluding cases in neonates and pregnant or post-partum females. Twenty-six patients (15 M, 11F) were analyzed. Twenty-two patients were over age 60 with ten over age 80. Common underlying diseases were cardiac (valvular disease, coronary artery bypass grafts, prior endocarditis)-11, neurological events (Parkinson's, stroke, dementia)-8, diabetes-7, malignancy-8, chronic renal insufficiency-7. The most common admitting diagnoses were intestinal disease (cholecystitis, hemorrhage, diverticulitis, diarrhea)-8, pneumonia-6, skin/bone/or soft tissue infections-6, primary bacteremia of unclear etiology-7, urinary infection-3, possible infectious endocarditis-2. Prolonged antibiotic therapy(>14 days) was given to 14 of 26 patients (4 with clinically diagnosed infectious endocarditis). Nine patients expired within 21 days of admission (4 within 7 days of admission). Colonoscopy had been performed on three patients (1M, 2F) with primary bacteremia or suspected endocarditis within 14 days prior to admission. All had diverticular disease and a polyp was removed from one. None of the three patients received endocarditis prophylaxis prior to colonoscopy and all had valvular abnormalities on transthoracic echocardiography. This finding suggests that the intestinal tract may be a reservoir for GBS in adults, and that an association may exist between intestinal pathology and GBS bacteremia with possible endocarditis.

63 Determining the Significance of Coagulase-Negative Staphylococci (CNS) Isolated from Blood Cultures at a Community Hospital: A Role for Species Level Identification. S.D. KIM, *L.C. MCDONALD, J.M. MILLER, S. MCALLISTER, R. JERRIS, W.R. JARVIS. Centers for Disease Control and Prevention (CDC), Atlanta, GA and Dekalb Medical Center, Decatur, GA.

CNS are a leading cause of bloodstream infection (BSI) in U.S. hospitals. However, CNS from the skin frequently contaminate blood cultures making their interpretation difficult. The misinterpretation of CNS blood culture contaminants is costly and contributes to unnecessary antimicrobial use. Although blood culture contaminants more likely consist of different species of CNS isolated from successive cultures, the National Nosocomial Surveillance (NNIS) System definition of BSI does not require identical CNS species from successive cultures; many clinical laboratories do not report species-level identification of CNS. To determine whether species-level identification could improve the interpretation of blood culture isolates, we reviewed clinical and laboratory findings in a subset of patients identified during a 6 month community hospital survey in which all CNS blood culture isolates were saved and later identified to the species level at CDC. Of 171 patients with blood cultures reported positive for CNS, 41 (24%) had ≥2 positive blood cultures and 130 (76%) had a single positive culture. The medical records of 36 (88%) patients with ≥2 positives were randomly selected for review. Of these patients, 22 (61%) had BSI according to the NNIS definition; species-level identification of CNS isolates revealed 5 (23%) patients with NNIS-defined BSI who did not have an identical CNS species in ≥2 cultures, suggesting CNS from these patients were contaminants. Species-level identification of CNS would reduce the misinterpretation of probable contaminants if only patients with ≥2 blood cultures positive for the same CNS species were considered likely to have BSI.

64 **Rates and Risk Factors for Recurrent Clostridium difficile Associated Disease (CDAD) During Hospitalizations Following an Initial CDAD Episode.** *B. OSTROWSKY, S. JIDPUGDEEBODIN, AND M. SAMORE, Beth Israel Deaconess Medical Center(BIDMC), Boston, MA, and Vichaiyut Hospital, Bangkok,Thailand.

A registry of 1032 patients (pts) detected to have CDAD by infection control surveillance at a single institution during a 6 yr period (Jan/91-Dec/96) was used to examine the risk of recurrent CDAD during hospitalizations that followed an initial episode of CDAD. 446 pts with initial episodes of CDAD had 1218 subsequent hospitalizations (excluding readmissions <30 days (d) following the initial episode); the median interval between the initial episode of CDAD and subsequent hospitalization was 305 d (range: 30-2216). 81 of these hospitalizations were associated with recurrent CDAD; in 45 instances, the positive cytotoxin was detected ≤ 3d after admission (adm) and in the other 35, >3d after adm. The cumulative risk of recurrent CDAD >3d after adm (among pts with LOS >3d) was 4.0%. A nested case-control analysis was performed to examine risk factors for recurrences occurring >3d after adm. Controls were chosen by randomly selecting for each case 3 hospitalized pts with prior CDAD who did not develop recurrent CDAD and whose LOS was ≥ the interval between adm and toxin positivity in the case. Clinical data were extracted by computerized databases and chart review on 32 cases (for 2 pts who had >1 subsequent hospitalization with recurrent CDAD, 1 adm was randomly selected) and 96 controls. Both matched and unmatched analyses were performed and yielded similar results. The median interval in days between adm and positive toxin for cases was 9 days (range: 4-75). Cases were similar to controls with respect to age, sex, and underlying co-morbidities. By multivariable logistic regression, risk factors for recurrent CDAD were: interval between initial episode of CDAD and subsequent hospitalization <60d (adjusted OR=2.8, p=0.04) and exposure to 2nd/3rd generation cephalosporins (adjusted OR 2.9 p=0.02). A trend was seen toward a lower risk of recurrence in pts exposed to oral or intravenous metronidazole (adjusted OR= 0.13 p=0.056). In summary, pts with prior CDAD who are readmitted represent a population for whom strategies to prevent CDAD might be appropriately targeted. A potential protective effect of metronidazole against recurrent CDAD should be considered unconfirmed because of the limited number of pts but worthy of further study.

65 Morbidity, mortality, and health-care burden of nosocomial *Clostridium difficile*-associated diarrhea (N-CDAD) in Canadian hospitals. *MARK A. MILLER, MEAGAN HYLAND, MARIANNA OFNER, MARIE GOURDEAU, MAGUED ISHAK, the Canadian Hospital Epidemiology Committee, and the Canadian Nosocomial Infection Surveillance Program, Health Canada.

We conducted laboratory-based surveillance for N-CDAD in 19 Canadian hospital sites in 8 provinces to measure morbidity, mortality, and the burden of disease. Starting Jan/97, centers tested all inpatient diarrheal stools received in the laboratory for *C. difficile* toxin (CDT) for 6 weeks or until 200 samples/center were tested. CDT(+) patients were assessed for inclusion as a "case" if the surveillance definition was met (loose stool for 2 days without other cause AND CDT(+) or visualized pseudomembranes AND symptom onset ≥ 3 days post-admission), and the cases' charts were then reviewed.

During the study period, 371/2062 individuals (18%) were CDT(+) and 269 (13%) met the case definition. The period prevalence N-CDAD rate was calculated 2 ways: per 1000 admissions and per 100,00 patient-days. The mean [median; 95% CI] hospital rates were 5.86 [3.7; 3.4 - 8.4] per 1000 admissions and 66.3 [57.9; 37.5 - 95.1] per 100,000 patient-days. 76% of the cases were on a medical or surgical floor at the time of diagnosis. 250 (93%) cases developed it during their original hospitalization, and 19 (7%) were readmissions for this complication with an average stay of 13.6 (± 7.8) days.

41 cases (15.2%) died during the surveillance period after being diagnosed with N-CDAD, 4 of whom (1.5% of total) were considered to have died directly due to N-CDAD. Overall survival was associated with N-CDAD therapy (OR=3.12, (95% CI: 1.2, 7.8), p=0.006). In addition, the following morbidity was observed directly due to N-CDAD: dehydration (3%), hypokalemia (2%), GI hemorrhage requiring transfusion (1%), bowel perforation (0.4%), secondary sepsis (0.4%), "other" [i.e. ileus, GI bleed, treatment side-effect] (2%). The cost of readmissions alone for N-CDAD per year per site was estimated at CDN$128,200.00

N-CDAD is a common and serious nosocomial infectious complication in Canada and is associated with mortality, important morbidity, and constitutes a financial burden to the institution.

66 **Population-Based Study of Nosocomial *Clostridium difficile* Associated Disease (CDAD): Risk Factors and Prediction Models Using a Case-Cohort Study Design.** *MATTHEW H. SAMORE. Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA

We performed a population-based study of risk factors for nosocomial CDAD using a case-cohort study design. The base population consisted of all medical-surgical admissions to a tertiary-referral hospital during a 22 month period (Jan/94-Oct/95) who had a length of stay >3 days (d). A 7.5% random sample of the population was selected to form the study subcohort (n=977, 8 of whom developed CDAD). Cases (from the entire base population) were identified through surveillance and were defined as patients diagnosed with CDAD >3 d after admission (n=162). Patients who had a positive toxin assay within 21 d before and 3 d after admission were excluded. For developing prediction rules, patients discharged in 1994 and 1995 were divided into a test set and validation set, respectively. Survival analytic methods were used, with the follow-up time defined as the interval in days between admission and positive toxin in cases or duration of hospital stay in the rest of the subcohort. Clinical variables and exposures occurring within 3 d of admission were collected using computerized clinical databases. Variables studied included age, sex, ward location, service, principal diagnosis, co-morbidities, major surgical procedure, admitting laboratory tests, history of prior CDAD, antibiotic use, H2 blockers, antacids, anti- and pro-motility agents. By Cox regression (with standard errors appropriately calculated for the case-cohort design), independent risk factors for CDAD were: age (adjusted hazard ratio (HR), per decade: 1.3 p<.001); prior CDAD with interval since initial episode >60 d (adjusted HR: 3.8 p=.001); prior CDAD with interval <60 d (adjusted HR: 8.9 p<.001); treatment with broad spectrum beta-lactam antibiotics (adjusted HR=2.2 p=.001); principal diagnosis of diabetic peripheral vascular disease (HR=2.1 p=.007). The prediction model had a c statistic of .71 on the test set and .68 on the validation set. In summary, identification of patients at high risk for CDAD on the basis of clinical information available during the first few days of hospitalization may be useful for purposes of risk factor modification or implementation of preventative strategies. The study design employed here avoids some of the potential biases of case-control studies and permits utilization of survival analytic methods.

67 Antibiotic (AB) Prescribing in Nursing Homes (NH): A Longitudinal Study. *JM MYLOTTE, State Univeristy of New York at Buffalo, Buffalo, NY.

Objectives: To measure AB prescribing in the NH setting and correlate this with occurrence of nosocomial infection (NI). Design: Prospective observational study. Setting: 4 nonproprietary NHs [WC, LS, SC and BW]. Interventions: None. Study Period: February 1996 to November 1997; WC [21months], LS [15 months], SC [22 months], and BW [18 months]. Methods: Incidence of AB use = number of AB courses begun per 1000 resident care days (RCD) per month. AB utilization ratio (AUR) per month = number of AB days/number of RCDX 100. NI rates = number of NIs per 1000 RCD per month. Mean values were compared using one-way ANOVA. Correlations were assessed using simple linear regression. Results: Mean incidence of AB use differed significantly among the 4 NH: 3.8 (BW), 3.8 (LS), 5.8 (SC), and 7.2 (WC) [$P < .001$] as did mean AUR per month: 2.2% (BW), 3.1% (LS), 5.9% (SC), and 7.2% (WC) [$P < .001$]. There was a significant difference in the mean overall NI rate: 2.9 (BW), 1.5 (LS), 4.1 (SC), and 4.2 (WC) [$P < .001$], in the mean rate of urinary NI: 2.9 (BW), 0.8 (LS), 1.2 (SC), and 2.2 (WC) [$P < .001$], and in the mean rate of respiratory NI 1.8 (BW), 0.3 (LS), 2.1 (SC), and 1.6 (WC) [P = .04]. For all 4 NH combined, there was a highly significant positive correlation between the incidence of AB use per month and the monthly rate of NI ($R^2 = 0.52$; $P < .001$). However, all of the variation in incidence of AB use was explained by the variation in the rate of respiratory NI plus urinary NI ($R^2 = .53$; $P < .001$) and less so by the rate of respiratory NI alone ($R^2 = .35$; $P < .001$). Conclusions: Two different measures of AB use detected variations in prescribing among 4 NH. These measures may be useful for interfacility comparisons after adjusting for case-mix differences. Despite variations in rates, rates of respiratory plus urinary NI explained much of the variation in AB use; the diagnosis of these infections in the NH setting appears to be an important factor influencing physicians to prescribe AB.

68 Vancomycin-Resistant Enterococci (VRE) in a Veterans Affairs (VA) Nursing Home Care Unit (NHCU): A Three-Year Perspective. *LARRY STRAUSBAUGH, SHERRI ATHERTON, RITA TJOELKER, Portland VA Medical Center, Portland, OR.

Nursing home administrators often hesitate to accept patients colonized with VRE. They fear that it will spread quickly through their facilities and cause substantial morbidity, if not mortality, among their frail, elderly residents. In order to evaluate the legitimacy of these fears, we reviewed our experience with VRE at a large VA NHCU over a three-year period. The Portland VA NHCU is a 120-bed, skilled nursing facility, whose daily census ranged from 70 to 109 patients during the study period, FY95 through FY97. After recognizing the initial VRE case in the first quarter of FY95, we adopted modified contact precautions for all VRE-positive residents. We also monitored the results of all cultures obtained for clinical indications and, on occasion, performed additional surveillance cultures. The latter included those obtained during a one-day, facility-wide, prevalence study in FY96. During the study period a total of 41 NHCU residents were colonized with VRE: 5 were identified in FY95; 19 in FY96; and 17 in FY97. Of the 41 VRE-positive residents, 28 were known to be colonized prior to their admission. Of the 13 residents acquiring VRE in the NHCU, two were colonized in FY95, 9 in FY96, and 2 in FY97. Six of the FY96 cases were detected solely by surveillance cultures obtained during the one-day survey that established a prevalence of 9%. No VRE infections occurred during the three-year study period. Therefore, the entry of VRE-positive individuals into our NHCU posed little risk to other residents. Transmission within the facility occurred at only a modest rate and the feared morbidity and mortality from VRE infections failed to materialize.

69 **Lack of Transmission of Vancomycin-Resistant Enterococci (VRE) in Long Term Care Facilities (LTCF).** C. GREENAWAY and *M.A. MILLER, Centre Hospitalier Régional du Sûroit, Valleyfield, Quebec, Canada; SMBD-Jewish General Hospital, Montreal, Quebec, Canada; and McGill University, Montreal, Quebec, Canada.

VRE has become an important nosocomial pathogen in acute care hospitals (ACH). However, very little is known about the epidemiology of transmission of VRE in LTCF or the most cost effective infection control measures in LTCF.

Methods: From Nov/1996 to Nov/1997, 3 individuals definitely colonized (DC) and 3 recently colonized (RC) with VRE were transferred out from an ACH and were followed in 4 different LTCF. Point prevalence surveys were done for rectal colonization of VRE in these 6 patients and in all patients on the same wards in the LTCF. Environmental cultures were also taken in the LTCF rooms of DC and RC patients during these surveys. Infection control measures in the LTCF included: placing all DC and RC patients in a private room with a private toilet but with permission to circulate freely on the ward, handwashing education, and gowns/gloves only when direct prolonged contact with the patient was anticipated. All small medical equipment was left in the DC/RC patients' rooms, except in one LTCF.

Results: No transmission of VRE occurred during the study period, as evidenced by repeatedly negative VRE cultures in all patients on the same ward as DC and RC patients. Only 2 environmental cultures on each of 2 occasions were positive in only 1 DC patient's room. The mean length of stay of DC patients in the LTCF was 82 days (range: 29-111 days).

Conclusions: Transmission of VRE did not occur after admission of 3 DC and 3 RC patients to 4 LTCF after a mean of 82 days of exposure and moderately stringent infection control measures, which are easily applicable in a long term care setting. Spread of VRE in LTCF may not be as common as in acute-care settings.

70 Point-prevalence survey and risk factors for inter-facility transmission of vancomycin-resistant enterococci (VRE) colonization among patients at acute and long-term care facilities in one community. TRICK WE*, KUEHNERT MJ, QUIRK SB, ARDUINO MJ, AGUERO SM, JARVIS WR. Hospital Infections Program, Centers for Disease Control and Prevention (CDC), Atlanta, GA, Siouxland District Health Department (SDHD), Sioux City, IA.

Acute and long-term care facility patients are at an increasing risk for colonization by vancomycin-resistant enterococci (VRE). Interfacility transfer of colonized residents is one obstacle to VRE control within a community. From December 1996 to February 1997, an increased number of VRE isolates (0 to 65) was reported to the Siouxland District Health Department. We conducted a point-prevalence survey of VRE colonization in all 32 health care facilities in the district. A case-control study was performed to evaluate risk factors for colonization with VRE, including patient transfer between facilities. Genome typing was performed to determine clonality of VRE isolates. Samples were collected from 1,934 (85.3%) of 2,266 eligible patients. The overall prevalence of VRE colonization was 40 (2.1%) of 1,934; prevalence in individual facilities ranged from 0 to 20%. In the case-control study, case-patients from long-term care facilities were significantly more likely to have been inpatients at one specific acute-care facility (Facility A) than were randomly selected control patients, 11 (37%) of 30 vs 3 (4.5%) of 66, p<0.001. Molecular typing of isolates revealed four genome types: 27 type-A, four type-B, and a single isolate each, of genome types C and D. All case-patients who had inpatient exposure to Facility A were colonized by genome type-A. The four type-B isolates were from residents at one acute and one long-term care facility, both geographically remote from other health care facilities. Early after the introduction of VRE to a community, interfacility transfer of VRE-colonized patients contributes to transmission of VRE from acute to long-term care facilities. To minimize VRE transmission, coordinated VRE control efforts are needed between acute and long-term care facilities.

71 **Pneumonia and Invasive Pneumococcal Disease: Long Term Care Facility- vs. Community-Acquired.** J Hofmann[1], JL Silber[1], MS Cetron[2], RA Strikas[2], S Paul[3], RF Breiman[2]. [1]UMDNJ/RWJ Medical School, Camden NJ; [2]Centers for Disease Control & Prevention, Atlanta, GA; [3]NJ Dept. of Health & Senior Services, Trenton, NJ. Pneumonia and invasive pneumococcal infections (IPI) are a major cause of morbidity and mortality, especially among older adults. During an ongoing project to promote pneumococcal immunization, active surveillance for pneumonia and IPI among adults was conducted at 20 acute care facilities in two New Jersey counties from October 1994-September 1996. Medical records of all patients ≥18 years of age hospitalized for pneumonia or IPI were reviewed, and the subset of patients admitted from long term care facilities (LTCF) was compared to those admitted from the general community. We identified 6070 admissions during the study period, 5785 (95%) for pneumonia and 285 (5%) for IPI; 4699 (77%) were from the community and 1346 (23%) from LTCFs. The characteristics of patients hospitalized with pneumonia or IPI are compared below. Incidences are per 100 000 population/year.

Patient characteristic	LTCF*	Community**	p value
Median age (years)	83	67	<0.001
Female gender (%)	62	50	<0.001
White race (%)	92	82	<0.001
Median length of stay (days)	9	7	<0.001
Alive at discharge (%)	82	89	<0.001
Confirmed pneumococcal infection (%)	5	8	<0.01
Incidence of pneumonia, age ≥65 yrs	6425	841	-
Incidence of IPI, age ≥65 yrs	471	38	-

*Incidence based on LTCF bed census + admissions/yr; **Incidence based on 1995 census data

The incidence of pneumonia and IPI requiring hospitalization among residents of LTCFs vastly exceeds that of the general community; LTCF residents with pneumonia or IPI are older, remain hospitalized longer, and are more likely to die as a result of their illness compared with patients admitted from the community. Laboratory-confirmed pneumococcal infection accounted for 6% of all pneumonias identified, but this likely underestimates the true incidence of pneumococcal disease in our surveillance population as diagnostic tests are insensitive and frequently underutilized. Targeted efforts to increase pneumococcal and influenza immunization coverage among eligible LTCF residents to levels recommended by Healthy People 2000 may have a major impact on the burden of these diseases.

72 Nursing Home-Acquired Pneumonia (NHAP): Severity of Illness (SOI) and Outcome of Intravenous (IV) Antibiotic (AB) Treatment (Tx) in an Inpatient Acute Geriatrics Unit (AGU) Versus in a Nursing Home (NH). *J. MYLOTTE, C. SALUDADES, B. NAUGHTON, Z. MASZAROVICS. School of Medicine and Biomedical Sciences, State Univ of New York at Buffalo, Buffalo, NY.

Objective: to evaluate the validity of the pneumonia prognosis index (PPI) as a measure of SOI in residents with NHAP and to compare the outcome of IV AB Tx of NHAP in an inpatient AGU vs in a NH after accounting for SOI. Design: Retrospective chart review. Setting: 2 nonproprietary NHs (400 beds) and an AGU (20 beds) at a county hospital admitting only NH residents. Methods: NHAP was defined as symptoms, signs, and radiologic evidence of P. All residents intially received IV AB Tx followed by oral Tx. The study population consisted of 158 episodes of NHAP: N = 58 treated in the NH and N = 100 treated in the AGU. SOI was determined using the PPI calculated at the onset of P. Mortality at 7, 14, 21, and 30 days after onset of Tx was assessed. Results: The PPI stratified the 158 episodes of NHAP into low- and high-risk mortality groups; the distribution of episodes among risk strata of the PPI was similar for the two groups indicating that SOI of P was similar. Mean (± SD) duration of AB Tx was 9.6 ± 3.4 days in the AGU vs 10.7 ± 4.5 days in the NH ($P = .26$); however, mean (±SD) duration of IV AB Tx was significantly longer in the NH (8.2 ± 4.1 days [NH] vs 6.4 ± 2.6 days [AGU]; $P = .007$). Mortality was the same at all time points assessed. 30-day mortality was 21% for those treated in the AGU vs 24.1% in the NH ($P = .66$); the 30-day mortality predicted by the PPI for the most severely ill residents was 29% while the actual mortality for this group was 33%. Conclusions: The PPI appears to be a useful measure of SOI of residents with NHAP and accurately predicted 30-day mortality in those with this infection. NH residents with P, even those who are severely ill, can be successfully treated in the NH with IV therapy; their 30-day mortality was no different from those with the same SOI admitted to a hospital for Tx.

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Clonal Outbreak of Vancomycin-Resistant *Enterococcus faecium* (VREF) in the Medical Intensive Care Unit (MICU) of a Cancer Center (CC)

ISSAM RAAD*, HEND HANNA, MICHELLE MENDOZA, RAY HACHEM, AMIN ALRAHWAN, JALAL ABBAS, JAN UMPHREY. The University of Texas M. D. Anderson Cancer Center, Houston, TX.

During September 1996, a leukemia patient was admitted to CC with VREF bacteremia and diarrhea. The patient was confused and had four different admissions to MICU (a 16-bed unit). During November 1996, one nosocomial case of VREF was identified in the MICU, in December seven new cases were observed, and in January 1997, six cases. By pulse gel electrophoresis all the VREF strains were either identical with that of the index leukemia patient or clonally related. The incidence density of VREF outbreak strain infection/colonization in the MICU increased from 3/1000 ICU days in November 1996 to 23/1000 ICU days in January 1997. In early January 1997 several infection control (IC) measures were instituted: 1) The MICU was closed to new admissions for three days; 2) Environmental decontamination of the unit was performed; 3) All patients and subsequent admissions were placed on contact isolation and screened with stool cultures for VRE; 4) Cohorting of nursing staff with VREF culture-positive patients was instituted; 5) MICU personnel were educated and observed for proper IC measures; and 6) Special stethoscopes were assigned to each MICU patient and other non-disposable equipment were disinfected before removal from MICU rooms. Following the initiation of these measures, no new nosocomial VRE infections occurred in the MICU over the subsequent eleven months. Multifaceted IC measures, including decontamination of the environment and non-disposable equipment can prevent nosocomial transmission of VREF.

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The Natural History of Carriage of VRE Using PCR Detection of Van A, Van B, and Van C-1 Directly from Stool Samples/Rectal Swabs: What We Don't Know Can't Hurt Us, Can It? JESSICA WRIGHT, HELEN DEDIER, JIU ZHAO, MEL KRAJDEN, IIVI CAMPBELL, MITCH WEINSTEIN, JAMES BRUNTON and *JOHN CONLY, The Toronto Hospital, Univ. of Toronto, Toronto, ON, Canada

Little data exists on the long term carriage of VRE, particularly using more sensitive techniques such as PCR. The duration of carriage has significant ramifications for isolation and utilization of resources. A rapid convenient PCR based detection for the Van A, Van B and Van C-1 genes (single and multiplex) directly from stool samples/rectal swabs was developed and evaluated on a sample of 266 stool specimens collected from 20 patients during an outbreak of VRE (Van B *E. faecium*) in a dialysis population. Specimens were evaluated qualitatively using M-enterococcal (M-ent) agar with 6 mg/L vancomycin. Serial dilutions of stool from 10^{-2} to 10^{-6} were enumerated for VRE using M-ent agar and broth. After optimizing conditions PCR was done directly from an extract of the original sample after overnight incubation in Todd-Hewitt broth with 0.4 g/L Na azide. Quantitative culture results varied from $<10^3$-$4x10^8$ cfu/gm wet weight stool. Of the 266 specimens 111 paired specimens had culture and a single PCR assay for Van B. Fifty-five paired specimens were assayed by multiplex PCR, single PCR and culture. In 7 patients with intermittent stool/rectal carriage of VRE (initial + followed by negative and then further +) the direct PCR remained + suggesting the continued colonization of VRE but at a level below the detection limits of standard culture. Direct PCR detection from stool samples is a sensitive and convenient method to rapidly identify intestinal tract carriage of VRE and also serves to illustrate the prolonged and non-culture detectable carriage of VRE. Infection control and isolation strategies must be designed to take this into consideration.

Concordance	Single PCR (n=111)	Multiplex PCR (n=55)
PCR +/Culture +	49 (44.1%)	20 (36.4%)
PCR -/Culture -	24 (21.6%)	27 (49%)
PCR +/Culture -	36 (32.4%)	7 (12.7%)
PCR -/Culture +	2 (1.8%)	1 (1.8%)

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Intermittent Vancomycin-Resistant Enterococcus (VRE) Colonization in Human Immunodeficiency Virus (HIV) Infected Patients. *S. TALLAPRAGADA, J.E. TOPAL, P.A. FARREL, D. CALLAN, and L.M. DEMBRY. Yale University School of Medicine and Yale-New Haven Hospital, New Haven, CT.

VRE is endemic in our HIV population with over 50 different strain types identified since 1992 by contour-clamped homogeneous gel electrophoresis (CHEF). Intermittent gastrointestinal (GI) carriage has been documented by in-patient rectal/peri-rectal surveillance cultures. The significance of a negative culture for VRE is unclear. If a negative VRE culture is not indicative of true loss of GI colonization, then positive VRE cultures before and after a negative culture should be of the same strain type. Intermittently colonized (IC) hospitalized HIV + patients were identified retrospectively (7/1/94-6/30/97). IC was defined as at least one VRE-positive rectal swab culture followed by at least one VRE-negative culture and at least one subsequent VRE-positive culture. VRE strain-relatedness was determined by CHEF. 25 patients met criteria for IC. Cultures were obtained over a median of 196 days (range 5-235) per patient. 39 episodes of IC were identified; 23 (59%) had the same VRE strain (SS) before and after a negative culture and 16 (41%) were different VRE strains (DS) (p=0.11). The mean time between the SS cultures was 60.4 days and between the DS cultures was 172.9 days (p=0.14). 20 patients had two or more consecutive positive VRE cultures. The same consecutive strains (SCS) were found in 95 (80%) and different consecutive strains (DCS) in 24 (20%) episodes (p<0.001). The mean time between SCS cultures was 18.2 days and between DCS cultures was 30.0 days (p=0.07). The similar proportions of SS and DS during IC suggests that some patients with negative cultures lost colonization and acquired new strains of VRE. The time period between DS cultures was longer than the SS cultures but the difference was not statistically significant. Consecutive positive VRE cultures were more likely to be of the same strain type; however, those obtained at least 30 days apart were more likely to be different strains. A larger prospective study may clarify the number and timing of negative cultures needed to accurately determine true loss of GI colonization.

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The Utility of Culturing Roommates of Patients with Vancomycin Resistant Enterococcus. *CA MUTO, TB KARCHMER, EG CAGE, L DURBIN, B SIMONTON, BM FARR. University of Virginia Health System, Charlottesville, VA.

Vancomycin resistant enterococci (VRE) may be transmitted from patient to patient via clinicians' hands or contaminated environmental surfaces. For this reason CDC guidelines recommend culturing roommates of patients identified as being colonized with VRE. The CDC conducted a 6 week study in an Atlanta hospital with a 29% prevalence of VRE to assess the utility of this recommendation. The prevalence of VRE was the same whether or not the room-mate had VRE. It was concluded that VRE status of roommates did not predict and Standard Precautions (SP) should prevent transmission (SHEA 1997, abstract#21). The University of Virginia cared for 91,109 patients during the past 3.3 years, 442 (0.48%) with VRE. Studies here found the predominant risk factor for VRE acquisition was proximity to unisolated VRE patients during the preceding week (Anglim et al, SHEA 1996, abstract #15) and SP resulted in 16-fold more spread of MRSA than Contact Precautions (Jernigan et al, AmJEpi 143:496,1996). Because of these conflicting results, we evaluated the concordance rate of roommates in a database including 17,081 weekly perirectal cultures of patients on a high risk floors, with prolonged stay, and/or antibiotic therapy. Roommates of patients identified as having VRE during the week before identification were isolated until 2 weekly cultures starting one week after last contact were negative. 16 (13%) of 123 pairs of roommates were concordant for VRE colonization. This exceeded the overall risk of acquisition in the institution (RR=27.8, 95%CI, 17.4-44.3, $p<10^{-4}$) and the risk among high risk patients being cultured weekly (RR=5.2, 95%CI, 3.3-8.3, $p=10^{-4}$). CONCLUSION: The results of the present study support the finding by Anglim et al. that proximity to unisolated VRE patients is an important risk factor for acquisition and recommendations to isolate and culture roommates of unisolated patients found to be newly colonized with VRE. Differences between this study and the CDC study were likely due to differences in study design. The much smaller CDC study had lower statistical power and did not provide followup of roomates to allow time for development of positive cultures after last contact. In a hospital with near universal exposure to VRE, however, antibiotic exposure would likely be the primary predictor for development of a positive culture.

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Association between Mucositis Severity and Vancomycin-resistant Enterococci (VRE) Bacteremia in VRE-colonized Cancer Patients.

*MATTHEW J. KUEHNERT, JOHN A. JERNIGAN, AMY PULLEN, and WILLIAM R. JARVIS. Centers for Disease Control and Prevention and Emory University School of Medicine, Atlanta, GA.

VRE are a rapidly increasing and often untreatable cause of infection in hospitalized patients. Over a three-year period, >90% of VRE-bacteremias in Emory University Hospital (EUH) occurred in patients with cancer. Mucositis, an inflammation of the oral mucosa often caused by cancer treatment, has been hypothesized to be a risk factor for VRE-infection. To determine the role of mucositis severity in the development of VRE-bacteremia, we studied EUH Hematology-Oncology Unit patients with VRE-bacteremia, i.e., case-patients, or VRE-colonization (defined by VRE-positive stool culture), i.e., control-patients, from 9/1/94 to 8/31/97. Oral mucositis severity, scored 0-4, was recorded on the day of VRE-bacteremia for case-patients and on hospital day 22 (the median duration between case-patient hospital admission and VRE-bacteremia) for control-patients. Other potential risk factors, including demographics, underlying illness, severity of illness (measured by APACHE II score), antimicrobial use, neutrophil count, duration of neutropenia, length of stay, and incidence of other nosocomial infections also were measured. There were 19 case-patients and 32 control-patients. In univariate analysis comparing case-patients with control-patients, only differences in mucositis (median score 3 vs 1, p<0.01) and severity of illness (median score 14 vs 13, p=0.05) were statistically significant. Upon dichotomization, mucositis remained statistically significant (score ≥3 vs ≤2, 10/13 vs 9/38 patients, OR=10.7, p<0.01). In logistic regression models exploring all variables on a continuous or dichotomous scale, including severity of illness, only mucositis was independently significant. Increased severity of mucositis is independently associated with VRE-bacteremia in VRE-colonized patients. Mucositis may indicate diffuse gastrointestinal mucosal breakdown which promotes bloodstream invasion by gut-colonizing VRE. Alteration of mucositis severity or interventions aimed at altering VRE-colonization status may help to prevent VRE-bacteremia in VRE-colonized cancer patients.

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The Cost of a VRE Admission Screening & Contact Follow-up Program in a Tertiary Care Hospital. MACPHAIL GLP, LAM-LI D, O'NEIL LA, KUREISHI A.* Foothills Medical Centre (FMC), Calgary, Alberta, Canada.

FMC is a tertiary care trauma centre with 750 acute care beds and 180 long term care beds. To date, VRE has not become endemic in our institution, likely as a result of the aggressive VRE prevention program of the Infection Prevention Office. The details of the program have evolved over time, as the geographic distribution of VRE has changed. Since January 1997, patients who were in hospital in an institution outside of Canada or in an endemic area within Canada for longer than 48 hours within the past year have been identified as potential carriers of VRE and isolated until such time as their rectal swab was known to be negative for VRE. Between January 8th and September 30th, 1997, a total of 80 patients fell into this category. As a result of screening, three carriers were identified and isolated for the remainder of their hospital stay (a total of 89 days). All three were directly admitted to the Intensive Care Unit (ICU) of FMC from ICU's in the United States. In addition, an electronic alert is placed on the patient care system to ensure prompt isolation whenever a VRE positive patient is readmitted. The costs (in U.S. dollars) associated with this portion of the prevention program were as follows: $ 3,481 for consumption of patient care supplies such as gloves, laundry, disinfectants and dedicated equipment; $ 3,226 for laboratory screening; $ 11,708 for Infection Prevention labor; and $ 10,472 for private rooms. The total cost of the admission screening program was therefore $ 28,887 for the 9 month period. This can be expressed as $ 9,629 per VRE carrier who was thereby appropriately isolated or as $361 per patient admitted from a VRE endemic area. We also screen renal outpatients on a quarterly basis for a cost of $ 24,071 between Jan. and Nov. 1997. Sixty-seven possible contacts of three VRE positive patients were also screened, giving a post-contact screening cost of $ 2,701. No additional positives were found in these screens. We previously calculated the cost of containing a 10 day VRE outbreak in our institution in April of 1997 to be $ 217,998. In comparison to this figure, prevention seems a very worthwhile investment.

79 The Tepid Zone: Risk Factors for Nosocomial Transmission of Legionnaires' Disease and for Colonization of Hospital Water Systems by *Legionella*. J. KOOL*, D. BERGMIRE-SWEAT, E. BROWN, D. MASSI, J. PRUCKLER, B. FIELDS, R. BENSON, M. KOLCZACK, J. BUTLER, Centers for Disease Control and Prevention, Atlanta, GA, and Texas Department of Health, Austin, TX.

Increased reporting of Legionnaires' disease (LD) in patients at multiple hospitals in San Antonio, Texas, prompted an investigation into risk factors for transmission of LD and determinants for *Legionella* colonization of hospital hot water systems. We searched laboratory databases to identify patients with LD in the past 3 years and to determine the number of diagnostic tests for *Legionella* performed annually. In the 16 largest hospitals in San Antonio and Austin, we measured hot water temperature and chlorine concentration and cultured potable water for *Legionella*. Poisson and linear regression were used for analysis. Eight cases of nosocomial LD were identified with onset in 1996. Hospitals that frequently used *Legionella* urinary antigen tests were more likely to detect cases of LD (p=0.01). *Legionella* was isolated from the water systems of 11 of 12 hospitals in San Antonio; the 12th had just experienced an outbreak of LD and had implemented control measures. Transmission occurred in 5 hospitals. The number of nosocomial LD cases in each hospital tended to be correlated with the proportion of sites that tested positive for *Legionella* (p=0.06), but not with mean *Legionella* counts (p=0.3). Hospitals using chloramines (n=4) or metal ionization (n=1) for disinfection were *Legionella*-free. All hospitals using free chlorine (n=11) were colonized; in these, the proportion of sites testing positive was inversely correlated with chlorine concentration (p=0.01). Water temperatures in most hospitals were within the optimal range for *Legionella* growth. Increased reporting of nosocomial LD was attributable to increased use of urinary antigen tests; prior LD cases may have gone unrecognized. The association between colonization of hospital water and transmission should be prospectively studied to determine optimal control strategies.

80 Hospital's Water System Related to a Significant Increase in *Mycobacterium kansasii* Colonization. *KATHY L. BROOKS,[1] STEVEN A. DAUENHAUER,[1] RONDA K. FOX,[1] WENDY M. GROSS,[2] ELIZABETH A. CARLIN,[3] and JOEL N. MASLOW.[3] Overton Brooks VAMC, Shreveport, LA,[1] TB Reference Laboratory, VAMC, West Haven, CT[2] and VAMC, Boston, MA.[3]

Between August 1996 and February 1997, a total of 15 of 27 positive mycobacteria cultures was identified as *M. kansasii* at the Overton Brooks VAMC. During this time period, the isolation rate of *M. kansasii* was 14/1000 vs. the usual rate of 0.7/1000. The isolated strains had unique characteristics: 1) Smears of AFB concentrates were negative; 2) Positive cultures were negative for *M. kansasii* using nucleic probe; 3) Catalase production was low; and 4) Only one of multiple specimens per patient was positive. Laboratory reagents used in processing of specimens were eliminated as a source. Samples of the hospital water supply were cultured from various locations: patient-room sink faucets, ice machines, city water supply, and the hospital's two 250,000 gallon holding tanks. Three of 22 samples grew isolates of *M. kansasii* that were probe-negative and also low catalase producers. Pulsed-field gel electrophoresis and high-performance liquid chromatography techniques were employed to further confirm the relationship between the patient and water-borne isolates. It was also learned that between July 1996 and February 1997, potable water from the holding tanks was distributed monthly rather than on the normal two-week cycle. With the implication that a correlation between the potable water source and the patient isolates may exist, the following steps were taken: 1) Patients were instructed to rinse their mouths and gargle with sterile water prior to sputum induction, and 2) Potable water in the hospital's holding tanks was to be cycled at the regular two-week intervals. It is hypothesized that the hospital's water system was the source of *M. kansasii* colonization of the 15 sputum specimens that resulted in clinical confusion, potential for adverse side effects from anti-tuberculous medications, and unnecessary costs of diagnostic and therapeutic interventions.

81 Efficiency of a manual disinfection procedure to eliminate Hepatitis C Virus (HCV) from experimentally-contaminated digestive endoscopes.

*B. CHANZY, D. LUU DUC-BIN, B. ROUSSET, P. MORAND, C MOREL-BACCARD, B. MARCHETTI, J. FAUCONNIER, M.R. MALLARET, J.P. ZARSKI AND J.M. SEIGNEURIN. University Hospital of Grenoble, France.

It is now well demonstrated that invasive medical procedures may be involved as a source of transmission of infectious diseases. The transmission of HCV by endoscopy has been reported, but data remain controversial. We report here an investigation of the efficiency of a routine complete hand-washing disinfection for the elimination of HCV from all the four channels of flexible submersible endoscopes after experimental contamination. Nine endoscopes were first contaminated with 15 ml of HCV PCR positive serum (mean titer with Amplicor™ Roche HCV Monitor® assay = 6.05 $\log_{10}$ +/- 0.15), and then sampled with sterile water. The difference between the mean HCV RNA titer of the inoculum and the sampling was 0.64 $\log_{10}$ (95% CI = 0.46 – 0.82). This represents a weak, but significant, decrease of the RNA copy number after sampling. The sensitivity of the virus detection after concentration was also estimated, and reached 250 HCV RNA copies per 50 ml of sampling solution. The disinfection procedure was carried out on 10 endoscopes. Virus inoculum titers were up to 5.9 log10 HCV RNA copy number. No virus was detected by PCR (Cobas® Amplicor™ HCV assay) on any of the 10 endoscopes, while all the internal controls were positive, suggesting the absence of inhibitory effect on the PCR reaction. It must be emphasized that our study was designed to determine the overall efficiency of a standard disinfection procedure employed for reprocessing endoscopes contaminated by HCV. These results provide some evidence that patient-to-patient endoscopic HCV transmission could be avoided with current appropriate disinfection process, including brushing, cleaning and a 20 minute 2% glutaraldehyde disinfection.

82 **Validation of cleaning and disinfection processes in a washer-disinfector.** TIGIST BELHU[1], CRISTINA BRADLEY[4], LARS ENGSTRÖM[3], PAUL HÅKANSSON[3], LISA LINDGREN[2], ANNA-LISA LINDQVIST[2], EVA MARCUSSON[1], ULRIKA RANSJÖ[1], KLAS RUDBÄCK[3], BIRGITTA WIBERG[2]

[1] Department of Laboratory Medicine and [2] Central Operating Department, Karolinska sjukhuset, Stockholm, Sweden, [3] Getinge Disinfection AB, Växjö, Sweden, [4] Hospital Infection Laboratory, Birmingham, UK

Disinfection processes such as heat, aldehydes or alcohols may kill vegetative microorganisms, but this does not guarantee the removal of organic contamination which may give rise to clinical symptoms in the patient and is not always destroyed by subsequent autoclaving. There is a need for a quantifiable method, which can be used for validation of cleaning procedures and can be performed in any infection control laboratory. We have used suspensions in horse blood of *Enterococcus faecalis* to test disinfection and of *Bacillus subtilis* spores to test cleaning in a washer-disinfector.. Instruments used for laparoscopic surgery were contaminated with a blood - bacteria suspension containing 10^7 organisms /mL, dried and processed in a washer-disinfector using a regular process. Remaining contamination was cultured quantitatively. 19 instruments were investigated in 10 experiments each. Results showed that cleaning and disinfection, measured as log reduction > 5-6, was achieved on surfaces that were adequately in contact with the water flow in the machine. The tests are quantifiable, and can be used to evaluate and to develop better cleaning and disinfection processes

83 Nosocomial *Acinetobacter baumannii* Infections Associated with Mechanical Ventilation in an Intensive Care Unit. *TERESA M. AIKENS, JEAN C. KEE, JANET A. HERRINGTON, JAMES A. TYRA, KIM C. CHAPIN-ROBERTSON, CHARLES J. HOFF, AND KEITH M. RAMSEY, University of South Alabama College of Medicine, Mobile, AL, and Bayer Corporation, West Haven, CT.

The majority of nosocomial infections in Intensive Care Units (ICU) are associated with devices such as ventilators, Foleys, and central lines. Implementation of NNIS device-specific infection rates in July 1994 revealed ventilator-associated pneumonias (VAP) per 1000 device da of 25-51.3, thus exceeding the NNIS rate of 16.9, despite comparable device utilization rates. Isolates of *Acinetobacter baumannii* accounted for most of these VAP. Our goal was to determine the method of spread and potential environmental source of this bacteria. A case control study compared consecutive patients with newly diagnosed *A. baumannii* infections (n=11) versus non-infected controls (n=9) admitted to the ICU. Common events, including surgical procedures, arterial and central lines, Foley catheters, mechanical ventilation, bronchoscopy, and cardiac catheterization were analyzed by Pearson Chi square analysis, with only mechanical ventilation being statistically significant (p<.05). An adjusted odds ratio (O.R.) analysis revealed that patients with *A. baumannii* were more likely to have been mechanically ventilated (O.R.=18.8:1) than the control group. Subsequent environmental surveillance revealed that reusable ventilatory circuits were contaminated with *A. baumannii*, which were identified as identical to the source patients' isolates by field inversion gel electrophoresis (FIGE). A change to disposable circuits eliminated the spread of this organism and reduced our overall VAP rates to 7.5-11.8 per 1000 device da. We conclude: (1) NNIS surveillance of VAP revealed *A. baumannii* infections associated with mechanical ventilation, leading to successful identification of an environmental source. (2) Eradication of the environmental source of *A. baumannii* eliminated *A. baumannii* infections, and reduced the overall VAP rates.

84 Persistence of an Endemic (Toxigenic) Isolate of *C. difficile* in the Environment of a General Medicine Ward. *STUART H. COHEN, YAJARAYMA J. TANG, DARUSH RAHMANI, and JOSEPH SILVA, JR., Univ. of California, Davis Medical Center, Sacramento, CA

We previously reported results of studies on the epidemiology of *Clostridium difficile*-associated diarrhea (CDAD) in endemic settings using arbitrarily primed PCR (AP-PCR). We report here the persistence and prevalence of several endemic strains of *C. difficile* in the environment of a general medicine ward, and their isolation from the stool of patients with CDAD over a two year period. Between April 1995-April 1997, 84 cases of CDAD were reported in the general medicine ward with an incidence rate of 17.2 cases/1000 discharges. During this period, 196 isolates were recovered from the environment. The environmental isolates were grouped into 24 different AP-PCR types. The predominant type, type 1, a toxigenic isolate, accounted for 51.02% of all isolates. This type was associated with 29.76% cases of CDAD during the 24 month period (25/84 patients). Type 1 has remained the predominant environmental strain throughout the study period. In the last 6 months of the study, 29.6% cases of CDAD due to type 1 have occurred in rooms in which it was endemic. A second AP-PCR type (type 2), first isolated in Sept. 1995 was associated with a significant number of clinical cases between Sept. 95-March 96. This type accounted for 11. 22% of the environmental isolates and was found in 14.28% of CDAD patients over the study period. The results presented here indicate that environmental contamination and persistence of endemic strains in the environment play a major role in the acquisition and the high incidence rate of CDAD observed in this ward.

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First results of the German Nosocomial Infection Surveillance System for intensive care units: Determining the duration of surveillance periods in ICUs to identify outliners

*· PETRA GASTMEIER[1], DORIT SOHR[1], CHRISTINE GEFFERS[1], JUDITH KOCH[1], ALFRED NASSAUER[2], HENNING RÜDEN[1].

[1] Institute of Hygiene of the Free University of Berlin, [2] Robert Koch Institute Berlin

A German nosocomial infection surveillance system for ICUs was started in 1997 as a pilot project to gather reference data for quality assurance activities. Nineteen ICUs from all over the country participate on a voluntary basis; another 50 ICUs will join the network at the beginning of 1998. Although the NNIS method is used, all ICUs agreed to participate for at least one year. Before starting surveillance, the surveillance staff was carefully trained in the application of CDC criteria on a case study basis. After ten months of surveillance, we have an overview of 11 706 patients with a total of 52 292 patient days, of which 23 537 were ventilation days, 41 042 CVC days and 42 640 urinary catheter days. There was a mean ventilator-associated pneumonia rate of 17.1 / 1000 ventilator days, a mean CVC-associated primary bloodstream infection rate of 2.5 / 1000 CVC days and a urinary tract infection rate of 4.1 / 1000 urinary catheter days. 25 %, 50 % and 75 % percentiles were determined for each rate, and the mean of these rates including the confidence intervals was calculated for each ICU. For estimating device-associated infection rates we used 95 % confidence limits for the mean of a Poisson distributed variable. In the case of ventilator-associated pneumonia 300 ventilator days are necessary to achieve sufficient accuracy (length of the CI95 was 0.8 times our corresponding rate). This requires an observation period of 6 months in larger ICUs and 18 months in smaller ones. Thus, we conclude that an ICU should continuously perform surveillance for at least 6 to 18 months depending on the size of the ICU and the device-utilization rate to obtain meaningful data about a possible outliner position for ventilator-associated pneumonia rates.

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Introduction of NNIS Based Continuous Surveillance to a Regional General Intensive Care Unit in the United Kingdom.

EDWARD T.M. SMYTH*, C HUGH WEBB, and JULIAN R.JOHNSTON, The Royal Hospitals, Belfast, Northern Ireland, BT12 6BA.

In the UK National Health Service the introduction of contracting has increased the demand for reliable nosocomial infection (NI) data. There are no established accepted UK national criteria for NI surveillance. Comparison between data published by different bodies is therefore impossible. NI in the intensive care unit (ICU) continues to be a major source of morbidity and mortality. We piloted continuous surveillance of nosocomial bloodstream, lower respiratory tract and urinary tract infection in an 11 bedded regional general ICU during a nine month period. National Nosocomial Infections Surveillance (NNIS) System scoring criteria were used to enable comparison with NNIS data from medical/surgical ICU's. Explanatory educational seminars for all ICU staff were given by infection control staff and responsibility for surveillance agreed as follows: Daily summary and device utilization data – ward nurses; NI episode records – ICU medical staff; post ICU discharge surveillance – Infection Control Nurses (ICN); daily laboratory liaison – medical microbiology staff. Automated data entry of completed questionnaires was employed (Formic Ltd., London UK). Device utilization ratios were all above the 90th percentile for a medical/surgical ICU (based on NNIS semi-annual report from October 1986-April 1997). There were 82 infections during 2667 patient days giving an overall infection rate of 30.74 per 1000 patient days. Average length of stay was 7.89 days. Infection rates per 1000 device days were; urinary tract 1.54 (10th-25th percentile); bloodstream 9.17 (>90th percentile); ventilator-associated pneumonia 20.48 (>90th percentile). Nurses collected data reliably but unit medical staff required regular facilitation by microbiologists. This pilot study demonstrated the feasibility of applying NNIS criteria to NI surveillance in a UK regional ICU. Differences between this unit and US medical/surgical ICU's were highlighted. ICU medical staff need more time and data feedback in order to develop ownership of the surveillance program.

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Nosocomial Infections (NI) in Coronary Care Units (CCUs) in the United States.

MICHAEL J. RICHARDS*, JONATHAN R. EDWARDS, DAVID H. CULVER, ROBERT P. GAYNES and the National Nosocomial Infections Surveillance (NNIS) System, Hospital Infections Program, CDC, Atlanta, GA.

Patient characteristics in CCUs suggest that the pattern of NI may differ from that seen in other types of Intensive Care Unit (ICU). To describe the epidemiology of NI in CCUs in the United States, we analyzed data collected during 1992-1997 from 102 CCUs, where ≥80% of patients had nonsurgical cardiac disease, in 93 NNIS hospitals, using the standard definitions and protocols of the ICU surveillance component. Data on 227,451 patients with 6698 NI were analyzed. As in adult medical ICUs, the most frequent infections, urinary tract infections (35%), pneumonia (24%) and primary bloodstream infections (17%) were almost always associated with use of an invasive device (93% with urinary catheters, 82% with a ventilator, 82% with a central line, respectively). However, the median overall patient infection rate (no. of NI per 100 patients) was lower in CCUs than in medical ICUs (2.7 vs.7.4, p<0.0001); this may be explained by lower device utilization rates for the three major invasive devices-- urinary catheter, ventilator and central line days per patient day (pooled mean values 0.44 vs 0.69, 0.18 vs 0.47, 0.28 vs. 0.50, CCUs vs.medical ICUs, respectively). Once we controlled for device use, device-associated infection rates in CCUs were not consistently lower than in medical ICUs, and did not correlate with length of stay, number of hospital beds, number of CCU beds, or hospital teaching affiliation. The distribution of pathogens in CCUs differed from that in medical ICUs. Additionally those pathogens reported from CCUs were more intrinsically susceptible to antimicrobial agents, e.g., *Escherichia coli* (27%) was the most commonly reported urinary isolate, unlike medical ICUs where *C. albicans (21%)* was most common. Only 10% of CCU-reported urinary isolates were *C. albicans*. Among primary bloodstream isolates *Staphylococcus aureus* were more than twice as common as enterococci (24% vs.10%) in CCUs. Sixty-one percent of reported isolates from nosocomial pneumonia were aerobic gram negative bacteria, but the most common species reported was *S. aureus* (21%). Our analysis suggests that the epidemiology of NI in CCUs differs from that in medical ICUs, particularly in the distribution of pathogens. These differences may affect empiric antibiotic therapy.

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Standardization of nosocomial infection (NI) rates in intensive care units (ICU) according to two severity-of-illness scores.

* PETRA GASTMEIER[1], DORIT SOHR[1], KARIN MENZEL[2], HENNING RÜDEN[1]
[1] Institute of Hygiene of the Free University Berlin, [2] Community Hospital Wismar, Germany

It is controversial whether NI rate adjustment in addition to extrinsic risk factor adjustment is really necessary for the routine surveillance of ICU patients. An investigation in a medical/surgical intensive care unit of a medium-sized hospital was carried out for one year to determine whether considering the severity of illness on the first ICU day instead of for all ICU days is sufficient to stratify patients according to their intrinsic risk. Two severity-of-illness scoring systems were used: the APACHE II and the therapeutic intervention scoring system (TISS). An intensive care specialist recorded both scores for each patient day and the development of nosocomial infections according CDC definitions. During the observation period, 270 patients were treated for a total of 2288 patient days. An APACHE II score >20 was recorded for 15.9 % of all patient days, and a TISS score > 30 for 26.4 %. On the first ICU day 14.8 % had an APACHE II score > 20 and 36.7 % a TISS score > 30. Forty-seven patients developed a total of 69 NI. The overall incidence rate was 25.6 %. The incidence rate of patients with an APACHE II score > 20 on at least one day was 49.2 NI / 100 patients and 18.0 / 100 patient days for those without a > 20 APACHE II score on any day. The quotient of the two rates yields an incidence ratio of 2.7. Considering only the first day on the ICU, we calculated incidence rates of 45.0 and 21.9 NI / 100 patient days with an incidence ratio of 2.1. The corresponding incidence ratio was 8.0 for patients with a TISS score > 30 on at least one day and 2.4 for those with a TISS score > 30 on the first ICU day.. Because of the remarkable differences between the two ratios for the first day and the entire period on the ICU we do not recommend using these scores on admission. However, recording scores everyday is impractical and involves a heavy workload.

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Surveillance Of ICU-Associated Infections: Is The Accuracy Lower If No Postdischarge Follow Up Of Patients Is Carried Out?

CHRISTINE GEFFERS[1], *PETRA GASTMEIER[1], HELGA BRÄUER[1], FRANZ DASCHNER[2], HENNING RÜDEN[1]
[1] Institute of Hygiene, Free University Berlin, [2] Institute for Environmental Medicine and Hospital Epidemiology, Albert-Ludwigs-University Freiburg

The NNIS system defines an ICU-associated infection as a condition that is neither present nor in its incubation period at the time of admission; it rather becomes apparent during the ICU stay (up to 48 hours after the patient has left the ICU). Thus a postdischarge follow up appears to be necessary. In order to determine how many infections are missed if no postdischarge follow up is done, we followed up patients from surgical or interdisciplinary ICUs in eight German hospitals. Infections were diagnosed in accordance with the CDC definitions. Infections that became apparent within 48 hours after admission were disregarded. We compared surveillance results with and without postdischarge follow up. A total of 6061 patient-days was recorded (1231 patients within a four-month period). Without postdischarge follow up 37 urinary tract infections (UTIs) were diagnosed, compared with 43 (+6) with postdischarge follow up; thus 14% of the UTIs were missed if no postdischarge follow up was performed. A number of nosocomial pneumonias (8%) were also missed if surveillance was carried out without postdischarge follow up: Without postdischarge follow up 54 pneumonias were diagnosed, compared with 59 (+5) with postdischarge follow up. We did not diagnose any blood stream infections within 48 hours after the patients had left the ICU. A total of 122 nosocomial infections (NIs) with postdischarge follow up was recorded, compared with 109 NIs without postdischarge follow up. About 11% of all ICU-associated NIs were missed if no postdischarge follow up was done. Since it is very time-consuming and labor-intensive to follow up patients after their transfer from the ICU, we do not support a postdischarge follow up of these patients.

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Do Hospital Antibiograms Reflect Resistance in Nosocomial Infections?

SCOTT K FRIDKIN*, ERICA R PRYOR, JONATHON R EDWARDS, JOHN E MCGOWAN Jr., FRED C TENOVER, ROBERT P GAYNES, and Intensive Care Antimicrobial Resistance Epidemiology (ICARE) Hospitals, CDC and Rollins School of Public Health, Emory University, Atlanta, GA.

With increasing concerns over antimicrobial resistant pathogens, many hospitals worldwide utilize susceptibility data from all isolates processed by the microbiology laboratory (i.e., antibiograms) to guide empiric therapy for nosocomial infections. The clinical relevance of these data are uncertain. During 1996-1997, 41 U.S. hospitals participating in the National Nosocomial Infections Surveillance (NNIS) system sent susceptibility data on all non-duplicate isolates from intensive care unit (ICU) patients processed by their laboratories as a part of Project ICARE (NNIS-ICARE), and they also sent data on nosocomial infections as part of the ICU component of NNIS (NNIS-ICU). We compared the rates of methicillin-resistant *S. aureus* (MRSA) and vancomycin-resistant enterococci (VRE) among pathogens associated with nosocomial infection (i.e., NNIS-ICU rates) to the rates reported through NNIS-ICARE. Only data reported from the same ICUs during the same months were used for analysis. Data were pooled for all ICUs within each hospital, and resistance rates were calculated for each hospital testing ≥10 isolates. Seventeen hospitals reported 210/556 (38%) *S. aureus* isolates as MRSA in NNIS-ICU, compared to 428/1511 (28%) in NNIS-ICARE. Eleven hospitals reported 43/301 (14.2%) enterococci as VRE in NNIS-ICU compared to 141/751 (18.7%) in NNIS-ICARE. In a pair-wise comparison controlling for differences in rates at individual hospitals, the MRSA rate was, on average, 11% higher among NNIS-ICU isolates than NNIS-ICARE isolates (p=0.01, Wilcoxon signed rank test). In contrast, the VRE rate was, on average, the same among NNIS-ICU isolates as ICARE-NNIS isolates (p=0.5, Wilcoxon signed rank test).

In this study of pathogens isolated from ICU patients, antibiograms may accurately reflect the rate of VRE, but may underestimate the rate of MRSA that is associated with nosocomial infection. Although the difference in MRSA rates is significant, the magnitude of the difference is small.

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Outbreak of Pyrogenic Reactions in Patients Undergoing Cardiac Catheterization (CC), Brazil. *ROSEMARY DUFFY, BRAULIO COUTO, REUBEN GRANICH, CARLOS STARLING, DENISE CARDO, and WILLIAM JARVIS. Centers for Disease Control and Prevention, Atlanta, GA, Vera Cruz Hospital, Belo Horizonte, Brazil.

Reuse of cardiac catheters designed for single use has become common in many developing countries. The effects of reprocessing on catheter integrity and safety and the efficacy of this practice are unknown. During January-August 1997, 28 CC patients developed pyrogenic reactions at a hospital in Brazil. A case-patient was defined as any patient experiencing chills and/or hypotension ≤ 12 hours after CC. To identify case-patients, we reviewed available medical records of all patients undergoing CC during the months when documented reactions occurred. We observed CCs, reviewed methods of catheter cleaning and sterilization, and performed bacterial cultures and endotoxin assays of some catheters and water used to reprocess catheters. Of the 320 CC patients reviewed, 28 (8.8%) met the case definition. No breaks in aseptic technique were detected during the CCs. After use, catheters were rinsed with sodium heparin and taken to a reprocessing room where they were cleaned with soap and water, flushed with enzyme solution, rinsed with deionized water, blown dry, and sterilized with ethylene oxide. Reprocessing staff frequently changed and were not reliably trained; there were no written standard operating practices (SOPs) for catheter reprocessing. Cardiac catheters examined had holes and reglued tips; some were completely occluded. Catheters and water used to reprocess catheters had elevated endotoxin (median=1460, range=32.7 to 2,080 EU/ml); the water also had high concentrations of bacteria (median=110,000, range= <1 to 3,280,000 CFU/ml). CC procedures were repeatedly performed using reprocessed catheters. Use of inadequately reprocessed catheters contaminated with endotoxin were associated with pyrogenic reactions. Reuse of single use medical equipment should be avoided unless SOPs can be established and documented to reliably and safely disinfect/sterilize the device.

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A Foodborne Outbreak of Gastroenteritis (GI) in a Teaching Hospital. *R. CHOTANI, L. KARANFIL, M. O'BRIEN, P. PRYOR, S. HARRINGTON, M. CONLON, E. SAGENKAHN, S. HESS, B. GRIFFITH, M. JONES, W. MERZ, J. DICK, T. PERL, Johns Hopkins University Hospital, Baltimore, MD.

Acute foodborne gastroenteritis disease typified by vomiting after a short incubation period can be due to *Staphylococcus aureus, Bacillus cereus*, or heavy metals (cadmium, copper, tin, or zinc). Hospital employees who ate lunch at restaurant A on December 9, reported an acute GI illness of short incubation period, typified by a dramatic onset of nausea, vomiting, abdominal pain and diarrhea. Once restaurant A was implicated, we inspected the facility, interviewed and inspected the food handlers, and quarantined certain foods. Seventy-five people who ate lunch at restaurant A answered questionnaires. Of the 75, 40 were ill and 35 were non-ill control subjects. The mean age of cases and controls was 39 years, and 85% were females. The incubation period was 15 minutes to 19 hours (hrs) (mean: 4 hrs) and symptoms lasted from less than 24 to 72 hrs (mean: 24 hrs). The cases developed nausea (93%), vomiting (78%), abdominal cramps (68%), diarrhea (63%), fatigue (63%), headache (48%), chills (43%), body aches (25%) and fever (18%). One case (2.5%) was hospitalized, 11 (27.5%) cases sought medical care and 25 (62.5%) were bedridden. Stool and nasal cultures did not grow pathogens. Foods associated with the GI were green beans (GB)-OR (Odds Ratio) =36.4 (95% CI 6.9-341.6, $p<0.0001$), and tortellini-OR=5.5 (95% CI 1.0-54.5, $p=0.02$). Persons who ate corn or vegetable soup were less likely to develop GI, OR=0.23 (95% CI 0.04-1.1, $p=0.03$). Based on multivariate regression analysis only GB were implicated ($p<0.005$). GB were served as a side dish at lunch, December 9. The frozen GB were steamed, then seasoned with garlic mix (non-sterile preparation), olive oil, salt and pepper. The beans were cooked at 375° for 20 minutes. *Bacillus* spp. was recovered from the garlic mix. Identification using cellular fatty acid content was consistent with *B. subtilis* and not *B. cereus*. No other organisms grew from any of the other food specimens. The FDA laboratories will examine specimens to rule out heavy metals. *B. subtilis* is an unusual species to implicate in foodborne illness and has rarely contributed to GI outbreaks.

93

Control of Pertussis Exposures at a University Hospital during a Community-based Outbreak. *R. TODD WIBLIN, JEAN POTTINGER, CHERYL CARTER, BRENDA BARR, and LOREEN HERWALDT. The University of Iowa College of Medicine and Hospitals and Clinics, Iowa City, IA.

From late July 1997 through November 1997, an outbreak of pertussis occurred in Johnson County, Iowa. Pertussis rates reached a 30-year high, with numerous PCR-confirmed cases in both adults and children. At the University of Iowa Hospitals and Clinics (UIHC), a major employer in Johnson County, 13 employees and 3 patients had documented pertussis. Two of the patients acquired pertussis in the UIHC. Once persons with pertussis were identified, they were treated with antimicrobial agents, furloughed from work for 5 days (employees), or placed on respiratory droplet precautions (patients). Despite these efforts, 298 employees and 60 patients had a significant (>10 minute) face-to-face exposure at UIHC to persons with pertussis. All persons with known high risk exposures were treated with prophylactic antimicrobial agents. No persons who received prophylactic antimicrobial agents developed pertussis, but many had adverse effects from the therapy. Initially, erythromycin was used for prophylaxis. About 30% of those treated did not tolerate the recommended dosage (500 mg QID) due to nausea and vomiting, and 1 employee was evaluated in the emergency department for abdominal cramping. Subsequently, trimethoprim-sulfamethoxazole was used as the first line prophylactic agent. Most persons tolerated this therapy, although a substantial minority discontinued treatment due to drug rash or gastrointestinal intolerance. A post-exposure survey of employees will be performed to document the details of antibiotic-related morbidity. Case identification, exposure tracking, and antibiotic prophylaxis required over 150 hours of the nurse and physician epidemiologists' time. Post-exposure prophylaxis cost $4357 for antimicrobial agents alone. The furlough of thirty employees increased the cost of exposures further. Even a few pertussis cases generate significant expenses for a healthcare organization. Much of this expense may have been avoided if a pertussis vaccine were available for adults.

94

Micrococcal Bacteremia in Patients with Primary Pulmonary Hypertension on Epoprostenol. *ERIC R. EHRENSING, ALAN M. STAMM, MARK F. AARON, ROBERT C. BOURGE, Univ. of Alabama at Birmingham, Birmingham, AL

Micrococci are aerobic gram-positive cocci in the same family as Staphylococci. Epoprostenol (prostacyclin) is used to treat primary pulmonary hypertension by continuous infusion from a cooled pump through a Groshong catheter. It has no known immunomodulatory properties, although its side effects include fever, chills, nausea, rash, and petechiae. Six patients among 58 receiving continuous infusion of epoprostenol developed micrococcal bacteremia. All were female and newly symptomatic. Symptoms included fever, chills, malaise, nausea, vomiting, and diarrhea. One patient had recurrent micrococcal bacteremia and one patient died from bacteremia despite therapy. Most patients had multiple positive blood cultures, and some had more than one organism present. In a retrospective analysis of all the micrococcal isolates from 1/96 to 7/97 at our hospital, 18% (6/33) were patients using epoprostenol. Among patients with multiple isolates of micrococcus (to remove contaminated blood cultures), 60% (6/10) were using epoprostenol. Until now, disease due to this organism has been reported only in one group of patients, cancer patients with recent chemotherapy. It has also been reported as a contaminant in sterile fluids. Four micrococcal isolates from epoprostenol patients were genotyped and found to be unrelated. Also, the organisms had dissimilar antibiotic susceptibility profiles. Therefore, in the absence of evidence for contamination or Groshong infection, this micrococcal infection in epoprostenol patients deserves further study. Also, since the side effects of epoprostenol use are so similar to symptoms of infection, users of epoprostenol should evaluate all patients with fever, chills, and nausea, and treat all patients with blood cultures positive for micrococcus species. We believe this is the first report of micrococcal infection in a group of immunocompetent hosts, and the first report of a death due to Micrococcus.

95

Control of a Community-wide Outbreak of Measles. *VERLA COWAN, VALERIE HUGGINS-MARTIN, PEGGY BRINDLE, CAROL VANDERPLOEG, KARLYN STANKYE, FRAN CAPPA, BARBARA RIEHM, KAREN STEINGART, and JOSEPH YAO. Southwest Washington Medical Center and Southwest Washington Health District, Vancouver, Washington, U.S.A.

We report herein the epidemiologic investigations and control of a community-wide outbreak of measles in Clark County, WA, where no cases of measles had been reported since 1991. The outbreak began with the hospitalization of a 17-yr old Japanese exchange student with unrecognized measles on March 14, 1996. Over a 3-month period, a total of 33 cases (31 confirmed, 2 probable) of measles were identified in Clark County for an attack rate of 11.3 per 100,000 population. Median age of cases was 22 years (range 5 mon. to 45 yrs), with highest age-specific incidence rates among children <5 yrs and those aged 15-19 yrs. Of note were 25 (76%) cases in persons ≥20 yrs, including 4 (12%) cases occurring in those 40-44 yrs. The ethnic origins of the cases were white (97%), Hispanic (6%) and Asian (3%). Of the 13 (39%) cases acquired in healthcare settings, 8 occurred in healthcare workers (HCW; age range 20-43 yrs), 4 of whom were considered previously immune to measles by age criteria (born before 1957), recalled history of measles, or documentation of 1 dose of measles vaccination. The patterns of measles transmission included patient to HCW (4 cases), patient to patient (2), HCW to patient (3), and HCW to HCW (2). Outbreak control measures included prompt identification, reporting and isolation precautions of suspected cases, community-wide vaccination campaigns to ensure 2 doses of vaccines for all susceptible individuals, and exclusion of susceptible individuals from schools and healthcare settings. To prevent nosocomial transmission, criteria for determining measles immunity in HCW were revised: 1) born before 1948 with clear memory of measles infection; 2) serologic evidence of immunity (measles IgG antibody present); or 3) documentation of 2 doses of MMR vaccine received after 1967. Serologic testing for measles immunity was obtained in 799 HCW, and 34 (4%) were determined non-immune. Age distribution of the non-immune HCW was as follows: 5 (15%) in ages 20-29 yrs; 16 (47%) in ages 30-39 yrs; 9 (26%) in ages 40-49 yrs; and 4 (12%) in ages >49 yrs. Of the 20,000 doses of MMR vaccines administered during the outbreak, 1,222 doses were given to hospital HCW (1,041 first dose and 181 second dose). Among 302 (29%) responses from mail and telephone survey of the vaccinated HCW, 55 (18%) reported adverse reactions (fever, rash, arthralgia, myalgia, erythema or swelling of injection site), of which 3 cases resulted in brief loss of work. This investigation illustrates the importance of close and rapid collaboration among primary care providers, hospital personnel and public health authorities to develop control strategies and implement preventive measures for outbreaks of communicable diseases.

96

Characteristics of exposures to varicella and herpes zoster in six hospitals. SHERRILYN WAINWRIGHT*, DENISE CARDO, RAYMOND A. STRIKAS, WALTER W. WILLIAMS, and the NaSH Surveillance Group. Centers for Disease Control and Prevention (CDC), Atlanta, GA.

Exposures to varicella zoster virus (VZV) can cause loss of resources to the hospital resulting from susceptible health care workers (HCWs) becoming ill or being kept out of work following exposure. The National Surveillance System for HCWs (NaSH) has been developed to track individual HCW's immune status to vaccine-preventable diseases (VPDs) as well as exposures to VPDs. To assess the characteristics and outcomes of exposures to VZV in six hospitals participating in NaSH, the source of exposure, number of susceptible HCWs, number of HCWs who developed illness, and number of work days lost, and causes of exposures were examined. From February 1996 through November 1997, 72 VZV exposure events were reported (54 varicella, 12 disseminated herpes zoster [DHZ] and 6 localized herpes zoster [LHZ]. The sources of exposure to varicella included 24 (44%) patients, 25 (46%) HCWs and 7 (9%) visitors. Patients were the source for 92% and 67% of exposures to DHZ and LHZ, respectively. Available data indicate that of 1086 exposed HCWs, 32 (3%) were susceptible to VZV and 11 had unknown immune status. Five HCWs developed infection. Follow-up of exposed susceptible HCWs indicated that 11 HCWs were sent home for a total of 111 days off work. The 5 HCWs who developed illness were off work for 47 days. None of the 11 HCWs with unknown immune status became ill, but 3 were sent home for a total of 23 days off work. We have information on patient exposures for 45 exposure events; of the 152 patients exposed to VZV, 34 (22%) were susceptible. For 36 exposures, information on the causes of exposure was available: 25 occurred because the source patient was not identified at the time of exposure and 4 occurred because infection control measures were not properly followed. Exposures to VZV are frequent and result in lost work days. A system that facilitates the identification of the immune status of HCWs can minimize HCWs who need to be sent home from work after exposure to VZV.

S1

Response of English Hospitals to the New Nosocomial Infection National Surveillance Scheme. *R. COELLO, A. PEARSON, J. WILSON, J. SEDGWICK, V. WARD, A. CHARLETT, B. WARD, and E.M. COOKE, PHLS Central Public Health Laboratory, London, UK

In order to provide national data on hospital-acquired infection (HAI) in England, a new surveillance scheme, the Nosocomial Infection National Surveillance Scheme (NINSS), has been developed by the Public Health Laboratory Service in conjunction with the Department of Health. The objectives are to develop standard protocols and definitions for the surveillance of HAI, to estimate the incidence of these infections in England, to provide comparative data to detect differences between hospitals and changes over time within individual hospitals and nationally. The surveillance system is targeted on infections, groups of patients, or micro-organisms. Each type of targeted surveillance is called a module. Since the launch of the scheme in March 1996, modules for hospital-acquired bacteraemias (HAB) and for surgical site infection (SSI) for defined categories of surgical procedures, have been developed. Participation in the scheme is voluntary and confidential. Surveillance is carried out for at least three consecutive months. Data are collected by using optical mark recognition (OMR) forms, which are analysed centrally. Since October 1996, 102 hospitals have participated, of which 97 are in the National Health Service (approximately 37% of all NHS hospitals). Fifty-two hospitals chose SSI, 39 HAB, and 11 both. The categories of surgical procedures chosen most often were hip replacement, abdominal hysterectomy, knee replacement and large bowel surgery (77%, 58% and 42% and 38% of hospitals, respectively). Experience from the first year has shown that the scheme has been well received and is feasible without additional local resources. Reports from NINSS provide incidence data, which are adjusted for major risk factors and can be used for comparative purposes.

S2

A Regional Data Set of Infection Rates for Long-Term Care Facilities: Description of a Valuable Benchmarking Tool. *KURT B. STEVENSON, Intermountain Infection Control, Boise, Idaho

The acuity of medical care is increasing in long-term care facilities, due in part to shorter lengths of hospital stay, with a potential increased risk for the development of nosocomial infections. The overall incidence of reported infections range widely and may not be useful for comparison when examining the rates at an individual facility. I describe the development of standardized infection control programs among 6 long-term care facilities in close geographic proximity with similar patient populations and demonstrate the value of pooled infection rate data for regional interfacility comparison and benchmarking. Surveillance in each facility is conducted by a licensed nurse trained and supervised by an infectious diseases physician. Standard definitions for infections are utilized (McGeer, A. et al. Am J Infect Control 1991; 19: 1-7). The data set consists of a total of 257,738 resident days over two years with 1095 total infections for a pooled mean rate of 4.68 infections per 1000 resident days. Infections for specific categories are expressed as pooled mean rates per 1000 resident days: 456 urinary tract infections (rate 1.82); 339 respiratory infections (rate 1.45); 228 skin and soft tissue infections (rate 1.04); 53 gastrointestinal infections (rate 0.27); 6 febrile illnesses (rate 0.03); and 3 bloodstream infections (rate 0.01). Data analysis is patterned after the National Nosocomial Infections Surveillance (NNIS) program. Each individual facility can compare total and specific infection rates with the pooled means and percentiles from the data set. A complete analysis of the data and specific examples will be presented.

S3

STARLING, C.E.F.; ALMEIDA, F.F.; COUTO, B.R.G.M.,

Introduction: the AVALIA system, developed with a methodology based on the United States' JCAHO (*Joint Commission for the Accreditation of Healthcare Organizations*) concepts, is a tool to analyze hospital performance based in the control of nosocomial infections (NI) and based on the calculation of scores. In this paper, we present the hospital evaluation and classification methods used by AVALIA, the computer system that supports this methodology and some results of its use in Brazilian hospitals. Methodology: the criteria for the evaluation of hospitals is structured in 6 topic groups: totaling 26 questions of different weight: I-NI Control Services Organization; II-Epidemiological Surveillance; III-Training and Skill Providing Activities of Human Resources; IV-Control Activities and Support Areas; V-Control of Invasive Procedures; VI-Research Activities (optional item). The score given for each question varies from 0 to 5 points. If, in one particular question, the hospital does not fit in any of the scores, it receives a zero score, with the exception of question 1.a (existence of, at least, a NI control commission) which was a disqualifying question, invalidating the evaluation. With the 26 questions the hospital is evaluated and the result is then calculated using a weighted average (WA) of the scores given in each question. Finally the hospital is classified: D ($0\% < WA \leq 25\%$) → the hospital does not meet the minimum necessary for NI control, and should be re-evaluated in 3 months; C ($25\% < WA \leq 50\%$) → the hospital meets the minimum requirements for NI control, and should be re-evaluated in 6 months; B ($50\% < WA \leq 75\%$) → the hospital has good NI control, but not enough to carry out highly complex procedures (cardiac transplant, for example); A ($75\% < WA \leq 100\%$) → the Hospital has very good NI control to carry out highly complex procedures, if it is accredited to do so. If $WA \geq 90\%$ the hospital receives an excellence quality plaque in NI control. **Results**: AVALIA was used in 8 hospitals in Belo Horizonte (H1-H8), with the following results: H1 (37%, C); H2 (39%, C); H3 (49%, C); H4 (52%, B); H5 (53%, B); H6 (54%, B); H7 (66%, B); H8 (85%, A). **Conclusions**: the AVALIA system is a tool in continuous development, an important instrument in hospital classification. The next step is its large scale use and an analysis of the correlation with the incidence of NI, which is already being implemented.

S4

Prospective Surveillance To Use The Data In Decision Making. ***LOPES, J. M. M. , COUTO, B. R. G. M. , STARLING, C. E. F. Centro Geral de Pediatria - Fundação Hospitalar do Estado de Minas Gerais - Brazil.**

In order to provide a 150-bed referral pediatric public hospital with data on nosocomial infections (NI) and thus to implement control policies, in 1992 we started a prospective surveillance by establishing the NNIS method and CDC - 1988 definitions.

From January 1993 to December 1996 (960 NI; 11,147 discharges; 101,139 patient-days) the ICU rates were: 8.28% or 15.95 NI/ 1000 patient-days; the overall NI rate was 8.61% or 9.49 NI/ 1000 patient-days. Over the time, excluding the ICU, the overall NI rate, showing a trend to slow, changed from 14.98% or 16.57 NI/ 1000 patient-days in 1993 to 3.28% or 3.78 NI/ 1000 patient-days in 1996 ($p < 0.05$). The six most frequent sites were: EENT = 30.42%; SST-SKIN = 22.81%; PNEU = 10.73%; UR = 7.92%; SST-ST = 6.46%; BSI = 6.25%.

Knowing the epidemiology of NI, enabled us to establish the occurrence, distribution and expected incidence of NI, to know baseline rates of endemic infections, to recognize trends and keep track of possible outbreaks, therefore, preventing strategies could be implemented as a benefit of the NNIS method applied.

As time goes by, and the surveillance continues, our knowledge about the hospital environment increases and more specific continuous quality improvement projects and comparisons can be targeted.

NNIS methodology can be applied successfully in pediatric public hospitals in Brazil.

S5

Hospitalwide surveillance of nosocomial infection in a large teaching Italian hospital. Preliminary results over ten months period.

*CARLO MARENA, ANTONELLA RIVA, ANTONIO TRIARICO, DONATA PASSERINI, PIETRO OLIVIERI, SILVIA AZZARETTI, VIRGINIA QUATTRONE, *LORENZO LODOLA. Chief Medical Executive, I.R.C.C.S. "Policlinico San Matteo", P.Le Golgi 2 - 27100 Pavia, Department of Preventive Medicine, Section of Hygiene, University of Pavia, Italy.

San Matteo Hospital is a 1200-bed teaching Hospital for acute care affiliated with University of Pavia. As part of an active surveillance program, prospective comprehensive surveillance was started on February 1997, to gather nosocomial infection (NI) baseline information. NI were classified following CDC definitions. Data collection was obtained by the weekly activities of thirteen Infection Control Practitioner (ICP) at each unit of the hospital. Surveillance culture sets were obtained from two internal laboratories at one month intervals. During the study period, San Matteo Hospital produced 33.042 discharges representing 265.295 patient-days. During this period 1.140 NI were detected for an incidence rate of 3.4%, or 4.2 NI/1000 patient-days. The incidence of main hospital-wide NI sites were the following : surgical site infection (SSI) 0.83%, lower respiratory tract infection (LRTI) 0.69%, urinary tract infection (UTI) 0.66%, intravascular catheters 0.27% , other 0.27% . The positive microbiological cultures were associated to 715 (62.8%) of NI, 425 (37.2%) were identified by using clinical data. The five most common pathogens isolated were: S. aureus 267 (37.3%), E. coli 156 (21.8%), P. aeruginosa 140 (19.5%), Klebsiella pneumoniae 111 (15.5%), S. epidermidis 98 (13.7%). The mortality rate related to NI (deaths related to NI/patients with NI) was 6.5%. The main prevalent NI site was SSI. This ongoing study provides a baseline information for future surveillance methods which will be useful to focus effective infection control strategies.

S6

Monitoring the Effectiveness of Infection Control Measures by Repeated Prevalence Surveys

*DIANA BOGAERS, ELLA van NIEUWLAND and PETER van KEULEN. Ignatius Hospital Breda, Breda, The Netherlands.

Objectives: To monitor trends in nosocomial infections (NI) and the relation with infection control measures.

Methods: One day prevalence surveys performed every six months from April 1992 until November 1996 (CDC-criteria were applied). All patients present on the day of the survey were included.

Results: During 10 surveys, 3573 patients were included. The mean age was 56 y (SD:19.6, median 63 y) and the majority were female (54%). Overall there were 8.7 NI per 100 patients. Over the years there was a significant decrease in the prevalence of NI which was entirely caused by a significant reduction in the prevalence of Urinary Tract Infections (UTI) (see table).

	1992	1993	1994	1995	1996
All NI prevalence	10.3	10.5	8.1	7.3	7.9
UTI prevalence	6.0	5.8	4.3	2.1	3.3
Other NI prevalence	4.3	4.7	3.8	5.2	4.6
Total no of patients	745	702	713	692	721

During the study period there was an active policy to optimize the use of urinary catheters, focused on restricted use of urinary catheters and promoting intermittent catheterization in postoperative and neurological patients.

Conclusions: Prevalence surveys are effective and useful methods to monitor trends in NI rates. An active program to control UTI's resulted in a significant decrease of the UTI prevalence.

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S7

Catheter Related Sepsis in an ICU. EVONNE T CURRAN*, MALCOLM G BOOTH, LYNN DICKSON, MICHAEL LOCHART and JOHN HOOD

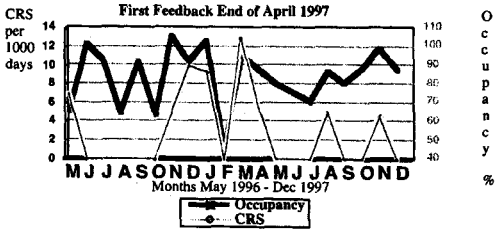
Surveillance of hospital acquired infection reduces incidence when relevant data is fed back to clinicians. It is important to ensure that the period of surveillance is sufficiently long to determine a true rate and any changes. It behoves Infection Control Teams to design effective surveillance programmes whilst minimising input for both clinical and infection control practitioners.

This programme in a 7 bedded ICU was designed to detect and reduce catheter related sepsis (CRS). It began in May 1996. The programme takes less than 2 hours per month to complete. The main results are as follows:

a) At least 6 months data is required to give true background levels.
b) Incidence appears to increase with occupancy ≥80%
c) Reductions in CRS need to be compared with occupancy.

	Pre feedback	Post feedback
Occupancy <80%	1/4 25% months positive	0/2 0% months positive
Occupancy ≥80%	5/8 62.5% months positive	2/6 33% months positive

Catheter Related Sepsis (CRS) and Occupancy in ICU May 1996 - December 1997



S8

Infection Rates In a Cardiac Intensive Care Unit (CICU) Before and After Merging With a Neurosurgical Intensive Care Unit (NICU) In Ribeirão Preto, Brazil. *SILVIA N.S. FONSECA, SÔNIA R.M. KUNZLE, SHEILA SILVA, MARCUS FEREZ, JORGE SCHMIDT JR. Hospital São Francisco, Ribeirão Preto, São Paulo State, Brazil. We have been doing daily prospective active surveillance using the National Nosocomial Infection Surveillance (NNIS) system in our hospital since July 95. Despite the implementation of several infection control measures proposed by the Centers for Disease Control and Prevention (CDC), especially regarding prevention of urinary tract infections (UTI), pneumonia (pneum) and central-catheter related (CCR) infections we could never demonstrate a drop in our very high infection rates. We decided to analyze our data to verify why our proposed guidelines were not working. Up to August (Aug) 96, we had two ICU: CICU (13 beds), for the care of heart surgery patients (pts), and a 5-bed NICU. After Aug 96, the two merged ; data (device-days and infections) from the neurosurgical pts were separated from the heart surgery pts data. We compared rates from NICU and CICU, in two different periods, Period I : Jan 96 to Aug 96 (before merging) and Period II: Jan 97 to Aug 97. We calculated the percentage of neurosurgical pts in CICU in period II. We also determined the number of health care workers (HCW) working in every shift in CICU in both periods. In period I, 709 pts were admitted to CICU and in period II, 868; 112 (13%) were neurosurgical pts. The mean rate for UTI, pneum and CCR infections in CICU went up from 9.7, 39.95 and 6.94 infections/1,000 device-days in period I to 18.98, 57.19 and 14.98 respectively in period II ($p<0.05$). However, if neurosurgical pts were excluded, the mean UTI, pneum and CCR infection rate did not change in the two periods (15.66, 36.48 and 10.3 respectively, $p<0.05$). We looked at the infection rates of neuro pts in period I (NICU) and period II (CICU) and realized that the rates did not differ ($p<0.05$). Comparing period I and period II , the mean number of patients daily in CICU went up from 8.37 to 10.45 ($p<0.05$) ; the mean number of HCW there stayed the same: 6.34 and 6.4 HCW/ shift respectively. We concluded that the neurosurgical pts were responsible for the apparent increase of the infection rates in CICU; also, despite of the fact that the ratio pt/HCW was higher, the infection rate of heart surgery pts stayed the same, perhaps because of the implementation of infection control measures.

S9

Site Specific Rate of Nosocomial Infections Occuring in a Bone Marrow Transplant Unit. M.L.SAMPLE*, V. ROTH, C. OXLEY, G. GARBER. Ottawa General Hospital and the University of Ottawa. Ottawa, Ontario, Canada.

Over the past 20 years, bone marrow transplantation (BMT) has become the treatment of choice for many hematologic malignancies. Infection is an anticipated complication for many of these patients, often with significant adverse consequences. We conducted a prospective surveillance study in our inpatient/outpatient BMT unit to determine the overall and site specific rate of nosocomial infections. Outpatient BMT patients were included in the analysis because the frequency of their visits exposes them to the hospital's endogenous flora. NNIS definitions were used with modifications for absence of leukocyte response. Infections were determined based on clinical data with culture confirmation when available. Between November 1, 1996 and January 31, 1997, 65 patients were studied. The overall infection rate was 39.3 infections/1000 days at risk. Rates currently being reported from other institutions range between 5.18 - 46.3 /1000 days at risk.

Site	Infections (n=65)	Infection Rate/1000 days (n=1093)
All Sites	43	39.3
Blood	5	4.6
GI Tract	10	9.1
Mucositis	18	16.5
Skin/soft tissue	6	5.5
Urinary tract	2	1.8
Other	2	1.8

S10

A prospective study of nosocomial infections in bone marrow transplant patients.

CARLO MARENA, MARIA LUISA CARENINI, DONATA PASSERINI, ANTONIO TRIARICO, PIETRO OLIVIERI, VIRGINIA QUATTRONE, SILVIA AZZARETTI, *LORENZO LODOLA.
Chief Medical Executive, Department of Haemathology, I.R.C.C.S. "Policlinico San Matteo", Institute of Hygiene-University of Pavia, P.Le Golgi 2 - 27100 Pavia, Italy.

The objective of this study was to define the incidence of nosocomial infection (NI) occurring in adult patients undergoing bone marrow transplantation (BMT). Between February and November 1997, in ongoing continuous prospective surveillance for NI, all patients admitted to the BMT unit, were assessed for the development of NI in any site. Routine infection control surveillance was conducted by the infection control personnel. According to CDC definition, a total of 17 NI were identified in 64 discharged patients for an overall incidence rate of 26.5%. The rate of bloodstream infection was 3.1. Other site-specific rates were : urinary tract, 3.1; respiratory tract, 10.9; intravascular catheters 9.3. Among 25 pathogenes identified, there were 5, (20%) S. aureus, 4 (16%) Coagulase-negative staphylococci; 4, (16%) E. coli, 3, (12%) P. aeruginosa, 3, (12%) Acinetobacter spp, 3, (12%) Candida, 1, (4%) S. cohnii, 1, (4%) S. simulans, 1, (4%) Enterobacter faecalis. In addition, the screening surveillance cultures performed during hospitalization, showed 22 episodes of colonization in absence of signs or symptoms of infection. The distribution of colonization sites was the following: gastrointestinal tract 10 (15.6%), vaginal 9 (14%), soft tissue 3 (4.6%). The study shown a lower incidence of NI with respect to what reported by others. Continued prospective surveillance seem to be effective in preventing NI among patients undergoing BMT.

S11

Comparison of Poisson regression models and control charts to detect nosocomial outbreaks

Bandeira, AC; Brites, C; Badaró, F; Silva, N; Barreiro, C; Fernandes, E; Badaró, R. Hospital Aliança, Salvador, Brazil*

Monitoring nosocomial infection is a mandatory activity for all hospital surveillance program today. Several methods and tools are available to quick and early identification of nosocomial outbreaks. This abstract presents a comparison of regression technique and control charts for nosocomial outbreak detection. **Methods:** From January through November 1997 nosocomial infection [NI] rates (per month) were stratified by admission sectors and modeled as Poisson processes using multiple regression techniques and control charts at Hospital Aliança in Salvador, Bahia - Brazil. NNIS definitions were applied for surveillance purposes. Infection rates above $\mu + 2\sigma$ for control charts and standardized residuals outside 95% confidence region for Poisson regression were investigated for outbreaks. SAS version 6.11 and GLIM 4.0 softwares were used for Poisson regression. **Results:** A total of 138 NI per 22,816 patient-days occurred during the study period in 8 admission wards [3 ICU's and 5 general care units (GCU)]. Mean infection rates per sector varied from 0.75 per 1000 patient-days to 15.30 per 1000 patient-days. Control charts and Poisson modeling each pointed out six possible outbreaks (5 in ICU's and 1 in GCU's). Nevertheless, after conducting investigative efforts only one true outbreak was identified by both methods. **Conclusion:** The simpler control charts is a valid tool for monitoring nosocomial infection and have similar sensitivity as Poisson regression method and may be a good alternative for hospital with poor access to the sophisticated computer programs.

S14

Community-acquired Bacteremia (CAB) at a Teaching (T) vs Nonteaching (NT) Hospital (H): Influence of Acute Severity of Illness (ASOI) and Infectious Diseases Consultation (IDC) on Outcome. *J. MYLOTTE, L. KAHLER, AND C. MCCANN. State Univ. of New York at Buffalo, Buffalo, N.Y.

Objective: To compare the outcome of CAB at a TH vs a NTH with special reference to the influence of ASOI and IDC. Setting: TH is a 400-bed urban, public facility in Buffalo, NY with 5 full-time ID consultants; NTH is a 160-bed community hospital in a suburb of Buffalo with 1 ID consultant. Design: Retrospective chart review of patients with CAB during 1995. Methods: CAB was defined as a patient with positive blood cultures within 48 hours of admission and no admissions in the prior 30 days. ASOI was measured using the APACHE III (APIII) system. Only IDCs done within the first 3 days of admission were included. Outcome was status 30-days post admission. Results: Patients with CAB at the NTH (N = 75) were older on average than at the TH (N = 174) [75 vs 61; $P < .001$] but patients at the TH were more acutely ill (mean APIII 64 [TH] vs 53 [NTH]; $P = .01$), had HIV/AIDS (16% [TH] vs 0% [NTH]; $P < .001$), and had dialysis (14% [TH] vs 0% [NTH]; $P < .001$). Bacteriology of CAB was similar except for *S. aureus* (25% of cases [TH] vs 9% [NTH]; $P = .004$) and *E. coli* (14% of cases [TH] vs 41% [NTH]; $P < .001$). Sources of CAB were similar between the Hs. Treatment of CAB was appropriate in 94% [TH] vs 93% [NTH]. IDCs were requested more often at the NTH (39%) vs TH (14%;$P < .001$); there was no relationship between mean APIII and IDC at either H. Patients with IDC were treated, on average, longer (16 days vs 11.7 days; $P = .052$ at TH and 12.8 vs 10.2; $P = .24$ at NTH). 30-day mortality was similar overall (20.1% [TH] vs 16.7% [NTH]; $P = .53$) or with IDC: TH (with 20% vs 20% without IDC; $P = .99$) and NTH (with 18.5% vs 15.6% without IDC; $P = .76$). At both H those with admission APIII > 49 had a higher 30-day mortality: TH (< 50 [6%] vs ≥ 50 [29%]; $P < .001$) and NTH (< 50 [0%] vs > 50 [31%]; $P < .001$). When patients at each H were stratified by low and high APIII, there was still no impact of IDC on outcome. Conclusions: Differences in clinical characteristics of CAB cases at a TH vs a NTH existed, but ASOI was most important in predicting mortality at both H. IDC was used infrequently and had no impact on mortality but appeared to lengthen therapy.

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S15

Nosocomial Infections (NI) in Neutropenic Patients With Cancer. D. FORSTER[1], *M. DETTENKOFER[1], R. BABIKIR[1], W. EBNER[1], F. D. DASCHNER[1], R. MERTELSMANN[2]. [1]Inst. for Environm. Medicine and Hosp. Epidemiology, [2]Dept. of Internal Medicine I, Univ. Hospital of Freiburg, Germany.

In order to identify overall and site-specific rates of nosocomial infections (NI) in neutropenic cancer patients, a prospective study was started in February 1997 in a general oncology ward (OW) and the bone marrow transplantation unit (BMTU) of our institution. NI during neutropenia were defined according to the criteria proposed by Carlisle et al. (1993) and standard criteria for localized catheter-associated infections (CAI). Neutropenia was defined as an absolute leucocyte count $< 1 \times 10^9/l$. In the BMTU, 54 patients with a total of 696 neutropenic days were investigated. 36 (66.6 %) patients were undergoing BMT and 18 (33.3 %) peripheral blood stem cell transplantation. 322 patients with a total of 247 neutropenic days were studied in the OW. In the BMTU, 34 NI were identified in 54 patients, in the OW 16 NI in the 40 neutropenic patients. The proportion of NI occuring during neutropenia was 87.2 % for the BMTU and 61.5 % for the OW. Site specific incidence rates (NI/100 neutropenic patients) and incidence densities (NI/1000 neutropenic days) are:

Type of NI	NI/100 neutropenic patients		NI/1000 neutropenic days	
	BMTU	OW	BMTU	OW
BSI	33.3	15	25.8	24.2
Pneumonia	14.8	7.5	11.5	12.1
CAI	11.1	2.5	8.6	4.1
Gastroenteritis	1.9	7.5	1.4	12.1
UTI	1.9	7.5	1.4	12.1
Overall rates	63	40	48.7	64.6

Despite of a moderate overall incidence (8.1/100 patients) and incidence density (8.1/1000 patient days) of NI in the OW, incidence densities of NI during neutropenia are comparable to rates of the BMTU. BSI in the neutropenic state were identified more frequently than in previous reports. 41.9 % of isolated pathogens in BSI were streptococci. 32.3 % were coagulase-negative staphylococci.

S16

Risk Factors for Infection in Hospitalized Trauma Patients. G. PAPIA*, B.A. MCLELLAN, P. EL-HELOU, M. LOUIE, A. RACHLIS, J.P. SZALAI, and A.E. SIMOR, Sunnybrook Health Science Centre, University of Toronto, Toronto, Ont., Canada.

Infection is an important complication in patients hospitalized with multiple injuries and trauma. A study was done in order to determine the frequency, types, risk factors, and outcomes of infections occurring in trauma patients. Prospective surveillance for nosocomial infections was conducted for all trauma patients (excluding burns) admitted for more than 24 hours to a tertiary-care regional trauma centre between Jan. 1-Dec. 31, 1996. CDC definitions of infection were used for surveillance. A total of 460 patients (412 males) with a mean age of 41 yrs (range: 16-92 yrs) were followed. Most (86%) sustained blunt trauma; 14% sustained penetrating injuries. 349 (62%) patients were admitted to an intensive care unit, and 72% had at least one surgical procedure.

A total of 367 infections occurred in 209 (37%) patients, involving the following sites: 101 (28%) lower respiratory tract; 89 (24%) urinary tract; 67 (18%) surgical wound; 47 (13%) skin/soft tissue; 19 (5%) intra-abdominal; 17 (5%) primary bloodstream; and 27 (8%) other sites. Infection was diagnosed a mean of 23 days after admission, and was complicated by septic shock in 36 (10%) cases. Infection was also associated with ARDS (9%), and multiorgan failure (4%). The mean length of stay in hospital for infected patients was 35 days compared to 11 days for those noninfected ($p<0.01$). Twenty-nine patients died including 15 (7%) infected patients and 14 (6%) noninfected; death was attributed to infection in 4 patients. In a multivariate analysis, infected patients were more likely to have been intubated (OR 2.8, $p<0.001$); to have had a greater Injury Severity Score (OR 3.7, $p<0.001$); to have had multiple surgical procedures (OR 3.8, $p=0.003$); and to have received multiple blood transfusions (OR 3.9, $p<0.001$). First surgical procedure within 24 hrs of admissions was protective (OR 0.3, $p<0.001$). These results confirm that infection is a common complication in patients with major trauma, and that improved approaches to risk reduction and infection prevention need to be developed.

S17

Impact of Newer Medical Devices on Nosocomial Infection Surveillance: Etiologic Fraction of Bloodstream Infections (BSI) in Patients with Implantable Left Ventricular Devices (LVADs) in a Cardiothoracic Intensive Care Unit (CTICU). *STEVEN K. SCHMITT, JANET M. SERKEY, STEVEN M.GORDON, CYNTHIA A. FATICA, and PATRICK M. MCCARTHY, Cleveland Clinic Foundation (CCF), Cleveland, OH.

Implantable left ventricular assist devices have been approved by the FDA as a "bridge to transplantation," successfully addressing the need for cardiovascular support in patients with end-stage heart failure refractory to medical therapy. Since 1991, more than 135 LVADs have been implanted in critically-ill patients at the CCF, many of whom have had multiple comorbid diseases. We have previously reported on the association of bloodstream infections with LVADs (*Ann Thorac Surg 1996;61:359*); the primary objective of this study was to assess the etiologic fraction of BSIs in the CTICU attributable to exposure to LVADs. All patients with a LVAD (n = 99) and a nosocomial BSI first occurring in the CTICU between January 1995 and September 1997 were retrospectively identified from a database of nosocomial BSI maintained by prospective surveillance. The overall nosocomial BSI rate for all patients in the CTICU at the CCF during the study period was 8 per 1000 (319 episodes in 39,449 patient ICU days). A total of 6.3% (20) of nosocomial BSIs occurred in patients with LVAD. The etiologic fraction of nosocomial BSI in patients with LVADs increased from 3.4% in 1995 to 10.3% in 1997. Bloodstream pathogens associated with LVADs included gram negative aerobic organisms (55%), fungi (20%), gram-positive organisms (20%), and polymicrobial (5%). During the same period, bloodstream pathogens in the overall CTICU population included gram negative aerobic organisms (43%), gram negative anaerobic organisms (1%), fungi (11%), gram positive organisms (33%), and polymicrobial (12%). Of note, 3 LVAD patients developed BSI with VRE during the study period. We conclude that patients with newer implantable medical devices may contribute an important fraction of BSI in the CTICU, requiring modification of surveillance efforts to identify and prevent these infections.

S18

Management of Implantable Electrophysiologic Cardiac Device Infections. *JIMMY CHUA, IRENE LEE, STEVEN GORDON, and BRUCE WILKOFF. Cleveland Clinic Foundation (CCF), Cleveland, Ohio.

Infections involving implantable cardioverter defibrillators (ICDs) and cardiac pacemakers (PM) are expected to increase with the increase in patients undergoing device implantation. Our standard approach to ICD and PM infections involves removal of all foreign material including the device and leads, antimicrobial therapy, and reimplantation at a new anatomic site. We reviewed 38 cases of PM infections and 13 cases of ICD infections occurring in 51 patients treated at CCF between March 1996 and December 1997. The mean age of patients was 67 years; 64% were men and 86% had their implantable devices placed at other institutions. The mean interval from implantation of the target device to diagnosis of infection was 62 weeks (range: 0-564 wks). The most common signs and symptoms included warmth over pocket (86%), pain and/or tenderness (63%), erythema (68%), discharge (39%), and fever (20%). The most common pathogens were *Staphylococcus epidermidis* (63%), *S. aureus* (18%), and aerobic gram negative rods (16%); 10% of patients had device associated bacteremias. The most common signs of infection were localized to the subcutaneous or submuscular tissue pocket and included warmth (86%), erythema (68%), pain or tenderness (63%), discharge (39%), and pocket erosion (24%). Prior to evaluation at our institution, 73% of patients had received antibiotic therapy (mean 45 days), 62% were hospitalized for treatment of infection (mean 10 days), and 32% underwent either removal or repositioning of the device without removal of leads. At CCF, all remaining electrophysiologic devices were removed and percutaneous transvenous extraction of all leads was successful in 98% of patients. 29 patients had cardiac echocardiography and 10% (4) had vegetations attached to transvenous leads. ICDs or PMs were subsequently reimplanted in 34 patients (90% at a different anatomical sites) a mean interval of 6 days from explantation (range 0-25 days). 96% of patients received antimicrobial therapy after explantation for a mean of 20 days (range 1-56 days). There has been no subsequent device infections to date in any patient undergoing reimplantation. We conclude that the combination of abandonment of the infected ICD or PM implantation site with percutaneous transvenous extraction of implanted transvenous leads techniques and antimicrobial therapy allows for timely and successful reimplantation.

S19

Risk Factors for Mortality in Hospitalized Patients with Indwelling urinary catheters: Catheter-associated urinary Tract Infection Alone Is Not a Risk Factor for Mortality. **TAMBYAH PA, KNASINSKI V, MAKI DG. University of Wisconsin Medical School, Madison, WI.**

Catheter-associated urinary tract infection (CAUTI) is the most common nosocomial infection. Widely cited studies have suggested that CAUTI is a significant *independent* risk factor for increased hospital mortality. (N Engl J Med 1982;307:637-42, Am J Epidemiol 1992;135:291-301). We prospectively studied 1000 newly-catheterized patients in our hospital; besides daily urine cultures, data were collected on risk factors known to predispose to CAUTI and in-hospital mortality. There were 44 deaths overall during the study. By univariate analysis, the following risk factors were found to be significantly associated with hospital mortality: increasing age, APACHE II score, antibiotic use, CAUTI and presence of other active nosocomial infections (NIs). However, when a stepwise procedure was used for both logistic and discriminant analysis, the only risk factors that consistently achieved statistical significance in predicting hospital mortality were APACHE II score (OR 5.1, 95% C.I. 2.1-12.4, P<0.01) and presence of other NIs (OR 13.0, 95% CI 6.0-28.0, P<0.01). Age (P=0.213), antibiotic use (P=0.502) and CAUTI (P=0.874) did *not* show a significant contribution after adjusting for the other parameters. CAUTI was also strongly associated with Other NIs (P<0.001, Fisher's exact test). We conclude that CAUTI alone is *not* an independent risk factor for mortality in hospitalized catheterized patients. Prior studies purporting to show it is did not take into other NIs into account in their analyses. CAUTI is, however, an important reservoir of multiresistant nosocomial pathogens, and thus new and more effective measures for the prevention of CAUTI would reduce the burden of antimicrobial therapy in this vulnerable population.

S22

Ventilator-Associated Pneumonia (VAP): Risk Factors and Outcome Assessment. **M.E. RUPP*, J.H. SISSON, D. PETERSON, F. RADKEY, B. WINFIELD, K.M. OLSEN, K.D. PATIL The University of Nebraska Medical Center, Omaha, Nebraska.**

Ventilator-associated pneumonia (VAP) is a significant medical problem resulting in an estimated 30,000 deaths per year in the United States. As part of a multi-phase VAP prevention program, we performed a case-control study to ascertain risk factors and outcome measures for VAP at UNMC. 32 VAP patients were matched with 32 mechanically-ventilated patients who did not develop VAP. Patients were evenly matched with regard to age, gender, race, and severity of illness. Univariate/ multivariate analysis was conducted on 30 different risk factors for VAP. Univariate analysis identified the following risk factors to be significant: macroscopic upper gastrointestinal tract (UGI) bleeding (p=0.05), altered consciousness (p=0.005), and self-extubation (p=0.04). Head trauma (p=0.098) and use of antibiotics (p=0.079) were observed as possible trends. Multivariate analysis did not reveal significant independent risk factors, although UGI bleeding (p=0.09) and altered consciousness (p=0.08) trended toward significance. VAP was associated with a 27% mortality rate, an excess ICU stay of 8 days (p=0.009), an excess hospital stay of 14.2 days (p=0.03), and an excess hospital cost of $38,700 per case. We conclude that VAP is associated with significant cost, and prevention measures at UNMC should focus on UGI bleeding prevention, preservation of consciousness, and prevention of self-extubation.

S23

Evaluation of a Sterile, Non Air-Dependent, Enteral Feeding System. M.E. RUPP*, R.A. WESEMAN, N. MARION, P.C. IWEN. The University of Nebraska Medical Center, Omaha, Nebraska.

Open enteral feeding systems (decanted from cans) have been associated with significant bacterial contamination and nosocomial infection. To prevent bacterial overgrowth and nosocomial infection, hang-times for these enteral feeding solutions is of short duration. Unfortunately, short hang-time often results in wasted formula and inefficient use of personnel time. We evaluated the rate of bacterial contamination associated with prolonged hang-time of a sterile, non air-dependent, closed-system enteral feeding solution (UltraPak®, Nestle Clinical Nutrition, Deerfield, IL). 15 patients, all of whom were liver transplant recipients, were enrolled. The mean age of these patients was 49.5 years. 7 were male and 8 were female. All were receiving immunosuppressive therapy. The hang-time of the 1500 ml closed-system enteral feeding system was dictated by the flow rate and ranged from 10 h to 35 h (mean 22.7 h, median 24.2 h). Administration sets were changed when the feeding containers were changed. At the conclusion of the feeding, the residual enteral feeding solution was cultured quantitatively for aerobic bacteria. 52 bags were cultured and none were found to harbor bacteria. 5 patients experienced nosocomial infections during the peritransplant period consisting of 5 surgical site infections, 2 *C. difficile*-assoc colitis, and 1 bloodstream infection. None of these infections were associated with the closed-system enteral feeding preparation. 3 patients died. The mean time from transplant to discharge was 18.75 d. We conclude that when properly handled, sterile, non air-dependent, closed-system, enteral feedings can be administered safely using prolonged hang-times. These systems represent an advancement in the enteral nourishment of the immunocompromised patient and should result in less wasted formula, more efficient use of personnel time, and associated cost savings.

S24

Impact of Extending the Interval for Ventilator Circuit Change from 7 to 14 Days on the Incidence of Nosocomial Ventilator-associated Pneumonia. *D.G. MAKI, D. OFF, M.A. ZILZ, University of Wisconsin, Madison, WI.

Mechanical ventilation (MV) is associated with a high incidence of nosocomial pneumonia. Because condensate within the circuitry tubing can become heavily colonized by nosocomial organisms during use, most hospitals replace the circuitry, including humidifier, at periodic intervals, most frequently every 2-7 days. We previously showed that extending the interval for circuit replacement from 2 to 7 days had no effect on the incidence of ventilator-associated pneumonia in our university hospital (SHEA 1995). We now report a prospective study of the impact of extending the interval for routine circuitry replacement from 7 days to 14 days in our university hospital. Data on MV-associated nosocomial lower respiratory infections (LRTIs) were collected from ventilated patients during Aug-Oct 1995 , when 7 days was used as the interval for replacement of circuitry, after which, the interval was extended to 14 days hospital-wide; the same data were collected after 9 months of implementation of the new policy, Aug-Oct 1996:

	7 days	14 days
No. MV-days	2626	2113
Nosocomial LRTIs per 1000 MV-Days	8.8	6.6

Patients requiring MV during both periods were similar in risk factors for nosocomial LRTIs. There were no significant differences in the incidence of nosocomial LRTIs, the overall incidence of nosocomial infection or case-fatality during MV between the two periods. These data indicate that extending the interval for replacement of ventilator circuitry to 14 days does not increase the incidence of nosocomial LRTIs and can permit even greater cost savings.

S25

Hemodialysis Vascular Access Infections: One Year Experience at an Outpatient, Multicenter Hemodialysis Facility. *KURT B. STEVENSON, Saint Alphonsus Nephrology Center, Idaho Nephrology Associates, and Intermountain Infection Control, Boise, Idaho.

Infectious complications involving vascular access sites constitute a major source of morbidity and mortality for patients receiving hemodialysis. Strategies for prevention of these infections have been proposed by the CDC and National Kidney Foundation but a standardized system for surveillance and data reporting has not been established. Likewise, there is little comparison data reported in the medical literature. Such a system would be an extremely beneficial benchmarking tool for individual dialysis centers. We report our initial one year experience from an outpatient, multicenter facility responsible for 24,705 hemodialysis sessions (20,580 permanent graft/shunt, 3054 Permacath, and 1041 temporary catheter sessions) in 1997. CDC definitions for blood stream infection, clinical sepsis, or vascular site infection (without bacteremia) were employed. Identified were 136 total infections for a rate of 5.51/1000 dialysis sessions (ds). There were 28 blood stream infections (1.13/1000 ds) and 10 episodes of clinical sepsis (0.40 /1000 ds). Ninety eight vascular site infections were identified (3.97/1000 ds) comprised of 47 permanent graft/shunt infections (rate of 2.28/1000 dialysis sessions), 39 Permacath infections (rate of 12.77/1000 dialysis sessions) and 12 temporary access infections (rate of 11.53/1000 dialysis sessions). This represents one of the first reports of extensive incidence data of hemodialysis vascular access infections. This surveillance and data reporting system could be standardized for hemodialysis centers allowing reliable comparison and benchmarking.

S26

INVESTIGATION OF AN OUTBREAK OF PYROGENIC REACTION IN HEMODIALYSIS

STARLING,C; PEIXOTO, M.L.B; LEITE, E.M.M.; COUTO,B.
São Francisco de Assis Hospital. Belo Horizonte. MG. Brazil

INTRODUCTION:pyrogenic reactions (PR) are complications that can occur in hemodialysis patients. The rate of PR reported in the literature varies between 2.3 to 18.0 PR per 1000 hemodialysis sessions. At the São Francisco de Assis Hospital (SFAH), on average, 526 hemodialysis sessions are carried out per month, which are followed by specific method of surveillance for PR as well as for nosocomial infection. In the month of September, 1997, an increase in the number of PR cases was identified, characterized as an outbreak of PR. The objective of this study is to describe the investigation undertaken to identify the problems that generated such an event.**METHODOLOGY:** identification of the outbreak by the calculation of endemic curves. For the investigation, a time-line was constructed, with all the events which preceded the outbreak and during the same.Moreover, all of the fluids of the dialysis process were collected and analyzed for the presence of pyrogen and all information about the cases, professionals involved, and risk factors related was also collected and analyzed.The definition of case was: presence of fever or chills during a hemodialysis session.**RESULTS:** in the month of Sept., 1997, a rate of 51.2 PR/1000 hemodialysis sessions was observed (26 cases), versus a monthly average, in the preceding period, of only 3.1 PR/1000 hemodialysis sessions.The analysis of pyrogens showed an increased concentration at all outlets of the Deionization Water Treatment System (DWTS) and at entry point from the public water network.During the period the outbreak occurred (July & Aug.) the DWTS underwent a renovation. Other serious problems were also identified and related to the outbreak. In study cases,a greater occurrence of PR was observed at the machines with storage tanks.**CONCLUSION:** there was contamination in the system as a whole, with an increase of endotoxins during the process.To solve the problem, ultra-filters,better disinfection and handling of the storage tanks and capillaries were recommended.The surveillance program used was altered:more detailed information about the hemodialysis sessions was included. In subsequent months, there was a reduction, to basic levels, in the incidence of pyrogenic reaction.

S27

Methods to Reduce the Incidence of Peritonitis in Patients on Continuous Ambulatory Peritoneal Dialysis (CAPD) .LINDA JENDRESKY*, BEVERLY WILLIAMS, TREVOR GRAZETTE AND WARREN SHAPIRO, Brookdale University Hospital and Medical Center (BUHMC), Brooklyn, NY

In CAPD patients peritonitis remains an important cause of morbidity and mortality. In 1995, national peritonitis rates were 1 infection per 12-16 patient months. BUHMC's rate of infection during this time was 1 infection per 9 patient months. A Multidisciplinary Task Force was established to review the current practice of assessment, identification and management of peritonitis and exit site infections (which may lead to peritonitis) in order to recommend an approach for improving our infection rates. During each monthly patient visit we made an assessment of patient compliance with our accepted practice which included an observation of: handwashing practices, exit site care, dressing change technique, and knowledge of the signs and symptoms of infection and risk factors (personal, environmental or behavioral) that contribute to infection. Definitions with criteria for new, recurrent and chronic infections were developed as an aid to guide treatment decisions. A revised clinical guideline incorporating treatment regimens based on type of infection was developed to including protocols for exit site care, handwashing products and procedures, collection technique for peritoneal fluid samples, stat gram stains, and indications for nasal and blood cultures. If peritonitis developed the patient was retrained regarding aseptic technique, hygiene practices, environmental cleanliness, the importance of adherence to the antibiotic regimen and completion of therapy. Four weekly follow-up appointments were given to monitor response to antibiotic therapy and improvement in patient compliance. Infection rate improved from the initial 1 infection per 9 patient months in '95 to 1 infection per 13 patent months in '96 and 1 infection per 18 patient months in '97, which is lower than the published national rate. These data suggest that our modified approach to the CAPD patient before and after the development of peritonitis in regards to the increased awareness of techniques to prevent infection, among both staff and patient may have impacted positively on the rate of infection in our CAPD population.

S28

A Silver Opportunity For Reducing Nosocomial Urinary Tract Infections

R.RAMIREZ, MD, *A.DOBIN, BSN,CIC, E.BRITTEN, RN, S.WADMAN,MD
North Broward Hospital District, Ft. Lauderdale, FL

The North Broward Hospital District (NBHD) is a multi-hospital system located in northern Broward County, Florida. Two of the acute care facilities, namely Coral Springs Medical Center (CSMC) and Imperial Point Medical Center (IPMC), elected to trial a silver/hydrogel coated Foley catheter as a quality improvement project to reduce the incidence of nosocomial urinary tract infections (NUTI). Historical data was available for both acute care centers. Both hospitals have different specialties and different patient populations. A three month study was begun March 1997 through May 1997 with a complete hospital-wide switch over to the new silver coated catheter. Staff members were not made aware of this new product in order to prevent any changes in practice that could affect the outcome. At CSMC, our baseline data revealed 16 catheter-associated NUTI's with a rate of 0.50% per 100 admissions. For the study period, there were 7 catheter-associated NUTI's with a rate of 0.03% per 100 admissions. These rates represent a 56% reduction in NUTI's. At IPMC, our baseline data revealed 13 catheter-associated NUTI's with a rate of 0.96% per 100 admissions. For the study period there were 5 catheter-associated NUTI's with a rate of 0.41% per 100 admissions. These rates represent a 58% reduction in NUTI's. As a result of this study, the silver coated Foley catheter has been instituted throughout the NBHD with an annual estimated cost savings of over $130,000 for treatment of NUTI.

S29

Evaluation of the Need for Pre-Cystometrogram (CMG)-Antibiotic Prophylaxis in a Chronic Care Population. *B.NURSE, R.BONCZEK, M.COLLINS, R.WURZEL. Hospital for Special Care, New Britain, CT

Hospital for Special Care is a 200-bed rehabilitation and chronic care facility. The most common nosocomial event is urinary tract infection (UTI). The average number of patients with urinary drainage devices (foleys, suprapubic caths, intermittent straight caths) is 50. The majority are medically compromised and ventilator-dependent. Practice guidelines were developed to provide a standard of care for patients with long-term catheters and resulting GU complications (e.g., bladder calculi, nephrolithiasis) and to gather data to support discontinuation of catheters where possible. Urodynamic studies (CMG) are part of this protocol.

Over an eight (8) month period, thirty (30) patients were evaluated before CMG and for at least one (1) month post-procedure. Specimens for urinalysis and culture prior to procedure were obtained from twenty-nine (29) patients. Fifteen (15) (47%) out of thirty-two (32) specimens prior to CMG had bacterial or fungal growth. All patients were evaluated prior to each procedure by an advanced practice RN (with physician input) for signs/symptoms of active UTI. No patient received antibiotics solely for pre-procedural prophylaxis. Three (3) patients (10%) had received antibiotic therapy for UTI one week prior to CMG. Five (5) patients (17%) were on antibiotics for UTI at the time of the CMG. All patients were monitored for UTI (GU symptoms, fever or change in clinical status) for one (1) month after CMG by an Infectious Diseases physician. There were no occurrences of UTI found post-procedure in patients who had positive urine cultures prior to CMG.

It is our conclusion that antibiotic prophylaxis is not mandatory in the long term GU complicated patient who is asymptomatic prior to CMG. Careful attention to aseptic technique during the procedure, and proper cleaning of equipment before and after each patient, remains most important in prevention of post-CMG UTIs.

S30

Bacteremia Associated with Central Venous Access Devices (CVADs) - Four Years of Surveillance in an Acute Oncology Setting. *CINDI WIGSTON, DARLENE CANN, JEFFREY LIPTON, MARK MINDEN, HANS MESSNER, ALLISON MCGEER. Ontario Cancer Institute/Princess Margaret Hospital, Toronto, Canada.

In 1991/2, concern about the rate of infections associated with central venous access at the our 159 bed medical oncology center led the establishment of a central venous access task force and surveillance for complications associated with CVADs. Policies were revised in1992, and implemented with education in 1993. All CVADs inserted at our centre were followed until line removal or patient death or transfer to another institution. Positive blood, site and tip cultures were reviewed, and unit/clinic staff reported clinical site and tunnel infections. Bacteremias were defined and categorized based on the NNIS definition of primary bacteremia, with modification to allow assessment of febrile neutropenic patients.In late 1995, the hospital was re-engineered, with re-definition of patient care roles, and substantial changes in nursing care staffing. In the first four years of surveillance, 848 CVADs were inserted. The most common devices were double lumen, tunnelled, subclavian lines (CLs, N=664) and single lumen central implanted ports (PACs, N=175). CLs were followed for a median of 140 days (range 1-1038), and PACs for 157 days (range 0-1039). Overall 47% of CLs and 14% of PACs were associated with at least one episode of definite or possible catheter-related sepsis (CRS) (P). Overall infection rates were 2.8/1000 CL days, and 0.7/1000 PAC days (P). Initial infections occurred at a median of 52 days post insertion (range 1-756) for CLs and 84 days post-insertion for PACs (range 1-684). The most common organisms causing CRS were coagulase negative staphylococci, *Corynebacterium* species, enterococci, viridans group streptococci, yeast, *Pseudomonas spp.* and *S. aureus*. Catheters were not routinely removed for CRS, and 77% of CL and 66% of PAC-associated CRS were treated successfully without the need for CVAD removal (P=NS). The only complication associated with lack of CVAD removal was relapse of the CRS after completion of antibiotic therapy. CRS rates per 1000 line days were calculated for CLs for six month intervals for the period 1993-1996, and were as follows: 5.1 (Jan-June/93), 6.3, 3.3,3.6,3.8,4.2 (Jul-Dec/95), 5.3,5.3. Education and policy change appeared to result in a substantial initial decrease in the CRS rate from 1993 to 1994/5. Despite careful planning and education programs, changes associated with the re-engineering process appear to have resulted in a significant increase in the CRS rate.

S31

Nosocomial Bacteremia (NB) at the National Cancer Institute in Mexico. Central Catheter-Related Nosocomial Bacteremia (CCNB), a New Proposal. PATRICIA VOLKOW, SILVIA SANDOVAL, DIANA VILAR-COMPTE*, MARGARITA DE LA ROSA , PATRICIA GORDILLO. Instituto Nacional de Cancerología (INCan) Mexico City.

Elders, patients in intensive care and those with cancer are at mayor risk for nosocomial bateremia (NB). The extensive use of central intravenous lines is one of the main factors for developing NB. The NB is largely preventable with the use of strict care and control measures of the catheter. NB has traditionally been classified as primary and secondary; CCNB are included within the primary, an therefore it has been impossible to quantify the problem. The INCan is a tertiary care teaching hospital for adult patients with cancer.The continuous work of an Intravenous therapy Team (IVTT) at the INCan with a defined protocol of care and diagnostic criteria for CCNB make us to propose CCNB as a defined entity. We describe the occurrence of NB between 1994 and 1998, pathogens' distribution and attributable mortality. CCNB was considered if sources of sepsis was unknown and had a central intravenous catheter with two or more of the following criteria: A)Positive blood cultures obtained from the catheter and peripheral puncture with the same microorganism. B) Same pathogens isolated from blood and catheter tip culture. C) Sepsis refractory to antimicrobial therapy or improvement with catheter removal d) Sepsis remission with specific antimicrobial therapy and negative blood cultures obtained through the catheter. During the study period, 2671 patients had blood-cultures drawn, (12% of all the admissions). Two hundred and fifty-six NB were identified in 198 patients; 82 (71%) were primary NB, 50 (19.5%) secondary and 24 (9.4%) were CCNB. The incidence rate of NB was 1.15 per 1000 admissions, 0.82 for primary, 0.22 for secondary and 0.11 for CCNB. Attributable mortality was 17.6%, 8.4% for primary NB, 28% for secondary NB and 12.5 for CCNB. The main pathogens isolated from primary NB were: *E coli* 21%, Coagulase negative *Staphylococci* 17% and *Enterobacter sp.* 13.2%; from secondary NB: *E coli* 24%, *Pseudomonas sp.* 22%, and Coagulase negative *Staphylococci* 14%; from CCNB: Coagulase negative *Staphylococci* 28.6%, *Candida sp.* 19%, *Pseudomonas sp.* 14.3% and *S. aureus* 9.5%. The main type of NB we saw, was probably related to the type of patients attended in this hospital. The frequency of NB is in the lower level reported in the literature. The low frequency of CCNB is probably the result of the extended work protocol provided by the IVTT.

S32

Outcome of peripheral intravenous lines. *SARAY STANCIC, CRISTINA M.DAIAN, and WALDEMAR G. JOHANSON, UMDNJ- New Jersey Medical School, Newark, New Jersey.

Peripheral intravenous catheters (IVs) cause patient discomfort and are a source of preventable complications. We performed an observational study of the outcome of peripheral IVs inserted for patients admitted to medicine floors. Over a 1 month period, we enrolled 108 consecutive patients; they had a total of 186 IVs inserted. The average hospital length of stay was 4.9 days; 59.2% of patients had one IV, 25% had 2 IVs, and 15% had 3 or more IVs. The mean duration of the IVs was 2.69 days but 36% lasted 1 day or less. Overall 44% of IVs had unsatisfactory outcomes (local symptoms, IV infiltrated or fell out). Frank phlebitis occurred in 2.2 % of IVs. Univariate analyses were performed for determinants of IV duration and outcome; we considered: inserter, site of IV, gauge, fluids infused, KCl, heparin, erythromycin or other antibiotic infusion. An analysis of the impact of the IV duration on the IV outcome was also performed. Data were collected and analyzed using the Medlog database. Poor outcomes were not related to the IV duration. The inserter (floor/ER nurse, MD, medical student) had no effect on outcome or duration. Antecubital IVs had the shortest duration. Erythromycin infusion had an adverse effect on IV outcome. KCl administration unexpectedly increased IV duration. In conclusion, although present recommendations support changing IVs every 3 days, our data shows that the majority of IVs lasted less than 3 days. Greater care should be employed for IV insertion and maintenance to minimize patient discomfort and conserve resources. Antecubital sites should be avoided. Alternative strategies for IVs should be developed for patients requiring [illegible]

S33

The Influence of Antiseptic Impregnated (AI) Single and Multiple Lumen Central Venous Catheters (CVC) on Catheter Related Bloodstream Infections (CRBSI) in a Tertiary Care Center. *CYNTHIA WHITENER, PAMELA RICKERT, DAPHNE BERISH, MARY ANN BORDNER, PennState Geisinger Health System, Hershey Medical Center, Hershey, PA.

Several studies have shown the use of AI single and multiple lumen CVCs reduces the incidence of CRBSIs, and can be cost-beneficial. In our institution, many types of CVCs are not AI, such as Swan-Ganz catheters and peripherally inserted central catheters (PICC). Therefore, we sought to determine the impact of AI CVCs in the midst of frequent use of non-AI central catheters on overall CRBSI rates for adults in the intensive and intermediate care units. We conducted a trial of exclusive use of AI single and multiple lumen CVCs impregnated with silver sulfadiazine and chlorhexidine over a one year period. A mix of AI and non-AI single and multiple lumen CVCs were used during the pre-trial 6 months, 100% were AI during the study year, and 0% were AI during the follow-up year. All other types of central catheters were uncoated during all 3 periods. During the 6 months previous to the trial, 44% of all CVC days were with single and multiple lumen CVCs, compared to 31% the study year and 27% the subsequent year. CVC days for Swan-Ganz catheters steadily decreased over the 3 periods: 32%, 27%, and 23% of the total CVC days, but increased for PICC use: 12%, 22%, and 32% of the total CVC days. The CRBSI rate per 1000 catheter days was 2.7, 3.5, and 2.0 during the pre-trial, trial, and post-trial periods respectively. In conclusion, the use of AI single and multiple lumen CVCs did not influence the overall CRBSI rate in our patient population. The frequent use of other types of CVCs, including the increasing use of PICCs, and the already low baseline CRBSI rate may help to explain this finding.

S34

A Prospective, Randomized, Comparative Study of Antimicrobial Dressings (Chlorhexidine, Biopatch ™) in the Prevention of Catheter-related Nosocomial Bloodstream Infections in a Neonatal Intensive Care Unit. *EDWARD N. ROBINSON, JR., DEBORAH R. HOUSTON, PETER GAL, J.L. RANSOM, CHRISTOPHER L. SHAFFER, ALLISON DUBUISSON, SUSAN COBLE, and ANDREW DAVEY. Moses Cone Health System, Greensboro, NC.

To reduce the incidence of primary microbial bloodstream infections in the infants residing in our neonatal intensive care unit, we examined the efficacy and safety of a chlorhexidine impregnated dressing (Biopatch™, Johnson & Johnson Medical Inc.) when applied at or after the third day of life to the insertion site of central vascular access catheters. After informed consent was obtained from the parent or guardian, infants were randomized to receive standard catheter care consisting of betadine ointment with a transparent covering or to receive the chlorhexidine dressing with a transparent covering. Of eighty-six infants randomized, six did not receive an eligible central access device (i.e. central venous line or percutaneous venous catheter). Of the remaining eighty infants, thirty-six were randomized to receive a chlorhexidine dressing and forty-four were assigned to standard catheter care. Eight infants of the chlorhexidine dressing group and one infant from the referent group experienced protocol deviations (e.g. no chlorhexidine dressing was applied or the infant was transferred to another facility). This allowed twenty-eight infants to receive the chlorhexidine dressing and to be compared to forty-three infants who received standard catheter care. Six infants in the chlorhexidine dressing group developed primary microbial blood steam infections (3 coagulase negative staphylococci, 2 yeast, 1 Enterobacter) compared to nine infants in the referent group (7 coagulase negative staphylococci, 2 yeast). The results were not significantly different (X^2, p=0.8047). A few of the infants on whom the chlorhexidine dressing was applied experienced significant hypersensitivity reactions at the applied site or inadvertent removal of the central venous access catheter during dressing change. With no reduction in microbial invasion and with concerns of hypersensitivity reaction and catheter loss, we decided to forego use of this special dressing in our neonatal intensive care unit.

S35

ANALYSIS OF RISK FACTORS FOR VENTILATOR-ASSOCIATED NOSOCOMIAL PNEUMONIA IN A RIYADH HOSPITAL. GWEN CUNNINGHAM, WAGIH DIAZMATI, ZIAD MEMISH*, GBOLAHAN ONI. KING FAHAD NATIONAL GUARD HOSPITAL. RIYADH KINGDOM OF SAUDI ARABIA.

Ventilator-associated pneumonia (VAP) continues to be a major cause of morbidity and mortality in intensive care units. In an attempt to recognize the causative factors in our hospital Intensive Care Units (ICU's), a one (1) year prospective study was undertaken. We analyzed data on 202 patients ventilated in our ICU's during the period of 16th December 1996 to 15th December 1997. Fifty one patients out of 202 (25.2%) developed pneumonia. The number of VAP per 1000 person days of ventilation for the entire study group is 16.8. The mean duration of intubation among patients who developed VAP was found to be significantly higher than among patients without VAP (26.7 days vs: 11.1 days) Patients whose diagnosis at admission was MVA-Head Injury or MVA-Multiple injuries are significantly at higher risk of VAP than are those without such diagnosis (P=0.01 in each case). Patients who had coma were significantly at higher risk of VAP than those without it. (RR=1.9; P=0.009). Those patients who had one type of surgery or the other were at higher risk of VAP than those who had no surgery (RR=2.2, P=0.001). Craniotomy and Thoractomy procedures were significantly associated with VAP (P<0.05). Gram negative organisms were the commonest pathogens causing pneumonia in our patients population, accounting for 62.5% followed by Gram positive organisms at 28.7%. To reduce the incidence of VAP, particular attention must be given to those patients who are admitted with MVA-Head Injury, or MVA-Multiple Injuries. Similarly, special attention must be given to patients who undergo craniotomy and thoractomy procedures. The results show our rates to be slightly above the 75th percentile value of the National Nosocomial Infections Surveillance System (N.N.I.S.) data for medical/surgical ICU's. As more data are collected and our intervention strategies effectively in place, these will assist us more accurately in our efforts to decrease the infection rate.

S37

Vancomycin Resistant Enterococcal (VRE) Outbreak in a V.A. Hospital: Common Source or Coincidence?

B.A.CATTO[1]*, M.GARDENHIRE[1], E.HOOD[1], N.STOUT[1], S.VERDERY[1], J.P.RISSING[1], B.J.MARSTON[2], and J.S.HALVOSA[3]. VAMC/MCG, Augusta, Ga.[1] Emory University School of Medicine/ VAMC, Atlanta, Ga.[2] and Grady Memorial Hospital, Atlanta, Ga.[3]

Emergence of VRE in hospitals is commonly characterized by introduction and spread of a single strain, followed by the gradual appearance of a broad variety of strains. We describe the nearly simultaneous introduction of 3 strains of VRE at our hospital. On 4/10/96 the first clinical isolate of VRE at the Augusta VAMC was identified. The isolate was recovered from penile discharge from a long-term patient in the MICU. During the last 4 days of May, 2 patients located in MICU cubicles on either side of the index patient developed positive blood/ pleural fluid and urine cultures respectively, raising concern about nosocomial transmission. We used a recently described amplification-based molecular typing technique called infrequent-restriction site polymerase chain reaction (IRS-PCR) to generate DNA fingerprints for these isolates. Each fingerprint was unique, suggesting that the isolates were not epidemiologically related. These results were confirmed by pulsed-field gel electrophoresis. In this apparent outbreak situation, we found IRS-PCR to be useful for the rapid characterization of VRE.

S38

Epidemiologic Analysis for Acquisition of Vancomycin-Resistant *Enterococcus* (VRE) in an Intensive Care Unit in Brazil.

ROSANGELA F. CEREDA, EDUARDO A.S. MEDEIROS, AGDA VINAGRE, SINAIDA T.M.S. REGO, ARIANE HASHIMOTO, NALDY FEBRE, FERNANDA PARREIRA, LILIAM M. SEJAS, JOSÉ LUIS AMARAL, HÉLIO S. SADER. Escola Paulista de Medicina, Univ. Federal de São Paulo, Brazil.

During the past several years, enterococci exhibiting high-level gentamicin resistence and ampicillin resistance have been described in Brasilian hospitals. **Objective:** To determine the prevalence of gastrointestinal tract colonization with VRE at ward entry and to study the incidence of nosocomial acquisition of colonization and infection with resistant enterococci. **Methods:** Consecutive patients admitted to a 16-bed medical/surgical intensive care unit of a 600-bed teaching hospital, São Paulo, Brazil, between April 1, 1996 and April 1, 1997, were enrolled. Anal swab was collected twice a week and plated in two agar screen plates. All samples were plated onto selective culture supplemented with 6mg/L of vancomycin. From each plate, one or more colonies morphologically resembling enterococci were initially identified by *MicroScan* and *Vitek* system. All presumed enterococci were further identified. Disk diffusion tests for vancomycin were performed on Mueller-Hinton agar according to the standards of the NCCLS. Minimum inhibitory concentrations for vancomycin were determined by E-test. **Results:** A total of 516 rectal swabs were cultured, and 37 vancomycin-intermediate-resistant enterococci isolates (VIRE MIC=16 mg/L) were detected in 11 patients. The species distribution were: 28(76%) *E. gallinarum*, 5(13%) *E. casseliflavus*, 3(8%) *E. faecalis*, 1 *E. faecium*. Infection control measures were used for patients identified with VRE included barrier precautions and private room. The monitoring sterile body fluid cultures indicated that none patient was infected with VRE. **Conclusion:** Periodic retal swab culture surveys are more sensitive in detecting the prevalence of VRE colonization and can provide strategic information to guide infection control activities. Despite the increased use of vancomycin in our hospital, VRE has not been detected yet.

S39

Risk Factors for Vancomycin-Resistant *Enterococcus faecium*, and Genotypic Similarity Between Strains Isolated From Patients Over an Eighteen Month Period. J.M. HYATT*, P. FITZPATRICK, and J.J. SCHENTAG. The Clinical Pharmacokinetics Laboratory, Millard Fillmore Health System, Buffalo, NY.

Patients with *E. faecium* (Ef) cultured (any site) between 1/96 and 7/97 were identified by computerized database. Vancomycin-resistant isolates (VRE) were genotyped using pulsed field gel electrophoresis (PFGE). Additional data collected for risk factor evaluation for patients with either VRE or vancomycin-susceptible (VSE) isolates included, length of stay prior to Ef isolation (prior LOS), serum albumin, prior MRSA or *C. difficile* infection, abdominal surgery, ICU stay, dialysis (Y/N), diabetes (Y/N) and prior antibiotic exposure. Pearson Chi-square was used for univariate analysis of risk factors for VRE, and logistic regression was used for multivariate analysis.

Sixty-one patients had Ef isolated, and 13 of these (21%) had isolates resistant to vancomycin. Isolates from eleven patients were available for PFGE. Five different PFGE patterns were seen in isolates from nine patients (A,B,G,H,I). The other two patients with VRE had isolates with 1 and 2 band differences from strain B. There were no common contacts by date of isolation, room location or medical service.

Prior MRSA infections were present in 5 of 13 patients with VRE (38%) vs 3 of 48 patients with VSE (6%) ($p<0.01$). Vancomycin exposure was seen in 7 of 13 VRE patients (54%) vs 8 of 48 (17%) of VSE patients ($p<0.05$). Two VRE patients had inappropriate prior vancomycin exposure. All 13 VRE patients had albumin concentrations <3.0 g/dl vs 31 of 48 (65%) VSE patients ($p<0.05$). By logistic regression analysis, prior LOS ($p<0.05$), serum albumin concentration less than 3.0 g/dl ($p<0.0001$, O.R. = 0.123, C.I. 0.048 - 0.318), and exposure to vancomycin ($p<0.05$, O.R.= 4.27, C.I. 1.01 - 18.1) were significant risks for VRE.

VRE surveillance is ongoing. Based on this analysis, a daily log of patients with prior LOS >30 days, serum albumin <3.0 g/dl, and vancomycin exposure in the last 14 days is being reviewed. Patient nutritional status as well as appropriateness of vancomycin therapy is being evaluated so that therapy may be adjusted accordingly.

S40

A Statistical Approach to Evaluating VRE Rectal Colonization for Polyclonality. MARCELO GARECA, RONALD LENEFSKY, PATRICIA BRONZERT and *BRIAN P. CURRIE, Albert Einstein College of Medicine and Montefiore Medical Center, Bronx, NY.

A sampling methodology based on the binomial distribution was developed in order to quantitate the probability of detecting polyclonality among VRE positive rectal cultures. It was mathematically determined that PFGE typing of 23 VRE colonies randomly chosen from isolation plates inoculated with rectal swabs enriched in broth provided a 91.1% chance of detecting any DNA strain type with a frequency in the total population of ≥ 10%. Application to 5 patients with VAN A phenotype VRE positive rectal swab cultures (3 *E. faecium* and 2 *E. faecalis*) indicated that in 4/5 patients there was probable VRE colonization with a single clone of either vancomycin-resistant *E. faecium* or *E. faecalis*. Rectal colonization of one patient with high level vancomycin-resistant *E. faecalis* appeared to be polyclonal (21/23 colonies selected had an identical PFGE pattern and 2/23 colonies selected shared a second distinct PFGE pattern). In conclusion, VRE rectal colonization can be polyclonal, but most often appears to be the result of colonization with a predominant single clone of either high level vancomycin-resistant *E. faecium* or *E. faecalis*. This sampling methodology can serve as a model for any investigation that seeks to quantitate the probability of polyclonality among patients colonized or infected with any bacterial pathogen.

S41

Prevalence of Unsuspected Vancomycin-Resistant *Enterococci* (VRE) Rectal Colonization. *KRISHNA AGARWAL, SHIRLEY CHUDE-SOKEI, EDNA CRAWFORD, CHRISTINA TRAN, and MATTHEW B. GOETZ, West Los Angeles VAMC and UCLA School of Medicine, Los Angeles CA.

Background: The utility of isolating VRE-colonized patients (P) is related to prevalence of unsuspected VRE colonization and the rate of P-to-P transmission of VRE. Thus, to assess the efficacy of VRE isolation, we have assessed the prevalence of unsuspected VRE colonization and consequent P-to-P transmission of VRE.

Results: In the 15 months prior to 11/94, 4 clinical isolate of VRE were identified in our facility. In 11/94, VRE were isolated from rectal surveillance cultures (RS Cx) obtained from 4 of 74 (1%) medical in-P not known to be VRE+. Despite use of recommended isolation measures, VRE became endemic after 7/95 with an average of 6 - 7 new clinical cases identified monthly. Because of concerns about the utility of isolation measures directed only at clinically identified VRE+ P, RS Cx were obtained from all medical in-P on the most highly impacted ward in 9/97. At that time, 7/32 (22%) of RS Cx were + for VRE from P not previously known to be VRE+; 2 other P were previously known to be VRE+ . In 12/97 RS Cx demonstrated VRE in 6/40 (15%) of P not previously known to be VRE+; no P on the unit had been previously known to be VRE+. Although P who were identified as VRE carriers solely on the basis of + RS Cx were not isolated, no increase in the number of VRE clinical isolates was found during the 3 months following the initial round of surveillance cultures.

Conclusions: In institutions where VRE is endemic, high rates of unsuspected rectal colonization by VRE may mitigate the utility of the routine isolation only of P found to be VRE+ on the basis of + clinical cultures. Given the difficulties associated with isolating all patients pending the results of RS Cx, it may be preferable to emphasize the routine application of handwashing, other routine infection control measures, and the appropriate utilization of vancomycin and other antimicrobials in clinical settings where serious, invasive enterococcal infections are unusual.

S42

Accurate Tracking of Vancomycin Resistance Among Enterococci Requires Species Identification. *DANIEL F. SAHM, MARY L. HICKEY, MARK K. MARSILIO BARBARA H. HELLER, KARLA M. TOMFOHRDE, and CLYDE THORNSBERRY, MRL Pharmaceutical Services, Reston, VA

The emergence and continued dissemination of vancomycin resistance among enterococci underscore the need for accurate and reliable surveillance strategies. Vancomycin-resistant enterococci (VRE) exhibit species-specific resistance trends, but many vancomycin-resistance studies are limited by considering enterococci only as a group, rather than delineating among species. We analyzed the resistance profiles of two important VRE, *Enterococcus faecium* and *Enterococcus faecalis*, with data collected since 1995 by The Surveillance Network™ (TSN) Database-USA. This surveillance network electronically collects and compiles data from more than 100 U.S. laboratories on a daily basis. When both species were considered together as *Enterococcus* spp., 12.0% of the 15,007 strains were vancomycin resistant, but species-specific analyses revealed that 48.0% of 3,146 *E. faecium* strains were resistant whereas only 2.0% of 11,861 *E. faecalis* strains were resistant. The overwhelming proportion of resistance observed among strains of *E. faecium* compared to *E. faecalis* was a consistent feature for strains isolated from both inpatients (51.0% vs 2.5%) and outpatients (43.0% vs 1.7%). Among strains isolated from inpatients, the pattern was maintained for strains isolated from both intensive care unit (ICU) (53.0% vs 2.0%) and non-ICU (50.0% vs 2.6%) patients. The relationship between *E. faecium* and *E. faecalis* for vancomycin resistance was maintained for all sites of infection for inpatients: blood (42.0% vs 1.4%), urinary tract (57.0% vs 4.0%), and normally sterile sites (46.0% vs. 3.0%). Because vancomycin resistance among *E. faecalis* is relatively rare, widespread emergence and dissemination of resistance in this more common of the two species would significantly add to the problem currently encountered with *E. faecium*. Our results indicate that in order to understand and control VRE, surveillance strategies must include enterococcal species identification.

S43

Comparison of Amplified Fragment Length Polymorphism (AFLP) with Pulsed - Field Gel Electrophoresis (PFGE) for Molecular Typing of Vancomycin-Resistant Enterococci (VRE). Nick A. Antonishyn, Ryan R. McDonald, Edward L. Chan, Carla E. Woodmansee, Pamela S. Falk, C. Glen Mayhall, *Saskatchewan Health, Regina, SK and University of Texas Medical Branch, Galveston, TX.

PFGE is the "gold standard" for typing VRE. We typed 22 epidemiologically well characterized isolates of VRE from a VRE outbreak in a university hospital by both PFGE and AFLP. The in-house AFLP assay was based on the selective PCR amplification of restriction fragments from a total digest of genomic DNA. The ligation of adaptors with primer-specific sites coupled with the selective nucleotide principle of AFLP allowed the full potential of PCR to be realized. Fluorescence-based fragment analysis and PAGE using the ABI Prism™ 377 DNA Sequencer provided the accurate band sizing required for homology assessment. The actual fragment length information obtained by AFLP was well suited for cluster analysis and database development. For PFGE, genomic DNA was digested with the restriction endonuclease *Sma*I followed by PFGE using the GenePath strain typing system (Bio-Rad Laboratories, Hercules, CA). After the isolates were typed by PFGE, the gels were analyzed manually and by computer. Using the software package, a dendrogram was developed. PFGE identified 3 clusters of VRE containing 15, 3 and 3 isolates, respectively. Clustering by PFGE matched clustering by epidemiological characteristics. One isolate was unrelated to the isolates in any of the clusters by epidemiological characteristics and by PFGE (46-77%). By PFGE, the banding patterns of isolates in each cluster varied by ≤ 4 bands. Computer analysis of the gels indicated that the isolates in each cluster were closely related (80% to 100%). By AFLP, the relationships of isolates within each cluster were at least 98% similar. The isolate unrelated to the isolates in the clusters by epidemiology and PFGE was also unrelated by AFLP (93%). Typing by each of these techniques requires about the same amount of time. For epidemiologically related isolates of VRE, molecular typing by PFGE and AFLP appear to give equivalent results.

S44

Molecular Epidemiology of Vancomycin-Resistant *Enterococcus faecium* Strains in a Large Urban Hospital over a 5 Year Period. *WERNER E. BISCHOFF, TAMMY M. REYNOLDS, GAYE O. HALL, RICHARD P. WENZEL and MICHAEL B. EDMOND, Medical College of Virginia, Campus of Virginia Commonwealth University, Richmond, VA

The prevalence of vancomycin-resistance in enterococci, especially in *Enterococcus faecium* (VREF), has dramatically increased in the last few years. To investigate the history of VREF in an 800 bed tertiary care hospital, all incident clinical VREF-isolates from 6/92 to 6/97 were typed via PFGE, and the transfer history of the patients was documented. 430 VREF isolates from urine(52%), wound (16%), blood (12%), cath.tips (5%) and other sites (15%) were studied. VREF specimens from Non-ICU patients accounted for 68% and from ICU-patients for 32%. Over the years the number of VREF increased with high rates during winter months and lower rates in late summer months. Four distinct banding patterns (A, B, C and D) could be detected by PFGE in 323 samples (75%). Strain A (125; 29%) appeared in 6/92 as the first VREF and was found until 1/95 through the entire hospital. Type B (96; 22%) was initially detected in 2/93 and disappeared in 11/96. Strain C (10; 2%) was limited within the turn of the year 1996 to 1997. Strain D (92; 21%) showed two major peaks during 3/96 - 8/96 and 1/97 to 2/97. Unrelated strains (107; 25%) appeared one year after the first VREF-isolate and the numbers increased slightly over the years. Nosocomial acquisition (i.e., no known detection prior to admission and first isolation from cultures performed > two days after hospitalization) accounted for 352 (89%) of 394 patients. The endemic situation in our hospital underscores the capability of VREF to survive in the hospital environment. Despite implementation of the CDC-guidelines the percentage of related strains and nosocomial cases indicates a high transfer rate inside the hospital. We conclude that the results imply an urgent need for more effective infection control measures and their stringent enforcement throughout the entire hospital.

S45

Results of CDC Recommended Interventions, Plus Required Gowning for VRE, a 3 Year Summary

L. KEHLER RN BSN, P. KELLER BSMT MS CIC, S. BORNGESSER BSMT, M.B. SNYDER MD*, Sinai Hospital, Detroit MI.

An increased incidence of patients (pts) culture positive for VRE was noted between 7/1/94 and 12/30/94 (9.1/month), up from an average of 1.8 pts/mo between 1/93 and 6/94. "VRE isolation" (private room; gown and gloves worn by all entering the room; strict handwashing; dedication of non-critical items; and special cleaning after discharge) was initiated in 12/94. Extensive inservices for staff were conducted, daily rounds to educate and assure appropriate practice were performed. Criteria for use of vancomycin led to reduced usage as prophylaxis for cardiac surgery. Use of metronidazole for C.difficilewas reinforced. The incidence of VRE culture + patients rose to 20 in 2/95, then declined steadily to a low of 9 in 11/95. In 1995 DNA typing of 113/147 isolates identified 21 different strains, and of 141 instances where nosocomial transmission was implied, only 38 were supported by DNA typing. Review of person-place and time charts (11/1/94 to 12/31/97) revealed no clusters of nosocomial transmission. The average incidence of patients culture positive for VRE remained stable in 1995 (14.5/month) and 1996 (13.3/mo), then increased in the winter of '96-'97 (22.8/mo between Oct'96 and Feb'97). The average incidence of VRE in '97 increased to to 18.3/mo. The average number of patients culture positive for VRE on admission decreased from an average of 6.9/mo (52% of all VRE pts) in '95 to 4.5/mo in '96 (34%) then increased to 6.1/mo in '97 (34%). Nosocomial bloodstream infections (BSI) remained stable in '95 (an average of 1.1/mo in '95 and 0.9/mo in '96, then increased to 2.3/mo in '97. Usage of vancomycin, ceftizoxime and ceftazidime decreased slightly in '97 (0.5 gm/pt day), from usage in '96 (0.8 gm/pt day). Since 11/94 574 patients have been culture positive for VRE (11/1/94 to 12/1/97).

Conclusion: While the use of CDC-recommended interventions plus required gowning initially decreased the incidence of patients culture + for VRE in our institution, and prevented any outbreaks or clusters of infection, nosocomial BSI with VRE have increased. Nosocomial aquisition appears multi-factorial, and it is unknown if use of VRE isolation has kept transmission lower than it would have been without isolation.

S46

Nosocomial VRE (NVRE) at a University Teaching Hospital. L. MERMEL*, J. DEMPSEY, S. PARENTEAU, N. MAGILL, B. CIFELLI, S. GENTILE. Rhode Island Hospital & Brown Univ. School of Medicine, Providence, RI.

We report our experience with VRE at our 719 bed university-affiliate hospital. 3/96-11/97 we had 264 NVRE cases (colonization or infection). This was 0.9 cases/10^3 pt days or 5 cases/10^3 pt discharges compared with 0.5/10^3 pt days and 2/10^3 pt discharges from 5/94-2/96 as reported at the 1996 SHEA mtg. 228 of the 264 NVRE cases were colonization only (86%), 36 cases were infections (17 UTIs, 5 BSIs, 7 wound & 7 misc. infections). Of the 228 cases of colonization, 216 were stool only, 12 were urine specimens. 220 & 44 NVRE cases were on medical and surgical services, respectively. Control measures consist of gown & gloves to enter rooms of all pts with VRE, VRE culture of all stools received in the micro lab, repeated surveillance stool cultures on wards with new NVRE cases, education, and molecular subtyping of environmental & pt NVRE isolates. 1-12/97, 3% of 2450 routine stool cultures received in the micro lab grew VRE compared with 27% of 1420 ward surveillance stool cultures. Although the yield of screening all stool cultures received in the micro lab appears to be low, 41% of the 135 new NVRE cases in 1997 were detected this way. Of 177 environmental cultures performed, 45% and 4% yielded VRE when carried out on wards with and without known cases of VRE on the ward at the time, respectively. Of the environmental sites cultured at least 9 times, the highest recovery rate of VRE was from pt telephones (67%), bed rails (53%), and overbed tables (44%). 3 healthcare worker hand cultures grew VRE identical by PFGE to isolates from pts on the same ward at the same time. Some hand cultures with VRE were done after the healthcare worker had washed their hands. We isolated VRE from 2 of 7 sink faucet handles. Thus, after gloves are removed and hands are washed, VRE may colonize healthcare worker hands when faucet handles are turned off. There was a dramatic downward trend of new NVRE cases/month in 1997 from a high of 41 cases in 1/97 to <20 cases/month thereafter & 1-3 cases/month over the last 4 months. This followed intensive monitoring for isolation compliance, education and renovating the ward that had the most NVRE cases (now with fewer patients and wash sinks without faucet handles).

S47

Emergence and Control of Vancomycin Resistant Enterococcus (VRE) at an Urban Medical Center. BLUMBERG HM*, BARNETT B, HALVOSA JS, WHITE N, METZGER B, RAY S. Emory University School of Medicine and Grady Memorial Hospital (GMH), Atlanta, GA.

VRE is a highly resistant pathogen which has been recovered from patients at numerous hospitals in the US. We studied the clinical and molecular epidemiology of VRE at a public inner-city teaching hospital from January 1995 when VRE was first recovered at GMH through December 1997. Clinical records were reviewed on patients from whom VRE was recovered, pulsed-field gel electrophoresis (PFGE) was performed on isolates. Surveillance cultures were performed every 2 weeks throughout the study period in the SICU and MICU. HICPAC guidelines were adopted but enhanced infection controls (IC) measures including efforts to ensure optimal compliance with contact isolation and enhanced environmental cleaning were implemented April 1997. A total of 351 VRE isolates were recovered from 262 patients; 142 patients had clinical isolates recovered and 120 had only positive surveillance cultures. 95.7% of the VRE isolates were *E. faecium*;4.3% were *faecalis*. 79.9% of the clinical isolates were nosocomially acquired. 30% of the 142 patients with clinical isolates had definite infection, 11% had possible infection and 59% had colonization. The number of positive VRE surveillance cultures decreased significantly from 99/806 (12.3%) between Jan 1996 and March 1997 to 29/517 (5.6%) between April and Dec 1997 (OR=2.36, 95%CI 1.50-3.71, P<0.001) following implementation of expanded IC efforts. This was most marked in the SICU where there was a decrease in positive surveillance cultures from 14.9 to 2.5%. VRE isolates from 235 patients were available for molecular typing; there were 25 different PFGE patterns but 70.2% belonged to 2 closely related PFGE types. Following the decrease in nosocomial transmission, an increased number of different PFGE patterns were encountered suggesting introduction of multiple clones from the community. In summary, the emergence of VRE was associated with nosocomial transmission of predominantly 2 closely related strains. Most clinical isolates recovered represented colonization and did not require treatment. Following enhanced IC measures consisting of efforts to improve compliance with contact isolation precautions and enhanced environmental cleaning, there was a marked reduction of recovery of VRE.

S48

Control of Vancomycin Use Through on Line Computerized Ordering. *KALYANI VANGALA, SUSAN HATFIELD, JEFFREY KUPER, ARLENE M. POTTS, MAUREEN BUENO, JOSEPH F. JOHN, UMDNJ-Robert Wood Johnson Medical School and Robert Wood Johnson University Hospital, New Brunswick, N.J

There is no clear strategy to control nosocomial vancomycin-resistant enterococci (VRE). VRE emerged in our academic medical center hospital of 400 beds, with a monthly 1995 average of 0.63 cases/1000 patient days. One strategy to control VRE—reduction of vancomycin (V) use—prompted us to implement a computerized vancomycin ordering and tracking system. **Methods.** Starting May, 1996, we implemented computerized serial prescribing prompts that included a choice of the six CDC indications for appropriate V use: #1. Bacteria susceptible only to V; #2. Penicillin allergy or short-term therapy of Gram-positive cocci in a normally sterile body fluid; #3. Endocarditis prophylaxis with penicillin allergy; #4. Implantation of prosthetic material; #5. Routine surgical prophylaxis with severe penicillin allergy; #6. Need for liquid V. F or pharmacy release, prescribers had to proceed through a series of ordering screens to select the appropriate indication and duration of use. Use outside the prescribed guidelines required both review and verbal approval by an infectious diseases attending physician (IDMD). **Results.** From January 1995 through March 1996, vancomycin use averaged 5485 grams/quarter (15.5 g/100 patient days). Over the next 14 months, usage averaged 3371 grams/quarter (9.0 g/100 patient days). Of an average of 243 approved courses per month after implementation, the percentage by indication were #1. 13.7%; #2. 16.3%; #3-#5. 34%; #6. 2.1%. Approval by an IDMD accounted for 29.3%. Usage outside the computer-implemented guidelines was 2.7% compared to a pre-implementation rate of 32.6% as determined for two random months. After implementation cases of VRE averaged 0.39/1000 patient days. **Conclusions.** An interactive computerized order form and tracking system had a substantial impact on vancomycin use at our medical center but necessitated frequent intervention by an IDMD.

S51

Utilization of Computerized Antibiotic Orders as a Case Finding Method to Identify Post-operative Infections in Patients Undergoing Vascular and Coronary Artery Bypass Graft (CABG) Procedures. *DONNA WEATHERWAX, EILEEN HANLEY, ELEANOR CURRIE, JANET PRESSEL-HAAS, CAROL KILLIAN, RICHARD A. VENEZIA. Albany Medical Center (AMC), Albany, NY

Identifying post-operative infections can be labor intensive. Traditional case finding methods have included chart, laboratory, pharmacy, and radiographic reviews as well as, unit rounds. AMC is a tertiary care hospital which performs approximately 1150 CABG and 1100 vascular operative procedures per year. Our department evaluated a case finding method using a computerized link with pharmacy to identify inpatients who received antibiotics (ABXs) as an indicator of post-operative pneumonia (POP), surgical site infections (SSIs) and bloodstream infections (BSIs). Pharmacy review was conducted on 566 patients undergoing CABG and 227 patients undergoing major vascular procedures. Based on ABX ordering, the charts of 198 CABG and 76 vascular patients were reviewed to identify infections. Using CDC criteria, 18 POPs, 9 SSIs and 13 BSIs were identified in the CABG patients while 3 POPs, 1 SSI and 3 BSIs were identified in the vascular patients. At the end of the surveillance period, a retrospective chart review was conducted on 96% (354) of CABG and 89% (135) of vascular patients who did not receive post-operative ABXs. ICD 9 diagnosis codes, discharge summaries, laboratory results and physicians' progress notes were reviewed and no additional infections were found. Sensitivity and specificity were calculated separately for POPs, SSIs and BSIs in both populations. Sensitivity was 100% and specificity ranged from 64% - 66% in both populations for all 3 types of infections. This method eliminated approximately 65% (519) of patients requiring additional review while maintaining 100% sensitivity. This validated that case finding by this method at our institution is efficient, highly sensitive and could be used as an alternative to conventional methods in these populations.

S52

Extra Post-operative Days Attributable to Surgical Site Infection (SSI) : a Increase, Significant but Smaller than Usually Reported. *JACQUES FABRY, HASSANE ABIDI, ANNE SAVEY, JOSEPH HAJJAR, GABRIEL PINZARU and ISO Sud-Est Study Group. C.CLIN Sud-Est, University Hospital - Lyon, France.

Published estimates of increased Post Operative Stay (POS) after SSI ranged from 5.5 to 23.4 days and could be explained either by the infection and/or by the risk factors of infections (age, health conditions, DRG, severity, type of surgery, etc.). We attempt to assess the magnitude of this increase using a multivariate general linear model (SPSS inc., 1993) which makes it possible to control for these confounding variables. PATIENTS : 20 570 surgical patients (day-care excluded) prospectively followed-up within the French South-East Surveillance network and hospitalized in 73 hospitals. VARIABLES : age (3 classes), NNIS score (4), type of surgery (10), single or multiple procedures, endoscopic methods (Y/N), emergency (Y/N) which were routinely collected during surveillance. RESULTS : with exception of neurologic and ophtalmologic surgery, SSI are associated with a very large increase in POS : nearly 11 days globally and between 3.6 and 21.0 according to the group of surgery. When entered in the general multivariate linear model, all univariatly significant variables remained associated with an increased POS, but with a smaller magnitude : 2.3 days attributable to a NNIS=3, 2.1 days to an age>70yr, 1.6 days to a non-endoscopic procedure, 1.3 days to a multiple procedure and only 1.8 days to the occurrence of an SSI *per se*. Within each group of surgery, the increase of POS independently associated with SSI varies between 1.4 days (urology) and 3.5 days (ENT). CONCLUSION : The increase of POS associated with the occurrence of an SSI is highly significant, but it could be of a rather limited range when estimated after control of some basic patient and procedure characteristics. I would be perhaps unwise to attempt to justify the efforts required for the prevention of SSI by claiming that they would result in a major economic advantage.

S53

Epidemology of Postpartum Infections. *D.S. YOKOE, C. CHRISTIANSEN, J. LIVINGSTON, R. PLATT, Brigham and Women's Hospital, Channing Laboratory, and Harvard Pilgrim Health Care, Boston, MA

Objectives: We assessed occurrence and the location of diagnosis and care of postpartum infections.

Methods: This was a cohort study of 2,826 women who underwent vaginal delivery (2,301) or cesarean section (525) between 1/1/93 and 6/30/95 and who received their postpartum care at health centers with automated full text medical records, pharmacy and claims data. Infections were identified from three sources: routine inpatient surveillance, the HMO's automated records and claims files, and questionnaires mailed to all women. We screened automated medical records and hospital and emergency room claims for any of 90 diagnostic, testing, treatment, or pharmacy dispensing codes suggestive of postpartum infection during the 30 days following delivery. Questionnaires regarding postpartum infection were mailed to all women. Full text medical records were reviewed of all patients identified through inpatient surveillance or questionnaire, as were a sample of records with one of the 90 automated codes. Postpartum infections were confirmed if they satisfied National Nosocomial Infection Surveillance (NNIS) system definitions. Infection rates were extrapolated from the sampled fractions of records reviewed.

Results: Approximately 6.5% (185/2,826) of women undergoing vaginal delivery or cesarean section experienced a postpartum infection, including surgical site infections (1.5%), endometritis (0.6%), episiotomy site infection (0.1%), mastitis (3.1%), and urinary tract infections (1.5%). Nearly all infections (~96%, 178 cases) occurred after hospital discharge, and 89% (158 cases) did not return to the delivering hospital. Automated codes were the most useful screen, identifying 97% of all infections.

Conclusions: Postpartum infections requiring medical attention were common following both vaginal and cesarean delivery, although many of these may not have been healthcare associated. Mastitis and UTI accounted for over 70% of these infections. With decreasing length of hospitalization, nearly all postpartum infections became manifest after discharge and rarely came to the attention of the hospital that performed the delivery. Efficient methods for post-discharge surveillance of these infections are needed.

S54

Appropiateness Evaluation Protocol (AEP) as a method to evaluate eficiency of two surgical procedures in cholecystectomy.MARIA J. HERNANDEZ,* VICTOR M. SOLANO, MARIA T. JIMENEZ, MARIA S. CORBACHO, JOSE L. ARRIBAS. Preventive Medicine. Miguel Servet Hospital. Zaragoza (Spain)

Laparotomic cholecystectomy (LC) has replaced open cholecystectomy (OC) as the treatment of choice in syntomatic gallstone disease. Majority of studies don't include additional days of stay due to nosocomial infection. The objective of this paper is to describe and analyze the eficiency of both procedures using a method based on the AEP. We estimated the additional days of hospital stay with/without taking into account wound infection (WI). If a readmission resulting from a treatment failure for WI, all days of care were attributed to WI. A sample of cholecystectomy procedures developed in our hospital during 1996 was obtained from the admission data. Variables that are included: age, sex, type of procedure, ASA risk score, hospital stay, additional days (AD), additional days due to WI (ADWI) and global additional days (AD+ADWI). We developed the statistical analysis using the T-Student and X^2 tests (Mantel-Haenszel test was used to find a linear association). A multivariate analysis was developed taking AD+ADWI as outcome variable. Number of studied procedures was 275; 97 (35%) OC and 178 (65%) LC. The mean age difference (8,9 years older in OC) was statistically significant ($p<0,001$). There was a positive linear association ($p<0,001$) between ASA risk score and procedure (higher in OC). WI showed statistical differences ($p<0,001$): 18,6% in OC and 1,7% in LC. Hospital stay was higher (12,1 days, CI95%: 9,5-14,7) in OC, AD were higher (2,9 days, CI95%: 1,9-3,8) in OC, ADWI were higher (1,38 days, CI95%: 0,2-2,5) in OC and AD+ADWI were higher (4,3 days, CI95%: 2,8-5,8) in OC. The multivariate analysis showed that age, WI and OC were risk factors for the global additional days in our patients. In our hospital, LC appears as a eficient method relative to OC. Anyway, we have to notice that eligible patients differs in each type of surgery

S55

Evaluation of Patient Risk for Surgical Site Infections following Spinal Surgery. S. MURPHEY, *E. LOMENZO, S. MARCUS, P. LUPINACCI and W. HAUCK, Jefferson Medical College and Thomas Jefferson University Hospital, Philadelphia, PA.

Thomas Jefferson University Hospital (TJUH) is a regional spinal cord injury center, receiving large numbers of acutely injured patients for care. To evaluate risk for surgical site infections following spinal surgery, we analyzed patient and procedure-related characteristics. From all 2879 class 1 spinal fusions and laminectomies performed 1990 to 1993, 691 controls were selected by a random number table (20% sample) and compared to all 117 surgical site infections (both spine and bone graft donor site) observed in this period. Patient and procedure-related variables were analyzed by the Classification and Regression Tree (CART) system. Five of the 14 variables studied were found to be most significant by CART and by logistic regression analysis. These were ASA score, acute spinal cord injury, prior spinal surgery, procedure duration and obesity. The 75 percentile procedure duration time for TJUH spinal procedures was much longer than the published NNIS duration cut point; fusion-7 hrs., laminectomy-4 hrs. The 5 variables were used to create a 0 to 2 score, analogous to the NNIS score range possible when all procedures are class 1. Both our CART-derived risk score and the NNIS risk index calculated using TJUH-specific duration points were equally effective in predicting low risk and high risk patients. Compared to published NNIS data (Am J Infect Control 1996 24: 380-8), TJUH performs more spinal fusions (67.7% of controls and 82.1% of infections in our database vs. 33.4% of NNIS procedures 6/94 - 5/95) and has a higher mean OR time. Our database contains more patients with higher risk scores by either method compared to the NNIS/patients. Nevertheless, a more complex, procedure-specific risk index performs no better than the NNIS risk index (adjusted for our OR times) in this population.

S59

***Communication, Communication, Communication-A* Program to Increase Flu Vaccination Among Health Care Workers.** *LYNNE KARANFIL, SUSAN HESS, GERRI MOLER, EDWARD BERNACKI, BERYL ROSENSTEIN, TRISH PERL, Johns Hopkins Hospital (JHH), Baltimore, MD

Each year 30,000 people die from influenza (flu) in the U.S. In 1918, more people died from the flu than were killed in 4 wars *(W W I, W W II, Vietnam, and Korean War)*. Annually $4.6 billion is spent on the flu. Yearly, 25% of health care workers (hcws) develop influenza; only 30% of them are vaccinated. The Centers for Disease Control and Prevention recommend that hcws get the flu vaccine. In October 1996, the JHH began its annual flu campaign; during Infection Control week notices were distributed and there was an informational board about the flu vaccination campaign. By November, only 30% (2,212 out of 7,400) staff were vaccinated (57% of physicians and 22% of other hcws). A survey of 416 patient care staff (mostly nurses) found:

- 52% *were afraid to get the vaccine for fear of side-effects or developing the flu*
- 14%, *didn't know the vaccine was being offered*
- 40% *felt vaccination times were inconvenient or couldn't leave their unit*

Rolling carts went to the units and an additional 500 hcws were vaccinated. 36 patients were admitted with culture positive influenza during the season. Nine (25%) were unisolated causing exposure in 35 unvaccinated hcws. One child developed nosocomial influenza. A customer service strategy developed for the 97-98 season included a flier addressing the misinformation about the flu vaccine and the extended times for vaccination. Posters were placed on all units. Communication through e-mail emphasized the vaccine for hcws and patients. Additionally, vaccination took place at large meetings, more convenient locations and by rolling carts to the units. By 12/12/97, 54% (4011/7400) of hcws were vaccinated for a 55% increase (85% physicians and 45% other hcws). Communication and education can increase vaccine rates.

S60

Evaluation of an E-mail System for Communication of Significant Cultures in a Medical Center. *MARISEL SEGARRA-NEWNHAM, MARJORIE J. STENBERG and EVELYN HUNT, Veterans Affairs Medical Center, West Palm Beach, FL

Information about resistant organisms must be communicated quickly to institute appropriate precautions and treatment. As part of our computerized medical record (EMR), we have developed an E-mail system that is activated by the Microbiology Laboratory at the time of identification of positive cultures of sterile sites. This message reaches two infectious diseases (ID) physicians, the ID clinical pharmacist, the infection control nurse, and the Microbiology supervisor. If needed, a contact precaution order is entered in the EMR. An Infection Control Alert" produces a warning in the chart that comes on the screen whenever the chart is accessed. The ID clinical pharmacist initiates a medication review with recommendations and follow-up when appropriate. A review of three months of E-mails showed that most messages involved positive blood cultures (n=59) with 57% representing true bacteremia. Thirty seven messages involved isolation of resistant organisms, mainly methicillin resistant Staphylococci and nine acid fast bacilli-positive specimens. An alert was written in the chart in a median of 53 minutes after the message was sent. Evaluation of antibiotic therapy resulted in change to appropriate agents in 11 cases and discontinuation of unnecessary therapy in one case with *Clostridium difficile* diarrhea. This E-mail method improves the communication within an ID team and can potentially improve patient care. An average of 2 messages per day were received with most messages read within minutes. Medical centers without EMR can implement this method if E-mail access is available and team members review their mailbox consistently throughout the day.

S61

A Novel Approach to Improve Antibiotic Prescribing Through Focused Physician Education and Physician Initiated Academic Detailing. *CHARLES S. SALEMI, JIM WARMINGTON, PATRICIA GRAY, Southern California Permanente Medical Group, Department of Pharmaceutical Services, Fontana, CA.

In early 1996, the Fontana Area Antibiotic Surveillance Team (AST), (consisting of two Infectious Disease Physicians, two Nurse Epidemiologists, and one Clinical Pharmacist) conducted a retrospective review of 123 inpatients receiving third generation cephalosporins (TGCs) in order to identify opportunities to improve overall use and decrease the potential for drug resistance. This review identified a 53% incidence of inappropriate initial use of one particular TGC, ceftazidime (CTZ), 25% inappropriate ongoing use of CTZ and 68% of CTZ use that could be discontinued or changed to oral antibiotics based on Kaiser Permanente guidelines. Because there is a documented correlation between inappropriate TGC use and increased gram negative rod resistance, the AST developed an educational approach to reduce inappropriate CTZ prescribing. The educational methods employed included emphasis of antibiotic use reevaluation after three days, education of physicians which focused on TGC guidelines and applicable pharmacodynamic parameters including spectrum of activity and pharmacokinetics through the Area Pharmacy and Therapeutics (P&T) Newsletter, and further education of prescribers through physician initiated academic detailing (PIAD), (one-on-one, nonthreatening, informal and brief, physician conducted discussions with prescribers). Three month follow-up study (5/97-8/97) of 114 uses of CTZ showed considerable improvement: There was a 31% incidence of inappropriate initial use, a 42% improvement, and a 13% incidence of inappropriate ongoing use, a 48% improvement. With respect to CTZ antibiotic usage days, the initial appropriate use increased to 92%, a 147% improvement and ongoing appropriate use to 85%, an 89% improvement. As indicated by the results of this program, there was a significant improvement in the prescribing of CTZ that was realized through focused education of prescribers and PIAD. This project has demonstrated that focused education of prescribers and PIAD are two approaches that should be considered to assist in improving any prescribing patterns by physicians and can ultimately enhance clinical effectiveness of therapies and improve patient outcomes.

S62

Infection Control And Pediatric Residents: Knowledge And Practice. *A. GUTTMANN, J.PONSONBY, and A. MATLOW, The Hospital for Sick Children and the University of Toronto, Toronto, Ontario.

As part of a quality management project to improve infection control in our institution we assessed the practices and knowledge of pediatric residents.
Methods: A questionnaire on infection control was developed with two sections, one on clinical practice and the other on knowledge base. It was distributed to 29 pediatric residents before and after an educational session on infection control. All 29 (100%) voluntarily completed both surveys.
Results: In terms of clinical practice only 7/29 (24%) reported following isolation precautions "all of the time", with 14/29 (48%) "most of the time". The most commonly cited reasons for not following precautions were time constraints and inaccessibility of barrier precautions. 20/29 (69%) reported washing hands before and after every patient contact. Only 5/29 (17%) reported receiving an influenza shot every year, with the most common reason for failure to do so as "never knew you were supposed to". 10/29 (34%) had suffered a needlestick injury, 8/10 (80%) reported the injury. Chi-square analysis revealed no significant differences in practice amongst the different levels of residents. Knowledge base was assessed with 44 questions with a total score of 49. The median score for the pre-test was 30 (range 24-35). There was no significant difference in score between residents in years 1-3 but the fourth year residents scored significantly higher (mean 32.6, SD 1.517; p=0.113). The median score for the post-test was 38 (range 31-45). The third and fourth year residents did significantly better than those in years 1 and 2 (p=0.022).
Conclusion: Infection control practices amongst pediatric residents needs to be improved. Education about infection control can improve knowledge and may ameliorate practice.

S63

Comparison of Traditional Statistical Control Charting Methods with Time Between Adverse Events in Cardiac Surgical Site Infection (SSI) Surveillance. *PIERRE J. PLOURDE, LYNN BRAMBILLA, NILA MACFARLANE, EDWARD PASCOE, ALLAN RONALD, GODFREY HARDING, St. Boniface General Hospital and Univ. of Manitoba, Winnipeg, MB

Surveillance of cardiac SSIs was initiated in January 1995 for all coronary artery bypass graft (CABG) and prosthetic valve procedures. Surgeon-specific, risk index-stratified wound infection rates were compared to NNIS rates and reported back to individual physicians on an annual basis. The unadjusted SSI rates in 1995 and 1996 were 3.62% (21 out of 580 procedures) and 3.38% (21 out of 621), respectively. The majority of procedures (77%) were CABG. Although the overall SSI rate is within NNIS norms, surgeon-specific analysis revealed one outlier whose SSI rate was significantly elevated (7.17%). Tracking number of infection-free cases between adverse events using g-charting analysis proved superior over statistical control charting in detecting this outlier. Because of low monthly denominators, all surgeons occasionally had uninterpretably high SSI rates 2 and 3 standard deviations above the mean. As well, incidence data was usually not available until several months after the fact. However, using g-charting methods, only the outlier surgeon demonstrated statistically significant deviations from the mean number of cases between infections on a regular basis, providing valuable information to guide appropriate interventions. In retrospect, g-charting information could have been available on a real time basis, enabling a more prompt response from the infection control team. Future SSI monitoring efforts will make more use of g-charting methods. Representative charts will be presented to demonstrate dramatic advantages of g-charting.

S64

Case Management Program as a Useful Tool for Hospital Epidemiology and Continuous Quality Improvement. *RODOLFO QUIROS, ANDRES TORN, DANIEL ESPINOSA, CRISTINA ROMERO, LILIANA TORANZO, EDUARDO EPSTEIN, Sistema de Protección Médica, Buenos Aires, Argentina.

Different strategies can be applied in order to improve the quality of care for the acute hospital inpatients. One of them could be a utilization management program implemented through case managers. In order to evaluate the impact of this strategy we conducted this pilot study. Between March and November 1997 we followed prospectively all patients, members of our HMO, admitted at two tertiary-care non-teaching hospitals where a clinician and a nurse conducted the program. Principal diagnosis (ICD-9 code), immunization status, severity of principal diagnosis (1-5), number of comorbidities, surgical procedures, medical complications (MC) and adverse events (AE) were registered for each patient. MC was an unexpected illness or injury not related with medical intervention. AE was an undesirable and unanticipated outcome related with medical procedures requiring medical intervention for its resolution. The utilization review was performed concurrently according with *Length of Stay Guidelines* (Milliman & Robertson Inc, Albany, NY) and if extra-days occurred, those were identified by cause. During the study period both the average length of stay (ALOS) and the mortality rate were significant reduced in comparison with 1996 (4.35±4.52 days vs 5.73±6.61, p<0.0001; and 3.8% vs 4.7%, p<0.023; respectively), without changes in the average of severity illness score (2.3±0.83 vs 2.2 ±0.84, p=NS). The MC+AE rate was 2.3 per 100 patient-days. By multivariate analysis the risk to develop MC and/or AE was significant associated only with LOS (OR=1.2, p<0.0001), severity of illness (OR=1.3, p=0.005) and age (OR=2.0, p<0.0001). On the other hand, LOS was significant influenced by complications (p<0.0001), severity of illness (p<0.0001), number of comorbidities (p<0.0001), emergency (p<0.0001) and age (p=0.042). The principal cause of additional days was the presence of complications (33.6 extra-days per 100 patient-days) followed by medical decision of an unnecessary admission or prolonged LOS (12.8 extra-days per 100 patient-days). This program allowed a more rational use of medical resources by the soon identification of preventable extra-days and by the improvement of medical care for high-risk patients.

S65

Use of Multi-dimensional Scaling and Cluster Analysis Techniques to Characterize Health Care Providers Attitudes Towards Handwashing.

*JAIME E. HERNANDEZ, THOMAS MCCLELLAN and JAMES FORSYTHE West Virginia University, Charleston Division, and Charleston Area Medical Center, Charleston, West Virginia.

Consistent, correct hand washing between patient contact is one of the simplest, most effective measures to prevent nosocomial infection. Despite several decades of study, education and continues efforts to remove perceived barriers, handwashing rates continue to be less than optimal in health care facilities. Interventions such as education, policing, peer encouragement, rewards and automated sinks have had only temporary success. Multi-dimensional scaling and cluster analysis are anthropological techniques devised to develop hierarchical models for the assessment of cognitive dimensions of contrast. We applied these techniques to health care providers in our facility to attempt to better understand the reasons behind the lack of compliance with handwashing. In depth interviews of nurses and residents were conducted with the aid of an open-ended questionnaire and a tape recorder. Thirty nine percent of healthcare workers listed personal protection as the main reason for handwashing, 24% cited infection control and 15% listed contamination or soiling as the reason. Only 12% listed a procedure as the reason for handwashing. When asked to mention positive aspects of handwashing 46% listed infection control, 23% listed cleanliness and 12% listed protection of self or relatives. Thirty five percent of respondents listed time constrains as the main barrier for handwashing, 26% listed handwashing as not being a priority for patient care and 17% listed suboptimal facilities. When asked to mention negative aspects of handwashing 46% of respondents listed skin dryness and irritation, while 29% listed time constrains and 12% listed inadequate facilities. Eight percent of respondents answer that they probably should but don't wash their hands, without giving a reason. When asked about potential interventions to improve handwashing, 42% mentioned education and training and 18% mentioned improved quality of soaps and cleaners and 18% mentioned scare tactics. Lack of compliance with handwashing in healthcare facilities is a complex phenomenon. The above mentioned techniques appear helpful to understand such complexity but further study is needed to assess their ability to identify useful interventions.

S66

Reengineering of IV Therapy Services and the effect on Bacteremia and Phlebitis Rates. LINDA JENDRESKY*, HELEN VAN SHEA, JOWENDY RAMUS, SUZANNE PENNACHIO, Brookdale University Hospital and Medical Center (BUHMC), Brooklyn, NY.

There are many studies which support the concept of a dedicated IV Therapy Team for insertion and maintenance of IV lines, and the effect on bacteremia and complication rates. In today's healthcare environment, organizations explore opportunities to restructure existing programs so they will provide quality outcomes in a cost effective manner. In October 1996, BUHMC's reengenieering resulted in the elimination of the IV Therapy Service. The Infection Control Department was faced with the task of assuring a comparable services without an increase in the incidence of infection. First, the former IV Team Nurse Manager was transferred to the Infection Control Department and developed an IV Certification Program for all registered nurses. A comprehensive program was formulated which involved training, competency, monitoring, and outcome measures. The program included 4 hours of classroom training, observation of insertion technique, and a competency component. A monitoring tool was developed to collect data on compliance with key elements: 3 day site changes, 24 hour site change if insertion was in the Emergency Department, site labeling and cases of phlebitis. The Infection Control Coordinator was contacted to assist with difficult insertions. Housewide bacteremia rates were compared in 1996 prior and following the elimination of the service in 1997 which revealed no significant increase in bacteremia rates per 1000 patient days (1.3 in '96 compared to 0.7 in '97). The percentage of bacteremias related to IV therapy revealed 10% in '96 compared to 7.4% in '97. IV associated 5+ phlebitis cases increased from 1 case/month in '96 to 2 - 4 cases/month in '97. In conclusion, the Nursing model of IV Therapy verses a dedicated team did not effect the rate of bacteremia cases, but did result in an increase in phlebitis cases. Retraining efforts will focus on the early identification of IV site complications.

S67

Empirical Antimicrobial Therapy Utility Program - It's Application to Hospital Acquired Respiratory Infections. *JOSEPH M. BLONDEAU, GLEN TILLOTSON and DAVID VAUGHAN. University Hospital, Saskatoon, Saskatchewan Canada and Bayer Corporation, Toronto, Ontario, Canada and West Haven, CT U.S.A.

Antimicrobial resistance is a global concern and often national susceptibility/ resistance data may not be representative of trends present locally or at an individual institution. We have designed a simple, easy to use method by which physicians and formulary developers can apply local susceptibility data to specific infections. Antimicrobial susceptibility data was collected from the published literature as was current information relating to the etiology of hospital acquired respiratory infections. The data was then analyzed using a simple formula* to demonstrate the likely overall antimicrobial activity. (*List all etiologic agents by percentage incidence, multiply the % susceptibility of each pathogen and add together). When applied to a few antibacterial agents, the scores for utility activity against pathogens in nosocomial pneumonia (score out of 68). Results are also available for 9 additional agents and other infections.

Ampicillin/sulbactam	62.4%	Ceftriaxone	81.3%
Cefamandole	65.3%	Ciprofloxacin	93.2%
Cefoperazone	89.3%	Imipenem	96.8%
Cefotetan	77.3%	Netilmicin	94.6%
Ceftazidime	94.0%	Ticarcillin/clavulanate	81.0%
Ceftizoxime	81.3%		

This method can be applied to local information pertaining to specific infections and more importantly, local susceptibility rates. The results presented show a clear difference in activity of different agents. This method can easily be applied to all nosocomial infections and can impact on formulary development and better direct a clinician's empiric prescribing.

S68

Nosocomial Primary Bacteremias in a Brazilian Hospital: Rates, Etiology and Cost-Effective Based Treatment Strategies.

LUIS FERNANDO A.CAMARGO*; ROGÉRIO ZEIGLER; PATRÍCIA Q.FONSECA; TÂNIA MARA V. STRABELLI; DAVID EVERSON UIP.

Heart Institute, University of Sao Paulo School of Medicine, Sao Paulo,Brazil

Rates of primary nosocomial bacteremia have increased during the past decade in most hospitals and contribute to patient mortality and length of stay. In this report, we summarize rates, etiology, bacterial susceptibilities and proposed cost-effective treatment strategies for nosocomial primary bacteremia in adults.The study was conducted at the Heart Institute, which is a Brazilian 314-bed tertiary-care-hospital. From 1993 to 1996, a prospective surveillance of blood cultures classified primary nosocomial bacteremias according to standard criteria. Expected success rates of different antibiotic treatments were estimated considering the percentage of the different bacteria as a causative agent of primary bacteremia and their antibiotic susceptibilities to the proposed antibiotics (considering only patients over 12 years of age). The 14-day cost of parenteral treatment was calculated using a Brazilian index of prices and converted to US dollars.

A total of 429 primary bacteremias occurred in the 4-year period (313 in adults and 116 in children) with steady values and an average rate of 12.9 primary bacteremias/1000 admissions. *S.aureus* and coagulase-negative staphylococci were the most common agents. Considering patients over 12 years of age, clindamycin plus amikacin was considered the preferred empiric antibiotic regimen for the treatment of primary bacteremia in low-risk patients (expected success rate of 61.8% and total cost of $ 1121) compared to ciprofloxacin alone (67.7% and $2080) and cefotaxime + clindamycin (58% and $3529). For high-risk patients vancomycin plus amikacin was the most cost-effective regimen (91.6% and $ 1917) as compared to vancomycin+ceftazidime (89.4% $3752) and vancomycin+imipenem (94.9% and $ 5096).We conclude that our hospital has stable rates of nosocomial primary bacteremia, although higher than NNISS data. Based on surveillance of blood cultures, empirical treatment strategies for adults can be proposed for high and low-risk patients, considering estimated costs and efficacy of the antimicrobial agents (according to the observed antimicrobial susceptibilities). A prospective trial is, however, recommended to confirm the results of the empirical treatments proposed.

S69

Impact of Performance Improvement Intervention on Blood Culture Contamination (BCC) Rate *J. VAN VOORHIS, F. KOCKA, C. NATHAN D. MARSH, S. WELBEL. Cook County Hospital (CCH), Rush Medical College, Chicago Il

BCC should not exceed 3% (ASM Standard). We defined BCC as a single BC that yielded only skin flora. In 1994 BCC at CCH was 7.6%. We introduced a commercial skin prep kit containing 2% tincture of iodine in 2-95. We monitored BCC hospital-wide and selected 5 focus units for performance feedback because they accounted for the majority of blood cultures and contaminants. Because BCC did not drop to 3% one year after this intervention other interventions were introduced hospital-wide: 1-designated phlebotomist SICU; no femoral line draws AER, rate review Trauma; 2-counseling personnel AER & Trauma, memos to Directors; 3-¶ rate adjusted for positive catheter tips & corresponding blood culture, feedback to unit Quality Assurance; 4- laboratory slip documentation of draw site and phlebotomist signature; 5-memo to Directors regarding BCC rate and laboratory slip compliance documentation. We have demonstrated a substantial reduction in

Interventions	I1	I2	I3	I4	I5
Unit	1-6 -95	7-12 -95	1-6 -96	7-12 -96	1-6 -97	7-12 -97
MICU	NA**	NA	NA	11.0 (7.6)¶	5.3 (3.6)	7.7 (5.9)
SICU	NA	NA	7.5	12.5 (5.6)	6.3 (5.2)	8.0 (5.6)
Trauma	¶3	11.1	8.2	9.0(5.2)	7.1 (5.9)	9.7 (4.8)
AER	4.4	5.3	4.1	4.2 (4.2)	3.6 (3.6)	2.9 (2.9)
PER	3.0	3.2	3.2	2.2 (2.2)	2.1 (2.1)	2.2 (2.2)
Hospital-wide	5.6	4.8	4.7	5.2 (4.9)	4.0 (3.6)	5.3 (3.0)

[Legend: **Mean % rate; NA=Not Available]

BCC approaching or achieving the ASM standard of 3% by a multifaceted approach and by recognition that the BCC rate should be adjusted for catheter tip colonization.

S70

Comparison of Distribution of Microbiological Isolates in Intensive Care Units (ICUs) and Wards: A Marker for Effective Infection Control in ICUs?

*U. Fluckiger, R. Frei, W. Zimmerli, AF Widmer. Univ. Hospital, Basel, Switzerland

In the literature, the distribution of microbiological isolates in ICUs differs from those in general wards. We believe that an effective infection control program should lead to a similar distribution. We compared the distribution of isolates of 345 positive blood cultures, 1320 sputum cultures, and 1579 urine cultures found in the ICUs (41 beds) and the other hospital wards (HW) (800 beds) during 1997. Only the first isolate per specimen per patient was included.

Isolates in percentages of the blood cultures	HW	ICU
coagulase-negative staphylococci	38%	40%
E. coli (EC)	15%	13%
Staphylococcus aureus (SA)	13%	8%
others	34%	39%
Isolates in percentages of the sputum cultures		
Yeasts	35%	30%
Haemophilus spp.	18%	13%
Staphylococcus aureus (SA)	9%	12%
others	38%	45%
Isolates in percentages of the urine cultures		
E. coli (EC)	40%	37%
enterococci (E)	17%	13%
others	43%	50%

The 3 most frequent isolates (over 60% of the total isolates) in the blood cultures and the sputum cultures were comparable in both units. No methicillin-resistant SA or vancomycin-resistant E was isolated and no difference in quinolone resistance among EC was found. We postulate that the comparison of the microbiological distribution of isolates can be used as a surrogate marker for the effectiveness of a strict antimicrobial policy and a meticulous infection control.

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S71

Please Stratify: Excess Mortality is Related Only to Patients With Deep Surgical Site Infections. *K. B. POULSEN, C. H. WACHMANN, A. BREMMELGAARD, A. I. SØRENSEN, D. RAAHAVE, and J. V. PETERSEN, Statens Serum Institut and Frederiksberg Hospital, Copenhagen, Denmark.

A cohort of 4515 surgical patients was selected from ten common non-high-risk orthopedic and general surgical intervention groups, such as fracture of the hip and herniectomy. 291 patients with a Surgical Site Infections (SSI) were matched 1:1 to uninfected controls, and the mortality rate was investigated with a follow-up period from four to eight years. There were no excess overall mortality for the infected patients. However, stratifying by deep and superficial SSI, a Cox regression model showed that only the former had a significantly increased mortality ratio of 1.7 (1.2-2.2). The highest risk appeared during the first six months after surgery, where the patients with deep SSI had an increased mortality rate of 2.5 (1.5-4.1). The 70% of the patients with a superficial SSI thus seemed to mask the higher mortality ratio associated with deep infections. Stratification by severity is therefore necessary when analyzing data from investigations of SSI.

S72

Cost Reduction and the Prevention of Nosocomial Infections. *VIRGINIA KENNEDY, Infection Prevention & Management Associates, Inc. Houston, TX, LAYNE GENTRY, SUSAN HOUSTON and RABIH ELSOUKI, St. Luke's Episcopal Hospital, Houston, TX.

When prioritizing infection prevention program resources, health care organizations need to consider financial and quality outcomes. A simplified approach for determining the financial and quality impact of nosocomial infections (NI) is utilized in this tertiary care facility to direct performance improvement (PI) activities. DRG grouped patients with a specified NI are compared to the same DRG non infected patient population, within a designated time period. The crude mortality rate (CMR), length of stay (LOS), charges, revenue, variable costs, fixed costs and net margin per case are determined for patients with and without the NI. Utilizing this approach, the organization reviewed nosocomial pneumonia (NP) in the intensive care units in 1996, when the rate per 1000 patient days was 6.5±1.08. DRG 104 through 107 (valve replacement and coronary bypass) predominated. NP patients' LOS was double to triple that of DRG matched controls and CMR was 34.9% compared to 5.7%. The financial outcome was adversely affected by $800,000. A multidisciplinary PI team has developed interventions resulting in the NP rate decreasing to 4.53±1.56 per 1000 patient days. Financial expenditures are estimated to have decreased by $150,000. This approach provides the infection control program with quality and cost-effectiveness information.

S73

Standard Precautions (SP) Programs and Infection Control (IC) Resources Available in Smaller vs. Larger Healthcare Facilities: Results of Two Statewide Surveys. *SE BEEKMANN, K MCCOY, T VAUGHN, BN DOEBBELING. The University of Iowa, and the Iowa City VAMC, Iowa City, IA.

In an ongoing study, we have been evaluating the relationship of institutional organizational and program factors to percutaneous injury and mucocutaneous exposure rates. IC practitioners in all Iowa and Virginia hospitals and the largest chronic care facilities in Iowa were surveyed in 1996-97 (N = 240). Respondents (N = 148, 62%) reported on workforce characteristics (including full-time employee equivalents [FTEs]), SP training programs, IC resources available, injuries, exposures, and SP compliance. Larger hospitals were defined as having >100 beds (N = 62); smaller facilities have 100 beds or fewer (N = 77).

Annual SP training was required at 100% of facilities for nurses, and 99% of facilities for housekeepers and lab workers. Annual SP training was significantly more likely to be required of MDs in large hospitals (p=.047). 96-100% of employees other than MDs had been trained in the previous year, compared to 27% of MDs in small facilities and 37% of MDs in large facilities.

Larger hospitals were significantly more likely to provide SP training by in-person lectures for new employees (p=.001); other training methods did not differ by hospital size. Larger facilities offer SP training more frequently for new (p=.008) and current employees (p=.004). Half (53%) of larger hospitals and one-fourth (25%) of smaller facilities offer training at least once per month for new employees. At least 30 "person hours" per year were devoted to SP training (not including record keeping), by more IC practitioners from larger facilities than from smaller facilities (59% vs. 33%, p=.005). The average annual direct costs for SP training materials/supplies (no personnel costs) was $558 for smaller and $492 for larger facilities.

A mean of 0.6 FTEs (clerical + professional) in smaller facilities and 1.4 FTEs in larger facilities were devoted to IC. There were more IC FTEs in larger hospitals (p=.0001), however 43/125 (34%) of facilities did not meet the CDC guideline for 1 IC FTE for every 250 occupied beds. Having fewer than recommended IC FTEs did not differ significantly by facility size, although most (7/10) hospitals without any IC FTEs have fewer than 100 beds. We conclude that SP training is provided more frequently by larger facilities. Further, more IC person-hours but lower costs (excluding personnel) were required to provide this training. Only two-thirds (66%) of responding facilities provide IC staffing at recommended levels, regardless of hospital size.

S74

Isolation Gowns Prevent Health Care Workers (HCWs) From Contaminating Their Clothing, and Possibly Their Hands, with Methicillin-Resistant *Staphylococcus aureus* (MRSA) and Resistant Enterococci. J. M. BOYCE, AND C. CHENEVERT. Brown Univ. and Miriam Hospital, Providence, RI.

Current guidelines recommend that HCWs wear gowns when having substantial contact with patients who have multi-drug resistant pathogens. We conducted a prospective study to assess the ability of disposable isolation gowns to prevent contamination of HCW clothing, and to study the possible role of contaminated clothing as a source of HCW hand contamination. A total of 35 patients with MRSA, vancomycin-resistant enterococci (VRE) or ampicillin-resistant enterococci (ARE) were included in the study. HCWs donned new disposable gowns and gloves and then had direct contact with the 35 patients. Afterwards, their gowns were cultured for MRSA, VRE or ARE by using contact plates. Then gowns were removed, and uniforms worn under the gowns were cultured. We found that 14 (40%) of 35 HCWs who wore isolation gowns contaminated the gown with MRSA, VRE or ARE. From 2 to 200 colonies were recovered from contaminated gowns. None of the nursing uniforms worn under isolation gowns became contaminated with MRSA, VRE or ARE. In addition, with 16/35 patients, a HCW also cared for patients while using gloves and wearing a laboratory coat over their uniform. After the 16 HCWs removed the gloves and washed their hands, their hands were cultured. Then the HCWs were asked to touch their laboratory coat with their hands, which were cultured again. We found that 11/16 HCWs contaminated their laboratory coat while having direct contact with patients. All hand cultures taken after gloves were removed and hands were washed were negative. Three of 11 HCWs (27%) who subsequently touched their contaminated laboratory coat grew MRSA or ARE from their hands. We conclude that disposable isolation gowns prevent HCWs from contaminating their uniforms with MRSA, VRE or ARE. Contaminated clothing may serve as a source from which HCWs can contaminate their hands. These findings support currently recommended barrier precautions for resistant organisms.

S75

Low Compliance to Isolation Policies Related to Cross Infection of Multidrug-resistant *Acinetobacter* spp. in ICU.

*LUIS F. CAMARGO, SERGIO B. WEY, CLÁUDIA LASELVA, CLAUDIA VALONE, SANDRA KUHL, CRESIO R. PEREIRA, SANDRA BALTIERI, ELIAS KNOBEL. Hospital Israelita Albert Einstein. São Paulo. Brazil

Background: Nosocomial infections due to multidrug-resistant (MDR) agents are frequent complications in ICU patients. **Objective**: To determine the efficacy of Isolation Policies in preventing the spread of MDR agents in ICU. **Setting**: 25-bed-general- intensive care unit and 38-bed stepdown unit. **Casuistic and Methods**: The staff was trained on isolation policies in February 1997. Between March and November 1997, 110 patients met the criteria for isolation, that were presence of any gram negative rod resistant to ceftazidime and/or imipenem, MRSA, VRE or any *Acinetobacter* spp. The isolation policies required that patients should be placed in private rooms, the staff should use gowns and gloves. Masks were required for respiratory infection/colonization and stetoscopes were dedicated to each room. Handwashing was reinforced. Surveillance cultures were performed weekly from: tracheal secretions, surgical wounds, drains and ulcers. The heath care workers (HCW) were observed during two weeks for compliance to the policies. Ribotyping was used for *Acinetobacter* strains. **Results**: The proportions of compliance to the isolation policies are analyzed by profession. Physicians performed appropriated handwashing in 41% of the time, correct gown utilization in 36% and use of dedicated stetoscope in 72%. Nurses had a success of 53%, 94% and 55% and repiratory therapist had 83%, 100% and 100% success rate for the same policies. During the study period, two outbreaks of MDR *Acinetobacter baummanii* occurred in the ICU. Both followed the admission of an index cases that were transferred from another hospital and both outbreaks were due to strain R7. **Conclusion**: A good compliance for isolation policies was obtained by the respiratory therapist team. In spite of this two cluster of MDR *Acinetobacter* occurred. A better educational approach might be necessary for physicians and nurses. The infection control measures adopted might not be sufficient for avoid control of MDR agents in ICU.

S76

Factors Associated with Adequacy of Standard Precautions (SP) Training: Results of Two Statewide Surveys. K MCCOY, SE BEEKMANN, T VAUGHN, K FERGUSON, J TORNER, *BN DOEBBELING. The University of Iowa and the Iowa City VAMC, Iowa City, IA.

Infection control practitioners (ICP) in all Iowa and Virginia hospitals and the largest chronic care facilities in Iowa were surveyed in 1996-97 (N = 240). Respondents (N = 148, 62%) reported on workforce characteristics, leadership support, management commitment to infection control, safety climate, and percutaneous injuries over the previous year. Facility-level American Hospital Association (AHA) data were used to assess organizational structure and complexity. Factor analysis was performed on the survey data and used to create factor scales.

An analysis using a logistic regression model was done to identify variables associated with adequacy of training to use SP. The outcome variable was ICP agreement or strong agreement that facility workers had been adequately trained to observe and monitor SP compliance.

Five variables were found to be independently associated with adequacy of SP training. Failure of any institutional leader to comply personally with SP was associated with decreased odds of adequate worker training to observe and monitor SP (OR=0.136, CI_{95}=.03,.72; p=.019). ICPs in multi-institutional systems were 2.5 times more likely to believe workers were adequately trained to observe and monitor SP compliance (CI_{95}=1.08,6.05; p=.032). SP training provided through a video format (or any other AV material) is associated with an odds ratio of 0.33 for workers having been adequately trained to observe and monitor SP compliance (CI_{95}=.11,.96; p=.041). When ICPs agreed that employees received regular feedback on their unit's SP compliance, workers were 1.6 times more likely to have been adequately trained to observe and monitor SP compliance (CI_{95}=1.03,2.66; p=.039). One factor from the factor analysis with varimax rotation of the ICPs' rating of their facilities' safety climates was associated with adequacy of SP training. The Job Demands Scale (3 items) had an OR of 0.57 for workers having been adequately trained as job demands in the facility increased (CI_{95}=.42,.77; p=.0003).

These data demonstrate the critical role of organizational factors and the safety climate, including feedback and job demands, in establishing the adequacy of training to observe and monitor SP compliance. Interventions targeted at increasing unit-level feedback on SP compliance to workers and decreasing job demands are needed.

S77

California Skilled Nursing Facilities - A Survey of Infection Prevention and Control Practices and Educational Needs, 1997. * CHRISTINE K. CAHILL and MARGUERITE McMILLAN JACKSON, California Department Health Services (DHS), Sacramento, CA and University of California San Diego Medical Center, San Diego, CA

In 1996, California hospital infection control practitioners (ICP) reported to DHS, Licensing and Certification Program (L&C) increasing problems associated with transferring patients colonized or infected with vancomycin-resistant enterococcus (VRE) to Skilled Nursing Facilities (SNF). Reasons cited by SNF administrators for not accepting VRE patients included: possible written deficiencies and fines imposed by L&C, outbreaks of VRE required to be reported and investigated by L&C, excessive, non-reimbursable expenses related to isolation, and inability to implement the Centers for Disease Control and Prevention *Guideline for isolation precautions in hospitals*. In response, L&C convened a task force of SNF ICP and representatives from SNF professional organizations. The task force opposed new regulations and recommended a collaborative, statewide educational approach to address this problem. To assess the isolation practices and educational needs of SNF, L&C surveyed, by questionnaire, 1454 SNF. The survey consisted of three parts: a facility biographical profile, an antibiotic-resistant microorganism isolation profile, and an educational needs assessment. The 30.5% response rate was analyzed by type of SNF (e.g. free standing SNF (FS-SNF) or hospital-based SNF). The survey results confirmed that shortage of private rooms for VRE patients who required contact isolation as recommended by the CDC was a contributing reason for SNF hesitation to accept VRE patients. In response to the educational needs assessment four, two-day infection surveillance, prevention and control conferences were developed and presented to more than 600 SNF ICP and state surveyors. The results of the educational conferences assisted SNF ICP in developing patient-focused VRE isolation guidelines which assess for the potential of environmental contamination rather than a standardized, one policy fits all, institutional isolation policy. The results of the survey will be summarized and presented to conference participants.

S78

Pathogenic Organisms Associated with Artificial Fingernail (AN) Use by Health Care Workers (HCW). S HEDDERWICK, *S McNEIL, M LYONS, M RAMSEY, & C KAUFFMAN. VA Medical Center & University of Michigan, Ann Arbor, MI.

No standard policy exists to guide the wearing of AN by HCW despite potential transmission of pathogens to patients. At our institution a previous survey found that 12% of HCW wore AN. We studied 20 HCW who wore permanent acrylic AN. Controls for each nailed HCW were selected from HCW in similar jobs. Nail surfaces were swabbed and subungual debris was collected and cultures for gram (+) and gram (−) bacteria (GNB) and yeasts were performed. Log_{10} colony forming units (CFU) on surface and subungual cultures of both hands were recorded. CFU ($x \pm SD$)of all organisms isolated from nailed HCW and controls did not differ (5.9 ± 1.2 & 5.7 ± 0.7, respectively). However, nailed HCW were more likely to have a pathogen (*S. aureus*, GNB, or yeast) isolated from nails than controls (85% vs 50%; p= 0.04). The mean CFU of pathogens isolated from nailed HCW and controls were 2.4 ± 1.6 & 1.2 ± 1.8 respectively (p= 0.03). *Enterobacter* was the most common GNB; *C.albicans* and *C.parapsilosis* were the most common yeasts. MRSA was isolated from 15% of nailed HCW and no controls (p=0.2). More cultures from nailed HCW grew GNB than those from controls (55% vs 18%; p< 0.001). There was no statistically significant difference between the number of cultures from nailed HCW and controls growing *S. aureus* (28% vs 10%; p= 0.09) or yeasts (40% vs 20%; p= 0.09). In summary, HCW wearing AN were more likely to have GNB, *S. aureus* (including MRSA), and yeasts isolated from their fingernails than control HCW. Wearing permanent artificial fingernails may predispose HCW to harbor pathogens and could play a role in transmission of these organisms to patients.

S81

Creutzfeld-Jacob Disease (CJD): Report from a VA National Surveillance System. *G ROSELLE, K KIZER, J BOOSS, A RAHMAN, S KRALOVIC, L DANKO, L SIMBARTL. VAHQ, Wash, DC, VAMC, Cinti., OH, Univ. Cinti. Col Med., Cinti., OH, VAMC, West Haven, CT, Yale Univ. Sch of Med., New Haven, CT.

The issue of potentially contaminated blood products and the safety of meat in the food supply has made the number of cases and case rates of CJD a nationally important question. Since VA is one of the largest health care systems in the U.S., it is an appropriate venue for such surveillance. Annually, the VA electronically transmits a census instrument to VA medical centers, including associated clinics and nursing homes, and independent outpatient clinics. Two weeks after release, facility self-reported data are electronically transmitted to a central data site for review and analysis. Unusual or discrepant reports are confirmed by telephone. For federal fiscal year (FY) 1996 the following question was asked: "Report the **total** number of newly diagnosed patients with Creutzfeldt-Jakob Dis. during FY 96." Thirteen cases of CJD were reported; one station reporting 7 of the identified patients verified that the number was correct. Chart review of all 13 cases was undertaken by a qualified neurologist (JB) to validate the diagnosis. Of the 13 reviewed files, 4 were considered supportive of CJD, yielding a VA rate of approx. $1.6/10^6$ patients served nationally, consistent with a U.S. national estimate of approximately one case/10^6 population (VA vs. U.S., p=0.24; Poisson Prob. Dist.) of the other 9 patients, specific diagnoses were found in the medical record for 8 (Alzheimer's Dis.=4, Pick's Dis.=1, CVA=1, cerebral atrophy=1, liver cirrhosis=1) and one had dementia of unknown etiology. Therefore, despite the VA's long term care component, the reported rate for CJD in the VA is approximately that seen in the U.S. Also of note, facility self-reporting has inherent inaccuracies and should be supplemented with data validation or replaced by an automated system to decrease reporting errors.

S82

Marked Leucocytosis in patients with C. difficile colitis indicates poor prognosis.
*EMMANUEL ELUEZE, MD, PhD. and RAJA SHEKAR, MD.
St Lukes Medical Center, Cleveland, OH.

C. difficile colitis is an increasingly common antibiotic associated nosocomial infection with significant morbidity and mortality. The clinical spectrum varies from asymptomatic carrier status, to a fulminant and sometimes lethal pseudomembranous colitis. The occurrence of leucocytosis in patients with C. difficile associated diarrhea have been noted in several studies. One of us has observed leucocytosis to be the presenting feature in some patients with C. difficile colitis. We hypothesised that marked leucocytosis may be associated with more severe disease and or poor outcome. A retrospective chart review of all patients with C. difficile infection admitted to St. Luke's Medical Center between June 1993 and June 1996 was undertaken. Inclusion was based on the presence of diarrhea, a positive stool test for C. difficile cytotoxin and available white cell count. One hundred and fortytwo (9%) of 1,126 stool samples sent to the laboratory during this period were positive for C. difficile cytotoxin. 107 patients met the above inclusion criteria, of whom 19 (18%) had marked leucocytosis (wbc > 20, 000). In 107 age and sex matched controls seen during the same period with C. difficile cytotoxin negative stool test, marked leucocytosis was seen in 13 (12%) of them. Clindamycin, cephalosporins, penicillins and ciprofloxacin use were associated with higher risk of developing C. difficile associated diarrhea. There were no significant differences in the mean number of stools/day (4.9 ± 1.5 vs 6.2 ± 4), degree of pyrexia ($38.5 \pm .7$ vs $38.6 \pm .6$) and hypoalbuminemia ($2.6 \pm .5$ vs $2.7 \pm .4$ respectively in patients with and without marked leucocytosis. However, there was a significant difference in fatal outcome. In the group of patients with marked leucocytosis, 6 of the 19 patients (31%) had a fatal outcome, compared to 11 of the 88 patients (12.5%) in the group without leucocytosis ($p < 0.05$). We conclude that marked leucocytosis is not uncommon in patients with C. difficile associated diarrhea and that it may be associated with higher mortality.

S83

Changes in the Oxyhemoglobin Curve in Sepsis: A pilot study. *ALICE H. M. WONG, DONALD J. ABRAHAM, GAJANAN S. JOSHI, RICHARD P. WENZEL, Medical College of Virginia campus of Virginia Commonwealth University, Richmond, VA.

Sepsis and septic shock represent the thirteenth leading cause of death in the United States. Furthermore, sepsis is the most commonly reported cause of death among hospitalized patients in non-coronary intensive care units. Since tissue hypoxia is thought to be one of the devastating sequelae of septic shock, basic mechanisms have been studied. Previous investigators have observed an initial rise and subsequent fall in erythrocyte 2,3 DPG levels in the setting of septic shock with a leftward shift in the oxyhemoglobin dissociation curve. Presumably the fall in 2,3 DPG levels represents exhaustion of the circulating erythrocytes' compensatory mechanisms for hypoxia and anemia. However, it has not been determined if there is a stepwise relationship between 2,3 DPG levels and severity of sepsis, and shifts in the oxyhemoglobin dissociation curve (p50) with increasing severity of sepsis have not been described. Recently, the American College of Physicians-Society of Critical Care Medicine Consensus Conference described hierarchical categories of sepsis based on the Systemic Inflammatory Response Syndrome (SIRS). Patients meeting criteria for SIRS with sepsis, severe sepsis or septic shock were enrolled in our study within 48 hours of meeting the SIRS criteria. The p50 values and 2,3 DPG levels were determined in 7 patients (3 patients with septic shock, 1 patient with severe sepsis and 3 patients with sepsis). The mean 2,3 DPG level was 1.17 ± 0.25 µmol/ml in the patients with septic shock and 1.63 ± 0.30 µmol/ml in the patients with sepsis (normal range 1.6-2.6). The p50 for the patients with septic shock tended to be higher (range 26.24-30.62 mm Hg) than the patient with severe sepsis (27.17 mm Hg) or the patients with sepsis (range 25.95-25.98). Two of the three deaths occurred in the septic shock group. The recently developed drug RSR13, which causes a rightward shift of the p50 is one of the most potent allosteric effectors of hemoglobin. It may have therapeutic implications for patients with nosocomial or community-acquired septic shock if it could increase the ability to transfer oxygen to tissues.

S84

Catheter-associated Urinary Tract Infection (CAUTI) Is Rarely Symptomatic: Results of a Prospective study of 1035 patients.
TAMBYAH PA, HALVORSON K, MAKI DG.University of Wisconsin Medical School, Madison, WI.

CAUTI is the most common nosocomial infections, accounting for more than one million nosocomial infections each year in U.S. hospitals. We prospectively studied 1035 newly-catheterized patients in our hospital; each patient was seen daily, a quantitative urine culture was obtained and the patient was queried regarding dysuria, urethral or flank pain, and was monitored for fever and other signs of infection. To critically assess the impact of CAUTI on patients' symptoms, we analyzed a subset of 801 patients, 63 (7.9%) of whom developed CAUTI (>10^5 CFU/mL), who did not have another (confounding) identifiable site of infection, besides the urinary tract. As seen (Table), there were no significant differences between the two groups in subjective symptoms commonly associated with UTI; most were afebrile. Only 79 out of 139 CAUTIs were detected by the primary team taking care of the patients. Thus, 43% of the CAUTIs were not treated. Overall, only 2 of 1035 catheterized patients had concordant BSI; in both, an infected intravascular line could not be excluded. We conclude that whereas CAUTIs are a major reservoir of resistant organisms in the hospital, however, they are rarely symptomatic; only a minute fraction go on to cause nosocomial BSI.

Percent with	No CAUTI (n=738)	CAUTI (n=63)
Dysuria	2.7	1.5
Pain	4.1	1.5
Urgency	3.5	2.7.
Fever >38.5°C	6.9	4.7
Mean Max Temperature,°C	37.9	37.5
Peripheral wbc, x10^3/mm^3	11.6	11.2

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S85 Nosocomial *Enterobacter Sakazakii* Infections

Kwan Kew Lai*, Seema R. Naravane.
The University of Massachusetts Medical School and the University of Massachusetts Medical Center, Worcester, MA.

Enterobacter sakazakii (ES) is a rare cause of infections. Most infections reported in the literature have been in neonates and infants. From August 1, 1995 to September 8, 1996, 5 cases of nosocomial ES infections involving 1 child and 4 adults were noted. The infections included 3 blood stream (BSI) and 2 respiratory tract infections (RTI). The BSIs were due to a central line, biliary sepsis, and abdominal infection. Three patients had malignancies: embryonic rhadomyosarcoma, metastatic tonsillar carcinoma, and Klatskin tumor Two of these 3 patients underwent chemotherapy and 1 was neutropenic when bacteremic with ES. Contrary to reports in the literature which state that susceptibility results showing resistance to ampicillin are likely to exclude ES. Our ES isolates were resistant to ampicillin and cefazolin. They were susceptible to the beta-lactam antibiotics, third generation cephalosporins, aminoglycosides, and TMP/SMX, with the exception of 1 ES isolate from the patient with biliary sepsis. This was resistant to cefotaxime, gentamicin, and piperacillin/tazobactam. Two patients were treated with ceftazidime, 1 each with ampicillin/sulbactam, cefotaxime, and imipenem. Two patients recovered and 3 died. Two deaths were directly attributed to ES septicemia. ES infections are rare but can be associated with a high mortality.

S86 Pelvic Osteomyelitis Following Bladder Suspension Using Bone Anchors.

MARK ENZLER* MD, HOWARD AGINS MD, PATRICK CULLIGAN MD, and REBECCA WURTZ MD. Evanston Hospital and Northwestern University Medical School, Evanston IL

We report 4 cases of pelvic osteomyelitis following surgery to correct urinary incontinence (UI). All of the procedures involved the use of titanium bone screws, which were placed in the pubic rami to serve as anchor points for bladder neck suspensions. Procedures using these bone anchors generally require less operative and inpatient recovery time than the standard bladder neck suspensions which use rectus fascia or Cooper's ligament as anchor points. The average age of the patients was 75 years (range, 71 - 80 years). The initial procedure was performed at three different hospitals. The patients presented a mean of 9.3 weeks (range 4 - 24 weeks) after surgery with suprapubic pain, swelling and/or cellulitis. Two had previously received courses of oral antibiotics for wound drainage. Pelvic CT scans showed soft tissue swelling behind the symphysis pubis and erosion of the adjacent bone. Abscesses (all cases), and infected bone (3 cases) were surgically débrided, and the metal screws and suspensory suture removed. One patient required two débridements and another needed débridement of a sterile sinus tract that developed after initial débridement. Cultures showed: 1. *Pseudomonas aeruginosa* plus *Staphylococcus aureus*; 2. *P. aeruginosa* plus coagulase-negative staphylococcus; 3. *S. aureus*; and 4. *Citrobacter sp.* plus a gram-positive coccus. All cases required prolonged (4-6 weeks) intravenous antibiotics. Osteomyelitis pubis rarely complicates conventional surgical procedures to correct UI, yet it appears to be an emerging problem with the use of titanium bone anchors. Optimal management requires surgical débridement and prolonged antibiotics. The cause and incidence of this complication with the use of bone anchors have not yet been determined.

M1 Surgical Site Infection (SSI) Outbreak Linked to Faulty Operating Room (OR) Ventilation.

*JEFFREY P. ENGEL, CAROL MCLAY, and ELIZABETH SASSER, East Carolina Univ. School of Medicine and Pitt County Memorial Hospital, Greenville, NC

OR air handling is critical to the maintenance of a sterile environment. Few SSI outbreaks, however, have ever been traced to faulty OR ventilation. Over a 4 month period, an increase in deep SSI was detected among patients undergoing clean, elective surgeries: laminectomy (5 cases), hip arthroplasty (4 cases), and carotid endarterectomy (1 case). Retrospective comparison to the 16 month pre-outbreak period showed that the SSI rate increased from 0.07% to 1.3% (risk ratio=20; 95% C.I., 4-94; p<0.001) for laminectomy, and from 1.7% to 4.3% (risk ratio=3; 95% C.I., 0.7-13; p=0.16) for hip arthroplasty. No obvious common source was implicated as several organisms were isolated, and multiple surgical teams were involved. Infected and non-infected cases were similar for NNIS risk categories of SSI: ASA score and duration of procedure. Infections were geographically clustered along a single corridor in the OR suite. Factors temporally related to the outbreak included construction/renovation and negative room pressure found during an unscheduled maintenance check in rooms along the involved corridor. Moreover, OR doors were frequently found ajar during cases. Two interventions were immediately enacted: continuous monitoring of ventilation pressure in all ORs with immediate correction of any discrepancies, and an educational program aimed to stop non-essential traffic through ORs and to keep OR doors closed during cases. SSI rates returned to pre-outbreak levels following these interventions. This investigation emphasizes the important relationship of OR ventilation to infectious outcomes in surgical patients.

M2 Air Pollution in Wound Vicinity: Comparison of two Central Ventilation Ceiling Systems for Operating Rooms in Daily Routine.

*WERNER E. BISCHOFF, RICUS RICHTER, GUNNAR FRANK and JOHANNES SANDER, Medical College of Virginia, Campus of Virginia Commonwealth University, Richmond, VA; Labor Dr Sander, Hannover, Germany.

Central ventilation ceiling systems (CVC) represent significant expenses for surgical departments. To compare the efficacy of modern CVC in protection of the operative site, the air pollution in wound vicinity was measured under two CVCs. The CVC system in OR-1 included a 1.80 x 1.80 m air outlet with perforated steel sheets, a body exhaust system and a partition wall between anesthetic and operating areas. OR-2 was equipped with a 2.40 x 2.40 m low air turbulence CVC covered by a two-layer synthetic fabric. To determine the air quality, the concentrations of particles $\geq$ 5 µm (laser-particle counter) and airborne bacteria (slit-sampler) were continuously measured 10-15 cm from the surgical field during 50 hip replacements in each OR. Length of operation, number of staff and door movements were documented. The mean integrals of particles $\geq$ 5 µm demonstrated a significant lower air pollution in OR-1 compared to OR-2 (171,584 particles/m^3 air to 540,692 particles/m^3 air; $p < 0.05$). The same result was found for the amount of airborne bacteria (OR-1: 0.35 cfus/m^3 air; OR-2: 1.04 cfus/m^3 air; $p < 0.05$). To determine the influence of staff on air pollution, a bivariate correlation analysis was performed for each OR. The mean integrals of particles correlated in OR-1 only with the length of operation and in OR-2 with the amount of airborne bacteria. No correlation was found between the mean integrals of particles and the number of staff or the door movements/operation in both ORs. Comparing the ORs with each other revealed significantly higher rates in door movements/operation and length of operations for OR-1. In comparison to a relatively new central ventilation system with a larger low air turbulence intake, a CVC system with partition walls and body exhaust system is superior in protecting the operative site from airborne contamination. These systems should be considered in the planning phase of ORs to minimize the risk of surgical infections.

M3 Room Pressure: A Critical Parameter for Special Ventilation Rooms.

NANCY RICE, *ANDREW STREIFEL, and DONALD VESLEY, School of Public Heath, University of Minnesota, Minneapolis, MN

The control of special ventilation room parameters is essential for the safety of patients and personnel. Room pressure is most often designated as positive (air flow out) for protective and negative (airflow in) for airborne infection isolation ventilation. A two season long-term room pressure evaluation was conducted on a total of 18 rooms: 8 standard rooms (S), 4 airborne infection isolation (AI) and 6 protective (P) environment rooms. The pressures of 3 types of room ventilation were measured using a digital pressure gauge-piezoresistive pressure sensor (Energy Conservatory, Mpls.) The gauge is sensitive to 0.1 Pascal's (250 Pa = 1.0 inch water gauge). With doors closed, the rooms were measured 30 times each for a cooling and a heating season. The S showed the least amount of variability in pressure differential, with an average of -0.21 Pa (median -0.18 Pa), and standard deviation of 0.15 Pa. AI rooms showed more variability in pressure, with an overall average of -0.25 Pa, (median -0.8 Pa), and a standard deviation of 0.23 Pa. P rooms had the greatest fluctuation in pressure with an average of 8.4 Pa (median 8.1 Pa) and a standard deviation of 3.0 Pa. Several of the special ventilation rooms, especially the P rooms, experienced sudden, dramatic pressure changes, which have the potential to compromise the protective properties of the rooms. The unexpected changes, sometimes as large as 14 Pa, may be related to fluctuations in damper position, air supply, or air exhaust. Other factors that may influence room pressures include room architectural differences (sealed vs. unsealed), stack effect, HVAC zone interactions, and outdoor temperature. The pressure changes noted in this study support the need for standardization of pressure parameters for special ventilation rooms. Maintaining standard pressure levels will require continuous room pressure monitoring.

M4 Room Pressure: A Critical Parameter for Special Ventilation Rooms.

NANCY RICE, *ANDREW STREIFEL, and DONALD VESLEY, School of Public Heath, University of Minnesota, Minneapolis, MN

The control of special ventilation room parameters is essential for the safety of patients and personnel. Room pressure is most often designated as positive (air flow out) for protective and negative (airflow in) for airborne infection isolation ventilation. A two season long-term room pressure evaluation was conducted on a total of 18 rooms: 8 standard rooms (S), 4 airborne infection isolation (AI) and 6 protective (P) environment rooms. The pressures of 3 types of room ventilation were measured using a digital pressure gauge-piezoresistive pressure sensor (Energy Conservatory, Mpls.) The gauge is sensitive to 0.1 Pascal's (250 Pa = 1.0 inch water gauge). With doors closed, the rooms were measured 30 times each for a cooling and a heating season. The S showed the least amount of variability in pressure differential, with an average of -0.21 Pa (median -0.18 Pa), and standard deviation of 0.15 Pa. AI rooms showed more variability in pressure, with an overall average of -0.25 Pa, (median -0.8 Pa), and a standard deviation of 0.23 Pa. P rooms had the greatest fluctuation in pressure with an average of 8.4 Pa (median 8.1 Pa) and a standard deviation of 3.0 Pa. Several of the special ventilation rooms, especially the P rooms, experienced sudden, dramatic pressure changes, which have the potential to compromise the protective properties of the rooms. The unexpected changes, sometimes as large as 14 Pa, may be related to fluctuations in damper position, air supply, or air exhaust. Other factors that may influence room pressures include room architectural differences (sealed vs. unsealed), stack effect, HVAC zone interactions, and outdoor temperature. The pressure changes noted in this study support the need for standardization of pressure parameters for special ventilation rooms. Maintaining standard pressure levels will require continuous room pressure monitoring.

M5

Comparison of Floor Buffers as a Source of Aerosolization of Fungal Spores in a Bone Marrow Transplant Unit (BMTU). JEAN M. PRZYKUCKI, MSN, CIC, L. SADKOWSKI, MT(ASCP), CAROL THOMPSON, MSN, MICHAEL G. RINALDI, Ph.D. and JAN E. PATTERSON, MD South Texas Veterans Health Care System, San Antonio, TX.

Immunocompromised patients in a BMTU or Solid Organ Transplant Unit have been shown to be at risk for acquiring nosocomial infections from the surrounding hospital environment. An informal survey of three BMT Units in the VA System indicated that there was a variation on policy of use of buffers in these areas. Two models of floor buffers were evaluated to determine if there was a difference in the aerosolization of fungal spores during the buffing process. Prior to air sampling, the outer hallway of the BMTU was cleaned using fresh solution of hospital approved disinfectant and new mop; new wax was NOT applied. Dust skirts and new filters were used on each unit. Buffer B has an additional vacuum unit and micro filter capable of trapping ≥ 0.2 micron size particles. Air samples for fungal cultures were obtained using the Biotest RSC Plus Air Sampler prior to and during the operation of each buffer. Samples were obtained walking with environmental service personnel maintaining 3 ft. distance from operating equipment. The right half of the corridor was used for Buffer A and the left half of the corridor for Buffer B. The baseline air sample recovered only 1 CFU/m^3 of *Alternaria* sp. The number of fungal CFU/m^3 recovered from Buffer A was 27% higher than Buffer B. Twenty-six (26) fungal CFU/m^3 (14 *Aspergillus sydowii*, 8 *Alternaria* sp. 2 *Cladosporium* sp. & 2 *Penicillium* sp.) were recovered from Buffer A. Seven (7) fungal CFU/m3 (4 *Alternaria* sp. 2 *Cladosporium* sp. & 1 *Penicillium* sp.) were recovered from air sample taken using Buffer B. Floor buffing may be potential source of environmental contamination on a ward housing immunocompromised patients. Buffing equipment varies in its ability to aerosolize fungal spores which could potentially become a source of nosocomial infection and may need to be compared and evaluated prior to use. Dedicated cleaning and buffing equipment should be considered for areas such as a BMTU.

M6

Environmental Surveillance Monitor Increases Educational Awareness of and Compliance with Infection Control and OSHA Policies. PAUL F. JURGENSEN, MD, FACP; *MARY M. McNALLY,RN, CIC; KATHY DEIGHTON,RN; SHARI OLIVER, RRT, CIC; MARTHA KRAESKI, Memorial Health Systems, Savannah, Georgia.

Memorial Health Systems of Savannah, Georgia, is a 530-bed tertiary care facility which provides full medical, surgical, trauma and children's services to the southeast coastal region. In late 1994, an environmental rounds monitor was introduced as a surveillance tool to monitor compliance with Infection Control and OSHA policies: safety and cleanliness of the environment and knowledge of infection control practices. Prior to this, there was a high turnover rate of management and staff, diverse products were used, the biohazardous waste management program was not standardized; these factors lead to confusion and diversity of practices. A tool was developed to monitor the following areas of practice: handwashing, isolation measures, knowledge and understanding of BSI, environmental cleanliness and safety inclusive of refrigerator logs, crash cart and linen cart cleanliness and storage, and proper handling of biohazardous linen and waste. In 1996, this monitor was expanded to include safety and engineering indicators. At that time, weekly environmental rounds became multidisciplinary and this department was recognized by the JCAHO for this successful endeavor. Results: Multidisciplinary environmental rounds are performed on a weekly basis. A plan of action to correct deficiencies is required within ten (10) days. As a result of these surveys, awareness and accountability of infection control, safety, risk management, engineering/maintenance and environmental issues has increased. From 1996 to 1997, 25 of the 58 indicators demonstrated improvement, a 43% improvement rate; 15 of the 58 indicators (26%) demonstrated a decrease; and 18 of the 58 indicators (31%) remained equal in compliance. There has been an increase in communication on construction issues, engineering needs and, finally, a revision of policies/procedures reflecting changes in waste disposal, exposure control plans, body substance isolation, and other issues related to regulatory compliance.

M9

"Community-Acquired" MRSA and MSSA: How Often Are They Community-Acquired? *KATHRYN B. KIRKLAND, WANDA LAMM, CONNIE CLARK, Duke University Medical Center, Durham, NC, Nash General Hospital, Rocky Mount, NC

In recent years, there has been increasing concern that methicillin-resistant Staphylococcus aureus (MRSA), once considered a primarily nosocomial infection, is being spread in the community. We studied cases of staphylococcal colonization and infection at a 292 bed community hospital to determine the proportion of "community-acquired" MRSA and methicillin-sensitive S. aureus (MSSA) infections that were likely to have been acquired outside the healthcare setting. Using CDC definitions for nosocomial infections, we identified 91 patients with MRSA colonization and infection during 1997; 83 patients with MSSA identified during the fourth quarter of 1997 were used for comparison. We determined whether the patients were admitted from home or a healthcare facility, and the number of hospital visits during the 2 years prior to admission. We defined a true community-acquired case as colonization or infection in a patient admitted from home, with no hospitalizations or emergency room (ER) visits within the preceding 2 years. Sixty-nine percent of both MRSA and MSSA cases were infections; the remainder were colonization. Twenty-one (23%) of the 91 MRSA cases and 10 (12%) of the 83 MSSA cases were nosocomially-acquired. However, of the 70 "community-acquired" MRSA cases, 26 (37%) were admitted from other healthcare facilities, 15 (21%) had been hospitalized during the 3 preceding months, and, in the 2 preceding years, 18 (25%) had been hospitalized, and 6 (9%) had had emergency room (ER) visits. Thus, only 4 (6%) of 70 "community-acquired" MRSA cases met our definition of true community-acquired. Among the 73 "community-acquired" MSSA cases, 14 (19%) were admitted from other healthcare facilities, 18 (25%) had been hospitalized during the 3 preceding months, and, in the 2 preceding years, 15 (21%) had been hospitalized, and 16 (22%) had had ER visits. Overall, 10 (14%) of 73 "community-acquired" MSSA cases met our definition of true community-acquired. Most cases of "community-acquired" MRSA and MSSA colonization and infection occur in patients who have had substantial contact with hospitals and other healthcare facilities, suggesting that these infections continue to be predominantly nosocomially transmitted.

M10

The effect of bloodstream hospital infection by *Staphylococcus aureus* resistant to methicillin on the mortality and the length of hospital stay. MARINA MOREIRA, EDUARDO A.S. MEDEIROS, ANTONIO C.C. PIGNATARI, SERGIO B. WEY, DENISE M. CARDO. Escola Paulista de Medicina, UNIFESP, Brazil

Objectives - To identify the attributed mortality rate of bloodstream nosocomial infection by *Staphylococcus aureus* resistant to methicillin (MRSA) and its effect thought length of stay.

Disign - Case-control study. **Setting:** Hospital São Paulo da Universidade Federal de São Paulo, a 660-bed, tertiary-care teaching hospital in São Paulo, Brazil. **Patients:** Seventy one adults patients with nosocomial-acquired MRSA bacteremia diagnosed between January 1, 1991, and September 30, 1992, and 71 MRSA-free controls were matched by the following criteria: age, sex, underlyng disease, surgical procedure, same risk time and admission date.

Results - The incidence of patients with hospital sepsis due MRSA accounted for 73,22% of the patients with hospital bloodstream infection due *Staphylococcus aureus*. The mortality rate of the cases was 56,33 (40/71) and 11,26 (8/71) of the controls. The attributable mortality rate was 45,07% (OR=17,0; IC 95%=3,58 - 202,26; p=0,000001). The length of hospital stay median time was of 32,55 days for the cases and 29,75 for the controls (p = 0,32).

Conclusion - The bloodstream hospital infection by MRSA it itself does a high level of mortality independently from the patients base disease.

M11

Impact of Cost-Control Measures on the Duration of an Outbreak of Methicillin-Resistant Staph. aureus (MRSA) on a Cardiothoracic Surgery Unit (CSU)

STEFAN WEBER*, STEFAN ZIESING, PETRA WEBER, ANDREAS KLOS, INGRID HINRICHS and DIETER BITTER-SUERMANN

Hannover Medical School, Hannover, Germany

In December 1996, we detected an outbreak of MRSA on a CSU of a University affiliated hospital. The incidence of MRSA raised from 4.7 / 1000 patient days (pd). to 43.8 /1000 pd. We recommended standard barrier precautions according to international guidelines. We were not able to assess compliance to our recommendations. However, rates of MRSA colonization decreased from January to March 1997 to 1.4 / 1000 pd, only to raise again in April and May 1997, with a rate of 14.8 / 1000 admissions with 2 deaths reported. Pulsed Field Gel Electrophoresis showed that the outbreak strains from December and April/May were identical.

The recommendations were not followed due to the costs of these measures. Notably, staff and patients were not screened for nasal carriage, isolation guidelines were not followed as strictly as was requested. We identified several possible patient to patient transmissions, one case of patient (child) to visitor (mother) transmission or vice versa, and one physical therapist who carried the outbreak strain in her nares. Several inservices were done to improve standard barrier precautions and screening procedures. During this second outbreak, half a unit was designated for MRSA patients only. MRSA isolation rates went back to normal in June/July 1997.

The second outbreak had a substantial impact on hospital revenues. A conservative estimate projected a loss of approx. $ 150,000, predominantly because less patients could be admitted to cardiothoracic surgery units at that time. We conclude that the costs of the second outbreak of MRSA outnumber the saved costs of the first outbreak at least by a factor of 50.

M12

Infection Control Practices and Mupirocin; A Good Team to Combat Methicillin-Resistant *Staphylococcus Aureus* (MRSA) in a Neonatal Intensive Care Unit (NICU). *B. GRIFFITH, R. CHOTANI, S. HARRINGTON, L. KARANFIL, F. NORTHINGTON, T. PERL, Johns Hopkins Hospital, Baltimore, MD

MRSA infections are devastating in neonates. The most common modes of transmitting MRSA are through breaks in infection control practices and from person to person. Because the anterior nares is the ecologic niche of *S. aureus*, cultures of this body site are used to identify MRSA carriage. Infection control practices (isolation, handwashing) alone are frequently inadequate to control MRSA clusters/outbreaks. A 26 week preterm infant was colonized in 8/96 with MRSA from an endotracheal tube (ET) culture in our 36 bed level III NICU. In 10/96, a full term infant (3120 grams) colonized with MRSA (ET culture) was identified. Surveillance cultures (anterior nares) of all NICU patients (n=32) were performed on 10/30/96. No further MRSA carriers were identified. On 11/30/96, the second colonized infant developed our first nosocomial MRSA bloodstream infection (BSI). Pulse field gel electrophoresis (PFGE) revealed that both patient isolates were epidemiologically related, differing by 2 bands. Contact Precautions and private rooms/cohorting were utilized for both infants until discharge. Strict handwashing policies were reinforced. December 1996 surveillance cultures of the NICU patients and health care workers (HCW) (n=132) did not grow MRSA. No further isolates of MRSA occurred until 5/27/97 when an infant with ichthyosis developed a MRSA BSI. Repeat surveillance cultures in all NICU patients (n=30) identified 4 additional MRSA carriers, one of whom developed a MRSA BSI. PFGE demonstrated that all isolates were identical and epidemiologically linked to the two isolates from the original cluster. Repeat surveillance cultures of HCW's (n=135) revealed 2 carriers of MRSA. Both staff members and 4/5 patient carriers were treated with intranasal mupirocin. After treatment, they were recultured and remained negative for MRSA. On 7/30/97, follow-up surveillance cultures of NICU patients (n=31) did not reveal MRSA. Isolation, handwashing, and other infection control practices were unsuccessful in eliminating MRSA from the unit. Intranasal mupirocin was a useful adjuvant to infection control practices to control MRSA from known site of carriage in our NICU.

M13

Longitudinal Surveillance and Control of Methicillin Resistant *Staphylococcus aureus* (MRSA) with Pulsed Field Gel Electrophoresis (PFGE). *TIMOTHY J. BABINCHAK, EDWARD B. ROTHERAM, JR., MALCOLM SLIFKIN, and CAROL RENNER. Allegheny University of the Health Sciences and Allegheny General Hospital, Pittsburgh, PA.

MRSA continues to be a significant nosocomial pathogen in university affiliated teaching hospitals. Prospective surveillance of 301 MRSA isolates with PFGE was performed from January 1994 through December 1997, in our 750-bed tertiary care teaching hospital. PFGE was performed by standard SMA1 restriction endonuclease enzyme digestion of chromosomal DNA. Types and subtypes were classified according to their first appearance on PFGE and genetic relatedness as characterized by fragment differences as compared to previously identified isolates. Thirty-two different patterns were recovered over the four year study period. These patterns could be grouped into twelve types with 20 subtypes. Type A was the predominant pattern and represented 68% of the isolates (206/301). Type A was the endemic organism in our institution as well as the community, and has remained stable throughout the study period. Nine types (D-L) appeared only sporadically. Their presence being transient and apparently limited by effective barrier isolation methods. Combined with active nasal and hand surveillance cultures, PFGE was able to link 12 health care workers with nosocomial outbreaks in 3 instances over 4 years (types A, B, and E). PFGE quickly identified the extent of the outbreak, identified and linked involved health care workers and documented patient to patient transmission. Subtype analysis was crucial in delineating involved health care workers and patients in the outbreak involving the endemic strain as the isolates were otherwise indistinguishable. Our longitudinal study has shown PFGE to be useful in distinguishing nosocomial outbreaks from endemic colonization, identification and control of types introduced from the community, and documentation of nosocomial transmission of MRSA. Real time use of PFGE allowed the rapid identification of colonized health care workers prompting treatment and combined with barrier isolation precautions limiting the spread of MRSA.

M14

The Risk of MRSA Bacteremia in Inpatients with Chronic Ulcers. MARY-CLAIRE ROGHMANN, ANWAR SIDDIQI, KAREN PLAISANCE, HAL STANDIFORD. VA Maryland Health Care System, Baltimore, MD.

The prevalence of MRSA colonization is higher in patients with wounds, ulcers or other areas of skin breakdown. Chronic ulcers, related to diabetes, peripheral vascular disease or immobility, are common in the geriatric population. We performed a cohort study of patients with chronic ulcers to quantitate the risk of MRSA bacteremia in this population. Over a five year period (1/90-5/95), 911 patients with chronic ulcers (CU), as determined by ICD9-CM code search, were admitted to the VAMC. During this time period, patients with skin breakdown such as CU were routinely cultured for MRSA. Computerized databases containing microbiology records, admissions and demographic factors of the cohort patients were reviewed and data was abstracted. Of these CU patients, 60% (545/911) had their CU cultured to detect MRSA and 30%(166/545) of these patients had their CU colonized with MRSA. CU patients with CU MRSA colonization were admitted more frequently (median [range]:1 day [1-25] vs.1 [1-9], p=<0.01, Wilcoxon Rank Sum Test); and for longer time periods (median [range]: 47 days [1-435] vs.19 [1-410], p=<0.01) compared to CU patients without CU MRSA colonization. In addition, they were more likely to have a decubitus ulcer (96% vs 92%, p=.08, chi-square) compared to non-colonized CU patients. MRSA bacteremia occurred in 4% (36/911) of CU patients during the study period and in 6% (32/545) of CU patients with CU cultured to detect MRSA. CU patients with CU MRSA colonization had an increased risk of MRSA bacteremia (RR 16, 95% CI, 6-44) regardless of type of ulcer. In 16 of the 29 patients with MRSA bacteremia and CU MRSA colonization, the MRSA colonization was known to precede the bacteremia. This cohort study identifies CU patients in an acute care setting as a high-risk population for MRSA bacteremia. This population should be targeted for interventions.

M15

Screening "High Risk" Patients for Methicillin-Resistant *Staphylococcus aureus* (MRSA) on Admission: Is it Cost-Effective? G. PAPIA*, M. LOUIE, A. TRALLA, C. JOHNSON, V. COLLINS, and A.E. SIMOR, Department of Microbiology, SD Laboratory Services, Sunnybrook Health Science Centre, Univ. of Toronto, Toronto, Ont., Canada.

The number of patients infected or colonized with MRSA has increased markedly in Ontario since 1995, and has increased to approximately 4% of all S. aureus isolates in our hospital. We wished to determine whether screening "high risk" patients for MRSA on admission to hospital would be a cost-effective method of control. From June 1, 1996-May 31, 1997, all patients directly transferred from another hospital or nursing home, or who had been hospitalized in the previous 3 months, were screened for MRSA within 72 hrs of admission. Specimens included nares, perineal, wound, and catheter exit site swabs, cultured on mannitol-salt agar. A case-control study was done to compare characteristics of patients with MRSA from those without the organism. Laboratory costs for MRSA screening and the costs associated with implementation of MRSA infection control measures (private room, gloves, gowns, decolonization therapy) were calculated.

A total of 3,673 screening specimens were obtained from 1,743 patients. MRSA was found on admission in 23 (1.3%) patients, representing 38% of the 61 patients with MRSA identified in our hospital during the year. Fifteen (65%) patients had been transferred from another hospital or long-term care facility. MRSA colonized patients were more likely to have been hospitalized outside of Canada in the previous 3 months (OR 7.8, p=0.06), or to have been transferred from a nursing home (OR 6.4, p=0.04). MRSA patients were in isolation for an average of 36 days. The laboratory cost for each specimen was $6.12 (materials, $1.03; labor, $5.09), for a total of $22,499.00/yr (CDN), and $977.30 for each MRSA patient identified. The average cost of implementing recommended infection control measures for patients colonized with MRSA was approximately $4,640.00 (CDN). If early identification of MRSA colonized patients prevents a single case of nosocomial MRSA infection or prevents even a few cases of nosocomial transmission of MRSA to other patients, the costs of this screening program are justifiable.

M16

Prevalence of Methicillin-Resistant *Staphylococcus aureus* (MRSA) Among Patients Visiting the Emergency Room at a Tertiary Hospital in Brazil. *J. RIBEIRO, J.M. BOYCE, F.D. VIEIRA , E.C. RIBEIRO, J.B. TAJRA, R.M.ALMEIDA, Hospital de Base, Brasilia, Brazil, and Miriam Hospital, Providence, RI.

In a number of geographic areas, an increasing percentage of patients (pts) with MRSA are found to be positive for the organism within 48-72 hrs of admission. This trend suggests the possibility that MRSA may be common in the community, which if true, might promote frequent empiric use of vancomycin in patients admitted with infections. We conducted a prospective study to determine the prevalence of MRSA among pts seen at an emergency room/observation unit (ER) at a tertiary hospital in Brazil. During a 5-month period, pts admitted to the ER on Mondays - Thursdays, and who were present less than 48 hrs, were included in the study. Moistened swabs were used to culture anterior nares, and swabs were plated directly and placed in enrichment broth. Susceptibility tests were performed using a Vitek machine, and oxacillin resistance was confirmed using oxacillin-salt agar screening plates and BBL Crystal ID system. Among 600 pts cultured, 145 (24.2%) were colonized with methicillin-susceptible *S. aureus*. Four pts (0.7%) were colonized with MRSA. Three of the 4 pts with MRSA had one or more previous hospital admissions in the preceding year. One patient had no previous exposure to a healthcare facility. We conclude that the prevalence of MRSA among pts visiting the ER is very low (0.7%) and that empiric use of vancomycin for suspected community-acquired *S. aureus* infections is seldom

M17

Misclassification of Susceptible Strains of *Staphylococcus aureus* as Methicillin-Resistant *S. aureus* (MRSA) by a Rapid Automated Susceptibility Testing System. *JULIVAL RIBEIRO, F.D. VIEIRA, TOM KING, JULIA B. D'AREZZO and JOHN M. BOYCE. Hospital de Base, Brasilia, Brazil; and VA Medical Center and Miriam Hospital, Providence, RI.

Misidentification of susceptible *S. aureus* as MRSA may lead to inappropriate use of vancomycin and unnecessary infection control measures. Most strains of MRSA are multi-drug resistant, although occasional strains may be susceptible to most non-beta-lactam antibiotics. During a recent survey of *S. aureus* colonization among patients at a tertiary hospital in Brazil, 6 isolates were identified by a Vitek machine (using GPS-BS cards) as resistant to penicillin, oxacillin and other beta-lactams, but susceptible to most non-beta-lactam antibiotics. During the same time period, 2 isolates with similar characteristics were identified as oxacillin-resistant by Vitek GPS-SA cards at a hospital in California. We studied these 8 isolates using standard disk diffusion and agar dilution methods, oxacillin-salt agar screening plates, BBL Crystal ID system, and PCR assays for the *mecA* gene. Known MRSA and susceptible control strains were included.

All 8 study isolates were resistant to penicillin, but susceptible to oxacillin, nafcillin, Augmentin, and ceftizoxime by disk diffusion tests. All had oxacillin MICs of $\leq$ 0.5 ug/ml by agar dilution tests, and were oxacillin-susceptible by BBL Crystal ID. None grew on oxacillin-salt agar screening plates. None were positive for *mecA* gene sequences by PCR. Moreover, all were susceptible to oxacillin when tested by a Vitek machine using GPS-101 cards. We conclude that some oxacillin-susceptible *S. aureus* strains may be misclassified as oxacillin-resistant (MRSA) by the Vitek system when certain GPS cards are used. Further studies are needed to identify the cause of the problem.

M18

Genotyping of *Staphylococcus aureus* using PCR on a repetitive sequence of *Mycoplasma pneumoniae*

A. van der Zee*, J.C. van Zon, H. Verbakel, A.G.M. Buiting, M.F. Peeters, A.M.C. Bergmans

St. Elisabeth Hospital, Laboratory of Molecular Microbiology, P.O. Box 747, 5000 AS Tilburg, The Netherlands

Fifty-four isolates of methicillin-resistent *Staphylococcus aureus* were typed by PCR using a primer based on a repetitive sequence of *Mycoplasma pneumoniae* [1]. Epidemiologically related strains showed identical banding patterns while unrelated strains often showed a different pattern. A total of eighteen different rep-PCR patterns could be distinguished reproducibly among the 54 strains. Multilocus enzyme electrophoresis (MEE) of the isolates had shown 9 different MEE types.

Currently, we are investigating 60 well-defined isolates of *S. aureus* [2] (typed by pulsed field gel electrophoresis and arbitrarily primed PCR) with the repetitive element-based PCR. We like to present the results of this comparison between various typing methods in Orlando.

The rep-PCR typing method described here probably presents an improved typing method compared to other methods described previously, because (i) primer amncaling is highly stringent, (ii) results are very reproducible, (iii) performance is easy and fast (one day), and (iv) discriminatory patterns are obtained (10-15 bands visible). It may be a useful tool for genetic analysis and monitoring of nosocomial spreading of staphylococci.

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M21 Nosocomial Infections Surveillance must be Evaluated to be Trusted: an Evaluation Study on a French Surgical Site Infections (SSI) Surveillance Network.

A. SAVEY*, M.-H. RICHARD, I. GENDRE, J. HAJJAR, G. PINZARU, J. FABRY and ISO Sud-Est Study Group. C.CLIN Sud-Est, University Hospital - Lyon, France.

The Infection Control Coordinating Center of South-East France has implemented a network for a multicentric continuous SSI surveillance based on the NNIS system methodology. More than 130 surgical units (SU) have voluntarily participated for at least 3 months, since 1995. An evaluation study of the network has been planned in 1996 (Feb.-April) to assess the data quality and to improve surveillance methodology. All the SU participating to the network during the 2nd trimester of 1995 have been considered (#28) and were visited by an independent trained practitioner (considered as a gold-standard): 1) to investigate by a questionnaire the organization of surveillance and results utilization, 2) to compare the # of patients registered in operating programs to the # of patients included in the database (exhaustiveness), 3) to check data quality and patient postdischarge follow-up on a representative sample of 159 patients (82 non infected and 77 with SSI) among the 3250 patients included for that 3 month period. An estimation of sensitivity (Se) and specificity (Sp) has also been calculated. 79% (22/28) of the SU organized a specific diffusion of the results and 79% (22/28) directly used the surveillance results to promote preventive actions. Exhaustiveness rate for patient inclusion reached 77 % (errors from +3 to -40 patients per unit). 88.2% of the 3028 items included in the database were identical with the information recorded by the investigator in the 159 medical charts; 4 diagnostic errors were noticed (3 false positives and 1 false negative), corresponding to an estimated Se of 57.2% and Sp of 99.9%. Only 62.3 % of the patients have been observed during a 30 day post-operative period as recommended. Exhaustiveness, data collection and definitions of problematic items could be improved. The item "date of last contact with the patient" will be added to encourage follow up after discharge. A regular evaluation is needed to assess surveillance accuracy and, particularly in a network system, to make that tool be trusted by the participants.

M22 DEFINING THE ANTIBIOTIC PROPHYLAXY FOR THE OBSTETRIC PATIENT THROUGH AN EPIDEMIOLOGICAL APPROACH

STARLING, C.E.F.; RIBEIRO, A.L.J.; COUTO, B.R.G.M.
Felicio Rocho Hospital (HFR), Belo Horizonte, MG, Brazil

Introduction: HFR is a general hospital with 400 beds, 30 of which are obstetric. In the present study, our main objective is to investigate the efficacy of a prophylactic antibiotic (ATB) as a preventive measure of nosocomial infection (NI), identifying the patients that benefited the most from this treatment. **Methodology**: a prospective cohort study, carried out between June/92 to March/97. The control group is made of patients who underwent a Cesarean section (C-section) and did not receive ATB, and the case group consisted of patients who underwent a C-section and received ATB (1 gr. of cephalothin after clamping the umbilical chord). In the statistical comparisons, any p-value < 0.10, in bilateral tests was considered significant. For the variables below, we compared the cases of NI in the presence of ATB versus absence of ATB: age < 20 years old, PIH (Pregnancy-Induced Hypertension), patients transferred from other hospitals, diabetes, corioamnionites, urinary tract infection, corticotherapy, long-term vesical catheter, gross contamination, intra-uterine death, obesity, C-section following labor, general anesthesia, C-section time > 1 hour, more than 4 vaginal examinations, membrane rupture, labor > 6 hours. **Results**: data from 3998 C-sections were analyzed. In the bivariate analysis, ATB was effective as a NI protector in only 5 situations: gross contamination (RR = 0.0; p = 0.063), C-section following labor (RR = 0.3; p = 0.098), more than 4 vaginal examinations (RR = 0.2; p = 0.011), long labor (RR = 0.3; p = 0.030), and membrane rupture for more than 6 hours (RR = 0.2; p = 0.021); in the 499 C-sections that received ATB, there were 6 NI (1.2%), and in the 241 that did not receive ATB, there were 14 NI (5.8%) with an RR for ATB = 0.2 (p = 0.001). As for the patients without any of these risk factors, even though 468 of them received ATB, there were 1.3% of NI (6 cases), against 1.5% (41 cases) in the 2790 cesareans without these risk factors and without ATB (RR = 0.9; p = 0.916). **Conclusion**: the study allowed us to identify patients with greater risk of NI and to optimize the use of prophylactic antibiotic in cesarean section.

M23 Objectives, Rationale and Baseline Characteristics of a French Network on the Surveillance of Nosocomial Infections Among Postpartum Women.

P. VANHEMS, F. TISSOT-GUERRAZ, G. PINZARU, R. GIRARD, A.S. RONNAUX-BARON, C. HAOND, C. MEFFRE, J. FABRY and the MATERNITY-NETWORK SURVEY. Centre Hospitalier Lyon-Sud and Univ. Claude Bernard, Lyon, France.

To estimate the incidence, of nosocomial infections (NI) among pospartum women, we started a surveillance network in the maternity units in the South-East of France. The units were enrolled in a voluntary way. One data collection form containing infection diagnoses and risk factors was filled up for each delivery. Data were sent to the coordination center every 4 months which provided a global analysis and a specific one per each unit. The rates of NI were separatly reported for 100 vaginal deliveries (VD) and for 100 cesarean sections (CS). We are reporting the baseline characteristics and the results of the first 4th months of surveillance (From January,1st to April, 30th 1997). 17 units got included. Among a total of 5,831 deliveries (expected number #6,983, inclusion rate: 83.5%), we recorded 16.6% CS. Their NI rate was 7.8% compared to a 2.2% NI rate in VD (p<0.001). The most frequent NIs were endometritis (#50, 47% of NI) for VD and urinary tract infections (#30, 40% of NI) for CS. NI associated factors (estimated by their odd-ratio: OR) are reported below:

Vaginal delivery (n=4,865)	OR of NI (95% CI)	Cesarean section (n=966)	OR of NI (95% CI)
Membrane rupture≥12 hours	2.8 (1.5-5.5)	Prophylactic CS	0.6 (0.4-0.9)
Blood loss≥800 ml	5.1 (2.6-9.8)	Hyperthermia during labor	2.4 (0.9-6.4)
Vaginal examinations≥5	1.7 (1.1-2.4)		
Forceps use	1.6 (1.1-2.5)		

The results of the multivariate analysis will be presented. Specific preventive measures should be associated to the standard procedures according to the type of delivery.

M24 Thirty Six Months of Continuous Surgical Site Infection (SSI) Surveillance: Use of Statistical Process Control (SPC) P Charts in Analysis. EDWARD T.M. SMYTH*, GERARD MCILVENNY and JOHN M. HOOD, The Royal Hospitals, Belfast, Northern Ireland, BT12 6BA.

A project was instituted to continuously monitor the incidence of surgical site infection (SSI) in the Surgical Directorate of The Royal Hospitals, Belfast, Northern Ireland in January 1995. Employing optical scanning technology (Formic Limited, London, UK) a SSI questionnaire was designed which included relevant data modelled on the National Nosocomial Infections Surveillance (NNIS) System for Surgical Site Infections including the SSI risk index. Scanning of completed questionnaires was followed by data processing for validation and correction of errors. The contents of the database were then analysed by the Quality Control module of Statistica (StatSoft, Inc., Tulsa, OK) and the relevant P chart constructed. A total of 7,666 surgical procedures were recorded. SSI lend themselves to analysis by P chart methodology. Control charts for attributes are applicable to situations when it is necessary to control a distinct quality attribute such as the number of SSI per 100 surgical procedures. The vertical or Y-axis in the P chart is scaled in terms of proportions (percentages). Data were analysed using SSI/100 surgical procedures with ±2 standard deviations (σ) representing upper and lower warning limits (UWL and LWL) respectively and ±3σ representing upper and lower control limits (UCL and LCL) respectively above and below the mean. P charts may be constructed employing crude SSI rates or may be refined using the SSI patient risk index. The crude SSI rate for all procedures and clean surgery was 2.78% and 1.17% respectively. Using the SSI risk index, the adjusted SSI rates for all procedures were 0.97%, 4.51%, 14.23% and 27.27% for risk indices 0, 1, 2 and 3 respectively. P charts allow continuous monitoring of SSI rates and using patient risk indices may allow interhospital comparisons to be made. Many governmental bodies are arguing for some form of national league tables regarding nosocomial infections. SPC charts may be one way of providing an easy to understand visual format that would be acceptable to most monitoring authorities.

M25 Is Targeted Surveillance Sufficient to Identify Problems in a Timely Manner? Findings from Surgical Site Infection (SSI) Surveillance after an outbreak in Cardiothoracic (CT) Surgical Procedures at a University Hospital. *MARY ANN BORDNER, CYNTHIA WHITENER, PennState Geisinger Health System, Hershey Medical Center, Hershey PA

Infection surveillance has shifted from comprehensive to targeted methods, rotating surveillance sites. This approach evolved due to increased time demands and cost containment pressures facing the medical community. The advantages of targeted surveillance should be weighed against the potential for delayed recognition of problem areas or missing an outbreak altogether. In early 1995, an increase in SSI rates, especially deep infections (DSWI) was noted by physicians in patients undergoing CT surgical procedures. In response, surveillance and data analysis were increased (J-J 95). Interdisciplinary meetings with staff from CT Surgery, Anesthesia, OR, Perfusion, and Infection Control were held to provide feedback of surveillance data and to discuss issues and concerns. Although the reasons for the increased infection rates were not identified, the SSI rates returned to those before the outbreak and CT surveillance and meetings were discontinued (June 96). Within a year an increase in SSIs was again noted by staff and surveillance was re-instituted (J-J 97). ⇧ ⇩ ⇧

	J-J 94	J-D 94	J-J 95	J-D 95	J-J 96	J-D 96	J-J 97	J-S 97*
No. procedures	157	157	238	203	241	279	216	118
DSWI (total SSI)	1 (8)	4 (8)	10 (15)	9 (18)	2 (5)	2 (5)	5 (7)	1 (5)
DSWI rate (%)	0.6	2.5	4.2	4.4	0.8	0.7	2.3	0.8
SSI rate (%)	5.1	5.1	6.3	8.9	2.1	1.9	3.2	4.2

* data incomplete

The role of increased surveillance and/or continuing education and awareness efforts on the SSI rates remains unclear. Time and financial demands necessitate choices and prioritization, however targeted surveillance may miss important events or delay their recognition. This potential must be considered when interpreting the results of targeted surveillance, and in determining the appropriate surveillance method.

M26 A PROPOSAL FOR SURVEILLANCE OF SURGICAL INFECTION AFTER PATIENT DISCHARGE

STARLING.C; PEIXOTO, M.L.B.; COUTO.B.
São Francisco de Assis Hospital, Belo Horizonte, MG, Brazil

INTRODUCTION: between 19% and 65% of surgical site infections (SSI) are diagnosed after patient discharge. Despite this alarming fact, the surveillance of the discharged patient still remains a great challenge for the controllers of nosocomial infection, due to the high costs and operational difficulties this surveillance requires. **OBJECTIVE:** to evaluate a surveillance system of discharged patients based on reports from the surgeons, describing the methodology used and the results obtained.

METHODOLOGY: at the end of every month, all surgeons receive (personally and hand delivered) a letter containing the concepts and diagnostic criteria of SSI (CDC, 1992) and a list with the name of their patients, the date of each surgery, and questions about the aspect of the wound at the time of removing the stitches. **RESULTS:** in the period between May and September of 1997 the proposed surveillance method for discharged patients was tested at the São Francisco de Assis Hospital (SFAH). Of a total of 617 surgeries undertaken in this period, there were 20 SSI, of which 13 of these infections were diagnosed in the hospital (65%) and 35% of them (7) identified in the surveillance of discharged patients. The rate of SSI, calculated without the data of discharged patients, was 2.1%, increasing to 3.2% when the SSIs diagnosed after the discharge of the patient were incorporated into the calculation.

CONCLUSION: the results show that the proposed method is feasible, having a minimum cost since the necessary resources are already incorporated into the routine of SFAH. However, a personal effort is necessary, person to person, and a mutual trust between professionals involved in order to achieve a continuity in this process, which is crucial for future analyses of epidemiological data.

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M27

Same Day Surgery at a Cancer Referral Center. A Four Years Experience with a 30 day Post-operative Surveillance Program. *DIANA VILAR-COMPTE, RODRIGO ROLDAN, REBECA COROMINAS, SILVIA SANDOVAL, MARGARITA DE LA ROSA, PATRICIA GORDILLO, PATRICIA VOLKOW. Instituto Nacional de Cancerologia (INCan), Mexico City.

One of the most important changes in healthcare delivery during the past decade has been the rapid expansion of ambulatory surgery. The rates of surgical site infection (SSI) reported for same day surgery (SDS) tend to be low. Only a few have either validated their programs or done post-discharge follow-up. The INCan is a tertiary care cancer referral center for adult patients in Mexico City. Between 2500 and 3000 surgical procedures are done annually, approximately 10% are minor surgeries. In 1993 a surgical wound surveillance program with post-discharge follow-up was started for inpatient and outpatient surgeries. In the present study we investigated the rate of SSI's in SDS and the risk factors associated to it. Between January 1993 and December 1996 all of the ambulatory surgical procedures followed by the program were included and classified as infected or not according to the 1992 CDC definitions for SSI. Rates per 100 surgeries were calculated and OR's and 95%CI's were calculated as appropriate. During these period the program followed-up 1064 SDS. Twenty-five SSI were registered (SSI rate= 2.35). According to the traditional wound class distribution, 884(83.1%) were class I, 134(12.6%) class II, 10(1%)class III, and 29(2.7%) fell into class IV (7 were not classified). SSI rate for each class was: 1.7%, 5.2%, 0 and 10.3% respectively. Most of the procedures were excisional biopsies performed by head and neck or soft tissue tumor's departments. Conventional risk factor for SSI such as obesity, duration of surgery, drains, staff surgeon and prophylactic antibiotics did not show any statistically significant association. The SSI in our hospital for SDS is consistent with previous reports. We did not find any significant associations. We believe that post-discharge follow-up identified more SSI's than conventional nosocomial surveillance methods; however the program has been not validated and the best surveillance method for ambulatory surgery has still to be defined.

M28

Pediatric Surgical Site Infections, 1991-1995. *CD CHRISTIE, AM GLOVER, SF REISING, MM ZIEGLER. Children's Hospital Med. Center, Cincinnati, OH.
Background and purpose: Surgical site infections (SSI's) are serious complications of high-volume, high-risk surgical procedures. Prospective surveillance records were reviewed in a 361-bed pediatric hospital to define the epidemiology and microbiology of in-patient SSI's. **Methods:** Active surveillance for in-patient SSI's used CDC/NNIS/ACOS criteria by review of discharges, daily; and microbiology reports, clinic visits and surgical procedures, weekly. **Results:** During 1991-5, 28,646 surgical procedures yielded 337 in-patient SSI's; rates were class I - 1.3% (121/9406), class II - 1% (140/17,595), class III - 6% (56/945) and class IV - 3% (20/700). 304 SSI's were reviewed (age, 2 days to 24 years; mean, 6 years). Among the 304 SSI's, 4 surgeons had 30-39, 2 had 20-29, 5 had 10-19 and 11 had 1-9 SSI's. Surgical services were general (50%), neuro (16%), orthopedic (9%), cardiac (7%), gastro-intestinal (7%), otolaryngology 6%, and genitourinary, nephrology and plastics (5%). In 300 SSI's, CDC classification was superficial/skin (33%), deep incisional (25%) and organ space (42%). Onset was 2-99 (median 11) days. SSI's were detected (292) in the first admission (74%), post discharge (2%), or at re-admission (24%). 78% (239) of 304 SSI's yielded 361 pathogens: *S. aureus* (50), *Enterococcus* sp. (45), *Coag. neg. staphylococcus* (40), viridans streptococci (17), other Gram positive aerobes (13), anaerobes (9), *E. coli* (52), *P. aeruginosa* (37), *Enterobacter* sp. (27), *Klebsiella* sp. (22), other Gram negative aerobes (34) and *Candida* sp. (15). 31% were polymicrobial infections. In 51 SSI's post appendectomy 73% were perforated/gangrenous; 29 pathogens were isolated: *E. coli* (22), *E. corrodens* (2). 26 SSI's after solid organ transplants (liver - 19, kidney - 6, heart - 1) yielded 23 pathogens: *Coag. neg. staphylococcus* (7), *Enterococcus* sp. (6), *P. aeruginosa* (5). 49 SSI's after neurosurgery produced 37 pathogens: *S. aureus* (15), *Coag. neg. staphylococcus* (12), *E. corrodens* (8). 26 SSI's post orthopedic surgery yielded 25 pathogens: *S. aureus* (9), *Enterococcus* (5) *P. aeruginosa* (3), *Enterobacter* sp. (3). 21 SSI's after cardiac surgery for major congenital defects yielded 16 pathogens: *S. aureus* (9), *Coag. neg. staphylococcus* (4). **Conclusion:** Knowledge of the local epidemiology, bacteriology and drug susceptibility of pediatric inpatient SSI's directed appropriate perioperative antibiotic prophylaxis and therapy.

M29

Infection rates in hip prosthesis surgery (HPS) in a community hospital in RibeirãoPreto, Brazil. SG SANTUCCI, IF RABELLO, RBL COSTA, R.X.C FILHO, JR ROSSANEZ, RICARDO F. MOREIRA. Hospital Santa Lydia. Ribeirão Preto, São Paulo State, Brazil.

Many sophisticated surgical procedures (SP), such as HPS have been done at a 80-bed community hospital since 1983 but it was only in August 1996 that a nosocomial infection control program (NICP) was started there. Prospective active surveillance of SP at a crowded operating room (OR) promptly showed many problems: patients (pts) frequently did not get showers before surgery, skin antisepsis was inconsistently performed, surgical instruments were improperly handled during surgery, and perioperative antibiotic prophylaxis (PAP) was inadequate. PAP never started at the proper time, it often lasted more than 5 days, and oral presentations of the antibiotics were frequently prescribed. Our NICP proposed basic infection control measures based on current international guidelines, that included proper patient skin care, reduced number of people at the OR, a PAP that started always at the anesthesia induction, parenteral, and lasted 48 hours or less, and teaching at the OR to explain to surgeons proper handling of surgical instruments. We determined the infection rates (IR), mortality and appropriateness of PAP in HPS in two periods: period I (August 95-Aug 96), retrospectively, and period II (September 96-Aug 97), prospectively. Patients were followed for at least 3 months. We calculated the direct costs of surgical site infections (SSI) of HPS. There were 90 pts at period I. 7 (7.7%) developed SSI, 6 (6.6%) had to remove the prosthesis, 2 (2.2%) had clinical sepsis, and one died (mortality rate 28.5%). The SSI direct costs were about $21,000. No pt received appropriate PAP. There were 91 pts in period II. 4 (4.4%) developed SSI, 3 (3.3%) had to remove the prosthesis, but no pt had sepsis or died. Ninety (99%) received appropriate PAP. The SSI direct costs were about $10,500. All SSI in both periods were detected in average 3 weeks after the SP. We concluded that basic infection control measures were still not in use in a hospital with sophisticated surgical procedures. We managed to reduce the waste of resources in PAP by having a high compliance rate of the surgeons. We detected a reduction in HPS infection rate and many other SP probably benefited from our NICP. More time is needed to establish if the SSI HPS rate will decrease to reach the international literature levels.

M30

Modifiable factors associated with surgical wound infections in Coronary Artery Bypass Surgery (CABG). HEWITT C. GOODPASTURE.

PAULA G. GHAZARIAN, JULIE L. COX J. JEAN A. CLARK. Via Christi Regional Medical Center 929 N. St. Francis, Wichita KS 67214-3882.

This study utilizes multivariate regression with severity adjustment on 425 CABG patients to assess surgical wound infection outcome correlations with over 800 patient, procedure or process variables. (International Severity Information Systems, Inc. Salt Lake City UT.) Significant correlations to surgical wound infections were defined as $p \leq .05$ (Wilcoxon Rank Sums). Results confirmed accepted risk factors for surgical site infections such as longer incision to close time (p=.005), history of diabetes (p=.01), or increased severity index (p=0001). The study also identified factors that have not previously been well described: low admission albumin (p=.04), low maximum albumin during hospitalization (p=.0001), left ventricular end diastolic pressure in heart catheterization (p=.02), previous Myocardial infarction (p=.001), return to the operating room (p=.001), longer duration between CABG and postoperative activity (first incentive spirometer [p=.002], first dangle [p=.003], first up in chair [p=.005] & first ambulation [p=.004]), longer intubation time (p=.001), longer time on bypass pump (p=.04), cardioplegia solution temperature (p=.009) and volume (p=.003), use of postoperative diuretics (p=.03), and use of antiemetics postoperatively (p=.02). This information presents not only better predictors of infection, but adds new possibilities with specific CABG process variables that could be altered to reduce infection risk.

M31

Surgical Site Infections is Not Necessarily a General Catastrophe for Health and Social Welfare. *K. B. POULSEN and A. GOTTSCHAU, Statens Serum Institut, Copenhagen, Denmark.

A group of 1301 patients were interviewed by self-administered questionnaires at the time of a surgical intervention during hospitalization. They were followed up at least once at a median time of 5.5 and 10 months postoperatively. The consequences of Surgical Site Infection (SSI) diagnosed by a surgeon during admittance were analyzed for 58 infected and 648 controls. Postdischarge SSI were analyzed for 263 cases and 767 controls. Changes in health were measured by General Health Questionnaire, Activities of Daily Living index, self-assessed health and were analyzed by a random coefficient regression model. It was found that the long-term prognosis of general health was unaffected by SSI. We also investigated the consumption of resources from family and friends, the use of home services and number of contacts to general doctors. These data were analyzed by multiple logistic regression. Significantly increased social dependence was found for patients with SSI compared to uninfected patients. SSI did not cause excess visits to doctors, even that 15% were prescribed antibiotics for a presumed SSI. Most of the SSI were found only after discharge and were thought to be of minor importance, which may explain why no chronic impairment was seen for patients with SSI. The causal relations between outcome and SSI needs to be further investigated to find new preventable risk factors.

M32

PROPHYLAXIS OF NOSOCOMIAL INFECTION POST KIDNEY TRANSPLANT: CEPHALOTHIN *VERSUS* CEFOTAXIME

STARLING,C.; LASMAR,E.; SILVA H.; URBANO,E.; COUTO,B.
Felicio Rocho Hospital (FRH). Belo Horizonte, MG, Brazil

Objective: evaluate the efficiency of two different schemes of antimicrobiotics for prevention of infections in immediate (up to 30 days) post-operative(PO)of kidney transplant:Cephalothin (Group A)versus Cefotaxime(Group B).**Methodology:**prospective cohort study of patients (pts) who underwent a kidney transplant at HFR between July 1991 and Oct. 1996.The nosocomial infections(NI) were diagnosed according to the criteria and concepts of CDC1988-92.The patients of group A (171 pts) received cephalothin (1g every 2 hrs during operation and 1g every 4 hrs for 72 hours) and group B (127 pts) received cefotaxime (1g every 12 hrs for 72 hours). **Results:** 298 patients who underwent kidney transplant were evaluated. 83(27.9%)developed some type NI in PO.Of the 171 patients of group A, 70 of the exhibited NI (40.9%) while, in group B, of the 127 patients, only 13 (10.2%)exhibited NI (p-value < 0.0001).The patients of group A have 4 times the risk of getting NI when compared to the patients of group B: relative risk (RR)=4.0, with a confidence interval of 95% (CI) to RR = [2.32;6.90]. In regard to the severity of the patients operated on, classified according to the score of the American Society of Anesthesiology (ASA), 95% of the patients of group A were of ASA = 3 and 5% of ASA = 4, versus 91% of ASA = 3 and 9% = 4 in group B (p-value = 0.399). In regard to the surgical procedure, in group A an average of 4.5 hours (SD = 1.3) was observed and in group B 4.7 hours, with SD = 1.4 hours (p-value = 0.575).In multivariate analysis, the lenght of surgery was the only significant risk factor for NI, within the variables studied (ASA, length of surgery, age, wound classification, sex and prophylatic antibiotic).For each hour of the surgery, the risk of NI increases 1.7 times (NI = [1.29; 2.20]; p-value < 0.001).In this same analysis, the use of cefotaxime showed to be protection factor for NI:OR=0.2(CI=[0.80;0.35];p-value< 0.001).**Conclusion:**this study suggests that 3rd generation cephalosporin is significantly more efficient than cephalothin in the prophylaxis of NI in kidney transplant.The colonization of the vesicle and of the skin by microoganisms resistant to cephalothin could justify this difference.

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M35

Exposures to blood and body fluids (BBF) in acute care hospitals (ACH): different profiles when comparing infected vs uninfected source patients.

Robillard P[1,2], Roy É[1,2], Pineault M[1]. [1]Montreal Department of Public Health, Montreal, Canada. [2] McGill University, Joint Departments of Epidemiology, Biostatistics and Occupational Health.

Objective: To compare BBF exposures reported to employee health services (EHS) with respect to infectious status of source patients for HIV, HBV and HCV. **Methods:** A surveillance network was implemented in 20 ACH throughout the province of Quebec, Canada. Data on BBF exposures were collected by EHS through a standardized questionnaire and a software provided to network members and are transferred twice a year for analysis. Data presented here are from 10 ACH participating to the network for at least 6 months in the period ranging from 05/01/95 to 09/30/97. **Results:** 2380 significant exposures (needlestick, cut, scratch, bite, mucous membrane and non intact skin) were reported to the network. 1890 (79.4%) of these were to identified source patients. 1529 (80.9%) were tested for at last one infection (HIV, HBV or HCV) and 201 (13.1%) were infected: HIV (6.2%), HBV (4.1%), HCV (8.9%). The vast majority of infectious status were known at the time of exposure. For infected sources, the proportion of mucocutaneous exposures was higher (30.4% vs 11.8%, $p < 0.001$), the proportion of physicians was higher (14.0% vs 8.7%, $p = 0.014$) and the proportion was higher for hypodermic needles attached to IV line (15.6% vs 8.8%, $p = 0.009$). **Conclusion:** Exposures presenting a lesser risk of seroconversion (mucocutaneous and exposures to needles withdrawn from an IV line) are, in proportion, more reported to EHS when source patient is infected, reflecting perhaps a lesser degree of underreporting of these exposures motivated by fear. Physicians do not traditionally report their BBF exposures to EHS but appear to do it more when source is infected.

M36

Differences in reported occupational exposures to blood/body fluids by status of source patients. SCOTT CAMPBELL, PAMELA SRIVASTAVA*, DENISE CARDO, and the NaSH Surveillance Group. Centers for Disease Control and Prevention (CDC), Atlanta, GA.

While occupational exposures to blood are frequent among health care workers (HCWs), the differences in reporting occupational exposures by source patient (SP) status are not well understood. To assess these differences, we examined the following variables for exposures reported in six hospitals participating in the National Surveillance System for Hospital Health Care Workers (NaSH): occupation of exposed HCWs; type of exposure; and purpose of device, circumstances of injury and depth of percutaneous injuries. From June 1995 through December 1997, 1514 occupational blood/body fluid exposures (1229 percutaneous, 191 mucous membrane, and 94 cutaneous) involving known SPs were reported to NaSH. For 1175 (78%) exposures, the SP had negative/unknown serostatus for human immunodeficiency virus (HIV), anti-hepatitis C virus (HCV), and hepatitis B surface antigen (HBsAg); 339 SPs were positive for HIV (188), anti-HCV (205) and/or HBsAg (33). Most (154/1514 [82%]) of the 188 HIV-infected SPs had AIDS or were symptomatic for HIV infection. The 1514 exposures were reported by 681 (45%) nurses, 504 (33%) physicians, 184(12%) technicians, and 145 (10%) other occupational groups. Of the 504 exposures reported by physicians, 28% (143) involved exposures to infected SPs, compared with 19% (196/1010) for all other occupational groups. For all groups combined (including physicians), mucocutaneous exposures accounted for 27% (93/339) of exposures to infected SPs vs 16% (192/1175) for non-infected SPs, and percutaneous injuries described as superficial accounted for 46% (113/246) vs 35% (349/984), respectively. The percentages reported for purpose of device and circumstances of injury did not vary by SP status. The results were similar when analyses were restricted to HIV-infected SPs. Previous surveys have shown that HCWs consider perceived SP status and the relative risk of the exposure before reporting an exposure; these data suggest that HCWs are more likely to report lower-risk exposures if they involve infected source patients.

M37

Epidemiology of Needlestick and Sharp Injuries in a Children's Hospital.

*Nalini Singh-Naz, Marie-Michèle Léger and Jeanette Morris. Children's National Medical Center, The George Washington University, Washington DC

Background: Needlestick and other sharp injuries are important Occupational Health injuries. Contaminated needlestick and sharp injury can transmit bloodborne pathogens to the health care worker. This study describes the epidemiology of needlestick and sharp injury over a five year period in a Children's Hospital.

Method: For the five year period (1992-1997) all cases of needlestick and sharp injuries were reviewed. All employees complete the incident report at the time of injury. Data was entered in Epi Info 6 and in EPINET data base.

Results: Two hundred and ninety seven injuries were reported for an average of 5 injuries per 100 employees per year. The highest number of injuries occurred in nurses (36%), residents and fellows (18%), attending MDs (15%), technologist (7%) and phlebotomists (5%). Most of these injuries occurred during drawing blood (20%), surgery (19%), delivery of medication (14%), and starting of IV (14%). Device associated injury were with the needle with disposable syringe (34%), butterfly needle (17%), surgical instrument (15%) and IV stylet (11%). Most injuries occurred in patients room (34%), operating room (22%), treatment room (14%), and in laboratory (9%). These injuries occurred during the transit for disposal (14%), sharps left in inappropriate place (12%), while placing in sharp container (7%) and recapping (6%). All employees received counseling and post-exposure prophylaxis was offered. Preliminary data of the source patients revealed 6% positive for HIV and no seroconversion to date in our employees.

Intervention: During the study period the needleless IV system and full service sharp management program providing prompt, regular removal and replacement of sharp container was implemented in 1994. Needlestick /exposure hotline was introduced in 1997.

Conclusion: Prompt and appropriate disposal of sharps will significantly reduce the rate of injury in health care workers. Prompt and regular removal of sharp containers helped to reduce the injury during disposal into overfilled sharp container.

M38

Findings from the Human Immunodeficiency Virus (HIV) Postexposure Prophylaxis (PEP) Registry: PEP Following Occupational HIV Exposure. *SUSAN A. WANG AND THE HIV PEP REGISTRY GROUP, CDC, Atlanta, GA

In the June 7, 1996, *Morbidity and Mortality Weekly Report*, the Public Health Service recommended the use of combinations of antiretroviral agents as PEP following certain occupational HIV exposures. Except for zidovudine, there is little information on the use or toxicity of antiretroviral drugs in persons not infected with HIV. The HIV PEP Registry was established by CDC, Glaxo Wellcome Inc., and Merck & Co., Inc., to collect information about the safety of taking antiretroviral drugs for HIV PEP. The Registry confidentially collects data on any health-care worker (HCW) who takes HIV PEP and who agrees to enrollment in the Registry through a health-care provider. From October 17, 1996, through August 10, 1997, 85 HCWs were prospectively enrolled in the Registry. Sixty-eight percent (58/85) of the PEP regimens prescribed for these HCWs consisted of at least three antiretroviral agents. Of the 53 HCWs for whom 6 week follow-up was available, 25 (47%) completed the prescribed PEP regimen, while 24 (45%) discontinued at least one PEP drug, and the remainder finished modified regimens. Of the 24 HCWs who discontinued at least one PEP drug, 17 (71%) stopped because of side effects attributed to PEP and 3 (13%) stopped because the source patient was determined to be HIV negative. Overall, 46 (87%) HCWs with follow-up reported some symptoms while on PEP: nausea (62%), fatigue or malaise (47%), vomiting (23%), diarrhea (13%), headache (11%), and fever (8%). The Registry is an important instrument for collecting data relevant to HIV PEP. Health-care providers are encouraged to enroll HCWs who take HIV PEP by calling 888-PEP-4HIV.

M39

Use Of Rapid HIV Test To Expedite Post-Exposure Prophylaxis (PEP) P.KELLER BSMT MS CIC, L.GRAHAM RN BSN COHN, L.KEHLER RN BSN, S.BORNGESSER BSMT, M.B.SNYDER MD*, Sinai Hospital, Detroit MI.

Use of a rapid test (SUDS) to identify the HIV status of each known sourceptient (pt) involved in an occupational exposure (occexp) to blood or body fluid was initiated on 12/1/96. Only employee health (EHS) and ER have the ability to order SUDS tests. SUDS (sensitivity 99.9%, specificity 99.6%) was chosen because PEP for HIV should ideally be initiated within 1-2 hours of exposure, and patient risk factors for HIV infection have shown poor correlation with results of HIV tests in cases of occexp. CDC recommendations were modified to eliminate reference to viral titer of sources, since that information is not always readily available. The decision to offer PEP (4 weeks of ZDV 200 mg TID, 3TC 150 mg BID, ± Indinavir 800 mg TID for increased risk exposures) is based on the severity of exposure and the results of source pt SUDS test. PEP had not been available to our employees before this time. 185 occupational exposures were reported between 12/1/96 and 11/30/97, compared to 146 reported in '96. 16 sources were not available for testing due to late reporting by exposed employees or pt refusal. The source was unknown in 20 cases. 148/164 known source patients were tested. 3 source patients were HIV positive by SUDS, and an additional source patient was known HIV+. All 4 employees exposed to HIV and 5 employees exposed to an unknown source elected PEP. No employee converted. Most occexp were reported promptly, but documentation and follow-up in EHS need improvement.

Conclusion: Use of a rapid test to identify HIV infection in source patients after occexp provides an effective and timely method of identifying which employees should receive PEP after occexp, and helps to relieve employee fears.

M40

Impact of an Hepatitis B Vaccination (HBv) Program for Health Care Workers (HCW) in Pediatric Hospital.

*GENTILE A, MAN C, ZOCCHI G, AMADO M, BICA C, DEL VALLE H, ROSEMFELD N, LAMY P. Htal. de Niños R. Gutierrez. Bs.As. Argentina

Hepatitis B vaccination program for HCW is a main component of biosafety. To evaluate the efficacy of HBv in HCW and to detect the risk factors associated with lack of schedule compliance we conducted a cohort study in a pediatric hospital in 1991-1997 period. A 0-1-6 HBv schedule was offered; AntiHBs titers ≥10 mUI/ml (ELISA) were considered protective and those ≥100 mUI/ml were consider hiperresponsive. It was analized age, sex, occupation, years of working, and the vaccination schedule compliance according of Ministry of Public Health (MPH) rules. We vaccinated 1327 HCW, 76% of them (1008/1327) achieved the Hbv schedule. Immunogenecity was measured in 61% of vaccinated HCW (615/1008) seroconvertion occurred in 89.3% (549/615), mean AntiHBs titer was 168.2 mUI/ml (10.1-869.7 mUI/ml). Hiperresponsiveness was observed in 72 % (395/549). Risk factors associated with the lack of the vaccine response were: ≥7 yrs of HCW working RR=2.11 (1.343.32), p=0.001 ; age ≥40 yrs RR=2.33 (1.49-3.65) p=0.0003 and nurse job RR=1.79 (1.11-2.87) p=0.002. 8.5% f HCW (52/615) failed to comply the MPH interval rules between 1st and 2nd dose (X=379.7 days, 91-1642 days) and the 19.2% of HCW (118/615), failed to comply the interval between 2nd y 3rd dose (X=290.8 days, 181-1795 days) but no significant difference were observed in both groups related to AntiHBs mean and range titers and the of hyperresponsiveness. 15.8% (210/1327) of HCW fail to comply the vaccination schedule, occupation was the only risk factor associated: odontologic and surgical nurses RR=2.20 (1.43-3.40) p=0.002 and maintenance workers RR=2.89 (1.70-4.93) p=0.003 were the high risk groups. An Hbv program allows to detect risk factors and to modify the future attitudes.

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M41

Preventing Disease Transmission: Evaluation of a Non-reusable Syringe. AD ROSENBERG, GD ROSENBERG, *EH TOBIN, LR KRILOV, LI GOOD, Hospital for Joint Diseases and New York University School of Medicine, New York, NY, Albany Medical College, Albany, NY, North Shore University Hospital, Manhasset, NY, Health Sciences Center SUNYat Stony Brook, Stony Brook, NY, UNIVEC, Garden City, NY

Reuse of conventional disposable syringes (CDsyrs) is associated with transmission of blood-borne pathogens. A non-reusable syringe (syr) containing a patented locking mechanism (Univec® safety locking syr (USLsyr)) was evaluated by 46 physicians and health care workers (HCWs) attending an annual anesthesiology conference (San Juan, PR, USA). Results of a confidential questionnaire regarding syringe reuse were analyzed after respondents compared characteristics of the USLsyr to CDsyrs. In a side-by-side comparison 98% found the USLsyr comparable to CDsyrs with respect to handling, feel, size and plunger movement. Of all respondents, 95% believed that the use of the USLsyr could prevent syr reuse among HCWs. Forty-three percent of the respondents indicated that they had reused CDsyrs from one patient to another in the past 5 years. Of the CDsyr reusers, 100% indicated that the USLsyr would prevent reuse. Of all respondents, 96% believed there might be (60% strongly) a role for the USLsyr in preventing reuse among intravenous drug abusers (IVDA). Respondents see a role for the USLsyr in needle exchange programs (80%), immunization programs (75%), clinics (71%), private offices (61%) and hospitals (77%). The results suggest that the USLsyr is comparable in handling characteristics to existing syrs and can be effective in decreasing reuse of syrs by HCWs and IVDA.

M42

Eliminate Rubella: Screen and Evaluate (ERASE): A Community Program to Ensure Rubella Immunity (RI) For Health Care Workers (HCWS) in Obstetrical (OB) Practice Settings. TIMOTHY W. LANE, MARIA LOGAN, WILLIAM GRUCHOW, CHARLES J. HANSEN. UNC-Chapel Hill, Moses Cone Health System (MCHS), and the UNC-G, Greensboro, NC.

Despite CDC and ACOG guidelines recommending RI for HCWs, few states require or enforce documentation of RI (DRI). As a result rubella and its sequela continue to occur in the general population and HCWs. We previously conducted a national survey of >1,500 OB MDs in the US (Infect Control Hosp Epidemiol, 1997;18(9):633-36.) regarding knowledge of their own RI and RI policy for HCWs in their practice setting. Twenty % of responding OBs did not have DRI and 66% of their practices had no policy for documenting HCWs RI. Because of the lack of RI programs in practice settings, we developed an educational program to help eliminate rubella by serologic screening and evaluation (ERASE) for private office-based OB practices in a mid-sized city of 200,000 in NC. Of 13 OB practices, 8 agreed to participate in the ERASE program; 3 practices required RI of their HCWs and were excluded. Two of the practices without RI programs refused participation. Rubella serology was provided as a free service by the IC Program of the MCHS and vaccinations were provided at cost. A total of 111 HCWs were evaluated: 58 HCWs (52%) had prior DRI by vaccine certification or positive serology; 53 HCWs (48%) did not have DRI. Characteristics associated with prior DRI ($p<0.05$) by X^2 were age <40 and female gender. Forty-eight of the 53 HCWs without DRI agreed to serologic screening and 7 of 48 (15%) were seronegative. Six of these 7 agreed to vaccination but one female HCW refused citing concern over adverse effects. Of the 16 male MDs participating, only 3 had prior DRI and 5 of the 8 without DRI refused serologic screening. All 4 female MDs had prior DRI. The ERASE program evaluated 111 HCWs in office-based OB practices and successfully documented or provided rubella immunity for 106. Seven HCWs, 15% of those screened, did not have RI and 6 accepted vaccination. Male MD HCWs were the least cooperative in this program but agreed that their practice employees should have RI. Lack of DRI was common for all types of HCWs in the evaluated OB practices. Health care epidemiologists and institutional-based IC programs should consider extending such programs beyond their traditional "walls."

M43

AN ANALYSIS OF OCCUPATIONAL EXPOSURES TO BLOODBORNE PATHOGENS IN A SAUDI HOSPITAL. JOLLEY BETTY-ANN, MAHON INEZ, AHEMD HANAN, AL QAHTANI MOHAMMED AND MEMISH ZIAD*. KING FAHAD NATIONAL GUARD HOSPITAL(K.F.N.G.H). KINGDOM OF SAUDI ARABIA.

K.F.N.G.H. is a 540-bed tertiary care hospital serviced by workers from 52 countries. Percutaneous or mucutaneous occupational exposure(s) are assessed for risk of transmission of HIV, Hepatitis B(HB) and Hepatitis C(HC). This retrospective study was done between July 1, 1996 to July 1, 1997. Data was collected on EPIN^{nt} 1997 report forms. Analysis was done using Epi Info Version 6.0. There was a total of 87 exposures(percutaneous=76), (mucutaneous=11). Mucutaneous exposures were not analyzed.Common workers exposed were RN(41), MD(10)and housekeepers(7). Frequent exposures occurred in ICU(16), pt. room(15), O.R.(12), labour and delivery(10). Sharp items causing injury: unknown (27.6%); skin injection, venous stick, suturing (each 11.8%), and IV start(9.2%). 50% of injuries occurred during use; 11.8% from inappropriate disposal. Alarmingly, the injured worker was the original user in only 56.6% of exposures. Common items were syringe & needle(20%), suture needle(13.3%) and unknown needle type(12%). Common sites were underside Lt. Index finger(17%), underside Rt. Index finger(14.1%) and underside 3rd finger Lt. hand(12.7%). Serology follow-up was not required in 48 exposed workers. Serology follow-up required: HIV + HC(12), HIV(7), HC(5), HB(1), HIV+HB+C(1) and unknown(2). There have been no known conversions to any pathogens(maximum time post-exposure=6 months). Our percutaneous injuries/100 beds/year are below the 1997 EPIN^{nt} U.S. rates(15.2 vs. 27); also our mucutaneous injuries(2.2 vs. 5.2). Under-reporting of occupational exposures are a well-known phenomenon. Our high percentage of sharps causing injury in the which the original use was unknown and the injured worker being the original user in 56.6% of exposures suggests that improper disposal of sharps is common. Strategies to promote the appropriate use and disposal of sharps hospital-wide are indicated. Although our sample size is small, it is representative of 52 countries and excluding the high percentage of unknown sharps causing injuries has strong associations with large EPNI^{nt} studies done in U.S.(1995), Italy(1994), and Spain(1997). Our on-going prospective study for sharps injury and blood and body fluid exposure will evaluate our intervention strategies.

M45

Nosocomial Infection Surveillance in a Newborn Nursery: Evaluation after Two-Years. *B COIGNARD, B GRANDBASTIEN, N KACET, Y BERROUANE, P LEQUIEN, JL SALOMEZ, Lille University Hospital, France.

Introduction: The newborn nursery service of our hospital introduced nosocomial infection (NI) surveillance, a clinical, active, continuous, and prospective process, in June 95. We evaluated this surveillance system (SVS) after 2 years. Methods: We followed the CDC guidelines [1] for evaluating surveillance systems (SVSs). To document the real operation of and the perception about the SVS, an anonymous questionnaire was distributed to the service physicians involved in the SVS. Sensitivity was assessed by retrospective review of 120 randomly sampled charts. NI incidence secular trends were studied using time-series analysis on laboratory data before and after the SVS introduction. Results : 1- Pertinence: The population surveyed had intrinsic risks. 55% of infants were hospitalized before the 7th day of life with a median gestational age of 34 weeks and a median birthweight of 1970 g. Extrinsic risks included vascular catheter (38% of infants), and ventilation (31%). The NI incidence density was 11 [10-12] per 1000 patient days overall. 2- System operation: The surveillance form (4 pages, filled out by physicians daily and validated by the infection control (IC) nurse weekly) has been judged clear. The IC nurse coordinated the information transmission between three levels (service, laboratory, and IC unit) in a simple and standardized way. 3- Usefulness: laboratory-based NI incidence decreased by 20% after the SVS was introduced. 4- Sensitivity: 79% [60-94] 5- Accuracy: Admission and discharge dates were accurate in 96% of the SVS forms, gestational age in 94% and birthweight in 89%. 6- Acceptability of the SVS has been rated good, being reinforced by regular feed-backs with posters displayed in the service. 7- Timeliness: The mean delay between occurrence of a NI and data entry was 3 months, and another 3 months before dissemination of the information to clinicians. Conclusion: The SVS has met its objectives: it is well accepted and the data quality has been validated. The SVS may have contributed to the decrease in NI incidence. Timeliness should be improved. Through this evaluation, all the system procedures had been documented. Evaluation may be routinely integrated to any NI surveillance system, to validate data which ultimately may be used in practice audits or accreditation procedures.

[1]: MMWR, 1988;37(S5):1-18.

M46

Nosocomial Infection Rates in Pediatric Intensive Care Unit in a Tertiary-Care Hospital in Brazil. MARCELO L. ABRAMCZYK, EDUARDO A.S. MEDEIROS, MAVILDE P. SILVA, RENATA MANTOVANI, VALERIA M. MOTA, ELISA HALKER, WERTER B. CARVALHO, EDUARDO S. CARVALHO. Escola Paulista de Medicina, Univ. Federal de São Paulo, Brazil.

Patients hospitalized in pediatric intensive care units are at high risk of developing nosocomial infections. Information on incidence, morbidity and mortality caused by nosocomial infection is essential to define the burden of illness in order to determine priorities for intervention and to measure the impact of control measures. **Objective:** To determine the epidemiology of nosocomial infections in pediatric intensive care unit (ICU). **Methods:** Data collected from 04/1996 to 06/1997 in the pediatric ICU component of NNIS system were used in this analysis. All patients in pediatric ICU were surveyed for nosocomial infections at all sites from the day of ICU admission until 48 hours after ICU discharge, if hospitalized, or until ICU discharge, if transferred from hospital. Nosocomial infection were defined using standard Centers for Disease Control definitions. For calculation of infection rates, denominator data included the total number of patients, the total number of patient-days in the ICU, or total number of urinary catheter, central line or ventilator-days per month. **Results:** Between April 1, 1996, and june 30, 1997, 405 patients were admited. The median overall nosocomial infection rate was 17,53%. When patient-days was used in the denominator, the nosocomial infection rate was 44.02 infections per 1,000 patient-days. The distributions of nosocomial rates were: 2.38 urinary tract infections per 1,000 catheter-days, 12.88 bloodstream infections per 1,000 central line days, 15.61 pneumonias per 1,000 ventilator-days. The crude mortality rate due nosocomial infection was 30.98%. The etiologic agents were *Candida* spp.(20%), *S. epidermidis* (7,5%), *K. pneumoniae* (17,5%), *A. baumannii* (12,5%), *S. aureus* (12,5%), *Enterococcus* spp. (5%), *Enterobacter* (5%), *E. coli* (7,5%), *P. aeruginosa* (7,5%), *Citrobacter* (2,5%), *Proteus* (2,5%). **Conclusion:** We have documented a substancial incidence of nosocomial infection in the pediatric ICU. Pediatricians should be familiar with the nosocomial infection rates and pathogens in the patients for whom they care and should familiarize themselves with the means of prevention and control.

M47

Risk Factors Associated With Acquisition of Multiresistant *Klebsiella pneumoniae* on a Neonatal Intensive Care Unit. WIL C. VAN DER ZWET, GERARD A. PARLEVLIET, PAUL H.M. SAVELKOUL, JOHANNES G.M. KOELEMAN and CHRISTINA M.J.E. VANDENBROUCKE-GRAULS. University Hospital Vrije Universiteit, Amsterdam.

Between August and November 1997, a nosocomial outbreak caused by multiresistant *K. pneumoniae* occurred in the Neonatal Intensive Care Unit (NICU) of our hospital. Twelve neonates became colonised and comparison of the isolates by Amplified Fragment Length Polymorfism revealed clonal similarity in 8 isolates (homology > 90%). We conducted a case control study to identify risk factors associated with acquisition of multiresistant *K. pneumoniae*. Hospital records of 24 patients were reviewed. A case patient was defined as any patient in the NICU who was colonised with the multiresistant Klebsiella. Control patients were admitted on the NICU in the same period and had at least one negative culture for *K. pneumoniae* of sputum, throat, anus or perineum. No single person of medical staf or nurses was significantly more involved with cases than with controls. Also there were no significant differences between cases and controls for Apgar score, type and duration of mechanical ventilation and intravascular catheters, and diagnostic procedures such as echoscopy. The following risk factors were identified:

risk factors	cases (n=8)	controls (n=16)	OR (95% C.I.) or p value
Mean gestational age (w)	29.05	34.36	p = 0.002
Mean birthweight (g)	1155	2210	p = 0.003
Birth-weight < 1500 g	6	3	OR= 13.0 (1.7-99.4)
Total stay in NICU (d)	22.4	9.5	p = 0.025

In conclusion: a single clone of multiresistant *K. pneumoniae* caused a nosocomial outbreak in the NICU. The cases had a lower gestational age and birth weight. These neonates need more care and handling and are therefore more at risk for colonisation.

M48

Patient to Patient Transmission *P. aeruginosa* (PA) in a Neonatal Intensive Care Unit (NICU). *MARYANN BORDNER, CYNTHIA J. WHITENER, PAMELA K. RICKERT, Penn State Geisinger Health System, Hershey Medical Center, Hershey PA

In November 1997, three patients were identified with PA in the NICU. Two had tracheal aspirates (TA) positive for PA (one had a blood stream infection (BSI) and the 2nd subsequently developed a BSI), the third patient had PA isolated from a TA and a chest tube wound. A review of BSI data revealed another (index) case in September 1997 and another patient subsequently developed a BSI bringing the total to 5 cases (4 BSI) within 10 weeks. An epidemiologic investigation was initiated focusing on respiratory issues since all patients were intubated and PA was isolated from respiratory sites. Hospitalized infants were cohorted and infection control practices reinforced. The frequency of PA in the NICU from all sites did not show an increase (95-97) and PA from BSI was infrequent.

	J-D92	J-J93	J-D93	J-J94	J-D94	J-J95	J-D95	J-J96	J-D96	J-J97	J-D97
No. BSI	0	0	1	0	1	0	0	0	3	0	4

Staff interviews failed to identify new procedures or equipment changes, alterations in the frequency of ventilator changes, or new water sources over the past 24 months. Staffing patterns indicated different attending and resident staff, but both respiratory therapy technicians and nurse practitioners changed equipment or performed procedures on all infants. Nurses are frequently "paired" with two or more infants during a shift and a review of these staffing patterns indicated "pairing" of infected infants within 2 weeks before the first PA isolate. Isolates were available from all but the index case and pulsed field gel electrophoreses (PFGE) revealed an identical pattern in 3 patients indicating probable patient to patient transmission. The index case was admitted from another hospital and had a TA positive for PA on the 2nd hospital day. We believe this community isolate may have represented a more virulent strain and once introduced into the NICU environment was transmitted to other patients, however isolates from this patient were not available for PGFE analysis and this theory remains unproven. Limited environmental cultures failed to identify PA. The investigation is ongoing.

M49

Nosocomial Infections in HIV infected children: preliminary results. PEDROSO A, RAMALHO MO, FONSECA MO, SAAD CA, RITCHMANN R, ABREU, ES, OLIVEIRA, A, CAVALCANTI NJF. Instituto de Infectologia Emilio Ribas, Sao Paulo, Brazil.

Background: there are few reports about nosocomial infections(NI) in HIV patients, specially in pediatric populations. To describe the role of NI, the incidence of infections by site and distribution of pathogens in pediatric HIV/AIDS subjects, we conducted a prospective cohort study in a Brazilian referral infectious diseases hospital (220 beds; 58 pediatric beds).

Setting/patients: all pediatric inpatients from January/ 95 to August /97 were enrolled. NI was notified according to CDC definitions.

Results: During the study period, a total of 1519 non-infected and 766 HIV-infected children were admitted at the hospital . Most of the HIV- infected children had AIDS The overall incidence rate of NI was 298/2285 (13%); the NI rates were 145/ 766 (18%) and 153/ 1519 (10%) for HIV positive and HIV negative patients, respectively [Odds ratio = 2.08, 95% Confidence interval 1.62 – 2.69 (p< 0.00000001)] . The most common infections were pneumonia [39/ 145 (26.9%)], bloodstream infections (BSI) [37/ 145 (25.25%)], cutaneous infection [23/ 145 (15.9%)], urinary tract infections (UTI) [21/ 145 (14.5%)] and otitis [09/ 145 (6.2%)]. We recovered 57 etiologic agents from 145 NI (39.3%). The most common agents recovered were *S.aureus* [16/ 57 (28.1%)], coagulase-negative staphylococci (CNS) [10/ 57 (17.5%)], *E. coli* [09/ 57 (15.8%)] and *Acinetobacter sp* [05/ 57 (8.8%)]. The most common found agent in BSI was CNS [9/ 23 (39.1%)] followed by *S.aureus* 6/ 23 (26.1%)

Conclusions: this study shows a greater risk of NI acquisition among HIV-infected patients in pediatric setting. Diversely from previously published data on NI in adults HIV-infected patients, the most common infection was pneumonia followed by BSI and the most common agent was CNS.

M50

Bloodstream Infections in Neonatal Intensive Care Unit Patients with Central Catheters. *DENISE F. BRATCHER, JUDY A. WRIGHT, and BETH H. STOVER, University of Louisville and Kosair Children's Hospital, Louisville, KY.

A prospective study of central catheter (CC) insertions was undertaken to define the scope of bloodstream infections (BSI) among 400 consecutive neonatal intensive care unit (NICU) patients having CC insertions from August 1995-March 1997. There were 150 BSI in 107 (27%) patients (62/257 male, 45/143 female). Twenty-nine patients had 2 BSI; 15 patients had 3 to 5 BSI. Of 120 infants whose birthweight (BW) was ≤1000 grams, 63 (53%) developed BSI. BSI occurred in 50% (5/10) of infants with BW ≤500 grams, and 60% (34/57) of the 501-750 gram BW infants. Of 91 patients whose gestational age was ≤26 weeks, 48 (53%) had BSI. Among BSI patients, the primary diagnosis included: prematurity (68), gastrointestinal or genitourinary abnormality (15), congenital heart disease (8), or other (16). Umbilical artery catheters represented the largest number of CC (292); only 19 (7%) were associated with BSI. The most common CC type associated with BSI was the percutaneous CC--60 BSI in 231 (26%) insertions. CC types at time of first BSI included 47 percutaneous CC, 19 umbilical artery catheters, 5 subclavian, 4 umbilical venous, 4 arterial, 2 jugular, and 1 femoral catheter. At time of first BSI, 55 patients had 1 CC present, 34 had ≥2 CC, while 25 infants had peripheral intravenous catheters (PIV). Total CC days at first BSI was ≤7 among 12 patients, 8-21 days in 54 patients, and 22-84 days in 41 patients. Age at onset of first BSI was ≤28 days in 83 infants. Coagulase-negative staphylococci were recovered in 109 BSI episodes, 75 of which were present at first BSI. Other pathogens included: S. Aureus, enteric organisms, and Candida species. Characteristics of NICU BSI patients included very low BW, percutaneous CC, PIV, and age ≤28 days. Stratification of NICU BSI should include BW ≤500 grams, BW 501-750 grams, number of CC present at BSI onset, and CC type.

M51

Case-Control Study of Candidemia vs. Bacteremia in a Neonatal Intensive Care Unit. *ADILIA WARRIS, BEN SEMMEKROT, ANDREAS VOSS, University Hospital St. Radboud, Nijmegen, The Netherlands.

Background. Risk-factors for the development of bloodstream infections (BSI) due to *candida* species are soundly documented, especially in the adult patient population. In general, the diagnosis of *candidemia* is problematic. Furthermore, the differential diagnosis between fungal and bacterial BSIs in neonates is cumbersome. *Objective.* Aim of this case-control study was to retrospectively identify potential risk factors of *candida* BSIs in preterm infants with proven fungal or bacterial BSIs. *Methods.* All infants admitted to our NICU in 1997 with clinical signs of sepsis and at least one bloodculture or CSF-culture positive for *candida* species served as "cases". Infants who developed a bacterial BSI (excluding potential contaminants such as *Staphylococcus epidermidis*) and were admitted in the same week as a case, were included as controls. In total 6 cases and 12 controls were available. *Results.* Case patients were significantly more premature than controls (mean gestation 27.7 vs. 29.3 wks). Regarding the antibiotic treatment before onset of BSI, cases received significantly more antibiotics of different classes (mean 4.2 vs. 1.6 classes) and were treated for a longer period (mean 16.7 vs. 3.8 days). Case-patients were ventilated more intensive than controls and were longer admitted to the NICU before onset of the *candidemia* (mean 21.7 vs. 9.4 days). Remarkable was a higher CRP-level in the case-patients (mean 78.5 vs. 61.9 mg/l). All the cases had a serious thrombopenia. No differences were seen in regard to: birth-weight, usage of central venous catheters, total parenteral feeding, white bloodcell count and mortality. *Conclusion.* Systemic *candida* infections must seriously be expected in the third week of admittance. It seems to be a disease of the most premature neonates and is associated with prolonged treatment with different classes of antibiotics and intensive artificial ventilation before onset of the *candidemia.*

M52

Neonatal Bacteremias: Impact of a Epidemiological Surveillance Program. Enfedaque C, Gentile A*, Del Valle H, Procopio A, Durante A, López E, Rivas N. Hospital de Niños Dr R. Gutierrez. Buenos Aires Argentina.

Epidemiological surveillance is an important component of the nosocomial infection program. We conducted a prospective study in a Neonatal Intensive Care Unit (NICU) in a terciary pediatric hospital, to stablish an epidemiologic diagnostic situation and to carry on control measures. Between april 1995 and november 1997, we studied all patients with nosocomial infections (NI), specially bloodstream infection (BSI) according the NISS criteria. We discussed the results at the Hospital Nosocomial infection Commitee and NICU. No changes were found in the NI rates:1995, 38/2619 (14.5%o),1996, 52/3489 (14.9%o), 1997, 45/3111 (14.46%o). We studied 137 NI episodes, 68/137 (49.6%) were BSI, 22 of them were central lines associated .Since 1996, the central lines BSI rates decreased significantly (1996:6/967, 6.2%o, 1997, 6/1036, 5.79%o vs. 1995, 9/570, 15.8%o p:0.001. We obtained blood samples in all patients, in 95 % of central lines the cultures were positive. Gram positive coccus were prevalent: 11/21 (52.4%), *Candidas*: 6/21 (28.5%) p=0.05 RR 3.6 (1.3-13.01) and gram negative bacilli: 4/21 (19%) p=0.009 RR 3.04 (1.21-7.65). In no associated central line BSI, gram negative bacilli were prevalent: 22/38 (57.9%). The most frequent microorganism central line BSI were coagulase negative *Staphylococcus* 8/21 (38.1%), *Candidas* 6/21 (28.6%) and multiresistant *Klebsiella pneumoniae* 3/21 (14.5%). In no associated central line BSI, *Pseudomonas* 8/38 (21%) were more prevalent (4/8 were *P. aeruginosa*), three of them were carbapenems resistant. Multiresistant *K. pneumoniae* was the second agent: 7/38 (18.4%). *Staphylococcus aureus* were 6/38 (15.8%). No risk factors were found in relationship between central and no central lines associated BSI. The mortality rate of BSI,central line associated BSI was 18.2% and no central line associated BSI was 23.9%, higher than NICU's total mortality rate:13.68%.Conclusions: Near fifty percent of our NI were BSI, the epidemiological surveillance was effective in decrease them after 1996.

M53

Tuberculosis Exposure in a Level III Neonatal Intensive Care Unit C.OXLEY, *C.KENNELLY, L.SUNG, L.SAMSON,T.BOWMAN, D.DAVIS, B.TOYE Ottawa General Hospital and Children's Hospital of Eastern Ontario.

Published reports of tuberculosis exposure and transmission in a pediatric population are rare. We describe the investigation and follow-up of infants in a 29 bed Level III Neonatal Intensive Care Unit (NICU) after exposure to a clinician with smear negative active pulmonary tuberculosis (T.B.). While working in the NICU, the health care worker (HCW) had been symptomatic with cough and hemoptysis and two weeks later a diagnosis of T.B. was confirmed. Since the determinants of transmission of T.B. are not completely understood, especially in this high risk population, a multi-disciplinary team was assembled to plan a response. In the absence of published guidelines, infants were considered "exposed" if either of the following criteria were met: 1. direct examination or resuscitation by the HCW 2. accommodation in an open cot in the unit. This information was obtained by extensive chart review and interview with the infected HCW. Of a total of 26 infants, 17 were considered exposed. Although the HCW was smear negative, with the increased risk of disease acquisition and mortality in premature infants, it was decided that INH prophylaxis would be recommended for those infants who met the criteria for exposure. Parents were contacted personally by the neonatologist and the potential seriousness of the situation was discussed. A direct liaison was made with the Children's Hospital of Eastern Ontario to establish clinics for initial and follow-up visits to monitor drug toxicity and compliance and to provide family support . After 3 months, INH therapy has been well tolerated by these young infants and to date, none have been identified to have T.B. infection or disease. This investigation underscores the importance of maintaining regularly scheduled and appropriate testing for T.B. infection for ALL HCWs and the need for HCW education regarding risk factors and clinical signs and symptoms of T.B. disease. It also demonstrates the difficulty of defining an exposure to T.B. in a population where there is significant morbidity and mortality.

M54

Observational Study of Infection Control Practices of Pediatric Health Care Workers (HCWs) Caring for Children with Suspected Tuberculosis (TB). *LISA SAIMAN, MILAGROS SOTO-IRIZARRY, PABLO SAN GABRIEL, SCOTT KELLERMAN, and WILLIAM JARVIS, Columbia University, New York, NY and CDC, Atlanta, GA.

To assess compliance with recommended infection control practices of pediatric HCWs caring for children admitted with suspected TB, we conducted an observational study from May 1996 to September 1997. Sixteen patients (mean age 9.7 yrs) were observed and 11 (69%) were placed in respiratory isolation for suspected TB at the time of admission. The diagnosis of TB was considered a mean of 12 days after admission in five patients. "Respiratory Isolation" signs were placed on all doors when the diagnosis of TB was suspected. Patients had 181 visits by HCWs (including 68 nurse and 55 physician visits) and 83 visits by family members during 122 hours of observation. Visitors closed doors promptly during 65% of all visits, but left doors inappropriately open an average of 13.9 minutes during the remaining visits. The hospital approved TB mask was worn during 127 HCW visits, but was worn incorrectly during 27 (21%) of these visits. The most common errors were improper placement of straps (18), use of one strap (5), and use of no straps (4). No mask was worn during six HCW visits. Professional staff was somewhat more likely to wear the appropriate mask correctly than ancillary staff [RR = 1.26 (0.95 < RR < 1.67)]. Only three children left their rooms during the study for medical procedures and two wore appropriate masks. Despite construction of a negative pressure room and a train-the-trainer fit test program, non-compliance with appropriate infection control practices for TB occurred. Automatic door closures, ongoing staff education regarding appropriate mask use, and education of families might improve compliance.

M55

"Bread and Butter" Infection Control (IC) Measures Decrease Nosocomial Infection (NI) Rates in a Neonatal Intensive Care Unit (NICU) in Ribeirão Preto, Brazil, as Measured by the National Nosocomial Infections Surveillance (NNIS) System. *SILVIA N. S. FONSECA, TÂNIA A. BERNARDES, SUELI DE ALMEIDA, M. CRISTINA MENEGUCCI, ATAIDE CAMARA, LUIZ SCATENA. Maternidade Sinhá Junqueira, Ribeirão Preto, SP, Brazil. It is sometimes difficult to measure the impact of IC measures in NI rates using conventional denominators such as 100 admissions or discharges. We describe here our experience with the NNIS system, before and after simple IC measures were established in a well-equipped 9 bed NICU. Daily surveillance for NI was done by the NICU attending pediatricians, using the Centers for Disease Control and Prevention (CDC) definitions, starting on September 1996. In March 97, the newly created department of IC was asked to help because the February NI rates were three times higher than the previous month in the <1,500 g birthweight (BW) group. Several basic IC measures were implemented then including routines for cleaning, disinfection and sterilization (when appropriate) of all equipment in contact with the NB, individual thermometers, stethoscopes, disposable one-use endotracheal suction tubes, single sterile saline vials for endotracheal suction, disposable single use sterile distilled water bottles for the ventilators, routine use of sterile techniques for invasive procedures, reinforcement of handwashing and universal precautions. We compared the mean NI rate (denominator:1,000 pt-days) in the BW group <1,500 g and in all BW groups in two periods: period I (September 96 to March 97) and period II (April 97 to October 97). We adjusted the NI rate to average length of stay (adjusted NI rate). The mean NI rate in period I in the BW group <1,500 g went from 59.64 in period I to 41.5; the adjusted mean NI rate went from 3.99 to 1.72 ($p< 0.05$). The mean NI adjusted rate for all BW groups went from 14.13 in period I to 4.65 in period II ($p< 0.05$). Even in months with high device-utilization rates (August, September 97), the correspondent NI rate was much lower compared to the period before the IC measures were implemented. We concluded that in our sophisticated NICU many simple ("bread and butter") IC measures were not done. The implementation of simple IC measures was of striking importance in decreasing the NI rates. Lifesupporting equipment is considered important in setting up a NICU but IC strategies are often overlooked. The NNIS system was important to demonstrate these findings to all hospital administrators and NICU staff.

M56

Application Of A Clinical Care Improvement Model To Improve Isolation Practices On A General Pediatrics Ward. A. GUTTMANN, J. GUOLO, J. PONSONBY, L. STREITENBERGER, M. WILLIAMS and *A. MATLOW, The Hospital for Sick Children and the University of Toronto, Toronto, Ontario.

Nosocomial infections develop in part due to the failure to practice routine infection control measures. Isolation signs serve to inform health care workers of the precautions required in the care of individual patients. The purpose of this study was to apply the rapid cycle improvement model developed at Dartmouth-Hitchcock Medical Center with the aim of improving isolation practice on a general pediatrics ward. A high level clinical process flow diagram was constructed detailing the admission assessment, isolation and discharge process for the child with a presumed communicable disease. The initial Plan-Do-Check-Act (PDCA) cycle focused on the appropriateness of isolation signage, defined as proper sign for patient symptoms on the door within 24 hours of admission. Baseline information was collected by reviewing all admissions to the ward over a five day period. Of 43 patients admitted, 3 were appropriately isolated, 17 were appropriately not isolated, and 23 were not appropriately isolated (53%). The planned intervention was attachment of a sticker with a checklist of isolation stickers to both the nursing admission assessment and nursing shift report forms. As post intervention follow-up, 68 consecutive admissions were tracked: 23 were appropriately isolated, 35 were appropriately not isolated, and 10 were not appropriately isolated (15%). The reduction in the number of patients not appropriately isolated after the intervention was significant($p<0.0001$). Ongoing efforts are required to sustain the gain and further improve isolation practices in our hospital.

M57

Reducing the Rate of Nosocomially Transmitted Respiratory Syncytial Virus in a Large Children Center. *LYNNE KARANFIL, MARTHA CONLON, BETH GRIFFITH, KELLY LYKENS, MICHAEL FORMAN, CAROLYN MASTERS, TRISH PERL, Johns Hopkins Hospital, Baltimore, MD

Respiratory syncytial virus (RSV) is a respiratory tract pathogen that causes significant morbidity in young children. Mortality can occur in children with chronic cardiopulmonary disease or immunosuppression. Each year, between November and April many children infected with RSV are admitted to hospitals with respiratory distress. RSV, transmitted through droplet and direct transmission, survives readily in the environment for long periods of time. During the 1990-1991 season, 20.2% of RSV cases at the Johns Hopkins Hospital Children's Center were nosocomial. In the fall of 1991 a multidisciplinary control plan was implemented. The control plan is based on a two stage process. It involves notifying staff that RSV is in the community and distributing information through a communication tree. *Stage Two* requires that nasopharyngeal aspirates (NPA) be obtained from all children < 3 years of age with respiratory symptoms. The aspirates are tested directly for RSV antigen and cultured for RSV. The children are placed on *RSV Precautions* (gloves to enter, mask & gown for close contact) pending those results. The proportion of nosocomial RSV cases dropped from 16.5% prior to the use of RSV control measures to 7.2% after the initiation of the control program. A case of RSV identified in the hospital was 2.6 times more likely to be nosocomially-acquired prior to the intervention as compared to after the intervention. Approximately 14 cases of RSV are prevented each year, resulting in a savings of 58 hospital days and over $84,000 in hospital related charges alone. The nosocomial spread of RSV can be reduced by a specific and feasible multidisciplinary control effort.

M60

Patterns of Antibiotic *Resistant Streptococcus pneumoniae* in Children Attending Day Care. ARCH G. MAINOUS III, *MARTIN E. EVANS, and WILLIAM B. TITLOW, University of Kentucky School of Medicine, Lexington, KY

The incidence of antibiotic resistance in health care institutions is a reflection of the prevalence of resistance in the community. Others have shown that antibiotic resistance is common among *S. pneumoniae* recovered from patients attending clinics or hospitals, and other studies have shown high prevalence of resistant *S. pneumoniae* carriage in isolated day care centers. We wished investigate the prevalence of resistant *S. pneumoniae* in a sample of children in day care centers in a region that included both urban and rural communities. Nasopharyngeal swabs were obtained from 104 children in 8 day care centers located in rural and urban central Kentucky in April and May 1997. *S. pneumoniae* was recovered from 35 children. Nineteen isolates were resistant to penicillin (14 relatively resistant, 5 highly resistant). Five (14%) penicillin resistant isolates were also resistant to cefotaxime, 9 (26%) were also resistant to erythromycin, and 14 (40%) were also resistant to trimethoprim-sulfamethoxazole. Children with resistant isolates were younger (2.7 ± 1.6 years) than children without resistant isolates (3.7 ± 1.1, $p=.02$). There was no relation between resistance and rural/urban day care location. Fully 18% of healthy children attending day care in central Kentucky harbor penicillin resistant *S. pneumoniae*. Many of these organisms are also resistant to other antibiotics. Limiting the effect of *S. pneumoniae* on drug resistance may require a reexamination of outpatient treatment strategies for childhood respiratory diseases. Knowledge of the high prevalence of resistant pneumococci in the community will help in the appropriate selection of antibiotic therapy for deep seated infections.

M61

Descriptive Study of Patients Colonized or Infected with *Stenotrophomonas maltophilia* at a University Hospital. P. DAVID ROGERS, JOHN D. CLEARY, *RATHEL L. NOLAN, Univ. of MS Schools of Pharmacy and Medicine, Jackson, MS. **Introduction:** *Stenotrophomonas maltophilia* is a multidrug resistant organism that is a frequent pathogen in some patient populations. We describe characteristics of patients colonized or infected with *S. maltophilia* at our institution. **Methods:** Charts of patients from whom *S. maltophilia* was isolated were prospectively reviewed. Data collected included demographics, underlying disease, prior antibiotics and immunosuppressive therapy, site of infection, and susceptibilities. Clinical isolates were banked for molecular typing. **Results:** Fifty patients were identified over a 14-month period. Data has been collected on 22 female and 15 male patients (37 total). Patients had a mean age of 40 years and mean length of hospital stay of 30 days. Patients were distributed across all hospital wards and medical services. Nine patients (24.3%) had solid tumors and 6 (16.2%) had hematological malignancies. Eleven patients (29.7%) had received steroid therapy and 21 (56.8%) had received H-2 antagonists. Eighteen patients (48.6%) were mechanically ventilated and had central venous catheters. Fourteen patients (37.8%) had tracheotomies. Of 34 patients who received antibiotic therapy prior to isolation of the organism, twelve (35.3%) had received an antipseudomonal penicillin and the same number had received and aminoglycoside. Sixteen (47.1%) received a third generation cephalosporin and 11 (32.4%) had received a quinolone. The average number of hospital days and antibiotic days prior to isolation of the organism were 11.7 and 8.9 days, respectively. Twenty-six (72.2%) patients' infections/colonizations were nosocomial. Sites of isolation included blood (2.7%), sputum/bronchial alveolar lavage (64.9%), wound (10.8%), urine (2.7%) and other (21.6%). Eleven patients (29.7%) died prior to discharge. **Conclusion:** At our institution *S. maltophilia* was isolated most frequently in patients with solid tumors and hematological malignancies, in patients who were mechanically ventilated, and/or with a central venous catheter, and in those receiving broad spectrum gram-negative antibiotic coverage. A case control study and analysis of strain relatedness via pulsed field gel electrophoresis is in progress.

M62 An Outbreak of Multidrug Resistant Enterobacter cloacae

* KWAN KEW LAI, SALLY A. FONTECCHIO, ANITA L. KELLEY, and ZITA S. MELVIN
University of Massachusetts Medical School and University of Massachusetts Medical Center, Worcester, MA.

From Dec. 16, 1995 to May 1, 1996, *E. Cloacae*(EC) susceptible only to imipenem, amikacin, and with variable susceptibilities to ofloxacin was isolated from 8 patients. All were from the burn unit(BU) and the ICUs with the exception of 1 patient whose isolate was first recovered while he was an outpatient. However he was hospitalized in the ICU 1 week prior. There were 6 males and 2 females with a mean age of 60 years (range 21 to 83). The mean length of stay was 47 days. All but 1 was infected. The infections included 2 blood stream infections, 4 UTIs, and 1 respiratory tract infection. All responded to treatment. Four died but death was not related to resistant EC. A case control study with patients with EC susceptible to the third generation cephalosporins as controls showed that patients with resistant EC had higher Apache II scores ($p = 0.01$) and a higher mortality rate ($p = 0.03$). The number of antibiotics used approached statistical significance ($p = 0.06$) but the duration of antibiotic use was not significant. Usage of the third generation cephalosporins showed an increase 3 months preceding the first case of resistant EC. Seven of the 8 isolates had identical chromosomal patterns by pulsed field gel electrophoresis (PFGE). The index case was in the BU and the 2nd and 3rd patients who subsequently had resistant EC were in the BU. The 4 other patients with similar PFGE patterns shared the same healthcare providers. Cross transmission contributed to the spread of resistant EC. Contact isolation and

M63

MULTIDRUG RESISTANT PROTEUS MIRABILIS IN A RESPIRATORY CARE UNIT. RICHARD VOGEL,* MARY MOTYL, BETH RAUCHER, BRIAN KOLL. BETH ISRAEL MEDICAL CENTER (BIMC) NEW YORK, NY.

Surveillance of bacteria with unusual susceptibility patterns is a very important tool in the detection and prevention of nosocomial transmission. From June to October 1997, six isolates of Proteus mirabilis (PM) that were sensitive to cefoxitin, but resistant to ceftazidime and aztreonam, were isolated from patients in the respiratory care unit (RCU). Three of the isolates were recovered from urine cultures, one from blood, one from urine and blood, and one from a gastrostomy site. By Diens test and ribotyping, two different strains were identified. Three were strain 1: ribotype 618-1, and three were strain 2: ribotype 618-4. The first patient was admitted with strain 1 from a long term care facility (Facility A). The second patient was admitted from Facility A with strain 1, but had been in the RCU one month prior to this admission. The third patient with Strain 1 developed a nosocomial infection in the RCU. All three patients with strain 2 became infected while in the RCU. Three additional RCU patients with PM isolates having this unusual susceptibility pattern prior to June 1997 were identified through a retrospective search. These isolates were not available for typing. Two of these patients were infected on admission and also from Facility A. Facility A has been contacted and we are working to determine where these patients originally acquired the organism. Because of the apparent nosocomial spread of PM, Infection Control intervened by reviewing appropriate policies and procedures especially those on aseptic technique with the staff members. No additional nosocomial spread of PM has been noted. During the time period when these infections were detected, there was only one patient from whom a sensitive PM was isolated in the RCU. Had this unusual susceptibility pattern not been detected through routine surveillance of multidrug resistance, this nosocomial spread may not have been noted.

M64

Isolation for Intensive Care Unit (ICU) Patients With Gram Negative Antibiotic Resistant Organisms (GNARO). *E.HENDERSON, D.LEDGERWOOD, K.HOPE, S.VINER, M.WHITE, G.ROSS, W.KRULICKI, T.LOUIE, Infection Control & Intensive Care Unit, Calgary Regional Health Authority & University of Calgary, Calgary, Alberta, Canada.

Prevalence of GNARO is increasing in hospitals. Gram-negative (GN) organisms are increasingly resistant to antimicrobials. Concern over spread of GNARO in a 12-bed medical-surgical ICU led to implementation of an isolation policy for colonized/infected patients in January, 1995. GNARO were defined as: (1) *Stenotrophomonas maltophilia* or *Acinetobacter* species; or (2) Enterobacteriacae or *Pseudomonas* species that were resistant to one of tobramycin, ciprofloxacin, ceftazidime or cefotaxime. Patients with GNARO were identified by: (1) diagnostic specimens and (2) routine screening (stool or rectal swab) of patients admitted from another institution. Patients with GNARO were managed by: (1) isolation precautions; (2) body surveillance (stool, skin and mucous membrane) cultures; and (3) weekly follow-up monitoring of stool and original site. Isolation precautions included use of: (1) a single room with signs; (2) antimicrobial soap for staff and patient; (3) gown and gloves for care; and (4) a "phenolic" for cleaning. In 1995-96, 42 of 487 (8.6%) patients admitted to ICU for > 48 hours were found to have 56 GNARO. Of 56 GNARO, 31 (55.4%) caused infection; 20 (35.7%) were colonizers and 5 (8.9%) were indetermine. *S. maltophilia* (7/32=21.9%) and *Pseudomonas* species (7/32=21.9%) were the most common GNARO in infected patients. *Pseudomonas* species (9/20=45.0%) was the most common colonizer. Comparison of GN infection rates before (1993-94) and after (1995-96) implementation of the isolation protocol showed a significant decrease in the GNI rates. Patient severity of illness did not change between 1993-1996.

	Infection Rate per 1000 ICU patient-days			
	1993	1994	1995	1996
Overall gram-negatives	45.0	50.7	32.3	33.4
S. maltophilia	5.7	5.3	1.3	3.1
Enterobacter species	9.3	6.4	5.0	1.9
E. coli	10.1	11.7	6.3	8.8

Isolation significantly reduced infections caused by GNARO, specifically *S. maltophilia* and *Enterobacter* species. Precautions for GNARO also appears to have the unanticipated benefit of significantly reducing the rate of antibiotic-sensitive GN infections in an ICU.

M65

Risk factors for multi-resistant gram-negative bacilli in hospitalized patients in Salvador, Brazil: a case-control study

Brites, C; Netto, EM; Bandeira, AC; Alaide, LA; Santos-Filho, LC; Barberino, MG; Badaró, R. Hospital Aliança, Hospital Espanhol and Federal University Hospital of Bahia (UFBA), Salvador, Brazil.

Antibiotic multi-resistant bacterial is one of the challenge emerged in this century. We evaluated the risk factors associated with emergence of multi-resistant gram-negative bacilli [MRB] in hospitalized patients in Salvador, Bahia - Brazil. **Methods:** We performed a case-control study involving three different hospitals from Sept. to Nov., 1996. Cases (N=30) were defined as any patient presenting with positive cultures for MRB. Controls (N=90) were selected on the same hospital and during the same period of hospitalization. We compared the frequency of invasive procedures, previous use of antibiotics, incidence of nosocomial infections, and patients age. MRB was defined as a resistant bacteria to at least, amynoglicosides, 3rd and 4th generation cephalosporins, and quinolones. Statistical analysis was done using Fisher-Freeman-Halton test, Kruskal-Wallis test, and unconditional logistic regression analysis. **Results:** Cases were more likely to have the following conditions: older age; higher number of invasive procedures; higher rates of infections during hospitalization; increased use of mechanical ventilatory support or urinary catheters; and higher rates of prophylactic antibiotic use. The only risk factor significantly associated with MRB isolation in multivariate analysis was *previous use of prophylactic antibiotics* [OR = 3,0; $p < 0.02$] while urinary catheter use was marginally significant [OR = 3,1; $p = 0.06$]. **Conclusion:** The finding that the major independent risk factor for MRB isolation was previous use of antibiotics reinforces the need of a strict antibiotic control program in hospital settings.

M66

Nosocomial Pneumonia with Antimicrobial-Resistant Bacteria Among Intensive Care Units (ICUs) Patients: Risk Factors and Survival.

PHILIPPE VANHEMS, ALAIN LEPAPE, ANNE SAVEY, GABRIEL PINZARU, JACQUES FABRY, AND THE ICU-NETWORK SURVEY. Centre Hospitalier Lyon-Sud, Univ. Claude Bernard, Lyon, France.

Risk factors of nosocomial pulmonary infection (NPI) with antimicrobial-resistant (R) bacteria (B) need to be better known especially in ICUs where their incidence has increased. The objectives of this study were to identify the risk factors associated with a first NPI due to R-B and to compare the survival after NPI due to R-B and due to sensitive (S)-B. B-susceptibility was tested for meticillin (MET), ampicillin, cefotaxim, and ceftazidim (CAZ). All patients hospitalized >48 hours in a mixed ICU were enrolled prospectively in a survey on NI which included 44 ICUs in the South-East of France. Among 7,276 patients recorded, 445 patients (6%) had a NPI due to S-B and 183 patients (2.5%) had a NPI due to R-B. Logistic regression was used to estimate the adjusted odd-ratio [AOR] of NPI due to R-B. The survival was calculated by the Kaplan-Meier method. The most frequent R-B were: *S Aureus* MET-R (43%), *P Aeruginosa* CAZ-R (16%) and *Acinetobacter* CAZ-R (15%). The risk factors of NPI with R-B were: a patient with a medical illness [AOR 1.98, (95% CI 1.35-2.91), p<0.001], a transfer from another hospital ward [AOR 1.66, (95% CI 1.14-2.42), p=0.007], a colonized central venous catheter [AOR 3.47, (95% CI 1.46-8.21), p=0.005], >8 days (d) in the ICU before NPI [AOR 1.02, (95% CI 1.01-1.05), p=0.03], >7d of intubation before the NPI [AOR 2.10, (95% CI 1.31-3.36), p=0.002]. The median survival after NPI with R-B was 35d (95% CI 19-51) and 32d (95% CI 26-38) for NPI with S-B, (p=0.92, logrank-test). NPI due to R-B could be reduced by specific preventive measures associated with the standard procedures. Survival after NPI did not differ by antimicrobial suceptibility of bacteria in our population.

M67

Profile of Antimicrobial Resistance of Nosocomial Bacteria in Ribeirão Preto, Brazil. *SILVIA N.S. FONSECA, SÔNIA M. KUNZLE, SHEILA SILVA, JORGE SCHMIDT JR, ROBERTO MELE. Hospital São Francisco, Ribeirão Preto, São Paulo State, Brazil. Very few hospitals in our region have any policies regarding antibiotic (antib) use, and antib can be bought over the counter at the pharmacies. In our private 180-bed general hospital that admits patients from the community and from other hospitals, we have had an active antib control program since 1987.Culture results of nosocomial infections and colonizations were analyzed from Aug 95 to Aug 97. The % of susceptible strains to several antib was determined . Five hundred and three strains of nosocomial gram-negative bacteria: *Enterobacter sp* (27%), *Pseudomonas sp* (18%), *E.coli* (17%), *Klebsiella sp* (13%), *Acinetobacter sp* (12%), *Proteus sp* (7%) and 245 strains of nosocomial gram-positive bacteria: *S.aureus* (48%), *Coagulase-negative staphylococci*, CNS (42%) were analyzed.

TABLE: PERCENTAGE OF SUSCEPTIBLE STRAINS

YEAR	95/96/97						
	Amikac	Ampic	Ceftaz	Cephalot	Ciprof	Gentam	Imipen
Enterobacter sp	85/80/71	0	81/70/67	5/1/2	71/96/86	67/75/81	95/98/100
Pseudomonas sp	85/83/91	0	92/83/89	0	85/83/84	85/80/84	92/100/95
E.coli	92/100	0/35/43	83/100	50/71/73	100/86/100	64/97/96	100/100
Klebsiella sp	89/97/96	11/0/0	78/92/96	33/80/91	100/97/91	78/89/96	100/100
Acinetobacter sp	-/14/26	-/0/0	-/5/16	-/0/0	-/9/26	-/2/26	-/98/94
Proteus sp	67/100/85	67/36/75	100	33/50/90	100	67/100	100
S.aureus	100/48/45	9/7/7		82/49/34	91/46/44	82/49/34	82/49/34
CNS	86/83/71	14/11/22		71/83/71	71/85/75	71/83/71	71/85/75

We obviously have a problem with increasing resistance of *S.aureus* and CNS, but the resistance of the majority of gram-negative bacteria has been stable or has decreased slightly from 95 to 97. Strategies to identify, isolate and possibly treat chronic carriers of resistant *S.aureus* and local policies in antib control for the other hospitals and the community are urgently needed.

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M68

Antibiotic Use in a Brazilian Hospital and its Relation with Bacterial Resistance

LUIS FERNANDO A.CAMARGO*; TANIA MARA V. STRABELLI; ROGÉRIO ZEIGLER; GEORGE W. B. CUNHA; DAVID EVERSON UIP.
Instituto do Coração(Heart Institute),University of Sao Paulo School of Medicine,Sao Paulo,Brazil

Antibiotic use is increasing worldwide and control strategies are recommended for economical reasons and in an attempt to control the emergence and dissemination of multiresistant bacteria. In this report, we summarize the antibiotic usage pattern in a tertiary-care-Brazilian hospital and compare the trends of consumption of some antibiotics with the respective bacterial susceptibilities.

The Heart Institute (Instituto do Coração) is a 314-bed tertiary-care-hospital for cardiovascular diseases with a highly restrictive antibiotic control policy, based mainly on compulsory consultation with an infectious disease specialist before prescribing antibiotics. Antibiotic use from 1992 to 1996 was calculated using the DDD (Daily Defined Dose) for the respective antibiotics. Bacterial antibiotic susceptibilities were obtained from the results of a prospective blood culture surveillance program initiated in 1993. Bacteria isolated during 1993/1994 were compared to those isolated during 1995/1996.

Comparing 1992 to 1996, there was an increase in the total use of cefotaxime (74%), ceftazidime (270%), vancomycin (50%), clindamycin (60%) and ceftriaxone (196%), while there was no increase for imipenem, ciprofloxacin and amikacin. Bacterial resistance increased moderately for ceftriaxone (11%), clindamycin (17.7%), cefotaxime (15%) and a lower rate of resistance developed for amikacin (3.3%), ceftazidime (3.1%) and ciprofloxacin (7.1%). There was no increase for imipenem and vancomycin. Although the general bacterial resistance to ceftazidime decreased only slightly, the increase of resistance for *Enterobacter/Klebsiella* was high and statistically significant.

We conclude that the antibiotic use in our hospital is increasing for most of the antibiotics even with a rigid control policy and additional measures other than restriction by infectious disease specialists are required. Our data suggest a relation between total antibiotic use and global bacterial resistance, although this depends greatly on the characteristics of both the antibiotics and the bacteria considered.

M69

Reduction in the Incidence of Infections with Drug Resistant Organisms through Computer-Based Patient Tracking. KM Mullane*, G Paulus, LT Hwang. Univ. of Illinois and VACHCS, Westside, Chicago Il.

MRSA and VRE are nosocomial pathogens that have become increasingly prevalent agents in the hospital setting. Risk factors for colonization with these organisms include prolonged hospitalization, debilitating chronic illnesses, exposure to surgical procedures/invasive devices and prolonged broad spectrum antibiotic usage. Surveillance cultures of individuals categorized as high risk have been advocated to identify patients colonized with these organisms. We observed that patients who were known to be colonized with these organisms were frequently readmitted to our institution and were not evaluated for persistent colonization or placed on contact precautions in a timely manner. In an attempt to better capture these individuals upon readmission, all patients with a past positive MRSA or VRE clinical or surveillance culture from October 1994 through June 1997, identified on daily microbiology rounds were entered on the hospital computer database. This database was auto-linked with admissions to activate a clinical alert to the Infection Control Team upon patient readmission. Within 24 hours of admission, the nursing unit was notified to initiate contact precautions and appropriate surveillance cultures were obtained. Of 77 patients with a history of a positive MRSA culture, 30 (39%) had persistently positive surveillance cultures upon readmission. Of 33 patients with VRE, 7 (21%) remained persistently positive on readmission. Mean rates of unique patients with MRSA identified by surveillance cultures or by clinical isolates fell from a mean of 29.22/1000 discharges in 1995 to 20.66 in 1996 and 15.71 for the first 6 months of 1997. Mean rates of unique patients with VRE were 13.01 in 1995, 8.72 in 1996 and 12.25 for the first 6 months of 1997. With no new implementation of antibiotic restrictions, the percent of *S. aureus* susceptible to oxacillin rose from 45% in the first quarter of 1995 to 77% at the end of the second quarter of 1997. The percent of vancomycin susceptible *E. faecium* rose from 21% to 34% during this same time period. Use of a database identifying patients with a history of MRSA and VRE carriage resulted in timely identification of those with persistent colonization, timely institution of isolation precautions and a decline in the number of unique patients with clinical infection or colonization with these organisms. In addition, overall susceptibility patterns of our institution have improved, possibly due to these interventions.

M72

Peripherally Inserted Central Catheters (PICCs) for Post-Discharge Intravenous (IV) Therapy Inserted by Certified Nurses at Hennepin County Medical Center (HCMC). JEANNE PFEIFFER, R.N., MPH, CIC, K. STEINMANN, MT (ASCP), *M.E. BENNETT, RN, MPH, CIC, C. LANIGAN, R.N., MA, M. SIMPSON, MD. Hennepin County Medical Center, Minneapolis, MN

HCMC is a 436 bed Level I trauma center, public teaching and research facility. Historically, patients who needed home IV therapy have been subjected to catheters inserted via central veins (Hickmans, buried ports, etc.). These catheters are associated with complications such as sepsis, pneumothorax, hemothorax, etc., and 2-4 times the cost of a PICC placement since they require physician insertion, operating room, anesthesia, and recovery. PICCs were introduced at HCMC in 1994 and are inserted by nurses who are certified to do this procedure at the bedside or in clinic. These catheters (Per-Q-caths) are placed at the time of discharge to administer antimicrobials, analgesics, hydration and hyperalimentation. Because standardized benchmarks for PICCs were not available and there was limited data in the literature, practitioners at HCMC selected this performance indicator to measure baseline complication rates. Between January 1995 and November 1997, there were 187 PICCs placed out of 241 (78%) attempts in adult patients. Nurses attempted to access all patients with palpable antecubital veins. Unsuccessful PICC candidates were referred back to the ordering physician. This placement rate is consistent with other published information on nurse insertions. Some facilities have improved their placement rate to >90% by placing PICCs strictly by fluoroscopy; others by performing cutdowns; or modified techniques which require physician intervention. Follow-up is complete on 116 (62%) cases, for a total of 3111 line days (LD), [range 1-168; average LD (ALD) 27]. Sixty (52%) of the patients, completed therapy. Thirty-five patients (30%) had catheter complications (ALD=22). The primary complication was occlusion in 13% of the patients (ALD= 15). Other complications included phlebitis 5%, ALD= 6; site infections 1.7%, ALD= 30; leakage 3.4%, ALD= 45; catheters migrated out 2.5%, ALD= 24; multiple complications 1.7%, ALD= 14; bacteremia 0.9%, LD= 51; broken catheter 0.9%, LD= 67; and pain in access 0.9%, LD= 3. PICCs placed at discharge by nurses after careful assessment for appropriate candidacy, are safe and cost effective compared to more invasive procedures and other types of accesses.

M73

Catheter-related Bacteremias caused by *Sphingomonas paucimobilis* and *Agrobacterium tumefaciens* in an Ambulatory Dialysis Unit for Children.

*WERNER E. BISCHOFF, INGRID HINRICHS, HARTMUT WEISSBRODT and DIETER BITTER-SUERMANN, Institute for Medical Microbiology, Medical School Hannover, Hannover, Germany

Sphingomonas paucimobilis (S.P.) and Agrobacterium tumefaciens (A.T.) are gram-neg. bacteria, which are recognized as emerging opportunistic human pathogens. During a two month period four cases of bacteremia combined with fever and shaking chills were observed in an ambulatory dialysis unit for children. Several bloodcultures revealed S.P. (3 patients) and A.T. (3 patients). To investigate the outbreak, environmental culturing was performed, including the dialysis devices, and data from patients charts and the construction of the dialysis unit were collected. S.P. could be detected in fluid samples of three dialysis devices, that have been used for the identified bacteremic patients. Additional bacteria found in dialysis fluids included *Pseudomonas aeruginosa, Burkholderia cepacia, Stenotrophomonas maltophilia* and other water related organisms. All four bacteremic patients had longterm dialysis catheters implanted. Fever and shaking chills occured immediately after dialysis sessions. After initiation of antibiotic treatment those patients demonstrated no more symptoms. The dialysis unit opened about five months prior to the identification of bacteremias. Water quality testing was never performed and two incidents of water pipes bursting were reported within the first weeks of the unit opening. Detection of the same water-related organisms in bloodcultures and dialysis samples implicates the dialysis devices as the source of infection. After exchange of fluid filters, cleansing of the water supplies and dialysis devices, and implementation of infection control guidelines no new cases appeared. This outbreak reinforces the need for surveillance programs in ambulatory dialysis units and development of policies and procedures for strict monitoring of dialysis fluids, including water and substitution fluids.

M74

"Candida" Bloodstream (BLS) Infections in the Department of Veterans Affairs (DVA) Analyzed Using a New Automated Emerging Pathogens Initiative (EPI) Program. G ROSELLE, *S KRALOVIC, L DANKO, L SIMBARTL. VAHQ, Wash, DC, VAMC, Cinti, OH, Univ Cinti Col Med, Cinti, OH.

From April 1997 through November 1997, the DVA's EPI survey of 123 Veteran Health Administration (VHA) medical centers identified 281 patients where at least one BLS source culture was positive for *Candida sp.* or other yeast. The average age of the patients was 64.4 years, compared to the average age of the VHA population of 59 years. In FY 1996, 23% of these patients with "*Candida*" BLS infections had a specimen source identified as an intravascular device. The majority of the yeast infections were due to *Candida sp.*, with *C. albicans* being the most common; other yeast genera were also present. The average length of stay for the admitted patients before the first positive BLS source culture was obtained was 26.6 days. The average time from obtaining the culture until a final result was recorded was about 7 days. Thirteen percent of the observations were known to be from outpatients. Discharge disposition for admitted patients with yeast BLS infections was 47.7% regular discharge, 3.6% to nursing home, 2.5% other, and 46.2% death. The most common ICD-9 coded first diagnoses for inpatients were disseminated candidiasis (7.9%), d. mellitus Type I (5.9%), mycoses-NEC-NOS (5.4%) and candidiasis-NOS (5.0%). The DVA's automated program allows for easy extraction of desired data on a large scale (using a national database) without individual chart review. The critical problem of nosocomial "*Candida*" BLS infections is demonstrated by the majority of these occurrences seen in inpatients with a lengthy hospital stay. The association with vascular devices and the high percentage of death corroborates existing data regarding these infections and identifies targets for intervention.

M75

Streptococcus mitis Bacteremia - A Pseudo Outbreak. D. THORNLEY, F. SMAILL, R. PENNIE, Departments of Infection Control and Infectious Diseases, Hamilton Health Science Corporation, Hamilton, Ontario

Within a 3 week period, three cases of septicemia with Streptococcus mitis, resistant to penicillin, occurred in children newly diagnosed with leukemia on the pediatric hematology service of our Children's Hospital. Streptococcus mitis had previously been infrequently isolated from these patients in our unit and infection with strains resistant to penicillin was unusual. Although there are reports in the literature of an increasing prevalence of septicemia with the alpha hemolytic streptococci in children undergoing intensive chemotherapy, the temporal and geographical association of these infections in our unit led to the investigation of a possible nosocomial source. The three children had been newly diagnosed with acute myelocytic leukemia, had a Broviac central line inserted within 10 days of their septicemia, and had been cared for in adjacent rooms on the ward. Two patients required transfer to the Intensive Care Unit for respiratory distress and both required intubation. Initial investigation indicated that all of the children were at a high risk for acquiring infection with this organism: all were neutropenic (granulocyte count less than 500 mm^3), all were receiving Septra prophylaxis, none was receiving IV antibiotics at the onset of infection, all had oropharyngeal mucositis and all had received intensive chemotherapy. All had received fluconazole for prophylaxis of oral candidiasis. There was no common use of mouth care solutions. No obvious breaks in technique for the management of central lines was identified. Two children had received other antibiotics within the four weeks prior to the septic episode. The three strains of Streptococcus mitis were typed by AP-PCR and all were distinctly different. Despite the close temporal and geographical clustering of these three episodes of septicemia with penicillin resistant Streptococcus mitis, molecular typing did not confirm nosocomial transmission. We conclude that these cases occurred in patients recognized as being at high risk of sepsis with alpha hemolytic streptococci and the temporal clustering occurred by chance. We are presently attempting to determine in this population the risk factors for colonization with strains of viridans streptococci that are resistant to penicillin.

M76

A Two-year Outbreak of *Enterobacter asburiae* in a Hematology Unit. *Y BERROUANE, A VACHEE, F PERRAUDIN, S HAETJENS, F BAUTERS, M SIMONET, C SAVAGE. Lille Univ Hospital, France.

Recently described, *E. asburiae* (EA) may occasionnally cause infections. Between May 1995 and October 1997, EA was isolated from 19 neutropenic patients (pts) in a hematology unit. Seven pts developed bacteremia, of whom 5 had a septic shock and 1 died. One pt developed a lower respiratory tract infection whereas all others had intestinal colonization ranging from 10^3 to 10^8 colony forming units / stool grams. Isolates were resistant to β-lactams except cefepime, cefpirome, and imipenem, to aminoglycosides except gentamicin and isepamicin, to colistin and to cetrimide. Review of medical records and of practices did not indicate any plausible source common to all cases. However, the epidemic curve and the line-listing suggested spread from a continuous common source, perhaps associated with staff hand carriage. The most likely route of transmission was ingestion. Therefore, environment culturing was focused on potential aqueous reservoirs. EA was isolated from drains of a utility sink, nurse sinks, and 3 of the 4 pt sinks sampled. The isolates produced slime heavily. Microbiologic studies of food, tap water, and spring water delivered to the unit were unrevealing. Personnel carrier state was not studied. Molecular typing showed that all environmental and pt isolates were identical or similar. Control measures included improving use of the utility sink, reinforcement of handwashing and isolation policies, changing and disinfecting all drains. We postulate that this species, which has the ability to form biofilms, thrives in moist environments as well as in the human intestinal lumen and may act as a multiresistant opportunistic pathogen. EA, differentiated from *E. cloacae* by only 2 tests, should not be misidentified.

M77

An Outbreak of Hepatitis B Virus (HBV) Infection in a New York Area Hospital. *RICHARD GARFEIN, SUSAN GOLDSTEIN, CATHERINE DENTINGER, CRAIG SHAPIRO, ERIC MAST of the Centers for Disease Control and Prevention, Atlanta, GA

Nosocomial HBV transmission can occur through healthcare worker-to-patient, patient-to-patient, and patient-to-worker routes. From April 1996 to July 1997, 12 patients with acute hepatitis B were identified at Hospital A through review of laboratory reports and medical records; admission to Hospital A during the six months prior to onset of illness was the only identified risk factor. Cases were all male with a mean age of 61 years (range=32-78 years) and did not all cluster in time. A case-control study was conducted to identify possible risk factors for nosocomial HBV infection, such as medical procedures or receipt of medications from multidose vials. Six control patients were matched to each case by age and date of hospital admission; for cases with multiple admissions, visits were treated separately and controls were selected for each visit, providing 19 case-visits with 114 controls for analysis. Patients who were on dialysis, HIV positive, or had a record of prior HBV infection or vaccination were ineligible as controls. Cases and controls did not differ by average length of hospital stay (14 vs. 13 days, p>0.05). HBV infection was associated with being admitted to one surgical ward (OR=6.7, 95% CI 1.7-32.5), but this accounted for only 5 cases. After adjusting for ward, having an invasive procedure performed at the bedside (e.g., incision and drainage, biopsy, or podiatry) was the only variable associated with HBV infection (OR=5.2, 95% CI 1.6-17.3). These two variables accounted for 8 (75%) of the cases. HBV infection was not associated with underlying medical condition, any one procedure, or the number or type of percutaneous medications received. Three different hepatitis B surface antigen (HBsAg) subtypes were identified among the cases, and review of laboratory records showed that 10 (83%) of the cases were on a ward at the same time as a HBsAg-positive patient. Direct observation and discussion with hospital staff revealed inconsistent adherence to infection control procedures, in particular changing gloves and washing hands after administering medications. In July 1997, additional infection control training was given to hospital staff and enhanced surveillance was implemented; during the following 6 months, no new cases were reported. In conclusion, patient-to-patient transmission from multiple sources and through multiple practices appeared to be responsible for this outbreak. Strict adherence to recommended infection control practices is necessary to prevent nosocomial HBV infection.

M78

Epidemiology of *Candida* spp. Colonization or Infection in Critically Ill Patients. *CRISTIANE G. J. MARINO, SERGIO B. WEY, EDUARDO A. S. MEDEIROS, ARNALDO L. COLOMBO, ADAUTO CASTELO FILHO, ELIAS KNOBEL - Universidade Federal de São Paulo and Hospital Israelita Albert Einstein - São Paulo, Brazil.

Background: During the last four decades the rate of *Candida* infections has increased mainly in critically ill patients. **Objective:** To determine the risk factors for infection/colonization due to *Candida* spp. **Setting:** 25 bed-general-Intensive Care Unit (ICU). **Design:** Nested case-control study. **Casuistic and Methods:** Between December 1995 and July 1996, 1069 patients were admitted at the ICU. The patient should stay in the ICU for more than 72 hours to be included in the study. The HIV-positive patients were excluded. We studied 16 risk factors in 190 patients. A multiple logistic regression (MLR) analysis using a conditional likelihood method was performed to evaluate several risk factors simultaneously. **Results:** The prevalence of *Candida* colonization or infection was 22.6% and the prevalence of *Candida* infections in the colonized patients was 17%. The urinary tract infection was the most frequently observed (57%), and nosocomial candidemia was observed in one patient (2.4%). *Candida albicans* was the most common specie isolated (67.4%), followed by *C. glabrata* (16.3%), *C. krusei* (7.0%), *C. parapsilosis* (4.7%), *C. tropicalis* (2.3%) and *C. guilhermondii* (2.3%). The MLR final model selected by a stepwise procedure included the following variables: age (OR 2.49; IC95% 1.07-5.85), APACHE II score (OR 1.93; IC 95% 0.90-4.15), Foley catheter (OR 6.99; IC 95% 0.89-5.55) and the presence of a previous bacterial infection (OR 6.85; IC 95% 0.64-7.35). This model permitted the calculation of the estimated probability for *Candida* colonization or infection in different situations during the stay in the ICU. For instance, if we admitted a patient older than 60 years, with an APACHE II score greater than 20, using a Foley catheter and with a bacterial infection, he would have an estimated probability for *Candida* spp. infection/colonization of 80%. On the other hand, a patient without these risk factors would have an estimated probability of 2% for these events. **Conclusions:** *Candida* infection/colonization in severely ill patients is frequent in the ICU setting, and the most important risk factor is: age over 60 years, followed by APACHE II score above 20, the presence of a Foley catheter and a previous bacterial infection.

M79

In vitro Activity of 19 Antimicrobial Agents Against 3513 Nosocomial Pathogens Collected from 48 Canadian Medical Centers. *JOSEPH M. BLONDEAU, DAVID VAUGHAN and THE CANADIAN ANTIMICROBIAL STUDY GROUP. University Hospital, Saskatoon, Saskatchewan, Canada and Bayer Corporation, Toronto, Ontario Canada.

Antimicrobial resistance is a global concern. Differentiation between resistance rates for nosocomial versus outpatient pathogens is important epidemiologically and because it impacts on the appropriate selection of antimicrobial therapy for infected patients. We studied resistance rates for 3513 nosocomial pathogens from 48 Canadian medical centers tested against 19 antimicrobial agents. All isolates were tested by the Microscan MIC type 2 panel and interpretation was in accordance with the manufacturer's instructions and NCCLS guidelines. The following are % susceptibility for ceftazidime (Cf), ceftriaxone (Ct), ciprofloxacin (Cp), imipenem (I), netilmicin (N), ticarcillin/clavulanic acid (T) respectively: *Enterobacteriaceae* 95, 95, 97.99, 98, 89; *E.coli*, all 99 except T (91); *Enterobacter* species 78, 78, 96, 99, 99, 71; Citrobacter species 79, 80, 89, 100, 94, 73; *Proteus* species 99, 88, 99, 88, 99, 98; *Pseudomonas aeruginosa* 88, 20, 82, 88, 81, 36; *Staphylococcus aureus*, all >95; *Enterococcus* species 4, 9, 62, 95, 43, 38. Susceptibility rates for other species of microorganisms and agents tested varied considerably. Some institutions had higher than average resistance rates for some pathogens (i.e. *Pseudomonas aeruginosa*) and some agents. Detection of antimicrobial resistance amongst nosocomial pathogens is vital to patient care, and is important epidemiologically. Defining institution specific resistance problems will likely aid infection control initiatives.

M80

Reduced *in vitro* Adherence to Biomaterials of Vancomycin-Resistant versus Vancomycin-Sensitive Enterococci. *ROYA N. BORAZJANI and DONALD G. AHEARN. Georgia State University. Atlanta, GA 30303.

There has been a rapid increase in the incidence of infection and colonization with glycopeptide-resistant, Gram-positive bacteria in American and European hospitals in the last eight years. The *in vitro* primary adherence of vancomycin susceptible (VSE, 25 strains) and vancomycin resistant (VRE, 15 strains) enterococci to sections of silicone and hydrogel-silver-coated latex catheters was determined with radiolabeled cells and ATP analyses. The isolates included 23 *E. faecalis*, 15 *E. faecium*, 3 *E. gallinarum*, 2 *E. avium* and one *E. casseliflavous*. Among the 15 VRE, the only four with VanA phenotypes were isolated from the Atlanta, GA area and all VanB phenotypes were from CA. In general, VSE adhered more than VRE to both catheters (P> 0.05) and adherence to hydrogel-silver-coated latex was lower (P >0.05) than the adherence to silicone. Adaptation of representative VanA and VanB phenotypes to Ag^{+} and Hg^{++} (>50μg/ml) respectively in tryptic soy (TS) broth resulted in loss of resistance to vancomycin. These adapted enterococci showed increased uptake of leucine when adhered to biomaterials compared to non-adapted cells. No *vanA* gene amplicon was detected in the adapted isolates. Silver-adapted strains could be maintained in TS agar but not in TS broth. The data suggest that among wild type strains of enterococci vancomycin resistance and heavy metal resistance are inversely correlated.

M81

Isoniazid Resistant Cavitary Tuberculosis in a Physician Following Isoniazid Prophylaxis. *TB KARCHMER, JD PHIPPS, BJ COYNER, EG CAGE, BM FARR. Univ. of Virginia Health System, Charlottesville, VA.

A 28-year old white male resident physician with previously negative PPDs attended a bronchoscopy on 12/12/95 wearing an isolation mask with a plastic visor attached. The patient's BAL showed 3+ AFB on smear and grew *M. tuberculosis*, susceptible to INH, rifampin, ethambutol and streptomycin. The resident physician had a PPD placed on 4/16/96 that showed 14mmX16mm induration. His chest radiograph showed slight biapical pleural thickening and a faint irregular soft tissue density in the left upper lobe interpreted as being due to scarring or granulomatous disease. Chest CT was recommended for "further characterization," but not done. INH and B6 were begun on 5/1/96. At the end of June, the physician completed his residency and moved to this hospital to begin fellowship training. A more penetrated CXR performed on 6/28/96 was read as showing minimal biapical pleural thickening with "no significant cardiopulmonary abnormality." He continued INH prophylaxis until the end of Nov. 1996. He did well until the last week of Jan. 1997, when he noted fatigue and malaise. On 2/1/97, he noted onset of a dry cough which became productive of green sputum 3 days later, associated with left pleuritic chest pain. He was treated with azithromycin for 5 days without response, noting onset of drenching night sweats. CXR on 2/11/97 showed cavitary infiltrate in the left upper lobe at the same site as the infiltrate observed in the CXR of 4/19/96. Sputum showed 3+AFB. He was treated with a 5 drug regimen until culture grew *M. tuberculosis* susceptible to rifampin, ethambutol and streptomycin and resistant to INH. His regimen was tapered to rifampin, PZA and ethambutol to complete a 9 month course. He has remained well for 6 weeks since completion of therapy. 1 of 50 HCW with negative baseline PPDs exposed to the physician during his illness converted a PPD. His family stayed with relatives until he had been treated for 2 weeks and was responding to therapy. His 2 children were both treated prophylactically with rifampin and none of the family converted a PPD. The hospital where the resident worked had not had patients with INH resistant strains during his work there and the failure of INH prophylaxis in this case may have represented development of resistance during monotherapy of early active disease, as suggested by the first CXR. When a CXR performed because of a PPD conversion suggests possible infiltrate, further evaluation is indicated to rule out active disease before initiating single drug prophylaxis.

M82

Influence of BCG immunization on two step tuberculin skin test results in healthy medical and nursing students in São Paulo (SP), Brazil (BR).

D. GARRETT*, K. LASERSON, E.A.S. MEDEIROS, P.C. VIANNA, R. DUFFY, W. JARVIS, N. BINKIN; Centers for Disease Control and Prevention, Atlanta, GA USA; Universidade Federal de SP, BR.

To obtain baseline prevalence of positive tuberculin skin test (TST) reactions for a possible intervention study to improve health care worker safety, rates of TST positivity and boosting were studied in 574 medical and nursing students from SP, BR. BCG vaccine is usually given at birth in BR, but additionally had been administered to the first year students five months previous to TST. All students were healthy and had no known TB history or exposure. Students completed an exposure questionnaire, and 0.1mm Tubersol was administered using the Mantoux method by two trained nurses who read the test at 48-72 hours. For those with <10mm reactions, a second TST was placed 7-10 days later. Boosting was defined as an increase of ≥6mm, from <10mm to ≥10 mm. Multivariate analysis was used to examine risk factors for a≥10mm and ≥15mm reaction and for boosting. Of the 574 students tested, 244 (43%) had initial TSTs ≥10mm and 44 (8%) ≥15mm. Of the 330 with initially negative results and who completed both steps, 98 (30%) boosted. No association was observed between level of clinical exposure, as measured by year of training, and TST positivity or boosting. Having a recent BCG vaccine was the strongest predictor of a positive TST at both the 10mm cutoff (odds ratio (OR)=3.4; 95% confidence interval (CI) 2.3-5.1) and the15mm cutoff (OR=3.0; 95% CI 1.6-5.8). There were no significant predictors of boosting. When analysis was limited to the 430 upperclass students who had not received recent BCG, 149 (35%) had TSTs ≥10mm and 23 (5%) ≥15mm, and 84 (30%) boosted. Male sex and the presence of a BCG scar were significantly associated with TSTs ≥10mm (OR=1.7; 95% CI 1.0-2.7 and OR=1.8; 95% CI 0.99-3.2, respectively) but not ≥15mm. In the upperclass students, the presence of a BCG scar was associated with boosting, although results were not statistically significant (OR= 1.9; 95% CI .91-4.1). In SP, BR, levels of TST positivity and boosting were high, especially among students who had been recently BCG-vaccinated. No relationship was observed between level of clinical exposure and TST positivity or boosting. These findings underline the importance of two-step testing in health care workers with a previous history of BCG vaccination and the difficulty of interpreting TST results in settings where BCG is widely used.

M83

Pseudo-Outbreak of *Mycobacterium gordonae*.

S. BORNGESSER, MT(ASCP)*, P. KELLER, MT(ASCP), MS, CIC, L. KEHLER, RN, BSN, M. SNYDER, M.D., Sinai Hospital, Detroit, MI.

An increased number of *Mycobacterium gordonae* isolates was noted in our 598 bed, urban, teaching hospital in late 1996 and early 1997. The increase is thought to be due to laboratory contamination. The rate of *M. gordonae* per 100 positive AFB cultures increased from 7.5% and 5.1% in 1994 and 1995, to 26.8% and 46.4% in 1996 and 1997. Eighteen of 23 isolates cultured between January and May 1997 were submitted to Michigan Department of Community Health for pulsed field gel electrophoresis; twelve isolates were genetically similar (same strain) while 2 were "probably related". Twenty-one of 23 *M. gordonae* isolates were recovered from respiratory specimens. No commonalties were identified among risk factors such as: person, place or time, endoscopy, intubation, respiratory therapy, use of oral lidocaine spray, introduction of tap water into the respiratory tract, or presence of other concomitant respiratory illnesses. Only 1 patient had symptoms meeting the definition of pulmonary disease due to non-tuberculous *Mycobacterium* according to American Thoracic Society guidelines. This person and 1 other were treated. Laboratory procedure review revealed that AFB specimens were processed with multi-use stock solutions. Solution purity cultures were "no growth", but original solutions had been depleted and could not be cultured. Cultures positive for *M. gordonae* were not processed consecutively. Typically a Medical Technologist processes AFB specimens, but between July 1996 and April 1997 a laboratory aide performed this task. No variation in methods used to detect Mycobacteria was identified. Although a definite source of the *M.gordonae* was not determined, it is suspected that stock solutions may have been contaminated when the lab aide processed AFB specimens, resulting in random contamination of specimens within a finite time frame.

M84

Susceptibility of *Cryptosporidium parvum* (Cp) to Disinfection and Sterilization Processes.

*SUSAN L. BARBEE, DAVID J. WEBER, MARK D. SOBSEY, WILLIAM A. RUTALA, Univ. of North Carolina at Chapel Hill, Chapel Hill, NC

Cp is a common cause of self-limited gastroenteritis in the normal host but can cause potentially life threatening disease in immunocompromised persons. It is a highly infectious enteric pathogen with an ID_{50} of 132 oocysts although infection may follow ingestion of 30 oocysts. Cp may be transmitted via the following routes: person-to-person, potable water, swimming in pools, contaminated food, and animal contact. Transmission has been well described in households, hospitals, and child care centers. Because contaminated surfaces and equipment may play a role in transmission we studied the susceptibility of Cp to common disinfection and sterilization processes.

A quantitative suspension test was used. Disinfectants were diluted in sterile water to their use dilution. After exposure, the disinfectant was neutralized and Cp viability was assessed using a quantal cell infectivity assay (MDCK cells). Sterilization processes included steam (121°C, 10 min), ethylene oxide (54 °C, 2 hr), and Sterrad 100. The latter two processes were assessed by placing Cp oocysts on stainless steel carriers which were then placed within a narrow lumened test unit.

The susceptibility of Cp to disinfectants as measured by the $\log_{10}$ reduction in infectivity of oocyts was as follows (conc., °C, minutes): TBQ, a quaternary ammonium (QUAT) (1:128, 20, 10) 0-logs; Clorox, a hypochlorite (5.25%, 20, 10) <1-log; Vesphene IIse, a phenolic (1:128, 20, 10) 0.6-logs, Betadine; an iodophor (1%, 20, 20) 0-logs; ethanol (70%, 20, 10) 0-logs; hydrogen peroxide (6%, 20, 20) ≥3-logs; hydrogen peroxide (3%, 20, 20) 2.04-logs; hydrogen peroxide (6%, 20, 10) 2.7-logs; hydrogen peroxide (3%, 20, 10) 1.8-logs; Sporox, a hydrogen peroxide (6.0%, 20, 20) ≥3-logs; Cidex, a glutaraldehyde (2.4%, 25, 45) 0.3-logs; peracetic acid (0.35%, 20, 20) 0-logs; peracetic acid (0.2%, 50, 12) 1.83-logs; peracetic acid-Steris (0.2%, 23-25, 12) 0-logs; peracetic acid-Steris (0.2%. 48-50, 12) 1.8-logs; Cidex OPA, an ortho-phthalaldehyde (undiluted, 20, 20) 0-logs. All sterilization processes inactivated ≥3-logs.

In conclusion, all sterilization processes inactivated Cp. Hydrogen peroxide (6%, 20, 20) was the only surface disinfectant highly effective. Agents which inactivated 1-3 logs of Cp included hydrogen peroxide at lower concentrations or exposure times and peracetic acid. Less than 1-log of Cp was inactivated by Clorox, a phenolic, a QUAT, a glutaraldehyde, and ortho-phthalaldehyde. Prevention of Cp transmission may rely on preventing contamination of the environment and other measures.

M85

Antimicrobial Activity of Home Disinfectants and Natural Products Against Potential Human Pathogens.

*WILLIAM A RUTALA, SUSAN L BARBEE, NEWMAN C AGUIAR, MARK D SOBSEY, DAVID J WEBER. Univ of North Carolina at Chapel Hill, Chapel Hill, NC

Experimental studies have shown that contaminated surface environments may serve as the source for transmission of infectious agents. Disinfection of environmental surfaces has been proposed as a means to decrease or eliminate potential pathogens and thereby decrease acquisition of disease. In addition to commercial products, a variety of home products are also used for disinfection by the public. This study was designed to evaluate both home disinfectants and natural products used in the home for their antimicrobial activity against potential human pathogens. In addition, we evaluated the activity of these products against antibiotic resistant pathogens.

A quantitative suspension test was performed. The following test organisms were exposed to disinfectants for 30 sec and 5 min at 20°C: *S. aureus* (MSSA & MRSA), *Salmonella choleraesuis (Sc)*, *E. coli* O157:H7, *P. aeruginosa (Pa)*, *Enterococcus* (VSE & VRE), and polio virus.

Our results revealed that the following compounds demonstrated excellent antimicrobial activity (>5.6-8.2 log reduction depending on the sensitivity of the assay) at both 30 sec and 5 min exposures: a quaternary ammonium compound (TBQ), a phenolic (Vesphene IIse), a hypochlorite (1:10 Clorox), ethanol, a household product (Lysol antibacterial spray). A second household disinfectant (Mr. Clean) eliminated 4- to >6 logs of pathogenic microorganisms. A third household disinfectant (Lysol disinfectant) consistently eliminated ~4-logs of microorganisms at both 30 sec and 5 min exposures. Two natural products, vinegar and baking soda, in general were much less effective than chemical disinfectants. However, vinegar demonstrated significant activity against two gram-negative bacilli (i.e., *Pa*, *Sc*). Selected disinfectants (Vesphene, Clorox, Lysol antibacterial, Lysol disinfectant, vinegar) were tested against MSSA and MRSA, and VSA and VRE. All chemical disinfectants completely inactivated both resistant and susceptible bacteria at both 30 sec and 5 min exposures. Vinegar was ineffective at 30 sec but demonstrated 3.7-5.3 log-reduction of *Enterococcus* regardless of susceptibility at 5 min. Against polio only two products demonstrated excellent activity (i.e., >3-log reduction), Clorox 1:10 dilution and Lysol disinfectant. All other products tested inactivated <1-log of polio. In conclusion, the natural products were less effective than home disinfectants. A variety of disinfectants were highly effective against potential bacterial pathogens. Only Clorox and Lysol disinfectant were effective against polio.

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Tambyah PA: Maki DG
Tang YJ: Cohen SH
Taylor G: Holton DL
Tenover FC: Fridkin SK
Tenover FC: Fridkin SK
Tenover FC: Hubert SK
Thompson C: Przykucki JM
Thompson W: Holton DL
Thornsberry C: Sahm DF
Tillotson G: Blondeau JM
Timmapuri S: Chakraborty R
Tissot-Guerraz F: Vanhems P
Titlow WB: Mainous,III AG
Tjoelker R: Strausbaugh L
Tkatch LS: Gross CM
Tobin EH: Rosenberg AD
Tokars JI: Trick WE
Tomfohrde KM: Sahm DF
Topal JE: Tallapragada S
Toranzo L: Quiros R
Torn A: Quiros R
Torner J: McCoy K
Towner KJ: Grundmann H
Toye B: Oxley C
Tralla A: Papia G
Tran C: Agarwal K
Traynor P: Garrison T
Triarico A: Marena C
Triarico A: Marena C
Tristram D: Stock ML
Tyra JA: Aikens TM
Umphrey J: Raad I
Urbano E: Starling C
Vachee A: Berrouane Y
Valone C: Camargo LF
van Keulen P: Bogaers D
van Nieuwland E: Bogaers D
van Zon JC: van der Zee A
Van Boven CPA: Bernards AT
Van Der Reyden TJK: Bernards AT
Van Shea H: Jendresky L
Vandenbroucke-Grauls CMJE: van der Zwet WC
Vanderploeg C: Cowan V
Vaneechoutte M: Grundmann H
Vaughan D: Blondeau JM
Vaughan D: Blondeau JM
Vaughn T: Beekmann SE
Vaughn T: McCoy K
Venezia RA: Veeder AV
Venezia RA: Weatherwax D
Verbakel H: van der Zee A
Verdery S: Catto BA
Vesley D: Rice N
Vianna PC: Garrett D
Vieira FD: Ribeiro J
Vierira FD: Ribeiro J
Vilar-Compte D: Volkow P
Vinagre A: Cereda RF
Viner S: Henderson E
Volkow P: Vilar-Compte D
Voss A: Schouten MA
Voss A: Warris A
Wachmann CH: Poulsen KB
Wadman S: Ramirez R
Ward B: Coello R
Ward V: Coello R
Warmington J: Salemi CS
Watson E: Sellick JA
Webb CH: Smyth ETM
Weber DJ: Barbee SL
Weber DJ: Rutala WA
Weber P: Weber S
Weinstein M: Wright J
Weinstein RA: Bonten M
Weissbrodt H: Bischoff WE
Welbel S: van Voorhis J
Welsh MA: Blumberg HM
Wenzel RP: Bischoff WE
Wenzel RP: Bischoff WE
Wenzel RP: Wong A
Weseman RA: Rupp ME
Westbrook DM: Sherertz RJ
Wey SB: Camargo LF
Wey SB: Marino CG
Wey SB: Moreira MM
White M: Henderson E
White N: Blumberg HM
Whitener C: Bordner M
Whitener CJ: Bordner M
Wiberg B: Belhu T
Widmer AF: Fluckiger U
Wilkoff B: Chua J
Williams B: Jendresky L
Williams M: Guttmann A
Williams WW: Wainwright S
Wilson J: Coello R
Windus D: Garrison T
Winfield B: Rupp ME
Woodmansee CE: Antonishyn NA
Wright JA: Bratcher DF
Wurtz R: Enzler M
Wurzel R: Nurse B
Wyndham J: Blumberg HM
Yao J: Cowan V
Yen BM: Trick WE
Yomtovian RA: Conte SM
Zarski JP: Chanzy B
Zawacki A: Potter-Bynoe G
Zeigler R: Camargo LFA
Zeigler R: Camargo LFA
Zhao J: Wright J
Ziegler MM: Christie CD
Ziesing S: Weber S
Zilz MA: Maki DG
Zimmerli W: Fluckiger U
Zocchi G: Gentile A