developed methicillin-sensitive *S aureus* (MSSA) infection. They surveyed 1,417 ICUs in 17 Western European countries. There were 10,038 patients in ICUs who were part of the European Prevalence of Infection in Intensive Care (EPIC) study. Prevalence of MRSA and MSSA ICU-acquired infections, risk factors, and mortality were determined.

On the study day, 21% of patients had ICU-acquired infections. The most commonly reported pathogen was *S aureus* (30%). Overall, 60% of *S aureus* strains were resistant to methicillin (with a wide intercountry variation). The most commonly reported MRSA infections were pneumonia and lower respiratory tract infections. The most important risk factor for MRSA was the length of stay in the ICU. MRSA infection reduced the chance of survival, particularly when it was found in lower respiratory tract infections. The risk of mortality was three times higher in patients with MRSA than in those with MSSA. The authors concluded that patients in ICU are at high risk of becoming infected with MRSA; the longer they stay, the higher the risk. Patients with MRSA infections are less likely to survive than those with MSSA.

FROM: Ibelings MM, Bruining HA. Methicillin-resistant *Staphylococcus aureus:* acquisition and risk of death in patients in the intensive care unit. *Eur J Surg* 1998;164:411-418.

Impact of Clindamycin Restriction on *Clostridium difficile*

Widespread antibiotic use has been associated with increases in both bacterial resistance and nosocomial infection. Climo and coinvestigators from Hunter Holmes McGuire Veterans' Hospital characterized the impact of hospitalwide clindamycin restriction on the incidence of *Clostridium difficile*-associated diarrhea (CDAD) and on antimicrobial prescribing practices.

An outbreak of CDAD was found to be caused by a clonal isolate of clindamycin-resistant *C difficile* and was associated with increased use of clindamycin. Hospitalwide requirement of approval by an infectious disease consultant of clindamycin use led to an overall reduction in clindamycin use, a sustained reduction in the mean number of cases of CDAD (11.5 cases/mo vs 3.33 cases/mo; $P<.001$), and an increase in clindamycin susceptibility among *C difficile* isolates (9% vs 61%; $P<.001$). A parallel increase was noted in the use of, and costs associated with, other antibiotics with antianaerobic activity, including cefotetan, ticarcillin-clavulanate, and imipenem-cilastin. The hospital realized overall cost savings as a result of the decreased incidence of CDAD.

Hospital formulary restriction of clindamycin was found to be an effective way to decrease CDAD. It also can lead to a return in clindamycin susceptibility among isolates and can effect cost savings to the hospital.

FROM: Climo MW, Israel DS, Wong ES, Williams D, Coudron P, Markowitz SM. Hospital-wide restriction of clindamycin: effect on the incidence of *Clostridium difficile*-associated diarrhea and cost. *Ann Intern Med* 1998;128:989-995.

Chart Reminders for Pneumococcal Vaccination

Researchers from the University of Oklahoma Health Science Center reported the results of a pharmacy-based program to increase pneumococcal vaccination rates using simple chart reminders. On a daily basis, inpatient records on general medicine and cardiology services at an academic medical center were reviewed to determine which patients were eligible to receive pneumococcal vaccine. Eligible inpatients were interviewed, and the percentage of nonvaccinated inpatients given vaccine during hospitalization was determined. During an intervention period, reminders were placed on charts requesting a vaccine when indicated.

Of 447 inpatients, 224 (50.1%) had one or more indications for receiving pneumococcal vaccine but only 64 (28.6%) had been vaccinated previously. Of 224 vaccine-eligible patients, 158 (70.5%) had a prior hospitalization within the previous 5 years. Previous hospitalization was not significantly associated with receiving (48 [30.4%] of 158) or not receiving (16 [24.2%] of 66; $P=.35$) vaccine prior to admission. During the observational period, 0 of 80 vaccine-eligible, nonvaccinated inpatients were vaccinated before discharge. In comparison, 23 (29%) of 80 inpatients were vaccinated after a chart reminder ($P<.001$). During the intervention period, vaccination rates were 10-fold higher on general medicine services than on cardiology services.

The authors concluded that a hospital-based pharmacy vaccination program that relied on simple chart reminders was significantly associated with increased vaccination rates among inpatients at risk for invasive pneumococcal disease.

FROM: Vondracek TG, Pham TP, Huycke MM. A hospital-based pharmacy intervention program for pneumococcal vaccination. *Arch Intern Med* 1998;158:1543-1547.

Group B Streptococcal Necrotizing Fasciitis

Necrotizing fasciitis, a severe and uncommon infection involving the subcutaneous tissues, usually is caused by group A streptococci; group B streptococci (*Streptococcus agalactiae)* have been reported to cause necrotizing fasciitis in only four instances (two involving neonates) over the past 4 decades. Researchers from Sir Mortimer B. Davis-Jewish General Hospital and McGill University, Montreal, Quebec, Canada, reported three cases of group B streptococcal necrotizing fasciitis in adults in southern Ontario and Quebec within a 10-month period. All three patients had serious underlying illness, and all required surgical debridement in addition to antibiotic therapy. One of the cases fulfilled the criteria for streptococcal toxic shock-like syndrome. Group B streptococcus has been recognized as a frequent cause of serious disease in adults. It has become evident over the past decade that invasive streptococcal infections are on the increase. The authors suggest that group B streptococcus recently has acquired an increased ability to cause necrotizing fasciitis and suggest that this may represent the emergence of a new clinical syndrome in adults.

FROM: Gardam MA, Low DE, Saginur R, Miller MA. Group B streptococcal necrotizing fasciitis and streptococcal toxic shock-like syndrome in adults. *Arch Intern Med* 1998;158:1704-1708.

Biofilms in Hemodialysis Tubing

Man and coinvestigators conducted a study of biofilms associated with hemodialysis machines. Biofilms consist of microorganisms immobilized at a substratum surface embedded in an organic polymer matrix of bacterial origin. Tubing drawn from the fluid pathways within dialysis machines of various models were investigated for biofilm.

Scanning electron microscopy (SEM) performed on approximately 2-cm^2 samples of the tubing inner surfaces revealed that the inner surfaces of the tubing were covered with biofilms consisting of numerous deposits and glycocalix at different stages of formation, with components containing bacteria and algae. Evaluations of biomass were performed from tubing sections of various lengths and inner diameters put in tubes containing water for injection and

immersed in an ultrasound washtub for 1 hour to ensure sloughing of the biofilm. Living bacteria were identified by plating on nutrient agar media and incubation for 48 hour at 37° C.

Epifluorescent stains were used for the total bacteria count. Lipopolysaccharide levels were determined by endotoxin activity measurements. Polyoside contents were determined by the colometric method, and the chemical oxygen demand was measured to evaluate the amount of organic substance. Biofilms detached from tubing samples drawn from the water path, bicarbonate path, and fresh dialysate path within dialysis machines contained approximately 1310^3-1310^6 total bacteria/cm^2, yet only some living bacteria were found. Endotoxin levels ranged from 1 to 12 EU/cm^2.

In contrast in the dialysate fluid, no bacteria were found, and the endotoxin content was below the detection level of the method. The polyoside content and chemical oxygen demand of the biomass ranged from 11 to 83 µg/cm^2 and from 53 to 234 µg/cm^2, respectively.

The authors concluded that a germ- and endotoxin-free dialysate does not exclude the risks and hazards of bacteria and endotoxin discharge from biofilm developed on the fluid pathway tubing, acting as a reservoir for continuous contamination, and efforts in the optimization of cleaning and disinfection procedures used for hemodialysis systems should aim to detach and neutralize biofilm when necessary.

FROM: Man NK, Degremont A, Darbord JC, Collet M, Vaillant P. Evidence of bacterial biofilm in tubing from hydraulic pathway of hemodialysis system. *Artif Organs* 1998;22:596-600.

Microbial Contamination of Endoscopes After Manual Cleaning

Colonoscopes and other types of endoscopes that are exposed to the intestinal tract present a special bacterial decontamination challenge because the colon has a large and diverse microbial population. Chu and coinvestigators from Advanced Sterilization Products, Irvine, California, conducted a study to determine the levels and types of microorganisms (bioburden) present on flexible gastrointestinal endoscopes. The bioburden of colonoscope insertion-tube surfaces and suction channels were determined after use and after manual cleaning. After use, the bioburden in suction channels averaged 7.0×10^9 colony-forming units (cfu); cleaning reduced this level to 1.3×10^5. Cleaning of tube surfaces reduced the after-use bioburden from a level of 5.1×10^5 to 2.2×10^4 cfu.

Gram-negative rods accounted for approximately 99% of the bioburden within the suction channel after use and after cleaning. After use, microbial flora were predominantly *Escherichia coli* and *Bacteroides.* The flora shifted to waterborne *Pseudomonas* organisms and other members of the family *Enterobacteriaceae* after cleaning. Gram-positive bacteria were the primary isolates from the device surfaces both after use (56%) and after cleaning (47%). Because gram-positive cocci and diphtheroids are a part of the normal microbiota of the skin, these bacteria may have been introduced by the hospital environment or by handling.

After the cleaning of in-use colonoscopes, fewer than 10^6 vegetative bacteria could be recovered. This value is several logs lower than some previous estimates. This finding may be useful in the formulation of sterilization and disinfection cycles. Microflora from the colonoscopes indicated that the cleaning process introduced waterborne and enteric microorganisms, which highlights the importance of sanitation in the device reprocessing area.

FROM: Chu NS, McAlister D, Antonoplos PA. Natural bioburden levels detected on flexible gastrointestinal endoscopes after clinical use and manual cleaning. *Gastrointest Endosc* 1998;48:137-142.

Acinetobacter baumanii Outbreak

Acinetobacter baumanii is an important opportunistic pathogen that is evolving rapidly toward multidrug resistance and is involved in various nosocomial infections that often are severe. It is difficult to prevent *A baumanii* infection because *A baumanii* is ubiquitous and the epidemiology of the infections it causes is complex. Researchers at the Hotel-Dieu Hospital, Nantez, France, longitudinally analyzed the epidemiology of infections caused by *A baumanii* in a medical and surgical intensive-care unit for almost 5 years and assessed the relation between fluoroquinolone use and the persistence of multidrug-resistant clones.

Three case-control studies and a retrospective cohort study were conducted in a 20-bed medical and surgical intensive-care unit. *A baumanii* was isolated from 45 patients in urine (31%), the lower respiratory tract (26.7%), wounds (17.8%), blood (11.1%), skin (6.7%), cerebrospinal fluid (4.4%), and sinus specimens (2.2%). One death was due to *A baumanii* infection.

Antimicrobial resistance pattern and molecular typing were used to characterize isolates. The incidence of *A baumanii* infection and the use of fluoroquinolones were calculated annually. Initially, 28 patients developed *A baumanii* infection. Eleven isolates had the same antimicrobial susceptibility profile, genotypic profile, or both (epidemic cases), and 17 were heterogeneous (endemic cases). A surgical procedure done in an emergency operating room was the main risk factor for epidemic cases, whereas previous receipt of a fluoroquinolone was the only risk factor for endemic cases. The opening of a new operating room combined with the restriction of fluoroquinolone use contributed to a transitory reduction in the incidence of infection. When a third epidemiological study was done, previous receipt of a fluoroquinolone was again an independent risk factor, and a parallel was seen between the amount of intravenous fluoroquinolones prescribed and the incidence of endemic infection. Epidemic infections coexisted with endemic infections favored by the selection pressure of intravenous fluoroquinolones.

FROM: Villers D, Espaze E, Coste-Burel M, Giauffret F, Ninin E, Nicolas F, et al. Nosocomial *Acinetobacter baumanii* infections: microbiological and clinical epidemiology. *Ann Intern Med* 1998;129:182-189.

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