patch at the skin-catheter junction; daily bathing of ICU patients with chlorhexidine; application of semitransparent access-site dressings (for ease of bathing and site inspection and protection of the site from secretions); avoidance of the femoral site for catheterization because of a higher risk of infection (most likely related to the density of the skin flora); rotation of peripheral catheters to a new site at specified intervals (e.g., every 72–96 h), which may be facilitated by use of an IV therapy team; and application of aseptic technique when accessing pressure transducers or other vascular ports.

Unresolved issues include the role of gut translocation rather than vascular access sites as a cause of primary bacteremia in immunocompromised patients and the implications for surveillance definitions; the best frequency for rotation of CVC sites (given that guidewire-assisted catheter changes at the same site do not lessen and can even increase infection risk); the appropriate role of mupirocin ointment, a topical antibiotic with excellent antistaphylococcal activity, in site care; the relative degrees of risk posed by peripherally inserted central catheters (PICC lines); and the risk-benefit of prophylactic use of heparin (to avoid catheter thrombi, which may be associated with increased risk of infection) or of vancomycin or alcohol (as catheter flushes or "locks"—i.e., concentrated anti-infective solutions instilled into the catheter lumen) for high-risk patients.

Vascular device–related infection is suspected on the basis of the appearance of the catheter site or the presence of fever or bacteremia without another source in patients with vascular catheters. The diagnosis is confirmed by the recovery of the same species of microorganism from peripheral-blood cultures (preferably two samples drawn from peripheral veins by separate venipunctures) and from semiquantitative or quantitative cultures of the vascular catheter tip. Less commonly used diagnostic measures include (1) differential (faster) time to positivity (>2 h) for blood drawn through the vascular access device than for a sample from a peripheral vein and (2) differences in quantitative cultures (a threefold or greater "step-up") for blood samples drawn simultaneously from a peripheral vein and from a CVC, which should show the step-up if infected. When infusion-related sepsis is considered (e.g., because of the abrupt onset of fever or shock temporally related to infusion therapy), a sample of the infusate or blood product should be retained for culture.

Therapy for vascular access–related infection is directed at the pathogen recovered from the blood and/or infected site. Important considerations in treatment are the need for an echocardiogram (to evaluate the patient for endocarditis), the duration of therapy, and the need to remove potentially infected catheters. In one report, approximately one-fourth of patients with intravascular catheter–associated *S. aureus* bacteremia who were studied by transesophageal echocardiography had evidence of endocarditis; this test may be useful in determining the appropriate duration of treatment.

Detailed consensus guidelines for the management of intravascular catheter–related infections have been published and recommend catheter removal in most cases of bacteremia or fungemia due to nontunneled CVCs. When attempting to salvage a potentially infected catheter, some clinicians use the "antibiotic lock" technique, which may facilitate penetration of infected biofilms, in addition to systemic antimicrobial therapy (see *www.idsociety.org/Other_Guidelines/*).

The authors of the consensus treatment guidelines advise that the decision to remove a tunneled catheter or implanted device suspected of being the source of bacteremia or fungemia should be based on the severity of the patient's illness, the strength of evidence that the device is infected, the presence of local or systemic complications, an assessment of the specific pathogens, and the patient's response to antimicrobial therapy if the catheter or device is initially retained. For patients with track-site infection, successful therapy without catheter removal is unusual. For patients with suppurative venous thrombophlebitis, excision of affected veins is usually required.

ISOLATION TECHNIQUES

Written policies for the isolation of infectious patients are a standard component of infection control programs. To replace its prior pathogen-specific guidelines, the CDC published recommendations in 2006 for the control of multidrug-resistant organisms in health care settings; in 2007, the CDC published a revised edition of its basic isolation guidelines to provide updated recommendations for all components of health care, including acute-care hospitals and long-term, ambulatory, and home-care settings (see *www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf*).

Standard precautions are designed for the care of all patients in hospitals and aim to reduce the risk of transmission of microorganisms from both recognized and unrecognized sources. These precautions include gloving as well as hand cleansing for potential contact with (1) blood; (2) all other body fluids, secretions, and excretions, whether or not they contain visible blood; (3) nonintact skin; and (4) mucous membranes. Depending on exposure risks, standard precautions also include use of masks, eye protection, and gowns.

Precautions for the care of patients with potentially contagious clinical syndromes (e.g., acute diarrhea) or with suspected or diagnosed colonization or infection by transmissible pathogens are based on probable routes of transmission: *airborne*, *droplet*, or *contact*, for which personnel don, at a minimum, N95 respirators, surgical face masks, or glove and gown, respectively. Sets of precautions may be combined for diseases that have more than one route of transmission (e.g., contact and airborne isolation for varicella).

Some prevalent antibiotic-resistant pathogens, particularly those that colonize the gastrointestinal tract (e.g., vancomycin-resistant enterococci [VRE] and even multidrug-resistant gram-negative bacilli such as carbapenemase-producing strains of *K. pneumoniae* [KPCs]), may be present on *intact* skin of patients in hospitals (the "fecal patina"). This issue has led some experts to recommend gloving for all contact with patients who are acutely ill and/or in high-risk units, such as ICUs or LTACHs. Wearing gloves does not replace the need for hand hygiene because hands sometimes (in up to 20% of interactions) become contaminated during wearing or removal of gloves.

EPIDEMIC AND EMERGING PROBLEMS

Outbreaks are always big news but probably account for <5% of nosocomial infections. The investigation and control of nosocomial epidemics require that infection control personnel (1) develop a case definition, (2) confirm that an outbreak really exists (since apparent epidemics may actually be pseudo-outbreaks due to surveillance or laboratory artifacts), (3) review aseptic practices and disinfectant use, (4) determine the extent of the outbreak, (5) perform an epidemiologic investigation to determine modes of transmission, (6) work closely with microbiology personnel to culture for common sources or personnel carriers as appropriate and to type epidemiologically important isolates, and (7) heighten surveillance to judge the effect of control measures. Control measures generally include reinforcing routine aseptic practices and hand hygiene, ensuring appropriate isolation of cases (and instituting cohort isolation and nursing if needed), and implementing further controls on the basis of the investigation's findings. Examples of some emerging and potential epidemic problems follow.

VIRAL RESPIRATORY INFECTIONS: PANDEMIC INFLUENZA

Infections caused by the severe acute respiratory syndrome (SARS)–associated coronavirus challenged health care systems globally in 2003 (Chap. 223), and in 2012 Middle East respiratory syndrome coronavirus (MERS-CoV) emerged as a more geographically localized problem (Chap. 223). For SARS, basic infection-control measures helped to keep the worldwide case and death counts at ~8000 and ~800, respectively, although the virus was unforgiving of lapses in protocol adherence or laboratory biosafety. The epidemiology of SARS—spread largely in households once patients were ill or in hospitals—contrasts markedly with that of influenza (Chap. 224), which is often contagious a day before symptom onset; can spread rapidly in the community among nonimmune persons; and, even in its seasonal variety, kills as many as 35,000 persons each year in the United States.

Control of seasonal influenza has depended on (1) the use of effective vaccines, with increasingly broad evidence-based recommendations for vaccination of children, the general public, and health care