

918 should be cultured. If cultures yield *Legionella* and if typing of clinical and environmental isolates reveals a correlation, eradication measures should be pursued. An alternative approach is to periodically culture tap water in wards housing high-risk patients. If *Legionella* is found, a concerted effort should be made to culture samples from all patients with nosocomial pneumonia for *Legionella*.

ANTIBIOTIC-RESISTANT BACTERIA

Emerging multidrug-resistant bacteria like KPCs are harbingers of a potential “postantibiotic” era. Control of antibiotic resistance depends on close laboratory surveillance, with early detection of problems; on aggressive reinforcement of routine asepsis; on implementation of barrier precautions for all colonized and/or infected patients; on use of patient-surveillance cultures to more fully ascertain the extent of patient colonization; on antimicrobial stewardship to lessen ecologic pressures; and on timely initiation of an epidemiologic investigation when rates increase. Molecular typing (e.g., pulsed-field gel electrophoresis and, most recently, whole-genome sequencing) can help differentiate an outbreak due to a single strain (which necessitates an emphasis on hand hygiene and an evaluation of potential common-source exposures) from a polyclonal outbreak (which requires an emphasis on antibiotic prudence and device bundles; Table 168-4). Continuing emergence of multidrug-resistant organisms suggests that control efforts have been insufficient and that regional or broader (national and global) strategies and interventions are urgently needed (see www.cdc.gov/drugresistance/threat-report-2013/ and www.gov.uk/government/publications/uk-5-year-antimicrobial-resistance-strategy-2013-to-2018/).

Currently, several antibiotic resistance problems are of particular concern. First, over the past decade or so, the emergence of community-associated methicillin-resistant *S. aureus* (CA-MRSA) has been dramatic in many countries, with as many as 50% of community-acquired “staph infections” in some U.S. cities now caused by strains resistant to β -lactam antibiotics (Chap. 172). The incursion of CA-MRSA into hospitals is well documented and has impacted surveillance and control of nosocomial MRSA infections.

Second, in the ongoing global reemergence of nosocomial multidrug-resistant gram-negative bacilli, new problems include plasmid-mediated resistance to fluoroquinolones, metallo- β -lactamase-mediated resistance to carbapenems, KPCs, and panresistant strains of *Acinetobacter*. The problematic New Delhi metallo- β -lactamase (NDM) is plasmid-mediated, has been highly successful in inter-genus transmission, and has quickly become a global threat (see wwwnc.cdc.gov/eid/article/17/10/11-0655_article.htm). For several years, KPCs were a very focal problem in the United States (predominantly in Brooklyn, NY), but more recently these strains have become a national threat. Many multidrug-resistant gram-negative bacilli are susceptible only to colistin, a drug that is consequently being “rediscovered,” or to no available agents.

Third, there has been renewed recognition of the role of nursing homes, and now LTACHs, in the spread of resistant gram-negative bacilli such as KPCs. In some LTACHs, as many as 30–50% of patients may be colonized with KPCs.

Fourth, there has been increasing community-based spread of *E. coli* strains harboring an enzyme, CTX-M, that renders them broadly resistant to β -lactam antibiotics. Given the community focus of spread, these strains may be seen as a gram-negative version of CA-MRSA.

Finally, clinical infections with MRSA strains exhibiting high-level vancomycin resistance due to VRE-derived plasmids have been reported in a few patients—almost all in the United States and most in Michigan—in the setting of prolonged or repeated treatment with vancomycin and/or VRE colonization. Much more common is vancomycin “MIC creep”: an increasing prevalence of MRSA strains that exhibit upper-limit susceptibility to vancomycin.

Colonized personnel who are implicated in nosocomial transmission of multidrug-resistant pathogens and patients who pose a threat can be decontaminated, depending on the pathogen. In a few ICUs,

nonabsorbed antimicrobial agents for gastrointestinal decontamination of patients have been used successfully as a temporary emergency control measure for outbreaks of infection due to gram-negative bacilli. Potentially, manipulation of patients’ intestinal microbiome could be a more durable strategy to control outbreaks of multidrug-resistant pathogens that have a gastrointestinal reservoir.



In several trials over the past 10 years, source control—i.e., removal of patients’ fecal patina—by daily bathing with chlorhexidine has reduced the risk of bacteremia in ICU patients. “Search-and-destroy” methods—i.e., active surveillance cultures to detect and isolate the “resistance iceberg” of patients colonized with MRSA—in nonoutbreak settings are credited with elimination of nosocomial MRSA in the Netherlands and Denmark. In a recent multicenter trial in the United States, universal source control with chlorhexidine and nasal mupirocin was significantly more effective for controlling MRSA than was a search-and-destroy approach and led to control of other pathogens as well, providing a broad (“horizontal”) rather than a narrower (“vertical”) intervention (see www.ahrq.gov/professionals/systems/hospital/universal_icu_decolonization/). For some pathogens, such as VRE, enforcement of environmental cleaning also reduces cross-transmission risk.

Because the excessive use of broad-spectrum antibiotics underlies many resistance problems, “antibiotic stewardship” has been promulgated actively. The main tenets are to restrict the use of particular agents to narrowly defined indications in order to limit selective pressure on the nosocomial flora and, when broad-spectrum therapy is begun empirically in critically ill patients, to “de-escalate” treatment as soon as possible on the basis of the results of culture and susceptibility tests.

BIOTERRORISM AND OTHER “SURGE-EVENT” PREPAREDNESS



The horrific attack on the World Trade Center in New York City on September 11, 2001; the subsequent mailings of anthrax spores in the United States; the Boston Marathon bombing in 2013; and ongoing revelations of terrorist plans and activities in many other countries as well as the United States have made bioterrorism a prominent source of concern to hospital infection-control programs. The essentials for hospital preparedness entail education, internal and external communication, and risk assessment. Up-to-date information is available from the CDC (see www.bt.cdc.gov).

EMPLOYEE HEALTH SERVICE ISSUES

An institution’s employee health service is a critical component of its infection control efforts. New employees should be processed through the service, where a contagious-disease history can be taken; evidence of immunity to a variety of diseases, such as hepatitis B, chickenpox, measles, mumps, and rubella, can be sought; immunizations for hepatitis B, measles, mumps, rubella, varicella, and pertussis (the only vaccine-preventable childhood disease that is on the rise again in the United States) can be given as needed; baseline tuberculosis testing can be performed; and education about personal responsibility for infection control can be initiated. Evaluations of employees should be codified to meet the requirements of accrediting and regulatory agencies.

The employee health service must have protocols for dealing with workers exposed to contagious diseases (e.g., influenza) and those percutaneously or mucosally exposed to the blood of patients infected with HIV or hepatitis B or C virus. For example, postexposure HIV prophylaxis (PEP) with combination antiretroviral agents is recommended, as indicated; free consultation is available from the CDC-funded PEPLine (888-HIV-4911). Protocols are also needed for dealing with caregivers who have common contagious diseases (such as chickenpox, group A streptococcal infection, influenza or another respiratory infection, or infectious diarrhea) and for those who have less common but high-visibility public health problems (such as chronic hepatitis B or C or HIV infection) for which exposure-control guidelines have been published by the CDC and by the Society for Healthcare Epidemiology of America.