of all epidemiologists working in state and territorial health department have no formal academic training in that discipline. States reported that approximately 48% of epidemiologists work in infectious diseases (a figure that is close to optimal), but that the rest of the public health disciplines, such as chronic disease, maternal child health, occupational health, oral health, bioterrorism/emergency preparedness, injury, and environmental health, are far below optimal capacity; further, >60% of states epidemiologic funding support comes from federal sources. Most states reported having an insufficient number of epidemiology staff and resources to carry out essential public health services.

In response to the training needs identified by this assessment, CSTE, CDC, and Association of Schools of Public Health developed a 2-year applied epidemiology training fellowship that places trainees in state health departments. CSTE hosted the first national epidemiology workforce summit in January 2004 to identify strategies for building epidemiologic capacity in the U.S. public health system.

Infectious disease testing is one of the core capacities of public health laboratories. Such laboratories play a key role in supporting outbreak investigation and surveillance activities. Public health laboratory staff must meet unique requirements and posses technical skills that require a long learning curve. Staff also need to have the knowledge of public health principals and relevance of their work to public health activities. Special recruitment and retention issues are challenging the public health laboratory workforce, including increasing vacancy rates and an increasing demand for skilled workers in light of the Select Agent Rule. At the same time, technology is changing rapidly, with new tests emerging almost daily. Solutions offered were salary parity with the private sector, innovative training, creation of interest in laboratory sciences, and continuing education. The National Laboratory Training Network has helped by offering courses, and Emerging Infectious Diseases fellowships are also attracting new workers. In 2000, Association of Public Health Laboratories survey of state laboratory directors led to the "Green Book," which forecasts impending vacancies up to 40% in certain public health laboratory areas. This finding led to the development of the Center for Public Health Laboratory Leadership, which offers corrective courses and ventures.

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Methicillin-Resistant *Staphylococcus aureus*[1]

Methicillin-resistant *Staphylococcus aureus* (MRSA) is first and foremost a pathogen of healthcare settings. It is the most common pathogen associated with nosocomial infections in the United States, particularly nosocomial pneumonia and surgical site infections. It is also a frequent cause of bloodstream and skin and soft tissue infections. The percentage of *S. aureus* isolates resistant to oxacillin/methicillin in U.S. intensive care units increased from 30% to 40% in the mid-1990s to 57% in 2002.

Data from a recent Duke Infection Control Outreach Network survey indicate that of patients with healthcare-associated MRSA infections, 39% were from nursing homes, 37% had been hospitalized in the previous 90 days, 10% had received home health care, and 10% received dialysis. Data suggest that MRSA bacteremia is associated with an increased likelihood of death, longer hospital stays, and increased cost of hospitalization, when compared with bacteremia levels caused by methicillin-susceptible strains. Increasing resistance to vancomycin among MRSA also complicates therapy, which is already difficult because of multidrug resistance among healthcare-associated MRSA. Because spread of MRSA in healthcare settings is often clonal, hand hygiene and barrier precautions are often effective in interrupting spread. Targeted surveillance for MRSA is also a useful aid for infection control. Data from the Duke network indicate that the spread of MRSA can be curtailed in healthcare settings, given vigilance and adequate funding of infection control activities.

MRSA is now spreading in community settings. Reports from the early 1980s indicate that patients in the community without established risk factors for MRSA (i.e., recent hospitalization, residence in a long-term care facility, or dialysis) sought medical care with MRSA infections. In the late 1990s, four children in Minnesota and North Dakota died from community-associated MRSA

[1]Presenters: Keith Kaye, Duke University; Ruth Lynnfield, Minnesota State Department of Heath; and Barry Kreiswirth, New York University Public Heath Research Institute.

infections. The isolates were susceptible to most non-β-lactam drugs, had pulsed-field gel electrophoresis (PFGE) profiles that differed from typical healthcare-associated MRSA, and contained the Panton-Valentine leukocidin toxin. Prospective surveillance for MRSA in Minnesota at 12 sentinel hospitals (6 in metropolitan areas and 6 in rural areas) indicated that community-associated MRSA patients were significantly younger than healthcare-associated MRSA patients and more likely to have skin and soft tissue infections than respiratory or urinary tract infections. A study in Texas showed that incision and drainage of abscesses due to community-associated MRSA was more effective management than administering antimicrobial agents alone, particularly since many patients were given ineffective antimicrobial agents (i.e., β-lactam agents).

Molecular analysis of the community-associated MRSA strains showed that the methicillin resistance gene *mecA* is typically carried on a much smaller genetic element than is seen in healthcare-associated MRSA. Four distinct elements, called staphylococcal chromosome cassette mec (or SCCmec), have been described. In the United States, SCCmec type II, which is approximately 60 kb in size and also carries an erythromycin resistance determinant, predominates among healthcare-associated MRSA, while SCCmec type IV, which is only 23 kb in length and carries no other resistance determinants, is typically associated with community-associated MRSA. Three major strain typing methods, PFGE, multi-locus sequence typing (MLST), and staphylococcal protein A typing (spa typing), are used to study the spread of MRSA. MLST identified a series of five major lineages (also called clonal complexes) of MRSA globally, while spa typing and PFGE subdivide this group into approximately a dozen epidemic clones. Virulence determinates for MRSA include a series of enterotoxins, toxic shock toxin, and the Panton-Valentine leukocidin toxin.

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Battling 21st-Century Scourges with a 14th-Century Toolbox[1]

A range of quarantine approaches were used in five jurisdictions heavily affected by the outbreak of severe acute respiratory syndrome (SARS) in 2003. Implementation of modern quarantine was resource intensive, involved coordination of multiple sectors of society, frequently required new legislative actions or authorities, and was highly dependent on effective communication.

In Toronto, Ontario, Canada, quarantine ranged from home quarantine with active surveillance to enhanced passive surveillance augmented by education about prevention and a contact number to call if symptoms developed. Healthcare workers were occasionally required to adhere to "work quarantine." New legislation in Ontario authorized compulsory quarantine with active follow-up for compliance. Although 30,000 people in Toronto were recommended for quarantine, enforcement orders had to be issued in only 27 instances. A comprehensive infrastructure was developed to support those in quarantine; masks, thermometers, food, and financial assistance, as well as psychosocial support, were provided. Should SARS return to Toronto, the same measures would be used to ensure that close contacts of infected persons are isolated and actively monitored.

In Taiwan, from April 28 to July 4, 2003, travelers arriving from World Health Organization–designated SARS-affected areas were quarantined for 10 days (level B quarantine). During the SARS epidemic, 50,319 persons who were close contacts of SARS patients were placed under level A quarantine; suspected or probable SARS was diagnosed for 112 (0.22%). A total of 80,813 persons were placed under level B quarantine; 21 (0.03%) of these cases were diagnosed as suspected or probable SARS. The strategies were later modified as understanding of the infectivity of SARS increased, so that close contacts and travelers from local transmission areas were required to follow guidelines of self health management, including isolation at home only when they had a fever. Fever monitoring at international ports initially continued year-round; its ongoing utility will be further examined.

Singapore relied on effective quarantine of all persons who had unprotected close contact with symptomatic case-patients. Critical systems were implemented for quarantine

[1]Presenters: Bonnie Henry, Toronto Public Health; Ih-Jen Su, Center for Disease Control, Taipei; Souk Kai Chew, Medical Services Epidemiology and Disease Control, Singapore; Thomas Tsang, Hong Kong Department of Health; and Zonghan Zhu, Beijing Municipal Health Bureau.