Building a Surveillance Framework for Drug-Resistant *Streptococcus pneumoniae* and Methicillin-Resistant *Staphylococcus aureus*

SURVEILLANCE CONFERENCE: IMPROVING STATE-BASED SURVEILLANCE
MARCH 12-13, 2003
ATLANTA, GEORGIA

Division of Healthcare Quality Promotion/
Division of Bacterial and Mycotic Diseases
National Center for Infectious Diseases
Centers for Disease Control and Prevention

MEETING SUMMARY

The Centers for Disease Control and Prevention (CDC) convened a conference on March 12-13, 2003, in Atlanta, Georgia, to consider state-based surveillance for drug-resistant streptococcus pneumoniae (DRSP) and methicillin-resistant staphylococcus aureus (MRSA) in the United States. The conference was chaired jointly by the Division of Healthcare Quality Promotion (DHQP) and the Division of Bacterial and Mycotic Diseases (DBMD), National Center for Infectious Diseases (NCID).

WEDNESDAY, MARCH 13, 2003

RIBBON CUTTING: Welcome and Opening Remarks
D*r. Scott Fridkin, DHQP, NCID, CDC*

Dr. Fridkin welcomed the participants and reviewed the agenda. The goals of the meeting are to: 1) provide an overview of the scientific studies conducted by DHQP and DBMD to identify valid and meaningful ways to perform surveillance for DRSP and MRSA at the state level, 2) share lessons learned from states' experiences in monitoring DRSP and MRSA and implementing prevention programs, and 3) provide an informal setting for a two-way exchange between CDC and the state health departments that are engaged in DRSP and MRSA surveillance.

SELECTING YOUR BLUEPRINT: The Need for Good Surveillance Data
Dr. Todd Weber, Assistant to the Director (Acting) for Antimicrobial Resistance, NCID, CDC

Public health surveillance is the ongoing, systematic collection, analysis, and interpretation of data essential to the planning, implementation, and evaluation of public health practice. Effective surveillance requires synthesis of data, timely dissemination of data, and integration of data with decision making about prevention and control. Surveillance data on antimicrobial resistance can be used to: 1) describe the scope and magnitude of the problem 2) determine the impact, 3) evaluate prevention programs, 4) promote the development of new antimicrobial agents and diagnostic tools, and 4) generate resources. Surveillance for antimicrobial resistance poses unique challenges, however, because of the large amount of laboratory data required for the characterization of cases, the changing patterns and mechanisms of resistance, the effect of patterns of antimicrobial use, and difficulties in attributing outcomes.

In 1999, CDC jointed with other federal agencies to create an Interagency Task Force on Antimicrobial Resistance. The Task Force subsequently developed a Public Health Action Plan to Combat Antimicrobial Resistance, which was published in January 2001. The Plan provides a blueprint for coordinated federal actions to address the emerging threat of antimicrobial resistance. It designates priorities, identifies responsible agencies, and creates timelines for action items in four areas: surveillance, prevention and control, research, and product development. Implementation has been

contingent on the availability of resources. The next increment of resources will be used to improve surveillance, prevention, and control in states, communities, and healthcare systems.

Why Monitor Drug Resistance: The Case for *Streptococcus pneumoniae*
Dr. Cynthia Whitney, DBMD, NCID, CDC

There are clear reasons to track drug resistance in *Streptococcus pneumoniae.*

- *S. pneumoniae* is a major cause of both common infections and less common but serious diseases. In the United States in 1999, *S. pneumoniae* infections caused 125,000 hospitalizations for pneumonia, 63,000 bloodstream infections, 3,000 cases of meningitis, 5 million cases of otitis media in children, and at least 1 million additional cases of otitis media in adults.
- Drug resistance in *S. pneumoniae* is becoming more common. Since the early 1990s, the prevalence of invasive isolates with both single and multiple resistance has been increasing rapidly. This increase is notable because resistance can lead to treatment failures for pneumococcal meningitis and otitis media. High-level resistance can also affect treatment of pneumococcal pneumonia.
- Tools to intervene against resistance are now available. These include the 7-valent pneumococcal conjugate vaccine (PCV-7; Prevnar™) licensed in February 2000 and the federally- and non-federally-funded appropriate antibiotic use programs throughout the country.
- Prevention programs require local data on resistance. Once data are collected, they can be used to raise local awareness of the problem, monitor trends, detect the emergence of new resistance profiles, identify high-prevalence areas needing intervention, provide data on the impact of prevention efforts (vaccine, appropriate use campaigns), and, in some cases, guide the development of national and local clinical management guidelines.

Many states have already recognized the importance of monitoring the spread of this pathogen and have implemented state reporting requirements for invasive *S. pneumoniae* (ISP) disease in children <5 years and for drug-resistant *S. pneumoniae*.

Why Monitor Drug Resistance: The Case for *Staphylococcus aureus*
Dr. Scott Fridkin, DHQP, NCID, CDC

The United States has witnessed three changes in the epidemiology and biology of methicillin-resistant *S. aureus*: 1) continuing increases in MRSA in hospitalized patients, 2) emergence and transmission of community-onset MRSA, and 3) emergence of vancomycin-resistant *S. aureus* (VRSA).

CDC has been monitoring MRSA for decades, with a focus on hospitalized patients. Since the early 1990s, the proportion of nosocomial *S. aureus* infections that are resistant to oxacillin (MRSA) has risen steadily, with the prevalence of MRSA isolates from intensive-care units reaching 50% by 1999. An estimated 290,000 U.S. patients were

hospitalized with *S. aureus* infections in 2000; of these, 41.5% were MRSA, resulting in 120,000 MRSA infections.

In the late 1990s, National Nosocomial Infections Surveillance (NNIS) data began to show dramatically increasing proportions of MRSA in outpatient areas. Subsequently, CDC began investigating outbreaks of MRSA in non-healthcare settings. Outbreaks have occurred among competitive sports teams, persons in correctional facilities, school children, and, most recently, men who have sex with men. CDC has also conducted prospective studies to evaluate the relationship between carriage in the community and community-onset disease in persons without established risk factors. These studies have yielded estimated carriage rates of 1%-5% and a population-based rate of 180 MRSA infections/100,000; 10% of these cases may be in persons with community-onset disease.

Given the changing epidemiology of MRSA, CDC has developed new terminology to shift the focus from where pathogens are acquired to where infections occur. The working vocabulary includes the following:

- Healthcare-onset infection (nosocomial) – includes hospital-onset, dialysis unit-onset, long-term care-onset, and other infections with strong links to health care
- Community-onset infection – onset outside a healthcare facility
- Healthcare-associated infection – hospital-onset or community-onset in persons with established risk factors (previous MRSA or, in past year: hospitalization/ long-term care, surgery, dialysis, current use of invasive device
- Community-associated infection – community-onset in persons without established risk factors

Community-onset MRSA has some unique biological characteristics:

- PFGE patterns appeared to be different from those for typical hospital strains.
- Isolates are susceptible to non-beta-lactam agents.
- Unique toxic genes are more prevalent in community-onset cases.
- A unique resistance element (staphylococcal chromosome cassette [SCC*mec*] IV) has been described in selected community-onset strains. SCC*mec* IV is smaller than SCC*mec* I, II, and III (hospital strains) and might be more mobile.

A third development is the emergence of *S. aureus* that is fully resistant to vancomycin (VRSA). The first two confirmed clinical infections caused by VRSA occurred in 2002, both in outpatient settings. The response to the emergence of VRSA includes: 1) improved detection in clinical laboratories, 2) improved communication between health departments and clinical microbiology labs, and 3) efforts to make VRSA reportable.

The outbreaks of MRSA in new populations, the unique biology of community-associated MRSA, and the emergence of VRSA in outpatient settings underscore the need for comprehensive and timely MRSA surveillance data from a variety of sources. Surveillance data are needed to: 1) understand the changing epidemiology of MRSA, 2) develop a framework for implementing prevention programs, and 3) facilitate outbreak response and treatment guidance. Given the inevitable limitations in treatment options in the era of vancomycin-resistant *S. aureus*, timely data will be essential. CDC is

committed to providing technical assistance and leadership and encouraging interactive development of state-based surveillance efforts.

BREAKING GROUND PLENARY: How to Get Started

DRSP Surveillance in New Mexico
Dr. Bernadette Albanese, New Mexico Department of Health

Both invasive and drug-resistant *S. pneumoniae* were added to New Mexico's Notifiable Condition List in 1997. Drug resistance was defined as nonsusceptibility to any antimicrobial drug tested by a clinical laboratory. Surveillance included both invasive and drug-resistant non-invasive isolates. All isolates were to be forwarded to the state public health lab. Reporting was passive and generated mainly from clinical laboratories.

For the first 3 years, the data were not reviewed. An evaluation conducted in 2000-2001 revealed: 1) low numbers of reported cases, presumably the result of underreporting by laboratories and poor reporting from other sources, 2) data errors (e.g., misinterpretation of culture results, incorrect classification of invasive vs. noninvasive isolates, incomplete/inaccurate data on clinical syndrome, incorrect data entry), 3) inaccurate reporting of data in summary reports, and 4) lack of information on isolates sent to the state laboratory.

Subsequent efforts to improve surveillance included:

- Conducting a survey of clinical laboratories to evaluate susceptibility testing methods and reporting practices, which found that only 30% of clinical laboratories were sending isolates to the state laboratory
- Modifying reporting requirements to include all invasive isolates and only penicillin-nonsusceptible noninvasive isolates
- Creating a flow chart and instruction sheets for reporting sources
- Reinforcing the need to send isolates to the state lab and providing supplies
- Asking laboratories to fax susceptibility results to the state lab
- Repeating susceptibility testing and performing serotyping at the state laboratory
- Following up laboratory mailings with instructions
- Conducting site visits to larger clinical laboratories

As a result, the number of reported cases increased by 85% between 1999 and 2001. The percentage of cases with isolates sent to the state laboratory increased from 11% to 38% over the same period.

In 2001, 197 of 350 reported cases were invasive. (Given the lack of denominator data, results for the penicillin-nonsusceptible noninvasive cases were found to be of little value; in 2003, reporting was limited to invasive cases only.) Labs provided susceptibility reports for 82% of invasive cases but sent isolates to the state lab for only 36%. Most (91%) of the culture specimens for invasive cases were from blood. Data on clinical syndromes were limited. Incidence rates for invasive *S. pneumoniae* peaked in very young children and among the elderly. The overall incidence rate for the state was 10.7/100,000, about half of what would be expected based on national estimates.

Overall, invasive isolates were 20% nonsusceptible and 8% resistant. In children ages 1-4 years, 35% of invasive cases were penicillin nonsusceptible. The percent agreement between clinical laboratory and state lab susceptibility results ranged from 67% to 100%; 9 of 12 labs participating in a quality assurance exercise had at least one discrepant result.

New Mexico's experience yielded several lessons about conducting DRSP surveillance:

- Do:
  - Be proactive; assign staff to the surveillance program.
  - Determine what data you want to collect (desired data vs. notifiable disease requirements vs. data that can be obtained consistently and accurately)
  - Decide if isolates need to be collected centrally.
  - Focus on laboratories; make site visits.
  - Analyze data annually, and disseminate results promptly.
- Do not:
  - Ignore data.
  - Track noninvasive cases (unless denominator data are available).
  - Assume that everyone understands the data collection/interpretation process.
  - Give up.

As the tenth Emerging Infections Program (EIP) site, New Mexico will be incorporated into the active population-based surveillance program. Other surveillance plans include: 1) changing the Notifiable Condition List to include only invasive *S. pneumoniae*, 2) discontinuing repeat susceptibility testing and serotyping at the state laboratory, and 3) continuing annual analyses and reports.

Implementing DRSP Sentinel Surveillance in Colorado
Dr. Ken Gershman, Colorado Department of Public Health & Environment

Colorado has had Epidemiology and Laboratory Capacity (ELC) funding since October 1995. The DRSP surveillance method proposed in the original application was isolate-based sentinel surveillance (submission of invasive isolates from a sample of hospitals); the health department abandoned this effort and switched to data submission only in 1997. When Colorado became an EIP site in 2000, sentinel surveillance was discontinued in the five-county Denver metropolitan area and replaced with active, population-based surveillance. In the Denver metropolitan area, all invasive *S. pneumoniae* isolates are submitted to the state laboratory and forwarded to a reference lab for antibiotic susceptibility testing. Other regions of the state continue to conduct sentinel surveillance.

Colorado's initial experience demonstrated the difficulties in conducting isolate-based sentinel surveillance for DRSP; only 11 of 22 hospitals submitted all or nearly all isolates. The program also required considerable laboratory resources for minimum inhibitory concentration (MIC) testing and epidemiology resources for tracking and facilitating submission of isolates and managing and analyzing data. In September 1997, the effort was discontinued and replaced with a program of enhanced sentinel surveillance in which participating hospitals submit monthly summaries of results of their

antibiotic susceptibility testing of invasive (blood and CSF) *S. pneumoniae* isolates to penicillin and cefotaxime. Currently, 17 hospitals outside the Denver metropolitan area submit reports.

In June 1998, DRSP was added to the list of laboratory-reportable conditions; the decision was based on the need for both numerator and denominator data. Laboratories submit monthly reports by use of a simple, one-page fax form; data are entered into a simple Excel spreadsheet. Monthly reminder calls (as needed) are vitally important in building personal relationships with laboratory staff, which yield two-way benefits. Half-yearly and yearly summaries are mailed to all laboratories; data are also posted on the health department's website and provided to the state's careful antibiotic use project. Limitations of the system include the trade-off between simplicity and the need/desire for more data and challenges related to interpretation of data derived from small numbers.

Challenges of Integrating Difference Surveillance Methods for DRSP
Dr. Kathryn Arnold, Georgia Division of Public Health

Like Colorado, Georgia is a "hybrid" state with two surveillance systems for DRSP. In the 20-county Atlanta metropolitan area, the state's EIP coordinates active surveillance for invasive *S. pneumoniae*, whereas the 159 counties outside the Atlanta metropolitan area have passive surveillance for DRSP. The active surveillance system includes active case-finding for all invasive *S. pneumoniae*, with chart review; monthly audits to ensure complete ascertainment; reporting of penicillin-resistant *S. pneumoniae*; isolate collection; and confirmatory susceptibility testing at the reference laboratory. Until recently, the passive surveillance system outside Atlanta included passive reporting of DRSP and case verification of non-specific reports. Data from the two systems cannot be integrated for analysis.

Georgia views DRSP surveillance as a mechanism to: 1) monitor pneumococcal resistance rates, 2) monitor the impact of pneumococcal conjugate vaccine and appropriate antibiotic use campaigns, 3) characterize resistant clones, and 4) identify significant rare events (e.g., vancomycin resistance). In an analysis of the effect of PCV-7 vaccine on rates of DRSP in Georgia children <5 years, both surveillance methods were able to detect a large impact, although the sensitivity of the passive system was low compared with active surveillance in the EIP area.

The advent of reporting of DRSP in children <5 years introduced some overlapping reporting categories: DRSP, meningitis, and *S. pneumoniae* in children <5. Georgia's solution in 2003 was to make all invasive *S. pneumoniae* reportable. The hope is that the simplification will yield better and more complete reporting from areas outside Atlanta and facilitate the detection of rare events.

Surveillance Methods: Nuts and Bolts
Ms. Elizabeth Zell, NCID, CDC

Surveillance systems have five main elements: 1) case definition, 2) surveillance population, 3) surveillance process, 4) confidentiality, and 5) incentives for participation. Types of surveillance include: active vs. passive surveillance, notifiable disease reporting, laboratory-based surveillance, reporting by volunteer providers, registries, surveys, information systems, sentinel event reporting, and record linkages. Surveillance systems can be evaluated by attributes such as: sensitivity, timeliness, representativeness, predictive value, accuracy/completeness of descriptive information, simplicity, flexibility, and acceptability.

The surveillance population is the population targeted by a defined surveillance system (e.g., hospital patients, school attendees, persons in a particular geographic area). The composition of the population under surveillance determines the generalizability of the findings.

Active, population-based surveillance is the gold standard but is time- and resource-intensive. In an active system, investigators actively seek cases on a routine/regular basis. Cases are reported by defined group (e.g., selected providers, hospitals, laboratories). Reports can be submitted via computer printout, telephone, email, or fax. In an active surveillance system, zero reported cases means no cases. An example is the EIP's Active Bacterial Core Surveillance (ABCs), an active, laboratory-based surveillance system that collects information on the susceptibility patterns of all invasive strains of *S. pneumoniae* in an entire area of surveillance. ABCs has a well-defined case definition and target population and captures 100% of laboratory-diagnosed cases.

In a passive surveillance system, disease reporting is initiated by others and often required by law. The purpose is to monitor trends and assess risk factors for prevention and control. Passive systems typically underreport cases and rates of disease. They are based on the assumption that any biases in reporting are constant/consistent over time. An example is passive reporting of polio in the United States.

A sentinel surveillance system has a limited case-ascertainment area, such as the largest hospital in a geographic area. The limitation to a finite group facilitates the collection of data. Findings are useful for documenting trends but are not population-based. Biased results are possible.

Antibiogram-based surveillance is the collection of cumulative antimicrobial susceptibility test data that are routinely summarized by laboratories. These data are easy to obtain but are not population-based. They allow for routine monitoring for antibiotic nonsusceptibility.

BREAKOUT SESSIONS A: Laying the Foundation
At this point, participants were asked to attend one of the following breakout sessions:

Tracking Resistance Using Sentinel Surveillance
In this session, presenters reported on state sentinel surveillance programs, after which the group discussed the limitations and benefits of this approach. Presenters included:

Dr. Cynthia Whitney, CDC; Mr. Scott Seys, Wyoming State Health Department; and Dr. J. Kathryn MacDonald, Washington State Department of Health.

Preparing for Vancomycin-Resistant *Staphylococcus aureus*
Mr. Jeff Hageman, CDC, and Ms. Dawn Sievert, Michigan Department of Community Health, reviewed the first reports of VRSA and moderated a discussion of enhanced detection and response.

ROUNDTABLE OPTIONS
During the lunch break, participants had the option of attending one of these roundtable discussions:

Developing a DRSP Surveillance Manual
Ms. Leigh Ann Hawley and Dr. Cynthia Whitney led a discussion of CDC's proposed surveillance manual for DRSP.

Developing a Vancomycin-Resistant *S. pneumoniae* Action Plan
Dr. Stephanie Schrag, CDC, moderated a discussion on development of a state and national action plan for vancomycin-resistant *S. pneumoniae.*

TOOLS OF THE TRADE PLENARY: Laboratory Issues

Building a Communication Infrastructure to Report Rare Events
Dr. Norman Crouch, Public Health Laboratory, Minnesota Department of Health

Communication between public health laboratories and private clinical laboratories is essential for the identification of rare events such as changes in susceptibility, new mechanisms of resistance, susceptibility of unusual pathogens, and unexpected sources of resistant organisms. Public-private laboratory requirements for detecting rare events include reliable data, continuous communication, effective collaboration, and willing cooperation. The role of state public health laboratories in identifying rare events centers on: 1) expanded antimicrobial surveillance, 2) reference testing for rare pathogens, 3) applied research, 4) quality assurance of laboratory tests, 5) training in laboratory methods, and 6) establishment of laboratory networks.

Three components contribute to a state public health laboratory's ability to identify rare events: laboratory-epidemiology partnerships, disease-reporting rules, and laboratory networks. In Minnesota, the laboratory-epidemiology partnership is facilitated by physical proximity, daily reporting, and real-time analyses. The state's disease-reporting rule requires submission of isolates to the state public health laboratory for selected reportable conditions, including invasive *S. pneumoniae* and *S. aureus*.

The Minnesota Laboratory System is an integrated network of public and private microbiology laboratories that is important to efforts related to antimicrobial resistance, emerging infectious diseases, infectious disease outbreaks, food safety, bioterrorism preparedness, and quality assurance. Minnesota also participates in CDC's national

laboratory system and the Laboratory Response Network for Bioterrorism. Minnesota's approach to developing a state laboratory network included: 1) identifying all clinical laboratories in the state, 2) conducting a laboratory survey, 3) developing a communications system, 4) providing challenge exercises, and 5) developing a comprehensive database.

Three laboratory network functions are relevant to antimicrobial resistance:

- Surveillance -- An annual antibiogram (i.e., yearly accumulation of sensitivity test data) is distributed to infection control practitioners, infectious disease specialists, and laboratories.
- Quality assurance – Challenge exercises are conducted to identify education and training needs, monitor preparedness and response, and build sustainable partnerships.
- Applied research – The network facilitates research collaborations among epidemiologists, private laboratories, academia, state agriculture staff, and CDC. Collaborative investigations have focused on issues such as quinolone resistance in *Campylobacter*, resistance in enterotoxigenic *E. coli*, and detection of erythromycin resistance in *B. pertussis*.

These types of laboratory network communication facilitate the identification of rare antimicrobial events by: 1) encouraging private laboratories to routinely send isolates to the state lab, 2) communicating unusual sensitivities immediately, 3) confirming unusual sensitivities, 4) ensuring the quality of laboratory data, and 5) ensuring the use of appropriate methods.

Laboratory Issues: Training Resources for Clinical Microbiology Laboratories
Ms. Janet Hindler, UCLA Medical Center

To promote accurate antimicrobial susceptibility testing, NCCLS, the international standards organization, provides specific recommendations for antimicrobial susceptibility testing and reporting of MRSA and DRSP. NCCLS standards for clinical and public health laboratories include: 1) instructions for performing tests, and 2) tables that suggest drugs to test/report, interpretative criteria (breakpoints), and quality control ranges. Both are updated annually. NCCLS antimicrobial susceptibility testing standards describe "reference methods." Clinical laboratories have the option of using either NCCLS methods as written or a method that performs comparably to an NCCLS reference method (e.g., FDA-cleared diagnostic device). Testing and reporting problems can occur with both MRSA and DRSP.

<u>MRSA testing methods and reporting concerns</u>
NCCLS instructions for testing for *S. aureus* provide precise details on inoculum preparation, incubation time and temperature, testing medium, drug concentration, and zones of inhibition. The inoculum must be prepared by a direct colony suspension method adjusted to match the 0.5 McFarland turbidity standard. Incubation is at 35^{o}C for 24 hours. MIC testing uses cation-adjusted Mueller-Hinton broth supplemented with NaCl. The agar screening test for oxacillin resistance in *S. aureus* should use an agar

plate containing 6 µg/ml of oxacillin and Mueller-Hinton agar supplemented with NaCl. Detection of susceptibility can be done by disk diffusion using an oxacillin disk on Mueller-Hinton agar; the plate should be read using transmitted light.

Accurate detection of MRSA can be difficult due to the presence of two subpopulations (one susceptible and the other resistant) that can coexist in a culture. False "susceptible" or false "resistant" results can be due to failure to follow current testing steps precisely, inadequate quality control, test system failure, or inaccurate organism identification. False "resistant" results can be due to testing of mixed cultures, borderline oxacillin-resistant strains, or drug degradation. False "susceptible" results can be due to failure to identify subtle growth as resistant. The FDA has recently approved the commercial PBP2a assay, a new rapid latex agglutination assay for detecting MRSA, but the test is costly, and its applications in clinical laboratories are not yet clear.

The NCCLS tables list antimicrobial agents that should be considered for routine testing and reporting by clinical microbiology laboratories. For *Staphylococcus* spp. Group A, laboratories should test and report oxacillin and penicillin. For *Staphylococcus* spp. Group B, laboratories should test but selectively report azithromycin or clarithromycin or erythromycin; clindamycin; linezolid; trimeth-sulfa; and vancomycin. NCCLS does not address how to report clindamycin results.

Issues of concern related to MRSA reporting include: 1) reporting all beta-lactam agents as resistant; 2) reporting additional agents; 3) recognizing community-acquired MRSA that are not multiply resistant; 4) reporting clindamycin for isolates that are erythromycin-resistant and clindamycin-susceptible; and 5) reporting to appropriate sources in a timely manner.

<u>DRSP testing methods and reporting concerns</u>

As with MRSA, NCCLS instructions for testing for *S. pneumoniae* standardize the inoculum, incubation time and temperature, and requirements for disk and MIC testing. The medium for disk diffusion testing is Mueller-Hinton agar with 5% sheep blood incubated in CO_2 for 20-24 hours at 35^{o}C. Quantitative MIC testing should be done by broth microdilution in cation-adjusted Mueller-Hinton agar with 2.5% lysed horse blood incubated for 20-24 hours at 35^{o}C. Because pneumococci are fragile organisms, only fresh colonies should be used.

The oxacillin disk screen test is a good test for predicting penicillin susceptibility. If the oxacillin zone diameter is ≥20mm, the isolate is susceptible to penicillin, cefotaxime/ ceftriaxone, and other beta-lactams. If the zone diameter is ≤19mm, susceptibility to penicillin and the third-generation cephalosporins must be confirmed by a MIC method. The E-test is a popular method for MIC testing.

As with MRSA, accurate detection of DRSP can be complicated by the presence of two subpopulations in a culture. False "susceptible" or false "resistant" results can be due to failure to follow current testing steps, inadequate quality control, test system failure, or inaccurate organism identification. False "resistant" results can be due to testing of

mixed cultures or drug degradation. False "susceptible" results can be due to testing of old colonies or poor growth of the isolate.

Issues of concern related to DRSP reporting include: 1) reporting of MICs for penicillin and cefotaxime/ceftriaxone when the oxacillin disk screen in ≤19mm; 2) for CFS isolates, ensuring that laboratories report MICs promptly and report the appropriate drugs; 3) reporting meningitis and non-meningitis interpretations for non-CSF isolates; and 4) reporting appropriate drugs.

Quality assurance and quality control of antimicrobial susceptibility testing are requirements for accreditation. Laboratories must test quality-control strains with known susceptibility patterns; verify patients' results; participate in proficiency surveys; verify new methods; and assess the competency of staff. A new laboratory standard (NCCLS M39-A) provides guidelines for analyzing and presenting cumulative antimicrobial susceptibility test data (annual antibiograms) to guide empiric therapy. Analysis of cumulative antibiogram data requires knowledge of the lab's analytical process.

Clinical laboratories need continuing education in antimicrobial susceptibility testing. CDC and the Association of Public Health Laboratories (APHL) are addressing these training needs. Resources include a CD-ROM developed at CDC and available free from APHL; the MASTER (Multi-Level Antimicrobial Susceptibility Testing Educational Resources) website, www.phppo.cdc.gov/dis/master/default.asp; and the National Laboratory Training Network.

Pros and Cons of Collecting Pneumococcal Isolates
Dr. Cynthia Whitney, CDC

The negative aspects of collecting pneumococcal isolates include the work and cost involved in collecting, testing, and storing isolates. On the plus side, isolate collection allows for use of standard testing methods, testing of a variety of drugs, and performance of specialized tests in the state laboratory. Factors that weigh into the decision to collect pneumococcal isolates include the following:

- Are laboratories using appropriate methods for testing pneumococci for resistance?
- How do susceptibility results from clinical laboratories compare with results from reference labs?
- What drugs are clinical laboratories testing?

In 2000, CDC conducted a survey of clinical laboratory susceptibility testing practices in ABCs sites. The objectives were to assess whether clinical labs used NCCLS-recommended testing methods for susceptibility testing of sterile-site pneumococci and to determine which drugs were tested. The survey was sent to all clinical laboratories (n=659) in nine ABCs areas in 2000. Questions addressed methods, drugs, and reporting. Of the 547 laboratories (83%) that responded to the survey, 357 (78%) did some pneumococcal susceptibility testing in-house. Half started with an oxacillin screen. The

antibiotics most frequently included in susceptibility testing were penicillin, cefotaxime/ceftriaxone, and vancomycin.

A second study compared MIC results for *S. pneumoniae* from clinical and reference laboratories, expressed in terms of dilution differences. Preliminary results for 877 comparisons of seven antibiotics showed generally good agreement between local and reference results. In general, clinical laboratory results were within 1 dilution of reference laboratory results. Errors of >1 dilution from reference results were most common with cefotaxime, erythromycin, clindamycin, and TMP/sulfa. Very major errors were most common with erythromycin and cotrimoxazole.

The assumption from these studies is that clinical laboratory pneumococcal susceptibility results are generally reliable. The problem is that relying on clinical laboratory results means limited information for some drugs of interest (e.g., fluoroquinolones). The decision on whether or not to collect isolates requires weighing the benefits against costs and workload.

Pneumococcal isolates that CDC wants to know about are:

- Pneumococci resistant (MIC>1 μg/ml) to vancomycin
- All sterile-site pneumococci isolated from children who have received pneumococcal conjugate vaccine

Understanding the Epidemiology of MRSA Infections in the United States
Dr. Fred Tenover, Associate Director for Laboratory Science, DHQP, NCID, CDC

In 1992, CDC replaced bacteriophage typing with pulsed-field gel electrophoresis (PFGE) for typing *S. aureus* strains in an effort to understand the epidemiology of *S. aureus* and MRSA in the United States. Although MRSA can be typed by use of several molecular strain typing techniques, CDC's MRSA dataset is based on only two: PFGE and multilocus sequence typing (MLST). PFGE was chosen because it provides very good discrimination among *S. aureus* strains and is available in most state health departments. It is also amenable to the high levels of standardization that are required to build a functional national MRSA database. MLST is available in only six laboratories worldwide. It is a nucleotide sequence-based approach for the unambiguous characterization of isolates. CDC uses the population genetics-based data derived from this method to validate PFGE results.

To genetically characterize an MRSA isolate by PFGE, bacterial DNA is cleaved with an enzyme. The resulting DNA fragments are cast into an agarose gel and exposed to a pulsed electric field. The electrophoresis run separates the DNA fragments into unique banding patterns, or fingerprints, that represent the chromosome of the organism. An image of the gel is scanned into a computer, and the banding patterns of the fragments are analyzed for similarities. The typing system was originally established for use in investigations of disease outbreaks to identify epidemiologically related isolates. In an outbreak scenario, isolates with fewer than three band differences are assumed to be closely related. These criteria are not applicable on a national scale; PFGE is not a

population genetics tool. However, it can be a surrogate if it is validated against a population genetics tool, such as MLST.

To better understand and track MRSA nationally, CDC is building a national database to correlate epidemiologic information with genetic fingerprints of MRSA isolates. The MRSA database is modeled and built on the existing PulseNet infrastructure. The objectives of the MRSA PulseNet System are to: 1) study the spread of MRSA in the United States, 2) identify clones associated with community-onset infections, vancomycin-intermediate *S. aureus*, and high virulence, and 3) link datasets already generated by state health department laboratories and CDC. To look at strains on a national basis, CDC needed more sophisticated tools, including software that would accommodate national databases, and selected the BioNumerics Program, a powerful biological data analysis system. The combination of the BioNumerics Program and PFGE validated by MLST, plus identification of the type of methicillin-specific gene (*mec*A) for defining lineages, comprises a powerful system to track strains nationally and look at genetic relatedness among strains in the database.

To date, CDC has identified seven pulsed-field types in the United States, corresponding to six MLST sequence types (STs). Four pulsed-field types are predominantly from healthcare institutions, and three are community-onset. Three of the pulsed-field types are described below:

USA100 is the most widespread and predominant pulsed-field type in the United States and is endemic in many U.S. hospitals. It is multi-resistant and has a specific MLST sequence type, ST 5. Three of the four SCC*mec* region types have been recognized in the United States. This strain type is globally disseminated, has been collecting resistance genes for several decades, and is effective in causing nosocomial infections.

There are two variations of USA100. SCC*mec*II, also called the New York/Tokyo clone, is the most prevalent. Tn*554* is present. The strain is multi-resistant (e.g., levofloxacin, erythromycin, clindamycin), with healthcare-related onset. This clone accounts for seven of the eight U.S. and one Japanese VISA isolates and the two VRSA isolates. SCC*mec*IV is also called the pediatric clone. Tn*554* is not present, and isolates are not multi-resistant.

USA 300 is associated with community-onset soft-tissue infections. The SCC*mec* region is type IV, suggesting a newly acquired *mec*. More than 94% of isolates are resistant to erythromycin, but 86% of these are clindamycin-susceptible. This strain was associated with outbreaks in prisons in Mississippi, Georgia, Tennessee, Texas, and Los Angeles County and with an outbreak in a football team in Pennsylvania.

USA 400 is another major community-onset strain. All isolates are MLST ST 1 and SCC*mec*IV. Isolates are not multi-resistant. Only 36% are resistant to erythromycin, but 81% of these are clindamycin inducible. This strain is prominent in Native Americans and was also associated with community-onset MRSA in Australia and Canada.

Dr. Tenover's conclusions were that:

- PFGE is a powerful tool that, used with other tools, is helping to increase the understanding of the epidemiology of various lineages of MRSA in the United States.
- There appear to be unique lineages of MRSA that are present in the community.
- These lineages are distinct from those associated with healthcare-acquired infections.

BREAKOUT SESSIONS B: Raising the Beams
Participants were asked to attend one of the following breakout sessions:

Nuts and Bolts of Collecting and Testing Isolates
Ms. Martha Boehme, Michigan Department of Community Health; Ms. Mary DeMartino, Iowa University Hygienic Laboratory; and Dr. Richard Facklam, CDC, reported on isolate collection systems in Michigan and Iowa and discussed logistical and testing considerations.

Tracking Resistance using Antibiogram-Based Surveillance
Dr. Chris Van Beneden and Dr. Scott Fridkin from CDC, and Ms. Felicita Medalla, Nebraska Health and Human Services, discussed the advantages and disadvantages of an antibiogram-based approach for collecting community-level data.

Bioterrorism and Antimicrobial Resistance: Enhancing Capacity through an Integrated System
Dr. Lee Harrison, University of Pittsburgh, and Dr. Steve Hinrichs, University of Nebraska Medical Center, shared examples showing how bioterrorism preparedness efforts can stimulate MRSA surveillance and dovetail into DRSP surveillance.

ADDING TO YOUR TOOLBOX PLENARY: Surveillance Odds and Ends

Considerations in Analyzing Your Data
Ms. Elizabeth Zell, CDC

A numerator can be the case count for a particular disease or the number with a particular attribute (e.g., % nonsusceptible). Cases can be available by onset date or by defined time period. If dates are available, case counts can be grouped by day, week, month, calendar quarter, or year. The denominator provides a source for rates (e.g., census data by county; live births) or percents (total number evaluated for a particular attribute). The crude incidence rate is the number of new occurrences of an event in a specific population during a specific time period per "x" number of people.

MIC results are generally grouped into three categories: susceptible (S), intermediate (I), or fully resistant (R). "Susceptible" refers to "S" only; "nonsusceptible" encompasses "I" and "R," and "Resistant" is "R" only. These need to be defined up front.

Analysis of data on DRSP and MRSA is primarily descriptive and can include: 1) calculating the percent nonsusceptible to either one antibiotic or multiple antibiotics, and 2) monitoring trends, with a focus on percents (population-based or sentinel-based data). Information can be used in reports and graphic presentations and can support recommendations.

Community-Associated MRSA in Los Angeles, 2002-2003
Dr. Elizabeth Bancroft, Los Angeles County Department of Health Services

During the past year, the Los Angeles County Department of Health Services investigated four outbreaks of community-associated MRSA.

In April 2002, three infants who had been in a newborn nursery were readmitted 5-13 days after discharge with MRSA cellulitis. Two additional infants had positive surveillance cultures. Isolates from the five cases were indistinguishable by PFGE. No source was found.

In an outbreak in the Los Angeles County Jail, 928 inmates had MRSA wound infections diagnosed in 2002. The Los Angeles County Jail is the largest jail system in the United States; 165,000 persons are incarcerated in the jail each year. Patients were reported as having spider bites but subsequently were found to be infected with MRSA. A study of cases in 2002 indicated that 9% of the inmates had an MRSA culture within 5 days of booking, suggesting acquisition of the infection before entering the jail. The health department issued recommendations for the diagnosis and treatment of skin infections in the jail and is working with the Los Angeles County Sheriff's Department to review policies and procedures on laundry, showers, environmental cleaning, skin care, and control of person-to-person transmission.

In September 2002, the health department investigated cases of MRSA infection in two athletes on the same team who were hospitalized with MRSA within the same week. Recommendations for hygiene and surveillance were provided. No additional cases have been identified.

In November 2002, physicians from two infectious disease practices notified the health department of MRSA skin infections among MSM; an estimated 30-40 infections were reported in a 2- to 3-month period. The health department has increased surveillance in selected clinics serving MSM and started a study of risk factors for infection in this population.

By PFGE, all four outbreaks of skin infections had an indistinguishable predominant strain that is different from that found in 11 non-skin nosocomial MRSA outbreaks investigated in Los Angeles in 1996-2002. The strain is consistent with PFGE patterns seen in other community MRSA outbreaks in other parts of the country. Selected MRSA isolates have been sent to CDC for testing for toxins and inducible clindamycin resistance.

The outbreaks have generated significant media attention. As a result, staff have spent more time responding to questions than collecting and analyzing data. Future plans related to MRSA outbreaks and surveillance include initiation of emergency room surveillance of skin and soft-tissue infections and generation of hospital antibiograms. Due to staffing constraints, the health department does not advocate making MRSA reportable.

Lessons Learned from Community-MRSA Surveillance in Minnesota
Ms. Kathleen LeDell, Minnesota Department of Health

Community-onset MRSA was first reported in the 1980s among injection drug users in Detroit and Boston and in children in Columbus, OH, and St. Louis, MO. In the 1990s, additional cases were reported from the Pacific region (Australia, New Zealand, Hawaii) and North America (Canada, Alaska, Illinois, Minnesota, North Dakota, Texas). In the published reports, community MRSA was noted mainly in younger patients, indigenous peoples, and racial minorities. Skin infections were most common, and isolates were typically susceptible to most antimicrobial classes other than beta-lactam agents. Isolates differed by phage type and molecular subtype when compared with healthcare-associated MRSA isolates.

In 1997, the Minnesota Department of Health (MDH) received reports of MRSA infections, some serious, in young patients without established risk factors. In 1999, the deaths of four children from rural Minnesota and North Dakota caused by infection with community-onset MRSA brought the problem to national attention. MDH participated in an Indian Health Service retrospective study in a Native American reservation in Minnesota and conducted a ten-hospital retrospective study of community-onset MRSA for 1996-1998.

To assess and characterize MRSA in Minnesota, MDH communicable disease reporting rules were amended in 1999. All cases of serious illness or death due to community-onset MRSA were made reportable, and sentinel sites were required to report all cases of MRSA to MDH. Twelve sentinel hospitals, including the ten that participated in the retrospective study, were selected. The objectives of the surveillance program initiated in 2000 were to: 1) characterize demographic and clinical differences between patients with community- and healthcare-associated MRSA infections, and 2) identify any microbiologic or molecular differences between the two types of isolates. MRSA isolates from the sentinel sites were sent to the MDH laboratory, where antimicrobial susceptibility testing and PFGE subtyping were performed on all community MRSA isolates and 25% of healthcare-associated isolates.

Results showed that community MRSA patients were much younger that hospital-associated cases (median age 23 vs. 68 years) and more likely to have MRSA cultured from skin (74% vs. 40%). Whites were over-represented among healthcare-associated patients, and Native Americans and Hispanics were over-represented among community MRSA patients. Isolates were generally susceptible to non-beta-lactam agents, with the exception of erythromycin (44% susceptible), and the healthcare-associated isolates were

generally resistant to many antimicrobial classes. Community isolates were more likely to be susceptible to all of the following classes: ciprofloxacin, clindamycin, trimethoprim-sulfamethoxazole, and gentamicin. MDH tested 107 community and 223 healthcare isolates by PFGE and identified 119 distinct subtype patterns. Among community isolates, the most common MRSA strain was clonal group A.

In 2001-2002, Connecticut, Georgia, Maryland, and Minnesota conducted community-onset MRSA surveillance as part of CDC's EIP. Minnesota collected only community isolates. Goals for the future are to identify potential risk factors and explore prevention strategies, clinical management issues, and potential virulence and host factors.

Lessons learned include the importance of: developing relationships with infection control practitioners and laboratorians, communicating with and acknowledging partners, offering/providing help whenever possible, and understanding demands on infection control practitioners and laboratorians and making reasonable requests for their time.

Thursday, March 13, 2003

WELCOME
Dr. James Hughes, Director, NCID, CDC

Dr. Hughes welcomed the participants to Day 2 of their deliberations, thanked them for their efforts, and commented on the importance of partnerships, the timeliness of the issues under discussion, and the opportunities that these issues provide for bridging the gulf between clinical medicine and public health.

WELDING IT TOGETHER: CDC Reporting Systems

National Healthcare Safety Network and Other DHQP Surveillance Efforts
Dr. Jerome Tokars, DHQP, NCID, CDC

DHQP is proposing a new vehicle for national healthcare surveillance, the National Healthcare Safety Network (NHSN). NHSN will combine three existing patient and healthcare worker surveillance systems: NNIS), Dialysis Surveillance Network, and National Surveillance System for Healthcare Workers (NaSH). NHSN is envisioned as a voluntary, confidential, web-based reporting and knowledge system. It will be built on standards to allow data integration and sharing and will be compatible with the proposed National Electronic Disease Surveillance System (NEDSS). NHSN will include data-reporting modules on patient safety and worker safety. The patient safety component will include a module on antimicrobial use and resistance. NHSN will allow entry (manual and electronic) of event and summary data for each module in the network. The data analysis features of the network are expected to range from simple reports and graphs to statistical analysis that will compare a healthcare facility's rates with national performance measures.

As part of CDC's smallpox vaccination program activities, DHQP has developed the Hospital Smallpox Vaccination Monitoring System (HSVMS). This is a voluntary system will help hospitals and other vaccine-monitoring sites with real-time monitoring and tracking of healthcare workers who receive smallpox vaccine.

A proposed state-based *S. aureus*/MRSA surveillance project is designed to estimate the healthcare- and community-related MRSA disease burden. The project has two components: 1) obtaining antibiograms from participating facilities, and 2) performing case reviews for a 5% sample. Pilot tests are planned for Michigan and Pennsylvania.

The Present: National Electronic Telecommunications System for Surveillance (NETSS) and Other Reporting Options
Dr. Ruth Ann Jajosky, Epidemiology Program Office, CDC

A notifiable disease is a disease for which regular, frequent, and timely information on individual cases is considered necessary for prevention and control. Nationally notifiable diseases are diseases recommended to be notifiable by the Council of State and Territorial Epidemiologists (CSTE) and CDC. The list of diseases varies by state and over time. Reporting of nationally notifiable diseases to CDC by the states is voluntary. Reporting is currently mandated only at the state level.

State and territorial health departments report cases of notifiable conditions to the National Notifiable Diseases Surveillance System (NNDSS) through the National Electronic Telecommunications System for Surveillance (NETSS). NETSS is a national computerized network used to transmit weekly surveillance information to CDC on nationally notifiable diseases. Two types of information are reported through NETSS: core surveillance data (date, county, age, sex, race/ethnicity) and some disease-specific epidemiologic information (NETSS extended record).

Provisional weekly reports of notifiable diseases are published in the *Morbidity and Mortality Weekly Report* (*MMWR*). Final, corrected data are published in the annual Summary of Notifiable Diseases, United States. Provisional and annual data are also available on the CDC website.

Drug-resistant *S. pneumoniae* invasive disease was added to NNDSS in 1995, and ISP disease in children <5 years was added in 2001. Each condition has a separate case definition and code. Accurate case enumeration requires duplicate reporting for cases meeting both definitions. States are advocating changes to resolve this issue. They argue that: 1) duplicate reporting is an unnecessary burden, 2) the NNDSS coding scheme precludes full enumeration of reported ISP cases and calculation of the proportion of cases that are drug-resistant, and 3) lack of information on antibiotics and susceptibility results limits the analytical value of the data. CDC hopes to defer any changes, however, pending the planned NETSS-to-NEDSS transition (see below). Issues for consideration include the following:

- Should NNDSS include disease-specific data for ISP or DRSP (antibiotics; susceptibility testing)?

- Should there be one case definition and code for all ISP, which would permit subclassifications for <5 years and DRSP?

The Future: National Electronic Disease Surveillance System (NEDSS)
Dr. Robert Pinner, Office of the Director, NCID, CDC

The National Electronic Disease Surveillance System (NEDSS) is an initiative that will promote the use of data and information system standards to improve the way surveillance data are collected, managed, transmitted, analyzed, accessed, and disseminated at the federal, state, and local levels. NEDSS is designed to address the limitations of current surveillance systems, such as: multiple incompatible disease-specific systems, incomplete and delayed data, burden of reporting, overwhelming volume of data to be managed by health departments, and lack of state-of-the-art technology.

The long-term vision is that of complementary electronic information systems that automatically gather health data from a variety of sources in real time; facilitate the monitoring of the health of communities; assist in the ongoing analysis of trends and detection of emerging public health problems; and provide information for setting public health policy. The NEDSS system architecture is designed to integrate and replace several current CDC surveillance systems, including NETSS. The NEDSS Base System is still in the early production stage.

Electronic messaging for clinical and laboratory reports is one of eight elements that will be implemented using the NEDSS information architecture. Electronic laboratory reporting (ELR) pilot activities have provided valuable lessons. In Hawaii, ELR increased the number of reports 2.3 times, reports arrived 4 days earlier, and demographic data were more complete. Projects are also underway in other sites.

HITTING THE NAIL ON THE HEAD PLENARY: Intervention Strategies to Control Antimicrobial Resistance

Using Surveillance Data to Promote Appropriate Antibiotic Use
Dr. Richard Besser, Campaign for Appropriate Antibiotic Use in the Community, NCID, CDC

In 1995, CDC launched a national campaign to reduce antimicrobial resistance through promotion of more appropriate antibiotic use. The Campaign for Appropriate Antibiotic Use in the Community uses two main approaches: establishing partnerships and developing materials to educate physicians and the public. Activities include developing and implementing interventions; assessing their impact on antibiotic use, resistance, and physician/patient satisfaction; and serving as a resource to groups undertaking campaigns. State-based campaigns are currently promoting appropriate antibiotic use around the country; 26 intervention sites receive federal funding to support their campaigns ($50,000-$100,00 each).

Surveillance data on antimicrobial resistance are being collected in many different ways and are an integral part of these campaigns. Pneumococcal antimicrobial resistance is being monitored by use of four approaches:

- Active, population-based surveillance – An example is the active, population-based ABCs system in Tennessee, which provides data on rates of resistance in participating counties.
- Enhanced, passive surveillance – In the Wisconsin Antibiotic Resistance Network (WARN), supported in part by a cooperative agreement with CDC, invasive isolates are sent to the state lab; 80%-90% of laboratories participate. South Carolina's Careful Antibiotic Use campaign surveys a sample of clinical laboratories and includes all pneumococcal isolates; data are aggregated to produce county-specific resistance rates.
- Annual antibiogram surveys – North Carolina requests antibiogram data from all non-specialty hospitals and aggregates data to provide statewide resistance rates.
- One-time snapshots

Data from these systems are essential for raising public awareness, targeting resources and activities, developing and informing treatment guidelines, monitoring trends, and motivating behavior change by prescribers. One challenge is maintaining a campaign's momentum as rates drop with increased use of pneumococcal conjugate vaccine.

The Potential Impact of Pneumococcal Conjugate Vaccine on DRSP
Dr. Cynthia Whitney, DBMD, NCID, CDC

The 7-valent pneumococcal conjugate vaccine was licensed in February 2000 and was widely implemented in Summer and Fall 2000. Since August 2001, there has been a shortage of vaccine in some parts of the country. The vaccine is recommended for all children <2 years and children 2-4 years with certain chronic illnesses and immunocompromising conditions. The vaccine should be considered for all children 2-4 years, with priority to those aged 24-35 months; Alaska Native, American Indian, and African-American children; and children attending day care.

Pre-licensure efficacy trials for PCV7 have shown good efficacy against invasive pneumococcal disease for vaccine serotypes, otitis media, and pneumonia. Potential effects of the vaccine include prevention of disease caused by vaccine-related serotypes and reduced transmission of pneumococci in households and day-care settings ("herd immunity"). A theoretical concern is "replacement" disease caused by non-vaccine serotypes.

ABCs defines a case as pneumococcus isolated from a normally sterile site. Case finding is active and laboratory-based, with audits to ensure complete reporting and chart reviews to obtain clinical information. Isolates undergo serotyping and susceptibility testing at reference laboratories. ABCs data for 1998-2001 show rapid reductions in cases of invasive pneumococcal disease in the target group of young children. Analysis of the data by serotype indicates that, despite the current shortages, the vaccine is responsible for most of the decrease. The "herd immunity" effect in adults is also substantial;

decreases in disease rates in adult populations are highest in the age group corresponding to parents of young children (20-39 years). The benefit to unvaccinated populations translates into fewer deaths and expensive hospitalizations. Reductions in disease caused by resistant strains are promising as well. In 2001, there were 35% fewer cases of invasive disease caused by resistant isolates compared to 1999.

Despite this progress, some questions remain:

- How far will disease drop?
- Will replacement disease occur?
- Will resistance among pneumococci drop?

Prevention Programs to Reduce Antimicrobial Resistance in Healthcare Settings
Dr. John Jernigan, DHQP, NCID, CDC

CDC's Campaign to Prevent Antimicrobial Resistance in Healthcare Settings is a health communication strategy to: 1) inform clinicians, patients, and other stakeholders, 2) raise awareness about the escalating problem of antimicrobial resistance in healthcare settings, and 3) motivate interest in and acceptance of intervention programs to prevent resistance. The Campaign promotes four strategies for controlling antimicrobial resistance in healthcare settings: 1) prevent infections, 2) diagnose and treat infections effectively, 3) optimize antimicrobial use, and 4) prevent transmission. Within the context of these strategies, multiple 12-step programs for clinicians who treat specialty-specific populations are being developed. These are targeted intervention programs with evidence-based action steps for clinicians caring for high-risk patients (e.g., hospitalized adults, dialysis patients, surgical patients, hospitalized children, long-term care residents). Partners include professional societies and the CDC Foundation.

Preventing transmission is especially important for MRSA control. MRSA is transmitted by direct body surface-to-body surface contact and indirect contact with contaminated intermediate objects. Infected or colonized patients are the major reservoir of transmission.

Early efforts to prevent MRSA transmission centered on standard precautions for all patients. Standard precautions are inexpensive and simple to implement, but compliance is generally low; they might not address all modes of transmission, and they might not be effective in all settings. Another option is standard precautions plus contact precautions for MRSA-colonized/infected patients (passively identified). This approach addresses all potential modes of transmission, might enhance compliance with standard precautions, and might be more effective than standard precautions in some settings. However, implementation is more difficult and expensive. Moreover, contact precautions are not applied to the entire reservoir of transmission. A third option is standard precautions plus contact precautions for MRSA colonized/infected patients identified through active surveillance. This approach identifies the entire reservoir of transmission and has been associated with successful control in some settings. It is, however, the most difficult and expensive option to implement.

The Healthcare Infection Control Practices Advisory Committee (HICPAC) is currently developing an updated *Guideline to Prevent Transmission of Infectious Agents in Healthcare Settings*. The proposed strategy for prevention of MRSA transmission is to vary the approach according to the clinical setting and patient population. Guidance on setting-specific approaches to MRSA control is provided.

LOOKING AROUND THE NEIGHBORHOOD: Communication Strategies

Arizona's Strategies in Communicating Results with Partners
Ms. Clare Kioski, Arizona Department of Health Services

Arizona's antibiotic resistance surveillance and prevention program, Strike Out Antibiotic Resistance, is designed to monitor bacterial infections that are resistant to antibiotics and provide education about appropriate use of antibiotics to healthcare providers and the public. The program collaborates with professional medical societies, community-based organizations, and pharmaceutical companies to coordinate and provide professional education through the State of Arizona Group on Understanding Antibiotic Resistant Organisms (SAGUARO) coalition. Additional partners include the Arizona Diamondbacks, managed-care plans, tribal health systems, hospitals and health systems, and laboratories.

Two essential partners are the Association for Professionals in Infection Control and Epidemiology (APIC) and the pharmaceutical industry. Ms. Kioski maintains her relationship with the local APIC chapter by providing updates at their meetings, assisting with mailings, speaking and exhibiting at their conferences, and sending alerts and information via email. Pharmaceutical companies help distribute guidelines and educational materials to providers' offices, support conferences, and provide NCCLS standards to all hospitals.

Additional strategies include: having the Governor proclaim an Antibiotic Resistance Month; exhibiting at conferences of professional organizations (e.g., American Academy of Pediatrics, Arizona Osteopathic Medicine Association, Arizona Academy of Family Physicians); posting antibiogram data on the health department's website; participating in grand rounds; submitting articles to professional publications; convening conferences featuring local experts; holding a poster contest for the campaign; and airing public service announcements at professional baseball games.

Los Angeles County's Strategies in Communicating Results with Partners
Dr. Elizabeth Bancroft, Los Angeles County Department of Health Services

Given the challenges associated with the size and ethnic diversity of the population of Los Angeles County, the size of the health department, and its severe fiscal deficits, Los Angeles County Department of Health Services has had to be imaginative in using resources in the health department to disseminate messages about antibiotic resistance. In July 2000, the health department initiated the Countywide Los Angeles Antibiotic Resistance Education Advocates (LA AREA) with a grant from CDC for a senior health

educator to develop patient education on antibiotic resistance. The position was vacant from September 2001-May 2002; there is no budget for outreach. Activities include:

- Features in health department publications (monthly newsletter to physicians, quarterly health magazine for clinics/schools/libraries, county retirement bulletin)
- Updates on the health department's website
- Press releases and media collaborations
- Periodic email updates to members of the Infectious Disease Association of California, infection control practitioners, and Los Angeles County physicians
- Outreach to health department providers (e.g., maternal and child health, public health nursing)
- Outreach to other partners (e.g., California Alliance for Appropriate Antibiotic Use [AWARE], PTA, Head Start, Los Angeles County Medicaid program, Binational Border Health)

THE INSPECTION: Panel Discussion on How to Address Surveillance Needs

Moderator: Dr. Bernadette Albanese, New Mexico Department of Health
Panel: Dr. Kathryn Arnold, Georgia Division of Public Health
Ms. Martha Boehme, Michigan Department of Community Health
Mr. Ali Danner, NCID, CDC
Ms. Mary DeMartino, Iowa University Hygienic Laboratory
Dr. Scott Fridkin, NCID, CDC
Dr. Ken Gershman, Colorado Dept of Public Health & Environment
Dr. Cynthia Whitney, NCID, CDC

The panel responded to the following questions from participants:

ISP in young children

Other than a VAERS report, to what extent should a case of ISP in a child with a history of vaccination be investigated?

A breakthrough case is not typically reported to VAERS. However, CDC is interested in learning about any case in a child <5 years who has received vaccine. Collection of serum samples is not currently recommended.

MRSA surveillence

Are CDC and CSTE considering making MRSA reportable? If yes, how can compliance be ensured? How can MRSA surveillance be conducted without making MRSA reportable?

Some subsets of MRSA disease are reportable in some states. In Minnesota, all cases of invasive disease with onset in the community and, in 12 sentinel sites, all cases of MRSA are reportable. Iowa made MRSA invasive isolates reportable as part of the statewide surveillance program. To improve compliance, states can limit the amount of data required from laboratories.

Have states conducting MRSA surveillance encountered resistance from hospitals regarding data sharing?

Open records practices vary among the states, depending on state statutes. Even when patient information is protected, confidentiality might not extend to hospitals. States considering making MRSA reportable need to think about how to protect hospitals.

Workload and demand associated with new surveillance systems/requirements
Surveillance work is a burden on laboratories. States' experiences show the importance of including clinical laboratories as partners in all efforts and of developing relationships between state health department laboratories and clinical labs. All state labs have bioterrorism funding that requires development of relationships with clinical labs.

Collection of isolates
How important is it to make a long-term funding commitment to isolate collection?
The decision depends on a state's priorities. Isolate collection should not be among the top three activities of a state surveillance program. As the epidemiology changes, however, special studies will require collection of isolates.

Closing Remarks
Dr. Todd Weber, Deputy Assistant to the Director (Acting) for Antimicrobial Resistance, NCID, CDC

Dr. Weber thanked the speakers, the other participants, and the meeting organizers. He noted that the better-than-expected attendance and the states' achievements in DRSP and MRSA surveillance – without funding – attest to the interest in and importance of the topics addressed at this meeting. He reminded the participants that CDC is committed to serving the states in their efforts. Dr. Whitney added her thanks to the participants and the meeting organizers.