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Report to the Chairman, Committee on Oversight and Government Reform, House of Representatives

September 2008

HEALTH-CARE-ASSOCIATED INFECTIONS IN HOSPITALS

An Overview of State Reporting Programs and Individual Hospital Initiatives to Reduce Certain Infections

GAO-08-808

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Highlights

Highlights of GAO-08-808, a report to the Chairman, Committee on Oversight and Government Reform, House of Representatives

Why GAO Did This Study

Health-care-associated infections (HAI) are infections that patients acquire while receiving treatment for other conditions. Normally treated with antimicrobial drugs, HAIs are a growing concern as exposure to multidrug-resistant organisms (MDRO) becomes more common. Infections caused by MDROs, such as methicillin-resistant *Staphylococcus aureus* (MRSA), lead to longer hospital stays, higher treatment costs, and higher mortality.

In response to demands for more public information on HAIs, some states began to establish HAI public reporting systems. The federal Centers for Disease Control and Prevention (CDC) developed a system—the National Healthcare Safety Network (NHSN)—to collect HAI data from hospitals and some states have chosen to use it for their programs. In addition, some hospitals have adopted initiatives to reduce MRSA by routinely testing some or all patients and isolating those who test positive for MRSA from contact with other patients.

GAO was asked to examine (1) the design and implementation of state HAI public reporting systems, (2) the initiatives hospitals have undertaken to reduce MRSA infections, and (3) the experience of certain early-adopting hospitals in overcoming challenges to implement such initiatives.

GAO interviewed state officials, reviewed documents, and surveyed or conducted site visits at hospitals with MRSA-reduction initiatives.

To view the full product, including the scope and methodology, click on GAO-08-808. For more information, contact Cynthia A. Bascetta at (202) 512-7114 or bascettac@gao.gov.

What GAO Found

GAO identified 23 states that had established mandatory HAI public reporting systems through February 2008; most have used similar approaches to design their programs and address resource and technological challenges that affect their implementation. Most states have designed programs that focus on a few measures that were developed or endorsed by the CDC. Three states have chosen to collect information on hospital-associated MRSA infections. In addition, a majority of states have chosen to adopt the CDC's NHSN. Adopting NHSN allows states to minimize some of the resource and technological challenges that they confront in implementing HAI reporting systems including providing training for hospital staff in data collection and developing systems to collect HAI data that meet accepted infection control standards.

GAO reviewed a sample of 14 hospitals (including several hospital systems) with MRSA-reduction initiatives that were selected to provide variation in location, teaching status, and population of metropolitan area. GAO found all use routine testing for MRSA, although they chose different patient populations to test and used various testing methodologies. Three hospitals tested all patients for MRSA, while the other hospitals almost universally tested patients in adult or neonatal intensive care units. The hospitals reported changing their general infection control policies or practices as part of their initiatives—all 14 made changes for hand hygiene and more than half made changes to their contact precautions or disinfection of environmental surfaces. The hospitals GAO reviewed reported needing varying levels of funding and staff resources to implement and operate their initiatives, but all hospitals that tracked MRSA infection rates reported a decline in MRSA infections as a result of their initiatives.

Two hospital systems that GAO visited overcame a similar set of challenges in implementing MRSA-reduction programs. Both systems had to design and execute processes to put the elements of their MRSA-reduction initiatives into effect and promote compliance with those processes by hospital staff. In designing their systems, both hospital systems incorporated these processes as much as possible into the normal workflow of hospital staff and promoted staff compliance through a combination of concerted leadership and specific procedures designed to facilitate staff compliance reinforced through detailed feedback on their performance. However, the two hospital systems took different approaches in obtaining resources for their initiatives. One directed substantial financial resources into its MRSA-reduction initiative to implement the initiative simultaneously for all patients at all three of its hospitals, while the other relied largely on existing resources and implemented its initiative more incrementally at selected hospitals and in selected units.

GAO received technical comments from the Department of Health and Human Services and oral comments from the American Hospital Association on a draft of this report.

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Abbreviations

AHA	American Hospital Association
AHRQ	Agency for Healthcare Research and Quality
AST	active surveillance testing
BSI	bloodstream infection
CDC	Centers for Disease Control and Prevention
CMS	Centers for Medicare & Medicaid Services
EMR	electronic medical record
ENH	Evanston Northwestern Healthcare
HAI	health-care-associated infection
HICPAC	Healthcare Infection Control Practices Advisory Committee
HHS	Department of Health and Human Services
ICP	infection control professional
ICU	intensive care unit
IHI	Institute for Healthcare Improvement
IPPS	inpatient prospective payment system
MDRO	multidrug-resistant organism
MRSA	methicillin-resistant *Staphylococcus aureus*
NHSN	National Healthcare Safety Network
NNIS	National Nosocomial Infections Surveillance
NQF	National Quality Forum
PCR	polymerase chain reaction
POA	present on admission
PSI	Patient Safety Indicator
SCIP	Surgical Care Improvement Project
SSI	surgical site infection
UPMC	University of Pittsburgh Medical Center
UTI	urinary tract infection
VAP	ventilator-associated pneumonia

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United States Government Accountability Office
Washington, DC 20548

September 5, 2008

The Honorable Henry Waxman
Chairman
Committee on Oversight and Government Reform
House of Representatives

Dear Mr. Chairman:

Health-care-associated infections (HAI) are one of the top 10 causes of death in the United States, according to estimates from the Centers for Disease Control and Prevention (CDC). Although patients can acquire HAIs in a wide variety of health care settings, including nursing homes and ambulatory surgery centers, hospital patients are especially vulnerable to HAIs. Normally treated with antimicrobial drugs, HAIs are a growing concern as multidrug-resistant organisms (MDRO) become more common.[1] Infections caused by MDROs lead to longer hospital stays, higher treatment costs, and higher mortality because they are more difficult to treat than infections caused by other organisms. A particular MDRO, methicillin-resistant *Staphylococcus aureus* (MRSA),[2] has gained attention recently. In 2003, it accounted for 64 percent of infections in intensive care units (ICU) caused by *Staphylococcus aureus*, one of the most common HAI pathogens, up from 36 percent in 1992.[3] Researchers estimate that the average cost of treating a MRSA infection exceeds $35,000.

In a separate report to you, we found that federal activities have not effectively addressed the HAI problem.[4] We also found that the extent of

[1]MDROs develop resistance to antimicrobial drugs when bacteria change or adapt in a way that allows them to survive in the presence of antibiotics designed to kill them. In some cases, bacteria become resistant to all available antibiotics.

[2]Although named for its resistance to methicillin, MRSA is also resistant to a large group of commonly prescribed antibiotics.

[3]R.M. Klevens et al., "Changes in the Epidemiology of Methicillin-Resistant Staphylococcus aureus in Intensive Care Units in US Hospitals, 1992–2003," *Clinical Infectious Diseases*, 2006, 42:389–91. These trends are based on data from 1,268 ICUs in 337 U.S. hospitals.

[4]GAO, *Health-Care-Associated Infections in Hospitals: Leadership Needed from HHS to Prioritize Prevention Practices and Improve Data on These Infections*, GAO-08-283 (Washington, D.C.: Mar. 31, 2008).

the problem, including the level of antimicrobial resistance, is uncertain because the data that CDC as well as other agencies of the Department of Health and Human Services (HHS)—such as the Centers for Medicare & Medicaid Services (CMS)—collect on HAIs are limited in scope and lack integration across multiple databases. CDC has created a data infrastructure that allows hospitals to voluntarily collect and input data using a uniform set of definitions on the incidence of selected HAIs in their own hospitals and to compare their rates with benchmarks derived from the data submitted by all participating hospitals. This began in the 1970s with the National Nosocomial Infections Surveillance (NNIS) system and continued with its replacement, the more sophisticated National Healthcare Safety Network (NHSN), introduced in 2005.

In response to demands for more public information on HAIs, some states have begun to develop and implement HAI public reporting systems—some using CDC's NHSN—to collect and disseminate HAI data from hospitals. Some states have also recently passed legislation relating specifically to MRSA, such as requiring specific actions for hospitals to prevent the spread of MRSA based in part on guidelines issued by CDC and collecting data from hospitals on MRSA cases that occur. In addition, some hospitals have implemented strategies for reducing MRSA by testing some or all patients and isolating those who test positive for MRSA from contact with other patients.

In response to your interest in these nonfederal efforts to address HAIs, including the role played by CDC's NHSN and its practice guidelines, we examined (1) the design and implementation of state HAI public reporting systems, (2) the initiatives hospitals have undertaken to reduce MRSA infections, and (3) the experience of certain early-adopting hospitals in overcoming challenges to implement such initiatives.

To describe the design and implementation of state HAI public reporting systems, we identified 23 states that were designing or had implemented state-mandated HAI public reporting systems through February 2008. We identified these programs through multiple sources, including resources maintained by organizations that track state infection control programs. We then collected information directly from each of those 23 states. However, we did not independently verify that there were no state-mandated HAI public reporting programs planned or underway in any of the remaining states. We excluded from consideration programs in several

states that collect limited data about HAIs, but do not report hospital-specific HAI data to the public.[5] For each of the 23 states, we reviewed the available legislation, administrative and departmental rules and regulations, advisory panel reports, and other documents for each system to compare the systems across states. However, the information that we collected does not provide a description or assessment of the legal requirements in any state regarding the collection and public reporting of data about HAIs or a comparison of the legal requirements among states regarding those requirements.

We also interviewed state officials and state hospital association representatives in 5 of the 23 states about the design, development, and implementation of their systems, including challenges they encountered, how they overcame those challenges, and how they validated the data from hospitals. We selected Missouri, New York, and Pennsylvania because each had relatively extensive experience in collecting HAI data, but used different data reporting systems. We selected Illinois and New Jersey because they had established mandatory reporting programs on MRSA infections designed to provide information on the performance of individual hospitals—as distinct from the communicable disease reporting systems that many state health department have operated for decades, which are designed primarily to provide an alert when new outbreaks of particular pathogens occur. What we learned about the challenges faced and implementation strategies adopted in those 5 states cannot be generalized to other states with HAI public reporting programs.

To describe the initiatives hospitals have undertaken to reduce MRSA infections, we consulted knowledgeable experts, and conducted a Web search to generate a list of hospitals or hospital systems[6] with MRSA-reduction initiatives. From among those, we selected 17 that provided the

[5]The HAI public reporting system in Arkansas does not require hospitals to report data to the state and will report only aggregate data on HAIs to the public. Nevada and Nebraska will not report any HAI data publicly. Utah has begun to collect HAI data from hospitals, but has not yet decided whether it will report these data to the public. Ohio requires hospitals to report quality data publicly, but did not include HAI measures in its initial set of measures. An advisory committee convened to consider and possibly recommend HAI measures for inclusion. Its final report was expected in August 2008.

[6]In several instances, including the two site visits we conducted, the MRSA-reduction initiative applied to multiple hospitals that belonged to the same hospital system. Because our analysis of MRSA-reduction initiatives examined the variation across the different initiatives, we use the term hospital in the following discussion to refer to the single or multiple facilities that adopted a particular MRSA-reduction initiative.

greatest diversity in terms of location, teaching status, and population of metropolitan area. To obtain information about the hospitals' MRSA-reduction initiatives, we visited 2 hospitals and sent surveys to officials at the remaining 15 hospitals, 12 of which responded. In total, we collected information from 14 hospitals with MRSA-reduction initiatives. Information on their characteristics is provided in appendix I. The information that we obtained from these 14 hospitals pertains specifically to those hospitals, and can not be generalized to other hospitals with MRSA-reduction initiatives.

To describe how early-adopting hospitals overcame challenges to implement MRSA-reduction initiatives, we visited Evanston Northwestern Healthcare (ENH) and the University of Pittsburgh Medical Center (UPMC). Both implemented MRSA-reduction initiatives several years ago and have published or otherwise publicly presented data on their outcomes. We interviewed key administrative and clinical personnel at each site to examine specific MRSA intervention options considered, challenges confronted, steps taken to overcome those challenges, and required financial and staff resources. Because these were case studies, what we found at these two hospitals can not be generalized to other hospitals with MRSA reduction initiatives.

We conducted this performance audit from October 2007 to September 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Results in Brief

Most of the 23 states we reviewed with state-mandated HAI public reporting programs have used similar approaches to design their programs and address resource and technological challenges that affect their implementation. Most of these states have relied at least to some extent on advisory committees or technical advisors and designed programs that focus on a few measures that were developed or endorsed by CDC. Three states have chosen to collect information on hospital-associated MRSA infections. In addition, although some states developed their own data collection systems, a majority of the states we reviewed have chosen to use NHSN, the HAI data collection system developed by CDC. Adopting CDC-endorsed measures and the NHSN for data collection allowed states to minimize some of the resource and technological challenges that they

confronted in implementing HAI reporting systems. These challenges included providing training for hospital staff in data collection as well as developing systems to collect HAI data that met accepted infection control standards and were user-friendly for those entering data.

The 14 hospitals with MRSA-reduction initiatives that we reviewed all conduct routine testing for MRSA, although they chose different patient populations to test and used various testing methodologies. Three hospitals tested all patients for MRSA, while the remaining hospitals almost universally tested patients in adult or neonatal intensive care units. The hospitals reported changing a number of general infection control policies or practices as part of their initiatives—all 14 made changes for hand hygiene and more than half made changes to their contact precautions or disinfection of environmental surfaces. The hospitals we reviewed reported needing varying levels of funding and staff resources to implement and operate their initiatives, but all hospitals that tracked MRSA infection rates reported a decline in MRSA infections as a result of their initiatives.

The two hospital systems that we visited overcame a similar set of challenges in implementing multifaceted MRSA-reduction initiatives. Both systems had to design and execute processes to put the elements of their MRSA-reduction initiatives into effect and promote compliance with those processes by hospital staff. In designing their MRSA-reduction initiatives, both hospital systems incorporated these processes as much as possible into the normal workflow of hospital staff and promoted staff compliance through a combination of concerted leadership on the part of the physicians who led their infection control programs and specific procedures designed to facilitate staff compliance reinforced through detailed feedback on their performance. However, the two hospital systems took different approaches to obtaining resources for their initiatives. One directed substantial financial resources into its MRSA-reduction initiative to implement the initiative simultaneously for all patients at all three of its hospitals, while the other relied largely on existing resources and implemented its initiative more incrementally at selected hospitals and on selected units.

We obtained technical comments from HHS that we incorporated as appropriate. In addition, the department highlighted the scientific contributions that CDC has made pertaining to the detection, measurement, and prevention of HAIs and MRSA. The American Hospital Association (AHA) provided oral comments that underscored the importance of using HAI data to prevent and reduce infections and that

raised serious concerns about using unvalidated NHSN data for public reporting of hospital performance on HAIs.

Background

HAIs are infections that patients may acquire during the course of receiving medical treatment for other conditions.[7] HAIs occur as the result of patient exposure to a variety of pathogens and affect many different body systems. According to CDC estimates, urinary tract infections (UTI), surgical site infections (SSI), bloodstream infections (BSI), and pneumonia account for more than 80 percent of all HAIs. Frequently, an infectious pathogen is introduced by an invasive procedure, such as surgery or insertion of a urinary catheter, central line,[8] or ventilator. As a result, a subset of UTIs are identified as catheter-associated UTIs, a subset of BSIs are identified as central line-associated BSIs, and a subset of pneumonia HAIs are identified as ventilator-associated pneumonia (VAP).

Hospital Practices to Reduce HAIs

Any acute care hospital that participates in Medicare or Medicaid or is accredited through the Joint Commission must have an infection control program with a designated person in charge.[9] Infection control professionals (ICPs) receive specialized training to prepare them to lead and staff these programs. ICPs identify cases of HAI and promote infection control practices that help to reduce the occurrence and spread of HAIs. These practices include rigorous maintenance of hand hygiene standards as well as contact precautions, which involve the use of gloves, gowns, and sometimes masks worn by health care workers to prevent them from carrying the pathogen from an infected patient to other patients. One approach has focused on ensuring that each item on a short list of specific practices is consistently implemented. For example, the Institute for

[7]The term HAI is often used synonymously with hospital-acquired infection and nosocomial infection. HAIs are distinct from community-acquired infections, which are infections that were transmitted to patients prior to their admission to a hospital or other health care facility.

[8]Central lines are intravenous lines inserted into a large vein typically in the neck or near the heart.

[9]To be eligible for payment under the Medicare and Medicaid programs, hospitals must comply with HHS-established health and safety standards, known as conditions of participation (COP), which include a COP for infection control. Many hospitals meet this requirement through accreditation by the Joint Commission.

Healthcare Improvement (IHI)[10] has developed "bundles" or "components of care" designed to reduce the incidence of central line-associated BSIs, SSIs, VAP, and MRSA. Each of these bundles consists of four to six specific practices that research has shown affect the incidence of that type of infection. These practices include hand hygiene and contact precautions, where appropriate.

Strong clinical evidence indicates that contact precautions help to reduce the incidence of HAIs. However, for contact precautions to work, they have to be carefully and consistently followed. Hospitals need to closely monitor and reinforce staff compliance with these and related activities such as hand hygiene and environmental cleaning.[11] At the same time, some research suggests that patients placed under contact precautions may receive less attention from clinicians, receive lower quality care, and experience more adverse events such as falls or pressure ulcers.[12]

MRSA

MRSA is a particularly prevalent MDRO. It can cause virtually any type of HAI, including skin infections, BSIs, pneumonia, SSIs, and UTIs. MRSA-positive patients may either have an active MRSA infection or be colonized with the organism. Colonized patients carry the bacteria in some part of their body, such as on their skin or in their nose, without showing any symptoms of infection themselves. Patients colonized with MRSA represent a primary source for transmission of the organism to other patients, often via the hands, clothing, or equipment of hospital staff. Individuals who acquire MRSA in a health care setting, such as a hospital, are referred to as having health-care-associated MRSA. Individuals who develop a MRSA infection outside of such settings and who do not have a history of recent hospitalization or surgery are referred to as having community-associated MRSA.

[10]IHI is an independent, nonprofit organization that works to improve the quality of health care.

[11]Hand hygiene is a general term that applies to handwashing, antiseptic handwash, antiseptic hand rub, or surgical hand antisepsis. Environmental cleaning refers to the disinfection of environmental surfaces and equipment for infection control efforts in hospitals.

[12]H.T. Stelfox et al., "Safety of Patients Isolated for Infection Control," *Journal of the American Medical Association* (Oct. 8, 2003) 290:14, 1899-1905; see also K.B. Kirkland & J.M. Weinstein, "Adverse effects of contact isolation" (Oct. 2, 1999) *The Lancet*, 354, 1177-1178; S. Saint et al., "Do physicians examine patients in contact isolation less frequently? A brief report," *American Journal of Infection Control*, 31:6 (October 2003) 354-356.

Because patients colonized with MRSA do not exhibit signs and symptoms of infection, the only way to identify them is through laboratory testing of specimens from asymptomatic patients. Specimens taken from a patient's nose can identify up to 80 percent of colonized patients and are therefore recommended for MRSA screening. Laboratory methods for MRSA testing use routine culture media, selective media, or polymerase chain reaction (PCR). Routine culture media require laboratory staff to culture specimens in a nutrient material, such as agar in a Petri dish, and then examine and test the organisms that grow in that medium. This process usually takes 2 to 5 days to produce results. Selective media are laboratory culture media that have been developed to identify the presence of specific organisms. Clinical specimens are swabbed onto culture plates containing selective media. The selective media allow certain organisms to grow while preventing other organisms from growing. In some cases, the selective media can also cause specific organisms to appear a certain color. MRSA test results using selective media are generally available within 24 hours. PCR is a highly sensitive, molecular testing technique that detects MRSA-specific DNA. PCR testing can identify a somewhat higher proportion of MRSA-positive patients than the alternative testing methods and it can generate results within 2 to 4 hours, but it is substantially more expensive than testing using routine or selective media. PCR screening costs $25 to $30 per test, while screening using selective media costs about $5 per test.[13]

Several European countries have largely eradicated transmission of MRSA to other patients by adopting procedures to identify and isolate MRSA-positive patients on admission, demonstrating that hospitals can keep the MRSA infection rate low or nonexistent. In the United States, the consensus among experts is that hospitals should take measures to prevent the transmission of the MRSA organism from any patient known to be infected or colonized with MRSA to other patients in the hospital. CDC's guidelines for reducing the incidence of MDROs, including MRSA, emphasize the importance of implementing several recommended practices when treating MRSA-positive patients, including contact precautions, hand hygiene, and effective environmental cleaning.[14] The guidelines recommend placing MRSA-positive patients in private rooms or

[13]These costs do not include laboratory overhead and personnel costs.

[14]J.D. Siegel et al., *Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006*, downloaded from www.cdc.gov/ncidod/dhqp/guidelines.html on Jun. 5, 2007.

"cohorting" them by placing them in rooms with other MRSA-positive patients. In addition, the guidelines recommend that hospitals exercise antibiotic stewardship by implementing processes that encourage and facilitate judicious use of antimicrobial agents to maximize therapeutic impact while minimizing the development of antibiotic resistance.

Infection control experts differ as to the scope of routine MRSA testing, known as active surveillance testing (AST), they recommend to identify MRSA-positive patients. Some recommend as much routine testing as is necessary to identify all MRSA-positive patients in a hospital, which, depending on the prevalence of MRSA in that hospital or community, can mean testing all admitted patients—universal AST. Other experts, as well as CDC guidelines, recommend targeted AST—testing populations within a hospital who are more likely than others to be colonized with MRSA. Populations targeted include patients in intensive care units, dialysis patients, and patients transferred from nursing homes or prisons. Targeted testing requires fewer resources than universal testing, but misses infected individuals outside of the targeted population.

Decolonization protocols have been developed to remove MRSA bacteria from a colonized patient's body, in order to reduce the likelihood that the patient will get an active infection or transmit the bacteria to someone else. Decolonization therapy can involve applying an antibiotic ointment in the nose for 5 days, bathing in chlorhexidine, or doing both. However, the clinical evidence supporting the effectiveness of these protocols in eradicating MRSA is limited, and researchers have reported that extensive use of this treatment can lead to increased MRSA resistance to the antibiotic in the nasal ointment. As a result, experts differ as to if and when to implement these protocols.

Federal Activities

CDC is the lead federal agency with respect to HAIs. It sets clinical definitions for identifying HAIs and has defined 13 categories of HAIs, including BSIs, SSIs, UTIs, and pneumonia. CDC's definitions and procedures for distinguishing HAIs from other infections, which rely on detailed clinical information obtained from patient medical records and direct observation, are widely accepted as the most appropriate technical

standard by ICPs and others in the field.[15] CDC's Healthcare Infection Control Practices Advisory Committee (HICPAC) publishes guidelines that assemble and assess practices intended to reduce particular types of infections.[16]

Since the 1970s, CDC has managed systems to collect HAI data from hospitals on a strictly voluntary and confidential basis. Following the transition from the NNIS to the NHSN in 2005, participation in CDC's system has grown from approximately 300 hospitals to approximately 1,000 hospitals as of December 2007. Through the NHSN, CDC has established protocols for hospitals to report outcome data on central line-associated BSIs, SSIs, catheter-associated UTIs, VAP, and postprocedure pneumonia.[17] These protocols include questions about the organisms causing the reported infections and the results of any laboratory tests of their antibiotic susceptibility. NHSN also collects data that enable hospitals to risk adjust their HAI rates to take account of differences in the severity of illness of their patients and in the complexity of procedures they perform. The use of risk-adjusted rates allows hospitals to more accurately compare their own progress in infection prevention and control to that of other hospitals, as well as to their own rates in the past. Though participation in the NHSN remains voluntary and is free of charge, enrolling hospitals must agree to follow these protocols in collecting the data that they submit. As was true of the NNIS, CDC releases data from the NHSN only in the form of aggregate rates for different types of infections, with information on the individual participating hospitals legally protected from disclosure.

In contrast to the confidentiality guaranteed to hospitals participating in CDC's data systems, there has been a movement in recent years toward making information about the quality of care provided by individual hospitals publicly available. Several organizations have developed

[15]See, *CDC/NHSN Surveillance Definition of Health Care-Associated Infection and Criteria for Specific Types of Infections in the Acute Care Setting* (www.cdc.gov/ncidod/dhqp/nhsn_documents.html) and CDC, *The National Healthcare Safety Network (NHSN) Manual: Patient Safety Component Protocol*, Division of Healthcare Quality Promotion, National Center for Infectious Diseases (Atlanta, Ga.: updated January 2008).

[16]See GAO-08-283 for a description of this process.

[17]The NHSN allows hospitals to identify and report HAIs that fall into any of the other 13 categories of HAIs for which CDC has developed definitions but without specific data collection protocols.

indicators to measure how often patients receive certain recommended processes of care for certain conditions (called process measures) and to measure how often adverse outcomes, such as infections, occur in certain patient populations (called outcome measures). For example, the Surgical Care Improvement Project (SCIP) has adopted a series of process measures to assess hospital compliance with practices designed to minimize SSIs, as well as other adverse events from surgery.[18] CMS routinely publishes the scores that hospitals receive for these SCIP measures on its Hospital Compare Web site, along with process and outcome measures for other medical conditions.[19]

States Have Designed Broadly Similar Mandatory HAI Public Reporting Systems, with Resource and Technological Challenges Affecting Implementation

Of the 23 states we reviewed that have state-mandated HAI public reporting programs, most have adopted similar approaches to address resource and technological challenges that affect their implementation. Most of these states have designed, and the early-adopting states have implemented, programs that focus on a few outcome and process measures that were developed or endorsed by CDC and are widely accepted by ICPs. Three states have decided to collect data on hospital-associated MRSA infections. In addition, after some early efforts by states to develop their own data collection systems, a majority of the states we reviewed have chosen to use NHSN, the HAI data collection system developed by CDC. Adopting CDC-endorsed measures and the NHSN for data collection allows states to minimize some of the resource and technological challenges that they confront in implementing HAI reporting systems.

[18]The CMS and CDC are represented on the SCIP steering committee, along with such groups as the American College of Surgeons, the American Hospital Association, the American Society of Anesthesiologists, the Institute for Healthcare Improvement, and the Joint Commission.

[19]This Web site can be accessed at www.hospitalcompare.hhs.gov . Since 2004, hospitals' submission of data for a series of process measures has been part of the Medicare hospital inpatient prospective payment system (IPPS). In addition, CMS issued a final rule stating that, effective October 1, 2008, hospitals would no longer receive higher payment under IPPS for eight preventable outcomes, including three HAIs. See 72 *Fed. Reg.* 47200, 47217-8 (Aug. 22, 2007).

States Have Designed HAI Public Reporting Systems with Most Using Similar Approaches

We reviewed 23 states that have state-mandated HAI public reporting systems (see table 1). By early 2008, 14 states had started to collect HAI data from hospitals. Most of the 23 states have adopted similar approaches involving (1) the use of advisory committees, (2) selection of many of the same measures, (3) decisions on systems for data collection, and (4) steps taken to validate the HAI data collected.

Table 1: States We Reviewed with HAI Public Reporting for Hospitals, by Date Data Collection Begins

State	Date data collection began or planned to begin
Pennsylvania	Jan 2004
Florida	April 2005
Missouri	Jul 2005
Vermont	Nov 2006
Maine	Jan 2007
New York	Jan 2007
Colorado	Jul 2007
Illinois	Jul 2007
South Carolina	Jul 2007
California	Jan 2008
Connecticut	Jan 2008
Delaware	Jan 2008
New Hampshire	Jan 2008
Tennessee	Jan 2008
Maryland	Jul 2008
Massachusetts	Jul 2008
Oklahoma	Jul 2008
Virginia	Jul 2008
Washington	Jul 2008
Minnesota	Jan 2009
New Jersey	Jan 2009
Oregon	Jan 2009
Texas	To be determined

Sources: State documents and communication with state government and hospital association officials.

Note: Some states have or will collect data on a pilot basis from the date listed above, but did not or will not publicly release data on hospitals until the pilot period, usually 6 months to a year, is completed.

Use of advisory committees

We identified 19 states that have instituted HAI advisory committees or use technical advisors. Many of these committee members and technical advisors are drawn from related occupations, organizations, or interests. These include clinicians such as physicians or nurses (13 states), consumers (10 states), hospital administrators or hospital association officials (11 states), and officials from the state health department (9 states). A few states also appoint advisory committee members who are academic researchers, technical specialists in microbiology or statistics, and representatives of health insurers, employers, and labor unions.

States seek input from their advisory committees or technical advisors on many of the same issues but differ in how extensively they rely on them. These issues include the initial selection of measures, data collection methods, the format of public reports, the selection of additional measures over time, data analysis techniques such as risk adjustment, and data validation methods. Several states have or plan to consult with advisory committees or technical advisors regarding all or nearly all these issues. Other states appear to restrict such consultation to as few as one or two of these issues.

Selection of HAI measures

More state reporting systems have chosen to collect data on HAI outcomes, such as the rate at which certain types of HAIs occur, than collect data on compliance with processes intended to prevent HAIs. Twenty-one states have selected or are actively considering one or more outcome measures (see table 2) compared to 13 states that have selected or are actively considering one or more process measures (see table 3). Eleven states have selected or are considering both outcome and process measures.

Table 2: Outcome Measures by States We Reviewed with HAI Reporting, by Defining Entity

	HAI outcome measures				
State[a]	Central line-associated BSI[b]	SSI[c]	VAP	Catheter-associated UTI	HAI-related patient safety indicators[d]
Pennsylvania[e]	**CDC**	**CDC**	**CDC**	**CDC**	
Florida					**AHRQ**
Missouri	**CDC**	**CDC**			
Vermont	**CDC**	**CDC**			
Maine	**CDC**				
New York	**CDC**	**CDC**			
Colorado	**CDC**	**CDC**			
Illinois	**CDC**				
South Carolina	**CDC**	**CDC**			
California					
Connecticut	**CDC**				
Delaware	CDC	CDC			
New Hampshire	**CDC**	**CDC**	**CDC**		
Tennessee	**CDC**	**CDC**			
Maryland	**CDC**	**CDC**			
Massachusetts	**CDC**	**CDC**			
Oklahoma	**CDC**		**CDC**		**AHRQ**
Virginia	**CDC**				
Washington	**CDC**	**CDC**	**CDC**		
Minnesota					
New Jersey	CDC	CDC			
Oregon	**CDC**	**CDC**			
Texas	CDC	CDC			

Sources: State documents and communication with state government and hospital association officials.

Notes:

CDC State has decided to collect data for this measure in accordance with CDC definitions and NHSN specifications.

CDC State is considering collection of data for this measure in accordance with CDC definitions and NHSN specifications.

AHRQ State has decided to collect data for "selected infections due to medical care" and "postoperative sepsis" in accordance with Agency for Healthcare Research and Quality (AHRQ) specifications.

[a]States listed in order of when they began collecting HAI data, as shown in table 1.

[b]Most states have chosen to collect data on this measure for ICU patients only.

[c]Most states have chosen to collect data on this measure only for patients undergoing one or more selected procedures, such as coronary artery bypass surgery, hysterectomy, and hip and knee replacement.

[d]One patient safety indicator captures selected infections due to medical care, which includes many device-related infections such as central line-associated BSIs. Another indicator identifies cases of postoperative sepsis, which is aimed at certain infections in surgical patients but is distinct from surgical site infections.

[e]Pennsylvania collected data on these measures according to CDC definitions but not according to NHSN specifications between 2004 and 2007. In January 2008, the state began using NHSN specifications.

Table 3: Process Measures by States We Reviewed with HAI Reporting

	HAI process measures					
State[a]	Antibiotics administered prior to surgery[b]	Health care worker influenza vaccination	Central line insertion practices[c]	Central line bundle[d]	VAP prevention practices[e]	Ventilator bundle[e]
Pennsylvania	[f]			[f]	[f]	
Florida	●					
Missouri					●[g]	
Vermont	●	○		●[h]		
Maine	●			●		●
New York						
Colorado						
Illinois	●					
South Carolina						
California	●	●	●			
Connecticut						
Delaware		○				
New Hampshire	●	●	●			
Tennessee						
Maryland	●	●				●
Massachusetts		○			○	
Oklahoma						
Virginia						
Washington						
Minnesota	●[i]					
New Jersey	●					
Oregon	●					
Texas						

Sources: State documents and communication with state government and hospital association officials.

Notes:

● State has decided to collect data for this measure.

○ State is considering collection of data for this measure.

[a]States listed in order of when they began collecting HAI data, as shown in table 1.

[b]Three measures, developed under the SCIP, are related to the routine administration of antibiotics to forestall SSIs: (1) the percentage of surgical patients who received an antibiotic within 1 hour prior to surgery, (2) the percentage of surgical patients who received the antibiotic recommended for their procedure, and (3) the percentage of surgical patients whose antibiotics were discontinued within 24 hours after the procedure's end time.

[c]Central line insertion practices is a set of process measures developed by CDC to monitor compliance with recommended practices outlined in CDC's guidelines for the prevention of intravascular catheter-related infections. They include occupation of the inserter, hand hygiene, use of sterile barrier precautions, type of skin preparation, location of insertion site, and type of central line inserted.

[d]Central line bundle was developed by IHI. It consists of five components: hand hygiene, using maximal sterile barrier precautions, chlorhexidine skin antisepsis, optimal catheter site selection, and prompt removal of lines that are no longer necessary. The bundle measure represents the percentage of patients for whom all five components of the bundle were complied with.

[e]VAP prevention practices include head-of-bed elevation and daily assessments of readiness to discontinue mechanical ventilation. These are two of the four components of the IHI ventilator bundle, which represents the percentage of patients for whom all four components of the bundle were complied with. The other two components of the ventilator bundle are medication to prevent peptic ulcer disease and medication or mechanical stimulation to prevent blood clots.

[f]Pennsylvania collects information on VAP prevention practices as well as some, but not all, items included in two of the other process measures: antibiotics administered prior to surgery and the central line bundle. However, it only collects these data for patients who develop SSIs, central line-associated BSIs, and VAP. It also collects similar information on patients who develop urinary tract infections. So Pennsylvania uses these data to help explain the infections that occur, rather than assess the extent to which hospitals comply with recommended infection prevention practices.

[g]Missouri hospitals report one VAP prevention measure, head-of-bed elevation, voluntarily.

[h]Vermont has hospitals self-report which components of the central line bundle they have adopted and whether they train their staff to perform those selected components and ensure that staff use them.

[i]Minnesota will also collect data for two additional SCIP infection prevention measures, one on controlling postoperative blood glucose levels for cardiac surgery patients and one on appropriate hair removal.

For the most part, states have chosen to publicly report on a handful of measures relating to HAI outcomes and process that are well-established and clearly defined. For the states selecting HAI outcome measures, all but one have selected or are considering measures developed by CDC. Among the states that have selected process measures, most have emphasized the SCIP measures designed to prevent SSIs that both CDC and CMS helped develop.

The HAI outcome measures selected by the state reporting systems have largely focused on two types of infections as defined by CDC. Of the 18 states that have selected HAI outcome measures, 17 have chosen to collect rates of central line-associated BSIs, as defined by CDC and in accordance with NHSN collection protocols (see table 2). Three other states are actively considering this measure. Twelve states have chosen to collect rates of SSIs for specified procedures, as defined by CDC and in accordance with NHSN collection protocols, while 3 other states are actively considering this measure. Surgical procedures that states have selected for this outcome measure include coronary artery bypass grafts, hip replacements, knee replacements, and hysterectomies. All 12 states

selecting the SSI measure were among the 17 that selected the central line-associated BSI measure. Both central line-associated BSIs and SSIs were recommended for use in public reporting by CDC's HICPAC and professional associations in infection control and epidemiology, and more recently by the National Quality Forum (NQF).[20]

The states that have chosen to measure processes of care designed to prevent HAIs have focused on surgical measures (see table 3). Specifically, 10 states decided to track the routine administration of antibiotics to forestall SSIs. Three measures of this process were adopted under the SCIP program: antibiotic received within 1 hour of surgery, appropriate antibiotic selection, and antibiotics discontinued within 24 hours after the surgery end time. These are the same surgical measures that CMS reports on its Hospital Compare Web site, and they have also been recommended for use in public reporting by CDC's HICPAC committee.

A smaller number of states have selected HAI outcome and process measures for which there is less agreement in the infection control community. For example, among the outcome measures, VAP and catheter-associated UTI rates have not been recommended for public reporting by HICPAC or the professional associations, although both are among the HAI measures endorsed by NQF.[21] Several states have also selected influenza vaccination for health care workers as a process measure. While not endorsed by NQF, this measure has been recommended for public reporting by HICPAC, and CDC plans to include it in the NHSN.

Of the 23 states we reviewed, only 2 have selected HAI outcome measures that substantially diverge from CDC definitions and protocols. Florida and Oklahoma selected two measures developed by the Agency for Healthcare Research and Quality (AHRQ) as part of its Patient Safety Indicators (PSI).[22] One PSI measure identifies "selected infections due to medical

[20]NQF, "National Voluntary Consensus Standards for the Reporting of Healthcare-Associated Infection Data" (Washington, D.C.: 2008). NQF is a voluntary standard-setting, consensus-building organization representing providers, consumers, purchasers, and researchers.

[21]NQF recently requested that CDC consider revising its definitions for these two measures. See NQF, "National Voluntary Consensus Standards for the Reporting of Healthcare-Associated Infection Data," p. 12.

[22]AHRQ is an HHS agency that conducts and funds research to promote more effective and higher quality care.

care," which includes (but is not limited to) device-related infections such as central line-associated BSIs. In contrast to SSIs, which are infections at the site of the surgery, the second HAI-related PSI measure, postoperative sepsis, focuses on major, systemwide infections that occur following surgery. The two PSI measures are calculated by analyzing combinations of diagnosis and procedure codes in administrative billing records to identify certain adverse events using computer software. Both states have also selected at least one of the measures commonly selected by other states that accord with CDC definitions and protocols or guidance (see tables 2 and 3).[23]

Data collection systems

With respect to setting up systems for collecting HAI data from hospitals, states have increasingly relied on CDC's NHSN (see table 4). In January 2007, New York became the first state to begin collecting data for public reporting using the NHSN, and by June 2007, CDC had completed its development of the NHSN sufficiently to open enrollment in the system to hospitals in every state. Prior to that date, 4 states developed their own data collection mechanisms, beginning with Pennsylvania in 2004. Since CDC opened enrollment in NHSN to all hospitals, no state has chosen not to use NHSN to collect at least some of its HAI data.[24] In addition to New York, Colorado, South Carolina, and Vermont began collecting data through NHSN in 2007, and 13 other states have decided to use NHSN for their HAI public reporting programs.[25] Included in the latter group is Pennsylvania, which discontinued its original system in favor of NHSN starting in January 2008. Meanwhile Minnesota, New Jersey, and Texas are considering whether to use NHSN to collect HAI data for public reporting. Currently, only 3 states—Florida, Maine, and Missouri—use systems that do not rely on the NHSN to collect HAI data, though Maine and Missouri draw on CDC's definitions.

[23]Florida selected the antibiotics administered prior to surgery process measures, and Oklahoma selected rates for central line-associated BSIs and VAP.

[24]A number of these states use other systems to collect data for measures not incorporated into NHSN, such as the SCIP measures on antibiotics administered prior to surgery.

[25]Although participation in the NHSN is, from a federal perspective, voluntary on the part of hospitals, and the confidentiality of the data they submit is protected by law, the mandatory state reporting programs require hospitals in those states to enroll in the NHSN and to authorize access to their data by state officials through the group feature in NHSN.

Table 4: Data Collection Systems, by States We Reviewed with HAI Reporting

State[a]	Data collection system	
	NHSN	State developed
Pennsylvania[b]	●	
Florida		●
Missouri		●
Vermont	●	
Maine		●
New York	●	
Colorado	●	
Illinois	●	
South Carolina	●	
California	●	
Connecticut	●	
Delaware	●	
New Hampshire	●	
Tennessee	●	
Maryland	●	
Massachusetts	●	
Oklahoma	●	
Virginia	●	
Washington	●	
Minnesota	○	
New Jersey	○	
Oregon	●	
Texas	○	

Sources: GAO analysis of state documents and communication with state government and hospital association officials.

Notes:

● Data collection system selected.

○ Data collection system being considered.

A number of states that use the NHSN also use other data collection systems for measures that are not incorporated into the NHSN, such as those for antibiotics administered prior to surgery.

[a]States listed in order of when they began collecting HAI data, as shown in table 1.

[b]From 2004 through 2007 Pennsylvania used its own state data collection system.

Data validation

Data collection systems may or may not incorporate procedures to independently verify the accuracy of the data submitted to them. However, according to infection control experts as well as state officials responsible for HAI reporting programs, unless such procedures are in place, there is a substantial risk that the data provided by hospitals in a mandatory public reporting system will be misleading because some hospitals will provide data that are more accurate and complete than others. This variation in reporting accuracy and completeness can occur for several reasons. First, as New York health department officials found, hospitals can provide inconsistent information because they interpret the relevant definitions differently. Second, some hospitals are likely to have infection control programs that are more effective than others in identifying HAIs, which means that they detect a higher proportion of the HAIs that occur in their facilities. Finally, the act of publicly reporting infection rates as a guide for patients to use in selecting a hospital may encourage hospitals to be less rigorous in seeking to detect HAIs, since the fewer they find the better they look compared to their competitors.

Because the HAI data collection systems developed by CDC, including NHSN, were based on a model of voluntary participation by hospitals for purposes of internal quality improvement without public disclosure of the results, CDC systems did not incorporate processes for independent data validation. Voluntary participation without public disclosure was presumed to minimize any incentive for hospitals to submit inaccurate data. Consequently, CDC has not conducted an ongoing or systematic validation study of the data currently being submitted to NHSN,[26] though it has collaborated with states that adopt NHSN for mandatory public reporting to develop methods that the states can use to ensure the submitted data are accurate.

[26]CDC researchers did conduct one pilot study in the mid-1990s that examined the accuracy of HAI reporting at nine hospitals participating in the voluntary NNIS system that preceded NHSN. In general they found that the patients that the hospitals reported as having HAIs did have them, but that an additional number of patients had HAIs that were not reported to NNIS. The extent of underreporting varied by type of infection, lower for BSIs and higher for UTIs, for example. The researchers concluded that "Data integrity is essential and can be accomplished only when an ongoing and objective method to assess the quality of the data is included as an integral part of the surveillance system." See T.G. Emori et al., "Accuracy of Reporting Nosocomial Infections in Intensive-Care-Unit Patients to the National Nosocomial Infections Surveillance System: A Pilot Study," *Infection Control and Hospital Epidemiology*, 19 (May 1998) 308-316.

Of the 23 states we reviewed, 4 have plans to validate the accuracy of the data collected from hospitals, while several others indicated they may develop such plans in the future. New York has made the most progress on implementing a broad data validation process. It has hired five ICPs to review a systematic sample of infection reports submitted to the NHSN from each New York hospital and compare the reports with the hospitals' medical records. The ICPs review medical records of ICU patients with bloodstream infections from each hospital, as well as records of matched patients with similar surgeries for whom infections were and were not reported. After identifying which patient medical records showed HAIs that should have been reported, they compare them to the infection reports submitted by the hospitals. For any discrepancies, state officials meet with hospital staff to better ensure the accuracy of the data for the next reporting period.

Three other states—Pennsylvania, Missouri, and South Carolina—have undertaken less extensive efforts to validate data they receive from hospitals. Pennsylvania has conducted inspections of a limited number of hospitals selected on the basis of statistical anomalies in the HAI data that they submitted. However, Pennsylvania state officials have developed plans to emulate New York's approach and hire auditors to review a sample of patient medical records from each hospital. In addition, they plan to analyze utilization data obtained from insurance plans. In Missouri, health department officials conducting annual onsite inspections of licensed hospitals compare a hospital's HAI reports with a sample of patient medical records. This is one of many items covered during a licensing inspection and it is not designed to be a comprehensive data validation effort. South Carolina has initiated a pilot program with one hospital system to develop data validation methods based on linking NHSN data with hospital billing data from the state's hospital discharge data set.

Officials in other states have indicated similar concerns about the accuracy of data submitted to HAI public reporting programs, but have not yet acted on those concerns. Documents from seven states supported efforts to validate the data submitted by hospitals to ensure their accuracy.[27] However, most of these states are just beginning to implement

[27]The seven states are Colorado, Connecticut, Maryland, New Hampshire, Oregon, Texas, and Washington.

their public reporting systems and have not yet begun to develop data validation methods.

Most States Do Not Require Hospitals to Track MRSA HAIs, though Some States Collect Limited MRSA Data through Public Reporting or Other Systems

States have generally not required MRSA-related outcome measures or process measures as a part of their public reporting programs, even though MRSA and other MDROs cause many HAIs. Three exceptions are Illinois, Maryland, and New Jersey. Illinois plans to collect data on the number of hospital patients with MRSA infections using diagnostic codes included in administrative data that hospitals routinely submit to the state. In January 2008, Illinois made two changes to its administrative data systems that will enhance its identification of hospital-associated MRSA infections. First, it required all hospitals to enter a code for each reported diagnosis to indicate if the condition was present when the patient was admitted.[28] The state also expanded the number of diagnosis codes that hospitals report to the state, from a maximum of 9 to 25, which will reduce the chances of undercounting the number of patients with MRSA infections for patients with more than 9 diagnoses.

New Jersey is also requiring hospitals to report on MRSA cases acquired in hospitals. Rather than rely on administrative data, New Jersey plans to use an MDRO module for the NHSN that CDC is developing and expects to release in the fall of 2008. Maryland has taken yet another approach by deciding to collect data on a MRSA-related process measure instead of outcomes. It will collect information from hospitals on the proportion of patients in ICUs who undergo AST for MRSA.

States also are able to obtain some data on HAIs caused by MRSA from the existing NHSN modules. Seventeen states have decided to use the NHSN to collect outcome measures on one or more types of HAIs for which there are NHSN protocols.[29] These protocols require hospitals to report available information about the pathogens causing the infections and the results of any antimicrobial susceptibility laboratory testing performed. However, these data are limited to the types of infections that the states require

[28]CMS developed this "present on admission" (POA) indicator to identify hospital-acquired conditions. All hospitals paid under Medicare's IPPS must attach this indicator to the diagnosis codes that they submit with their claims. Certain hospitals that Medicare pays outside of the IPPS, such as critical access hospitals, are not subject to this CMS requirement, but Illinois requires all hospitals to report the POA code.

[29]There are NHSN protocols for central line-associated BSIs, VAP, catheter-associated UTIs, SSIs, and postprocedure pneumonia.

hospitals to report, and most states have opted not to require hospitals to report on all types of HAIs in hospitals for which NHSN has developed protocols. Moreover, the existing NHSN modules do not include community-associated MRSA, which can only be reported through NHSN as part of the MDRO module to be released in fall of 2008.

Although MRSA does not appear on CDC's list of nationally notifiable infectious diseases for 2008, we found 13 states that classify MRSA infections as a reportable disease under their state communicable disease programs.[30] These programs require hospitals, laboratories, or other providers to report some or all MRSA cases to the state or local departments of health periodically.[31] In all but one of these states, those reporting MRSA cases are not asked to distinguish between health-care-associated and community-associated infections.

Resource and Technological Challenges Influence How States Implement HAI Reporting Systems

State and state hospital association officials we interviewed mentioned a variety of resource and technology challenges they faced in implementing their HAI reporting systems. These challenges often limited the scope of their reporting systems and the timing of their implementation. Regarding resource challenges, officials in one state reported that they needed to train and provide technical assistance for hospital staff, some of whom struggled to implement the clinically sophisticated NHSN protocols for data collection. A status report issued by another state noted that the state resources dedicated to training hospital staff to use the NHSN prevented the state from conducting other program activities such as data validation. Officials in several states reported trouble hiring and retaining the staff they needed to initiate their HAI reporting systems, sometimes due to a lack of financial resources. State officials underscored their need for highly trained personnel to effectively implement these reporting systems. Hospital association and state officials in several states noted that hospitals did not have enough qualified ICPs, which has exacerbated implementation challenges. One state official indicated that although the health department had financial resources to hire staff, it did not have enough office space.

[30]Several other states require hospitals and other providers to report only suspected cases of community-associated MRSA.

[31]Some states focus their reporting requirement on cases of invasive MRSA. The frequency of reporting varies from within 12 hours of identification in Connecticut to semiannually in Maine.

States also confronted technological challenges when implementing HAI reporting systems, especially if they developed their own data collection systems. Missouri officials, for example, found the system they developed had to balance competing technological demands to (1) collect all the necessary data elements for proper risk adjustment, (2) allow hospitals to extract the data using their existing computer systems, and (3) be user-friendly for those collecting and entering data. Pennsylvania also experienced technological challenges. For example, when it began collecting HAI data from hospitals using a data system that was developed for hospitals to report administrative data, it generated strong criticisms from hospital officials and clinicians who argued that this system did not collect the information needed to risk adjust the reported results as recommended by CDC.[32]

CDC had already dealt with such technological issues in developing the NHSN, building on its decades-long experience in operating the NNIS system. In June 2007, CDC opened enrollment in the NHSN to all U.S. hospitals. This made adoption of the NHSN an attractive option for state officials seeking to address these technological concerns. For example, New York officials reported to us that they considered developing their own data collection system tailored to the needs of the New York program before deciding to adopt the NHSN. Because New York's law required a reporting system that was functionally similar to the NHSN, these officials concluded that it made more sense to use the existing system than attempt to create a new system to perform the same functions.

These challenges, particularly with respect to resources, have affected the decisions states have made regarding timelines for implementation, measures to use, data collection mechanisms, and data validation processes. To ensure they have sufficient resources to adequately implement their reporting systems, some states have delayed the starting date for reporting or limited the number of measures to be collected. Frequently states restricted the measures that they selected to patients in certain units, such as ICUs, or those who underwent selected surgical procedures.

[32]Pennsylvania's original data collection system recorded each instance where hospitals found a patient had an HAI. However, it did not collect information on the number of patients at risk of developing comparable HAIs, information which the NHSN collects in order to risk adjust its results. In 2007 the Pennsylvania legislature passed a law that mandated adoption of NHSN for HAI data collection.

To avoid the resource and technological challenges of developing their own data collection systems, most states have decided to use the NHSN. State officials cited numerous reasons for adopting the NHSN, including that it is free to both the states and the hospitals, accessible on the Internet, requires no software development by the states or commercial software purchases by hospitals, uses professionally accepted definitions, and collects detailed data that hospitals can use for quality improvement. However, despite widespread recognition among state officials of the need to validate the data submitted by hospitals, only in a few states have officials determined how to accomplish data validation with the resources available to them.

Hospital MRSA-Reduction Initiatives Share Multiple Components, but Vary in Scope and Resource Requirements

All the hospitals with MRSA-reduction initiatives that we reviewed use routine testing for MRSA as part of their initiative, although they chose different patient populations to test. These hospitals reported changing a number of general infection control policies or practices as part of their initiatives, and all included patient or health care staff decolonization as part of their initiative despite limited support for such practices among infection control experts. The hospitals we reviewed reported needing varying levels of funding and staff resources to operate their initiatives, but all hospitals that tracked MRSA infection rates reported a decline in MRSA infections as a result of their initiatives.

All Initiatives Use Routine Testing for MRSA but Vary in How Testing Is Targeted and Conducted

All 14 hospitals we reviewed reported that they conduct AST as part of their MRSA-reduction initiative. However, these hospitals vary in the patient populations tested (see table 5). Three hospitals conduct universal AST, testing all patients admitted. The remaining hospitals conduct targeted AST, screening select patient populations deemed to be at risk for MRSA colonization. Of the hospitals that conduct targeted AST, all but one screen patients in adult or neonatal intensive care units and 5 screen surgical patients.

Table 5: Patient Populations Screened with Active Surveillance Testing, by Selected Hospital

		Targeted screening						
	All (Universal)	Adult intensive care unit	Neonatal intensive care unit	Surgical	Long-term care facility admissions	Jail or prison admissions	Dialysis	Other
Evanston Northwestern Healthcare	●	○	○	○	○	○	○	○
Medical University of South Carolina	●	○	○	○	○	○	○	○
Pitt County Memorial Hospital	●	○	○	○	○	○	○	○
Eastern Idaho Regional Medical Center		●	●	●[a]	●	●	●	●[b]
Centra, Lynchburg General and Virginia Baptist Hospitals		●		●[c]	●		●	●[d]
Wake Forest University Baptist Medical Center		●						●[e]
Mercy Medical Center					●			●[f]
Albany Medical Center			●	●				
Newark Beth Israel Medical Center		●	●					
Beth Israel Medical Center		●		●[g]				
Rochester General Hospital		●		●[h]				
University of Pittsburgh Medical Center		●						
Barnes-Jewish Hospital		●						
Pacific Hospital of Long Beach		●						

Source: GAO analysis of survey and site visit data.

Notes:

● Hospital screens patient population for MRSA.

○ Included in universal active surveillance testing where all admitted patients are tested.

[a]Screens patients admitted for open mediastinal procedures, total joint replacements, and open spine procedures.

[b]Screens patients admitted from another acute care hospital.

[c]Screens admissions to the surgical ICU.

[d]Screens patients who live in a household with a MRSA-positive individual or have been told in the past that they have an MDRO.

[e]Screens patients who have a length of stay in the hospital that is greater than 6 days and who have been given antibiotics; patients who have a length of stay greater than 21 days; patients known to have at least one MDRO; and patients transferred from other health care facilities.

[f]Screens patients with soft tissue or skin infections.

[g]Some surgical patients are screened.

[h]Screens cardiothoracic patients.

The hospitals we reviewed divide fairly evenly in their choice of testing methods. Five of the hospitals conduct AST using selective media, which generally produces results in 24 hours at a cost of approximately $5 per test. All but one of the remaining hospitals reported using PCR testing, which provides results in only 2 to 4 hours but costs about $25 to $30 per test, and the one remaining hospital reported using routine culture media. Two hospitals reported using more than one testing method. One of these hospitals reported that PCR testing is used only when results are needed quickly because of limited staff availability to operate the equipment.

Hospitals Expanded Infection Control Activities and Information Systems to Reduce MRSA

In implementing their MRSA-reduction initiatives, all the hospitals we reviewed reported changing general infection control policies or practices. CDC guidelines for managing MDROs include recommended practices relating to hand hygiene adherence, contact precautions, environmental cleaning, and judicious use of antibiotics. All 14 hospitals made changes to their existing policies or practices for hand hygiene, while more than half of the hospitals made changes to their contact precautions or environmental cleaning policies (see table 6).[33] Fewer hospitals reported making changes to their antibiotic stewardship policies.

[33]We do not know the extent to which hospitals already had in place extensive policies for contact precautions, environmental cleaning, or antibiotic stewardship. We asked hospitals to report changes they made to these policies for their MRSA-reduction initiatives.

Table 6: Policy or Practice Changes Implemented by Selected Hospitals as Part of MRSA-Reduction Initiatives

	Hand hygiene	Contact precautions	Enhanced environmental cleaning	Antibiotic stewardship
Evanston Northwestern Healthcare	●	●		●
Medical University of South Carolina	●			
Pitt County Memorial Hospital	●		●	
Eastern Idaho Regional Medical Center	●	●	●	●
Centra, Lynchburg General and Virginia Baptist Hospitals	●	●		
Wake Forest University Baptist Medical Center	●	●	●	●
Mercy Medical Center	●		●	
Albany Medical Center	●	●	●	●
Newark Beth Israel Medical Center	●		●	●
Beth Israel Medical Center	●	●	●	
Rochester General Hospital	●	●	●	●
University of Pittsburgh Medical Center	●	●	●	
Barnes-Jewish Hospital	●	●		
Pacific Hospital of Long Beach	●	●	●	●

Source: GAO analysis of survey and site visit data.

- Hand hygiene—All of the hospitals we reviewed reported changing hand hygiene policies as part of their MRSA-reduction initiative. Eleven of the hospitals reported conducting observation audits to monitor compliance with hand hygiene protocols. Two of these hospitals noted that their audits are coupled with immediate feedback to staff who are noncompliant. More than half of the hospitals also reported increasing staff training or public awareness campaigns to increase compliance with hand hygiene among staff or hospital visitors, or both. Multiple hospitals have increased the use of alcohol-based gel hand sanitizers as part of their initiatives by providing more product dispensers in the hospital. In addition, 2 hospitals reported monitoring the consumption of hand hygiene products, such as hand sanitizer or soap, to gauge hand hygiene compliance. For more information on the changes hospitals made to hand hygiene polices, see appendix II, table 7.

- Contact precautions—Most hospitals reported making changes to their contact precautions as part of their MRSA-reduction initiatives, for example, by requiring health care workers to wear gowns and gloves when in contact with a MRSA-positive patient or with equipment used on a MRSA-positive patient. Two hospitals also began requiring health care workers to wear masks in addition to gowns and gloves when in contact

with a MRSA-positive patient.[34] Multiple hospitals use signs at room entrances of MRSA-positive patients to remind health care workers to follow contact precautions when entering those environments. Hospitals that changed their contact precautions also reported conducting audits to measure staff compliance with contact precaution procedures. For more information on the changes hospitals made to their contact precautions, see appendix II, table 8.

- Environmental cleaning—Most hospitals reported changing environmental cleaning procedures as part of their MRSA-reduction initiatives. Three hospitals reported that they disinfect patient equipment between uses or high-touch areas, such as keyboards and door knobs. Three hospitals implemented checklists for housekeeping staff to ensure that rooms are properly cleaned following the discharge of a MRSA-positive patient. One hospital began changing privacy curtains in patient rooms as part of its initiative because the curtains often become contaminated with MRSA. For more information on the changes hospitals made to environmental cleaning polices, see appendix II, table 9.

- Antibiotic stewardship—Half of the hospitals created new policies or revised their existing policies pertaining to antibiotic stewardship. These changes generally included tracking antibiotic prescriptions or restricting the use of certain antibiotics. For more information on the changes hospitals made to antibiotic stewardship policies, see appendix II, table 10.

In addition to changes in infection control practices, most of the hospitals we reviewed adapted their information systems to support their MRSA-reduction initiatives. All but 1 of the 14 hospitals has a mechanism to identify previously colonized patients readmitted to their hospital. Most of these hospitals reported that they track patients' MRSA status in electronic medical records, using flags to identify a patient as MRSA-positive each time the patient's electronic medical record is accessed. This enables the staff to immediately implement contact precautions, without the cost or time needed for additional screening.

[34]One of these hospitals reported that it included the use of masks because their use may help prevent health care staff from being colonized with MRSA in their nasal passages, a common site of MRSA colonization. However, a hospital official noted that the use of masks has not been adequately studied.

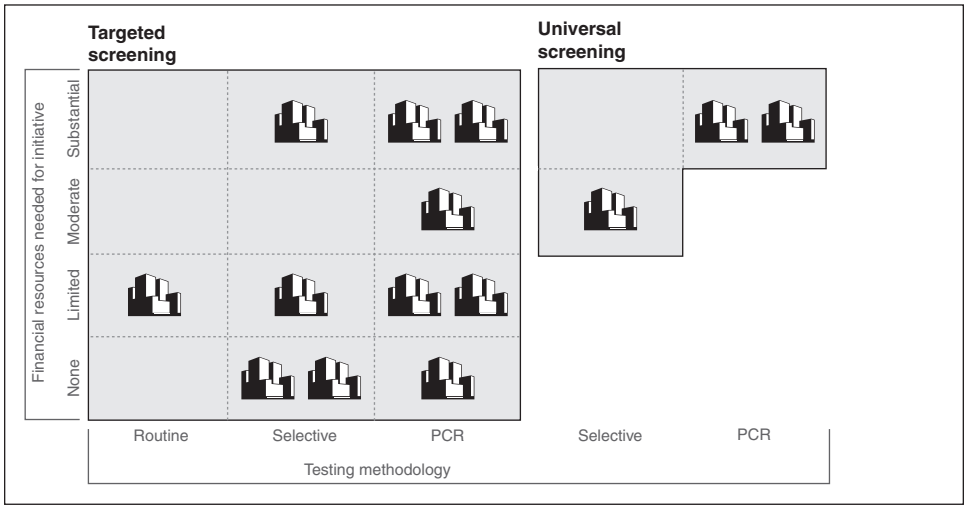
All 14 Hospitals Included Decolonization in Their MRSA-Reduction Initiatives

All the hospitals we reviewed included patient or health care staff decolonization as part of their MRSA-reduction initiatives, despite limited support for MRSA decolonization among infection control experts and in CDC's MDRO guidelines. Twelve hospitals reported decolonizing patients, with 6 of these hospitals decolonizing all MRSA-positive patients. Seven hospitals reported that they decolonize health care staff—6 hospitals test health care staff for MRSA colonization during outbreaks and decolonize those found to be positive while the other hospital decolonizes staff found to be MRSA-positive during voluntary testing. For more information on these hospitals' approaches to decolonization, see appendix II, table 11.

Hospital MRSA Initiatives Reported Needing Varying Levels of Funding and Staff Resources

The hospitals we reviewed reported needing varying levels of funding and staff resources to implement and operate their MRSA-reduction initiatives. Half of the hospitals reported needing limited or no additional funding for these initiatives. However, the remaining hospitals reported that moderate to substantial additional funds were needed. Six of the seven hospitals that reported needing moderate to substantial additional funding use the more expensive PCR testing or screen all patients (see fig. 1). Several of the remaining hospitals that reported needing limited or no additional resources also use PCR testing, but all of them conduct AST on targeted patient populations. Eight hospitals reported needing additional staff to conduct patient testing, laboratory staff to process the tests, or both.

Figure 1: Selected Hospital-Reported Financial Resource Needs for MRSA-Reduction Initiative, by Type of Screening and Test Method



Source: GAO.

Note: Reporting hospitals characterized the level of additional resources needed for their MRSA-reduction initiatives as none, limited, moderate, or substantial.

Most hospitals reported that they place all or most MRSA-positive patients in private rooms as part of their initiative. However, several of these hospitals noted that the availability of single or semiprivate rooms was a factor in the approach or scope of their MRSA-reduction initiative. For example, at Newark Beth Israel, the first priority is to place all MRSA-positive patients in single rooms. However, when single rooms are not available, a MRSA-positive patient is placed with another MRSA-positive patient. Eight hospitals reported at least some cohorting of MRSA-positive patients.

Hospitals with MRSA Initiatives Consistently Reported Reductions in MRSA Infection Rates

Of the 13 hospitals that tracked MRSA infection rates, all found a decline in MRSA infections as a result of their initiatives. Though some hospitals simply cited reductions or significant decreases in their MRSA infections, 5 hospitals provided estimates of the percentage by which their MRSA infection rates had declined. These estimates ranged from around 50 to 74 percent. Three hospitals assessed their reductions quantitatively, but in terms other than percentage or proportion. Two hospitals noted that infections from all organisms, not just MRSA, declined. Over half of the hospitals we reviewed reported that they have tracked MRSA colonization rates as part of their MRSA initiatives. Of the hospitals that reported

tracking MRSA colonization rates, half reported an observed decrease in the incidence of MRSA colonization since implementing their initiatives.

Two Hospital Systems Addressed Similar Challenges in Implementing MRSA-Reduction Initiatives

The two hospital systems that we visited overcame a similar set of challenges in implementing multifaceted MRSA-reduction programs. Both systems designed and executed processes to put the elements of their MRSA-reduction initiatives into effect and promote compliance with those processes by hospital staff. Both strove to facilitate the implementation of these processes by incorporating them as much as possible into the normal workflow of hospital staff. Both hospital systems promoted staff compliance with their MRSA-reduction initiatives through a combination of concerted leadership on the part of the physicians who led their infection control programs and specific procedures designed to facilitate staff compliance reinforced through detailed feedback on their performance. However, the two hospital systems took different approaches to marshalling resources for their initiatives. One directed substantial financial resources into its MRSA-reduction initiative to implement the initiative simultaneously for all patients at all of its hospitals, while the other relied largely on existing resources and implemented its initiative more incrementally at selected hospitals and on selected units.

The Two Systems Faced Process, Compliance, and Resource Challenges in Implementing Their MRSA Reduction Initiatives

The two hospital systems that we visited faced a similar set of challenges in implementing multifaceted MRSA-reduction programs over the past several years.[35] Evanston Northwestern Healthcare (ENH) and the University of Pittsburgh Medical Center (UPMC)—both multihospital systems[36]—each sought to reduce MRSA infections by instituting AST of patients for MRSA and ensuring consistent implementation of hospital procedures, such as hand hygiene procedures and contact precautions. To achieve these objectives, both systems had to overcome three challenges:

[35]UPMC and ENH began implementing their MRSA-reduction initiatives in January 2002 and February 2003, respectively.

[36]ENH is a 3-hospital system located on separate campuses in Chicago's northern suburbs. All 3 hospitals primarily function as community hospitals with many surgical and long-term care patients and relatively few ICU patients. UPMC is a 20-hospital system, largely located in the Pittsburgh metropolitan area but with some hospitals scattered across Western Pennsylvania. One of the UPMC hospitals is Presbyterian Hospital, a large academic medical center with a substantial number of ICUs and ICU patients. Some of the other hospitals in the UPMC system function more as community hospitals.

(1) designing and executing processes to put the elements of their MRSA-reduction initiatives into effect, (2) promoting compliance with those processes by hospital staff, and (3) marshalling the required financial and staff resources to implement their initiatives.

The Two Systems Incorporated Processes to Implement Their MRSA-Reduction Initiatives into Routine Hospital Workflows

The two systems put processes in place to ensure that all eligible patients were tested for MRSA and that any positive results were quickly communicated to the clinical staff to alert them to initiate contact precautions for those patients. Both strove to facilitate the implementation of these processes by incorporating them as much as possible into the normal workflow of hospital staff. At ENH, the implementation of universal AST at admission meant that collecting specimens and submitting them to the laboratory became part of the routine admission procedure for every patient. Because all patients were tested, there were no target populations to identify. Although UPMC did not adopt universal AST, its strategy of screening every patient in selected hospital units had a similar advantage in terms of clearly identifying the patients to be tested.[37]

Both hospitals devised processes for easing access to the supplies that staff needed to conduct MRSA testing and to initiate contact precautions for the patients who tested positive. ENH developed a packet with all the supplies needed for testing a patient for MRSA. The housekeeping staff was responsible for leaving this packet on the bed as it finished preparing each room for the next patient. At ENH, supplies needed for contact precautions were stocked on isolation supply carts that were delivered to the room of each patient who tested positive for MRSA. To reduce the time of the arrival of that cart for patients undergoing contact precautions, ENH officials revised their procedure for ordering the carts. Instead of having the nursing staff order the cart once it had received notice of a patient's positive test result, ENH officials instructed the laboratory staff to order the cart directly for all patients with positive test results. According to ENH officials, this reduced the time from test result to initiation of isolation precautions by approximately 45 minutes. UPMC staff designed a special container to install at each patient room that was routinely kept stocked with the gloves, gowns, and other supplies needed whenever a

[37]In addition to testing patients for MRSA on admission to the selected units, UPMC tested them again (unless they had already tested positive) once a week while on the unit and at the time of discharge from the unit. UPMC made it easier to ensure that patients were tested weekly by testing all patients in the unit on the same day of the week, rather than counting 7 days from each patient's admission date.

patient was placed under contact precautions. Moreover, UPMC programmed its laboratory information system so that a positive MRSA test result automatically generated a notification by fax, e-mail, and pager to the clinical staff on that patient's hospital unit to initiate contact precautions.

Concerted Leadership and Monitoring of Staff Performance Fostered Compliance with MRSA-Reduction Initiatives

Both hospital systems promoted staff compliance with their MRSA-reduction initiatives through a combination of concerted leadership on the part of the two physicians who led their respective infection control programs and specific procedures designed to facilitate staff compliance reinforced through detailed feedback on their performance. Much of the impetus for implementing MRSA-reduction programs at ENH and UPMC came from these two lead physicians, both of whom saw the potential to achieve substantial decreases in MRSA infection rates by putting a comprehensive program in place. These lead physicians worked extensively with hospital administrators and their fellow clinicians to build support for the MRSA-reduction initiative by documenting the extent of their existing problem with MRSA, laying out the steps that they could take to address the problem, and marshalling the evidence that the resulting initiative was producing positive results once implementation had begun. They also responded to any problems that arose during implementation or concerns expressed by the clinicians affected by the initiative by making adjustments in its operation. To identify emerging problems and find effective solutions, the lead physicians established internal working groups with representation across the affected hospital departments. At UPMC this group continued to meet regularly to review data on whether patients were being properly tested and isolated, to discuss any concerns raised by hospital staff, and to consider specific adjustments to the implementation of the initiative.

Both hospital systems relied heavily on information technology to facilitate compliance with the various components of the MRSA initiative. ENH made a number of specific adaptations to its electronic medical record (EMR) system.[38] For example, it added an orange banner on the medical record screen that highlighted any patient who had been admitted until staff entered a confirmation that the MRSA test had been performed.

[38]In 2003, ENH converted all its patient medical records to an EMR system. Paper records received from other facilities were scanned and converted into electronic documents, allowing ENH to become a completely "paperless" facility.

ENH also created a prominent flag in its EMR for any patient who had been identified as MRSA-positive during a previous admission or outpatient encounter; all such patients were immediately placed under contact precautions. UPMC incorporated similar reminders into its EMR system and also implemented a flag to identify patients who had previously tested positive for MRSA so that they could be immediately placed under contact precautions at subsequent admissions.

In addition, ENH and UPMC monitored staff compliance with targeted hospital procedures. At ENH, hospital ICPs used their electronic record system to measure the length of time it took staff on various units to perform the MRSA test and to respond to positive test results by implementing contact precautions. They used these data to provide feedback to both units and individual staff members on their relative performance. At UPMC, the infection control department provided similar feedback at monthly meetings with staff in the individual hospital units, where they presented data on the proportion of patients who were tested at UPMC's designated time points.

UPMC also expanded its oversight of staff compliance with standard hand hygiene procedures in conjunction with its MRSA-reduction initiative. To obtain more accurate information on staff compliance with those procedures, UPMC implemented routine audits that used trained, anonymous observers to assess staff performance. UPMC officials sent formal letters to clinical staff, including physicians, who were observed not following hand hygiene procedures. Less formally, UPMC officials provided immediate, positive feedback to staff members who were observed complying with their hand hygiene procedures.

One Hospital System Marshalled Substantial Resources to Effect Systemwide Change While the Other Implemented Incremental Changes with Existing Resources

ENH directed substantial financial resources into its MRSA-reduction initiative to implement the initiative simultaneously for all patients at all three of its hospitals, while UPMC relied largely on existing resources and implemented its initiative more incrementally at selected hospitals and on selected units. For both hospital systems, one key resource challenge was paying for an increased number of MRSA tests. Ultimately, both systems conducted analyses indicating that the increased costs of their initiatives were more than compensated for by the reduced cost of treating a smaller number of patients with MRSA infections.

ENH officials made a key strategic decision to move expeditiously to implement MRSA screening for all patients admitted to ENH's three hospitals. To do this, they developed an implementation plan based on an

analysis of clinical and financial data. Beginning in 2003, ENH piloted MRSA AST in one ICU. In 2004, it conducted a one-time prevalence survey[39] that determined that 8.5 percent of all patients were colonized with MRSA—most of them in units outside of the ICUs.[40] Based on this information and the ICU pilot experience, ENH officials developed a plan to implement universal AST within a year and budgeted $1 million per year in additional costs, mostly for the increased number of MRSA tests performed and additional laboratory staff. ENH officials conducted a cost-benefit analysis that concluded that the hospital system would save more from having fewer patients with MRSA infections needing treatment than it would spend for increased testing. Because ENH had collected detailed information on patient costs and charges over a number of years, these officials were able to develop their own estimates for the additional costs associated with an MRSA infection in the ENH hospitals.[41]

Administrators at ENH provisionally approved the MRSA-reduction initiative, pending confirmation during its first 2 years that it had the expected effect on the number of ENH patients who developed MRSA infections and had not increased overall costs. Ultimately, the number of MRSA cases at ENH decreased more rapidly than expected following implementation of the initiative, and the additional costs were less than expected—approximately $600,000 per year.

The cost-benefit analysis provided ENH officials with support for their choice of the more expensive PCR testing method. Under the plan, the projected cost savings from the anticipated reduction in MRSA infections were greater than the additional costs of the MRSA-reduction initiative,

[39]The prevalence survey determined the number of patients across all units of the three ENH hospitals who were colonized with MRSA at a particular point in time.

[40]This contrasted with a report published the previous year that 2.7 percent of patients admitted to Emory University Hospital were MRSA-positive. J.A. Jernigan et al., "Prevalence of and Risk Factors for Colonization with Methicillin-Resistant Staphylococcus Aureus at the Time of Hospital Admission," *Infection Control and Hospital Epidemiology*, 24:6 (June 2003) 409-14.

[41]Financial experts at ENH constructed an internal database that recorded actual costs associated with individual chargable items and procedures going back to fiscal year 2005. They used these data to assess the net costs of treating patients with MRSA infections, after taking account of any higher payments received, compared to the costs of treating comparable patients who did not have MRSA infections. These analyses found that ENH absorbed a net cost of approximately $10,000 for each patient with a MRSA-related respiratory infection and a net cost of $19,000 for each patient with a MRSA-related bloodstream infection.

even using PCR to test every patient at admission. ENH officials were willing to pay approximately $25 per test to obtain two advantages offered by PCR testing—faster results and greater sensitivity in detecting patients with MRSA. Getting results for most patients no later than 15 hours after testing reduces the amount of time that MRSA-positive patients spend in the hospital without contact precautions in place, which in turn reduces the chances that they will infect other patients.[42]

UMPC took a more incremental approach to implementing its MRSA-reduction initiative and, as a result, did not need additional resources. It began its initiative in 2002 in one ICU at Presbyterian Hospital, and expanded it over 4 years to other ICUs in that hospital and then to all adult ICUs in the 19 other hospitals in the UPMC system. This measured pace of expansion restricted the number of additional patients who needed to undergo contact precautions at any one time, which eased potential logistical problems that stem from the predominance of semiprivate rooms in UPMC hospitals. UPMC officials told us that they expect to continue making such incremental decisions on where and when to expand their MRSA-reduction initiative in the future. They stated that this could eventually lead to screening of all inpatient admissions.

UPMC officials have relied, as did their counterparts at ENH, on their analysis of clinical and financial data in developing and expanding their MRSA-reduction initiative. UPMC officials selected the initial hospital unit from those that had the largest number of MRSA infections and, therefore, the greatest potential for improvement, with additional consideration given to the readiness of staff on the unit to fully support the initiative. On that basis, they began with the 20-bed medical ICU at Presbyterian Hospital. Once the initiative was implemented and the ICU's MRSA infection rate declined, they made the case for expanding the initiative to other units within Presbyterian and to other UPMC hospitals. As with the initial selection of the first ICU, UPMC officials selected the units for expansion of the initiative based on those with the highest MRSA rates, and they plan to continue expanding participation in the initiative on that basis.

[42]Individual PCR tests require only about 2 to 4 hours to produce a result, but it takes additional time to transport specimens to the laboratory site and it is more efficient to conduct the tests in batches.

Because UPMC began its MRSA-reduction initiative with just one unit, and monitored its progress for 3 years before expanding to other units, UPMC officials could implement their initiative with a relatively small upfront investment of resources. They hired no new staff for the initiative. Instead, to meet the demand for increased MRSA testing, they reallocated existing laboratory staff and financial resources. Other additional costs, such as for increased use of gowns, gloves, and masks to maintain contact precautions, were relatively minor.[43] In selecting which test to use for screening patients, UPMC officials chose the relatively inexpensive selective media test, which costs approximately $5 and requires only about 40 seconds of laboratory technician time to perform. Although using selective media did not produce results as quickly as PCR would, UPMC officials found that they could nonetheless identify 81 percent of MRSA-positive patients within 24 hours.

UPMC's MRSA-reduction initiative has achieved large reductions in the number of MRSA cases at a relatively low cost, resulting in a highly favorable ratio of benefits to costs. UPMC officials estimate that their savings in terms of the reduced costs to treat a smaller number of MRSA cases were 12 to 32 times greater than the costs they incurred to test patients for MRSA and implement contact precautions for those who test positive. To calculate those savings, they relied on estimates from the published literature for determining the difference in treatment costs for patients with and without MRSA infections,[44] and multiplied that figure by the reduction in the number of MRSA infections that have occurred in their targeted units. UPMC officials have used these estimates to build support for expanding the MRSA-reduction initiative into other units of the UPMC hospitals besides ICUs, including orthopedic units.

Concluding Observations

Governmental initiatives to reduce HAIs involve a complicated mix of federal and state activities. The federal government, and in particular its lead agency for HAIs, CDC, have over the last few decades evolved a role that involves certain discrete activities. These include the development of guidelines that assess and recommend specific clinical practices for

[43]UPMC officials estimated that the total cost, including testing, for the first year of the initiative was just over $62,000.

[44]P.W. Stone et al., "A Systematic Audit of Economic Evidence Linking Nosociomial Infections and Infection Control Interventions: 1990-2000," *American Journal of Infection Control*, 30 (2002) 145-52.

reducing HAIs. They also include the development and promulgation of procedures and definitions that enable ICPs to determine in a systematic and consistent way which patients have HAIs, and to measure their HAI rates over time. In addition, CDC has initiated and maintained data collection programs, such as NHSN, that provide a mechanism that hospitals can use to both collect information on their own HAIs and compare their experience with that of other hospitals using the same set of clinical definitions and data collection procedures. CDC provides these services to participating hospitals free of charge, and by law protects the confidentiality of the data that hospitals submit.

Meanwhile, at least 23 states have taken initiatives that seek to use comparable information about HAIs for a quite different purpose—informing consumers about the relative performance of specific hospitals. As the states have set up these programs, and confronted the challenges of implementing them with limited resources, many have found compelling advantages in drawing on CDC's procedures and data collection systems. CDC protocols for identifying HAIs are widely respected for their clinical sophistication, and are well known to the ICPs in individual hospitals who will most likely be the ones to report the data. NHSN not only incorporates those widely accepted definitions and procedures, it is also available at no cost to the hospitals that use it. Thus many states have chosen to implement their public reporting programs by mandating that hospitals in their states enroll in NHSN. Although CDC itself may not publicly release HAI data on individual hospitals enrolled in NHSN, hospitals can give access to the state agencies to view and analyze their data using the group feature of NHSN. The state agencies can then use those data for their public reporting programs.

The increasing number of states opting to use information obtained from this federal data collection system to publicly report on the relative performance of individual hospitals raises concerns about the lack of established mechanisms to check the completeness and accuracy of the data submitted by hospitals. When the data are released to the public in order to influence consumers to choose hospitals with lower rates of HAIs, hospitals may have an incentive to minimize the number of HAI cases that they identify and report if they believe either that the hospitals with which they compete for patients could be minimizing the number of HAIs they reported or that those hospitals have actually achieved lower rates of HAIs than their own hospital. NHSN was created under a completely different paradigm, in which hospitals voluntarily collected the data on HAIs to inform their own internal efforts to reduce HAIs, with a legal protection from public release. Because the data were intended strictly for internal

use, CDC officials assumed that hospitals had an incentive to generate the most accurate and complete data possible. Consequently, the NHSN did not develop any process or mechanism to audit the accuracy and completeness of the data that hospitals submitted.

Both CDC and state officials have noted that converting NHSN to a source for publicly reported data on HAIs fundamentally changes the incentives for participating hospitals, and thereby creates a need for procedures to independently validate the data that hospitals submit. Specifically, CDC has collaborated with states using NHSN for public reporting to develop and implement data validation as part of their programs. However, few states have so far acted on this advice. Specific procedures for validating HAI data need to be developed and tested, and resources allocated to implement them. To some extent, New York has done the most to accomplish these tasks, but its experience indicates that systematic data validation requires substantial staff resources. Unless other states can marshal the resources needed to ensure the accuracy and completeness of the HAI data submitted by their hospitals, they are unlikely to make substantial progress in addressing this issue.

Comments from HHS and the American Hospital Association and Our Evaluation

We obtained written comments on our draft report from HHS, which were largely technical in nature. Overall, HHS commended GAO for developing a helpful report on an important topic. The department also highlighted the contributions that CDC has made, including its research into understanding the epidemiology of MRSA and HAIs. HHS noted that CDC's work in this area is reflected in a large number of scientific publications pertaining to the detection, measurement, and prevention of HAIs and MRSA. In addition, we incorporated the technical comments that HHS provided as appropriate.

The vice president of quality and patient safety policy for the American Hospital Association (AHA) provided oral comments on our draft report. The AHA appreciated that our report addressed state reporting programs for HAIs as a whole, along with a detailed review of hospital initiatives to reduce MRSA. It highlighted the technical and resource challenges described in our report that hospitals face in conducting HAI surveillance and prevention activities, which smaller hospitals in particular may have difficulty overcoming. Therefore, the AHA believes that it is important to link the collection of HAI data to achieving a reduction of HAIs including MRSA, and to acknowledge that different hospitals can use different approaches to accomplish this objective. In addition, the AHA expressed serious concern about public reporting of HAI data collected through

NHSN. It noted that the NHSN data were not validated and that hospitals vary in how they collect the data submitted to NHSN. As a result, the AHA felt that the NHSN data do not provide a valid comparative assessment of hospital performance. The AHA also provided technical comments that we incorporated as appropriate.

We agree with HHS that CDC has played a central role in developing both the science and the data collection systems on which current efforts to assess and reduce HAIs rest. At the same time, we share AHA's concerns that to be viable in the long run, systems for collecting HAI data for public reporting need to produce data that are clinically accurate and that assist hospitals in their efforts to reduce HAIs. As evidenced by its widespread adoption, CDC's NHSN has made a substantial contribution in that direction, though questions remain regarding how best to ensure that the data it produces are accurate and complete.

As arranged with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days after its issuance date. At that time, we will send copies of this report to the Secretary of HHS and other interested parties. We will also make copies available to others on request. In addition, the report will be available at no charge on GAO's Web site at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-7114 or bascettac@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix III.

Sincerely yours,

Cynthia Bascetta

Cynthia A. Bascetta
Director, Health Care

Appendix I: Characteristics of Selected Hospitals with MRSA-Reduction Initiatives

	Location	Beds	Teaching hospital[a]	Size of Metropolitan Area[b]	Census region
Albany Medical Center	Albany, NY	599	Yes	2	Middle Atlantic
Barnes-Jewish Hospital	Saint Louis, MO	1,183	Yes	1	West North Central
Beth Israel Medical Center	New York, NY	794	Yes	1	Middle Atlantic
Centra, Lynchburg General and Virginia Baptist Hospitals	Lynchburg, VA	494	No	3	South Atlantic
Eastern Idaho Regional Medical Center	Idaho Falls, ID	289	No	3	Mountain
Evanston Northwestern Healthcare	Evanston, IL	629	Yes	1	East North Central
Pacific Hospital of Long Beach	Long Beach, CA	171	No	1	Pacific
Pitt County Memorial Hospital	Greenville, NC	761	Yes	3	South Atlantic
Medical University of South Carolina	Charleston, SC	596	Yes	2	South Atlantic
Mercy Medical Center	Cedar Rapids, IA	318	No	3	West North Central
Newark Beth Israel Medical Center	Newark, NJ	407	Yes	1	Middle Atlantic
Rochester General Hospital	Rochester, NY	492	No	1	Middle Atlantic
Wake Forest University Baptist Medical Center	Winston-Salem, NC	953	Yes	2	South Atlantic
University of Pittsburgh Medical Center	Pittsburgh, PA	1,492	Yes	1	Middle Atlantic

Sources: American Hospital Association, U.S. Census Bureau, Association of American Medical Colleges, U.S. Department of Agriculture.

[a]Hospitals were designated as teaching hospitals if they were members of the Association of American Medical Colleges' Council of Teaching Hospitals and Health Systems.

[b]All hospitals were located in metropolitan counties according to the Economic Research Service of the U.S. Department of Agriculture, using the rural-urban continuum codes defined by the U.S. Census Bureau. The codes break down as follows: 1= Counties in metropolitan areas of 1 million population or more; 2= Counties in metropolitan areas of 250,000 to 1 million population; and 3= Counties in metropolitan areas of fewer than 250,000 population.

Appendix II: Changes Made by Selected Hospitals with MRSA-Reduction Initiatives

Table 7: Hand Hygiene Changes by Selected Hospitals with MRSA-Reduction Initiatives

	Hand hygiene compliance audits	Enhanced staff training or public education campaigns	Increased number of dispensers of alcohol-based hand sanitizer	Monitor consumption of hand hygiene products
Albany Medical Center	●	●	●	
Barnes-Jewish Hospital	●	●		
Beth Israel Medical Center	●	●		
Centra, Lynchburg General and Virginia Baptist Hospitals	●			
Eastern Idaho Regional Medical Center	●	●	●	●
Evanston Northwestern Healthcare	●			
Pacific Hospital of Long Beach		●		
Pitt County Memorial Hospital	●			
Medical University of South Carolina		●		
Mercy Medical Center	●			
Newark Beth Israel Medical Center	●		●	●
Rochester General Hospital		●	●	
Wake Forest University Baptist Medical Center	●			
University of Pittsburgh Medical Center	●	●	●	

Source: GAO analysis of survey and site visit data.

Table 8: Contact Precaution Changes by Selected Hospitals with MRSA-Reduction Initiatives

	Required gown & gloves for contact with MRSA-positive patients and their environment	Isolation cart/supply holder	Mask required when in contact with MRSA-positive patient	Room entrance signs or checklists to remind staff of MDRO patient	Enhanced staff training or public awareness campaigns	MRSA-positive patients in private rooms or cohorted	Contact precaution compliance audits
Albany Medical Center	●					●	
Barnes-Jewish Hospital		●			●	●	●
Beth-Israel Medical Center				●	●	●	●
Centra, Lynchburg General and Virginia Baptist Hospitals						●	●
Eastern Idaho Regional Medical Center	●		●		●	●	
Evanston Northwestern Healthcare		●		●		●	
Pacific Hospital of Long Beach						●	
Pitt County Memorial Hospital						●	
Medical University of South Carolina						●	
Mercy Medical Center						●	
Newark Beth Israel Medical Center						●	
Rochester General Hospital					●	●	●
Wake Forest University Baptist Medical Center	●					●	●
University of Pittsburgh Medical Center	●	●	●	●	●	●	●

Source: GAO analysis of survey and site visit data.

Table 9: Environmental Cleaning Changes by Selected Hospitals with MRSA-Reduction Initiatives

	Checklist or electronic notification system for housekeeping staff	Environmental cleaning compliance audits	Enhanced training	Change curtains	Enhanced cleaning of hospital environment or patient equipment	Dedicated equipment for MRSA-positive patients
Albany Medical Center	●					
Barnes-Jewish Hospital						
Beth Israel Medical Center	●	●	●		●	
Centra, Lynchburg General and Virginia Baptist Hospitals						
Eastern Idaho Regional Medical Center		●	●			
Evanston Northwestern Healthcare						
Pacific Hospital of Long Beach			●			
Pitt County Memorial Hospital						
Medical University of South Carolina						
Mercy Medical Center		●				
Newark Beth Israel Medical Center					●	
Rochester General Hospital					●	●
Wake Forest University Baptist Medical Center		●			●	
University of Pittsburgh Medical Center	●			●	●	

Source: GAO analysis of survey and site visit data.

Table 10: Antibiotic Stewardship Changes by Selected Hospitals with MRSA-Reduction Initiatives

	Description
Albany Medical Center	• Antibiotic stewardship team • Electronic system to track antibiotic usage and evaluate microorganism combinations • Reduced usage of certain antibiotics
Barnes-Jewish Hospital	
Beth Israel Medical Center	
Centra, Lynchburg General and Virginia Baptist Hospitals	
Eastern Idaho Regional Medical Center	
Evanston Northwestern Healthcare	• Tracking of mupirocin resistance • Removal by pharmacy of mupirocin ointment from authorized use for anything other than decolonization to keep resistance under control • Tracking of utilization of vancomycin
Pacific Hospital of Long Beach	• Education • Implementation of the hospital antibiogram, which tests for the sensitivity of isolated bacterial strains to different antibiotics
Pitt County Memorial Hospital	
Medical University of South Carolina	
Mercy Medical Center	
Newark Beth Israel Medical Center	• Development of an antibiotic deescalation program • Introduction of an antibiotic substitution policy • Institution of antibiotic restriction requiring approval by an infectious diseases specialist
Rochester General Hospital	• Monitor drug selection and duration and make recommendations based on this review • In process of implementing an electronic surveillance system with antibiotic monitoring capabilities
Wake Forest University Baptist Medical Center	• Two pharmacy positions dedicated to antibiotic stewardship • Physician dedicated to the prudent use of antibiotics
University of Pittsburgh Medical Center	

Source: GAO analysis of survey and site visit data.

Table 11: Decolonization Characteristics by Selected Hospitals with MRSA-Reduction Initiatives

	All MRSA-positive patients identified through screening	Orthopedic surgery patients	Cardiothoracic surgery patients	Other	Health care workers
Albany Medical Center	●	○	○	○	
Barnes-Jewish Hospital					●[f]
Beth Israel Medical Center		●	●		●[f]
Centra, Lynchburg General and Virginia Baptist Hospitals				●[b]	
Eastern Idaho Regional Medical Center	●	○	○	○	●[f,g]
Evanston Northwestern Healthcare	●	○	○	○	
Medical University of South Carolina					●[f]
Mercy Medical Center		●			
Newark Beth Israel Medical Center	●	○	○	○	●[f]
Pacific Hospital of Long Beach	●	○	○	○[c]	
Pitt County Memorial Hospital	●	○	○	○	●[h]
Rochester General Hospital			●[a]		
Wake Forest University Baptist Medical Center				●[d]	
University of Pittsburgh Medical Center				●[e]	●[f]

Source: GAO analysis of survey and site visit data.

Notes:

● Hospital decolonizes these individuals.

○ Included within "All MRSA-positive patients" category.

[a]All cardiothoracic surgery patients, including those who have not tested positive for MRSA, receive decolonization therapy. Mupirocin ointment is also applied to chest tube sites when removing chest tubes.

[b]MRSA-positive patients scheduled to undergo implant procedures are decolonized.

[c]All patients admitted to hospital undergo skin decolonization plus daily cleansing.

[d]Newly colonized patients are decolonized. Patients with a history of MRSA are decolonized at a physician's request.

[e]Patients are decolonized only if they request it and if the physician believes that decolonization is reasonable.

[f]Health care workers are decolonized if identified as MRSA-positive as part of an outbreak investigation.

[g]All newly hired health care workers are screened and decolonized if positive.

[h]Health care workers are provided voluntary MRSA screening at annual physical, and MRSA decolonization is offered at no charge for those who test positive.

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

Cynthia A. Bascetta at (202) 512-7114 or bascettac@gao.gov

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