# 2008

## Developing a System for Collecting and Publicly Reporting Data on Healthcare-Associated Infections in Maryland

### Report and Recommendations of the Technical Advisory Committee on Healthcare-Associated Infections

Marilyn Moon, Ph.D.
*Chair*

Rex W. Cowdry, M.D.
*Executive Director*

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Pamela W. Barclay
*Director*
*Center for Hospital Services*

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## EXECUTIVE SUMMARY

Over the past decade, there has been increasing awareness of the significant cost associated with medical errors, both in terms of financial resources and more importantly, human life and suffering. In 1999, the Institute of Medicine (IOM) published *To Err is Human – Building a Safer Health System*. This document launched the Patient Safety Movement and was a "Call to Action" for a national effort to make health care safe. This landmark publication put forth the idea that mandatory public reporting for medical errors was essential to help health care professionals and organizations both identify and learn from these mistakes with the ultimate goal being improved outcomes for patients. Healthcare-associated infections (HAIs), which are common, serious, and costly adverse outcomes of medical care, were identified in this IOM report as among the most pressing problems in the health care field. Healthcare-associated infections are the most common adverse event encountered by hospitalized patients.

In response to the significant impact HAIs have had on both patients and the health care system, a large number of states have already passed or are considering legislation regarding mandatory public reporting of HAIs. In the State of Maryland, Senate Bill 135, *Hospitals-Comparable Evaluation System-Health Care-Associated Infection Information*, became law on July 1, 2006 as Chapter 42 of Maryland Law. This law requires that the Hospital Performance Evaluation Guide developed by the Maryland Health Care Commission be expanded to include healthcare-associated infection information from hospitals.

This document presents the Report and Recommendations of the Technical Advisory Committee on Healthcare-Associated Infections for ***Developing a System for Collecting and Publicly Reporting Data on Healthcare-Associated Infections in Maryland.*** The Technical Advisory Committee's Report and Recommendations is designed to provide guidance in implementing SB 135 and strengthening public reporting of HAI measures. The Report outlines the Technical Advisory Committee's recommendations regarding steps that the Commission should take over the two-year period, 2008-2009, to expand the Hospital Performance Evaluation Guide to include additional information on HAI. The recommendations include:

### *HAI Process and Outcome Measures for Public Reporting*

**<u>Recommendation 1.</u> The Technical Advisory Committee recommends that public reporting of data on healthcare-associated infections be initiated with the following three measures: Central Line-Associated Bloodstream Infections (CLA-BSIs) in All Intensive Care Units (ICUs), Health Care Worker (HCW) Influenza Vaccination, and Compliance with Active Surveillance Testing (AST) for MRSA in All ICUs. The implementation plan for public reporting should include provisions for:**

- **An opportunity for hospitals to preview the 1st two quarters of data prior to releasing the data publicly;**
- **The development of an appropriate risk-adjustment methodology for outcome measures that require adjustment for patient-specific factors associated with increased risk of infection; and**

- **Periodic reevaluation and reassessment of Maryland's HAI public reporting process with opportunities to alter recommended measures/methods of reporting if new data becomes available or significant difficulties with regards to implementation arise.**

**Recommendation 2. The Technical Advisory Committee recommends that the second phase of the public reporting system add further HAI outcome and process measures including, but not limited to, select Class I and II deep and organ space Surgical Site Infections (SSIs) and Ventilator-Associated Pneumonia (VAP) Bundle Compliance.**

**Recommendation 3. The Technical Advisory Committee recommends that the collection and reporting of the Surgical Care Improvement Project (SCIP) measures relating to HAIs be continued and expanded to include additional surgeries defined by the SCIP strata and additional process measures not currently being reported by Maryland hospitals. Reporting for SCIP-Infection Measures 1-3 regarding surgical antimicrobial prophylaxis are currently only being reported on the Maryland Hospital Performance Evaluation Guide for hip, knee and colon surgeries. The Technical Advisory Committee recommends expanding these measures to include the other SCIP strata (i.e., hysterectomy, CABG, other cardiac surgery and vascular surgery). The remaining SCIP measures related to HAIs, but not currently being reported in Maryland should be implemented (i.e., SCIP-Inf 4 and 6 relating to cardiac surgery patients with controlled 6 a.m. postoperative blood glucose and surgery patients with appropriate hair removal). SCIP-Inf 7, colorectal surgery patients with immediate postoperative normothermia, should be added if endorsed by the National Quality Forum.**

### *Data Collection and Reporting System*

**Recommendation 4. The Technical Advisory Committee recommends that the National Healthcare Safety Network (NHSN) be the vehicle for collecting data on CLA-BSI, HCW Influenza Vaccination, Surgical Site Infections, and future HAI process and outcome measures as appropriate, and that hospitals receive training in the NHSN system. Appropriately trained and certified infection control professionals, when eligible, should be designated to perform surveillance involved in the documentation of HAIs to ensure infections are identified similarly among institutions.**

**Recommendation 5. The Technical Advisory Committee recommends the development of strategies for validating publicly reported HAI measures.**

### *Implementing Public Reporting of HAI Data*

**Recommendation 6. The Technical Advisory Committee recommends that the Maryland Health Care Commission establish a permanent standing HAI Advisory Committee. This standing Advisory Committee should consist of representatives from acute care hospitals, long term care facilities, ambulatory surgery centers, freestanding hemodialysis centers, SHEA and APIC. The committee should consist of at least one of each of the following: a hospital epidemiologist, an infection prevention and control professional, a public health specialist, a public**

**health lawyer, a statistician, an ethicist, quality improvement/patient safety expert, and a patient/health care consumer.**

**Recommendation 7. To focus attention on the importance of hand hygiene in reducing HAIs, the Technical Advisory Committee recommends the development of a state-wide hand hygiene campaign in conjunction with other recommendations in this Report.**

**Recommendation 8. The Technical Advisory Committee recommends the development of a research agenda that addresses the impact of public reporting, the development of appropriate risk adjustment methods, and the development of improved measures for VAP, Hand Hygiene, and Pediatric Respiratory Syncytial Virus (RSV).**

## List of Abbreviations Used in this Report

| | |
|---|---|
| **APIC** | Association for Professionals in Infection Control and Epidemiology |
| **AMP** | Antimicrobial Prophylaxis |
| **AST** | Active Surveillance Testing |
| **BSI** | Bloodstream Infection |
| **CABG** | Coronary Artery Bypass Graft |
| **CAP** | Community Acquired Pneumonia |
| **CA-UTI** | Catheter-associated Urinary Tract Infection |
| **CDC** | Centers for Disease Control and Prevention |
| **CHG** | Chlorhexidine Gluconate |
| **CLA-BSI** | Central Line-associated Bloodstream Infections |
| **CMS** | Centers for Medicare and Medicaid Services |
| **DHMH** | Department of Health and Mental Hygiene (Maryland) |
| **DHQP** | Division of Healthcare Quality Promotion (CDC) |
| **DVT** | Deep Vein Thrombosis |
| **HAI** | Healthcare-Associated Infections |
| **HAI-TAC** | Healthcare-Associated Infections Technical Advisory Committee |
| **HH** | Hand Hygiene |
| **HICPAC** | Healthcare Infection Control Practices Advisory Committee |
| **HCW** | Healthcare Workers |
| **HQA** | Hospital Quality Alliance |
| **IHI** | Institute for Healthcare Improvement |
| **ICP** | Infection Prevention and Control Professional |
| **ICU** | Intensive Care Unit |
| **IOM** | Institute of Medicine |
| **LCBI** | Laboratory-Confirmed Bloodstream Infection |
| **MDRO** | Multi-drug Resistant Organism |
| **MIHRS** | Missouri Healthcare-Associated Infection Reporting System |
| **MRSA** | Methicillin-resistant *Staphylococcus aureus* |
| **MSSA** | Methicillin-susceptible *Staphylococcus aureus* |
| **NHSN** | National Healthcare Safety Network |
| **NICU** | Neonatal Intensive Care Unit |
| **NNIS** | National Nosocomial Infections Surveillance System |
| **NQF** | National Quality Forum |
| **RSV** | Respiratory Syncytial Virus |
| **SCIP** | Surgical Care Improvement Project |
| **SIP** | Surgical Infection Prevention |
| **SHEA** | Society for Healthcare Epidemiology of America |
| **SSI** | Surgical Site Infection |
| **Tdap** | Tetanus and Pertussis Vaccine |
| **VA** | Veterans Administration |
| **VAP** | Ventilator-associated Pneumonia |
| **VRE** | Vancomycin-resistant *enterococcus* |

# I. INTRODUCTION

## Background

Maryland has been a leader in collecting and publicly reporting information on quality measures with the goals of promoting knowledgeable patient choices about health care providers and providing feedback to health care providers and policymakers to benchmark performance and inform quality improvement initiatives. In 1999, the Maryland General Assembly adopted legislation (Chapter 657-HB 705 of the Acts of 1999) requiring the Maryland Health Care Commission to establish a system to comparatively evaluate quality of care outcomes and performance measurements of hospitals and ambulatory surgical facilities. On January 31, 2002, the Commission released the initial version of the Hospital Performance Evaluation Guide on its website (http://mhcc.maryland.gov/consumerinfo/hospitalguide/index.htm).

In January 2005, the Maryland Health Care Commission adopted a plan for publicly reporting healthcare-associated infections data on the Hospital Performance Evaluation Guide. Healthcare-associated infections (HAI) are infections that patients acquire during the course of receiving medical treatment for other conditions.[1,2] HAIs are the most common complication affecting hospitalized patients, with between 5 and 10 percent of patients acquiring one or more infections during their hospitalization.[3]

This initial plan adopted by the Commission required all Maryland hospitals to begin collecting and reporting a set of three process measures designed to prevent infections for patients undergoing hip, knee, and colon surgery: (1) proportion of patients receiving antimicrobial prophylaxis within one hour prior to incision (SCIP-INF-1); (2) proportion of patients receiving the appropriate antimicrobial agent based on current guidelines (SCIP-INF-2); and, (3) proportion of patients whose antimicrobial prophylaxis is discontinued with 24-hours following surgery (SCIP-INF-3). These measures, referred to as Surgical Care Improvement Project (SCIP) measures, have been endorsed by the National Quality Forum (NQF) and adopted by the Centers for Medicare and Medicaid Services (CMS), the Joint Commission, and Hospital Quality Alliance (HQA). The Commission initiated data collection for these measures in April 2005. Following a pilot period, the Commission began publicly reporting information concerning the first generation of process improvement measures on healthcare-associated infections in June 2006. The initial data publicly reported on the Hospital Guide measured compliance with the administration of antibiotics prior to surgery and the discontinuance of antibiotics following surgery. In September 2007, the Commission expanded the SCIP process measure set to report on the proportion of hip, knee, and colon surgery patients receiving the appropriate antibiotic (SCIP-INF-2).

Given the impact of HAI, a number of states, including Maryland, have enacted legislation mandating hospitals and other health care organizations to publicly report HAI data. During its 2006 session, the Maryland General Assembly enacted legislation requiring the Maryland Health Care Commission to include HAI information in its existing Hospital Performance Evaluation Guide. *Hospitals-Comparable Evaluation System-Health Care-Associated Infection Information* (SB 135) (Refer to Appendix 1), which became law on July 1,

2006, specifies that the system for reporting data must adhere to the current recommendations of the federal Centers for Disease Control and Prevention (CDC) and the CDC Healthcare Infection Control Practices Advisory Committee (HICPAC) regarding the public reporting of HAIs. HICPAC recommends that the development of statewide reporting systems: (1) use established public health surveillance methods in the design and implementation of mandatory HAI reporting systems; (2) create multidisciplinary advisory panels, including persons with expertise in the prevention and control of HAIs, to monitor the planning and oversight of HAI public reporting systems; (3) choose appropriate process and outcome measures based on facility type and phase in measures to allow time for facilities to adapt and to permit ongoing evaluation of data validity; and (4) provide regular and confidential feedback of performance data to healthcare providers.

### Technical Advisory Committee on Healthcare-Associated Infections

To assist in developing a plan for expanding the HAI data on the Hospital Performance Evaluation Guide, the Maryland Health Care Commission appointed an HAI Technical Advisory Committee (TAC). The HAI-TAC, chaired by Pamela W. Barclay, the Commission's Director of the Center for Hospital Services, is composed of 10-members representing infection prevention and control professionals, hospital epidemiologists, health insurers, critical care nursing, and researchers (Refer to Figure 1). Biographical information regarding each Committee member may be found in Appendix 2.

The purpose of the Technical Advisory Committee was to study and develop recommendations to the Commission on the design and content of a system for collecting and publicly reporting HAI data. In conducting its study, the Committee met monthly beginning in November 2006. The Committee reviewed guidelines from the Centers for Disease Control and Prevention and professional associations, evidence from the medical literature regarding appropriate measures for analyzing and reporting data on healthcare-associated infections, the work of the Maryland Patient Safety Center Intensive Care Unit Collaborative, and the work of other states in implementing legislative mandates to collect and publicly report data on infections.

To gain an understanding of the characteristics of current programs for infection prevention and control, the Technical Advisory Committee developed a statewide survey that was sent to Maryland hospital infection prevention and control program directors. The survey collected information on staffing, infection surveillance scope and approaches, and data collection and reporting systems. The Committee had briefings by representatives from Florida, Pennsylvania, Virginia, New York, Missouri, and Texas to learn about alternative approaches to collecting and reporting healthcare-associated infections data. R. Monina Klevens, DDS, MPH, of the Division of Healthcare Quality Promotion at the National Center for Infectious Diseases, briefed the Committee on the CDC National Healthcare Safety Network. A summary of the major agenda items considered at Technical Advisory Committee meetings is provided in Appendix 3.

**Figure 1**
**Maryland Health Care Commission**
**Technical Advisory Committee on Healthcare-Associated Infections**

## Chair

**Pamela W. Barclay**
Director, Center for Hospital Services
Maryland Health Care Commission

## Members

**Beverly Collins, MD, MBA, MS**
Medical Director, Healthcare Informatics
CareFirst BlueCross BlueShield

**Jacqueline Daley, HBSc, MLT, CIC, CSPDS**
Director, Infection Prevention and Control
Sinai Hospital of Baltimore

**Elizabeth P. (Libby) Fuss, RN, MS, CIC**
Senior Infection Control Practitioner
University of Maryland Medical Center

**Lynne V. Karanfil, RN, MA, CIC**
Corporate Coordinator, Infection Control
MedStar Health-Performance Improvement

**Debbie Malick, BSN, MBA**
Administrative Director, Critical Care Services
Washington County Hospital

**Peggy (Margaret) A. Pass, RN, BSN, MS, CIC**
Infection Control Epidemiologist
Johns Hopkins Hospital

**Trish M. Perl, MD, MSc***
Professor of Medicine, Pathology and Epidemiology
Hospital Epidemiologist
Johns Hopkins Medical Institutions

**Michael Anne Preas, RN, BSN**
Infection Prevention and Control
Shady Grove Adventist Hospital

**Brenda J. Roup, PhD, RN, CIC**
Nurse Consultant, Infection Control
Department of Health and Mental Hygiene
Community Health Administration
Office of Epidemiology and Disease Control

**Albert W. Wu, MD, MPH**
Professor, Health Policy and Management
Johns Hopkins Bloomberg School of Public Health
Senior Advisor, World Alliance on Patient Safety
World Health Organization

## Staff

**Deborah Rajca**
Program Manager
Center for Hospital Services
Maryland Health Care Commission

**Catherine Passaretti, MD**
Infectious Diseases Fellow
Johns Hopkins University

**Note: Dr. Perl served on the Technical Advisory Committee from November 2006-June 2007.*

## Purpose of the Report

This document presents the Report and Recommendations of the Technical Advisory Committee on Healthcare-Associated Infections for ***Developing a System for Collecting and Publicly Reporting Data on Healthcare-Associated Infections in Maryland.*** The Technical Advisory Committee's Report and Recommendations is designed to provide guidance in implementing SB 135 and strengthening public reporting of HAI measures. The Report outlines the Technical Advisory Committee's recommendations regarding steps that the Commission should take over the two-year period, 2008-2009, to expand the Hospital Performance Evaluation Guide to include additional information on HAI.

The Report provides information and analyses which will aid in developing a plan for HAI data collection for the 47 acute general hospitals in Maryland. While this Report does not directly address other facilities, such as dialysis centers and long-term care facilities, the issue of public reporting of HAIs in these institutions will be addressed by the Commission in future activities. This Report reflects the currently published research and expert advice on public reporting and HAIs. Given the ever-changing nature of health care and the increasing body of knowledge on HAIs as public reporting becomes more widespread across the United States, the information and analysis in the Report will be re-evaluated and updated on a regular basis to reflect advances in medical research.

## About the Maryland Health Care Commission

The Maryland Health Care Commission is a 15-member, independent regulatory commission, functioning administratively within the Maryland Department of Health and Mental Hygiene. The 15 Commissioners are appointed by the Governor with the advice and consent of the Maryland Senate. The Maryland General Assembly created the Commission in 1999 through the consolidation of two existing commissions to "establish a streamlined health care regulatory system within the State of Maryland in a manner such that a single State health policy can be better articulated, coordinated, and implemented in order to better serve the citizens of this State." The Commission is organized around five major topic areas: Center for Hospital Services; Center for Long-term Care and Community-Based Services; Center for Financing and Health Policy; Center for Information Services and Analysis; and Center for Health Information Technology. The Center for Hospital Services is responsible for: developing the State Health Plan for Health Care Facilities and Services; administering the Certificate of Need program; and Hospital Quality Initiatives, including the Hospital Performance Evaluation Guide.

## References


1. Centers for Disease Control and Prevention, CDC's Role in Monitoring and Preventing Healthcare-Associated Infections, Statement by Denise Cardo, M.D., Director, Division of Healthcare Quality Promotion, National Center for Infectious Diseases, Testimony before the Committee on Energy and Commerce, Subcommittee on Oversight and Investigations, U.S. House of Representatives, March 29, 2006.
2. The Healthcare Infection Control Practices Advisory Committee defines health care-associated infections (HAI) as localized or systemic conditions resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s) that: (1) occurs in a patient in a health care setting (e.g., hospital or outpatient clinic); (2) was not found to be present or incubating at the time of admission unless the infection was related to a previous admission; and (3) if the setting is a hospital, meeting the criteria for a specific infection site as defined by CDC. McKibben, L. et al. Guidance on Public Reporting of Healthcare-Associated Infections. *American Journal of Infection Control*, Vol. 33, No. 4, May 2005, p. 225.
3. Burke. JP. Infection Control—A problem for patient safety. *NEJM*. 2003; 348: 651-656.

## II. OVERVIEW: MARYLAND HOSPITAL INFECTION PREVENTION AND CONTROL PROGRAMS

To gain an understanding of the characteristics of current programs, the Technical Advisory Committee developed a Survey of Maryland Hospital Infection Prevention and Control Programs. The survey instrument was organized in seven major sections: hospital and contact information; program staffing and responsibilities; surveillance scope and methods; microbiologic surveillance; surveillance of infections; information technology; and, participation in CDC systems and quality improvement initiatives.

The survey was prepared in an on-line format using *SurveyMonkey* software (A copy of the survey instrument is provided in Appendix 4). An electronic link to the survey was forwarded via e-mail to the Infection Prevention and Control Professional staff at each hospital in May 2007. A letter regarding the survey was also sent to the Chief Executive Officer of each hospital. All 47 Maryland acute care hospitals responded to the survey.

### Overview of Maryland Hospitals

There are 47 non-Federal, acute general hospitals licensed to operate a total of 10,681 beds in Maryland. On average, acute general hospitals were licensed for 227 beds as of July 1, 2007. Table 1 shows the distribution of Maryland hospitals by total number of licensed beds.

**Table 1**
**Distribution of Acute General Hospitals by Number of Licensed Beds: Maryland, July 1, 2007**

| Number of Licensed Beds | Number of Hospitals | Percent of Total | Number of Beds | Percent of Total |
|---|---|---|---|---|
| 400+ | 3 | 6.4% | 2,075 | 19.4% |
| 300-399 | 6 | 12.8% | 2,137 | 20.0% |
| 200-299 | 18 | 38.3% | 4,541 | 42.5% |
| 100-199 | 11 | 23.4% | 1,486 | 13.9% |
| 50-99 | 4 | 8.5% | 299 | 2.8% |
| <50 | 5 | 10.6% | 143 | 1.3% |
| **Total** | **47** | 100.0% | 10,681 | 100.0% |

Source: Maryland Health Care Commission, Annual Report on Hospital Services and Licensed Bed Capacity: Fiscal Year 2008.

Forty-six (46) of the 47 acute general hospitals operate adult intensive care units (Refer to Table 2). In addition, four hospitals report pediatric intensive care units and 14 hospitals report neonatal intensive care units. One Maryland hospital operates a burn care unit.

**Table 2**
**Intensive Care Unit (ICU) Beds by Type:**
**Maryland, July 1, 2007**

| ICU Type | Number of Hospitals | Number of Beds |
|---|---|---|
| Adult ICU | 46 | 1,138 |
| Pediatric ICU | 4 | 58 |
| Neonatal ICU | 14 | 388 |
| Burn ICU | 1 | 10 |

Source: Maryland Health Care Commission, Annual Report on Hospital Services and Licensed Bed Capacity: Fiscal Year 2008.

## Program Staffing

Data collected in the survey shows that a total of 111.5 full-time equivalent (FTE) staff, including certified and non-certified Infection Prevention and Control Professionals (ICPs), data analysts, and support staff, were employed by Maryland hospital infection prevention and control programs at the time of the survey. Certified and non-certified ICPs accounted for 85 FTE staff. Hospitals reported that most ICPs were registered nurses—72 percent or 61 of the 85 FTEs. On average, there were 1.59 FTE ICPs per 200 licensed acute care hospital beds in Maryland. Table 3 provides a summary of full-time equivalent ICP staff by region.

**Table 3**
**Number of Acute Care Hospitals, Licensed Beds and Full-Time Equivalent Infection Control Staff: Maryland, 2007**

| Jurisdiction/Region | Number of Hospitals | Number of Licensed Beds | Infection Prevention and Control Program Staff | | FTE Staff Per 200 Beds | |
|---|---|---|---|---|---|---|
| | | | Total FTEs | FTE ICPs | Total | ICPs |
| **Western Maryland** (Allegany, Frederick, Garrett, Washington Counties) | 5 | 808 | 9 | 6 | 2.23 | 1.49 |
| **Montgomery County** | 5 | 1,350 | 12 | 11 | 1.78 | 1.63 |
| **Southern Maryland** (Calvert, Charles, Prince George's, and St. Mary's Counties) | 8 | 1,185 | 15 | 9 | 2.53 | 1.52 |
| **Central Maryland** (Anne Arundel, Baltimore, Carroll, Harford, Howard Counties and Baltimore City) | 22 | 6,574 | 66.5 | 51 | 2.02 | 1.55 |
| **Eastern Shore** (Caroline, Cecil, Dorchester, Kent, Queen Anne's, Talbot, Somerset, Wicomico, and Worcester Counties) | 7 | 764 | 9 | 8 | 2.35 | 2.09 |
| **Total** | **47** | **10,681** | **111.5** | **85** | **2.09** | **1.59** |

Source: Maryland Health Care Commission, Survey of Infection Control and Prevention Programs, 2007. (The number of total FTE Infection Prevention and Control Staff includes data analysts and support staff.)

For almost one-half of hospitals (21), the Infection Prevention and Control Program reports to the Quality/Performance Improvement area within the hospital. The Infection Prevention and Control Program reports to Hospital Administration in 13 hospitals and to Nursing in 10 hospitals.

In addition to Infection Prevention and Control responsibilities, most hospitals reported that program staff were responsible for, or participate in, Emergency/Disaster Preparedness, Employee Health, Epidemiology, N95 Respirator Mask Fit Testing[1], Performance/Quality Improvement Measures, and Reportable Diseases.

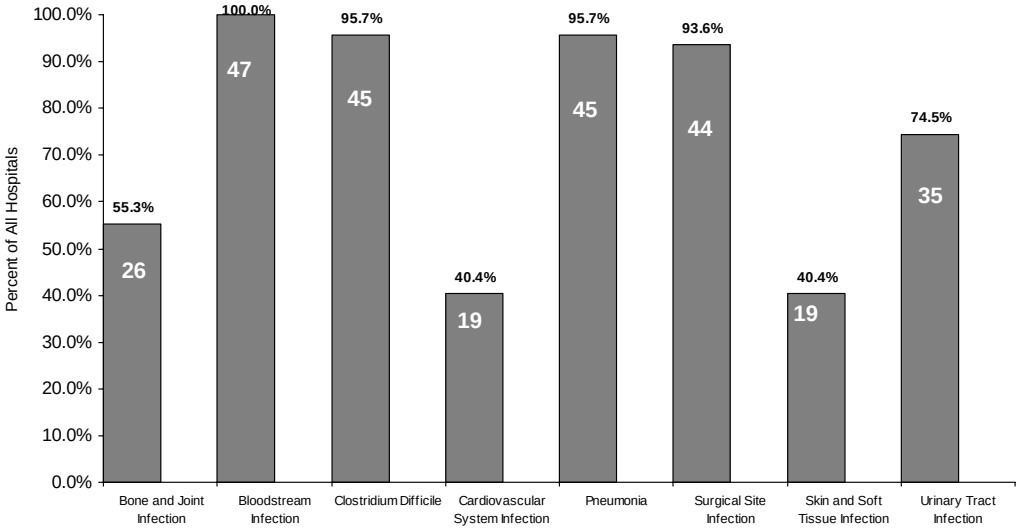
### Surveillance Programs

All Maryland hospitals reported surveillance programs for bloodstream infections. As shown in Figure 2, the vast majority of hospitals had surveillance programs for *Clostridium difficile* (45 hospitals), pneumonia (45 hospitals), and surgical site infections (44 hospitals). About three-quarters of hospitals (35) reported surveillance programs for urinary tract infections. Other surveillance programs reported by hospitals included: bone and joint infections (26 hospitals); cardiovascular system infections (19 hospitals); and, skin and soft tissue infections (19 hospitals)

Figure 3 shows the number of hospitals performing various surveillance activities by location within the hospital. Intensive care units, including ICU, CCU, and NICUs, were the focus of surveillance programs for pneumonia. For bloodstream infections, 38.3 percent of hospitals reported focusing surveillance on intensive care areas and 57.4 percent reported surveillance in both intensive and non-intensive care areas of the hospital.

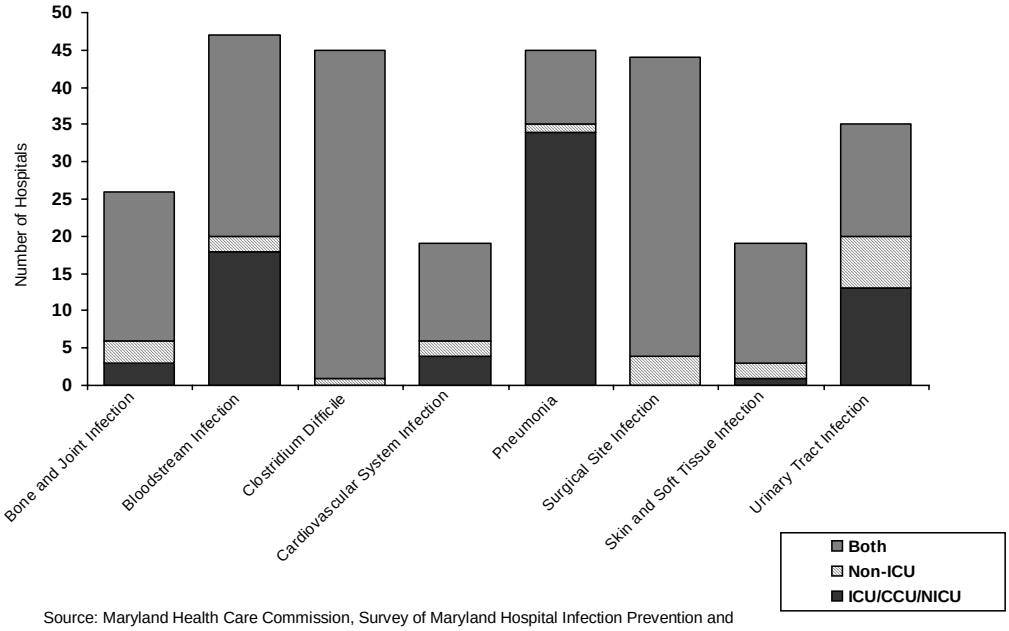
As shown in Table 4, the great majority of Maryland hospitals reported continuous surveillance programs. For bloodstream infections, 97.9 percent of hospitals reported continuous surveillance programs. A large proportion of Maryland hospitals also reported continuous surveillance programs for *Clostridium difficile* (89.4 percent), pneumonia (85.1 percent), and surgical site infections (85.1 percent).

**Figure 1**
**Characteristics of Hospital Infection Prevention and Control Surveillance Programs: Maryland, 2007**




Source: Maryland Health Care Commission, Survey of Maryland Hospital Infection Prevention and Control Programs, 2007.

**Figure 2**
**Hospital Infection Prevention and Control Surveillance Programs by Site: Maryland, 2007**




Source: Maryland Health Care Commission, Survey of Maryland Hospital Infection Prevention and Control Programs, 2007.

**Table 4**
**Hospital Surveillance Programs by Type and Time Period: Maryland, 2007**

| Surveillance Program | Number of Hospitals | | | | | Percent of Hospitals | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Time Period | | | Total Surveillance | Surveillance Not Performed | Time Period | | | Total Surveillance | Surveillance Not Performed |
| | Continuous | Episodic | Mixed | | | Continuous | Episodic | Mixed | | |
| Bone and Joint Infection | 21 | 2 | 2 | 25 | 22 | 44.7% | 4.3% | 4.3% | 53.2% | 46.8% |
| Bloodstream Infection | 46 | 0 | 1 | 47 | 0 | 97.9% | 0.0% | 2.1% | 100.0% | 0.0% |
| Clostridium Difficile | 42 | 2 | 1 | 45 | 2 | 89.4% | 4.3% | 2.1% | 95.7% | 4.3% |
| Cardiovascular System Infection | 11 | 6 | 1 | 18 | 29 | 23.4% | 12.8% | 2.1% | 38.3% | 61.7% |
| Eye,Ear, Nose, Throat, Mouth Infection | 5 | 5 | 1 | 11 | 36 | 10.6% | 10.6% | 2.1% | 23.4% | 76.6% |
| Lower Respiratory Tract Infection, Not Pneu | 9 | 4 | 1 | 14 | 33 | 19.1% | 8.5% | 2.1% | 29.8% | 70.2% |
| Pneumonia | 40 | 2 | 2 | 44 | 3 | 85.1% | 4.3% | 4.3% | 93.6% | 6.4% |
| Reproductive Tract Infection | 8 | 3 | 0 | 11 | 36 | 17.0% | 6.4% | 0.0% | 23.4% | 76.6% |
| Surgical Site Infection | 40 | 2 | 3 | 45 | 2 | 85.1% | 4.3% | 6.4% | 95.7% | 4.3% |
| Skin and Soft Tissue Infection | 15 | 3 | 1 | 19 | 28 | 31.9% | 6.4% | 2.1% | 40.4% | 59.6% |
| Urinary Tract Infection | 28 | 3 | 3 | 34 | 13 | 59.6% | 6.4% | 6.4% | 72.3% | 27.7% |
| Other | 20 | 1 | 2 | 23 | 24 | 42.6% | 2.1% | 4.3% | 48.9% | 51.1% |

Source: Maryland Health Care Commission, Survey of Maryland Hospital Infection Prevention and Control Programs, 2007.

Table 5 summarizes data reported by Maryland hospitals on active surveillance cultures for resistant organisms. Thirty-six (36) of Maryland's 47 hospitals reported performing active surveillance cultures for resistant organisms. Methicillin-resistant *Staphylococcus aureus* (MRSA) was targeted for active surveillance cultures by 32 hospitals (68.1 percent).

**Table 5**
**Hospital Active Surveillance Cultures for Resistant Organisms: Maryland, 2007**

| Active Surveillance Cultures | Number of Hospitals | Percent of Hospitals |
|---|---|---|
| **Perform Active Surveillance Cultures for Resistant Organisms:** | | |
| No | 11 | 23.4% |
| Yes | 36 | 76.6% |
| **Types of Active Surveillance Cultures:** | | |
| MRSA (Methicillin-resistant *Staphylococcus aureus*) | 32 | 68.1% |
| VRE (Vanocomycin-resistant *Enterococci*) | 7 | 14.9% |
| ESBL (Extended spectrum beta lactamase)-producing Gram-negative rods | 4 | 8.5% |
| Resistant *Pseudomonas aeruginosa* | 4 | 8.5% |
| Resistant *Acinetobacter species* | 5 | 10.6% |
| Other | 8 | 17.0% |

Source: Maryland Health Care Commission, Survey of Maryland Hospital Infection Prevention and Control Programs, 2007.

## Infection Prevention and Control Practices

All Maryland hospitals reported using the CDC/NHSN definition for infections. Forty-six of the 47 Maryland hospitals reported surveying for central line-associated bloodstream infections (CLABSIs), or those infections considered to be associated with a central line if the line was in use during the 48-hour period before development of the bloodstream infection. A

smaller number of hospitals (11) reported surveying for catheter-related bloodstream infections (CLRBSIs). CLABSI is broader in scope than CLRBSI and is used for surveillance of patient populations. CLRBSI is used by researchers and clinicians who have laboratory results that clearly relate the BSI to the central line.

The vast majority of Maryland hospitals reported that they have implemented care bundles or groups of evidence-based practices that together improve care to patients on central lines and ventilators. The entire Central Line Bundle has been implemented by 68.1 percent (32) of Maryland hospitals; 83 percent (39) have implemented the full Ventilator-Associated Pneumonia (VAP) Bundle (Refer to Tables 6 and 7).

**Table 6**
**Implementation of the Central Line Bundle: Maryland, 2007**

| Central Line Bundle | Number of Hospitals | Percent of Hospitals |
|---|---|---|
| **Implementation of the Central Line Bundle** | | |
| Yes-Entire Bundle | 32 | 68.1% |
| No | 2 | 4.3% |
| **Key Components** | | |
| Hand Hygiene | 12 | 25.5% |
| Maximal Barrier Precautions Upon Insertion | 9 | 19.1% |
| Chlorhexidine Skin Antisepsis | 12 | 25.5% |
| Optimal Catheter Site Selection, with Subclavian Vein as Preferred Site for Non-Tunneled Catheters | 10 | 21.3% |
| Daily Review of Line Necessity with Prompt Removal of Unnecessary Lines | 2 | 4.3% |
| Other | 6 | 12.8% |

Source: Maryland Health Care Commission, Survey of Maryland Hospital Infection Prevention and Control Programs, 2007.

**Table 7**
**Implementation of the Ventilator-Associated Pneumonia (VAP) Bundle: Maryland, 2007**

| VAP Bundle | Number of Hospitals | Percent of Hospitals |
|---|---|---|
| **Implementation of the VAP Bundle** | | |
| Yes-Entire Bundle | 39 | 83.0% |
| No | 3 | 6.4% |
| **Key Components** | | |
| Elevation of the Head of the Bed | 3 | 6.4% |
| Daily Sedation Vacations and Assessment of Readiness to Extubate | 2 | 4.3% |
| Peptic Ulcer Disease Prophylaxis | 2 | 4.3% |
| Deep Venous Thrombosis Prophylaxis | 2 | 4.3% |
| Other | 4 | 8.5% |

Source: Maryland Health Care Commission, Survey of Maryland Hospital Infection Prevention and Control Programs, 2007.

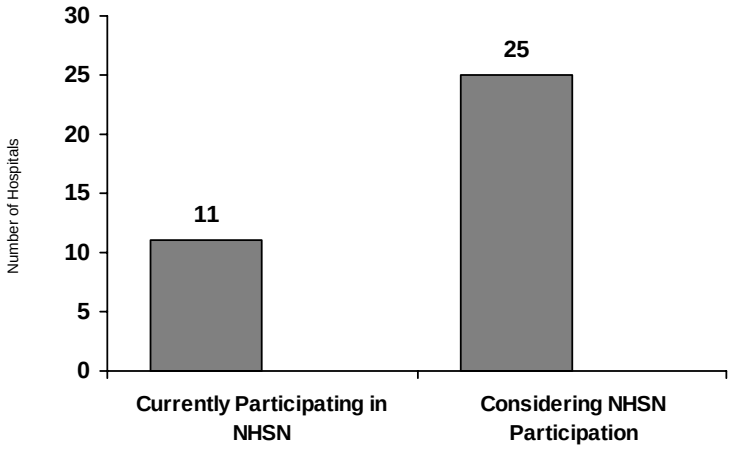
## Participation in the National Health Safety Network

The National Healthcare Safety Network (NHSN) is an internet-based surveillance system for healthcare-associated infections data developed and operated by the Division of Healthcare Quality Promotion (DHQP) at the CDC. The CDC initially opened NHSN

enrollment to a limited number of facilities in 2005, followed by a national open enrollment for hospitals and outpatient hemodialysis centers in 2007. NHSN enables healthcare facilities to participate in a voluntary national surveillance system and to share data with public agencies.

As of May 2007, eleven (11) Maryland hospitals reported participating in NHSN.[2,3] Another 25 hospitals indicated that they are considering participation in NHSN.

**Figure 3**
**Current and Future Participation in CDC National Health Safety Network System (NHSN)**




Source: Maryland Health Care Commission, Survey of Maryland Hospital Infection Prevention and Control Programs, 2007.

## Information Technology

The use of specialized software to access laboratory, pharmacy, and patient data to identify, benchmark, and monitor infections has not been widely adopted to date. Only 10 Maryland hospitals reported using specialized software to collect and/or analyze infection prevention and control data. The facilities using specialized software reported using AICE, Setnet, Theradoc, and Vecna as well as their own hospital software (Refer to Table 8).

**Table 8**
**Specialized Software to Collect and/or Analyze Infections Data: Maryland, 2007**

| Specialized Software | Number of Hospitals | Percent of Hospitals |
|---|---|---|
| **Use of Specialized Software to Collect and/or Analyze Infections Data** | | |
| Yes | 10 | 21.3% |
| No | 37 | 78.7% |

Source: Maryland Health Care Commission, Survey of Maryland Hospital Infection Prevention and Control Programs, 2007.

### Participation in Quality Improvement Initiatives

Almost three-quarters (33) of Maryland hospitals reported participating in the 5 Million Lives Campaign, a national, voluntary initiative sponsored by the Institute for Healthcare Improvement that aims to protect patients from medical harm (Refer to Table 9). The 5 Million Lives Campaign challenges hospitals to implement changes in care that save lives and reduce patient injuries, including interventions targeted to prevent central-line infections, surgical site infections, and ventilator-associated pneumonias, and to reduce surgical complications and methicillin-resistant *Staphylococcus aureus* (MRSA) infections. [4] As of May 2007, four Maryland hospitals reported participating in the Leapfrog Group's public reporting initiative that examines performance on quality and safety practices. An additional seven hospitals indicated that participation in the Leapfrog Group's reporting was under consideration. Other quality improvement initiatives that Maryland hospitals reported participating in included: Premier Hospital Quality Incentive Project (9 hospitals); VA Health System MRSA Prevention Initiative (5 hospitals); and Voluntary Hospital Association Transforming the ICU Project (2 hospitals).

The Maryland Patient Safety Center, created in 2004 by the Maryland Health Care Commission to bring health care providers together to improve patient safety and health care quality for Maryland residents, recently announced a MRSA Prevention Initiative. Twenty (20) hospitals, six dialysis units, and four long-term care facilities are participating in this MRSA Prevention Initiative. [5]

**Table 9**
**Hospital Participation in Quality Improvement Intiatives: Maryland, 2007**

| Initiative | Current Participant | | Participation Under Consideration |
|---|---|---|---|
| | Yes | No | |
| Institute for Healthcare Improvement 5 Million Lives Campaign | 33 | 8 | 4 |
| The Leapfrog Group | 4 | 26 | 7 |
| Premier Hospital Quality Incentive Project | 9 | 23 | 3 |
| VA Health Care System MRSA Prevention Initiative | 5 | 27 | 2 |
| Volunteer Hospital Association Transforming the ICU | 2 | 30 | 2 |
| Other | 8 | 3 | 0 |

Source: Maryland Health Care Commission, Survey of Maryland Hospital Infection Prevention and Control Programs, 2007.
(Note: Four of the 47 Maryland hospitals did not respond to this question)

## References


1. N95 respirators/masks, which are designed to help provide respiratory protection for the wearer, are fluid resistant, disposable and may be worn in surgery. The N95 respirator/mask has a filter efficiency level of 95% or greater against particulate aerosols free of oil when tested against a 0.3 micron particle. "N" refers to "Not resistant to oil" and "95" refers to filter efficiency.
2. According to the CDC, as of November 10, 2007, 10 Maryland hospitals are enrolled in NHSN (Communication from Maggie Dudeck, MPH, User Support Specialist).
3. Prior to the NHSN system, the Centers for Disease Control and Prevention maintained the National Nosocomial Infections Surveillance System (NNIS). According to the survey, 16 Maryland hospitals participated in the former NNIS system.
4. Institute for Healthcare Improvement, Protecting 5 Million Lives from Harm, December 12, 2006.
5. Communication from Anne Millman, Project Manager, Delmarva Foundation, November 1, 2007.

## III. PRINCIPLES TO GUIDE THE DEVELOPMENT OF A HEALTHCARE-ASSOCIATED INFECTIONS DATA COLLECTION AND REPORTING SYSTEM

To guide the development of a reporting system for healthcare-associated infections data, the Technical Advisory Committee adopted the following set of principles:

1. The HAI data reporting system should: allow patients to make informed choices about providers; be of value to participating facilities in promoting infection prevention and control; and, inform State health policy efforts designed to improve quality and reduce the burden of illness.

2. The HAI reporting system should include a comprehensive set of evidence-based measures incorporating both processes of care and outcomes. Outcome measures should be risk-adjusted as appropriate. Based on the recommendations of professional organizations, the Institute of Medicine[1,2] and standards advocated by quality improvement organizations, the measures selected for reporting should be based on the following criteria:

   - ***Impact***— the extent of the burden—disability, mortality, and economic costs—imposed by the condition, including effects on patients, families, communities, and societies.
   - ***Improvability***—the extent of the gap between current practice and evidence-based best practice and the likelihood that the gap can be closed and conditions improved through change in an area; and the opportunity to achieve dramatic improvements in quality aims identified in the Institute of Medicine's *Quality Chasm*[3] report (safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity)
   - ***Inclusiveness***—the relevance of an area to a broad range of individuals with regard to age, gender, socioeconomic status, and ethnicity/race (equity); the generalizability of associated quality improvement strategies to many types of conditions and illnesses across the spectrum of health care (representativeness); and the breadth of change effected through such strategies across a range of health care settings and providers (reach).
   - ***Frequency***—the outcome/process measured must be frequent enough that there is confidence in the accuracy of the outcome being measured.
   - ***Feasibility***—data on selected measures can be obtained within the normal flow of clinical care and the resource burden of collection/analysis/reporting of the measure is manageable for institutions/ICPs. A clear and explicit definition of the outcome/process exists that is consistent between providers/institutions. Data can be readily audited.

- ***Functionality***—the intended audience (patients, care providers, and hospital administrators) can understand the results of the measure and are likely to find these results helpful for decision making, improving quality, and reducing the burden of illness.

3. HAI data that are publicly reported should be validated to ensure accuracy and completeness.

4. To ensure accurate and comparable data across facilities, uniform definitions developed by the Centers for Disease Control and Prevention should be used to collect HAI data.

5. The development of the HAI data reporting system should provide support for: training; enhancing the infrastructure required to collect, report, and analyze HAI data; and, establishing a future research agenda.

## References


1. Adams K and Corrigan JM. Priority Areas for National Action: Transforming Health Care Quality. Institute of Medicine. National Academies Press. 2003.
2. Wong, ES, Rupp ME, Mermel L, et al. Public disclosure of healthcare-associated infections: the role of the Society for Healthcare Epidemiology of America. *Infect Control Hosp Epidemiol*. 2005; 26(2): 210-2.
3. Corrigan JM. Crossing the Quality Chasm: A New Health System for the 21st Century. Institute of Medicine. National Academies Press. 2001.

## IV. STATE INITIATIVES: COLLECTION AND REPORTING OF HEALTHCARE-ASSOCIATED INFECTIONS DATA

Data reported by the Association for Professionals in Infection Control and Epidemiology indicates that 34 states have adopted legislation designed to address healthcare-associated infections (HAIs). As shown on Table 10, the vast majority of those states have mandated public reporting of HAI data as part of their legislative initiatives.

**Table 10**
**Status of Public Reporting of Healthcare-Associated Infections Data by State: 2007**

| State | Legislation Adopted | | | Study Bills Adopted | Current Legislative Activity | No Legislative Activity |
|---|---|---|---|---|---|---|
| | Public Reporting Mandated | Reporting to State Government Only Mandated | Voluntary Reporting | | | |
| Alabama | | | | | | V |
| Alaska | | | | V | | |
| Arizona | | | | | | V |
| Arkansas | | | V | | | |
| California | V | | | | | |
| Colorado | V | | | | | |
| Connecticut | V | | | | | |
| Delaware | V | | | | | |
| District of Columbia | | | | | | V |
| Florida | V | | | | | |
| Georgia | | | | | V | |
| Hawaii | | | | | V | |
| Idaho | | | | V | | |
| Illinois | V | | | | | |
| Indiana | | | | V | | |
| Iowa | | | | | | V |
| Kansas | | | | | V | |
| Kentucky | | | | | | V |
| Louisana | | | | | | V |
| Maine | V | | | | | |
| Maryland | V | | | | | |
| Massachusetts | | | | | V | |
| Michigan | | | | | V | |
| Minnesota | V | | | | | |
| Mississippi | | | | | V | |
| Missouri | V | | | | | |
| Montana | V | | | | | V |
| Nebraska | | | V | | | |
| Nevada | | V | | | | |
| New Hampshire | V | | | | | |
| New Jersey | | V | | | | |
| New Mexico | | | | V | | |
| New York | V | | | | | |
| North Carolina | V | | | | | |
| North Dakota | | | | | | V |
| Ohio | | | | V | | |
| Oklahoma | V | | | | | |
| Oregon | V | | | | | |
| Pennsylvania | V | | | | | |
| Rhode Island | V | | | | | |
| South Carolina | V | | | | | |
| South Dakota | | | | | | V |
| Tennessee | V | | | | | |
| Texas | V | | | | | |
| Utah | | | | V | | |
| Vermont | V | | | | | |
| Virginia | V | | | | | |
| Washington | V | | | | | |
| West Virginia | | | | | V | |
| Wisconsin | | | | | | V |
| Wyoming | | | | | V | |
| **TOTAL** | **24** | **2** | **2** | **6** | **8** | **10** |

Source: Association for Professionals in Infection Control and Epidemiology, August 20, 2007.

# V. HEALTHCARE-ASSOCIATED INFECTIONS: PERFORMANCE MEASURES AND DATA COLLECTION SYSTEM

## Introduction

Over the past decade, there has been increasing awareness of the significant cost associated with medical errors, both in terms of financial resources and more importantly, human life and suffering. In 1999, the Institute of Medicine (IOM) published *To Err is Human – Building a Safer Health System*.[1] This document launched the Patient Safety Movement and was a "Call to Action" for a national effort to make health care safe. This landmark publication put forth the idea that mandatory public reporting for medical errors was essential to help health care practitioners and organizations both identify and learn from these mistakes with the ultimate goal being improved outcomes for patients. Healthcare-associated infections (HAIs), which are common, serious, and costly adverse outcomes of medical care, were identified in this IOM report as among the most pressing problems in the health care field. Healthcare-associated infections are the most common adverse event encountered by hospitalized patients. Up to ten percent of people admitted to an acute care hospital may develop a HAI during their admission.[2] An estimated 1.7 million HAIs are thought to occur yearly in the United States leading to approximately 98,987 deaths[3] and over $4.5 billion in excess health care costs.[4]

In response to the significant impact HAIs have had on both patients and the health care system, a large number of states have already passed or are considering legislation with regards to mandatory public reporting of HAIs. In the State of Maryland, Senate Bill 135, *Hospitals-Comparable Evaluation System-Health Care-Associated Infection Information*, became law on July 1, 2006 as Chapter 42 of Maryland Law. This law requires "the comparable evaluation system established by the Maryland Health Care Commission to include healthcare-associated infection information from hospitals; requiring the system to adhere, to the extent possible, to certain recommendations regarding public reporting of healthcare-associated infections; and generally relating to the inclusion of healthcare-associated infection information from hospitals in a certain comparable evaluation system."[5]

## Selection of HAI Performance Measures

### Recommendations of Professional Organizations

In the development of this Report, recommendations from professional and federal organizations such as the Centers for Disease Control and Prevention (CDC), the Healthcare Infection Control Practices Advisory Committee (HICPAC), the Association for Professionals in Infection Control and Epidemiology (APIC) and the Society for Healthcare Epidemiology of America (SHEA) were reviewed in depth. In addition, the Technical Advisory Committee reviewed and incorporated information from the National Quality Forum's draft National Voluntary Consensus Standards for the Reporting of Healthcare-associated Infections Data.

Specific recommendations and guidelines from HICPAC, a federal advisory committee comprised of 14 infection prevention and control experts, include using established public health surveillance methods when designing and implementing mandatory HAI reporting systems,

creating multidisciplinary advisory panels to monitor the planning and oversight of HAI public reporting systems, choosing appropriate process and outcome measures based on facility type, phasing in measures to allow time for facilities to adapt and to permit ongoing evaluation of data validity, and providing regular and confidential feedback of performance data to healthcare providers. Specifically, HICPAC recommends two outcome measures (central line-associated bloodstream infections and surgical site infections) and three process measures (central line insertion practices, influenza vaccination coverage among patients, and healthcare personnel and surgical antimicrobial prophylaxis) as appropriate measures to be reported.[6]

The Association of Professionals in Infection Control and Epidemiology (APIC) similarly made a set of recommendations in a 2005 position paper on mandatory reporting which emphasized the importance of appropriate risk adjustment and standardization of data collection and analysis. Both APIC and HICPAC underscored the importance of education at all levels and the need to continually reevaluate and research the impact of public reporting. In addition, APIC stressed the importance of providing adequate support in the form of funding and infrastructure so that resources are not diverted away from infection prevention activities.[7] Additional recommendations from SHEA include using measures with clearly defined numerators and denominators, using measures that are frequent and as easy to collect as possible and ensuring appropriate risk adjustment to provide adequate comparison among institutions.[8]

### Criteria for Evaluation and Selection of Measures

In order to develop an evidence-based method of implementing public reporting in the State of Maryland, all potential HAI outcome and process measures deemed by the HAI Technical Advisory Committee to be relevant were evaluated on the basis of six criteria. A literature review was performed and pertinent literature on HAI outcome and process measures is summarized below. In addition, members of the HAI Technical Advisory Committee as well as a group of other experts in the field of hospital epidemiology and infection prevention and control were asked to rate each of the HAI outcome and process measures based on the six defined criteria using a scale from 1 through 5, with 1 being the lowest level of the measure and 5 the highest (Refer to Appendices 5 and 6 for the survey and results). Using this information, those measures ranked most highly were prioritized in the timeline and plan for public reporting of HAIs in Maryland. The following set of six criteria reflect the reporting system principles adopted by the Technical Advisory Committee, the recommendations of the professional organizations noted earlier, standards for improving healthcare quality advocated by the Institute of Medicine, and standards advocated for public reporting of other types of health outcomes:[9-11]

(1) **Impact** – Significant disability, mortality, suffering and economic costs are imposed by the condition on patients, patients' families, and/or the community. For process measures (i.e., active surveillance or HCW influenza vaccination), implementing the process of interest has the potential to reduce disability, mortality, suffering and economic costs due to the associated HAI.

(2) **Improvability** – A significant gap exists between the current practice relating to the HAI of interest and the evidence-based best practice. In addition, this gap can be closed or intervened upon and conditions can be improved through change in an area (i.e., rates of central line associated bloodstream infections can be improved by implementation of

central line bundles, etc.) Dramatic improvements in quality aims identified in the *Quality Chasm* report (safety, effectiveness, patient-centeredness, timeliness, efficiency and equity) can be achieved.

(3) **Inclusiveness –** The measure is relevant to a broad range of individuals with regard to age, gender, socioeconomic status and ethnicity/race. The associated quality improvement strategies are generalizable to many types of conditions and illnesses across the spectrum of health care.

(4) **Frequency –** The outcome/process measured must be frequent enough that there is confidence in the accuracy of the outcome/process being measured.

(5) **Feasibility –** Data on selected measures can be obtained within the normal flow of clinical care and the resource burden of collection/analysis/reporting of the measure is manageable for institutions/ICPs. A clear and explicit definition of the outcome/process exists that is consistent between providers/institutions. Data can be readily audited.

(6**) Functionality** – The intended audience (patients, care providers, hospital administrators) can understand the results of the measure and are likely to find these results helpful for decision making, improving quality and reducing the burden of illness.

Table 11 provides a ranking system for the proposed criteria.

**Table 11**
**Criteria and Ranking System for Potential Outcome and Process Measures for Mandatory Public Reporting of HAIs in Maryland**

| | Low | Moderate | High |
|---|---|---|---|
| **Impact** | Minimal cost in terms of morbidity and financial indices for outcome measures. For processes, interventions make little difference in outcome. | Moderate cost in terms of morbidity and financial indices. For processes, intervention reduces rates of HAI moderately. | High cost in terms of morbidity/mortality and financial indices. For processes, intervention significantly reduces rates of HAI. |
| **Improvability** | No evidence that intervening improves rates. | Limited data indicating intervention may be helpful. | Evidence based guidelines for prevention exist, well designed studies showing interventions can reduce rates of HAIs. |
| **Inclusiveness** | Measure impacts a limited population with regards to age, sex, ethnicity, socioeconomic status | Measure impacts several different gender, age, ethnic and SES groups | Measure impacts all or most individuals regardless of age, sex, ethnicity and socioeconomic status |
| **Frequency** | Infrequent event | Moderately frequent | Frequent |
| **Feasibility** | Difficult to implement, resource and labor intensive. No clear established definition/diagnostic test. | Difficult to implement but some data already being collected in most institutions. Easy to use definition. | Clear definition with clear-cut numerators and denominators. System for collecting data already in place in most institutions. |
| **Functionality** | Measure not meaningful to consumers or is difficult to interpret. No clear method for risk adjustment. Goal for improvement not clear. | Measure inherently meaningful to all consumers. Some difficulty with comparison between institutions, risk adjustment necessary. | Measure is meaningful and easy to interpret; Risk adjustment not necessary/measure is easily comparable between institutions. Clear goals. |

## Potential HAI Outcome Measures

Outcome measures gauge the results of treatment and may include mortality, non-fatal adverse events and patient reported experience and health status. Potential HAI outcome measures evaluated in this Report include: (1) central line-associated bloodstream infections (CLA-BSIs); (2) surgical site infections (SSIs); (3) ventilator-associated pneumonias (VAPs); (4) catheter-associated urinary tract infections (CA-UTIs); and (5) nosocomial transmission of methicillin resistant *Staphylococcus aureus* (MRSA) and vancomycin resistant *Enterococci* (VRE) in intensive care units (ICUs). Each of these potential outcome measures is evaluated based on expert opinion and medical research using the criteria and ranking system outlined above in Table 11.

### CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS (CLA-BSI) IN ALL INTENSIVE CARE UNITS

#### Criteria and Review of the Literature

- **Impact**

Central line-associated bloodstream infections (CLA-BSI) are often devastating infections that occur in hospitals, and in particular in intensive care units (ICUs) throughout the United States. CLA-BSI, with an attributable mortality estimated at anywhere from 12-35%, are often considered one of the most serious HAIs. In addition to leading to increased mortality, these infections extend length of intensive care unit stay by approximately 5 days and total hospital stay by 5-16 days for each infection. These infections also impose a significant financial burden on institutions with estimated attributable costs ranging from $12,000 to $30,000 per episode.[12-15]

- **Improvability**

A number of well-designed studies have shown that several interventions can help institutions reduce rates of CLA-BSIs. Clearly, multimodal education programs have been shown to reduce rates of CLA-BSIs by anywhere from 50-75%.[16-20] In addition, CDC guidelines provide a set of evidence based interventions for preventing CLA-BSIs. Category 1A recommendations include health care education on proper use, care and insertion of intravascular catheters, appropriate hand hygiene and aseptic technique during insertion and care of catheters, prompt removal of non-essential catheters, use of chlorhexidine gluconate for insertion site preparation, minimizing line manipulation and safe injection practices.[12] Use of maximal barrier sterile precautions during the insertion of central venous catheters has also been shown to reduce rates of CLA-BSIs.[21]

- **Inclusiveness**

CLA-BSIs can affect individuals of all ages, ethnicities, socioeconomic strata and genders. Interventions to reduce rates are generalizable across all of these groups.

- **Frequency**

Although episodes of CLA-BSI are not as frequent as episodes of ventilator-associated pneumonia (VAP) or catheter-associated urinary tract infections (CA-UTI), these infections still impact a large number of patients. CLA-BSIs account for over 250,000 infections each year across the U.S. According to 2006 National Health Safety Network (NHSN) data, pooled means for CLA-BSI rates range from 1.5 to 6.8 CLA-BSIs per 1000 central line days.[22] Approximately 3-7% of patients with central lines will develop a CLA-BSI.

- **Feasibility**

As compared to detection of other types of hospital acquired infections, methods of detection of CLA-BSI, while clearly not perfect are more sensitive, specific and have a higher positive predictive value as compared to methods of detection of other HAIs such as VAP or CA-UTI. Emori et al. evaluated the accuracy of reporting rates of nosocomial bloodstream infections, pneumonias, urinary tract infections and surgical site infections to NNIS in 1998 and found that primary bloodstream infections (with a positive predictive value of 87%, sensitivity of 85% and specificity of 98.6%) were the most accurately identified and reported HAI.[23] Not only are there relatively reliable tests available for identification of CLA-BSIs but a majority of hospitals are already collecting data on this measure. Of the 47 acute care hospitals in the Maryland, a recent Commission survey showed that all of these institutions were already collecting data on the number of CLA-BSIs either in ICUs alone or institution-wide.

Although, collection of data on CLA-BSIs is quite feasible, several potential stumbling blocks in diagnosis of these infections can occur. Identification of CLA-BSIs is occasionally challenging when blood cultures grow skin contaminant organisms which may or may not represent true infection. In addition, identification of patients with central lines may be difficult as the location of line tip termination may not be clearly documented in the medical record.

- **Functionality**

Health care consumers, ranging from patients to administrators to health care providers, more easily understand the implication of rates of outcome measures such as CLA-BSIs as compared to process measures. Difficulties arise, however, when trying to compare rates of the outcomes of interest between institutions due to differences in patient mix as well as varying rates of device

utilization. For these reasons, appropriate risk adjustment is necessary to allow for fair comparison between institutions. Risk adjustment helps to eliminate variables that institutions cannot control but that significantly influence infection rates. In the area of CLA-BSIs, rates are typically stratified by different types of unit (e.g., certain types of ICUs such as burn units are known to have higher rates of CLA-BSIs than compared to other units). In addition, both the CDC and Joint Commission recommend expressing and reporting rates of CLA-BSI per 1,000 catheter days rather than per 100 catheters, patient days or discharges. Clearly, longer duration of catheter use has been associated with higher rates of CLA-BSIs and use of catheter days as the denominator is a proxy risk adjustment.

### Measures and Calculations

**Numerator:** Number of CLA-BSIs in the unit of interest (as per NHSN, laboratory-confirmed)

**Denominator Data:** Total number of central line days in the unit of interest

For ICUs and locations other than specialty care areas and NICUs, the number of patients with one or more central lines of any type should be collected daily, ideally at about the same time each day, and then summed with the total reported for the month.

**Calculation of CLA-BSI Rate:**
(Total number of CLA-BSIs/Total central line days) x 1,000

**Calculation of Central Line Utilization Ratio**:
Total number of central line days/Total number of patient days in the unit of interest

**Risk Stratification**: By ICU type

### Data Source

Medical record

**Definitions based on NHSN definitions**:[24] See Glossary (Appendix 7)

## SURGICAL SITE INFECTIONS (SSI)

### Criteria and Review of the Literature

- **Impact**

Surgical site infections incur significant morbidity, mortality and cost. SSIs have been shown to extend length of stay by an average of 6.5 days and increase cost by $5,000 to $10,000 per SSI.[25-26] More importantly, however,

patients with surgical site infections are five times more likely to be readmitted to the hospital, 1.6 times more likely to have an ICU stay and twice as likely to die.[27]

Given that development of infections following Class III (contaminated) and Class IV (dirty infected) surgeries is often due to the nature of the surgery rather than surgical technique or hospital characteristics, mandatory public reporting of SSIs should focus on Class I (clean) or Class II (clean contaminated) surgeries. In addition, the majority of morbidity, mortality and cost is incurred by more severe infections. In the area of SSIs, deep incisional and organ space infections are much more costly and, due to the severity of these infections, more likely to be diagnosed. For both of these reasons and for the purpose of public reporting, deep and organ space infections should be the primary focus rather than superficial SSIs which are often difficult to diagnose, may be treated in the outpatient arena, and are less likely to be captured by a mandatory public reporting system.

- **Improvability**

SSIs are another type of infection where rates have been reduced by the introduction of evidence based interventions. Guidelines for the prevention of SSIs were released by the CDC in 1999. These guidelines recommend interventions such as using sterile surgical instruments, maintaining a sterile surgical field, ensuring rigorous antiseptic preparation of the incision, the use of antiseptic wash the night before and morning of surgery, and appropriate use of perioperative antimicrobials.[28] Other interventions such as maintaining normothermia during surgery have also been associated with decreased rates of SSI. [29] Despite the existence of these guidelines and studies showing the benefits of these interventions, adherence to the guidelines remains variable. For example, despite multiple studies showing a clear reduction in SSIs with appropriate use of perioperative antibiotics, adherence with this practice occurs in only 45-55% of cases.[30] This gap between evidence-based best practices and what actually occurs in hospitals indicates that interventions which improve adherence (especially in institutions with unacceptably high rates of infections) may reduce rates of SSIs.

- **Inclusiveness**

Rates of surgical site infections vary somewhat by type of operation, patient characteristics and institutions, however, these infections continue to affect a broad range of ethnicities, socioeconomic strata, genders, and ages. Further investigation into the most frequent and most representative types of surgery in Maryland will need to be done to determine which procedures should be involved in public reporting.

- **Frequency**

Surgical site infections are the third most common HAI accounting for approximately 25% of all HAIs in the U.S. in a given year. In the U.S., SSIs

occur following approximately 2.6% of the 30 million surgical procedures that are performed each year, accounting for approximately 500,000 infections each year.[31-32]

- **Feasibility**

Although SSIs are an attractive candidate for public reporting in that they are important infections affecting a broad range of patients where there is a possibility of intervention and improvement in rates, several potential limitations to reporting these infections exist. Detection of SSIs can be problematic. Evaluation of current methods of detection of SSI based on CDC/NHSN criteria reveals that these methods have a sensitivity of only 67% and a positive predictive value of 75%.[23] The relatively low sensitivity and positive predictive value of SSI detection can be explained by several observations. Firstly, current surveillance definitions include subjective components, such as a surgeon's diagnosis of SSI, which create the opportunity for substantial variation in judgment and documentation. Secondly, a majority of SSIs occur days or weeks after hospital discharge and elude hospital-based tracking systems. Post-discharge surveillance is very labor intensive and tracking patients can be difficult, especially if the patient goes to a hospital out-of-state. Currently, no adequate system exists to allow for easy sharing of information on readmissions for infections between institutions, making the issue of post-discharge surveillance even more difficult.

In addition, current surveillance methods are so resource-intensive that many hospitals are able to monitor only selected procedures, and those procedures monitored vary from institution to institution across the state. Surgeries chosen to be reported must be performed with adequate frequency to permit meaningful comparisons between institutions. Examples of such surgeries may include, but are not limited to, coronary artery bypass surgery, colon surgery, laminectomy or hip/knee replacements. Not only do the surgeries surveilled differ from institution to institution, but the surveillance intensity may differ as well. To require mandatory reporting of SSIs, consistent case finding methodologies must be clearly outlined.

- **Functionality**

Rates of SSIs, similar to rates of CLA-BSIs, are inherently understandable for both patients and those involved in health care. As mentioned above, however, certain surgeries occur more or less frequently at different institutions and patient case mix varies widely from institution to institution. Both of these factors could clearly impact SSI rates and make meaningful comparison more difficult.

## Measures and Calculations

**Numerator:** Number of SSIs for each specific type of operation during specified time period.

**Denominator:** Total number of each specific type of operation during a specified time period, expressed per 100 surgeries

**Calculation of SSI Rate:**
Number of SSI in patients during specified time period/Number of operations during specified time x 100

**Risk Stratification:** Stratify by type of operative procedure and NHSN SSI risk index

**Data Source**
Medical Record and information from post-discharge surveillance

**Definitions based on NHSN definitions** - See Glossary (Appendix 7) for definitions of superficial incisional, deep incisional and organ space SSIs, Wound class and NHSN SSI risk index.

## VENTILATOR-ASSOCIATED PNEUMONIA (VAP) IN INTENSIVE CARE UNITS

### Criteria and Review of the Literature

- **Impact**

Ventilator-associated pneumonia (VAP) cost both institutions and patients a great deal in terms of financial burden as well as increased morbidity and mortality. Patients with VAP have increased hospital costs of up to $40,000 per episode.[33] Patients with VAP also have been shown to require mechanical ventilation for longer durations and to have ICU stays prolonged by an average of 6.1 days.[34-36] Perhaps most importantly, attributable mortality for VAP, while not as high as for CA-BSI, is still significant at 18.5 %.[37]

- **Improvability**

Several interventions have been shown to reduce rates of VAP in the ICU setting. CDC guidelines for the prevention of healthcare-associated pneumonias include such measures as appropriate hand hygiene before and after patient care, good oral care/hygiene, aggressive weaning from the ventilator and use of noninvasive ventilation if at all possible, elevation of the head of the bed to 30-45 degrees and changing of the ventilator circuit no more frequently than every 48 hours.[38] Staff education and introduction of "ventilator bundles" have been shown to decrease rates of VAP by up to 55%.[39-42] One commonly used ventilator bundle which was developed by the Institute for Healthcare Improvement (IHI) includes four elements: (1) head of bed elevation of 30 degrees or greater; (2) daily "sedation vacation" (i.e., weaning of sedation to allow patient to waken enough to assess readiness to extubate) and daily

assessment of readiness to extubate; (3) peptic ulcer disease prophylaxis; and (4) deep venous thrombosis prophylaxis. In addition to ventilator bundles, other interventions such as chlorhexidine oral rinses, while not consistently shown to decrease mortality and currently not routinely recommended by the CDC, in some studies do appear to reduce rates of VAP (Relative Risk 0.76).[43]

- **Inclusiveness**

Although by definition, VAP affects only those patients who are ventilated and has a predilection for elderly or otherwise ill individuals, this infection still has a significant impact on people of different genders, ethnicities, and socioeconomic strata.

- **Frequency**

VAP is the second most frequent HAI occurring in 10-42% of mechanically ventilated patients.[34,44-47]

- **Feasibility**

Diagnosis of VAP varies widely from institution to institution and provider to provider. Despite the fact that VAP occurs relatively frequently, many conditions that occur in ICU patients, such as acute respiratory distress syndrome, pulmonary embolus, atelectasis and congestive heart failure, may produce very similar clinical symptoms. Multiple studies have illustrated the protean problems with obtaining a consistent diagnosis of VAP between providers and institutions. Over half of the patients with VAP do not truly have the disease when strict clinical definitions are applied and over one-third of patients who do meet the clinical criteria for VAP go undiagnosed. In addition, inter-observer agreement with regards to the diagnosis is quite poor.[48-52] Sensitivity of the diagnosis of VAP has been estimated at 68% with a positive predictive value of 89%.[23] Several sets of diagnostic criteria (NHSN criteria, Clinical Pulmonary Infection Score and Johanson criteria) exist and are used by different institutions leading to very different diagnoses of VAP between institutions and making comparing rates of VAP between institutions quite difficult. For these reasons, VAP currently is not included in the HICPAC recommendations for public reporting of HAIs due to concerns that inaccurate rates may be reported resulting in invalid comparisons and misleading information for patients.

- **Functionality**

Given the significant limitations in diagnosing VAP as well as obtaining agreement on the diagnosis between various observers, comparison of VAP rates between institutions currently has limited utility. Further research in the area of VAP and refinement of the diagnosis is necessary before VAP rates can be publicly reported.

**Measures**

**Numerator:** Number of episodes of ventilator-associated pneumonia

**Denominator:** Total number of ventilator days

**Calculation of VAP Rate**:
(Total number of VAP/Total ventilator days) x 1,000

**Calculation of VAP Utilization Ratio**:
Total number of ventilator days/Total number of patient days in the unit of interest

**Definitions** - See Glossary (Appendix 7) for definitions of VAP and Ventilator

**Data Source**

Medical Record

## CATHETER-ASSOCIATED URINARY TRACT INFECTIONS (CA-UTIS)

### Criteria and Review of the Literature

- **Impact**

Catheter-associated urinary tract infections (CA-UTIs) are frequent events that affect approximately 800,000 hospitalized patients each year and account for 40% of all healthcare associated infections.[53] Although CA-UTIs are frequent HAIs, the financial cost of these infections to the institution is far less than the cost associated with other HAIs such as catheter-associated bloodstream infections or ventilator associated pneumonias. The weight-adjusted mean cost estimate for an episode of CA-UTI is $758 as compared to $23,242 for a CA-BSI or $10,443 for a SSI.[26]

CA-UTIs can lead to serious consequences. Approximately 2.7% of patients with a CA-UTI will go on to develop bacteremia related to the UTI. [54] CA-UTIs have been shown to extend hospital stay by approximately 2.4 days.[55] and increase mortality by up to threefold.[56] Case fatality due to CA-UTIs has been estimated at 13% although accurate estimates of mortality and cost related to CA-UTIs have been somewhat limited due to variability in how these infections are diagnosed. [57]

- **Improvability**

Several interventions have been shown to reduce rates of CA-UTIs. Clearly, longer duration of catheterization (specifically longer than six days) has been associated with increased risk for developing a CA-UTI. Patients with

indwelling urinary catheters develop bacteriuria at a rate of 3-10% per day. [58] Up to 30% of the time, urinary catheters remain in place despite the fact that the catheter serves no useful purpose for either the patient or for monitoring urine output. In addition, physicians are often unaware of how long catheters have been in place or even which patients have an indwelling urinary catheter. Interventions that remind or require physicians to remove unnecessary catheters have been shown to decrease rates of CA-UTIs by 40-60% and decrease duration of catheterization by 3 days.[59-61]

In addition to reducing the duration of catheterization, closed system drainage bags and appropriate use of aseptic technique when inserting and caring for catheters have been shown to reduce rates of CA-UTIs.[62-64] Some studies also suggest that novel products such as silver alloy coated urinary catheters help decrease rates of CA-UTIs.[65]

- **Inclusiveness**

Up to 25% of patients admitted to an acute care hospital have a urinary catheter placed at some point during their hospital stay. Patients of all ages, races, ethnicities and socioeconomic strata have urinary catheters in place.

- **Frequency**

As mentioned above, CA-UTIs are frequent events affecting over 800,000 hospitalized patients each year in the United States.

- **Feasibility**

Catheter-associated urinary tract infections, although a frequent HAI, are quite difficult to diagnose. As mentioned above, a large percentage of patients who have a urinary catheter in place will develop bacteriuria. Definitions as to what constitutes a CA-UTI vary among different institutions and groups. Some definitions rely on symptoms and microorganism threshold whereas others rely on clinician diagnosis or initiation of treatment for a UTI. These definitions are often not useful in distinguishing between infected and non-infected catheterized patients and may not distinguish infections acquired in the hospital from those acquired in the community.[66-67] Given the lower morbidity, mortality and cost associated with CA-UTIs as compared to other HAIs and the difficulty in diagnosis as well as the burden of data collection and reporting, groups such as HICPAC and NQF have not recommended inclusion of this outcome measure for public reporting at this time.[6]

- **Functionality**

In addition to the difficulty in diagnosis and collecting data on CA-UTIs, this infection is not as inherently meaningful to patients and other healthcare consumers. UTIs are generally considered to be less severe infections. In

addition, given the variable definitions used by different institutions, comparing rates between hospitals and performing accurate risk adjustment would be difficult.

### Measures

**Numerator:** Number of CA-UTIs

**Denominator:** Total number of catheter days

**Calculation of CA-UTI Rate**:
(Total number of CA-UTIs/Total urinary catheter days) x 1,000

**Calculation of Urinary Catheter Utilization Ratio**:
Total number of urinary catheter days/Total number of patient days in the unit of interest

### Data Source

Medical Record

## NOSOCOMIAL TRANSMISSION OF METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA) AND VANCOMYCIN RESISTANT ENTEROCOCCI (VRE) IN THE INTENSIVE CARE UNIT

This is an outcome measure that evaluates rates of MRSA and VRE infection and colonization while in the hospital. This measure is distinct from the process measure of compliance with active surveillance testing (AST) for MRSA in the ICU setting. The process of AST looks at compliance with obtaining a nares swab for MRSA for all patients admitted upon admission to an ICU and weekly thereafter. The outcome of nosocomial transmission of MRSA and VRE implies reporting of actual rates of MRSA and VRE infection and colonization. Although these two measures are separate in this document, in reality, institution of active surveillance culturing for MRSA and VRE would be required to obtain rates of nosocomial transmission of these organisms. (AST would need to be in place in order to show that the patient acquired the infection or colonization while in the hospital rather than being admitted with the infection or colonization.)

For the purpose of reporting nosocomial rates of MRSA or VRE infection/colonization, each hospital admission would be considered separately and an infection or colonization would be considered nosocomially acquired if the patient had a nares/perirectal swab that was negative, and had no incubating infection with MRSA or VRE upon admission but subsequently developed colonization or infection after more than 48 hours in the hospital

## Criteria and Review of the Literature

- **Impact**

The incidence of infections with multiple drug resistant organisms (MDROs) clearly has been increasing over the past several decades and a growing body of evidence indicates that these infections are more deadly and costly than infections with drug susceptible organisms. Multiple studies have shown that nosocomially acquired MRSA colonization can lead not only to significant rates of infection but also to increased morbidity, longer hospital stays, and increased attributable costs.[68-69] Patients with MRSA bacteremia have higher rates of death due to disseminated infection as compared to those patients with MSSA bacteremia.[70] In addition, patients with MRSA bacteremia as compared to patients with MSSA bacteremia spend a median of two additional days in the hospital and incur over $6900 in increased hospital charges.[71] Similarly, bacteremia caused by VRE (as compared to bacteremia due to vancomycin susceptible enterococci) has been associated with increased cost and mortality.[72-73] Populations particularly affected by resistant bacteria include patients in intensive care units, those with prolonged hospital stays, and those who are immunosuppressed. MRSA and VRE infections acquired while in the hospital undoubtedly have a significant impact on admitted patients.

- **Improvability**

Several interventions have been shown to reduce transmission of MDROs within the healthcare setting. Measures such as aggressively identifying patients colonized or infected with MDROs and implementing contact precautions, which include physical separation of colonized or infected patients from other patients, performing hand hygiene before and after entering a patient's room and donning a clean gown and gloves during all contact with colonized or infected patients and those patients' environments, have been shown in some series to reduce transmission of MDROs.[74-75] In addition, pharmacologic interventions such as nasal mupirocin and chlorhexidine gluconate baths may help decrease colonization in certain patient groups and help prevent transmission from one patient to another via health care worker hands. A recent study by Simor et al. showed that a regimen of chlorhexidine gluconate baths, nasal mupirocin, doxycycline and rifampin was effective at eradicating MRSA colonization at 3 months.[76] Similarly, the combination of chlorhexidine gluconate baths and nasal mupirocin has been shown to be effective in eradicating MRSA colonization in hemodialysis patients.[77] In addition, several studies have suggested that not only colonization but rates of nosocomially acquired MRSA infections may be decreased by instituting a program of routine chlorhexidine gluconate baths and nasal mupirocin.[78]

- **Inclusiveness**

MDROs know no boundaries and can affect men and women of different ethnicities and socioeconomic strata.

- **Frequency**

Issues of antimicrobial resistance go hand-in-hand with issues of healthcare-associated infections and have become popular topics of discussion in the medical world as well as the lay press. Over the past several decades, infections caused by multiple drug resistant organisms such as MRSA and VRE, have increased tremendously. NNIS data from 2004 indicate that nearly 60% of all nosocomial *S. aureus* infections in ICUs were caused by MRSA and 29% of enterococcal isolates were caused by VRE.[79] A recent article in the *Journal of the American Medical Association* describing the epidemiology of invasive MRSA infections in nine centers across the U.S., including Baltimore, MD, illustrates the significant problem MRSA presents to hospitals in Maryland. In the Baltimore, MD surveillance site, community-associated invasive MRSA infections occurred at a rate of 29.7 per 100,000, community-onset healthcare-associated invasive MRSA infections at a rate of 62.9 per 100,000 and hospital-onset healthcare-associated invasive MRSA infections at a rate of 16.8 per 100,000. The rates for the Maryland site were the highest of the 9 surveillance sites.[80] Transmission of antimicrobial resistant pathogens from one patient who is either infected with an MDRO or asymptomatically colonized to other patients accounts at least in part for the rise in antimicrobial resistance seen in hospitals throughout the United States. Approximately 25% of all HAIs are thought to be due to MRSA. In one study of over 750 patients in five different hospitals, 3.4% were colonized with MRSA on admission and an additional 3.0% acquired colonization during hospitalization. Of those patients who acquired MRSA colonization while in the hospital, 25% developed an MRSA infection.[81]

- **Feasibility**

There is increasing interest, both from the medical community and those in patient advocacy and legislative groups to publicly report infection and/or colonization rates of MRSA and less commonly VRE. Reporting rates of nosocomial acquisition of MRSA and VRE is complicated by several different factors. Such reporting would require the institution of active surveillance for these organisms on admission and weekly post-admission. Active surveillance testing (AST) for the entire institution can be quite resource intensive in terms of laboratory time and supplies, extra materials needed for institution of contact precautions and infection prevention and control professional time to identify and notify staff of patients colonized or infected with MDROs.[82] Although available data suggest that AST in high risk populations may lead to lower nosocomial infection/colonization rates, data on AST for entire institutions is lacking. Experts in hospital epidemiology and organizations such as SHEA and APIC currently recommend AST only in high risk populations. Another complicating

factor is the growing problem of community-acquired MRSA (CA-MRSA). CA-MRSA is distinct from hospital-acquired MRSA and is significantly more common in certain patient populations making public reporting of rates of MRSA infection and/or colonization (rather than focusing solely on nosocomially acquired MRSA) much more difficult and confusing for health care consumers.

- **Functionality**

Comparison of rates of nosocomial transmission of MDROs between institutions may be difficult and these rates are not as intuitive as rates for CA-BSI or SSIs. Certain populations, such as intravenous drug users or prison inmates, have been found to have higher rates of colonization and infection with MRSA and these populations may be more or less common from institution to institution.[83] Several studies have shown that colonization pressure (or the presence of higher numbers of patients infected or colonized with MDROs on a particular unit) can increase the likelihood of acquisition of MRSA and VRE for previously uncolonized patients. In this era of community acquired MRSA, this may be a particularly important issue.[84-85] Given the growing stigma surrounding MDROs and particularly MRSA, appropriate methods of risk-adjustment need to be determined before this measure can be used for public reporting.

**Measures**

**Numerator:** Number of patients who acquired MRSA (or VRE or MDRO) infection or colonization after $\geq$48 hours in the hospital

**Denominator Options:** Patient days
Admissions
Discharges
Occupied beds

**Data Source**

Medical Record

**Definitions** - See Glossary (Appendix 7) for definitions of MDROs, Active Surveillance, and Colonization

## Potential HAI Process Measures

Process measures gauge whether the correct management strategies are implemented in the appropriate patients at the appropriate time. The potential process measures evaluated in this proposal include: (1) influenza vaccination of healthcare workers; (2) influenza vaccination for patients admitted with community-acquired pneumonia; (3) central line insertion bundle compliance; (4)

surgical antimicrobial prophylaxis compliance: (5) appropriate hair removal prior to surgery; (6) VAP bundle compliance; (7) compliance with active surveillance testing for MRSA in all intensive care units (ICUs); and (8) compliance with hand hygiene. Each of these potential process measures is evaluated based on expert opinion and medical research using the criteria and ranking system outlined in Table 11.

## INFLUENZA VACCINATION OF HEALTH CARE WORKERS (HCW)

### Criteria and Review of the Literature

- **Impact**

In the United States, influenza related diseases account for approximately 36,000 deaths and over 200,000 excess hospitalizations annually.[86] Groups at particular risk for influenza related morbidity and mortality include the elderly, the very young, patients with chronic heart, lung, kidney, liver disease, and the immunocompromised, all of whom frequently access various health care settings. Influenza can be transmitted within health care settings from patient to patient, visitor to patient, patient to health care worker and health care worker to patient. Health care workers (HCWs), typically younger and otherwise healthy individuals, have significant rates of clinical and subclinical influenza during the flu season as well as a tendency to continue to work even when they are ill, serving as a source of nosocomial transmission to both patients and other health care workers.[87-88]

Multiple organizations ranging from the CDC's Advisory Committee on Immunization Practices, the World Health Organization, the Society for Healthcare Epidemiology of America, and the Association for Professionals in Infection Control and Epidemiology have long recommended annual influenza vaccination for health care workers. Vaccination clearly reduces influenza among health care workers and their personal contacts and decreases absenteeism of essential workers in the midst of influenza season when health care facilities are already burdened.[89-90] Beyond the benefits to the health care worker and system, an increasing body of evidence has shown that patients also benefit when health care workers get vaccinated. Vaccination of health care workers has been associated with decreased rates of nosocomial influenza.[91] Perhaps more importantly, two studies in long term care facilities have shown decreased mortality among patients in sites where health care workers were vaccinated as compared to sites where routine vaccination was not offered.[92-94] Another recent cluster randomized, controlled study of 44 long term care facilities showed reduced rates of influenza like illness, influenza related hospitalizations and all-cause mortality in institutions where health care workers were encouraged to take the influenza vaccine.[95]

Although influenza vaccination of HCWs is clearly recommended by the CDC and other professional organizations, and in fact is one of the HAI process

measures recommended by HICPAC for mandatory public reporting, nosocomial cases of influenza are relatively rare in some institutions. In addition, many of the studies that have shown better outcomes with increased rates of HCW influenza vaccination were conducted in long term care settings rather than in acute care hospitals. For both of these reasons, influenza vaccination of HCWs, while important, may have slightly less impact in the overall field of HAIs.

- **Improvability**

Despite the data that influenza vaccination of health care workers is beneficial for both health care workers and patients, fewer than 50% of health care workers in the United States receive the influenza vaccine each year.[96] Identified barriers to vaccination of health care worker include lack of time, beliefs that the vaccine would cause influenza, inconvenience and cost of the vaccine. Many health care workers also are unaware that their vaccination may actually help protect patients.[94] CDC/HICPAC and SHEA have recommended measures such as providing influenza vaccination at no cost during all work shifts, enhanced education, vaccination clinics, mobile carts, leadership support and signed declination as measures to improve HCW vaccination rates.

- **Inclusiveness**

This process is applicable to all types of health care workers of varying backgrounds.

- **Frequency**

Influenza vaccination is recommended annually during influenza season. As mentioned above, however, cases of documented nosocomial influenza are relatively rare.

- **Feasibility**

Another potential limitation in the use of health care worker immunization rates for public reporting lies in data collection. Occupational health records at various institutions are variably easy to use and electronically accessible. A large amount of manual data collection and entry may be required which may be labor intensive.

- **Functionality**

Many patients, and for that matter, health care workers may not realize the impact that health care worker influenza vaccination can have on reducing the risk of developing influenza while in the hospital. Benefits of this measure, however, are that rates are easily comparable between institutions.

### Measures

**Numerator:** Number of influenza vaccinations given to health care personnel
**Denominator:** Number of health care personnel who work in the institution (excluding those with medical or religious contraindications or who can provide documentation that they have received the influenza vaccine elsewhere. Health care personnel for this purpose will be defined as those in direct contact with patients).

### Data Source

Occupational Health Records

## INFLUENZA VACCINATION FOR PATIENTS ADMITTED WITH COMMUNITY-ACQUIRED PNEUMONIA (CAP)

### Criteria and Review of the Literature

- **Impact**

Each year between 1990 and 1999, approximately 36,000 people died from influenza and between 1979 and 2001 over 226,000 were hospitalized annually due to influenza related illnesses. Mortality and morbidity associated with influenza is most pronounced in those at extremes of age and those with comorbid illnesses.[97-98] Influenza has a short incubation period and is effectively spread from person to person primarily through large-particle respiratory droplets. The concentration of frail elderly individuals and those with underlying illnesses that occurs in a hospital setting can easily lead to the spread of influenza infection. Nosocomial outbreaks of influenza are common and are associated with significant morbidity, mortality and increased cost of care. Mortality rates during nosocomial outbreaks vary among patient populations and between strains of influenza virus but typically range from 16% for acute care hospitals to 60% for immunosuppressed or ICU populations.[99] Although the economic impact of nosocomial influenza is difficult to measure, one study from 1993 estimated a mean excess hospital cost of over $7,500 per episode. This is likely an underestimate of the current cost.[100]

Interestingly, approximately 39-46% of patients admitted to the hospital with influenza-related illness have had prior hospitalizations within the past year.[101] The most effective strategy for preventing influenza virus infection and its potential complications includes annual influenza vaccine, especially for those at high risk. In healthy adults, inactivated influenza vaccination has been shown to prevent influenza related hospitalizations by up to 90% even when the vaccine strain and circulating strains are antigenically dissimilar. Older adults have been shown to have lower amounts of post-vaccination antibodies against influenza virus than younger adults. Despite lower antibody levels, the influenza vaccine

continues to be effective in reducing influenza-related illnesses, hospitalizations for pneumonia and influenza, and death in patients with and without high risk medical conditions.[102]

Inpatient vaccination represents a significant opportunity for intervening and reducing the spread of influenza. Hospital based influenza vaccination is currently recommended by multiple expert panels, including the CDC, the National Vaccine Advisory Committee and the Task Force on Community Preventive Services. In addition, influenza vaccination is used as a hospital quality indicator by both the Centers for Medicare and Medicaid Services (CMS) and the Joint Commission.

- **Improvability**

Opportunities to vaccinate hospitalized individuals who are frequently at risk for influenza related complications are often missed. A 2002 study of hospitalized Medicare patients revealed that only 1.9% received the influenza vaccine during their admission.[103] Similarly, a recent study in Michigan showed that in 2002 less than 7.1% of patients hospitalized in four different hospitals received the influenza vaccine.[104] In particular, vaccination rates are lower in African American and Hispanic populations. Several studies have shown that interventions ranging from computer reminders, standing orders and assigning responsibility to a specific individual (usually a nurse) are all effective at increasing vaccination rates to varying extents.[105] The Minneapolis Veterans Affairs Medical Center has been particularly successful, raising inpatient vaccination rates to over 85%, with a program of standing orders for influenza vaccines that allows nurses to vaccinate any inpatient on the day of discharge.[106]

- **Inclusiveness**

Influenza vaccination of all at risk hospitalized inpatients would affect all types of individuals of varying backgrounds.

- **Frequency**

Influenza vaccination of at risk hospitalized inpatients is a frequent event.

- **Feasibility**

Inpatient influenza vaccination in patients admitted to the hospital with community-acquired pneumonia is used as a quality indicator by CMS and the Joint Commission. A number of institutions are already collecting data on patient influenza vaccination in this subgroup of high risk patients. Although collection of data on all patients' influenza vaccinations may be prohibitive, collecting data on the subset of patients admitted with pneumonia would be quite feasible.

- **Functionality**

Many patients may not realize the impact that health care worker influenza vaccination can have on reducing the risk of developing influenza while in the hospital. Benefits of this measure, however, are that rates are easily comparable between institutions.

### Measures

**Numerator:** Number of influenza vaccinations given to inpatients admitted during influenza season with community-acquired pneumonia who have not been previously vaccinated this season
**Denominator:** Number of patients admitted with community-acquired pneumonia in the institution admitted while influenza vaccine is available (excluding those with medical or religious contraindications)

### Data Source

Medical Record

## CENTRAL LINE INSERTION BUNDLE

### Criteria and Review of the Literature

- **Impact**

HICPAC recommendations for process measures for a mandatory public reporting system on healthcare-associated infections include central line insertion practices (defined as use of maximal sterile barrier precautions and use of chlorhexidine gluconate for skin antisepsis). Other groups such as IHI have included other measures in their central line bundle such as hand hygiene, optimal catheter site selection (i.e., the subclavian site is preferred) and daily review of line necessity with prompt removal of unnecessary lines.

CLA-BSIs, as mentioned earlier, are expensive to both patients and institutions in terms of morbidity and mortality as well as financial costs. Several interventions with regard to central line insertion practices have been shown to reduce rates of CLA-BSIs and may be appropriate process measures for public reporting of HAIs. Use of maximal sterile barriers, which includes wearing a mask, cap, sterile gown and gloves, and a large drape during central line insertion has been shown to reduce CLA-BSIs by 50-66% as compared to patients whose central line barrier precautions included only sterile gloves and a small drape.[21,107]

A similar story is seen with the use of chlorhexidine gluconate (CHG) for catheter insertion site preparation. Numerous studies have shown a reduction in

rates of bloodstream infections with use of chlorhexidine as compared to alcohol or povidone iodine for skin preparation for central line insertion. Maki et al. showed that chlorhexidine gluconate skin preparation was associated with an odds ratio of developing infusion related bacteremia of 0.16 as compared to alcohol or povidone iodine.[108] A meta-analysis of studies comparing chlorhexidine gluconate and povidone iodine for central line insertion skin preparation suggested that overall chlorhexidine gluconate reduced the rate of catheter-related bloodstream infection by 49%.[109]

- **Improvability**

Despite the fact that there is substantial evidence and guidelines supporting the use of maximal sterile barriers for central line insertion, most studies show that these practices are not utilized consistently. A recent study of 516 hospitals showed that in non-VA hospitals maximal sterile barriers were used only 71% of the time and in VA hospitals this practice was used 84% of the time.[110] Other studies have shown even less compliance (44%) indicating that this may be an area for potential intervention.[17] Similarly, rates of compliance with chlorhexidine use during central line insertion varies from 69% to 91% at different institutions.[110] In addition, rates of compliance with more than one recommendation concurrently (i.e., using both maximal sterile barriers and chlorhexidine skin prep in patients undergoing central line insertion) are even further reduced.

- **Inclusiveness**

This process is applicable to all types of patients.

- **Frequency**

Central line insertion is a frequent practice.

- **Feasibility**

Current methods for data collection on central line insertion practices are not well standardized and may vary from institution to institution. Some of the data may require manual data collection and some data may not be available in the medical record. Some institutions that have implemented central line bundles have hired a separate observer to ensure that the bundles are being completed appropriately and that the data obtained are accurate.

- **Functionality**

No risk adjustment is necessary and a clear goal of 100% compliance exists. This process is easily compared among institutions. On the other hand,

this process measure may not be as meaningful, particularly to patients, as compared to some of the outcome measures.

### Measures

**Numerator:** Number of central line insertions in which the central line bundle was used
**Denominator:** Number of central line insertions
**Risk adjustment:** None necessary

### Data Source

Medical record

## SURGICAL ANTIMICROBIAL PROPHYLAXIS (AMP)

### Criteria and Review of the Literature

- **Impact**

As discussed above, surgical site infections are serious infections that result in increased morbidity, mortality and cost. The history of surgical antimicrobial prophylaxis extends back to the early 1960s when antimicrobials were shown to reduce signs of infection in experimental incisions contaminated with *Staphylococcus aureus*. Subsequently, multiple randomized controlled trials in various types of surgeries have shown that surgical site infection rates were lowest when antibiotics were administered, particularly when they were administered as temporally close to the incision time as possible.[111-116] The goal of surgical antimicrobial prophylaxis is to obtain serum and tissue antibiotic levels for the duration of the operation that are adequate to kill organisms likely to be encountered during the procedure. In addition, AMP should not lead to increased SSIs due to antimicrobial resistance. Surgical prophylaxis extended beyond 24 hours following the end of surgery has been associated with an increased risk of antimicrobial resistant SSIs. The CDC Surgical Site Prevention Guidelines recommend administration of prophylactic antimicrobials only when indicated, and that selection should be based on antimicrobial efficacy against the pathogens most likely to cause an infection for that specific operation. In addition, AMP should be administered intravenously and timed so that a bactericidal concentration of the drug is established in serum and tissue when the incision is made until, at most, a few hours after the incision is closed.[28] HICPAC guidelines on mandatory public reporting of HAIs as well as the Surgical Care Improvement Project (formerly the National Surgical Infection Prevention Project) recommend three process measures regarding surgical antimicrobial prophylaxis as part of mandatory public reporting. These three measures are: (1) the number of surgical patients who received AMP within one hour prior to surgical incision (or two hours for Vancomycin or fluoroquinolones); (2) the number of surgical patients who received a prophylactic antimicrobial agent that is consistent with currently published guidelines; and (3) the proportion of

patients whose prophylactic antimicrobial therapy is discontinued within 24 hours after the end of surgery.[117]

- **Improvability**

In 2002, the Centers for Medicare and Medicaid Services and the CDC initiated the Surgical Infection Prevention Project (now referred to as the Surgical Care Improvement Program) with the goal of decreasing morbidity and mortality from surgical site infections. Baseline results from this program showed that only 56% of patients received perioperative antibiotics within one hour prior to incision, 93% of patients received antimicrobials consistent with published guidelines and only 41% of patients' antibiotics were discontinued within 24 hours of surgery.[30] These results and similar studies indicate that there is substantial room for improvement in the area of surgical antimicrobial prophylaxis.

- **Inclusiveness**

This process is applicable to all types of patients.

- **Frequency**

Administration of surgical antimicrobial prophylaxis is a frequent event

- **Feasibility**

Some manual data collection may be required, which makes the process labor intensive. However, the measures are clearly defined and guidelines for appropriate use of antimicrobials exist. All Maryland hospitals are currently reporting the SCIP 1-3 measures to the Commission for hip, knee, and colon surgery.

- **Functionality**

No risk adjustment is necessary and a clear goal of 100% compliance exists. This process is easily compared among institutions. This process measure may not be as meaningful, particularly to patients, as compared to some of the outcome measures.

**Measures –** 3 measures expressed as a percentage

**Numerator:** Number of surgical patients undergoing operations that require antimicrobial prophylaxis who: (1) receive AMP within one hour prior to incision or two hours if receiving vancomycin or fluoroquinolone; (2) receive AMP recommended for their surgical procedure; and (3) whose

prophylactic antibiotics were discontinued within 24 hours after the end of surgery (closure of incision).

**Denominator:** Total number of surgical patients with primary surgical procedures

**Risk Stratification:** None necessary

### Data Source

Medical record and administrative data

## SURGICAL PATIENTS WITH APPROPRIATE HAIR REMOVAL

### Criteria and Review of the Literature

- **Impact**

Traditionally, hair removal around the intended surgical incision site has been a routine component of preoperative care. Methods of hair removal include shaving with a razor, shaving with clippers and using a depilatory cream. A recent Cochran review evaluated the connection between preoperative hair removal and subsequent surgical site infections. This review showed that there was no difference between no hair removal and hair removal via clippers or depilatory cream on the development of subsequent SSI. Significant differences were seen, however, in rates of SSI in patients shaved with a razor as compared to those who had hair removal done with clippers or a depilatory cream. Patients shaved with a razor were 2 times and 1.5 times more likely to develop a SSI compared to those who had hair removal with clippers or depilatory cream, respectively.[118] These results concur with the CDC guidelines on the prevention of surgical site infection which recommend removing hair preoperatively only when necessary and if hair removal is required, clippers are the preferred method of hair removal.

- **Improvability**

Few studies have been done on compliance with clipping or no hair removal versus shaving with a razor prior to surgical procedures. In general, however, the practice of using a razor is still common in many institutions indicating a substantial opportunity for improvement exists.

- **Inclusiveness**

This process is applicable to all types of patients.

- **Frequency**

Hair removal prior to surgery is a frequent event.

- **Feasibility**

Some manual data collection may be required which makes the process labor intensive but otherwise the measure is clearly defined and guidelines supporting this practice exist.

- **Functionality**

No risk adjustment is necessary and a clear goal of 100% compliance exists. This process is easily compared among institutions. This process measure may not be as meaningful, particularly to patients, compared to some of the outcome measures.

**Measures –** expressed as a percentage

**Numerator:** Number of surgery patients with surgical site hair removal done with clippers or no surgical site hair removal

**Denominator:** Number of selected surgical patients

**Risk Stratification:** None necessary

**Data Source**

Medical record

## VENTILATOR-ASSOCIATED PNEUMONIA (VAP) BUNDLE

### Criteria and Review of the Literature

- **Impact**

See impact section on ventilator-associated pneumonia.

- **Improvability**

Many interventions such as those included in IHI's "VAP" bundle and those in the CDC guidelines for the prevention of healthcare-associated pneumonia have been reported to reduce the incidence of VAP, but their implementation is variable, and not always sustained. There is potential for producing significant improvement in quality of patient care by effectively using such strategies.[119]

- **Inclusiveness**

This measure impacts all ventilated patients and has the potential to impact a broad variety of people.

- **Frequency**

This measure applies to all ventilated patients and as such will be a frequent intervention.

- **Feasibility**

Some manual data collection may be required which makes the process labor intensive but otherwise the measure is clearly defined.

- **Functionality**

No risk adjustment is necessary and a clear goal of 100% compliance exists. This process is easily compared among institutions. This process measure may not be as meaningful, particularly to patients, as compared to some of the outcome measures.

### Measures

**Numerator:** Number of intensive care unit patients on mechanical ventilation at the time of the survey for whom all four elements of the ventilator bundle are documented and in place. The ventilator bundle elements include: head of bed elevation 30 degrees or greater; daily sedation vacation and daily assessment of readiness to extubate; peptic ulcer disease prophylaxis; and deep venous thrombosis prophylaxis.

**Denominator:** Number of patients on mechanical ventilation

**Risk Adjustment:** None necessary

### Data Source

Medical Record

## COMPLIANCE WITH ACTIVE SURVEILLANCE TESTING FOR MRSA IN ALL ICUS

### Criteria and Review of the Literature

- **Impact**

Increasingly, both the lay public and the medical community have recognized the importance of addressing the issue of detection and prevention of antimicrobial resistant pathogens, in particular MRSA, in hospitals. In the past, the majority of *Staphylococcus aureus* isolates have been methicillin sensitive (sensitive to penicillin related antibiotics), however, over the past several decades with the development of increasing amounts of antibiotic resistance, rates of methicillin resistant *Staphylococcus aureus* (MRSA) have been rapidly rising.

MRSA is a bacteria which can cause both colonization (the organism can be cultured from a site but does not invade tissues or cause infection) and significant infectious complications in susceptible hosts. The anterior nares, throat, skin lesions and perineum have all been shown to be sites of colonization for MRSA. Detection of those patients who are colonized with MRSA is thought to be important because a significant number of colonized individuals (approximately 10-30%) will go on to develop an MRSA infection.[120-121] Patients infected with MRSA, as compared to patients infected with methicillin sensitive *Staphylococcus aureus* (MSSA), have longer hospital stays, increased hospital costs and worse clinical outcomes.[71, 122] Beyond the impact on the individual patient, however, colonized patients are thought to serve as a reservoir for transmission of MRSA to other patients in the health care setting.

Active surveillance testing (AST) for MRSA (i.e., performing nasal swab cultures for MRSA in patients on admission and at some regular interval thereafter to detect colonization) has been advocated by some as a method to reduce the risk of dissemination of MRSA and other multi-drug resistant organisms. Patients found to be colonized with MRSA could be offered treatment and contact precautions initiated (i.e., a patient found to be colonized with MRSA would be placed in a private room or cohorted with other patients known to be colonized or infected with MRSA and HCWs use clean gowns and gloves during contact with the patient or the patient's environment) in an attempt to limit the spread of MRSA within institutions.

The actual impact of active surveillance, however, has been difficult to determine because this intervention often takes place in conjunction with multiple other simultaneous control measures. A 2004 systematic review of the literature on the use of isolation precautions to reduce healthcare associated MRSA transmission concluded that efforts that include AST and isolation precautions can help reduce MRSA even in endemic settings, however, pointed out that the available studies on this topic were limited by plausible alternative explanations and inadequate reporting.[123] Several studies have failed to show a reduction in MRSA rates despite the institution of AST.[124-125] The majority of studies, however, support AST as a method of reducing colonization and infection with antibiotic resistant organisms, particularly in high risk populations. Most experts would agree that AST clearly can help reduce the spread of MRSA when in the midst of an outbreak situation and in high risk populations.[126-128] Fewer studies, however, have evaluated the use of routine surveillance culturing "house-wide" in controlling endemic MRSA. Studies that are available often focus on high risk populations such as ICU or immunosuppressed patients. Huang et al. showed that institution of a routine program of active surveillance cultures and subsequent contact precautions led to a 75% reduction in MRSA bacteremia in ICUs and a 40% reduction in non-ICU settings.[129] Several other studies have similarly showed reduction in MRSA infections with the institution of AST.[130-131] Use of AST also has been shown to be cost effective in outbreak and high risk settings.[132]

Given the recent debate in the literature and proposed legislation mandating in states such as Illinois and Maryland, CDC/HICPAC and groups such as SHEA and APIC have released recommendations with regards to AST. In HICPAC's 2006 *Management of Multidrug-Resistant Organisms in the Healthcare Setting*, the CDC recommends further research to "determine the circumstances under which AST are most beneficial, but their use should be considered in some settings, especially if other control measures have been ineffective." Active surveillance for targeted MDROs in high risk populations, such as ICUs, is a category 1B recommendation. [133] Similarly, the 2003 Society for Healthcare Epidemiology of America guidelines for preventing nosocomial transmission of MRSA and VRE included recommendations that all hospitals perform AST for MRSA among high risk and high prevalence populations.[134] In general, although studies are available that support the use of AST, particularly in ICU or high risk settings, additional research will be required to fully determine the role of AST in preventing and controlling MRSA in more extensive hospital settings.

- **Improvability**

A 2005 survey of 463 infectious disease specialists across the United States showed that only 30% worked in hospitals where AST was routine. In contrast to that data, however, a recent survey by the Maryland Health Care Commission showed that 32 out of 47 hospitals in the State of Maryland are in the process of developing or already have a program in place to perform AST for MRSA. That survey also indicated that 89% of Maryland hospitals keep a database of patients who are known to be colonized or infected with MDROs. Although, a majority of institutions are already performing AST, improvement is still possible. In addition, even in institutions where AST is in place, nursing compliance with performing the cultures on admission is variable. No significant studies on improving compliance with AST have been completed to date.

- **Inclusiveness**

AST for ICU patients would involve patients of all genders, ages, races and socioeconomic strata.

- **Frequency**

AST of all ICU patients is a frequent process.

- **Feasibility**

The feasibility of implementing AST in ICUs across the State of Maryland is steadily increasing. Although the SHEA/APIC Position Paper on legislation of AST points out numerous concerns associated with the widespread institution of AST (i.e., AST for all patients admitted to the hospital) including the impact on infection prevention and control professional's workload and program resources,

loss of flexibility to respond to infection prevention and control issues by hospital epidemiologists and infection prevention and control specialists, the need for valid data, additional burden on the lab, and the additional institutional burden necessitated by an increased number of patients identified through AST that will require contact precautions, both organizations do support the use of AST in specific high-risk or ICU populations as necessary.[132] Although AST may well be an important tool in the prevention of HAIs due to MRSA, institutions must not lose sight of the importance of other interventions such as hand hygiene and contact precautions. The goal of AST is to identify patients who could potentially transmit MRSA in the hospital setting and place those patients on contact precautions. If health care workers are not compliant with contact precautions, the utility of AST remains unclear. Current estimates of compliance with contact precautions is <30% in most studies.[82] These issues will need to be monitored closely as AST for MRSA becomes more prevalent.

- **Functionality**

Compliance with AST as a process measure is something that is easy to measure and no risk adjustment is necessary. The goal of 100% of ICU patients receiving an admission anterior nares culture for MRSA is clear. Issues surrounding MRSA have clearly been increasingly recognized by health care professionals, patient advocacy groups and the general public. The extent to which all consumers understand the implications and even the definition of AST, however, remains unclear.

### Measures

**Numerator:** Number of patients admitted to any ICU who had an anterior nares swab cultured for MRSA on admission (If the patient is known to be previously positive, a repeat screen is at the discretion of the facility)

**Denominator:** Number of patients admitted to any ICU

* Note: This report does not dictate what the hospital is to do while awaiting screening results and the facility should follow the protocols and policies of their institution as well as CDC guidelines for MDROs.

### Data Source

Medical Record.

## HAND HYGIENE (HH) COMPLIANCE

### Criteria and Review of the Literature

- **Impact**

The history of the impact of hand hygiene dates back to the mid 1800's when Semmelweis showed a reduction in the rates of puerperal sepsis after promoting handwashing in a Vienna hospital. Since that time a number of studies have shown reduction in infection rates both in the hospital and in community settings across the world with institution and propagation of aggressive hand washing campaigns. Multiple studies have shown that health care workers can contaminate their hands with healthcare-associated pathogens.[135-136] Health care worker hands are commonly considered to be the most common source of transmission of MDROs from patient to patient and appropriate hand hygiene interrupts this cycle. Multiple studies have shown that hand antisepsis reduces rates of HAIs.[137-139] Several studies also have evaluated the cost-effectiveness of aggressive hand hygiene programs and found that even if hand hygiene prevents four or five HAIs over the course of the year, the program will be cost effective.[140-141]

The Maryland Department of Health and Mental Hygiene (DHMH) has recognized the importance of infection prevention and control programs and in particular, hand hygiene, in the battle against HAIs. The DHMH recently released a draft document for public comment regarding the adoption of infection control licensing requirements for Maryland hospitals. This includes requirements for hospitals to educate staff on appropriate HH before and after all patient contact, monitor HH compliance, to make supplies necessary to perform HH accessible in all patient care areas, and to monitor and document health care worker HH compliance.

- **Improvability**

Multiple studies have documented poor compliance with hand hygiene among health care workers with rates ranging from 5% to 81%.[142] Barriers to compliance include skin irritation caused by hand hygiene products, inaccessible hand hygiene supplies, lack of time, wearing gloves and interference with patient care. Alcohol based hand rubs have helped to ameliorate some of the access and irritation issues yet compliance with hand hygiene remains low. Despite aggressive HH campaigns in many institutions, health care workers may not understand or accept the importance of good HH.

Interventions that have been shown to be successful in increasing rates of compliance with HH include aggressive education campaigns, individual reinforcement, buy-in by administration, and making HH supplies as accessible as possible (i.e., sinks or alcohol based hand rubs available at every room). In most instances, a multi-modal approach is necessary to bring about change in health

care worker behavior. HH is considered to be a highly important issue by the CDC, World Health Organization, APIC, SHEA and infection prevention and control specialists throughout the world. The CDC released a set of evidence based guidelines in 2002 which thoroughly address this issue.[142]

- **Inclusiveness**

HH, perhaps more than any other intervention, truly impacts every individual who is admitted to the hospital.

- **Frequency**

HH is a very frequent event, however, the capability of the institution to perform routine monitoring of adherence to hand hygiene is highly variable and dependent on infection prevention and control staff and auditors. Often estimates of HH compliance are based on a limited number of observations.

- **Feasibility**

Although hand hygiene is clearly an essential part of patient care, the feasibility of using this process measure for public reporting is limited. Significant difficulties exist with regard to collecting data on hand hygiene. Frequently nurses and physicians are aware of the presence of infection prevention and control professionals. This simple awareness of an observer can result in behavior change and improved adherence to hand hygiene protocols that may not occur in other circumstances. To obtain true and accurate rates of compliance with hand hygiene, infection prevention and control departments frequently have to recruit "stealth" observers who are not known to be associated with the infection prevention and control department. Also, without following directly behind a health care worker into a patient room, it is often difficult to truly know whether that individual performed HH before and after patient contact. Frequently, alcohol hand gel and sinks are available within the room and hand hygiene may not be observed despite the fact that the health care worker actually performed adequate HH. In addition, there is no standard measurement between institutions and significant inter-observer variability may exist making it very difficult to compare rates of HH compliance between institutions.

- **Functionality**

HH is not a functional measure to use for public reporting of HAIs. As mentioned above, auditing of HH performance is different from institution to institution and dependent on the layout of the hospital and staff available to do the auditing. Difficulty in comparing this process measure between institutions would be significant.

### Measures

Measures of hand hygiene vary widely

### Data Source

Audit data

## HAI Data Collection System Options

Planning the development of an HAI data system requires consideration of the appropriate mechanism for identifying and collecting data on HAI cases. State HAI systems implemented to date have generally used one of three models to support data collection: (1) hospital administrative data bases; (2) State-sponsored data collection software; and (3) NHSN. The Technical Advisory Committee had briefings from states using each of these models.

### Use of Hospital Administrative Data Bases

According to the National Association of Health Data Organizations, 48 states have reporting systems for hospital discharge data. [143] As a result, hospital discharge data systems are a potential source of information regarding HAIs. Florida currently collects and reports information on rates of postoperative sepsis and infections due to medical care as defined by the Agency for Healthcare Research and Quality (AHRQ) using hospital discharge data. Postoperative sepsis is defined as the number of cases of sepsis per 1,000 elective surgery patients with an operating room procedure and a length of stay of 4 days or more. Patients with infections due to medical care are defined by surgical or medical discharges with International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes for Selected Infections due to Medical Care in any secondary diagnosis field.

Advantages to using administrative data are that the information is fairly easily accessible and the system for public reporting can be fairly rapidly designed and implemented. On the other hand, using administrative data may not accurately identify HAIs (low positive predictive value). [144]

### State-Sponsored Data Collection Software

Missouri developed its own data collection software called the Missouri Infection Reporting System (MIHRS) as part of its public HAI reporting initiative. Reporting for central line-associated bloodstream infections began on July 1, 2005 and included intensive care units. Reporting for surgical site infections began on January 1, 2006 and includes abdominal hysterectomy, hip arthroplasty (total, partial and revision), and coronary artery bypass graft surgeries in hospitals. Ambulatory surgical centers are reporting cases involving breast surgery and herniorrhaphy.

Like the NHSN system, MIHRS is an on-line, secure data collection tool. All data are uploaded on daily basis into a data warehouse where it can be reviewed at any time. Prior to publication, hospitals are offered an opportunity view the data on the website and provide comments that automatically go on the public reporting site. By offering hospitals a chance to preview the information before the public, Missouri is providing another validation measure to make certain that the information is correct.

In Missouri, the development of the software was funded by general revenue and there was a fiscal note attached to the law. The development work was performed with in-house information technology staff. About 80 hospitals and 25 ambulatory surgery centers report to MIHRS. Missouri has about 10-11 staff working on the project, however, time has been donated by other projects. Missouri is exploring making its software available to other states. [145]

Advantages of the Missouri system are that it is well-planned and allows for flexibility within institutions. Institutions can choose to use NHSN or MHIRS to report their HAI data. Disadvantages to the approach of developing a state data collection software application to support an HAI reporting system include the initial development costs and on-going expense of maintaining the system.

**National Healthcare Safety Network (NHSN)**

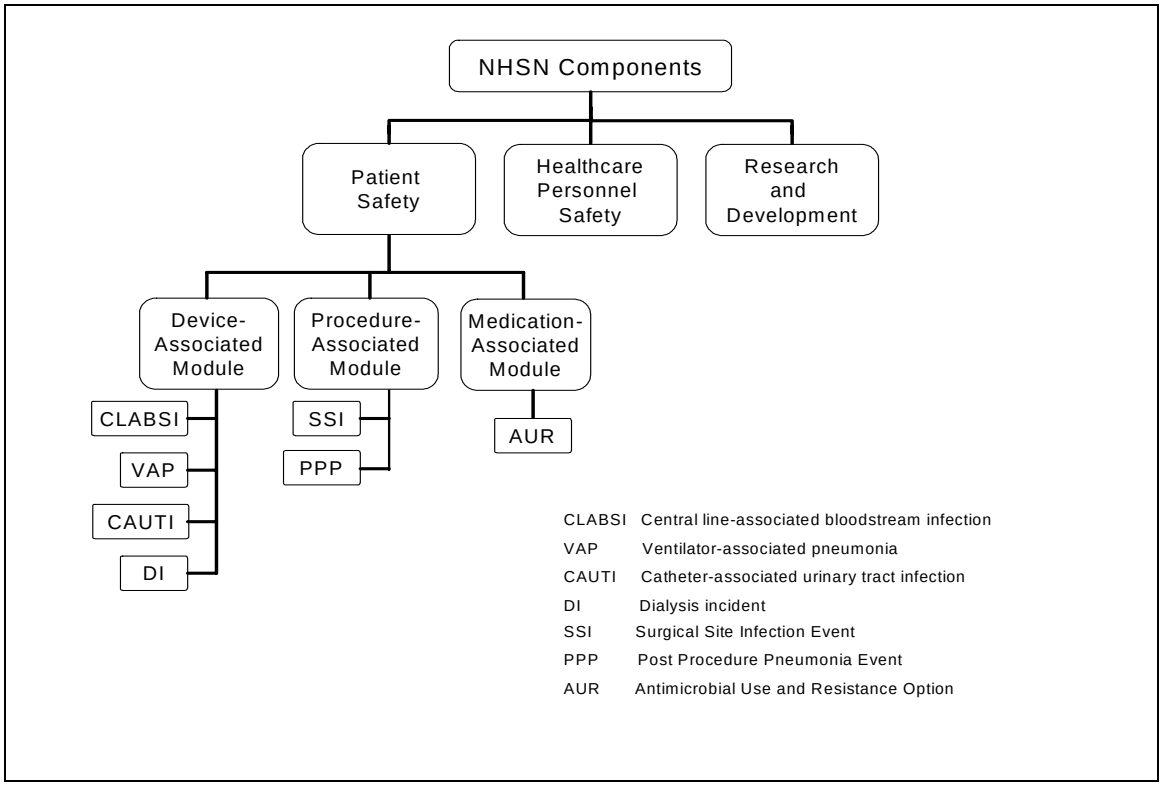
NHSN is a voluntary, internet-based surveillance system with components addressing patient and health care personnel safety. The system is managed by the Division of Healthcare Quality Promotion (DHQP) at CDC. According to CDC, the purposes of NHSN are to:

- Collect data from a sample of healthcare facilities in the United States to permit valid estimation of the magnitude of adverse events among patients and healthcare personnel.
- Collect data from a sample of healthcare facilities in the United States to permit valid estimation of the adherence to practices known to be associated with prevention of healthcare-associated infections (HAI).
- Analyze and report collected data to permit recognition of trends.
- Provide facilities with risk-adjusted data that can be used for interfacility comparisons and local quality improvement activities.
- Assist facilities in developing surveillance and analysis methods that permit timely recognition of patient and healthcare personnel safety problems and prompt intervention with appropriate measures.
- Conduct collaborative research studies with NHSN member facilities (e.g., describe the epidemiology of emerging HAI and pathogens, assess the importance of potential risk factors, further characterize HAI pathogens and their mechanisms of resistance, and evaluate alternative surveillance and prevention strategies).[146]

As shown in Figure 4, there are three modules within the NHSN patient safety component: (1) device-associated, (2) procedure-associated, and (3) medication-

associated. Within the device-associated module are central line-associated blood stream infections (CLA-BSI), ventilator-associated pneumonia (VAP), catheter-associated urinary tract infection (CA-UTI), and dialysis incident. The procedure module currently includes surgical site infections and post-procedure pneumonia events.

**Figure 4**
**National Healthcare Safety Network Components**




NHSN has a module under development for collection of health care worker influenza vaccination data. Additionally, modules will be available in the future through the Patient Safety Component that focus on multidrug resistant organisms, central line insertion practices, and high-risk patient influenza vaccination. [146, 147]

The NHSN system replaced the National Nosocomial Infections Surveillance System (NNIS), an ongoing collaborative surveillance system also sponsored by the CDC to obtain national data on nosocomial infections. After opening NHSN enrollment to a limited number of facilities in 2005, CDC initiated a national open enrollment for hospitals and outpatient hemodialysis centers in 2007. As of October 1, 2007, NHSN reported that there were about 700 reporting facilities. [148]

The Patient Safety Component of NHSN allows entry of event and denominator data for both device-associated and procedure-associated events. The system has detailed definitions and reporting protocols. The data analysis features of NHSN range from rate

tables and graphs to statistical analysis that compares the healthcare facility's rates with national performance measures. There is no charge for participation in the NHSN.

There are thirteen states currently using NHSN to support mandatory public reporting (Table 12). Under NHSN, health care facilities can use a feature of the application that permits a facility to designate a group and authorize access to their data. This function has been used to have all health care facilities within a state to join the group and confer rights to the state or other authorized entity to view data and analyze reports. [149]

**Table 12**
**States Using NHSN for Mandatory Public Reporting of HAI: November 2007**

| | |
|---|---|
| California | New York |
| Connecticut | South Carolina |
| Colorado | Tennessee |
| Delaware | Vermont |
| Oklahoma | Virginia |
| Pennsylvania | Washington |
| Massachusetts | |

Source: Communication from Monina Klevens, DDS, MPH, CAPT., USPHS, Healthcare Outcomes Branch, Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, November 9, 2007.

An advantage of using the NHSN system is that it allows comparisons not only to hospitals within the state, but also to hospitals throughout the country. NHSN definitions are considered the gold standard currently. In addition, as soon as the data are entered, that information can be used by the hospital for infection surveillance, monitoring, and feedback. These considerations, coupled with the fact that 11 Maryland hospitals already have enrolled in the NHSN system, support its use in collecting data for the public reporting of HAI data in Maryland.

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## VI. DEVELOPING A SYSTEM FOR COLLECTING AND PUBLICLY REPORTING DATA ON HEALTHCARE-ASSOCIATED INFECTIONS IN MARYLAND: RECOMMENDATIONS

Based on the Technical Advisory Committee's discussion, expert advice, and review of the medical literature, the following recommendations are made with regard to public reporting of data on healthcare-associated infections (HAIs) in the State of Maryland.

### *HAI Process and Outcome Measures for Public Reporting*

**Recommendation 1. The Technical Advisory Committee recommends that public reporting of data on healthcare-associated infections be initiated with the following three measures: Central Line-Associated Bloodstream Infections (CLA-BSIs) in All Intensive Care Units (ICUs), Health Care Worker (HCW) Influenza Vaccination, and Compliance with Active Surveillance Testing (AST) for MRSA in All ICUs. The implementation plan for public reporting should include provisions for:**

- **An opportunity for hospitals to preview the first two quarters of data prior to releasing the data publicly;**
- **The development of an appropriate risk-adjustment methodology for outcome measures that require adjustment for patient-specific factors associated with increased risk of infection; and**
- **Periodic reevaluation and reassessment of Maryland's HAI public reporting process with opportunities to alter recommended measures/methods of reporting if new data become available or significant difficulties with regard to implementation arise.**

Based on the six criteria for public reporting of HAIs defined in this report, CLA-BSIs were the outcome measure that ranked the highest. This measure is clearly important and results in significant morbidity and mortality for patients. CLA-BSIs were recommended as the initial HAI outcome measure to report publicly in Maryland for two reasons. First, as compared with other HAI outcome measures such as ventilator-associated pneumonia or catheter-associated urinary tract infections, well-established definitions and reporting protocols for CLA-BSIs exist. Second, as the results of the Commission's survey indicate, all hospitals in Maryland are collecting data on rates of CLA-BSIs in the ICU setting. For both of these reasons, this measure was thought to be the least burdensome HAI outcome measure for hospitals to collect and report.

In addition to reporting rates of CLA-BSIs, two additional process measures, Health Care Worker Influenza Vaccination and Compliance with Active Surveillance Testing for MRSA in ICUs, were also chosen for early implementation. These two processes were ranked highly by the Committee and experts in the field of infection prevention and control, are easily comparable between institutions, and implementation of these processes has the potential to reduce rates of HAIs. These two process measures also address HAIs and populations not covered by CLA-BSIs.

Although compliance with the Central Line Bundle was ranked more highly than these two process measures, the outcome associated with the bundle (i.e., CLA-BSI rates) is already recommended for inclusion and, as such, the Technical Advisory Committee thought public

reporting of process measures which pertain to other HAIs (i.e., Compliance with Active Surveillance Testing for MRSA in ICUs) and other populations (i.e., HCW Influenza Vaccination) would better use both institutional and state resources. In particular, given the escalating problem with MRSA in hospitals across Maryland and an accumulating body of evidence that active surveillance may help reduce nosocomial acquisition of and infection with MRSA, Compliance with Active Surveillance Testing for MRSA in ICUs was selected by the Committee for early inclusion despite ranking lower than some of the other process measures.

> **Recommendation 2. The Technical Advisory Committee recommends that the second phase of the public reporting system add further HAI outcome and process measures including, but not limited to, select Class I and II deep and organ space Surgical Site Infections (SSIs) and Ventilator-Associated Pneumonia (VAP) Bundle Compliance.**

The importance of monitoring SSIs is clearly recognized by the Technical Advisory Committee. Because SSIs were ranked second only to CLA-BSIs in terms of the six criteria, they were chosen as the second outcome measure to be implemented in Maryland. To facilitate public reporting of SSI rates, surgical procedures performed frequently by hospitals in Maryland chosen for SSI reporting include total hip/knee replacements, coronary artery bypass graft (CABG), and total abdominal hysterectomy.

For the second phase of implementation of public reporting of HAIs in Maryland, an additional process measure was chosen that is also ranked highly and that addresses HAIs not covered by the previously implemented measures. Although controversy over diagnosing and reporting VAP rates exists, VAP bundle compliance, a process that has been shown to help reduce rates of VAP within institutions, was selected as a proxy measure. The key components of the VAP bundle are elevation of the head of the bed, daily "sedation vacations" and assessment of readiness to extubate, peptic ulcer disease prophylaxis and deep venous thrombosis prophylaxis. Three reasons for VAP inclusion are: compliance with the VAP bundle is a clearly defined process measure; rates of compliance are easily comparable between institutions; and, components of the VAP bundle are also Surgical Care Improvement Project Process measures familiar to hospitals.

> **Recommendation 3. The Technical Advisory Committee recommends that the collection and reporting of the Surgical Care Improvement Project (SCIP) measures relating to HAIs be continued and expanded to include additional surgeries defined by the SCIP strata and additional process measures not currently being reported by Maryland hospitals. Reporting for SCIP-Infection Measures 1-3 regarding surgical antimicrobial prophylaxis are currently only being reported on the Maryland Hospital Performance Evaluation Guide for hip, knee and colon surgeries. The Technical Advisory Committee recommends expanding these measures to include the other SCIP strata (i.e., hysterectomy, CABG, other cardiac surgery and vascular surgery). The remaining SCIP measures related to HAIs, but not currently being reported in Maryland should be implemented (i.e., SCIP-Inf 4 and 6 relating to cardiac surgery patients with controlled 6 a.m. postoperative blood glucose and surgery patients with appropriate hair removal). SCIP-Inf 7, colorectal surgery patients with immediate postoperative normothermia, should be added if endorsed by the National Quality Forum.**

Rates of compliance with SCIP-Inf measures 1-3 regarding prophylactic antibiotics being received within one hour prior to surgical incision, appropriate antibiotic selection for surgical patients and prophylactic antibiotics being discontinued within 24 hours after surgery end time are currently being collected and publicly reported on the Maryland Hospital Performance Evaluation Guide for hip, knee, and colon surgeries. These measures were ranked very highly by the Technical Advisory Committee and other experts in the field of hospital epidemiology and infection prevention and control, and should continue to be reported as public reporting of other HAI measures progresses. Consistent with the recommendations of the Hospital Quality Alliance and the Centers for Medicare and Medicaid Services, the SCIP-Inf 1-3 measures should be collected and reported for all SCIP surgical strata. In addition to the SCIP measures already being reported, the Committee recommends expansion to include SCIP-Inf 4 and 6 measures, which are cardiac surgery patients with controlled 6 a.m. postoperative blood glucose and compliance with appropriate hair removal prior to surgery, respectively.

### *Data Collection and Reporting System*

**Recommendation 4. The Technical Advisory Committee recommends that the National Healthcare Safety Network (NHSN) be the vehicle for collecting data on CLA-BSI, HCW Influenza Vaccination, Surgical Site Infections, and future HAI process and outcome measures as appropriate, and that hospitals receive training in the NHSN system. Appropriately trained and certified infection control professionals, when eligible, should be designated to perform surveillance involved in the documentation of HAIs to ensure infections are identified similarly among institutions.**

NHSN is a secure, internet-based system that builds on surveillance standards and definitions establish by the CDC. NHSN currently has modules for reporting CLA-BSI and SSI events. A module for reporting HCW Influenza Vaccination will become available later this year. For measures not currently included in NHSN (e.g., Compliance with Active Surveillance Testing for MRSA in ICUs), the Maryland Health Care Commission will be required to develop a collection mechanism that can be used by Maryland hospitals.

The Technical Advisory Committee recommends that all acute care hospitals in the State of Maryland be required to join the NHSN user group for the State of Maryland and use this system as the primary vehicle for collecting data to be publicly reported on HAIs. As part of the NHSN training process, the Committee also recommends that the Maryland Health Care Commission arrange NHSN educational meetings to aid hospitals in the process of joining and using the NHSN system.

**Recommendation 5. The Technical Advisory Committee recommends the development of strategies for validating publicly reported HAI measures.**

To ensure that institutions are accurately reporting rates of infections and compliance with process measures, and that those institutions are using the same definitions, a method of validating and auditing data must be determined.

### *Implementing Public Reporting of HAI Data*

**<u>Recommendation 6</u>. The Technical Advisory Committee recommends that the Maryland Health Care Commission establish a permanent standing HAI Advisory Committee. This standing Advisory Committee should consist of representatives from acute care hospitals, long term care facilities, ambulatory surgery centers, freestanding hemodialysis centers, SHEA and APIC. The committee should consist of at least one of each of the following: a hospital epidemiologist, an infection prevention and control professional, a public health specialist, a public health lawyer, a statistician, an ethicist, a quality improvement/patient safety expert, and a patient/health care consumer.**

The Technical Advisory Committee recognizes that the field of public reporting of healthcare-associated infection data is rapidly changing. To this end, the Committee recommends the development of a permanent HAI Advisory Committee which will meet regularly to provide guidance on the format and content of HAI data to be publicly reported on the Hospital Performance Evaluation Guide, review and revise, as appropriate, the process and outcome measures selected for public reporting, and reassess issues relating to public reporting of HAIs. The Advisory Committee will provide advice and recommendations to the Commission on the pilot period, auditing and validation of data, and the development of risk-adjustment methodologies.

**<u>Recommendation 7</u>. To focus attention on the importance of hand hygiene in reducing HAIs, the Technical Advisory Committee recommends the development of a state-wide hand hygiene campaign in conjunction with other recommendations in this Report.**

Hand hygiene is an essential component of any program to reduce HAIs and was ranked highly by Technical Advisory Committee as well as other experts in the field of hospital epidemiology and infection prevention and control on the basis of impact, improvability, inclusiveness, and frequency. The committee, however, recognizes the current difficulties in being able to accurately obtain rates of compliance with hand hygiene and comparing these rates between institutions. As hand hygiene in the current environment would be difficult to use for public reporting, the Technical Advisory Committee recommends that while investigation into more standardized methods to assess hand hygiene compliance is ongoing, the State of Maryland should consider development and implementation of a state-wide hand hygiene campaign focusing on both the healthcare community and the general public.

**<u>Recommendation 8.</u> The Technical Advisory Committee recommends the development of a research agenda that addresses the impact of public reporting, the development of appropriate risk adjustment methods, and the development of improved measures for VAP, Hand Hygiene, and Pediatric Respiratory Syncytial Virus (RSV).**

A number of questions regarding the impact of mandatory public reporting of HAIs remain unanswered at this time. Further research on whether public reporting of HAIs results in a reduction in HAI rates and prevents morbidity and mortality in Maryland citizens is necessary. Evaluation of how frequently the public accesses data on HAIs and whether accessing this information impacts consumer health care choices is also essential. In addition, more functional

issues such as whether mandatory public reporting affects antibiotic utilization and rates of antimicrobial resistance should also be addressed.

Clearly, additional resources will be necessary to implement and maintain a HAI public reporting system. Resources include, but are not limited to, infection prevention and control team time and effort, laboratory specialist time and equipment, data management/information technology costs, and resources required to validate data. These resources will need to be monitored in conjunction with patient outcomes to determine whether the additional costs are counterbalanced by improvements in HAI related morbidity and mortality.

Appropriate methods of risk-adjustment for a number of the outcome measures remain unclear. Risks for different types of infections vary by the type of patient, care provided and healthcare facility. Given that hospitals across the State of Maryland have different case mixes, appropriate methods of risk adjustment for the various outcome measures need to be developed and validated.

At present, methods of evaluating health care worker compliance with hand hygiene vary widely and as such rates of hand hygiene compliance are not comparable between institutions. Investigation into standardized methods of monitoring and auditing hand hygiene compliance is essential. Further review and investigation of Joint Commission, CDC and WHO recommendations on measuring HH compliance are also needed.

VAP, despite its importance, is not included in the measures for HAI public reporting in Maryland due to the difficulty in finding a clear, universal definition and in comparing rates between institutions. Investigation of issues such as use of semi-quantitative cultures or other measures to ensure consistency between institutions is needed. Currently, the VAP Bundle includes stress ulcer disease and DVT prophylaxis. Further research as to whether these measures truly are effective in preventing VAP is necessary.

Research to develop outcome measures for healthcare-associated viral infection relevant to pediatrics (i.e., RSV) is needed. In addition, determining the utility of reporting rates of outcomes such as CLA-BSIs specifically in this population are necessary. Research is also needed to identify appropriate uses for chlorhexidine gluconate in the less than two months of age population.

*Also of note is that the Advisory Committee on Immunization Practices is now recommending the combined Tetanus, diphtheria and pertussis (Tdap) vaccine for all health care workers. While this is a relatively new recommendation, pertussis is a growing problem in the State of Maryland and this vaccine could be considered an adjunct measure to HCW influenza vaccination and may be incorporated with this HCW influenza vaccination in the future. Further research is needed with regards to the utility of mandatory pertussis vaccination for healthcare workers.

**Maryland Health Care Commission**
4160 Patterson Avenue
Baltimore, MD 21215

Telephone: 410.764.3460
FAX: 410.358.1236
TDD: 1.800.735.2258
Toll Free: 1.877.245.1762
www.mhcc.maryland.gov