

HHS Action Plan to Prevent Healthcare-Associated Infections: APPENDICES

Appendix A

Metric Number and Label	Metric	Measurement System	National 5-Year Prevention Target
1. CLABSI 1	CLABSIs per 1,000 device days by ICU and other locations	NHSN Administrative discharge data ¹	CLABSIs per 1,000 device days by ICU and other locations below present NHSN 25 th percentile by location type (75% reduction in SIR)
2. CLABSI 2	Laboratory detected bacteremia per 1,000 patient days	ADT/lab System Data Streams	50% reduction in laboratory detected bacteremia per 1,000 patient days
3. CLABSI 3	CLABSIs per 100 patient months	NHSN Administrative discharge data	50% reduction in CLABSIs per 100 patient months
4. CLABSI 4	Central line bundle compliance (non-emergent insertions)	NHSN CLIP module	100% compliance with central line bundle (non-emergent insertions)
5. C diff 1	Case rate per patient days and administrative/discharge data for ICD9 coded Clostridium difficile Infections	NHSN MDRO module and Administrative discharge data	30% reduction in the case rate per patient days and administrative / discharge data for ICD9 coded Clostridium difficile Infections NOTE: Preventability of endemic CDI is unknown; therefore, the experts suggested that HHS revisit this target in 2 years as prevention research findings may become available
6. C diff 2	Contact precautions	NHSN MDRO module	100% compliance with contact precautions
7. C diff 3	Appropriate hand hygiene practices	NHSN MDRO module	100% compliance with appropriate hand hygiene practices
8. CAUTI 1	Rate of BSI secondary to UTI / 1,000 patient days	NHSN	50-75% reduction in the rate of BSI secondary to UTI / 1,000 patient days
9. CAUTI 2	# of symptomatic UTI / 1,000 urinary catheter days	NHSN	25% reduction in the number of symptomatic UTI / 1,000 urinary catheter days

¹ Any source that would provide nationally representative hospital discharge coding (i.e., ICD9 or, in the future, ICD10) data, including such sources as the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project, the CDC National Center for Health Statistics or National Hospital Discharge Survey, and those in the Centers for Medicare and Medicaid Services (CMS).

	[Number of UTIs (ICD9+not present on admission) / (# major surgery ICD9+ urinary catheter ICD9)]*100 discharges	Administrative discharge data	25% reduction in the [Number of UTIs (ICD9+not present on admission) / (# major surgery ICD9+ urinary catheter ICD9)]*100 discharges ²
10. CAUTI 3	(Urinary catheter days / patient days)*100	NHSN	50% reduction in (urinary catheter days / patient days)*100
11. MRSA 1	Incidence rate (number per 100,000 persons) of invasive MRSA infections	CDC EIP/ABCs	50% reduction in incidence rate of all healthcare-associated invasive MRSA infections
12. MRSA 2	Incidence rate (number per 1,000 patient days) of hospital-onset MRSA bacteremia (hospital wide)	NHSN (starting 2009)	50% reduction in incidence rate of hospital-onset MRSA bacteremia (hospital wide)
13. MRSA 3	Number of hospitalizations with non-present on admission MRSA bacteremia/pneumonia/sepsis Number of hospitalizations with non-present on admission MRSA not otherwise specified (NOS)/pneumonia/sepsis	NHDS Administrative discharge data	25% reduction in hospitalizations with non-present on admission MRSA not otherwise specified (NOS)/pneumonia/sepsis 90% of facilities with fewer “hospitalizations” with non-present on admission MRSA not otherwise specified (NOS)/pneumonia/sepsis than predicted (i.e. model prediction)
14. SSI 1	Deep incision and organ space infection rates using NHSN definitions (SCIP procedures)	NHSN	Median deep incision and organ space infection rate for each procedure/risk group will be at or below the current NHSN 25 th percentile
15. SSI 2	Adherence to SCIP/NQF infection process measures (perioperative antibiotics, hair removal, postoperative glucose control, normothermia)	CMS SCIP	95% adherence rates to each SCIP/NQF infection process measure
16. VAP 1	VAP rate, ventilator utilization (vent days), intermediate outcome – duration of ventilation	NHSN definitions	Track performance, no national target
17. VAP 2	VAP process bundle: Continuous assessment of head of bed elevation; Daily oral care and daily assessment of readiness to extubate and sedation levels	Direct local observation	100% compliance with each metric in the VAP process bundle within 2 years

² Zhan C, et.al. Medical Care (in press)

Appendix B

Metric Number and Label	Metric	Measurement System	National 5-Year Prevention Target	NQF Measures³	Compendium Measures⁴
1. CLABSI 1	CLABSIs per 1000 device days by ICU and other locations	CDC NHSN; Administrative discharge data⁵	CLABSIs per 1000 device days by ICU and other locations below present NHSN 25th percentile by location type (75% reduction in SIR)	CLABSI rate: CLABSI rate for ICU and high-risk nursery (NRN) patients	CLABSI rate
2. CLABSI 4	Central line bundle compliance (non-emergent insertions)	NHSN CLIP Module	100% compliance with central line bundle (non-emergent insertions)	Central line bundle compliance (hand hygiene; maximal barrier precautions upon insertion; Chlorhexidine skin antiseptics; Optimal catheter site selection; Daily review of line necessity with prompt removal of unnecessary lines.)	1. Compliance with CVC insertion guidelines as documented on an insertion checklist 2. Compliance with documentation of daily assessment regarding the need for continuing CVC access. 3. Compliance with cleaning of catheter hubs and injection ports before they are accessed. 4. Compliance with avoiding the femoral vein site for CVC insertion in adult patients.
3. C diff 1	Case rate per patient days; administrative/discharge data for ICD9 coded Clostridium	CDC NHSN MDRO module; Administrative discharge data	30% reduction in the case rate per patient days and administrative/discharge data for ICD9 coded		CDI rates should be calculated according to the recently published recommendations. (Rates for healthcare onset,

³ NQF Endorsed Measures for Healthcare-Associated Infections (<http://www.qualityforum.org/pdf/reports/HAI%20Report.pdf>)

⁴ SHEA/IDSA “Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals” (http://www.cdc.gov/ncidod/dhqp/HAI_shea_idsa.html)

⁵ Any source that would provide nationally representative hospital discharge coding (i.e., ICD9 or, in the future, ICD10) data, including such sources as the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project, the CDC National Center for Health Statistics or National Hospital Discharge Survey, and those in the Centers for Medicare and Medicaid Services (CMS).

	difficile Infections		Clostridium difficile Infections. NOTE: Preventability of endemic CDI is unknown; therefore, meeting attendee experts suggested that HHS revisit this target in 2 years as prevention research findings may become available.		healthcare facility associated; community onset, healthcare facility associated; community associated; indeterminate onset; unknown; and recurrent CDIs)
4. CAUTI 2	# of symptomatic UTI / 1000 urinary catheter days [Number of UTIs (ICD9+not present on admission) / (# major surgery ICD9+ urinary catheter ICD9)]*100 discharges	CDC NHSN Administrative Discharge data	25% reduction in the number of symptomatic UTI/1000 urinary catheter days 25% reduction in the [Number of UTIs (ICD9+not present on admission) / (# major surgery ICD9+urinary catheter ICD9)]*100 discharges ⁶	Catheter-associated urinary tract infection rate for intensive care unit patients.	Rates of symptomatic CAUTI, stratified by risk factors (age, sex, ward, indication, and catheter-days)
5. MRSA 1	Incidence rate (number per 100,000 persons) of invasive MRSA infections	CDC EIP/ABCs	50% reduction in incidence rate of all healthcare-associated invasive MRSA infections		Overall prevalence or prevalence density of MRSA colonization and/or infection
6. SSI 1	Deep incision and organ space infection rates using NHSN definitions (SCIP procedures)	CDC NHSN	Median deep incision and organ space infection rate for each procedure/risk group will be at or below the	Surgical site infection rate: Deep wound and organ space infections as a result of elective surgery to include	Surgical site infection rate

⁶ Zhan C, et.al. Medical Care (in press)

			current NHSN 25th percentile	coronary artery bypass graft (CABG) and cardiac surgery; hip or knee arthroplasty; colon surgery; hysterectomy (abdominal and vaginal); and vascular surgery.	
7. SSI 2	Adherence to SCIP/NQF infection process measures (perioperative antibiotics, hair removal, postoperative glucose control, normothermia)	CMS SCIP	95% adherence rates to each SCIP/NQF infection process measure.	Cardiac surgery patients with controlled postoperative serum glucose; Surgery patients with appropriate hair removal; Prophylactic antibiotics received; Prophylactic antibiotics selection; Prophylactic antibiotics discontinued	Compliance with Centers for Medicare and Medicaid Services antimicrobial prophylaxis guidelines.

Appendix C – Current HHS HAI-Related Research Responsibilities (AHRQ, CDC, CMS, and NIH)

	AHRQ	CDC	CMS	NIH
Basic Discovery		Biofilms, resistance mechanisms		Vaccines, biofilms, studies of pathogenesis (intramural and extramural)
Surveillance	At a population level, using hospital inpatient and outpatient administrative databases	National Healthcare Safety Network (NHSN), Active Bacterial Core Surveillance, new measure development and validation, e-surveillance, electronic medical record capture		Electronic healthcare epidemiology surveillance system currently being installed at the NIH/Clinical Center
Epidemiology	Population-based epidemiologic studies (longitudinal trends, population risk associations)	Outbreak response, molecular epidemiology, other epidemiologic studies (burden estimates, risk factors, etc.)		Intramural studies in a unique clinical research hospital setting
Etiology		Identification of emerging pathogens through surveillance and outbreak response		Funding for clinical studies, basic studies characterizing new and/or emerging pathogens
Prevention Efficacy/Effectiveness		Prevention demonstration projects, intervention studies, investigation of novel/innovative prevention strategies		Proof of principle studies (intramural), comparative trials (extramural)
Prevention Implementation	Within organizations, systems of care, institutions, primary care networks	Prevention demonstration projects, prevention collaboratives, behavioral epidemiology, education, promotion	Through quality reporting, payment incentives, and special Quality Improvement Organization (QIO) programs	Clinical studies, including comparative trials (intramural and extramural)
Guidelines	Generate the evidence base for further guideline development	Healthcare Infection Control Practices Advisory Committee (HICPAC) produces evidence-based guidelines and related guidance; Maintain consistent case definitions in guidelines and NHSN		Research contributions to inform Public Health Service guidelines, society-sponsored guidelines, etc.

	AHRQ	CDC	CMS	NIH
Treatment Comparative Effectiveness Implementation	Comparative effectiveness of treatments Within organizations, systems of care, institutions, primary care networks	Comparative effectiveness of prevention strategies	Comparative effectiveness through information from coverage with evidence development	Comparative trials (intramural and extramural)
Quality/Safety of Healthcare	Patient Safety Organizations, measurement tools for baseline and evaluation and quality improvement, training, data collection	NHSN as a system to track infections; Develop baseline through measurement, training, and data collection; NHSN as a quality improvement tool	Through quality reporting, payment incentives, and special QIO programs	Developed and implemented electronic occurrence reporting system and ongoing clinical quality/performance measurement/performance improvement program at the NIH/Clinical Center
Efficiency and Costs	Improved quality and reduced costs, avoidable admissions and re-admissions (HAIs)	Cost estimate studies, assess impact, assess unintended consequences of prevention initiatives and policies related to HAI prevention	CMS does not pay for certain hospital-acquired infections	

Appendix D

Top 5 Hospital Allegations for Complaints & Incidents, CY2005 to CY2008

TOP 5 HOSPITAL ALLEGATIONS FOR COMPLAINTS & INCIDENTS

Ranking	Allegation	# Allegations
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CY2008 to date (01012008-08182008)

1	Quality of Care/Treatment	2426
2	Restrain/Seclusion - Death	2074
3	Resident/Patient/Client Rights	1205
4	Nursing Services	832
5	EMTALA	826
13	Infection Control	216

CFY2007

1	Quality of Care/Treatment	4103
2	Resident/Patient/Client Rights	2225
3	EMTALA	1346
4	Nursing Services	1157
5	Resident/Patient/Client Abuse	631
11	Infection Control	405

CY2006

1	Quality of Care/Treatment	3677
2	Resident/Patient/Client Rights	2101
3	EMTALA	1517
4	Nursing Services	1105
5	Resident/Patient/Client Abuse	608
12	Infection Control	314

CY2005

1	Quality of Care/Treatment	3872
2	Resident/Patient/Client Rights	3240
3	EMTALA	1483
4	Nursing Services	1139
5	Resident/Patient/Client Neglect	705

Source: QIES Workbench 8/21/2008; ACTS; Pennsylvania
Complaints and incidents are combined for this report

Note: Includes data for the State of Pennsylvania



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Appendix E

Hospital Acquired Conditions, Including Codes, Selected for October 1, 2008

HAC	CC/MCC (ICD-9-CM Codes)
1. Foreign Object Retained After Surgery	998.4 (CC) 998.7 (CC)
2. Air Embolism	999.1 (MCC)
3. Blood Incompatibility	999.6 (CC)
4. Pressure Ulcer Stages III & IV	707.23 (MCC) 707.24 (MCC)
5. Falls and Trauma: - Fracture - Dislocation - Intracranial Injury - Crushing Injury - Burn - Electric Shock	Codes within these ranges on the CC/MCC list: 800-829 830-839 850-854 925-929 940-949 991-994
6. Catheter-Associated Urinary Tract Infection (UTI)	996.64 (CC) Also excludes the following from acting as a CC/MCC: 112.2 (CC) 590.10 (CC) 590.11 (MCC) 590.2 (MCC) 590.3 (CC) 590.80 (CC) 590.81 (CC) 595.0 (CC) 597.0 (CC) 599.0 (CC)
7. Vascular Catheter-Associated Infection	999.31 (CC)
8. Manifestations of Poor Glycemic Control	250.10-250.13 (MCC) 250.20-250.23 (MCC) 251.0 (CC) 249.10-249.11 (MCC) 249.20-249.21 (MCC)
9a. Surgical Site Infection, Mediastinitis Following Coronary Artery Bypass Graft (CABG)	519.2 (MCC) And one of the following procedure codes: 36.10–36.19

HAC	CC/MCC (ICD-9-CM Codes)
9b. Surgical Site Infection Following Certain Orthopedic Procedures	996.67 (CC) 998.59 (CC) And one of the following procedure codes: 81.01-81.08, 81.23-81.24, 81.31-81.38, 81.83, 81.85
9c. Surgical Site Infection Following Bariatric Surgery for Obesity	<i>Principal Diagnosis</i> – 278.01 998.59 (CC) And one of the following procedure codes: 44.38, 44.39, or 44.95
10. Deep Vein Thrombosis and Pulmonary Embolism Following Certain Orthopedic Procedures	415.11 (MCC) 415.19 (MCC) 453.40-453.42 (MCC) And one of the following procedure codes: 00.85-00.87, 81.51-81.52, or 81.54

Appendix F

Hospital Compare Measures as of October 1, 2008

Acute Myocardial Infarction (AMI) – Heart Attack	Aspirin at Arrival
	Aspirin Prescribed at Discharge
	ACE Inhibitor or Angiotensin Receptor Blocker (ARB) for Left Ventricular Systolic Dysfunction
	Adult Smoking Cessation Advice/Counseling
	Beta-Blocker Prescribed at Discharge
	Beta-Blocker at Arrival
	Fibrinolytic Therapy Received within 30 Minutes of Hospital Arrival
	Primary Percutaneous Coronary Intervention (PCI) within 90 Minutes of Hospital Arrival
	AMI 30-day Mortality
Heart Failure (HF)	Discharge Instructions
	Evaluation of Left Ventricular Systolic Function
	ACE Inhibitor or Angiotensin Receptor Blocker (ARB) for Left Ventricular Systolic Dysfunction
	Adult Smoking Cessation Advice/Counseling
	HF 30-day Mortality
Pneumonia (PN)	Oxygenation Assessment
	Pneumococcal Vaccination
	Blood Culture Performed in the Emergency Department Prior to Initial Antibiotic Received in the Hospital
	Adult Smoking Cessation Advice/Counseling
	Initial Antibiotic Received within 6 Hours of Hospital Arrival
	Appropriate Initial Antibiotic Selection
	Influenza Vaccination
	PN 30-day Mortality
	Surgical Care Improvement Project (SCIP)
Prophylactic Antibiotic Selection for Surgical Patients	
Prophylactic Antibiotics Discontinued within 24 Hours After Surgery End Time	
Surgery Patients with Recommended Venous Thromboembolism (VTE) Prophylaxis Ordered	

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	Surgery Patients Who Received Recommended Venous Thromboembolism (VTE) Prophylaxis Within 24 Hours Prior to Surgery to 24 Hours After Surgery
Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS)	Communication with nurses
	Communication with doctors
	Responsiveness of hospital staff
	Pain management
	Communication about medicines
	Discharge information
	Cleanliness of hospital environment
	Quietness of hospital environment
	Overall rating of hospital
	Willingness to recommend hospital
Children's Asthma Care	Use of relievers for inpatient asthma
	Use of systemic corticosteroids for inpatient asthma

Appendix G – Stakeholder Feedback and Revisions to the Original Draft Metrics and Targets

Comments on the initial draft metrics published as part of the HHS Action Plan to Prevent Healthcare-Associated Infections in January 2009 were solicited and reviewed. While comments ranged from high level strategic observations to technical measurement details, overall commenters encouraged established baselines, both at the national and local level, use of standardized definitions and methods, engagement with the National Quality Forum (NQF), raised concerns regarding the use of national targets for payment or accreditation purposes and of the validity of proposed measures, and would like to have both a target rate and a percent reduction for all metrics. Commenters varied on the aggressiveness of the national targets, with some expressing concern that these targets were overly ambitious while others were concerned that the targets were not ambitious enough. Furthermore, commenters emphasized the need for flexibility in the metrics, to accommodate advances in electronic reporting and information technology and for advances in prevention of healthcare-associated infections (HAIs), in particular ventilator-associated pneumonia. Finally, some commenters expressed concern that the proposed process measures included in the HAI metrics do not have demonstrated correlation with reduced HAIs.

To address comments received on the Action Plan Metrics and Targets, proposed metrics have been updated to include the proposed source of metric data, baselines, and which agency would coordinate the measure. To respond to the requests for percentage reduction in HAIs in addition to HAI rates, a new type of metric, the standardized infection ratio (SIR), is being proposed. Although metrics using infection rates are NQF endorsed, the Department of Health and Human Services (HHS) staff will work with NQF to address future consideration by NQF of the SIR for endorsement. Below is a detailed technical description of the SIR.

To address concerns regarding validity, HHS is providing funding, utilizing Recovery Act of 2009 funds, to the Centers for Disease Control and Prevention (CDC) to support states in validating National Healthcare Safety Network (NHSN)-related measures and to support reporting on HHS metrics through NHSN. Also, most of the reporting metrics outlined here have already been endorsed by NQF and for population-based national measures on methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile*. Work to develop hospital level measures will be conducted in the next year utilizing support to CDC through funds available in the Recovery Act.

Finally, to address concerns regarding flexibility in accommodating new measures, reviewing progress on current measures, and incorporating new sources of measure data (e.g., electronic data, administrative data) or new measures, HHS and its constituent agencies will commit to an annual review and update of the HHS Action Plan Targets and Metrics. The process for annual review and update will include representatives from appropriate federal agencies, state and local health agencies, scientific and clinical experts on HAI prevention and performance measurement, healthcare providers, professional organizations, accreditation organizations, consumer groups, and other key stakeholders. The first meeting to review measures and provide updates will tentatively be held in late 2009 or early 2010.

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Metric Number and Label	Original HAI Elimination Metric	HAI Comparison Metric	Measurement System	National Baseline Established (State Baselines Established)	National 5-Year Prevention Target	Coordinator of Measurement System	Is the metric NQF endorsed?
1. CLABSI 1	CLABSIs per 1,000 device days by ICU and other locations	CLABSI SIR	NHSN Device-Associated Module	2006-2008 (proposed 2009, in consultation with states)	At least 50% reduction in central line-associated bloodstream infections in ICU and ward-located patients	CDC	Yes*
2. CLIP 1 (formerly CLABSI 4)	Central line bundle compliance (non-emergent insertions)	CLIP Adherence percentage	NHSN CLIP in Device-Associated Module	2009 (proposed 2009, in consultation with states)	100% adherence with central line bundle	CDC	Yes†
3a. C diff 1	Case rate per patient days; administrative/discharge data for ICD-9 CM coded <i>C. difficile</i> Infections	Hospitalizations with <i>C. difficile</i> per 1,000 patient discharges	Hospital discharge data	2008 (proposed 2008, in consultation with states)	At least 30% reduction in hospitalizations with <i>C. difficile</i> per 1,000 patient discharges	AHRQ or CDC	No
3b. C diff 2 (new)		<i>C. difficile</i> SIR	CDC NHSN MDRO/CDAD Module LabID‡	2009-2010	Reduce the facility-wide healthcare facility-onset <i>C. difficile</i> LabID event SIR by at least 30% from baseline	CDC	No
4. CAUTI 2	# of symptomatic UTI per 1,000 urinary catheter days	CAUTI SIR	CDC NHSN Device-Associated Module	2009 for ICUs and other locations 2009 for other hospital units (proposed 2009, in consultation with states)	Reduce the CAUTI SIR by at least 25% from baseline in ICU and other locations	CDC	Yes*

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5a. MRSA 1	Incidence rate (number per 100,000 persons) of invasive MRSA infections	MRSA Incidence rate (healthcare-associated)	CDC EIP/ABCs	2007-2008 (for non-EIP states, MRSA metric to be developed in collaboration with EIP states)	At least a 50% reduction in incidence of healthcare-associated invasive MRSA infections	CDC	No
5b. MRSA 2 (new)		MRSA bacteremia SIR	CDC NHSN MDRO/CDAD Module LabID [‡]	2009-2010	Reduce the facility-wide healthcare facility-onset MRSA bacteremia LabID event SIR by at least 25% from baseline	CDC	No
6. SSI 1	Deep incision and organ space infection rates using NHSN definitions (SCIP procedures)	SSI SIR	CDC NHSN Procedure-Associated Module	2006-2008 (proposed 2009, in consultation with states)	Reduce the admission and readmission SSI [§] SIR by at least 25% from baseline	CDC	Yes [¶]
7. SCIP 1 (formerly SSI 2)	Adherence to SCIP/NQF infection process measures	SCIP Adherence percentage	CMS SCIP	To be determined by CMS	At least 95% adherence to process measures to prevent surgical site infections	CMS	Yes

* NHSN SIR metric is derived from NQF-endorsed metric data

† NHSN does not collect information on daily review of line necessity, which is part of the NQF

‡ LabID, events reported through laboratory detection methods that produce proxy measures for infection surveillance

§ Inclusion of SSI events detected on admission and readmission reduces potential bias introduced by variability in post-discharge surveillance efforts

¶ The NQF-endorsed metric includes deep wound and organ space SSIs only which are included the target.

Understanding the Relationship between HAI Rate and SIR Comparison Metrics

The Original HAI Elimination Metrics listed above are very useful for performing evaluations. Several of these metrics are based on the science employed in the NHSN. For example, metric #1 (CLABSI 1) for CLABSI events measures the number of CLABSI events per 1,000 device (central line) days by ICU and other locations. While national aggregate CLABSI data are published in the annual NHSN Reports these rates must be stratified by types of locations to be risk-adjusted. This scientifically sound risk-adjustment strategy creates a practical challenge to summarizing this information nationally, regionally, or even for an individual healthcare facility. For instance, when comparing CLABSI rates, there may be quite a number of different types of locations for which a CLABSI rate could be reported. Given CLABSI rates among 15 different types of locations, one may observe many different combinations of patterns of temporal changes. This raises the need for a way to combine CLABSI rate data across location types.

A standardized infection ratio (SIR) is identical in concept to a standardized mortality ratio and can be used as an indirect standardization method for summarizing HAI experience across any number of stratified groups of data. To illustrate the method for calculating an SIR and understand how it could be used as an HAI comparison metric, the following example data are displayed below:

Risk Group Stratifier	Observed CLABSI Rates			NHSN CLABSI Rates for 2008 (Standard Population)		
	Location Type	#CLABSI	#Central line-days	CLABSI rate *	#CLABSI	#Central line-days
ICU	170	100,000	1.7	1200	600,000	2.0
WARD	58	58,000	1.0	600	400,000	1.5
$\text{SIR} = \frac{\text{observed}}{\text{expected}} = \frac{170 + 58}{100000 \times \left(\frac{2}{1000}\right) + 58,000 \times \left(\frac{1.5}{1000}\right)} = \frac{228}{200 + 87} = \frac{228}{287} = 0.79 \quad 95\% \text{ CI} = (0.628, 0.989)$						

* defined as the number of CLABSIs per 1000 central line-days

In the table above, there are two strata to illustrate risk-adjustment by location type for which national data exist from NHSN. The SIR calculation is based on dividing the total number of observed CLABSI events by an “expected” number using the CLABSI rates from the standard population. This “expected” number is calculated by multiplying the national CLABSI rate from the standard population by the observed number of central line-days for each stratum which can also be understood as a prediction or projection. If the observed data represented a follow-up period such as 2009 one would state that an SIR of 0.79 implies that there was a 21% reduction in CLABSIs overall for the nation, region, or facility.

The SIR concept and calculation is completely based on the underlying CLABSI rate data that exist across a potentially large group of strata. Thus, the SIR provides a single metric for performing comparisons rather than attempting to perform multiple comparisons across many strata which makes the task cumbersome. Given the underlying CLABSI rate data, one retains the option to perform comparisons within a particular set of strata where observed rates may differ significantly from the standard populations. These types of more detailed comparisons could be very useful and necessary for identifying areas for more focused prevention efforts.

The national 5-year prevention target for metric #1 could be implemented using the concept of an SIR equal to 0.25 as the goal. That is, an SIR value based on the observed CLABSI rate data at the 5-year mark could be calculated using NHSN CLABSI rate data stratified by location type as the baseline to assess whether the 75% reduction goal was met. There are statistical methods that allow for calculation of confidence intervals, hypothesis testing, and graphical presentation using this HAI summary comparison metric called the SIR.

The SIR concept and calculation can be applied equitably to other HAI metrics list above. This is especially true for HAI metrics for which national data are available and reasonably precise using a measurement system such as the NHSN. The SIR calculation methods differ in the risk group stratification only. To better understand metric #6 (SSI 1) see the following example data and SIR calculation:

Risk Group Stratifiers		Observed SSI Rates			NHSN SSI Rates for 2008 (Standard Population)		
Procedure Code	Risk Index Category	#SSI [†]	#procedures	SSI rate [*]	#SSI [†]	#procedures	SSI rate [*]
CBGB	1	315	12,600	2.5	2100	70,000	3.0
CBGB	2,3	210	7000	3.0	1000	20,000	5.0
HPRO	1	111	7400	1.5	1020	60,000	1.7
$\text{SIR} = \frac{\text{observed}}{\text{expected}} = \frac{315 + 210 + 111}{12600 \times \left(\frac{3.0}{100}\right) + 7000 \times \left(\frac{5.0}{100}\right) + 7400 \times \left(\frac{1.7}{100}\right)} = \frac{636}{378 + 350 + 125.8} = \frac{636}{853.8} = 0.74 \quad 95\% \text{ CI} = (0.649, 0.851)$							

[†] SSI, surgical site infection

^{*} defined as the number of deep incision or organ space SSIs per 100 procedures

This example uses SSI rate data stratified by procedure and risk index category. Nevertheless, an SIR can be calculated using the same calculation process as for CLABSI data except using different risk group stratifiers for these example data. The SIR for this set of observed

data is 0.74 which indicates there's a 26% reduction in the number of SSI events based on the baseline NHSN SSI rates as representing the standard population. Once again, these data can reflect the national picture at the 5-year mark and the SIR can serve as metric that summarizes the SSI experience into a single comparison.

There are clear advantages to reporting and comparing a single number for prevention assessment. However, since the SIR calculations are based on standard HAI rates among individual risk groups there is the ability to perform more detailed comparisons within any individual risk group should the need arise. Furthermore, the process for determining the best risk-adjustment for any HAI rate data is flexible and always based on more detailed risk factor analyses that provide ample scientific rigor supporting any SIR calculations. The extent to which any HAI rate data can be risk-adjusted is obviously related to the detail and volume of data that exist in a given measurement system.

In addition to the simplicity of the SIR concept and the advantages listed above, it is important to note another benefit of using an SIR comparison metric for HAI data. If there was need at any level of aggregation (national, regional, facility-wide, etc.) to combine the SIR values across mutually-exclusive data one could do so. The below table demonstrates how the example data from the previous two metric settings could be summarized.

HAI Metric	Observed HAIs			Expected HAIs		
	#CLABSI	#SSI [†]	#Combined HAI	#CLABSI	#SSI [†]	#Combined HAI
CLABSI 1	228			287		
SSI 1		636			853.8	
Combined HAI			228 + 636 = 864			287+853.8 = 1140.8
$\text{SIR} = \frac{\text{observed}}{\text{expected}} = \frac{228 + 636}{287 + 853.8} = \frac{864}{1140.8} = 0.76 \quad 95\% \text{ CI} = (0.673, 0.849)$						

[†] SSI, surgical site infection