



## Measure Information

This document contains the information submitted by measure developers/stewards, but is organized according to NQF's measure evaluation criteria and process. The item numbers refer to those in the submission form but may be in a slightly different order here. In general, the item numbers also reference the related criteria (e.g., item 1b.1 relates to sub criterion 1b).

### Brief Measure Information

**NQF #:** 2720

**Corresponding Measures:**

**Measure Title:** National Healthcare Safety Network (NHSN) Antimicrobial Use Measure

**Measure Steward:** Centers for Disease Control and Prevention

**sp.02. Brief Description of Measure:** Risk adjusted antimicrobial use ratios among hospitals

**1b.01. Developer Rationale:** The measure provides summary results that hospital and health system antimicrobial stewardship programs (ASPs) can use as quantitative aids in their efforts to evaluate and improve antibiotic prescribing. The Standardized Antimicrobial Administration Ratios (SAARs) that comprise the measure focus on high value targets and high level indicators of antimicrobial use for ASPs. The SAARs can be used by ASPs to benchmark antimicrobial use in multiple patient care locations, identify opportunities for improvement, and gauge the impact of stewardship efforts. At the outset, the SAARs provide a set of signals that often warrant further analysis, such as an evaluation of the extent to which a specific antibiotic or group of antibiotics accounts for a high or low SAAR value and the extent to which an antibiotic or group of antibiotics were used appropriately for specific indications. While the SAARs do not provide a definitive indication that antibiotics are overused or underused, they provide an important starting place for further analysis and possible action. Some of the analytic follow up can be completed with hospital- and patient care location-specific data reported to CDC's National Healthcare Safety Network (NHSN) Antimicrobial Use and Resistance (AUR) Module, using analytic features built into the NHSN application. However, additional analyses to determine the appropriateness of antibiotic use in individual instances are likely to require access to detailed, patient-level data that is beyond the scope of data collection and analysis using the NHSN module, e.g., clinical indications for specific antibiotics and dose and duration decisions.

---

**sp.12. Numerator Statement:** The measure Standardized Antimicrobial Administration Ratio is a ratio of the observed to the predicted rate of antimicrobial use for the given type of patient care locations. The numerator of the observed rate of antimicrobial use is the number of days of antimicrobial used in adult, pediatric and neonatal locations. The antimicrobials are categorized according to the antimicrobial spectra of activity. (see appendix E of <https://www.cdc.gov/nhsn/PDFs/pscManual/11pscAURcurrent.pdf>). The predicted rates of antimicrobial use are calculated using statistical risk models which are described in sp.22.

**sp.14. Denominator Statement:**

The measure, Standardized Antimicrobial Administration Ratio, is a ratio of the observed to the predicted rate of antimicrobial use for the given type of patient care locations. The denominator of the observed rate of antimicrobial use is the number of days where any patients presented in each type of patient care locations, which covers the adult or pediatric medical, surgical, medical-surgical wards, medical, surgical, medical-surgical intensive

care units, step-down units, neonatal intensive care units, and neonatal step-down nurseries in acute care and critical access hospitals.

The predicted rates of antimicrobial use are calculated using statistical risk models which are described in sp.22.

**sp.16. Denominator Exclusions:** Hospital patient care locations other than adult and pediatric medical ICU, medical-surgical ICU, surgical ICU (adult only), medical ward, medical-surgical ward, surgical ward, general hematology-oncology ward (adult only), and step-down unit (adult only) are excluded from this measure.

---

**Measure Type:** Process

**sp.28. Data Source:**

Electronic Health Data

**sp.07. Level of Analysis:**

Facility

---

**IF Endorsement Maintenance – Original Endorsement Date:** 2015-12-10 11:47 AM

**Most Recent Endorsement Date:** 10/23/2019 3:58:17 PM

---

**IF this measure is included in a composite, NQF Composite#/title:**

**IF this measure is paired/grouped, NQF#/title:**

**sp.03. IF PAIRED/GROUPED, what is the reason this measure must be reported with other measures to appropriately interpret results?:**

## 1. Importance to Measure and Report

Extent to which the specific measure focus is evidence-based, important to making significant gains in healthcare quality, and improving health outcomes for a specific high-priority (high-impact) aspect of healthcare where there is variation in or overall less-than-optimal performance. Measures must be judged to meet all sub criteria to pass this criterion and be evaluated against the remaining criteria

**1ma.01. Indicate whether there is new evidence about the measure since the most recent maintenance evaluation. If yes, please briefly summarize the new evidence, and ensure you have updated entries in the Evidence section as needed.**

[Response Begins]

No

[Response Ends]

Please separate added or updated information from the most recent measure evaluation within each question response in the Importance to Measure and Report: Evidence section. For example:

**Current Submission:**

Updated evidence information here.

**Previous (Year) Submission:**

Evidence from the previous submission here.

**1a.01. Provide a logic model.**

*Briefly describe the steps between the healthcare structures and processes (e.g., interventions, or services) and the patient's health outcome(s). The relationships in the diagram should be easily understood by general, non-technical audiences. Indicate the structure, process or outcome being measured.*

[Response Begins]

[Response Ends]

**1a.02. Select the type of source for the systematic review of the body of evidence that supports the performance measure.**

*A systematic review is a scientific investigation that focuses on a specific question and uses explicit, prespecified scientific methods to identify, select, assess, and summarize the findings of similar but separate studies. It may include a quantitative synthesis (meta-analysis), depending on the available data.*

[Response Begins]

US Preventive Services Task Force Recommendation

[Response Ends]

If the evidence is not based on a systematic review, skip to the end of the section and do not complete the repeatable question group below. If you wish to include more than one systematic review, add additional tables by clicking "Add" after the final question in the group.

**Evidence - Systematic Reviews Table (Repeatable)**

Group 1 - Evidence - Systematic Reviews Table

**1a.03. Provide the title, author, date, citation (including page number) and URL for the systematic review.**

[Response Begins]

[Response Ends]

**1a.04. Quote the guideline or recommendation verbatim about the process, structure or intermediate outcome being measured. If not a guideline, summarize the conclusions from the systematic review.**

[Response Begins]

[Response Ends]

**1a.05. Provide the grade assigned to the evidence associated with the recommendation, and include the definition of the grade.**

[Response Begins]

[Response Ends]

**1a.06. Provide all other grades and definitions from the evidence grading system.**

[Response Begins]

[Response Ends]

**1a.07. Provide the grade assigned to the recommendation, with definition of the grade.**

[Response Begins]

[Response Ends]

**1a.08. Provide all other grades and definitions from the recommendation grading system.**

[Response Begins]

[Response Ends]

**1a.09. Detail the quantity (how many studies) and quality (the type of studies) of the evidence.**

[Response Begins]

[Response Ends]

**1a.10. Provide the estimates of benefit, and consistency across studies.**

[Response Begins]

[Response Ends]

**1a.11. Indicate what, if any, harms were identified in the study.**

[Response Begins]

[Response Ends]

**1a.12. Identify any new studies conducted since the systematic review, and indicate whether the new studies change the conclusions from the systematic review.**

[Response Begins]

[Response Ends]

**1a.13. If source of evidence is NOT from a clinical practice guideline, USPSTF, or systematic review, describe the evidence on which you are basing the performance measure.**

[Response Begins]

[Response Ends]

**1a.14. Briefly synthesize the evidence that supports the measure.**

[Response Begins]

[Response Ends]

**1a.15. Detail the process used to identify the evidence.**

[Response Begins]

[Response Ends]

**1a.16. Provide the citation(s) for the evidence.**

[Response Begins]

[Response Ends]

**1b.01. Briefly explain the rationale for this measure.**

*Explain how the measure will improve the quality of care, and list the benefits or improvements in quality envisioned by use of this measure.*

[Response Begins]

The measure provides summary results that hospital and health system antimicrobial stewardship programs (ASPs) can use as quantitative aids in their efforts to evaluate and improve antibiotic prescribing. The Standardized Antimicrobial Administration Ratios (SAARs) that comprise the measure focus on high value targets and high level indicators of antimicrobial use for ASPs. The SAARs can be used by ASPs to benchmark antimicrobial use in multiple patient care locations, identify opportunities for improvement, and gauge the impact of stewardship efforts. At the outset, the SAARs provide a set of signals that often warrant further analysis, such as an evaluation of the extent to which a specific antibiotic or group of antibiotics accounts for a high or low SAAR value and the extent to which an antibiotic or group of antibiotics were used appropriately for specific indications. While the SAARs do not provide a definitive indication that antibiotics are overused or underused, they provide an important starting place for further analysis and possible action. Some of the analytic follow up can be completed with hospital- and patient care location-specific data reported to CDC's National Healthcare Safety Network (NHSN) Antimicrobial Use and Resistance (AUR) Module, using analytic features built into the NHSN application. However, additional analyses to determine the appropriateness of antibiotic use in individual instances are likely to require access to detailed, patient-level data that is beyond the scope of data collection and analysis using the NHSN module, e.g., clinical indications for specific antibiotics and dose and duration decisions.

[Response Ends]

**1b.02. Provide performance scores on the measure as specified (current and over time) at the specified level of analysis.**

*Include mean, std dev, min, max, interquartile range, and scores by decile. Describe the data source including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities include. This information also will be used to address the sub-criterion on improvement (4b) under Usability and Use.*

**[Response Begins]**

See Table 3 - NHSN SAAR Distribution and statistical comparison by reporting measure

**[Response Ends]**

**1b.03. If no or limited performance data on the measure as specified is reported above, then provide a summary of data from the literature that indicates opportunity for improvement or overall less than optimal performance on the specific focus of measurement. Include citations.**

**[Response Begins]**

Numerous individual studies and systematic reviews provide strong evidence that measurement of antimicrobial use and data-driven interventions by antimicrobial stewardship programs (ASPs) lead to more judicious use of antibiotics, reduced antimicrobial resistance, and other favorable healthcare outcomes (Davey 2017, Feazel 2014; Davey 2006; Davey 2013; Kaki 2011).

Antimicrobial use measurement enables ASPs to understand prescribing practices, focus efforts on improvement, and determine the impact of their activities (Pollack, 2014). Although standardized metrics have been developed to measure antibiotic use, differences in measurement, limited uptake, and variation among facilities has impeded the ability to compare antibiotic use among hospitals.

The measure serves as a quantitative guide for hospital and health system ASPs, enabling them to benchmark antibiotic use in their facilities and patient care locations against nationally aggregated data. The measure focuses on antibiotic agents that have been shown to be high value targets for antimicrobial stewardship programs activities such as protocols for use or post-prescription reviews to determine need for de-escalation, dose-optimization or oral conversion. Knowledge about antibiotic use patterns of these agents is a primary means to prioritize and evaluate antimicrobial stewardship efforts.

**Citations:**

Feazel LM, Malhotra A, Perencevich EN, Kaboli P, Diekema DJ, Schweizer ML. Effect of antibiotic stewardship programmes on Clostridium difficile incidence: a systematic review and meta-analysis. J Antimicrob Chemother. 2014;69(7):1748-54. <http://jac.oxfordjournals.org/content/69/7/1748.full.pdf>

Davey P, Brown E, Fenelon L, Finch R, Gould I, Holmes A, et al. Systematic review of antimicrobial drug prescribing in hospitals. Emerg Infect Dis. 2006;12(2):211-6. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3373108/>

Davey P, Brown E, Charani E, Fenelon L, Gould IM, Holmes A, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. Cochrane Database Syst Rev. 2013;4:CD003543. <http://onlinelibrary.wiley.com/store/10.1002/14651858.CD003543.pub3/asset/CD003543.pdf?v=1&t=hvxzajv5&s=a6f3c724ce051d8acba5866a07e3c5ac8c818e83>

Kaki R, Elligsen M, Walker S, Simor A, Palmay L, Daneman N. Impact of antimicrobial stewardship in critical care: a systematic review. J Antimicrob Chemother. 2011;66(6):1223-30. <http://jac.oxfordjournals.org/content/66/6/1223.full.pdf>

Pollack LA, Srinivasan A. Core Elements of Hospital Antibiotic Stewardship Programs from the Centers for Disease Control and Prevention. Clinical Infectious Diseases. 2014;59(suppl 3):S97-S100.

Barlam TF, Cosgrove SE, Abbo LM, MacDougall C, Schuetz AN, Septimus EJ, Srinivasan A, Dellit TH, Falck-Ytter YT, Fishman NO, Hamilton CW, Jenkins TC, Lipsett PA, Malani PN, May LS, Moran GJ, Neuhauser MM, Newland JG, Ohl CA, Samore MH, Seo SK, Trivedi KK. Executive Summary: Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clin Infect Dis. 2016 May 15;62(10):e51-e77.

Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E, Gould IM, Ramsay CR, Michie S. Cochrane Database of Systematic Reviews 2017, Issue 2. Art. No.: CD003543. DOI: 10.1002/14651858.CD003543.pub4

**[Response Ends]**

**1b.04. Provide disparities data from the measure as specified (current and over time) by population group, e.g., by race/ethnicity, gender, age, insurance status, socioeconomic status, and/or disability.**

*Describe the data source including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included. Include mean, std dev, min, max, interquartile range, and scores by decile. For measures that show high levels of performance, i.e., “topped out”, disparities data may demonstrate an opportunity for improvement/gap in care for certain sub-populations. This information also will be used to address the sub-criterion on improvement (4b) under Usability and Use.*

**[Response Begins]**

Data source includes 2,156 adult patient care locations from 449 acute care hospitals and 170 pediatric patient care locations from 109 acute care hospitals from which AU data reported for 2017 were used to update predictive models. These data do not include disparity descriptors such as race, ethnicity, gender and age. However there is no compelling external data or analytic work suggesting that variation in hospital antimicrobial use is associated with social risk factors.

**[Response Ends]**

**1b.05. If no or limited data on disparities from the measure as specified is reported above, then provide a summary of data from the literature that addresses disparities in care on the specific focus of measurement. Include citations. Not necessary if performance data provided in above.**

**[Response Begins]**

Sparse data are available on disparities in appropriateness of antibiotic use in hospitals. A retrospective analysis (1996-2007) of prospective data on all surgical patients treated for sepsis at a tertiary care center demonstrated no differences in demographic and comorbidities between inappropriately and appropriately treated groups. (Davies et al, 2014)

Davies SW, Efird JT, Guidry CA, Hranjec T, Metzger R, Swenson BR, et al. Does it Matter if we get it right? Impact of appropriateness of empiric antimicrobial therapy among surgical patients. Shock. 2014;42(3):185-91.

**[Response Ends]**

## 2. Scientific Acceptability of Measure Properties

Extent to which the measure, as specified, produces consistent (reliable) and credible (valid) results about the quality of care when implemented. Measures must be judged to meet the sub criteria for both reliability and validity to pass this criterion and be evaluated against the remaining criteria.

**spma.01. Indicate whether there are changes to the specifications since the last updates/submission. If yes, update the specifications in the Measure Specifications section of the Measure Submission Form, and explain your reasoning for the changes below.**

[Response Begins]

No

[Response Ends]

**spma.02. Briefly describe any important changes to the measure specifications since the last measure update and provide a rationale.**

For annual updates, please explain how the change in specifications affects the measure results. If a material change in specification is identified, data from re-testing of the measure with the new specifications is required for early maintenance review.

*For example, specifications may have been updated based on suggestions from a previous NQF CDP review.*

[Response Begins]

N/A

[Response Ends]

**sp.01. Provide the measure title.**

*Measure titles should be concise yet convey who and what is being measured (see [What Good Looks Like](#)).*

[Response Begins]

National Healthcare Safety Network (NHSN) Antimicrobial Use Measure

[Response Ends]

**sp.02. Provide a brief description of the measure.**

*Including type of score, measure focus, target population, timeframe, (e.g., Percentage of adult patients aged 18-75 years receiving one or more HbA1c tests per year).*

[Response Begins]

Risk adjusted antimicrobial use ratios among hospitals

[Response Ends]

**sp.04. Check all the clinical condition/topic areas that apply to your measure, below.**

*Please refrain from selecting the following answer option(s). We are in the process of phasing out these answer options and request that you instead select one of the other answer options as they apply to your measure.*



*Please do not select:*

- *Surgery: General*

**[Response Begins]**

Infectious Diseases (ID)

**[Response Ends]**

**sp.05. Check all the non-condition specific measure domain areas that apply to your measure, below.**

**[Response Begins]**

Safety: Overuse

**[Response Ends]**

**sp.06. Select one or more target population categories.**

*Select only those target populations which can be stratified in the reporting of the measure's result.*

*Please refrain from selecting the following answer option(s). We are in the process of phasing out these answer options and request that you instead select one of the other answer options as they apply to your measure.*

*Please do not select:*

- *Populations at Risk: Populations at Risk*

**[Response Begins]**

Adults (Age >= 18)

Children (Age < 18)

**[Response Ends]**

**sp.07. Select the levels of analysis that apply to your measure.**

*Check ONLY the levels of analysis for which the measure is SPECIFIED and TESTED.*

*Please refrain from selecting the following answer option(s). We are in the process of phasing out these answer options and request that you instead select one of the other answer options as they apply to your measure.*

*Please do not select:*

- *Clinician: Clinician*
- *Population: Population*

**[Response Begins]**

Facility

**[Response Ends]**

**sp.08. Indicate the care settings that apply to your measure.**

*Check ONLY the settings for which the measure is SPECIFIED and TESTED.*

**[Response Begins]**

Inpatient/Hospital

**[Response Ends]**

**sp.09. Provide a URL link to a web page specific for this measure that contains current detailed specifications including code lists, risk model details, and supplemental materials.**

*Do not enter a URL linking to a home page or to general information. If no URL is available, indicate "none available".*

**[Response Begins]**

<https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-saar-guide-508.pdf>

**[Response Ends]**

**sp.12. Attach the data dictionary, code table, or value sets (and risk model codes and coefficients when applicable). Excel formats (.xlsx or .csv) are preferred.**

*Attach an excel or csv file; if this poses an issue, [contact staff](#). Provide descriptors for any codes. Use one file with multiple worksheets, if needed.*

**[Response Begins]**

No data dictionary/code table – all information provided in the submission form

**[Response Ends]**

**sp.13. State the numerator.**

*Brief, narrative description of the measure focus or what is being measured about the target population, i.e., cases from the target population with the target process, condition, event, or outcome).*

*DO NOT include the rationale for the measure.*

**[Response Begins]**

The measure Standardized Antimicrobial Administration Ratio is a ratio of the observed to the predicted rate of antimicrobial use for the given type of patient care locations. The numerator of the observed rate of antimicrobial use is the number of days of antimicrobial used in adult, pediatric and neonatal locations. The antimicrobials are categorized according to the antimicrobial spectra of activity. (see appendix E of <https://www.cdc.gov/nhsn/PDFs/pscManual/11pscAURcurrent.pdf>). The predicted rates of antimicrobial use are calculated using statistical risk models which are described in sp.22.

**[Response Ends]**

**sp.14. Provide details needed to calculate the numerator.**

*All information required to identify and calculate the cases from the target population with the target process, condition, event, or outcome such as definitions, time period for data collection, specific data collection items/responses, code/value sets.*

*Note: lists of individual codes with descriptors that exceed 1 page should be provided in an Excel or csv file in required format at sp.11.*

**[Response Begins]**

#### Data collection

Through a multi-step process, antimicrobial use data are extracted from each hospital's electronic Medication Administration Records (eMAR) or Barcode Medication Administration (BCMA) system. The number of days of the patient presented in each patient care location was extracted from each hospital's Admission, Discharge, and Transfer (ADT) system. The number of days that an antimicrobial was administered via each administration routes (intravenous, intramuscular, digestive, or respiratory) for each patient care location are recorded. The data are aggregated for each calendar month using the third-party software vendor system or the healthcare system's corporate data warehouse prior to submitting to the NHSN.

#### Data Aggregation

Antimicrobial use data are aggregated by SAAR categories and types of patient care locations. The categories of antimicrobials and the type of patient care locations are shown below:

**Table 1. Adult SAARs**

SAAR Antimicrobial Agent Category	Locations	SAAR Type in NHSN
All antibacterial agents	All Adult SAAR Locations	Adult_All-Antibacterial_2017
Broad spectrum antibacterial agents predominantly used for hospital-onset infections	Adult Medical, Medical-Surgical, Surgical ICUs	Adult_BSHO_ICU_2017
	Adult Medical, Medical-Surgical, Surgical Wards	Adult_BSHO_Ward_2017
	Adult Step Down Units	Adult_BSHO_Step_2017
	Adult General Hematology-Oncology Wards	Adult_BSHO_ONC_2017
Broad spectrum antibacterial agents predominantly used for community-acquired infections	Adult Medical, Medical-Surgical, Surgical ICUs	Adult_BSCA_ICU_2017
	Adult Medical, Medical-Surgical, Surgical Wards	Adult_BSCA_Ward_2017
	Adult Step Down Units	Adult_BSCA_Step_2017
	Adult General Hematology-Oncology Wards	Adult_BSCA_ONC_2017
Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)	Adult Medical, Medical-Surgical, Surgical ICUs	Adult_GramPos_ICU_2017
	Adult Medical, Medical-Surgical, Surgical Wards	Adult_GramPos_Ward_2017
	Adult Step Down Units	Adult_GramPos_Step_2017
	Adult General Hematology-Oncology Wards	Adult_GramPos_ONC_2017
Narrow spectrum beta-lactam agents	Adult Medical, Medical-Surgical, Surgical ICUs	Adult_NSBL_ICU_2017
	Adult Medical, Medical-Surgical, Surgical Wards	Adult_NSBL_Ward_2017
	Adult Step Down Units	Adult_NSBL_Step_2017
	Adult General Hematology-Oncology Wards	Adult_NSBL_ONC_2017
Antibacterial agents posing the highest risk for CDI	Adult Medical, Medical-Surgical, Surgical ICUs	Adult_CDI_ICU_2017
	Adult Medical, Medical-Surgical, Surgical Wards	Adult_CDI_Ward_2017
	Adult Step Down Units	Adult_CDI_Step_2017
	Adult General Hematology-Oncology Wards	Adult_CDI_ONC_2017

SAAR Antimicrobial Agent Category	Locations	SAAR Type in NHSN
Antifungal agents predominantly used for invasive candidiasis	Adult Medical, Medical-Surgical, Surgical ICUs	Adult_Antifungal_ICU_2017
	Adult Medical, Medical-Surgical, Surgical Wards	Adult_Antifungal_Ward_2017
	Adult Step Down Units	Adult_Antifungal_Step_2017
	Adult General Hematology-Oncology Wards	Adult_Antifungal_ONC_2017

**Table 2: Pediatric SAARs**

SAAR Antimicrobial Agent Category	Locations	SAAR Type in NHSN
All antibacterial agents	All Pediatric locations	Ped_All-Antibacterial_2017
Broad spectrum antibacterial agents predominantly used for hospital-onset infections	Pediatric Medical and Medical-Surgical ICUs	Ped_BSHO_ICU_2017
	Pediatric Medical, Medical-Surgical, Surgical Wards	Ped_BSHO_Ward_2017
Broad spectrum antibacterial agents predominantly used for community-acquired infections	Pediatric Medical and Medical-Surgical ICUs	Ped_BSCA_ICU_2017
	Pediatric Medical, Medical-Surgical, Surgical Wards	Ped_BSCA_Ward_2017
Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)	Pediatric Medical and Medical-Surgical ICUs	Ped_GramPos_ICU_2017
	Pediatric Medical, Medical-Surgical, Surgical Wards	Ped_GramPos_Ward_2017
Narrow spectrum beta-lactam agents	Pediatric Medical and Medical-Surgical ICUs	Ped_NSBL_ICU_2017
	Pediatric Medical, Medical-Surgical, Surgical Wards	Ped_NSBL_Ward_2017
Azithromycin	Pediatric Medical and Medical-Surgical ICUs	Ped_Azith_ICU_2017
	Pediatric Medical, Medical-Surgical, Surgical Wards	Ped_Azith_Ward_2017
Antibacterial agents posing the highest risk for CDI	Pediatric Medical and Medical-Surgical ICUs	Ped_CDI_ICU_2017
	Pediatric Medical, Medical-Surgical, Surgical Wards	Ped_CDI_Ward_2017

SAAR Antimicrobial Agent Category	Locations	SAAR Type in NHSN
Antifungal agents predominantly used for invasive candidiasis	Pediatric Medical and Medical-Surgical ICUs	Ped_Antifungal_ICU_2017
	Pediatric Medical, Medical-Surgical, Surgical Wards	Ped_Antifungal_Ward_2017

**Table 3: Neonatal SAARs**

SAAR Antimicrobial Agent Category	Locations	SAAR Type in NHSN
All antibacterial agents	Step down Neonatal Nursery, Neonatal Critical Care (Level II/III), Neonatal Critical Care (Level III), Neonatal Critical Care (Level IV)	Neo_All-antibacterial_2018
Vancomycin predominantly used for treatment of late-onset sepsis	Step down Neonatal Nursery, Neonatal Critical Care (Level II/III), Neonatal Critical Care (Level III), Neonatal Critical Care (Level IV)	Neo_Vancomycin_2018
Broad spectrum antibacterial agents predominantly used for hospital-onset infections	Step down Neonatal Nursery, Neonatal Critical Care (Level II/III), Neonatal Critical Care (Level III), Neonatal Critical Care (Level IV)	Neo_BSHO_2018
Third generation Cephalosporins	Step down Neonatal Nursery, Neonatal Critical Care (Level II/III), Neonatal Critical Care (Level III), Neonatal Critical Care (Level IV)	Neo_3G-Cephalosporins_2018
Ampicillin predominantly used for treatment of early-onset sepsis	Step down Neonatal Nursery, Neonatal Critical Care (Level II/III), Neonatal Critical Care (Level III), Neonatal Critical Care (Level IV)	Neo_Ampicillin_2018
Aminoglycosides predominantly used for treatment of early-onset and late-onset sepsis	Step down Neonatal Nursery, Neonatal Critical Care (Level II/III), Neonatal Critical Care (Level III), Neonatal Critical Care (Level IV)	Neo_Aminoglycosides_2018
Fluconazole predominantly used for candidiasis	Neonatal Critical Care (Level II/III), Neonatal Critical Care (Level III), Neonatal Critical Care (Level IV)	Neo_Fluconazole_2018

[Response Ends]

**sp.15. State the denominator.**

*Brief, narrative description of the target population being measured.*

**[Response Begins]**

The measure, Standardized Antimicrobial Administration Ratio, is a ratio of the observed to the predicted rate of antimicrobial use for the given type of patient care locations. The denominator of the observed rate of antimicrobial use is the number of days where any patients presented in each type of patient care locations, which covers the adult or pediatric medical, surgical, medical-surgical wards, medical, surgical, medical-surgical intensive care units, step-down units, neonatal intensive care units, and neonatal step-down nurseries in acute care and critical access hospitals.

The predicted rates of antimicrobial use are calculated using statistical risk models which are described in sp.22.

**[Response Ends]**

**sp.16. Provide details needed to calculate the denominator.**

*All information required to identify and calculate the target population/denominator such as definitions, time period for data collection, specific data collection items/responses, code/value sets.*

*Note: lists of individual codes with descriptors that exceed 1 page should be provided in an Excel or csv file in required format at sp.11.*

**[Response Begins]**

The number of days where patient present is aggregated for each type of patient care locations. The types of patient care locations are as shown in the tables for sp.14.

**[Response Ends]**

**sp.17. Describe the denominator exclusions.**

*Brief narrative description of exclusions from the target population.*

**[Response Begins]**

Hospital patient care locations other than adult and pediatric medical ICU, medical-surgical ICU, surgical ICU (adult only), medical ward, medical-surgical ward, surgical ward, general hematology-oncology ward (adult only), and step-down unit (adult only) are excluded from this measure.

**[Response Ends]**

**sp.18. Provide details needed to calculate the denominator exclusions.**

*All information required to identify and calculate exclusions from the denominator such as definitions, time period for data collection, specific data collection items/responses, code/value sets – Note: lists of individual codes with descriptors that exceed 1 page should be provided in an Excel or csv file in required format at sp.11.*

**[Response Begins]**

Antimicrobial use and the data of days where patients present in the patient care locations that are not one of the locations mentioned in sp.14 are excluded from the scope of the measure.

**[Response Ends]**



**sp.19. Provide all information required to stratify the measure results, if necessary.**

*Include the stratification variables, definitions, specific data collection items/responses, code/value sets, and the risk-model covariates and coefficients for the clinically-adjusted version of the measure when appropriate. Note: lists of individual codes with descriptors that exceed 1 page should be provided in an Excel or csv file in required format in the Data Dictionary field.*

**[Response Begins]**

Statistical risk models were used to identify factors associated with differences in rates of antimicrobial use at the patient care location-level. Predictive models were constructed using forward stage wise Negative Binomial regression. In order to maximize objectivity in decision making and confidence in model results, two analysts independently developed predictive models for each group of antimicrobial agents. Final models developed by each analyst were compared and any differences in results were discussed among a team of analysts, statisticians, and subject matter experts. Final models are used to calculate predicted days of therapy adjusting for factors found to be statistically significantly associated with rates of antimicrobial use.

Hospital- and location-level variables were considered in predictive models.

Hospital-level factors:

- Hospital type: general acute care, critical access, children's, military, oncology, surgical, VA, women's, women's & children's
- Hospital teaching status: non-teaching, undergraduate only (medical students), graduate only (residents and/or fellows), major (medical school and post-graduate training)
- Total number of hospital beds
- Total number of hospital ICU beds
- Percentage of beds designated ICU beds- calculated as (total no. ICU beds/total no. beds)x100
- Average length of stay- calculated as (annual patient days/annual admissions)

Location-level factors:

- Patient care location: parameterized in different ways, levels with similar parameter estimates were grouped further
  - Example parameterization:
    - Unique patient care locations: medical ICU vs. medical-surgical ICU vs. surgical ICU vs. medical ward vs. medical-surgical ward vs. surgical ward vs. general hematology-oncology ward vs. step-down unit
    - Grouped by location type: ICU vs. ward vs. Onc vs. step-down

Significance of variables was assessed using Wald and likelihood ratio Chi-square tests at a 0.05 significance level and model fit improvement was assessed using Akaike Information Criterion and Bayesian Information Criterion.

**[Response Ends]**

**sp.20. Is this measure adjusted for socioeconomic status (SES)?**

**[Response Begins]**

No

**[Response Ends]**

**sp.21. Select the risk adjustment type.**



*Select type. Provide specifications for risk stratification and/or risk models in the Scientific Acceptability section.*

**[Response Begins]**

Statistical risk model with risk factors (specify number of risk factors)

**[Response Ends]**

**sp.22. Select the most relevant type of score.**

*Attachment: If available, please provide a sample report.*

**[Response Begins]**

Ratio

**[Response Ends]**

**sp.23. Select the appropriate interpretation of the measure score.**

*Classifies interpretation of score according to whether better quality or resource use is associated with a higher score, a lower score, a score falling within a defined interval, or a passing score*

**[Response Begins]**

Better quality = Lower score

**[Response Ends]**

**sp.24. Diagram or describe the calculation of the measure score as an ordered sequence of steps.**

*Identify the target population; exclusions; cases meeting the target process, condition, event, or outcome; time period of data, aggregating data; risk adjustment; etc.*

**[Response Begins]**

Risk adjustment is done with a statistical risk model. The variables considered for the predictive models of antimicrobial use rates are hospital- and patient care level-characteristics that hospitals report to the National Healthcare Safety Network (NHSN). No patient-level data are reported to the NHSN Antimicrobial Use and Resistance (AUR) Module. Adult and pediatric patient care locations and antimicrobial agent groups were modeled separately to further control for differences in use across different locations and patient populations. The predictive models were constructed using forward stagewise Negative Binomial regression assessing Wald and likelihood ratio Chi-square tests at a 0.05 significance level and model fit improvement using Akaike and Bayesian Information Criterion.

First, for each group of SAAR antimicrobial agents, univariate analyses were conducted to assess each hospital- and patient care-level factor using Negative Binomial regression. Univariate analysis results were assessed using Wald and likelihood ratio Chi-square tests at a 0.05 significance level. Forward stagewise regression allowed for models to be built by incrementally using Wald and likelihood Chi-square tests at a 0.05 significance level to assess variable significance and Akaike & Bayesian Information Criteria and likelihood ratio tests to assess improvement in model fit. Best fit models were chosen by assessing Akaike and Bayesian Information Criteria along with standard errors and sample size in each level of stratification.

Models with lowest AIC and/or BIC were selected, data was tested for influential observations, and sample sizes of stratification groups were assessed. NHSN required sufficient sample size across strata to evaluate any particular stratification that resulted in any parameterizations of the final models.

Bootstrap validation was conducted to validate performance of predictive models selected for each group of adult and pediatric antimicrobial agent categories.

[Response Ends]

**sp.27. If measure testing is based on a sample, provide instructions for obtaining the sample and guidance on minimum sample size.**

*Examples of samples used for testing:*

- Testing may be conducted on a sample of the accountable entities (e.g., hospital, physician). The analytic unit specified for the particular measure (e.g., physician, hospital, home health agency) determines the sampling strategy for scientific acceptability testing.
- The sample should represent the variety of entities whose performance will be measured. The [2010 Measure Testing Task Force](#) recognized that the samples used for reliability and validity testing often have limited generalizability because measured entities volunteer to participate. Ideally, however, all types of entities whose performance will be measured should be included in reliability and validity testing.
- The sample should include adequate numbers of units of measurement and adequate numbers of patients to answer the specific reliability or validity question with the chosen statistical method.
- When possible, units of measurement and patients within units should be randomly selected.

[Response Begins]

[Response Ends]

**sp.30. Select only the data sources for which the measure is specified.**

[Response Begins]

Electronic Health Data

[Response Ends]

**sp.31. Identify the specific data source or data collection instrument.**

*For example, provide the name of the database, clinical registry, collection instrument, etc., and describe how data are collected.*

[Response Begins]

Data

[Response Ends]

**sp.32. Provide the data collection instrument.**

[Response Begins]

Available at measure-specific web page URL identified in sp.09

[Response Ends]

**2ma.01. Indicate whether additional empirical reliability testing at the accountable entity level has been conducted. If yes, please provide results in the following section, Scientific Acceptability: Reliability - Testing. Include information on all testing conducted (prior testing as well as any new testing).**

***Please separate added or updated information from the most recent measure evaluation within each question response in the Scientific Acceptability sections. For example:***

***Current Submission:***

*Updated testing information here.*

***Previous Submission:***

*Testing from the previous submission here.*

**[Response Begins]**

No

**[Response Ends]**

**2ma.02. Indicate whether additional empirical validity testing at the accountable entity level has been conducted. If yes, please provide results in the following section, Scientific Acceptability: Validity - Testing. Include information on all testing conducted (prior testing as well as any new testing).**

***Please separate added or updated information from the most recent measure evaluation within each question response in the Scientific Acceptability sections. For example:***

***Current Submission:***

*Updated testing information here.*

***Previous Submission:***

*Testing from the previous submission here.*

**[Response Begins]**

No

**[Response Ends]**

**2ma.03. For outcome, patient-reported outcome, resource use, cost, and some process measures, risk adjustment/stratification may be conducted. Did you perform a risk adjustment or stratification analysis?**

**[Response Begins]**

No

**[Response Ends]**

**2ma.04. For maintenance measures in which risk adjustment/stratification has been performed, indicate whether additional risk adjustment testing has been conducted since the most recent maintenance evaluation. This may include updates to the risk adjustment analysis with additional clinical, demographic, and social risk factors.**

**Please update the Scientific Acceptability: Validity - Other Threats to Validity section.**

**Note: This section must be updated even if social risk factors are not included in the risk adjustment strategy.**

**[Response Begins]**

No additional risk adjustment analysis included

**[Response Ends]**

Measure testing must demonstrate adequate reliability and validity in order to be recommended for endorsement. Testing may be conducted for data elements and/or the computed measure score. Testing information and results should be entered in the appropriate fields in the Scientific Acceptability sections of the Measure Submission Form.

Measures must be tested for all the data sources and levels of analyses that are specified. If there is more than one set of data specifications or more than one level of analysis, contact NQF staff about how to present all the testing information in one form.

All required sections must be completed.

For composites with outcome and resource use measures, Questions 2b.23-2b.37 (Risk Adjustment) also must be completed.

If specified for multiple data sources/sets of specifications (e.g., claims and EHRs), Questions 2b.11-2b.13 also must be completed.

An appendix for supplemental materials may be submitted (see Question 1 in the Additional section), but there is no guarantee it will be reviewed.

Contact NQF staff with any questions. Check for resources at the [Submitting Standards webpage](#).

For information on the most updated guidance on how to address social risk factors variables and testing in this form refer to the release notes for the [2021 Measure Evaluation Criteria and Guidance](#).

Note: The information provided in this form is intended to aid the Standing Committee and other stakeholders in understanding to what degree the testing results for this measure meet NQF's evaluation criteria for testing.

2a. Reliability testing demonstrates the measure data elements are repeatable, producing the same results a high proportion of the time when assessed in the same population in the same time period and/or that the measure score is precise. For instrument-based measures (including PRO-PMs) and composite performance measures, reliability should be demonstrated for the computed performance score.

2b1. Validity testing demonstrates that the measure data elements are correct and/or the measure score correctly reflects the quality of care provided, adequately identifying differences in quality. For instrument based measures (including PRO-PMs) and composite performance measures, validity should be demonstrated for the computed performance score.

2b2. Exclusions are supported by the clinical evidence and are of sufficient frequency to warrant inclusion in the specifications of the measure;

AND

If patient preference (e.g., informed decision-making) is a basis for exclusion, there must be evidence that the exclusion impacts performance on the measure; in such cases, the measure must be specified so that the information about patient preference and the effect on the measure is transparent (e.g., numerator category computed separately, denominator exclusion category computed separately).

2b3. For outcome measures and other measures when indicated (e.g., resource use):

an evidence-based risk-adjustment strategy (e.g., risk models, risk stratification) is specified; is based on patient factors (including clinical and social risk factors) that influence the measured outcome and are present at start of care; 14,15 and has demonstrated adequate discrimination and calibration

rationale/data support no risk adjustment/ stratification.

2b4. Data analysis of computed measure scores demonstrates that methods for scoring and analysis of the specified measure allow for identification of statistically significant and practically/clinically meaningful 16 differences in performance;

OR

there is evidence of overall less-than-optimal performance.

2b5. If multiple data sources/methods are specified, there is demonstration they produce comparable results.

2b6. Analyses identify the extent and distribution of missing data (or nonresponse) and demonstrate that performance results are not biased due to systematic missing data (or differences between responders and non-responders) and how the specified handling of missing data minimizes bias.

2c. For composite performance measures, empirical analyses support the composite construction approach and demonstrate that:

2c1. the component measures fit the quality construct and add value to the overall composite while achieving the related objective of parsimony to the extent possible; and

2c2. the aggregation and weighting rules are consistent with the quality construct and rationale while achieving the related objective of simplicity to the extent possible.

(if not conducted or results not adequate, justification must be submitted and accepted)

### Definitions

Reliability testing applies to both the data elements and computed measure score. Examples of reliability testing for data elements include, but are not limited to: inter-rater/abstractor or intra-rater/abstractor studies; internal consistency for multi-item scales; test-retest for survey items. Reliability testing of the measure score addresses precision of measurement (e.g., signal-to-noise).

Validity testing applies to both the data elements and computed measure score. Validity testing of data elements typically analyzes agreement with another authoritative source of the same information. Examples of validity testing of the measure score include, but are not limited to: testing hypotheses that the measure scores indicate quality of care, e.g., measure scores are different for groups known to have differences in quality assessed by another valid quality measure or method; correlation of measure scores with another valid indicator of quality for the specific topic; or relationship to conceptually related measures (e.g., scores on process measures to scores on outcome measures). Face validity of the measure score as a quality indicator may be adequate if accomplished through a systematic and transparent process, by identified experts, and explicitly addresses whether performance scores resulting from the measure as specified can be used to distinguish good from poor quality. The degree of consensus and any areas of disagreement must be provided/discussed.

Examples of evidence that an exclusion distorts measure results include, but are not limited to: frequency of occurrence, variability of exclusions across providers, and sensitivity analyses with and without the exclusion.

Patient preference is not a clinical exception to eligibility and can be influenced by provider interventions.

Risk factors that influence outcomes should not be specified as exclusions.

With large enough sample sizes, small differences that are statistically significant may or may not be practically or clinically meaningful. The substantive question may be, for example, whether a statistically significant difference of one percentage point in the percentage of patients who received smoking cessation counseling (e.g., 74 percent v. 75 percent) is clinically meaningful; or

whether a statistically significant difference of \$25 in cost for an episode of care (e.g., \$5,000 v. \$5,025) is practically meaningful. Measures with overall less-than-optimal performance may not demonstrate much variability across providers.

Please separate added or updated information from the most recent measure evaluation within each question response in the Scientific Acceptability sections. For example:

**Current Submission:**

Updated testing information here.

**Previous (Year) Submission:**

Testing from the previous submission here.

**2a.01. Select only the data sources for which the measure is tested.**

**[Response Begins]**

Electronic Health Data

**[Response Ends]**

**2a.02. If an existing dataset was used, identify the specific dataset.**

*The dataset used for testing must be consistent with the measure specifications for target population and healthcare entities being measured; e.g., Medicare Part A claims, Medicaid claims, other commercial insurance, nursing home MDS, home health OASIS, clinical registry).*

**[Response Begins]**

Reliability testing at the data element level using a sample of hospitals that have reported antimicrobial use and days present to the CDC's National Healthcare Safety Network (NHSN) Antimicrobial Use and Resistance (AUR) Module during a 2-year time period, 2016 through 2018. Validity testing of the core measure data elements, antimicrobial days (i.e., days of therapy) and days present, and the core measure construct of antimicrobial groupings was completed by means of consensus development using a Delphi process during a series of meetings conducted from April to July 2018 among outside expert panel of Infectious Disease physicians and clinical pharmacists who are leaders in their domain.

**[Response Ends]**

**2a.03. Provide the dates of the data used in testing.**

*Use the following format: "MM-DD-YYYY - MM-DD-YYYY"*

**[Response Begins]**

01-01-2015 -12-31-2018

**[Response Ends]**

**2a.04. Select the levels of analysis for which the measure is tested.**

*Testing must be provided for all the levels specified and intended for measure implementation, e.g., individual clinician, hospital, health plan.*

*Please refrain from selecting the following answer option(s). We are in the process of phasing out these answer options and request that you instead select one of the other answer options as they apply to your measure.*

*Please do not select:*

- Clinician: Clinician
- Population: Population

**[Response Begins]**

Other (specify)

**[Other (specify) Please Explain]**

Patient care locations within hospitals

**[Response Ends]**

**2a.05. List the measured entities included in the testing and analysis (by level of analysis and data source).**

*Identify the number and descriptive characteristics of measured entities included in the analysis (e.g., size, location, type); if a sample was used, describe how entities were selected for inclusion in the sample.*

**[Response Begins]**

Reliability testing at the data element level using a sample of hospitals that have reported antimicrobial use and days present to the CDC's National Healthcare Safety Network (NHSN) Antimicrobial Use and Resistance (AUR) Module during a 3-year time period, 2011 through 2014. Thirteen facilities completed reliability testing of data elements collection and 24 facilities completed reliability testing of data aggregation. Reliability testing was expanded during the 3-year time period, 2016 through 2018, and included 48 facilities, and these facilities completed reliability testing for data elements collection and data aggregation.

A.) Data elements collection - included reliability testing of antimicrobial administration data elements collected from point of care systems (i.e., electronic medication administration record [eMAR] or bar coding medication administration [BCMA]) and patient care location data collected from admission/discharge/transfer (ADT) systems.

B.) Data aggregation - included reliability testing of the aggregation of numerator data (i.e., antimicrobial days by patient care location) and denominator data (i.e., days present by patient care location) in accordance with NHSN Antimicrobial Use and Resistance (AUR) protocol requirements.

**[Response Ends]**

**2a.06. Identify the number and descriptive characteristics of patients included in the analysis (e.g., age, sex, race, diagnosis), separated by level of analysis and data source; if a sample was used, describe how patients were selected for inclusion in the sample.**

*If there is a minimum case count used for testing, that minimum must be reflected in the specifications.*

**[Response Begins]**

Data collection for this measure does not include counts of individual patients or descriptive characteristics of individual patients because patient level data are aggregated prior to submission to NHSN.

**[Response Ends]**

**2a.07. If there are differences in the data or sample used for different aspects of testing (e.g., reliability, validity, exclusions, risk adjustment), identify how the data or sample are different for each aspect of testing.**

**[Response Begins]**

Yes, different samples were used for reliability testing and risk adjustment testing.

The size of the hospital samples used for reliability testing of A.) Data collection and B.) Data aggregation differed because of resource constraints. The hospital samples used for A.) and B.) were convenience samples comprised of teaching and non-teaching hospitals and hospitals with a range of bedsizes (42-919 beds).

The hospital samples used for reliability testing from 2016-2018 were a convenience sample comprised of teaching and non-teaching hospitals and with a range of bedsizes (12-619 beds).

The sample used for risk-adjustment included all eligible patient care locations reporting at least 9 months of data to the AU Option in 2017. For adult predictive models, this sample was comprised of 2,156 patient care locations (131 medical ICUs, 318 medical/surgical ICUs, 73 surgical ICUs, 472 medical wards, 554 medical/surgical wards, 247 surgical wards, 68 general hematology-oncology wards, 293 step-down units) from 449 hospitals. For pediatric predictive models, the sample was comprised of 170 patient care locations (4 medical ICUs, 46 medical/surgical ICUs, 21 medical wards, 94 medical/surgical wards, 5 surgical wards) from 109 hospitals.

**[Response Ends]**

**2a.08. List the social risk factors that were available and analyzed.**

*For example, patient-reported data (e.g., income, education, language), proxy variables when social risk data are not collected from each patient (e.g. census tract), or patient community characteristics (e.g. percent vacant housing, crime rate) which do not have to be a proxy for patient-level data.*

**[Response Begins]**

No patient-level sociodemographic variables are used in the measure and none were available for analysis.

**[Response Ends]**

Note: If accuracy/correctness (validity) of data elements was empirically tested, separate reliability testing of data elements is not required – in 2a.09 check patient or encounter-level



data; in 2a.010 enter “see validity testing section of data elements”; and enter “N/A” for 2a.11 and 2a.12.

**2a.09. Select the level of reliability testing conducted.**

*Choose one or both levels.*

**[Response Begins]**

Patient or Encounter-Level (e.g., inter-abstractor reliability; data element reliability must address ALL critical data elements)

**[Response Ends]**

**2a.10. For each level of reliability testing checked above, describe the method of reliability testing and what it tests.**

*Describe the steps—do not just name a method; what type of error does it test; what statistical analysis was used.*

**[Response Begins]**

**Data collection**

Through this multi-step process, hospitals compared the antimicrobial use data in the local eMAR or BCMA system to the antimicrobial use data that were collected using the third party software vendor system or the healthcare system’s corporate data warehouse to ensure the ‘data feed’ between the two systems, from eMAR or BCMA system to vendor system or data warehouse, was accurate. The data collected via the third party software system or corporate data warehouse are the data transferred to NHSN. Note: While the antimicrobial use data in the local eMAR or BCMA system was considered the gold standard, some hospitals did identify inconsistencies in their local systems that were addressed during the process. The steps used for reliability testing are as follows:

1. Hospitals manually review antimicrobial use line list generated from the eMAR or BCMA system to verify that all required antimicrobials are present on the line list or appropriately absent.
2. Hospitals manually review routes of antimicrobial administration collected to verify that all route data are accurately collected from eMAR or BCMA systems.
3. Hospitals include patient care location data from ADT systems in manual verification of antimicrobial administration and route of administration per patient per calendar day in three separate patient locations.

**Data Aggregation**

Through this process, hospitals and third party software vendors compared the numerator and denominator data in the third party software system pre- and post-aggregation completed by the software to ensure that the software was correctly aggregating the patient-level information. The gold standard in this process was the data obtained from eMAR, BCMA, and/or ADT systems.

1. Hospitals verify that day of discharge and transfer from a patient care location are included in aggregations of antimicrobial days and days present.
2. Hospitals confirm that facility-wide counts of days present conform to the NHSN protocol requirements.

**[Response Ends]**

**2a.11. For each level of reliability testing checked above, what were the statistical results from reliability testing?**

*For example, provide the percent agreement and kappa for the critical data elements, or distribution of reliability statistics from a signal-to-noise analysis. For score-level reliability testing, when using a signal-to-noise analysis, more than just one overall statistic should be reported (i.e., to demonstrate variation in reliability across providers). If a particular method yields only one statistic, this should be explained. In addition, reporting of results stratified by sample size is preferred (pg. 18, [NQF Measure Evaluation Criteria](#)).*

**[Response Begins]**

Percent agreement was used as the summary measure for reliability testing during the initial testing, 2011 through 2014, and the more recent testing, 2016 through 2018. NHSN's rules for what constitutes an antimicrobial day or a day present were invoked to confirm (or refute) that the third party vendor solution or corporate data warehouse conformed to the requirements. The CDC protocol for testing reliability of antimicrobial days and days present—and the percent agreement—was used to identify and correct systematic data omissions or erroneous data transformations before the reportable data were submitted to NHSN. The gold standard used to measure the percent agreement was the data in the local eMAR or BCMA system, which provided the basis for comparison with the measure data to be submitted from either a third party software system or a data warehouse. Percent agreement ranged from 60% to 80% for measure data elements at the outset of validation process, and by design the process led to >99% agreement for all required data elements prior to data submission to CDC.

**[Response Ends]**

**2a.12. Interpret the results, in terms of how they demonstrate reliability.**

*(In other words, what do the results mean and what are the norms for the test conducted?)*

**[Response Begins]**

Highly reliable data.

**[Response Ends]**

**2b.01. Select the level of validity testing that was conducted.**

**[Response Begins]**

Systematic assessment of face validity of performance measure score as an indicator of quality or resource use (i.e., is an accurate reflection of performance on quality or resource use and can distinguish good from poor performance)

**[Response Ends]**

**2b.02. For each level of testing checked above, describe the method of validity testing and what it tests.**

*Describe the steps—do not just name a method; what was tested, e.g., accuracy of data elements compared to authoritative source, relationship to another measure as expected; what statistical analysis was used.*

**[Response Begins]**

Validity testing of the core measure data elements, antimicrobial days (i.e., days of therapy) and days present, and the core measure construct of antimicrobial groupings was completed by means of consensus development using a Delphi process during a series of meetings conducted from April to July 2018 among outside expert panel of Infectious Disease physicians and clinical pharmacists who are leaders in their domain. The full list of panelists can be found below.

Expert panel informing Adult Standardized Antimicrobial Administration Ratio (SAARs):

Name	Title	Affiliation
Christopher Graber, MD	Infectious Disease Specialist, Clinical Director, VA Greater Los Angeles Antimicrobial Stewardship Program Director	VA Greater Los Angeles Healthcare System
Clark Force, RPh	Antimicrobial Stewardship Pharmacist	Tucson Medical Center
Eddie Stenehjem, MD	Medical Director of Intermountain Healthcare's Urban Central Region Antimicrobial Stewardship Program	Intermountain Healthcare
Edward Septimus, MD	Medical Director Infection Prevention and Epidemiology	Clinical Services Group HCA Healthcare System
Elizabeth Dodds-Ashley, PharmD	Associate Professor of Medicine, Clinical Pharmacist	Duke Antimicrobial Stewardship Outreach Network
Florian Daragjati, PharmD	Pharmacy Coordinator, Ascension Center for Excellence for Antimicrobial Stewardship and Infection Prevention	Ascension
Haley Burgess, PharmD	AVP, Clinical Pharmacy and Medication Safety	Clinical Services Group HCA Healthcare System
Kalvin Yu, MD	Regional Chief of Infectious Diseases, Southern California Permanente Medical Group	Kaiser Permanente West Los Angeles Medical Center
Kevin Hsueh, MD	Medical Director of Antimicrobial Stewardship, Associate Medical Director for Infection Prevention	Washington University School of Medicine
Makoto Jones, MD	Infectious Disease Physician, Associate Professor at University of Utah	VA Salt Lake City Healthcare System
Marc Meyer, BPharm, RPh	Clinical Pharmacist for Southwest Health System	Southwest Memorial Hospital
Marc Scheetz, PharmD	Infectious Disease Pharmacist	Northwestern Memorial Hospital
Matthew Goetz, MD	Chief, Infectious Diseases	VA Greater Los Angeles Healthcare System
Mohamad Fakih, MD	Senior Medical Director, Ascension Center for Excellence for Antimicrobial Stewardship and Infection Prevention	Ascension
Rebecca Battjes, MPH	Infection Preventionist	Ascension St. John Hospital
Rebekah Moehring, MD	Medical Director, Duke Antimicrobial Stewardship and Evaluation Team	Duke Center for Antimicrobial Stewardship and Infection Prevention, Duke Medical Center
Stanley Deresinski, MD	Clinical Professor of Medicine, Division of Infectious Diseases and Geographic Medicine	Stanford University School of Medicine
Whitney Buckel, PharmD	Antimicrobial Stewardship Pharmacist Manager	Intermountain Healthcare

Expert panel informing Pediatric SAARs:

Name	Title	Affiliation
Adam Hersh, MD, PhD	Associate Professor of Pediatrics, Division of Pediatric Infectious Diseases	University of Utah
Andrea Benin, MD	Senior Vice President, Quality and Patient Safety	Connecticut Children's Medical Center
Jared Olson, PharmD	Clinical Pharmacist, Infectious Diseases, Co-Director of Antimicrobial Stewardship Program	Intermountain Healthcare, Primary Children's Medical Center
Jason Child, PharmD	HIV/Infectious Diseases Clinical Specialist, Co-Director of Antimicrobial Stewardship	Children's Hospital Colorado
Jason Newland, MD	Professor of Pediatrics, Director of Antimicrobial Stewardship Program	Washington University, St. Louis Children's Hospital
Jeffrey Gerber, MD, PhD	Medical Director, Antimicrobial Stewardship Program, Associate Director for Pediatric Clinical Effectiveness	Children's Hospital of Philadelphia
Jennifer Giroto, PharmD	Associate Clinical Professor of Pharmacy Practice, Department of Pharmacy Practice	Connecticut Children's Medical Center
Matthew Kronman, MD	Associate Professor, Division of Infectious Diseases	Seattle Children's Hospital
Michael Smith, MD	Associate Professor of Pediatrics, Pediatric Infectious Diseases, Medical Director Pediatric Antimicrobial Stewardship	Duke University Medical Center
Pranita Tamma, MD	Director, Pediatric Antimicrobial Stewardship Program, Assistant Professor, Pediatrics	John Hopkins University School of Medicine
Ritu Banerjee, MD, PhD	Associate Professor of Pediatrics, Pediatric Infectious Diseases Specialist	Vanderbilt University School of Medicine

**[Response Ends]**

**2b.03. Provide the statistical results from validity testing.**

*Examples may include correlations or t-test results.*

**[Response Begins]**

**[Response Ends]**

**2b.04. Provide your interpretation of the results in terms of demonstrating validity. (i.e., what do the results mean and what are the norms for the test conducted?)**

**[Response Begins]**

Face validity of core measure data elements and measure constructs (i.e. antimicrobial groupings) demonstrated through a Delphi process at series of meetings with SME stakeholders beginning in April 2018.

**[Response Ends]**

**2b.05. Describe the method for determining if statistically significant and clinically/practically meaningful differences in performance measure scores among the measured entities can be identified.**

*Describe the steps—do not just name a method; what statistical analysis was used? Do not just repeat the information provided in Importance to Measure and Report: Gap in Care/Disparities.*

**[Response Begins]**

The models calculated the predicted number of antimicrobial days. These predicted numbers were summed to the appropriate level (either adult ICUs, adult wards, pediatric ICUs, pediatric wards, all adult ward and ICU locations, all pediatric ward and ICU locations). The Standardized Antimicrobial Administration Ratio (SAAR) and confidence interval were calculated as: reported number of antimicrobial days/predicted number of antimicrobial days. If observed and predicted antimicrobial days are  $\leq 100$ , the mid-p exact test is used to calculate 95% confidence intervals around SAAR values and calculate p-values by comparing SAAR values to a SAAR of 1. If observed and predicted antimicrobial days are  $>100$ , the Byar approximation method is used, assuming identical results with mid-P, based on the large sample theory, to calculate 95% confidence intervals and p-values for each SAAR value.

The SAAR is a summary metric that compares observed days of therapy to predicted days of therapy. A SAAR=1 indicates that antimicrobial use is equivalent to the referent group's antimicrobial use. A SAAR that is less than 1 may indicate antimicrobial underuse and a SAAR that is greater than 1 may indicate antimicrobial overuse. A SAAR alone, however, is not a definitive measure of the appropriateness or judiciousness of antimicrobial use and any SAAR value may warrant further investigation. Also, a SAAR that is statistically different from 1 does not mean that further investigation will be productive in identifying opportunities for improvement in antimicrobial use.

**[Response Ends]**

**2b.06. Describe the statistical results from testing the ability to identify statistically significant and/or clinically/practically meaningful differences in performance measure scores across measured entities.**

*Examples may include number and percentage of entities with scores that were statistically significantly different from mean or some benchmark, different from expected; how was meaningful difference defined.*

**[Response Begins]**

A meaningful difference in the SAAR was defined as a SAAR and a confidence interval that was statistically different from 1. See attached Table 3. NHSN Antimicrobial Use Measure Proposal for the number of patient care locations that had a statistically significant higher SAAR and the number of patient care locations that a statistically significant lower SAAR for each antimicrobial agent group.

First, for each group of SAAR antimicrobial agents, univariate analyses were conducted to assess each hospital- and patient care-level factor using Negative Binomial regression. Univariate analysis results were assessed using Wald and likelihood ratio Chi-square tests at a 0.05 significance level. Forward stagewise regression allowed for models to be built by incrementally using Wald and likelihood Chi-square tests at a 0.05 significance level to assess variable significance and Akaike & Bayesian Information Criteria and likelihood ratio tests to assess improvement in model fit. Best fit models were chosen by assessing Akaike and Bayesian Information Criteria along with standard errors and sample size in each level of stratification. Models with lowest AIC and/or BIC were selected, data was tested for influential observations, and sample sizes of stratification groups were assessed. NHSN required sufficient sample size across strata to evaluate any particular stratification that resulted in any parameterizations of the final models.

**[Response Ends]**

**2b.07. Provide your interpretation of the results in terms of demonstrating the ability to identify statistically significant and/or clinically/practically meaningful differences in performance across measured entities.**

*In other words, what do the results mean in terms of statistical and meaningful differences?*

**[Response Begins]**

SAAR calculations for each combination of patient care locations and antimicrobials provide summary results, which if statistically significant (i.e., statistically higher or lower than 1.0) are an indicator of possible overuse or underuse of antimicrobials. In practical terms, statistically significant SAAR results provide signals that warrant further evaluation, which can include medication use evaluations by antimicrobial stewardship programs (ASPs) for specific antimicrobial agents included in a SAAR antimicrobial category. While SAAR results that achieve statistical significance are not a definitive measure of appropriateness or judiciousness of antimicrobial use, ASPs use SAAR values to identify priorities for further analysis and possible action, and ASPs use SAAR values as a way to gauge impact of ASP interventions.

**[Response Ends]**

**2b.08. Describe the method of testing conducted to identify the extent and distribution of missing data (or non-response) and demonstrate that performance results are not biased due**

**to systematic missing data (or differences between responders and non-responders). Include how the specified handling of missing data minimizes bias.**

*Describe the steps—do not just name a method; what statistical analysis was used.*

**[Response Begins]**

Data files submitted with missing data elements are rejected electronically. Corrected data files are then resubmitted and accepted when complete.

**[Response Ends]**

**2b.09. Provide the overall frequency of missing data, the distribution of missing data across providers, and the results from testing related to missing data.**

*For example, provide results of sensitivity analysis of the effect of various rules for missing data/non-response. If no empirical sensitivity analysis was conducted, identify the approaches for handling missing data that were considered and benefits and drawbacks of each).*

**[Response Begins]**

AU numerator and denominator must be complete before the data files can be accepted into NHSN and used in the analyses.

**[Response Ends]**

**2b.10. Provide your interpretation of the results, in terms of demonstrating that performance results are not biased due to systematic missing data (or differences between responders and non-responders), and how the specified handling of missing data minimizes bias.**

*In other words, what do the results mean in terms of supporting the selected approach for missing data and what are the norms for the test conducted; if no empirical analysis was conducted, justify the selected approach for missing data.*

**[Response Begins]**

NA

**[Response Ends]**

Note: This item is directed to measures that are risk-adjusted (with or without social risk factors) OR to measures with more than one set of specifications/instructions (e.g., one set of specifications for how to identify and compute the measure from medical record abstraction and a different set of specifications for claims or eQMs). It does not apply to measures that use more than one source of data in one set of specifications/instructions (e.g., claims data to identify the denominator and medical record abstraction for the numerator). Comparability is not required when comparing performance scores with and without social risk factors in the risk adjustment model. However, if comparability is not demonstrated for measures with more than one set of specifications/instructions, the different specifications (e.g., for medical records vs. claims) should be submitted as separate measures.

**2b.11. Indicate whether there is more than one set of specifications for this measure.**

**[Response Begins]**

No, there is only one set of specifications for this measure

**[Response Ends]**

**2b.12. Describe the method of testing conducted to compare performance scores for the same entities across the different data sources/specifications.**

*Describe the steps—do not just name a method. Indicate what statistical analysis was used.*

**[Response Begins]**

**[Response Ends]**

**2b.13. Provide the statistical results from testing comparability of performance scores for the same entities when using different data sources/specifications.**

*Examples may include correlation, and/or rank order.*

**[Response Begins]**

**[Response Ends]**

**2b.14. Provide your interpretation of the results in terms of the differences in performance measure scores for the same entities across the different data sources/specifications.**

*In other words, what do the results mean and what are the norms for the test conducted.*

**[Response Begins]**

**[Response Ends]**

**2b.15. Indicate whether the measure uses exclusions.**

**[Response Begins]**

Yes, the measure uses exclusions.

**[Response Ends]**

**2b.16. Describe the method of testing exclusions and what was tested.**

*Describe the steps—do not just name a method; what was tested, e.g., whether exclusions affect overall performance scores; what statistical analysis was used?*

**[Response Begins]**

Not tested

**[Response Ends]**

**2b.17. Provide the statistical results from testing exclusions.**

*Include overall number and percentage of individuals excluded, frequency distribution of exclusions across measured entities, and impact on performance measure scores.*

[Response Begins]

[Response Ends]

**2b.18. Provide your interpretation of the results, in terms of demonstrating that exclusions are needed to prevent unfair distortion of performance results.**

*In other words, the value outweighs the burden of increased data collection and analysis. Note: If patient preference is an exclusion, the measure must be specified so that the effect on the performance score is transparent, e.g., scores with and without exclusion.*

[Response Begins]

[Response Ends]

**2b.19. Check all methods used to address risk factors.**

[Response Begins]

Statistical risk model with risk factors (specify number of risk factors)

[Response Ends]

**2b.20. If using statistical risk models, provide detailed risk model specifications, including the risk model method, risk factors, risk factor data sources, coefficients, equations, codes with descriptors, and definitions.**

[Response Begins]

Statistical risk models were used to identify factors associated with differences in rates of antimicrobial use at the patient care location-level. Predictive models were constructed using forward stage wise Negative Binomial regression. In order to maximize objectivity in decision making and confidence in model results, two analysts independently developed predictive models for each group of antimicrobial agents. Final models developed by each analyst were compared and any differences in results were discussed among a team of analysts, statisticians, and subject matter experts. Final models are used to calculate predicted days of therapy adjusting for factors found to be statistically significantly associated with rates of antimicrobial use.

Hospital- and location-level variables were considered in predictive models.

Hospital-level factors:

- Hospital type: general acute care, critical access, children's, military, oncology, surgical, VA, women's, women's & children's
- Hospital teaching status: non-teaching, undergraduate only (medical students), graduate only (residents and/or fellows), major (medical school and post-graduate training)
- Total number of hospital beds
- Total number of hospital ICU beds
- Percentage of beds designated ICU beds- calculated as (total no. ICU beds/total no. beds)x100
- Average length of stay- calculated as (annual patient days/annual admissions)

Location-level factors:



- Patient care location: parameterized in different ways, levels with similar parameter estimates were grouped further
  - Example parameterization:
    - Unique patient care locations: medical ICU vs. medical-surgical ICU vs. surgical ICU vs. medical ward vs. medical-surgical ward vs. surgical ward vs. general hematology-oncology ward vs. step-down unit
    - Grouped by location type: ICU vs. ward vs. Onc vs. step-down

Significance of variables was assessed using Wald and likelihood ratio Chi-square tests at a 0.05 significance level and model fit improvement was assessed using Akaike Information Criterion and Bayesian Information Criterion.

[Response Ends]

**2b.21. If an outcome or resource use measure is not risk-adjusted or stratified, provide rationale and analyses to demonstrate that controlling for differences in patient characteristics (i.e., case mix) is not needed to achieve fair comparisons across measured entities.**

[Response Begins]

N/A

[Response Ends]

**2b.22. Select all applicable resources and methods used to develop the conceptual model of how social risk impacts this outcome.**

[Response Begins]

Internal data analysis

[Response Ends]

**2b.23. Describe the conceptual and statistical methods and criteria used to test and select patient-level risk factors (e.g., clinical factors, social risk factors) used in the statistical risk model or for stratification by risk.**

*Please be sure to address the following: potential factors identified in the literature and/or expert panel; regression analysis; statistical significance of  $p < 0.10$  or other statistical tests; correlation of  $x$  or higher. Patient factors should be present at the start of care, if applicable. Also discuss any "ordering" of risk factor inclusion; note whether social risk factors are added after all clinical factors. Discuss any considerations regarding data sources (e.g., availability, specificity).*

[Response Begins]

The variables considered for the predictive models of antimicrobial use rates are hospital- and patient care level-characteristics that hospitals report to the National Healthcare Safety Network (NHSN). No patient-level data are reported to the NHSN Antimicrobial Use and Resistance (AUR) Module. The potential factors considered for the model were: hospital teaching status (major [medical school and post-graduate training], graduate only [residents and/or fellows], undergraduate only [medical students], not a teaching hospital); hospital bedsize; hospital ICU bedsize; percentage of ICU beds (among all beds); average length of stay (number of annual patient days divided by annual admissions); patient care location. The predictive models were constructed using forward stagewise Negative Binomial regression assessing Wald and likelihood

ratio Chi-square tests at a 0.05 significance level and model fit improvement using Akaike and Bayesian Information Criterion.

No patient level factors are included in this statistical risk models. However hospital and patient care location characteristics are used because of empirical evidence of AU variation associated with these characteristics.

Patient care location is indicative of patient mix and taken into account in predictive models. Adult patient care locations assessed in predictive models include: medical, medical-surgical, and surgical ICUs and wards, general hematology-oncology wards, and step-down units. Pediatric patient care locations assessed include: medical and medical-surgical ICUs and wards, and surgical wards. There were 0 pediatric surgical ICUs reporting to the AU Option in 2017. Patient care locations eligible for inclusion in predictive models were selected through expert panel discussions.

**[Response Ends]**

**2b.24. Detail the statistical results of the analyses used to test and select risk factors for inclusion in or exclusion from the risk model/stratification.**

**[Response Begins]**

First, for each group of SAAR antimicrobial agents, univariate analyses were conducted to assess each hospital- and patient care-level factor using Negative Binomial regression. Univariate analysis results were assessed using Wald and likelihood ratio Chi-square tests at a 0.05 significance level. Forward stage wise regression allowed for models to be built by incrementally using Wald and likelihood Chi-square tests at a 0.05 significance level to assess variable significance and Akaike & Bayesian Information Criteria and likelihood ratio tests to assess improvement in model fit. Best fit models were chosen by assessing Akaike and Bayesian Information Criteria along with standard errors and sample size in each level of stratification.

Adult SAAR Model Results:

BROAD SPECTRUM ANTIBACTERIAL AGENTS PREDOMINANTLY USED FOR HOSPITAL-ONSET INFECTIONS						
AIC=32426.53, BIC=32505.99						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-2.3357	0.049	-2.432	-2.239	2260.98	<.0001
Location type						
Medical ICU	1.0084	0.044	0.923	1.094	531.59	<.0001
Medical-Surgical ICU, Surgical ICU	0.8825	0.028	0.827	0.938	982.03	<.0001
General Hematology-Oncology Ward	0.3795	0.058	0.266	0.493	43.13	<.0001
Step-down Unit	0.2197	0.031	0.158	0.281	49.33	<.0001
Medical Ward	0.0781	0.027	0.025	0.132	8.25	0.0041
Medical-Surgical Ward, Surgical Ward	REF	.	.	.	.	.
Facility type						
Veteran's Affairs	-0.1821	0.030	-0.240	-0.124	37.96	<.0001
Critical access	-0.2465	0.088	-0.418	-0.075	7.92	0.0049
Military	-0.6278	0.063	-0.751	-0.505	99.86	<.0001
Women's	-1.1920	0.328	-1.834	-0.550	13.25	0.0003
General acute care, Oncology, Surgical, Women's & Children's	REF	.	.	.	.	.
Number of ICU beds, facility-wide						
≥8	0.1734	0.048	0.079	0.268	13.07	0.0003
<8	REF	.	.	.	.	.
Average length of stay, facility-wide (in days)						
≥3.6	0.1091	0.026	0.059	0.160	18.02	<.0001
<3.6	REF	.	.	.	.	.
Medical school affiliation type						
Undergraduate only	0.1394	0.030	0.081	0.198	22.09	<.0001
None, Graduate, Major	REF	.	.	.	.	.

  

BROAD SPECTRUM ANTIBACTERIAL AGENTS PREDOMINANTLY USED FOR COMMUNITY-ACQUIRED INFECTIONS						
AIC=31167.69, BIC=31241.48						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-3.9491	0.182	-4.305	-3.593	472.89	<.0001
Location type						
Medical ICU, Medical Ward, General Hematology-Oncology Ward	0.3598	0.026	0.310	0.410	197.15	<.0001
Medical-Surgical ICU, Medical-Surgical Ward	0.2938	0.025	0.245	0.343	136.88	<.0001
Step-down Unit	0.2083	0.030	0.149	0.268	46.93	<.0001
Surgical ICU, Surgical Ward	REF	.	.	.	.	.
Facility type						
Critical access, General acute care, Oncology	1.5380	0.180	1.186	1.890	73.19	<.0001
Surgical, Veteran's Affairs	1.2805	0.182	0.924	1.638	49.42	<.0001
Military	1.0781	0.187	0.712	1.444	33.36	<.0001
Womens, Womens Childrens	REF	.	.	.	.	.
Average length of stay, facility-wide (in days)						
<4.5	0.1714	0.022	0.129	0.214	63.64	<.0001
4.5 - 5.1	0.1128	0.023	0.068	0.158	23.95	<.0001
≥5.2	REF	.	.	.	.	.
Number of hospital beds, facility-wide						
<135	0.2505	0.025	0.201	0.300	99.39	<.0001
135 - 330	0.1545	0.019	0.117	0.192	65.90	<.0001
≥331	REF	.	.	.	.	.
ICU beds (as a percentage of total beds)						
<7.6%	0.1198	0.025	0.071	0.169	23.20	<.0001
≥7.6%	REF	.	.	.	.	.

ANTIBACTERIAL AGENTS PREDOMINANTLY USED FOR RESISTANT GRAM-POSITIVE INFECTIONS (e.g., MRSA)						
AIC=30225.82, BIC=30271.22						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-4.0018	0.200	-4.393	-3.611	402.38	<.0001
Location type						
Medical ICU, Medical-Surgical ICU, Surgical ICU	0.8382	0.032	0.775	0.902	667.29	<.0001
Med Ward, Med-Surg Ward, General Hematology-Oncology, Step-down	0.1443	0.029	0.088	0.201	24.78	<.0001
Surgical Ward	REF	.	.	.	.	.
Facility type						
Critical access, General acute care, Oncology, Surgical, Veteran's Affairs	1.1291	0.195	0.748	1.510	33.69	<.0001
Military	0.7007	0.202	0.305	1.097	12.02	0.0005
Women's, Women's & Children's	REF	.	.	.	.	.
Number of hospital beds, facility-wide						
≥66	0.1619	0.036	0.091	0.233	19.98	<.0001
<66	REF	.	.	.	.	.
Average length of stay, facility-wide (in days)						
≥3.3	0.1913	0.027	0.139	0.244	51.19	<.0001
<3.3	REF	.	.	.	.	.
NARROW SPECTRUM BETA-LACTAM AGENTS						
AIC=30014.69, BIC=30071.45						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-3.2228	0.070	-3.361	-3.085	2101.80	<.0001
Location type						
Surgical ICU, Surgical Ward	1.1285	0.068	0.995	1.262	276.13	<.0001
Medical-Surgical ICU, Medical-Surgical Ward	0.5004	0.064	0.374	0.626	60.55	<.0001
Step-down Unit	0.2857	0.068	0.152	0.420	17.51	<.0001
Medical ICU, Medical Ward	0.2145	0.065	0.087	0.342	10.85	0.001
General Hematology-Oncology Ward	REF	.	.	.	.	.
Average length of stay, facility-wide (in days)						
<3.5	0.2612	0.030	0.202	0.320	75.22	<.0001
≥5.8	0.1726	0.034	0.107	0.238	26.40	<.0001
3.5 - 5.7	REF	.	.	.	.	.
ICU beds (as a percentage of total beds)						
≥8.6%	0.1633	0.030	0.105	0.221	30.48	<.0001
<8.6%	REF	.	.	.	.	.
Number of hospital beds, facility-wide						
≥222	0.1112	0.023	0.066	0.156	23.37	<.0001
<222	REF	.	.	.	.	.

ANTIFUNGAL AGENTS PREDOMINANTLY USED FOR INVASIVE CANDIDIASIS						
AIC=25043.86, BIC=25128.99						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-6.7391	0.359	-7.443	-6.036	352.37	<.0001
Location type						
Surgical ICU, General Hematology-Oncology Ward	1.2644	0.060	1.146	1.382	440.72	<.0001
Medical ICU, Medical-Surgical ICU	0.8993	0.036	0.828	0.971	609.34	<.0001
Step-down Unit	0.1635	0.043	0.079	0.248	14.45	0.0001
Medical Ward, Medical-Surgical Ward, Surgical Ward	REF	.	.	.	.	.
Number of ICU beds, facility-wide						
≥78	0.7605	0.072	0.620	0.901	113.16	<.0001
15 - 77	0.4798	0.066	0.351	0.608	53.60	<.0001
8 - 14	0.3311	0.071	0.192	0.471	21.62	<.0001
<8	REF	.	.	.	.	.
Number of hospital beds, facility-wide						
176 - 306	0.1611	0.035	0.092	0.231	20.69	<.0001
<176 or ≥307	REF	.	.	.	.	.
Facility type						
Oncology	3.5368	0.592	2.377	4.696	35.74	<.0001
Critical access, General acute care, Surgical	1.9238	0.355	1.229	2.619	29.42	<.0001
Military, Veteran's Affairs	1.5391	0.358	0.838	2.240	18.53	<.0001
Women's, Women's & Children's	REF	.	.	.	.	.
Average length of stay, facility-wide (in days)						
≥5.2	0.3836	0.055	0.276	0.492	48.45	<.0001
4.5 - 5.1	0.2550	0.055	0.148	0.362	21.86	<.0001
3.0 - 4.4	0.1685	0.052	0.067	0.270	10.56	0.0012
<3.0	REF	.	.	.	.	.
COMPLEMENTARY AGENTS (aka Other antibacterials)						
AIC=30919.59, BIC=30970.67						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-2.5547	0.053	-2.658	-2.451	2343.21	<.0001
Location type						
Medical ICU	0.4980	0.039	0.422	0.574	163.19	<.0001
Medical-Surgical ICU	0.3324	0.030	0.273	0.392	120.09	<.0001
Surgical ICU, Medical Ward, Medical-Surgical Ward	0.2152	0.025	0.166	0.265	73.30	<.0001
General Hematology-Oncology Ward, Step-down Unit	0.1477	0.030	0.090	0.205	25.14	<.0001
Surgical Ward	REF	.	.	.	.	.
Average length of stay, facility-wide (in days)						
<3	0.1850	0.025	0.136	0.234	54.60	<.0001
≥3	REF	.	.	.	.	.
Facility type						
Critical access, General, Oncology, Surgical, Women's, Women's & Children's	0.3758	0.049	0.281	0.471	59.71	<.0001
Veteran's Affairs	0.2708	0.052	0.168	0.374	26.75	<.0001
Military	REF	.	.	.	.	.

ANTIBACTERIAL AGENTS POSING THE HIGHEST RISK FOR CDI						
AIC=32174.91, BIC=32237.35						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-2.6749	0.056	-2.784	-2.566	2323.70	<.0001
Location type						
Medical ICU, Medical-Surgical ICU, General Hematology-Oncology Ward	0.4922	0.028	0.437	0.547	309.10	<.0001
Medical Ward	0.3392	0.029	0.283	0.395	141.54	<.0001
Surgical ICU, Medical-Surgical Ward, Step-down Unit	0.2687	0.026	0.218	0.320	107.26	<.0001
Surgical Ward	REF	.	.	.	.	.
Facility type						
Critical access, General acute care, Oncology, Surgical	0.5005	0.048	0.407	0.594	109.63	<.0001
Veteran's Affairs	0.2427	0.052	0.141	0.345	21.85	<.0001
Military, Women's, Women's & Children's	REF	.	.	.	.	.
Medical school affiliation type						
None, undergraduate, graduate	0.0810	0.018	0.046	0.116	21.04	<.0001
Major	REF	.	.	.	.	.
Average length of stay, facility-wide (in days)						
<5.2	0.0773	0.019	0.039	0.115	15.87	<.0001
$\geq 5.2$	REF	.	.	.	.	.
Number of hospital beds, facility-wide						
<442	0.1469	0.022	0.105	0.189	46.73	<.0001
$\geq 442$	REF	.	.	.	.	.
Number of ICU beds, facility-wide						
<15	0.0628	0.020	0.023	0.103	9.60	0.0019
$\geq 15$	REF	.	.	.	.	.

Pediatric SAAR Model Results:

BROAD SPECTRUM ANTIBACTERIAL AGENTS PREDOMINANTLY USED FOR HOSPITAL-ONSET INFECTIONS						
AIC=2240.68, BIC=2256.36						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-3.0042	0.160	-3.317	-2.691	354.40	<.0001
ICU beds (as a percentage of total beds)						
$\geq 16.6\%$	0.2954	0.121	0.059	0.532	5.99	0.0144
<16.6%	REF	.	.	.	.	.
Location/Facility type combination						
Med-Surg ICUs in Children's, General, Military, Women's & Children's hospitals ; Med Wards in Children's hospitals	0.7558	0.182	0.400	1.112	17.30	<.0001
Med-Surg Wards in Children's, General, Military, Women's & Children's hospitals	0.4056	0.164	0.084	0.727	6.11	0.0134
Med ICUs in General acute care hospitals ; Med Wards in General, Military, Women's & Children's hospitals ; Surgical Wards in Children's, General acute care hospitals	REF	.	.	.	.	.

BROAD SPECTRUM ANTIBACTERIAL AGENTS PREDOMINANTLY USED FOR COMMUNITY-ACQUIRED INFECTIONS						
AIC=2234.81, BIC=2250.49						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-2.8862	0.118	-3.118	-2.655	596.67	<.0001
Number of hospital beds, facility-wide						
<450	0.4758	0.081	0.318	0.634	34.87	<.0001
$\geq 450$	REF	.	.	.	.	.
Facility Type						
General acute care, Womens Childrens	0.5476	0.091	0.369	0.726	36.23	<.0001
Childrens, Military	REF	.	.	.	.	.
Location type						
Medical-Surgical ICU, Medical ICU	0.2629	0.075	0.116	0.410	12.28	0.0005
Medical-Surgical Ward, Medical Ward, Surgical Ward	REF	.	.	.	.	.

NARROW SPECTRUM BETA-LACTAM AGENTS						
AIC=2116.13, BIC=2128.67						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-2.4703	0.043	-2.555	-2.386	3261.86	<.0001
Location/Facility type combination						
Med-Surg ICUs in Children's hospitals ; Surgical Wards in Children's, General acute care hospitals	0.6571	0.132	0.399	0.915	24.98	<.0001
Med and Med-Surg Wards in Children's, General, Military, Women's & Children's hospitals ; Med-Surg ICUs in General, Military, Women's & Children's hospitals ; Med ICUs in General acute care hospitals	REF	.	.	.	.	.
Number of hospital beds, facility-wide						
<204 or ≥450	0.3161	0.063	0.193	0.440	25.19	<.0001
204 - 449	REF	.	.	.	.	.
ANTIBACTERIAL AGENTS PREDOMINANTLY USED FOR RESISTANT GRAM-POSITIVE INFECTIONS (e.g., MRSA)						
AIC=2165.44, BIC=2174.85						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-2.5518	0.052	-2.653	-2.451	2436.92	<.0001
ICU location	0.4608	0.095	0.274	0.648	23.35	<.0001
AZITHROMYCIN						
AIC=1834.04, BIC=1855.99						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-6.2324	0.388	-6.993	-5.472	258.24	<.0001
Location type						
Medical-Surgical ICU, Medical ICU	2.3497	0.387	1.590	3.109	36.79	<.0001
Medical-Surgical Ward, Medical Ward	1.9694	0.380	1.224	2.715	26.82	<.0001
Surgical Ward	REF	.	.	.	.	.
Number of hospital beds, facility-wide						
<204	0.3832	0.185	0.020	0.746	4.28	0.0385
204 - 276	1.3460	0.187	0.980	1.712	51.91	<.0001
277 - 449	0.8030	0.149	0.512	1.094	29.23	<.0001
≥450	REF	.	.	.	.	.
ANTIFUNGAL AGENTS PREDOMINANTLY USED FOR INVASIVE CANDIDIASIS						
AIC=1503.42, BIC=1515.94						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-5.5790	0.139	-5.852	-5.306	1608.54	<.0001
ICU beds (as a percentage of total beds)						
≥16.6%	0.9569	0.171	0.621	1.292	31.25	<.0001
<16.6%	REF	.	.	.	.	.
Location type						
Medical-Surgical ICU, Medical ICU	1.1361	0.174	0.795	1.477	42.61	<.0001
Medical-Surgical Ward, Medical Ward, Surgical Ward	REF	.	.	.	.	.



COMPLEMENTARY AGENTS (aka Other antibacterials)						
AIC=2049.02, BIC=2064.69						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-3.3383	0.087	-3.509	-3.168	1467.30	<.0001
ICU beds (as a percentage of total beds)						
$\geq 16.6\%$	0.6375	0.087	0.468	0.808	54.01	<.0001
<16.6%	REF	.	.	.	.	.
Average length of stay, facility-wide (in days)						
$\geq 4.5$	0.2378	0.087	0.068	0.408	7.49	0.0062
<4.5	REF	.	.	.	.	.
Number of hospital beds, facility-wide						
$\geq 450$	0.2367	0.097	0.047	0.426	5.99	0.0144
<450	REF	.	.	.	.	.
ANTIBACTERIAL AGENTS POSING THE HIGHEST RISK FOR CDI						
AIC=2379.54, BIC=2398.36						
Parameter	Estimate	Standard Error	Wald 95% Confidence Limits		Wald $\chi^2$	$\chi^2$ P-Value
Intercept	-2.2753	0.118	-2.507	-2.044	371.36	<.0001
Location type						
Medical-Surgical ICU, Medical ICU	0.2711	0.081	0.113	0.429	11.33	0.0008
Medical-Surgical Ward, Medical Ward, Surgical Ward	REF	.	.	.	.	.
Number of hospital beds, facility-wide						
<386	0.3145	0.079	0.159	0.470	15.72	<.0001
$\geq 386$	REF	.	.	.	.	.
Average length of stay, facility-wide (in days)						
4.1 - 4.7	0.2139	0.083	0.051	0.377	6.65	0.0099
<4.1 or $\geq 4.8$	REF	.	.	.	.	.
Facility type						
General acute care, Women's & Children's	0.3656	0.100	0.170	0.562	13.36	0.0003
Children's, Military	REF	.	.	.	.	.

[Response Ends]

**2b.25. Describe the analyses and interpretation resulting in the decision to select or not select social risk factors.**

*Examples may include prevalence of the factor across measured entities, availability of the data source, empirical association with the outcome, contribution of unique variation in the outcome, or assessment of between-unit effects and within-unit effects. Also describe the impact of adjusting for risk (or making no adjustment) on providers at high or low extremes of risk.*

[Response Begins]

Did not incorporate social risk factors due to the absence of data demonstrating that these factors should be included in AU predictive models.

[Response Ends]



**2b.26. Describe the method of testing/analysis used to develop and validate the adequacy of the statistical model or stratification approach (describe the steps—do not just name a method; what statistical analysis was used). Provide the statistical results from testing the approach to control for differences in patient characteristics (i.e., case mix) below. If stratified ONLY, enter “N/A” for questions about the statistical risk model discrimination and calibration statistics.**

*Validation testing should be conducted in a data set that is separate from the one used to develop the model.*

**[Response Begins]**

See 2b.25)

Risk adjustment is done with a statistical risk model. The variables considered for the predictive models of antimicrobial use rates are hospital- and patient care level-characteristics that hospitals report to the National Healthcare Safety Network (NHSN). No patient-level data are reported to the NHSN Antimicrobial Use and Resistance (AUR) Module. Adult and pediatric patient care locations and antimicrobial agent groups were modeled separately to further control for differences in use across different locations and patient populations. The predictive models were constructed using forward stagewise Negative Binomial regression assessing Wald and likelihood ratio Chi-square tests at a 0.05 significance level and model fit improvement using Akaike and Bayesian Information Criterion.

First, for each group of SAAR antimicrobial agents, univariate analyses were conducted to assess each hospital- and patient care-level factor using Negative Binomial regression. Univariate analysis results were assessed using Wald and likelihood ratio Chi-square tests at a 0.05 significance level. Forward stagewise regression allowed for models to be built by incrementally using Wald and likelihood Chi-square tests at a 0.05 significance level to assess variable significance and Akaike & Bayesian Information Criteria and likelihood ratio tests to assess improvement in model fit. Best fit models were chosen by assessing Akaike and Bayesian Information Criteria along with standard errors and sample size in each level of stratification.

Models with lowest AIC and/or BIC were selected, data was tested for influential observations, and sample sizes of stratification groups were assessed. NHSN required sufficient sample size across strata to evaluate any particular stratification that resulted in any parameterizations of the final models.

Bootstrap validation was conducted to validate performance of predictive models selected for each group of adult and pediatric antimicrobial agent categories.

**[Response Ends]**

**2b.27. Provide risk model discrimination statistics.**

*For example, provide c-statistics or R-squared values.*

**[Response Begins]**

Likelihood Ratio Test, Akaike and Bayesian Information Criterion.

#2720 National Healthcare Safety Network (NHSN) Antimicrobial Use Measure, Submission Last  
Updated: Dec 05, 2022

		Akaike Information Criterion (AIC)	Bayesian Information Criterion (BIC)	Likelihood Ratio Test <sup>^</sup> Statistic (p-value)
<b>Adult Model</b>				
Broad spectrum antibacterial agents predominantly used for hospital-onset infections	Intercept only model	33735.30	33746.65	--
	Final model	32426.53	32505.99	1332.8 (<0.001)
Broad spectrum antibacterial agents predominantly used for community-acquired infections	Intercept only model	31756.13	31767.48	--
	Final model	31167.69	31241.48	610.4 (<0.001)
Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)	Intercept only model	31325.34	31336.69	--
	Final model	30225.82	30271.22	1111.5 (<0.001)
Narrow-spectrum beta-lactam agents	Intercept only model	30824.46	30835.81	--
	Final model	30014.69	30071.45	825.8 (<0.001)
Antifungal agents predominantly used for invasive candidiasis	Intercept only model	26260.25	26271.60	--
	Final model	25043.86	25128.99	1242.4 (<0.001)
Antibacterial agents posing the highest risk for CDI	Intercept only model	32801.06	32812.42	--
	Final model	32174.91	32237.35	644.1 (<0.001)
Complementary antibacterial agents not found in other mutually exclusive SAAR groups	Intercept only model	31223.64	31234.99	--
	Final model	30919.59	30970.67	318.1 (<0.001)
<sup>^</sup> Final model compared to intercept only model				
<b>Pediatric Model</b>				
Broad spectrum antibacterial agents predominantly used for hospital-onset infections	Intercept only model	2263.49	2269.76	--
	Final model	2240.68	2256.36	28.8 (<0.001)
Broad spectrum antibacterial agents predominantly used for community-acquired infections	Intercept only model	2279.84	2286.11	--
	Final model	2234.81	2250.49	51.0 (<0.001)
Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)	Intercept only model	2186.58	2192.85	--
	Final model	2165.44	2174.85	23.1 (<0.001)
Narrow-spectrum beta-lactam agents	Intercept only model	2157.71	2163.98	--
	Final model	2116.13	2128.67	45.6 (<0.001)
Azithromycin	Intercept only model	1896.47	1902.74	--
	Final model	1834.04	1855.99	72.4 (<0.001)
Antifungal agents predominantly used for invasive candidiasis	Intercept only model	1578.00	1584.26	--
	Final model	1503.42	1515.94	78.6 (<0.001)
Antibacterial agents posing the highest risk for CDI	Intercept only model	2407.35	2413.62	--
	Final model	2379.54	2398.36	35.8 (<0.001)
Complementary antibacterial agents not found in other mutually exclusive SAAR groups	Intercept only model	2100.82	2107.09	--
	Final model	2049.02	2064.69	57.8 (<0.001)
<sup>^</sup> Final model compared to intercept only model				

[Response Ends]

2b.28. Provide the statistical risk model calibration statistics (e.g., Hosmer-Lemeshow statistic).

**[Response Begins]**

Likelihood Ratio Test, Akaike and Bayesian Information Criterion. See 2b.27) for results.

**[Response Ends]**

**2b.29. Provide the risk decile plots or calibration curves used in calibrating the statistical risk model.**

*The preferred file format is .png, but most image formats are acceptable.*

**[Response Begins]**

**[Response Ends]**

**2b.30. Provide the results of the risk stratification analysis.**

**[Response Begins]**

**[Response Ends]**

**2b.31. Provide your interpretation of the results, in terms of demonstrating adequacy of controlling for differences in patient characteristics (i.e., case mix).**

*In other words, what do the results mean and what are the norms for the test conducted?*

**[Response Begins]**

**[Response Ends]**

**2b.32. Describe any additional testing conducted to justify the risk adjustment approach used in specifying the measure.**

*Not required but would provide additional support of adequacy of the risk model, e.g., testing of risk model in another data set; sensitivity analysis for missing data; other methods that were assessed.*

**[Response Begins]**

**[Response Ends]**

### 3. Feasibility

Extent to which the specifications including measure logic, require data that are readily available or could be captured without undue burden and can be implemented for performance measurement.

---

**3.01. Check all methods below that are used to generate the data elements needed to compute the measure score.**

[Response Begins]

[Response Ends]

**3.02. Detail to what extent the specified data elements are available electronically in defined fields.**

*In other words, indicate whether data elements that are needed to compute the performance measure score are in defined, computer-readable fields.*

[Response Begins]

ALL data elements are in defined fields in a combination of electronic sources

[Response Ends]

**3.03. If ALL the data elements needed to compute the performance measure score are not from electronic sources, specify a credible, near-term path to electronic capture, OR provide a rationale for using data elements not from electronic sources.**

[Response Begins]

[Response Ends]

**3.04. Describe any efforts to develop an eCQM.**

[Response Begins]

[Response Ends]

**3.06. Describe difficulties (as a result of testing and/or operational use of the measure) regarding data collection, availability of data, missing data, timing and frequency of data collection, sampling, patient confidentiality, time and cost of data collection, other feasibility/implementation issues.**

[Response Begins]

[Response Ends]

Consider implications for both individuals providing data (patients, service recipients, respondents) and those whose performance is being measured.

**3.07. Detail any fees, licensing, or other requirements to use any aspect of the measure as specified (e.g., value/code set, risk model, programming code, algorithm),**

**Attach the fee schedule here, if applicable.**

**[Response Begins]**

Does not apply--no fees, license, or other requirements

**[Response Ends]**

## 4. Usability and Use

Extent to which potential audiences (e.g., consumers, purchasers, providers, policy makers) are using or could use performance results for both accountability and performance improvement to achieve the goal of high-quality, efficient healthcare for individuals or populations.

---

Extent to which intended audiences (e.g., consumers, purchasers, providers, policy makers) can understand the results of the measure and are likely to find them useful for decision making.

NQF-endorsed measures are expected to be used in at least one accountability application within 3 years and publicly reported within 6 years of initial endorsement, in addition to demonstrating performance improvement.

### 4a.01. Check all current uses. For each current use checked, please provide:

Name of program and sponsor

URL

Purpose

Geographic area and number and percentage of accountable entities and patients included

Level of measurement and setting

[Response Begins]

Public Health/Disease Surveillance

Quality Improvement with Benchmarking (external benchmarking to multiple organizations)

Quality Improvement (Internal to the specific organization)

[Response Ends]

### 4a.02. Check all planned uses.

[Response Begins]

[Response Ends]

### 4a.03. If not currently publicly reported OR used in at least one other accountability application (e.g., payment program, certification, licensing), explain why the measure is not in use.

*For example, do policies or actions of the developer/steward or accountable entities restrict access to performance results or block implementation?*

[Response Begins]

The continued use of this measure is for public health/disease surveillance, quality improvement with benchmarking (external benchmarking to multiple organizations), and quality improvement (internal to the specific organization). Voluntary participation in reporting AU data to NHSN in accordance with the NHSN AU measure specification has increased to over a thousand hospitals nationwide. These hospitals are deriving benefits from the measure for patient care practices without use of the measure data in public reporting or payment programs. Lessons learned from this increasing field use of the measure, coupled with further development of the measure, specifically the predictive models, will enable use of the measure for accountability purposes. The measure steward, NHSN, seeks to add to predictive models

data about infectious disease burden and use of antimicrobials for prophylaxis. These are strong predictors of AU, and NHSN seeks to include them in predictive models.

**[Response Ends]**

**4a.04. If not currently publicly reported OR used in at least one other accountability application, provide a credible plan for implementation within the expected timeframes: used in any accountability application within 3 years, and publicly reported within 6 years of initial endorsement.**

*A credible plan includes the specific program, purpose, intended audience, and timeline for implementing the measure within the specified timeframes. A plan for accountability applications addresses mechanisms for data aggregation and reporting.*

**[Response Begins]**

NHSN serves as a national data aggregating system for AU and engages with multiple antimicrobial stewardship programs that use of AU data for stewardship purposes on a voluntary basis. The continuing growth in AU reporting to NHSN—a greater than five-fold increase in hospital participation since NQF initially endorsed the NHSN AU measure—is indicative of the measure’s value even without an external accountability application. As a result of this increased participation in AU reporting, much more AU data was available for NHSN to develop AU predictive models used in this measure proposal than were used in the initial proposal. Additional data, e.g., extent of infectious disease burden and indications for antimicrobial prophylaxis, are candidates for additions to NHSN’s AU predictive models. NHSN is working to identify or develop sources for these additional data, and will apply this work and work products in the next iteration of its AU predictive models. NHSN also continues to work with hospitals and healthcare systems that report AU data to NHSN to further evaluate the measure’s usefulness for antimicrobial stewardship programs and to refine the measure as needed to improve its value for assessing variation in antimicrobial use intra- and inter-organizationally.

**[Response Ends]**

**4a.05. Describe how performance results, data, and assistance with interpretation have been provided to those being measured or other users during development or implementation.**

*Detail how many and which types of measured entities and/or others were included. If only a sample of measured entities were included, describe the full population and how the sample was selected.*

**[Response Begins]**

All hospitals participating in NHSN’s AU surveillance have immediate access to the AU data submitted to the system and are able to use NHSN’s AU analytic features to analyze their data, including analyses based on the SAAR measure. In addition, NHSN provides direct technical support to hospitals participating in AU surveillance and NHSN publishes FAQ’s and other resource documents that assist with interpretation of AU results.

**[Response Ends]**

**4a.06. Describe the process for providing measure results, including when/how often results were provided, what data were provided, what educational/explanatory efforts were made, etc.**

**[Response Begins]**

Results are available via the NHSN application at all times and on an ongoing basis.

**[Response Ends]**

**4a.07. Summarize the feedback on measure performance and implementation from the measured entities and others. Describe how feedback was obtained.**

**[Response Begins]**

Feedback from multiple antimicrobial stewardship programs nationwide has been positive, as evidenced by the increase in hospital participation in NHSN's AU surveillance to over 1,000 hospitals, all of which participate voluntarily in AU reporting.

**[Response Ends]**

**4a.08. Summarize the feedback obtained from those being measured.**

**[Response Begins]**

Hospitals participating in the NHSN AU Option surveillance have used their SAARs for stewardship program purposes, including priority setting and interventions designed to improve antimicrobial use. . Many hospitals have shared their feedback and changes in stewardship practices on quarterly NHSN AU Option users calls, in conference abstracts and presentations and formal journal publications. Further, feedback was received via conference call and email during the remodeling process.

**[Response Ends]**

**4a.09. Summarize the feedback obtained from other users.**

**[Response Begins]**

Increasing numbering of state health departments (SHD) have gained access to AU data reported by hospitals in their jurisdictions to NHSN and these states are using the AU data to guide statewide antimicrobial stewardship methods.

**[Response Ends]**

**4a.10. Describe how the feedback described has been considered when developing or revising the measure specifications or implementation, including whether the measure was modified and why or why not.**

**[Response Begins]**

AMS programs participating in NHSN's AU surveillance have provided feedback that NHSN has used to update the measure specifications and facilitate use of measure data via the NHSN application.

**[Response Ends]**

**4b.01. You may refer to data provided in Importance to Measure and Report: Gap in Care/Disparities, but do not repeat here. Discuss any progress on improvement (trends in performance results, number and percentage of people receiving high-quality healthcare; Geographic area and number and percentage of accountable entities and patients included). If no improvement was demonstrated, provide an explanation. If not in use for performance improvement at the time of initial endorsement, provide a credible rationale that describes how the performance results could be used to further the goal of high-quality, efficient healthcare for individuals or populations.**

**[Response Begins]**

Hospitals participating in the NHSN AU Option surveillance have used their SAARs for stewardship program purposes, including priority setting and interventions designed to improve antimicrobial use. Many hospitals have shared their feedback and changes in stewardship practices on quarterly NHSN AU Option users calls, in conference abstracts and presentations and formal journal publications. Further, feedback was received via conference call and email during the remodeling process.



**[Response Ends]**

**4b.02. Explain any unexpected findings (positive or negative) during implementation of this measure, including unintended impacts on patients.**

**[Response Begins]**

No unintended negative consequences identified or reported.

**[Response Ends]**

**4b.03. Explain any unexpected benefits realized from implementation of this measure.**

**[Response Begins]**

- Better understanding of antimicrobial use data collected in the steward's hospital.
- Better understanding of how to use EHR or 3rd party vendor software responsible for collecting/reporting AU data.
- Improving hospital workflow based on data quality issues (ex: changes in order sets to fix free text entry; allowing off label administrations to be entered into EHR correctly).
- Improvement in the quality of data captured (ex: correcting errors in how routes are mapped).

**[Response Ends]**

## 5. Comparison to Related or Competing Measures

If a measure meets the above criteria and there are endorsed or new related measures (either the same measure focus or the same target population) or competing measures (both the same measure focus and the same target population), the measures are compared to address harmonization and/or selection of the best measure.

---

If you are updating a maintenance measure submission for the first time in MIMS, please note that the previous related and competing data appearing in question 5.03 may need to be entered in to 5.01 and 5.02, if the measures are NQF endorsed. Please review and update questions 5.01, 5.02, and 5.03 accordingly.

**5.01. Search and select all NQF-endorsed related measures (conceptually, either same measure focus or target population).**

***NOTE: If there are no related measures, please select N/A.***

*(Can search and select measures.)*

[Response Begins]

[Response Ends]

**5.02. Search and select all NQF-endorsed competing measures (conceptually, the measures have both the same measure focus and target population).**

***NOTE: If there are no competing measures, please select N/A.***

*(Can search and select measures.)*

[Response Begins]

[Response Ends]

**5.03. If there are related or competing measures to this measure, but they are not NQF-endorsed, please indicate the measure title and steward.**

[Response Begins]

[Response Ends]

**5.04. If this measure conceptually addresses EITHER the same measure focus OR the same target population as NQF-endorsed measure(s), indicate whether the measure specifications are harmonized to the extent possible.**

[Response Begins]

[Response Ends]

**5.05. If the measure specifications are not completely harmonized, identify the differences, rationale, and impact on interpretability and data collection burden.**

[Response Begins]

[Response Ends]

**5.06. Describe why this measure is superior to competing measures (e.g., a more valid or efficient way to measure quality). Alternatively, justify endorsing an additional measure.**

*Provide analyses when possible.*

**[Response Begins]**

**[Response Ends]**

## Appendix

**Supplemental materials may be provided in an appendix.:**

## Contact Information

**Measure Steward (Intellectual Property Owner):** Centers for Disease Control and Prevention

**Measure Steward Point of Contact:** Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Pollock, Daniel, dap1@cdc.gov

Poudyal, Natasha, qpp1@cdc.gov

Griffith, Ashley, rwz6@cdc.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov

**Measure Developer if different from Measure Steward:** Centers for Disease Control and Prevention

**Measure Developer Point(s) of Contact:** Sachs, Jody, jody.sachs@hhs.gov

Poudyal, Natasha, qpp1@cdc.gov

Griffith, Ashley, rwz6@cdc.gov

Sachs, Jody, jody.sachs@hhs.gov

Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Pollock, Daniel, dap1@cdc.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov  
Sachs, Jody, jody.sachs@hhs.gov

## Additional Information

1. Provide any supplemental materials, if needed, as an appendix. All supplemental materials (such as data collection instrument or methodology reports) should be collated one file with a table of contents or bookmarks. If material pertains to a specific criterion, that should be indicated.

[Response Begins]

[Response Ends]

2. List the workgroup/panel members' names and organizations.

*Describe the members' role in measure development.*

[Response Begins]

[Response Ends]

3. Indicate the year the measure was first released.

[Response Begins]

[Response Ends]

4. Indicate the month and year of the most recent revision.

[Response Begins]

[Response Ends]

5. Indicate the frequency of review, or an update schedule, for this measure.

[Response Begins]

[Response Ends]

6. Indicate the next scheduled update or review of this measure.

[Response Begins]

[Response Ends]

7. Provide a copyright statement, if applicable. Otherwise, indicate "N/A".

[Response Begins]

[Response Ends]

8. State any disclaimers, if applicable. Otherwise, indicate "N/A".

[Response Begins]

[Response Ends]

9. Provide any additional information or comments, if applicable. Otherwise, indicate "N/A".

[Response Begins]

**[Response Ends]**