Antimicrobial Use and Resistance (AUR) Module

Contents

Introduction

This module contains two options: one focused on antimicrobial use and the second on antimicrobial resistance. To participate in either option, facility personnel responsible for reporting antimicrobial use (AU) or resistance (AR) data to the National Healthcare Safety Network (NHSN) must coordinate with their pharmacy and/or laboratory information software providers to configure their system to generate standard formatted file(s) to be imported into NHSN. The format provided for data submission follows the Health Level 7 (HL7) Clinical Document Architecture (CDA) standard.[7] Manual data entry is not available for the AUR Module.

Purpose

The NHSN AUR Module provides a mechanism for facilities to report and to analyze AU and/or AR data to inform benchmarking, reduce antimicrobial resistant infections through antimicrobial stewardship, and interrupt transmission of resistant pathogens at individual facilities or facility networks.[6]

1. Antimicrobial Use (AU) Option

Introduction

Antimicrobial resistance rates continue to increase in hospitals across the United States.[1] One of the five CDC core actions to combat the spread of antimicrobial resistance is improving the use of antimicrobials.[2] Studies show that providing timely and reliable feedback of information to clinicians regarding their prescribing practices, such as through antimicrobial usage reports, can improve appropriateness of antimicrobial use.[3-5]

Objectives: The primary objective of the Antimicrobial Use (AU) Option is to facilitate risk-adjusted inter- and intra-facility antimicrobial use benchmarking. A secondary objective is to evaluate antimicrobial use trends over time at the facility and national levels.

Methodology: The primary antimicrobial use metric reported to the AU Option is antimicrobial days per 1,000 days present. An antimicrobial day (also known as day of therapy) is defined by any amount of a specific antimicrobial agent administered in a calendar day to a particular patient as documented in the electronic medication administration record (eMAR) and/or bar coding medication administration (BCMA) system (refer to Numerator Data section starting on page 14-4 for more information); all antimicrobial days for a specific agent administered across a population are summed in aggregate.[8-11] Days present are defined as the aggregate number of patients housed in a patient care location or facility anytime throughout a day during a calendar month (refer to Denominator Data section starting on page 14-6 for more information). For each facility, the numerator (antimicrobial days) is aggregated by month for each patient care location and overall for inpatient areas facility-wide (specifically, facility-wide inpatient or FacWideIN). Similarly, the denominator (days present) is calculated for the corresponding patient care-location-month or facility-wide inpatient-month. A secondary antimicrobial use metric, antimicrobial days per 100 admissions, is reported to the AU Option for facility-wide inpatient (FacWideIN) data.

The numerator and denominators are further defined below and must adhere to the data format specified by the HL7 CDA Implementation Guide developed by the CDC and HL7.[7] Manual data entry is not available for the NHSN AU Option.

Settings: All inpatient facilities enrolled in NHSN and reporting to the Patient Safety Component can participate in the AU Option. This includes facilities enrolled as general acute care hospitals, critical access hospitals, children's hospitals, long term acute care hospitals, pediatric long term acute care hospitals, military and veterans' hospitals, oncology hospitals, orthopedic hospitals, psychiatric hospitals, rehabilitation hospitals, surgical hospitals, women's hospitals, women's and children's hospitals, government and non-government hospitals for public health emergencies. Facilities must have the ability to collect the numerator and denominator data electronically and upload those data into NHSN using the required CDA specifications. NHSN does not currently support the submission of data

into the AU Option from ambulatory surgery centers, long term care facilities (for example, skilled nursing facilities, nursing homes) nor outpatient dialysis facilities.

NHSN strongly encourages the submission of data from all NHSN-defined inpatient locations (including procedural areas like operating rooms), facility-wide inpatient (FacWideIN), and select outpatient acute care settings (specifically, outpatient emergency department [ED], pediatric ED, and 24-hour observation area) from which the numerator and denominator data can be accurately electronically captured. The AU Option does not accept data from other outpatient locations such as outpatient clinics. The FacWideIN record should contain data from all inpatient locations and inpatient procedural areas from which the numerator and denominator can be accurately electronically captured. A comprehensive submission will enable a facility to optimize inter- and/or intra-facility comparisons among specific wards, combined wards, and facility-wide data.

NHSN delineates a CDC-defined designation (CDC Location) for patient care areas/locations where patients have similar disease conditions or are receiving care for similar medical or surgical specialties. Each facility location is "mapped" to one CDC Location within the NHSN facility. The specific CDC Location code is determined by the type of patients cared for in that area according to the NHSN location mapping algorithm for acuity level and service type. The patient care areas include adult, pediatric, and neonatal units as defined by NHSN Codes. See the NHSN Locations chapter for more information regarding location mapping. Note: facilities should not map a whole separate set locations for AUR reporting (for example, "1 North" and "1 North AUR"). Facilities are encouraged to report data from all inpatient locations which means facilities may report AUR data for more locations than are used for HAI reporting (for example, operating rooms, specialty ward locations like labor and delivery, etc.). Please work with Infection Control/Infection Prevention to determine the correct location mapping for your facility.

Requirements

Each month:

1. The facility must indicate the specific locations from which they plan to submit antimicrobial use data in the Patient Safety Monthly Reporting Plan.
    a. When reporting AU Option data from inpatient and outpatient locations, list FacWideIN, each individual inpatient location, and each individual outpatient location as separate rows in the plan.
2. The CDA files submitted by the facility contain all data fields outlined in the Table of Instructions (Appendix A) for each location.
3. The facility uploads data via CDA files for all locations indicated in the Monthly Reporting Plan.
    a. Submit one file for each individual patient care location as well as a separate file for FacWideIN. As an example, a facility with three patient care locations will upload three separate files for each individual location and one additional file for FacWideIN for a total of four files per month.

NHSN recommends the facility uploads data into NHSN for a given calendar month by the end of the subsequent calendar month.

Numerator Data (Antimicrobial Days):

Antimicrobial Days (also known as Days of Therapy): Defined as the aggregate sum of days for which any amount of a specific antimicrobial agent was administered to individual patients as documented in the eMAR and/or BCMA.[8-11] Appendix B provides the full list of antimicrobial agents collected in the NHSN AU Option. Aggregate antimicrobial days are reported monthly for inpatient locations, FacWideIN, and three select outpatient acute care settings (specifically, outpatient ED, pediatric ED, and 24-hour observation area) for select antimicrobial agents and stratified by route of administration (specifically, intravenous, intramuscular, digestive, and respiratory).

Refer to Table 1 and Table 2 for the definitions of drug-specific antimicrobial days and stratification based on route of administration. Antimicrobials are only counted as an antimicrobial day on the day of administration. For example, when a health care professional administers a patient 1 gram Vancomycin intravenously twice daily for three days, three "Vancomycin Days (total)" and three "Vancomycin Days (IV)" are counted when stratified by intravenous route of administration. Please note this rule also applies to antimicrobials that have an extended half-life (such as Dalbavancin, Oritavancin and Rezafungin) and in patients with renal impairment. Table 3 summarizes the data elements for numerator calculation. Appendix C provides additional examples of antimicrobial day calculation.

A whole number greater than or equal to 0 or "NA" must be reported for every antimicrobial agent and route of administration listed in Appendix B for every location record for each month. Antimicrobial agents and routes of administration cannot be left blank. Facilities should report "0" (zero) antimicrobial days when no aggregate use occurred during a given reporting period for a specific antimicrobial agent/route (for example, Zanamivir via the respiratory route) and that agent/route can be accurately captured in the eMAR or BCMA system.

Please note, facilities should report "NA" (Not Applicable) only when the administrations for an agent/route cannot be electronically captured at that facility (specifically, data are not available for a specific antimicrobial agent/route). Furthermore, facilities should consistently report "NA" across all locations and FacWideIN. For example, if a facility was unable to electronically capture Amikacin administered via the respiratory route (in the event of using the IV formulation for inhalation), the facility would report "NA" for the respiratory route of Amikacin for all individual locations and FacWideIN. The same rule also applies to non-formulary agents. If use of non-formulary agents can be accurately electronically captured, no use of those agents in each location/month would be reported as "0" (zero).

Table 1. Classification and Definition of Routes of Administration for Antimicrobial Days

Classification: Route of Administration[a]	Definition[b]
Intravenous (IV)	An intravascular route that begins with a vein.
Intramuscular (IM)	A route that begins within a muscle.
Digestive Tract	A route that begins anywhere in the digestive tract extending from the mouth through rectum.[c]
Respiratory Tract	A route that begins within the respiratory tract, including the oropharynx and nasopharynx.

[a] Other routes of administration are excluded from the AU Option reporting (for example, antibiotic locks, intraperitoneal, intrapleural, intraventricular, irrigation, topical) and should not be included in the total antimicrobial days nor the sub-stratification of the routes of administration.
[b] Definitions were drawn from SNOMED qualifier value hierarchy. Refer to the CDA Antimicrobial Use (AU) Toolkit for specific codes corresponding to each route of administration.
[c] For example, rectal administration of Vancomycin.

Table 2. Example Stratification of Antimicrobial Days by Route of Administration

Month/ Year- Location	Antimicrobial Agent	Drug-specific Antimicrobial Days				
		Total[a]	IV	IM	Digestive[b]	Respiratory
Month/ Year Location	Tobramycin	Tobramycin Days (Total)	Tobramycin Days (IV)	Tobramycin Days (IM)	Tobramycin Days (Digestive)	Tobramycin Days (Respiratory)
01/2022 Med Ward		1	1	0	0	1

[a] Drug-specific antimicrobial days (total) attributes one antimicrobial day for any route of administration. For example, if Tobramycin was administered to a patient intravenously *and* via a respiratory route on the same day, the antimicrobial days would be counted as "one Tobramycin Day (Total)" and the stratification by route of administration would be "one Tobramycin Day (IV)" and "one Tobramycin Day (Respiratory)".
[b] Tobramycin is used for an example of route stratification only and is not FDA approved for administration via the digestive route.

Table 3. Data Elements for Antimicrobial Days

Data Element	Details
Antimicrobial Agents	Defined as select antimicrobial agents and stratified by route of administration (specifically, intravenous, intramuscular, digestive, and respiratory). Refer to Appendix B for a complete list of antimicrobials. The list of select antimicrobials will evolve with time as new agents become commercially available and old agents are removed from the market. *Topical antimicrobial agents are not included in the NHSN AU Option.*
Data source	Antimicrobial days are derived from antimicrobial administration data documented in the eMAR and/or BCMA only. Usage derived from other data sources (for example, pharmacy orders, doses dispensed, doses billed) cannot be submitted.
Location	Antimicrobial days are aggregated for each inpatient location, facility-wide inpatient, and three select outpatient acute-care settings (specifically, outpatient ED, pediatric ED, and 24-hour observation area) per the NHSN location definitions.
Time Unit	Antimicrobial days for a specific antimicrobial agent and stratification by route of administration are aggregated monthly per location.

Denominator Data (Days Present and Admissions): The numerator will be analyzed against the denominators of days present (all locations) and admissions (for facility-wide inpatient [FacWideIN] only). The denominators are further defined below.

Days present: Days present are defined as the time period during which a given patient is at risk for antimicrobial exposure in a given patient location. The definition of days present differs from the definition of patient days used in other NHSN modules. Days present is further defined below in context of calculation for patient care location-specific analyses and facility-wide inpatient analyses. Please note that a separate calculation for days present is required for each patient care location compared to facility-wide inpatient.

For patient care location-specific analyses, days present are calculated as the number of patients who were present, regardless of patient status (for example, inpatient, observation), for any portion of each day during a calendar month for a patient care location. The patient can begin attributing to the days present count in an outpatient location such as an Emergency Department as soon as they have had an initial interaction with a medical professional (for example, the beginning of triage), regardless of when the patient is placed in a bed. The aggregate measure is calculated by summing days present for that location and month. The day of admission, discharge, and transfer to and from locations will be included in the days present count. Below are examples that illustrate appropriate days present calculation:

- A patient admitted to the medical ward on Monday and discharged two days later on Wednesday contributes three days present in the medical ward because the patient was present in that specific location at some point during each of the three calendar days (specifically, Monday, Tuesday, and Wednesday).

- On the day a patient is transferred from a medical critical care unit to a medical ward, the patient contributes one day present in the medical critical care unit and one day present in the medical ward because the patient was present in both locations at some point during that calendar day. Similarly, a patient contributes days present to the operating room or ED if data are submitted from these locations.
- One patient can only contribute one day present for a specific location per calendar day. While a patient cannot contribute more than one day present to any one unique location on the same day that patient can contribute a day present to two different locations on the same day. For example, a patient transferred from the surgical ward to the operating room and back to the surgical ward in a calendar day contributes one day present to the surgical ward and one day present to the operating room.

For facility-wide inpatient (FacWideIN) analyses, days present are calculated as the number of patients who were present in an inpatient location within the facility for any portion of each day during a calendar month. The aggregate measure is calculated by summing up all the days present for facility-wide inpatient for a given month. Thus, a sum of days present from location-specific analyses would be higher than days present for the facility (FacWideIN) because transfers between wards can account for multiple location "days present" for a given patient on a single calendar day. Therefore, it is not permissible to sum the individual days present for location-specific analyses to achieve the facility-wide inpatient (FacWideIN) days present count. The calculation must be a separate summation for facility-wide inpatient analyses.

Please note that only inpatient locations in which both the antimicrobial days (numerator) and the days present (denominator) can be accurately electronically captured should be included in the FacWideIN counts. Additionally, outpatient locations (ED, pediatric ED, and 24-hour observation) should **not** be included in FacWideIN counts.

Admissions: Admissions are defined as the aggregate number of patients admitted to an inpatient location within the facility (facility-wide inpatient) starting on first day of each calendar month through the last day of the calendar month. A patient is counted as an admission when they arrive in an NHSN designated inpatient location regardless of patient status (for example, inpatient, observation). Further, a patient admitted to an inpatient unit would be counted as an admission even if they were discharged that same calendar day. If in the ADT system a patient appears to move from an inpatient to an outpatient ED, pediatric ED or 24-hour observation location then back to an inpatient location, it should be counted as two separate admissions. In the AU Option, admissions are reported only for facility-wide inpatient (FacWideIN). Please note, the definition of admissions used in the AUR Module is different than the definition used in the NHSN MDRO/CDI Module.

Table 4. Location-specific and Facility-wide Inpatient Metrics

Patient Care Location-Specific Analyses
Rate of Antimicrobial Days per 1,000 Days Present $$\frac{Drug\ specific\ antimicrobial\ days\ per\ patient\ care\ location\ per\ month}{Days\ present\ per\ patient\ care\ location\ per\ month} \times 1000$$ Notes: • One patient can contribute only one day present per calendar day for each specific location. • Summed total may be higher when compared to facility-wide count (reflecting transfers between locations).
Facility-wide Inpatient Analyses
Rate of Antimicrobial Days per 1,000 Days Present $$\frac{Drug\ specific\ antimicrobial\ days\ for\ all\ inpatient\ units\ in\ a\ facility\ per\ month}{Days\ present\ per\ facility\ wide\ inpatient\ per\ month} \times 1000$$ Notes: • One patient can contribute only one day present per calendar day for a facility. Thus, one denominator is obtained for all inpatient locations in an entire facility. • The days present measure for facility-wide inpatient should be lower when compared to sum total from location-specific comparison. • Only include inpatient units where both the antimicrobial days (numerator) and the days present (denominator) can be accurately electronically captured. • Exclude outpatient locations.
Rate of Antimicrobial Days per 100 Admissions $$\frac{Drug\ specific\ antimicrobial\ days\ for\ all\ inpatient\ units\ in\ a\ facility\ per\ month}{Admissions\ per\ facility\ wide\ inpatient\ per\ month} \times 100$$ Notes: • Only calculated for facility-wide inpatient for the AU Option. • Only include inpatient units where both the antimicrobial days (numerator) and the days present and admissions (denominators) can be accurately electronically captured. • Exclude outpatient locations.

Data Analyses

All AU Option data reported to NHSN can be analyzed immediately after submission to NHSN. After generating analysis datasets within NHSN, users can view reported data using various NHSN analysis reports to visualize and analyze data in more detail. For example, descriptive analysis reports such as

line lists, bar charts and pie charts are available. In addition, measures of antimicrobial use are available in rate tables and Standardized Antimicrobial Administration Ratios (SAAR) reports.

Types of AU Option Analysis Reports

Standardized Antimicrobial Administration Ratio (SAAR):

The Standardized Antimicrobial Administration Ratio (SAAR) is a metric developed by CDC to analyze and report antimicrobial use data in summary form. The SAAR is calculated by dividing observed antimicrobial use by predicted antimicrobial use.

$$SAAR = \frac{Observed\ Antimicrobial\ Use}{Predicted\ Antimicrobial\ Use}$$

The observed antimicrobial use is the number of days of therapy, or antimicrobial days, reported by a facility for a specified category of antimicrobial agents in a specified group of patient care locations. The predicted antimicrobial use is calculated using predictive models developed by CDC and applied to nationally aggregated 2017 adult and pediatric or 2018 neonatal AU data reported to NHSN from the same group of patient care location types. Separate predictive models are developed for each specific antimicrobial agent category.

The SAAR can be generated for 22 antimicrobial agent categories (7 adult, 8 pediatric, and 7 neonatal) and 17 specific NHSN location types (8 adult, 5 pediatric, and 4 neonatal), for a total of 47 possible SAARs (see Appendix D), each of which can serve as a high-value target or high-level indicator for antimicrobial stewardship programs. The antimicrobial agent categories were determined by CDC with input from external adult, pediatric, and neonatal infectious disease physicians and pharmacists. The SAAR agent categories are listed below. The specific antimicrobial agents in each category can be found in Appendix E.

- Adult SAAR antimicrobial agent categories
  - All antibacterial agents
  - Broad spectrum antibacterial agents predominantly used for hospital-onset infections
  - Broad spectrum antibacterial agents predominantly used for community-acquired infections
  - Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)
  - Narrow spectrum beta-lactam agents
  - Antibacterial agents posing the highest risk for CDI (not mutually exclusive, agents may overlap with other categories)
  - Antifungal agents predominantly used for invasive candidiasis

- Pediatric SAAR antimicrobial agent categories
  - All antibacterial agents
  - Broad spectrum antibacterial agents predominantly used for hospital-onset infections
  - Broad spectrum antibacterial agents predominantly used for community-acquired infections

  - Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)
  - Narrow spectrum beta-lactam agents
  - Azithromycin
  - Antibacterial agents posing the highest risk for CDI (not mutually exclusive, agents may overlap with other categories)
  - Antifungal agents predominantly used for invasive candidiasis

- Neonatal SAAR antimicrobial agent categories
  - All neonatal antibacterial agents
  - Vancomycin predominantly used for treatment of late-onset sepsis
  - Broad spectrum antibacterial agents predominantly used for hospital-onset infections
  - Third generation Cephalosporins
  - Ampicillin predominantly used for treatment of early-onset sepsis
  - Aminoglycosides predominantly used for treatment of early-onset and late-onset sepsis
  - Fluconazole predominantly used for candidiasis

At present, SAARs are available to facilities that have submitted AU data from one of the 17 eligible adult, pediatric, and neonatal SAAR location types included in Table 5. As an important note, the SAARs generated in NHSN only include the SAAR eligible location types listed in Table 5. None of the SAARs contain AU data from all inpatient locations in a given facility. Therefore, none of the SAARs would be considered a "facility-wide" SAAR. In the future, as more facilities submit AU data, the NHSN Team plans to develop SAARs for additional location types.

Table 5. Location types able to generate SAARs

CDC Location Type	CDC Location Code	NSHN Healthcare Service Location (HL7) Code
Adult Locations		
Medical Critical Care	IN:ACUTE:CC:M	1027-2
Surgical Critical Care	IN:ACUTE:CC:S	1030-6
Medical-Surgical Critical Care	IN:ACUTE:CC:MS	1029-8
Medical Ward	IN:ACUTE:WARD:M	1060-3
Surgical Ward	IN:ACUTE:WARD:S	1072-8
Medical-Surgical Ward	IN:ACUTE:WARD:MS	1061-1
ONC General Hematology-Oncology Ward	IN:ACUTE:WARD:ONC_HONC	1232-8
Adult Step Down Unit	IN:ACUTE:STEP	1099-1
Pediatric Locations		
Pediatric Medical Critical Care	IN:ACUTE:CC:M:PED	1044-7
Pediatric Medical-Surgical Critical Care	IN:ACUTE:CC:MS_PED	1045-4
Pediatric Medical Ward	IN:ACUTE:WARD:M_PED	1076-9
Pediatric Surgical Ward	IN:ACUTE:WARD:S_PED	1086-8
Pediatric Medical-Surgical Ward	IN:ACUTE:WARD:MS_PED	1081-9

CDC Location Type	CDC Location Code	NSHN Healthcare Service Location (HL7) Code
Neonatal Locations		
Special Care Nursery (Level II)	IN:ACUTE:STEP:NURS	1041-3
Neonatal Critical Care (Level II/III)	IN:ACUTE:CC_STEP:NURS	1039-7
Neonatal Critical Care (Level III)	IN:ACUTE:CC:NURS	1040-5
Neonatal Critical Care (Level IV)	IN:ACUTE:CC:NURS_IV	1269-0

A high SAAR that achieves statistical significance (specifically, a SAAR value statistically significantly larger than 1.0) may indicate antimicrobial overuse. A SAAR that is not statistically different from 1.0 indicates antimicrobial use is equivalent to the referent population's antimicrobial use. A low SAAR that achieves statistical significance may indicate antimicrobial underuse. Please note, a SAAR alone is not a definitive measure of the appropriateness or judiciousness of antimicrobial use, and any SAAR may warrant further investigation. For example, a SAAR above 1.0 that does not achieve statistical significance may be associated with meaningful excess of antimicrobial use and further investigation may be needed. Also, a SAAR that is statistically different from 1.0 does not mean that further investigation will be productive. SAARs were created for hospital reporters to compare their use of antimicrobials in each SAAR category against the national benchmark. The groupings of antimicrobials for SAAR categories were based on expert opinions with a goal to optimize the usefulness for antimicrobial stewardship. Since these conditions are often multifactorial and often lagged in time, higher SAARs are not meant to indicate a definitive and immediate clinical consequence (for example, CDI incidence or specific antimicrobial resistant infection).

SAARs can be produced by month, quarter, half-year, year, or cumulative time periods. The SAAR report can be modified to show SAARs by a specific location or a subset of location types. However, keep in mind that SAARs can only be generated and/or modified to show data for the 17 select location types listed above in Table 5.

Additional details and guidance for the SAARs are available in the resources listed below:
SAAR Guide: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-saar-guide-508.pdf
Keys to Success with the SAAR: https://www.cdc.gov/nhsn/ps-analysis-resources/keys-to-success-saar.html
SAAR Table: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-SAARTables.pdf
SAAR Table – by Location: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-SAARTables-Location.pdf
SAAR Plot: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-SAARDotPlot-508.pdf
SAAR Bar Chart in Excel: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-qrg-saar-bartable-location-508.pdf

Targeted Assessment for Antimicrobial Stewardship (TAS):

The Targeted Assessment for Antimicrobial Stewardship (TAS) is a framework for quality improvement developed by the CDC to use NHSN AU Option data for action to optimize AU at facilities. TAS is available to hospitals participating in the NHSN AU Option. TAS can be used by antimicrobial stewards and others focused on optimizing AU within groups, such as health departments and health systems, as well as individual facilities.

The TAS Reports use a metric called the antimicrobial use cumulative attributable difference (AU-CAD). The AU-CAD represents the difference between the observed days and a selected Standardized Antimicrobial Administration Ratio (SAAR) target. The TAS Reports allow for ranking facilities within groups, or location groups and locations within individual facilities, by the AU-CAD, to identify where stewardship efforts may have the greatest impact. Since the SAAR is not a definitive measure of the appropriateness or judiciousness of AU, CDC cannot define SAAR targets for facilities or groups. Facilities and groups, however, can use their information on antibiotic use (for example, a medication use evaluation to assess appropriate courses of therapy) to establish improvement goals that can then be monitored with NHSN AU Option metrics (for example, the AU-CAD and SAAR).

$$\text{AU-CAD} = \text{Observed antimicrobial days} - (\text{Predicted antimicrobial days} \times \text{SAAR target})$$

The AU-CAD is the number of antimicrobial days needed to achieve a desired SAAR target. The higher the AU-CAD value, the greater the number of antimicrobial days that need to be reduced to meet the SAAR target. For example, if a facility has an AU-CAD of 75 when they run a TAS report with a SAAR target of 0.95, the interpretation would be “The facility would have needed 75 fewer antimicrobial days to reach their SAAR target of 0.95 during this time period.”

TAS Reports are located within the Analysis section of NHSN. You’ll notice the TAS Reports have their own subfolder within the Antimicrobial Use and Resistance Module folder. The TAS reports are separated by population (adult, pediatric, or neonatal) and by level of aggregation (group, facility, location group, and location). TAS reports include only those location types that can generate SAARs; in other words, the same locations in the SAAR reports will also be included in the TAS reports.

Table 6. Location types able to generate SAARs and included in TAS reports

Location Group in TAS Reports	CDC Location Type	CDC Location Code	NSHN Healthcare Service Location (HL7) Code
Adult			
ICU	Medical Critical Care	IN:ACUTE:CC:M	1027-2
ICU	Surgical Critical Care	IN:ACUTE:CC:S	1030-6
ICU	Medical-Surgical Critical Care	IN:ACUTE:CC:MS	1029-8

Location Group in TAS Reports	CDC Location Type	CDC Location Code	NSHN Healthcare Service Location (HL7) Code
Stepdown	Adult Step Down Unit	IN:ACUTE:STEP	1099-1
Ward	Medical Ward	IN:ACUTE:WARD:M	1060-3
Ward	Surgical Ward	IN:ACUTE:WARD:S	1072-8
Ward	Medical-Surgical Ward	IN:ACUTE:WARD:MS	1061-1
Oncology	ONC General Hematology-Oncology Ward	IN:ACUTE:WARD:ONC_HONC	1232-8
Pediatric			
ICU	Pediatric Medical Critical Care	IN:ACUTE:CC:M:PED	1044-7
ICU	Pediatric Medical-Surgical Critical Care	IN:ACUTE:CC:MS_PED	1045-4
Ward	Pediatric Medical Ward	IN:ACUTE:WARD:M_PED	1076-9
Ward	Pediatric Surgical Ward	IN:ACUTE:WARD:S_PED	1086-8
Ward	Pediatric Medical-Surgical Ward	IN:ACUTE:WARD:MS_PED	1081-9
Neonatal			
N/A	Step down Neonatal Nursery	IN:ACUTE:STEP:NURS	1041-3
N/A	Neonatal Critical Care (Level II/III)	IN:ACUTE:CC_STEP:NURS	1039-7
N/A	Neonatal Critical Care (Level III)	IN:ACUTE:CC:NURS	1040-5
N/A	Neonatal Critical Care (Level IV)	IN:ACUTE:CC:NURS_IV	1269-0

The TAS reports are available at different levels of aggregation:

- Group
  - Available only when running the TAS reports within an NHSN Group.
  - One table displays metrics pooled at the group level. All other tables in the Group reports display metrics at the facility level for each member facility in the group by SAAR type.
- Facility
  - Available only when running the TAS reports within an individual facility.
  - The reports display metrics pooled at the facility level for an individual facility.
- Location Group
  - The reports display metrics for a group of patient care locations based on how the locations are mapped in NHSN (see Table 6).
    - Adult location groups: ICUs, Wards, Stepdown, Oncology
    - Pediatric location groups: ICUs, Wards
    - Location groups are not available for neonatal TAS reports.
  - Two types of location group reports are available depending on your preferred sort:

    - Location groups (Separated): Rank is based on location group SAAR Type AU-CAD values *within the location group*. In other words, the SAAR Types are ranked based on location group AU-CAD value within that specific location group.
    - Location groups (Combined): Rank is based on location group SAAR Type AU-CAD values among all SAAR Types and location groups. In other words, SAAR Types and location groups are ranked according to the AU-CAD value alone.
- Locations
    - AU-CAD values are provided for each individual location able to generate SAARs (see Table 6).

Separately, the TAS Dashboard, found on the NHSN Patient Safety Component Home Page or in the Dashboard section of the left-hand navigation menu, allows NHSN facilities to visualize locations with the greatest need for antimicrobial stewardship. The TAS Dashboard displays AU-CADs over time, by quarter, for the most recent complete four calendar quarters at the group, facility, and location level. Unlike the TAS Reports, the time period and level of aggregation displayed by the TAS Dashboard cannot be changed.

Additional detail and guidance for the TAS reports and dashboards are available in the resources listed below:
TAS Guide: https://www.cdc.gov/nhsn/ps-analysis-resources/tas/tas-guide-508.pdf
TAS Report – Facility-level: https://www.cdc.gov/nhsn/ps-analysis-resources/tas/facility-level-508.pdf
TAS Report – Location group-level: https://www.cdc.gov/nhsn/ps-analysis-resources/tas/location-group-level-508.pdf
TAS Report – Location-level: https://www.cdc.gov/nhsn/ps-analysis-resources/tas/location-level-508.pdf
TAS Report – Group-level: https://www.cdc.gov/nhsn/ps-analysis-resources/tas/group-level-508.pdf
TAS Dashboard – Facility: https://www.cdc.gov/nhsn/ps-analysis-resources/tas/facility-508.pdf
TAS Dashboard – Group: https://www.cdc.gov/nhsn/ps-analysis-resources/tas/group-508.pdf

Rates:
As a supplement to the SAARs, rate tables showing the pooled mean rates and percentile distributions of specific antimicrobials for specific adult, pediatric and neonatal locations are available. Adult and pediatric SAAR location types can generate rates for antimicrobials predominantly used for extensively antimicrobial resistant bacteria. This rate table shows the antimicrobial days per 1,000 days present for a grouping of five specific drugs (listed in Appendix E) along with the pooled mean rate and percentile distributions for the 25th, 50th, 75th, and 90th percentiles based on the 2017 baseline adult and pediatric AU data. Rates can also be generated for well baby and special care (Level II) neonatal nurseries for select antimicrobial groupings. These rate tables show the antimicrobial days per 1,000 days present for specific antimicrobial groupings (listed in Appendix E) along with the pooled mean rate and percentile distributions for the 25th, 50th, 75th, and 90th percentiles based on the 2018 baseline neonatal AU data.

SAAR Baseline Rate Tables: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-qrg-ratetable-drugs-508.pdf

Additionally, users can generate basic rate tables as incidence density rates of antimicrobial days per 1,000 days present stratified by patient care location and facility-wide inpatient. A rate of antimicrobial days per 100 admissions can also be generated for facility-wide inpatient only. Default rate tables can be generated by antimicrobial category (specifically, antibacterial, antifungal, anti-influenza, antiviral) and class (for example, aminoglycosides, carbapenems, cephalosporins) for the most recent month of data submitted or all months of data submitted for FacWideIN or each individual location. Modifications can be made to any rate table to show specific months or locations. Specific rate tables can also be modified to produce a rate per individual antimicrobial, select antimicrobials within the same class, and select antimicrobials within different classes.

Rate Table – by location: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-RateTables-Location.pdf
Rate Table – FacWideIN: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-RateTables-FACWIDEIN.pdf

Descriptive analysis:
Line Lists: Line lists are the most customizable AU Option analysis report. The default line lists show the total antimicrobial days and the sub-stratification of routes of administration for each antimicrobial as well as the days present and admissions for each month and location of data submitted. Default line lists can be generated for the most recent month of data submitted or all months of data submitted, for FacWideIN or each individual location. Users can modify any line list to show specific months, locations, antimicrobials, and/or routes of administration. The line lists are the most helpful AU Option report when validating the data.

Line List: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-LineList.pdf

Bar Charts & Pie Charts: Bar charts and pie charts provide visualizations of the antimicrobial use within a facility. Default bar charts and pie charts can be generated for the most recent month of data submitted or all months of data submitted for FacWideIN or each individual location. There is also a bar chart that shows selected agent distribution by month.

Bar Chart: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-BarChart.pdf
Bar Chart – Selected drugs: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-BarChart-drugs-508.pdf
Pie Chart: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-QRG-PieChart.pdf

All AU Option data analysis reports can be exported from NHSN in various formats including Excel, CSV, SAS.

NHSN Group Analysis:

NHSN Group users can visualize and analyze AU data shared with them by member facilities using NHSN analysis reports. In addition to the Analysis Quick Reference Guides (QRGs) referenced in each section above and available from in the Antimicrobial Use and Resistance Module Reports section of the Analysis Quick Reference Guide page, Groups can find Group-specific resources on the NHSN Group Users page.

Additional Analysis Resources:

Users can find recorded training sessions and Quick Learn videos highlighting AU Option analysis reports on the AUR Training page.

References

1. Weiner LM, Webb AK, Limbago B, et al. Antimicrobial-resistant pathogens associated with adult healthcare-associated infections: summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2015-2017. Infect Control Hosp Epidemiol 2020;41:1-18.
2. Centers for Disease Control and Prevention. Antibiotic Resistance Threats in the United States, 2019. Available at: https://www.cdc.gov/antimicrobial-resistance/media/pdfs/2019-ar-threats-report-508.pdf.
3. Davey P, Marwick CA, Scott CL, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. Cochrane Database Syst Rev 2017:2;CD003543.
4. Ansari F, Gray K, Nathwani D, et al. Outcomes of an intervention to improve hospital antibiotic prescribing; interrupted time series with segmented regression analysis. J Antimicrob Chemother 2003;52:842-8.
5. Solomon DH, Van Houten L, Glynn RJ. Academic detailing to improve use of broad-spectrum antibiotics at an academic medical center. Arch Inter Med 2001;161:1897-902.
6. Barlam TF, Cosgrove SE, Abbo LM, et al. 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):e51-77. doi: 10.1093/cid/ciw118. Epub 2016 Apr 13. PMID: 27080992; PMCID: PMC5006285.
7. National Healthcare Safety Network (NHSN) Patient Safety Component: Clinical Document Architecture. http://www.cdc.gov/nhsn/cdaportal/index.html
8. Schwartz DN, Evans RS, Camins B, et al. Deriving measures of intensive care unit antimicrobial use from computerized pharmacy data: methods, validation, and overcoming barriers. Infect Control Hosp Epidemiol 2011;32:472-80.
9. Polk RE, Fox C, Mahoney A, Letcavage J, MacDougall C. Measurement of adult Antibacterial Drug Use in 130 US Hospitals: Comparison of Defined Daily Dose and Days of Therapy. Clin Infect Dis 2007;44:664-70.
10. Kuster SP, Ledergerber B, Hintermann A, et al. Quantitative antibiotic use in hospitals: comparison of measurements, literature review, and recommendations for standards of reporting. Infection 2008; 6:549-59.
11. Berrington A. Antimicrobial prescribing in hospitals: be careful what you measure. J Antimicrob Chemother 2010:65:163-168.
12. CLSI. 2020 Performance standards for antimicrobial susceptibility testing, 30th edition. CLSI document M100-ED20. Wayne, PA: Clinical and Laboratory Standards Institute; 2020.

Appendix A. Table of Instructions: Antimicrobial Use Option

Data Field	Data Field Description
Facility OID[a]	Required. Must be assigned to facility and included in the CDA data file prior to submission to NHSN.
Vendor (Application) OID[b]	Required. Must be assigned to a vendor's software application and included in the AU CDA data file prior to submission to NHSN. The Vendor (Application) OID should be obtained by the software vendor and is distinct from the Facility OID.
SDS Validation ID	Required. The Synthetic Data Set (SDS) Validation ID will be provided to the AU CDA vendor by the AUR Module Team upon confirmation that the AU Summary SDS Excel file passed validation as part of the AU SDS initiative.[c]
Vendor Software Name	Optional. Vendor software name is the name of the software application that generates the AU CDA file. NHSN collects this information to more effectively troubleshoot CDA files when needed.
Software Version	Optional. Software version is the version of the software application that generates the AU CDA file. NHSN collects this information to more effectively troubleshoot CDA files when needed.
Vendor Name	Optional. Vendor name is the name of the vendor that owns the software application that generates the AU CDA file. NHSN collects this information to more effectively troubleshoot CDA files when needed.
Month	Required. Record the 2-digit month during which the data were collected for this location.
Year	Required. Record the 4-digit year during which the data were collected for this location.
Location	Required. The patient care location for which the data are being uploaded.
Numerator: Antimicrobial days per month per location	Required. Antimicrobial days are defined as the aggregate sum of the days of therapy for which a specific antimicrobial was administered. These are required to be extracted from electronic medication administration record (eMAR) and/or bar coding medication administration (BCMA) system. Antimicrobial days are collected for select antimicrobial agents (refer to Appendix B) and stratified by route of administration.
Denominator(s): Days present	Required. Days present are defined as risk for antimicrobial exposure per each day of the calendar month stratified by location. For patient care location-specific analyses, days present is calculated as the number of patients who were present for any portion of each day during a calendar month for a patient care location. The patient can begin attributing to the days present count in an outpatient location such as an Emergency Department as soon as they have had an initial interaction with a medical professional (for example, the beginning of triage), regardless of when the patient is placed in a bed. For facility-wide inpatient analyses, days present are calculated as the number of patients who were present in an inpatient location within the facility for any portion of each day during a calendar month.

Data Field	Data Field Description
Admissions	Admissions are defined as the aggregate number of patients admitted to an inpatient location within the facility (facility-wide inpatient) starting on first day of each calendar month through the last day of the calendar month. A patient is counted as an admission when they arrive in an NHSN designated inpatient location regardless of patient status (for example, inpatient, observation). Further, a patient admitted to an inpatient unit would be counted as an admission even if they were discharged that same calendar day. If in the ADT system a patient appears to move from an inpatient to an outpatient ED, pediatric ED or 24-hour observation location then back to an inpatient location, it should be counted as two separate admissions. In the AU Option, admissions are only reported for facility-wide inpatient. Please note, the admissions definition used in the AUR Module is different than the definition used in the NHSN MDRO/CDI Module.

[a] Facilities interested in submitting data to NHSN via CDA must obtain a Facility OID (object identifier). More information on how to obtain an OID for your facility can be found on the CDA Submission Support Portal.

[b] AU CDA files are required to include a Vendor (Application) OID (object identifier) as part of the AU Option Synthetic Data Set initiative. More information on how to obtain a Vendor (Application) OID can be found on the Vendor (Application) Object Identifier page.

[c] More detailed information about the AU Synthetic Data Set validation process can be found on the AUR Synthetic Data Set Validation page.

Appendix B. List of Antimicrobials

Please note that mapping of standardized terminology (RXNORM) is provided in the Information Data Model (IDM) found in the Antimicrobial Use Toolkit. The list of NHSN drug codes as well as the drug values used for the development of the CDA files can be found here: Eligible Antimicrobials.

Antimicrobial Agent	Antimicrobial Category	Antimicrobial Class[a]	Antimicrobial Subclass[a]
AMANTADINE	Anti-influenza	M2 ion channel inhibitors	
AMIKACIN	Antibacterial	Aminoglycosides	
AMIKACIN LIPOSOMAL[b]	Antibacterial	Aminoglycosides	
AMOXICILLIN	Antibacterial	Penicillins	Aminopenicillin
AMOXICILLIN/ CLAVULANATE	Antibacterial	β-lactam/β-lactamase inhibitor combination	
AMPHOTERICIN B	Antifungal	Polyenes	
AMPHOTERICIN B LIPID COMPLEX	Antifungal	Polyenes	
AMPHOTERICIN B LIPOSOMAL	Antifungal	Polyenes	
AMPICILLIN	Antibacterial	Penicillins	Aminopenicillin
AMPICILLIN/ SULBACTAM	Antibacterial	β-lactam/β-lactamase inhibitor combination	
ANIDULAFUNGIN	Antifungal	Echinocandins	
AZITHROMYCIN	Antibacterial	Macrolides	
AZTREONAM	Antibacterial	Monobactams	
BALOXAVIR MARBOXIL	Anti-influenza	Polymerase acidic endonuclease inhibitors	
CASPOFUNGIN	Antifungal	Echinocandins	
CEFACLOR	Antibacterial	Cephalosporins	Cephalosporin 2nd generation
CEFADROXIL	Antibacterial	Cephalosporins	Cephalosporin 1st generation
CEFAZOLIN	Antibacterial	Cephalosporins	Cephalosporin 1st generation
CEFDINIR	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFEPIME	Antibacterial	Cephalosporins	Cephalosporin 4th generation
CEFEPIME/ ENMETAZOBACTAM	Antibacterial	β-lactam/β-lactamase inhibitor combination	
CEFIDEROCOL	Antibacterial	Cephalosporins	Siderophore
CEFIXIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFOTAXIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation

Antimicrobial Agent	Antimicrobial Category	Antimicrobial Class[a]	Antimicrobial Subclass[a]
CEFOTETAN	Antibacterial	Cephalosporins	Cephamycin
CEFOXITIN	Antibacterial	Cephalosporins	Cephamycin
CEFPODOXIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFPROZIL	Antibacterial	Cephalosporins	Cephalosporin 2nd generation
CEFTAROLINE	Antibacterial	Cephalosporins	Cephalosporins with anti-MRSA activity
CEFTAZIDIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFTAZIDIME/AVIBACTAM	Antibacterial	β-lactam/β-lactamase inhibitor combination	
CEFTOBIPROLE MEDOCARIL	Antibacterial	Cephalosporins	Cephalosporins with anti-MRSA activity
CEFTOLOZANE/ TAZOBACTAM	Antibacterial	β-lactam/β-lactamase inhibitor combination	
CEFTRIAXONE	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFUROXIME	Antibacterial	Cephalosporins	Cephalosporin 2nd generation
CEPHALEXIN	Antibacterial	Cephalosporins	Cephalosporin 1st generation
CIPROFLOXACIN	Antibacterial	Fluoroquinolones	
CLARITHROMYCIN	Antibacterial	Macrolides	
CLINDAMYCIN	Antibacterial	Lincosamides	
COLISTIMETHATE	Antibacterial	Polymyxins	
COLISTIN[c]	Antibacterial	Polymyxins	
DALBAVANCIN	Antibacterial	Glycopeptides	Lipoglycopeptides
DAPTOMYCIN	Antibacterial	Lipopeptides	
DELAFLOXACIN	Antibacterial	Fluoroquinolones	
DICLOXACILLIN	Antibacterial	Penicillins	Penicillinase-stable penicillins
DOXYCYCLINE	Antibacterial	Tetracyclines	
ERAVACYCLINE	Antibacterial	Tetracyclines	Fluorocycline
ERTAPENEM	Antibacterial	Carbapenems	
ERYTHROMYCIN	Antibacterial	Macrolides	
FIDAXOMICIN	Antibacterial	Macrocyclic	
FLUCONAZOLE	Antifungal	Azoles	
FOSFOMYCIN	Antibacterial	Fosfomycins	
GENTAMICIN	Antibacterial	Aminoglycosides	
IMIPENEM/ CILASTATIN	Antibacterial	Carbapenems	

Antimicrobial Agent	Antimicrobial Category	Antimicrobial Class[a]	Antimicrobial Subclass[a]
IMIPENEM/CILASTATIN/ RELEBACTAM	Antibacterial	β-lactam/β-lactamase inhibitor combination	
ISAVUCONAZONIUM	Antifungal	Azoles	
ITRACONAZOLE	Antifungal	Azoles	
LEFAMULIN	Antibacterial	Pleuromutilins	
LEVOFLOXACIN	Antibacterial	Fluoroquinolones	
LINEZOLID	Antibacterial	Oxazolidinones	
MEROPENEM	Antibacterial	Carbapenems	
MEROPENEM/ VABORBACTAM	Antibacterial	β-lactam/β-lactamase inhibitor combination	
METRONIDAZOLE	Antibacterial	Nitroimidazoles	
MICAFUNGIN	Antifungal	Echinocandins	
MINOCYCLINE	Antibacterial	Tetracyclines	
MOLNUPIRAVIR	Antiviral	Nucleoside Analog	
MOXIFLOXACIN	Antibacterial	Fluoroquinolones	
NAFCILLIN	Antibacterial	Penicillins	Penicillinase-stable penicillins
NIRMATRELVIR[d]	Antiviral	Protease Inhibitor	
NIRSEVIMAB[e]	Monoclonal Antibody	Fusion inhibitor	
NITROFURANTOIN	Antibacterial	Nitrofurans	
OMADACYCLINE	Antibacterial	Tetracyclines	Aminomethylcycline
ORITAVANCIN	Antibacterial	Glycopeptides	Lipoglycopeptides
OSELTAMIVIR	Anti-influenza	Neuraminidase inhibitors	
OXACILLIN	Antibacterial	Penicillins	Penicillinase-stable penicillins
PENICILLIN G	Antibacterial	Penicillins	Penicillin
PENICILLIN V	Antibacterial	Penicillins	Penicillin
PERAMIVIR	Anti-influenza	Neuraminidase inhibitors	
PIPERACILLIN/ TAZOBACTAM	Antibacterial	β-lactam/β-lactamase inhibitor combination	
PIVMECILLINAM	Antibacterial	Penicillins	
PLAZOMICIN	Antibacterial	Aminoglycosides	
POLYMYXIN B	Antibacterial	Polymyxins	
POSACONAZOLE	Antifungal	Azoles	

Antimicrobial Agent	Antimicrobial Category	Antimicrobial Class[a]	Antimicrobial Subclass[a]
REMDESIVIR	Antiviral	Nucleotide Analog	
REZAFUNGIN	Antifungal	Echinocandins	
RIFAMPIN	Antibacterial	Rifampin	
RIMANTADINE	Anti-influenza	M2 ion channel inhibitors	
SULBACTAM/ DURLOBACTAM	Antibacterial	β-lactam/β-lactamase inhibitor combination	
SULFAMETHOXAZOLE/ TRIMETHOPRIM	Antibacterial	Folate pathway inhibitors	
TEDIZOLID	Antibacterial	Oxazolidinones	
TELAVANCIN	Antibacterial	Glycopeptides	Lipoglycopeptides
TETRACYCLINE	Antibacterial	Tetracyclines	
TIGECYCLINE	Antibacterial	Glycylcyclines	
TINIDAZOLE	Antibacterial	Nitroimidazoles	
TOBRAMYCIN	Antibacterial	Aminoglycosides	
VANCOMYCIN	Antibacterial	Glycopeptides	Glycopeptide
VORICONAZOLE	Antifungal	Azoles	
ZANAMIVIR	Anti-influenza	Neuraminidase inhibitors	

[a] Adapted from CLSI M100[12]

[b] While reported separately in the CDA file, Amikacin Liposomal will be rolled up and reported in the NHSN AU Option analysis reports with Amikacin.

[c] While reported separately in the CDA file, Colistin will be rolled up and reported in the NHSN AU Option analysis reports with Colistimethate.

[d] Per Paxlovid prescribing information, Nirmatrelvir must be co-administered with Ritonavir. However, for public health surveillance, NHSN AU Option will be capturing only administered Nirmatrelvir.

[e] Nirsevimab is a long-acting monoclonal antibody for the prevention of respiratory syncytial virus–associated lower respiratory tract infection among infants and children aged <24 months.
(reference: Jones JM, Fleming-Dutra KE, Prill MM, et al. Use of Nirsevimab for the Prevention of Respiratory Syncytial Virus Disease Among Infants and Young Children: Recommendations of the Advisory Committee on Immunization Practices — United States, 2023. MMWR Morb Mortal Wkly Rep 2023;72:920–925. DOI: http://dx.doi.org/10.15585/mmwr.mm7234a4.)

Appendix C. Example Calculations of Antimicrobial Days

Example 1. Example eMAR and Calculation of Antimicrobial Days

This example illustrates the antimicrobial days calculation for a patient receiving 1 gram Meropenem intravenously every 8 hours and 1000mg Amikacin intravenously every 24 hours in the medical ward. Table 1 provides an example of administered doses for this patient documented in eMAR. Table 2 illustrates the calculation of Meropenem and Amikacin days by antimicrobial (total) and stratified by route of administration based on the administered doses of Meropenem and Amikacin documented in eMAR. Table 3 illustrates the contribution of this patient's antimicrobial days to the aggregate monthly report per patient care location.

Table 1. ***Example eMAR for patient housed in Medical Ward***

Medical Ward	Monday December 28	Tuesday December 29	Wednesday December 30
Meropenem 1g intravenously every 8 hours	Given: 2300	Given: 0700 Given: 1500 Given: 2300	Given: 0700
Amikacin 1000mg intravenously every 24 hours	Given: 2300	Given: 2300	

Table 2. ***Example of calculation of antimicrobial days***

Calculation	Monday December 28	Tuesday December 29	Wednesday December 30
Drug-specific Antimicrobial Days (total)	Meropenem Days = 1 Amikacin Days = 1	Meropenem Days = 1 Amikacin Days = 1	Meropenem Days = 1 Amikacin Days = 0
Drug-specific Antimicrobial Days Stratified by Route of Administration	Meropenem Days (IV) = 1 Amikacin Days (IV) = 1	Meropenem Days[a] (IV) = 1 Amikacin Days (IV) = 1	Meropenem Days (IV) = 1 Amikacin Days (IV) = 0

[a] Please note, despite receiving three administrations of Meropenem on December 29, the patient only contributed one total Meropenem antimicrobial day per calendar day.

Table 3. ***Example of antimicrobial days per month per patient care location***

Month/ Year-Location	Antimicrobial Agent	Drug-specific Antimicrobial Days				
		Total	IV	IM	Digestive	Respiratory
December Medical Ward	Meropenem	3	3	0	0	0
December Medical Ward	Amikacin	2	2	0	0	0

Example 2. Differences in Calculations for Patient Care Location and Facility-Wide Inpatient for a Patient Transferred Between Patient Care Locations

This example illustrates the antimicrobial days calculation for a patient receiving 1 gram Vancomycin every 8 hours that was transferred from the MICU to a medical ward on December 1. Table 1 provides an example of doses documented in eMAR administered to this patient in the MICU and Medical Ward. Table 2 illustrates the calculation of Vancomycin days by antimicrobial (total) and stratified by route of administration based on the administered doses of Vancomycin documented in eMAR. One Vancomycin day is attributed to both the MICU and Medical Ward locations since administrations took place in both units during the calendar day. Further, despite receiving two administrations of Vancomycin in the Medical Ward, the patient only attributes one total Vancomycin antimicrobial day for the Medical Ward per calendar day. Table 3 shows the contribution of this patient's Vancomycin days to the aggregate monthly report per location and facility-wide inpatient. Note that while the patient attributes one total Vancomycin day for both the MICU and the Medical Ward on December 1, only one total Vancomycin day can be attributed to the FacWideIN count that calendar day.

Table 1. ***Example eMAR for patient transferred from MICU to Medical Ward on December 1***

eMAR	Tuesday December 1 Location: MICU	Tuesday December 1 Location: Medical Ward
Vancomycin 1g intravenously every 8 hours	Given: 0700	Given: 1500 Given: 2300

Table 2. ***Example of calculation of antimicrobial days for December 1***

Calculation	Tuesday December 1 Location: MICU	Tuesday December 1 Location: Medical Ward
Drug-specific Antimicrobial Days (total)	Vancomycin Days = 1	Vancomycin Days = 1
Drug-specific Antimicrobial Days Stratified by Route of Administration	Vancomycin Days (IV) = 1	Vancomycin Days (IV) = 1

Table 3. ***Example of antimicrobial days per month per patient care location and facility-wide inpatient contributed from December 1***

Month/ Year-Location	Antimicrobial Agent	Drug-specific Antimicrobial Days				
		Total	IV	IM	Digestive	Respiratory
December MICU	Vancomycin	1	1	0	0	0
December Medical Ward	Vancomycin	1	1	0	0	0
December Facility-wide inpatient	Vancomycin	1	1	0	0	0

Example 3. Calculation of Antimicrobial Days for a Patient Care Location when a Patient Admission extends over Two Different Months

This example illustrates the antimicrobial days calculation for a patient receiving 1 gram Ceftriaxone intravenously every 24 hours for two days in the Surgical Ward (but spanning different months). Table 1 provides an example of administered doses for this patient documented in eMAR. Table 2 illustrates the calculation of Ceftriaxone days by antimicrobial (total) and stratification of route of administration based upon the administered doses of Ceftriaxone documented in eMAR. Table 3 illustrates the contribution of this patient's Ceftriaxone days to the aggregate monthly report per patient care location.

Note: The patient's FacWideIN admission (denominator) would be attributed to the month the patient was first physically located in an inpatient location within the facility. In the scenario highlighted here, the patient would attribute 1 admission to December and no admission to January (specifically, the patient would not be counted in the total January admissions count). The patient would continue to contribute one day present for each day the patient was in the location/facility.

Table 1. ***Example eMAR for patient housed in Surgical Ward***

eMAR	Thursday December 31 Location: Surgical Ward	Friday January 1 Location: Surgical Ward
Ceftriaxone 1g intravenously every 24 hours	Given: 0800	Given: 0800

Table 2. ***Example of calculation of antimicrobial days***

Calculation	Thursday December 31 Location: Surgical Ward	Friday January 1 Location: Surgical Ward
Drug-specific Antimicrobial Days (total)	Ceftriaxone Day = 1	Ceftriaxone Day = 1
Drug-specific Antimicrobial Days Stratified by Route of Administration	Ceftriaxone Day (IV) = 1	Ceftriaxone Day (IV) = 1

Table 3. ***Example of antimicrobial days per month per patient care location***

Month/ Year-Location	Antimicrobial Agent	Drug-specific Antimicrobial Days				
		Total	IV	IM	Digestive	Respiratory
December/ Surgical Ward	Ceftriaxone	1	1	0	0	0
January/ Surgical Ward	Ceftriaxone	1	1	0	0	0

Appendix D: List of SAARs[a]

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	Special Care Nursery (Level II), 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	Special Care Nursery (Level II), 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	Special Care Nursery (Level II), Neonatal Critical Care (Level II/III), Neonatal Critical Care (Level III), Neonatal Critical Care (Level IV)	Neo_BSHO_2018
Third generation Cephalosporins	Special Care Nursery (Level II), 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	Special Care Nursery (Level II), 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	Special Care Nursery (Level II), 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

[a] Users can find 2014 baseline SAAR details here: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/saar-2014-508.pdf.

Appendix E: Antimicrobial Groupings for SAAR & Rate Table Calculations[a]

Adult SAAR Antimicrobial Agent Categories

Adult All antibacterial agents

All antibacterial agents in the AUR protocol except:

- AMIKACIN LIPOSOME
- CEFEPIME/ ENMETAZOBACTAM
- CEFIDEROCOL
- CEFTOBIPROLE MEDOCARIL
- COLISTIN
- DELAFLOXACIN
- ERAVACYCLINE
- IMIPENEM/CILATATIN/RELEBACTAM
- LEFAMULIN
- MEROPENEM/VABORBACTAM
- OMADACYCLINE
- PIPERACILLIN
- PIVMECILLINAM
- PLAZOMICIN
- SULBACTAM/DURLOBACTAM
- TICARCILLIN/CLAVULANATE

Adult Broad spectrum antibacterial agents predominantly used for hospital-onset infections

- AMIKACIN (IV only)
- AZTREONAM (IV only)
- CEFEPIME
- CEFTAZIDIME
- DORIPENEM
- GENTAMICIN (IV only)
- IMIPENEM/CILASTATIN
- MEROPENEM
- PIPERACILLIN/TAZOBACTAM
- TOBRAMYCIN (IV only)

Adult Broad spectrum antibacterial agents predominantly used for community-acquired infections

- CEFACLOR
- CEFDINIR
- CEFIXIME
- CEFOTAXIME

- CEFPODOXIME
- CEFPROZIL
- CEFTRIAXONE
- CEFUROXIME
- CIPROFLOXACIN
- ERTAPENEM
- GEMIFLOXACIN
- LEVOFLOXACIN
- MOXIFLOXACIN

Adult Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)

- CEFTAROLINE
- DALBAVANCIN
- DAPTOMYCIN
- LINEZOLID
- ORITAVANCIN
- QUINUPRISTIN/DALFOPRISTIN
- TEDIZOLID
- TELAVANCIN
- VANCOMYCIN (IV only)

Adult Narrow spectrum beta-lactam agents

- AMOXICILLIN
- AMOXICILLIN/CLAVULANATE
- AMPICILLIN
- AMPICILLIN/SULBACTAM
- CEFADROXIL
- CEFAZOLIN
- CEFOTETAN
- CEFOXITIN
- CEPHALEXIN
- DICLOXACILLIN
- NAFCILLIN
- OXACILLIN
- PENICILLIN G
- PENICILLIN V

Adult Antibacterial agents posing the highest risk for CDI

This category contains antimicrobials that are part of other SAAR categories.

- CEFDINIR
- CEFEPIME
- CEFIXIME

- CEFOTAXIME
- CEFPODOXIME
- CEFTAZIDIME
- CEFTRIAXONE
- CIPROFLOXACIN
- CLINDAMYCIN
- GEMIFLOXACIN
- LEVOFLOXACIN
- MOXIFLOXACIN

Adult Antifungal agents predominantly used for invasive candidiasis

- ANIDULAFUNGIN
- CASPOFUNGIN
- FLUCONAZOLE
- MICAFUNGIN

Adult Rate Table

Adult Antibacterial agents predominantly used for extensively antibiotic resistant bacteria

- CEFTAZIDIME/AVIBACTAM
- CEFTOLOZANE/TAZOBACTAM
- COLISTIMETHATE (IV only)
- POLYMYXIN B (IV only)
- TIGECYCLINE

Pediatric SAAR Antimicrobial Agent Categories

Pediatric All antibacterial agents

All antibacterial agents in the AUR protocol except:

- AMIKACIN LIPOSOME
- CEFEPIME/ ENMETAZOBACTAM
- CEFIDEROCOL
- CEFTOBIPROLE MEDOCARIL
- COLISTIN
- DELAFLOXACIN
- ERAVACYCLINE
- IMIPENEM/CILATATIN/RELEBACTAM
- LEFAMULIN
- MEROPENEM/VABORBACTAM
- OMADACYCLINE
- PIPERACILLIN
- PIVMECILLINAM
- PLAZOMICIN

- SULBACTAM/DURLOBACTAM
- TICARCILLIN/CLAVULANATE

Pediatric Broad spectrum antibacterial agents predominantly used for hospital-onset infections

- AMIKACIN (IV only)
- AZTREONAM (IV only)
- CEFEPIME
- CEFTAZIDIME
- CIPROFLOXACIN
- DORIPENEM
- ERTAPENEM
- GEMIFLOXACIN
- IMIPENEM/CILASTATIN
- LEVOFLOXACIN
- MEROPENEM
- MOXIFLOXACIN
- PIPERACILLIN/TAZOBACTAM
- TOBRAMYCIN (IV only)

Pediatric Broad spectrum antibacterial agents predominantly used for community-acquired infections

- AMOXICILLIN/CLAVULANATE
- AMPICILLIN/SULBACTAM
- CEFACLOR
- CEFDINIR
- CEFIXIME
- CEFOTAXIME
- CEFPODOXIME
- CEFPROZIL
- CEFTRIAXONE
- CEFUROXIME

Pediatric Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)

- CEFTAROLINE
- CLINDAMYCIN
- DALBAVANCIN
- DAPTOMYCIN
- LINEZOLID
- ORITAVANCIN
- QUINUPRISTIN/DALFOPRISTIN
- TEDIZOLID
- TELAVANCIN
- VANCOMYCIN (IV only)

Pediatric Narrow spectrum beta-lactam agents

- AMOXICILLIN
- AMPICILLIN
- CEFADROXIL
- CEFAZOLIN
- CEFOTETAN
- CEFOXITIN
- CEPHALEXIN
- DICLOXACILLIN
- NAFCILLIN
- OXACILLIN
- PENICILLIN G
- PENICILLIN V

Pediatric Azithromycin

- AZITHROMYCIN

Pediatric Antibacterial agents posing the highest risk for CDI

This category contains antimicrobials that are part of other SAAR categories.

- CEFDINIR
- CEFEPIME
- CEFIXIME
- CEFOTAXIME
- CEFPODOXIME
- CEFTAZIDIME
- CEFTRIAXONE
- CIPROFLOXACIN
- CLINDAMYCIN
- GEMIFLOXACIN
- LEVOFLOXACIN
- MOXIFLOXACIN

Pediatric Antifungal agents predominantly used for invasive candidiasis

- ANIDULAFUNGIN
- CASPOFUNGIN
- FLUCONAZOLE
- MICAFUNGIN

Pediatric Rate Table

Pediatric Antibacterial agents predominantly used for extensively antibiotic resistant bacteria

- CEFTAZIDIME/AVIBACTAM
- CEFTOLOZANE/TAZOBACTAM
- COLISTIMETHATE (IV only)

- POLYMYXIN B (IV only)
- TIGECYCLINE

Neonatal SAAR Antimicrobial Agent Categories

Neonatal All antibacterial agents

All antibacterial agents in the AUR protocol except:

- AMIKACIN LIPOSOME
- CEFEPIME/ ENMETAZOBACTAM
- CEFIDEROCOL
- CEFTOBIPROLE MEDOCARIL
- CHLORAMPHENICOL
- COLISTIN
- DALBAVACIN
- DELAFLOXICIN
- DORIPENEM
- DOXYCYCLINE
- ERAVACYCLINE
- ERYTHROMYCIN/SULFISOXAZOLE
- GEMIFLOXACIN
- IMIPENEM/CILASTATIN/RELEBACTAM
- MEROPENEM/VABORBACTAM
- MINOCYCLINE
- OMADACYCLINE
- ORITIVANCIN
- PIPERACILLIN
- PIVMECILLINAM
- PLAZOMICIN
- SULBACTAM/DURLOBACTAM
- TETRACYCLINE
- TIGECYCLINE

Neonatal Vancomycin predominantly used for treatment of late-onset sepsis

- VANCOMYCIN (IV only)

Neonatal Broad spectrum antibacterial agents predominantly used for hospital-onset infections

- CEFEPIME (IV only)
- ERTAPENEM (IV only)
- IMIPENEM/CILASTATIN (IV only)
- MEROPENEM (IV only)
- PIPERACILLIN/TAZOBACTAM (IV only)

Neonatal Third generation Cephalosporins

- CEFOTAXIME (IV only)
- CEFTAZIDIME (IV only)
- CEFTRIAXONE (IV only)

Neonatal Ampicillin predominantly used for treatment of early-onset sepsis

- AMPICILLIN (IV only)

Neonatal Aminoglycosides predominantly used for treatment of early-onset and late-onset sepsis

- AMIKACIN (IV only)
- GENTAMICIN (IV only)
- TOBRAMYCIN (IV only)

Neonatal Fluconazole predominantly used for candidiasis

- FLUCONAZOLE (IV and oral only)

Neonatal Rate Tables

Fluconazole predominantly used for candidiasis used in Level II special care neonatal nurseries

- FLUCONAZOLE

Ampicillin predominantly used for treatment of early-onset sepsis used in well baby nurseries

- AMPICILLIN (IV only)

Aminoglycosides predominantly used for treatment of early-onset and late-onset sepsis used in well baby nurseries

- AMIKACIN (IV Only)
- GENTAMICIN (IV Only)
- TOBRAMYCIN (IV Only)

[a] Users can find 2014 baseline SAAR details here: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/saar-2014-508.pdf.

2. Antimicrobial Resistance (AR) Option

Introduction

The proportion of isolates resistant to specific antimicrobial agents is a common measure of antimicrobial resistance. Proportion susceptible (%S) can aid in clinical decision making (hospital antibiograms) and assessing the impact of transmission prevention and antimicrobial stewardship success, although the measure may not be very sensitive to measuring success of short-term efforts. Proportion susceptible also facilitates local or regional assessment of progression or improvement of a particular resistance problem to guide local or regional transmission prevention efforts. Validity of local and regional assessments of the magnitude of a particular resistance phenotype can be improved by using standardized methodology for aggregating proportion resistant.

Objectives:

1. Facilitate antimicrobial resistance data evaluation using a standardized approach to:
    a. Provide local practitioners with an improved awareness of a variety of antimicrobial resistance problems to aid in clinical decision making and prioritize transmission prevention efforts.
    b. Provide facility-specific measures in context of a regional and national perspective (specifically, benchmarking) that can inform decisions to accelerate transmission prevention efforts and reverse propagation of emerging or established resistant pathogens.
2. Allow regional and national assessment of antimicrobial resistant organisms of public health importance, including ecologic and infection burden assessment.

Methodology:

The AR Option reports antimicrobial resistance data as a proportion.[1] The proportion susceptible is defined as the number of susceptible isolates divided by the number of isolates tested for the specific antimicrobial agent being evaluated. For each facility, the numerator (specifically, number of susceptible isolates) is derived from isolate-level reports submitted. The ultimate source of the isolate data included in these reports is the laboratory information system (LIS). Laboratory results data from the electronic health record system (EHRs) can be used to populate the AR Option numerator records submitted to NHSN in healthcare settings where the LIS is directly connected to the EHRs. The AR Option obtains denominators of patient days and admissions from the ADT system (or similar system that allows for electronic access of required data elements).

Facilities must not employ manual means of data collection to report AR Option data to NHSN. Facilities that do not have access to discrete data elements needed for AR Option reporting are not eligible to participate in the AR Option. For example, facilities receiving results via PDF or fax for eligible organisms and/or required susceptibility results will not be able to participate in the AR Option as those data are not saved as discrete fields. Of note, beginning in January 2025, *Candida* isolates without susceptibility testing or without susceptibility testing results in discrete format become eligible for AR Option reporting. The sections below further define the numerator and denominator, which must adhere to the

data format specified by the Health Level 7 (HL7) CDA Implementation Guide developed by the CDC and HL7.[2] Manual data entry is not available for the AR Option.

Settings:
All inpatient facilities enrolled in NHSN and using the Patient Safety Component can participate in the AR Option. This includes facilities enrolled as general acute care hospitals, critical access hospitals, children's hospitals, long term acute care hospitals, pediatric long term acute care hospitals, military and veterans' hospitals, oncology hospitals, orthopedic hospitals, psychiatric hospitals, rehabilitation hospitals, surgical hospitals, women's hospitals, women's and children's hospitals, government and non-government hospitals for public health emergencies. Participating facilities must be able to collect the numerator and denominator data electronically and upload those data into NHSN using the required CDA specifications. NHSN does not currently support AR Option data submission from long term care facilities (for example, skilled nursing facilities and nursing homes) nor outpatient dialysis facilities.

NHSN strongly encourages reporting specimens at each facility from all NHSN defined inpatient locations (including inpatient procedural areas like operating rooms) and three select outpatient locations: Emergency Department (ED), Pediatric ED, and 24-hour Observation Area from which the numerator data can be accurately electronically captured. The AR Option does not accept specimens collected in other outpatient location types, such as outpatient clinics. The denominators of patient days and admissions are only reported at the facility-wide inpatient level (FacWideIN). The denominator of outpatient encounters is reported separately from the three select outpatient location types: ED, Pediatric ED, and 24-hour Observation Area. Previous experience with AUR Module implementation suggests that reporting from all NHSN patient care locations is easier than reporting from selected locations.

Requirements

Each month:

1. The facility must indicate they plan to submit AR Option data on the Patient Safety Monthly Reporting Plan.
    a. The facility must add FacWideIN to the plan to report AR Option data from inpatient locations. Individual inpatient locations should not be listed in the AR Option plan. Specifically, do not add a checkmark in the Antimicrobial Resistance column for the individual inpatient locations.
    b. The facility must add each outpatient location separately to report AR Option data from the three select outpatient location types.
2. The facility must report two record types for each month of surveillance.
    a. One event file for each isolate-based report.
        i. Isolate is defined as a population of a single organism observed in a culture obtained from a patient specimen.
        ii. Each AR Option event file contains the specific location of specimen collection.
        iii. Note: If the facility has no AR Events to report (specifically, there were no isolates that met the AR Option inclusion criteria), the facility can select the box on the NHSN Alert

screen to report "No AR Events". More information can be found here: Report No AR Events Guide. The "No AR Events" check box is available for each individual outpatient location and at the FacWideIN level.

b. One summary file for the FacWideIN denominator data report and one summary file for each outpatient location listed in the reporting plan.

NHSN recommends AR Option data be submitted to NHSN for a given calendar month by the end of the subsequent calendar month. However, facilities should wait at least seven calendar days following the end of the month before submitting data to ensure the lab completed all susceptibility testing and reported results back to the EHRs.

Isolate-based report

The facility must report all required data each month for each eligible isolate-based report (See Appendix F). The facility should only consider specimens collected in an inpatient or select outpatient location (ED, pediatric ED, and 24-hour observation) for eligibility. The facility should only report isolates to the AR Option with any antimicrobial susceptibility testing completed regardless of whether the drug is specified as required in the AR Option Protocol. For example, if a facility isolates *Enterococcus* species from a urine specimen but does not perform susceptibility testing on that isolate, the isolate is not eligible for reporting to the AR Option. However, beginning in January 2025, the *Candida* isolates without susceptibility testing or without access to susceptibility testing results are the exception to this rule and become eligible for AR Option reporting.

The facility should report all eligible isolates that meet the reporting guidelines outlined in this protocol to NHSN regardless of the antimicrobial resistance of the isolated organism. This means that even isolates that are susceptible to all required antimicrobials are eligible to be reported to the AR Option. Additionally, isolates in which all the *NHSN required* antimicrobials were not tested, but at least one non-required drug was tested, are eligible to be reported into NHSN. For example, if a facility tested a *Staphylococcus aureus* isolate for the non-required drug Telithromycin and none of the other 26 NHSN required antimicrobials were tested, that isolate would still be considered eligible for reporting to the AR Option. This is consistent with CLSI M39 Guidance on reporting cumulative susceptibility test results.[3] Non-culture based organism detection completed on the specimen instead of on a bacterial or fungal isolate (for example, T2Bacteria, T2Candida, or Karius Test) should not be submitted.

Report two distinct events based on specimens obtained in inpatient and select outpatient locations with susceptibility testing performed:

1. **Each** eligible organism isolated from an invasive source (blood or cerebrospinal fluid [CSF]) per patient, per 14 day period even across calendar months:
    a. There should be 14 days with no positive culture result from the laboratory for the patient and specific organism before the facility enters another invasive source AR Event into NHSN for the patient and specific organism. NOTE: The date of specimen collection is considered Day 1.
    b. After >14 days have passed with no positive culture results for that specific organism, the facility can report another positive culture from an invasive source with that specific

organism as an AR Event. For example, if a facility obtained a positive blood culture from a patient on January 1, the earliest another invasive specimen could be reported to NHSN for that same patient and organism would be January 15 (assuming there were no positive blood or CSF cultures in the interim).

2. The **first** eligible organism isolated from any eligible non-invasive culture source (lower respiratory, urine, skin, soft tissue, wound and musculoskeletal), per patient, per month.
    a. Only one AR event is allowed per calendar month for the same patient/organism for lower respiratory, urine, or skin, soft tissue, wound and musculoskeletal specimens.

Note: The AR Option 14 day rule starts with the day of specimen collection and applies only to those specimens collected in an inpatient location or select outpatient location (ED, pediatric ED, or 24-hour observation area) in the reporting facility. Outpatient locations other than the ED, pediatric ED, and 24-hour observation area (for example, wound clinic or outpatient laboratory) should not be included in the 14 day rule. Further, cultures obtained while the patient was at *another* healthcare facility should not be included in the 14 day calculations.

A. Eligible organisms

Facilities and vendors should refer to the AR Option Pathogen Roll-up Workbook found in the Antimicrobial Resistance Toolkit for eligible organisms for AR Option reporting and the complete list of their associated SNOMED codes. All organisms in the Workbook are eligible for reporting. Facilities and vendors should first rollup the eligible organisms using the Pathogen Roll-up Workbook before applying the isolate selection rules and rules for the removal of same day duplicates. When genus level codes are eligible for reporting, remember to report the species level code, if provided by the lab, to prevent over de-duplication of AR Events. Refer to the AR Option Pathogen Roll-up Reference Guide, also found in the AR Toolkit, for guidance using the workbook and determining which SNOMED codes are accepted into NHSN.

Eligible organisms include:

- All *Acinetobacter* species
- All *Candida* species
- *Nakaseomyces glabratus (Candida glabrata)*
- *Pichia kudriavzevii (Candida krusei)*
- All *Citrobacter* species
- All *Enterobacter* species
- All *Enterococcus* species
- *Escherichia coli*
- All *Klebsiella* species
- *Morganella morganii*
- All *Proteus* species
- *Pseudomonas aeruginosa*
- *Serratia marcescens*
- *Staphylococcus aureus*
- *Stenotrophomonas maltophilia*
- *Streptococcus agalactiae*

- *Streptococcus pneumoniae*
- *Streptococcus pyogenes*

B. Specimen Sources

Eligible specimen source groups include blood, CSF, urine, lower respiratory, skin, soft tissue, wound, and musculoskeletal. Facilities and vendors should refer to the Specimen Source tab of Information Data Model (IDM) found in the Antimicrobial Resistance Toolkit for the complete list of eligible specimen sources and their associated SNOMED codes. Facilities should only report those SNOMED codes listed in the AR Specimen Source value set on the Specimen Source tab in the IDM. Do not include SNOMED children specimen types unless specifically listed.

1. Eligible invasive specimen sources include cerebrospinal fluid (CSF) and blood specimens. (Table 1)

   Note: Report blood or CSF cultures growing the same eligible specific organism (genus and species or genus only if the species has not been identified) only if the patient had no positive blood or CSF culture result with that specific organism (genus and species or genus only if the species has not been identified) within the last 14 days, even across calendar months.

2. Eligible non-invasive specimen sources include lower respiratory (for example, sputum, bronchoalveolar lavage), urine, skin, soft tissue, wound, and musculoskeletal specimens.

Table 1: Example of 14 day rule for a specific organism from a single patient in an inpatient location

Date	Lab Result	Reported to NHSN?	Justification
January 1	*Staphylococcus aureus* isolated from blood culture	Yes	Patient's first blood culture of inpatient admission; *Staphylococcus aureus* is isolated; facility reports AR Event into NHSN.
January 4	*Staphylococcus aureus* isolated from blood culture	No	It has been less than 14 days since the last positive culture (January 1) from the patient isolating *Staphylococcus aureus.*
January 16	*Staphylococcus aureus* isolated from CSF culture	No	It has been less than 14 days since the last positive culture (January 4) from the patient isolating *Staphylococcus aureus*.
January 31	*Staphylococcus aureus* isolated from blood culture	Yes	It has more than 14 days since the last positive culture (January 16) from the patient isolating *Staphylococcus aureus*; facility reports AR Event into NHSN.

The facility should evaluate all isolate test results using either the algorithm in Figure 1 (Invasive specimens) or Figure 2 (Non-invasive specimens) to determine reportable AR events for each calendar month.

- For eligible invasive specimens, there should be 14 days with no positive culture result from the laboratory for the patient and specific organism before the facility enters another invasive source AR Event into NHSN for the patient and specific organism (Figure 1). Based on the 14 day rule, at a maximum, a patient would have no more than three invasive isolates per specific organism reported per month.
- For eligible non-invasive specimens, the facility should report all first non-invasive isolates (chronologically) per patient, per month, per organism as an AR Event (Figure 2).

C. Required Data

Required data include data available from the LIS, EHRs, and administrative data systems. The set of variables for each isolate consists of a variable to identify the NHSN facility, specimen-/patient-related data, and antimicrobial susceptibility data as outlined below.

For additional information on each variable please see Appendix G.

- Facility identifier
  - Unique NHSN Facility ID (Object Identifier [OID] is used in the CDA)

- Specimen-/Patient-related data
  - Patient identifier
  - Date of birth
  - Sex
  - Race (optional variable)
  - Ethnicity (optional variable)
  - Whether the patient was admitted to the facility during the encounter (True/False)
  - Date admitted to facility (see details in Appendix G)
  - Specimen collection date
  - Specimen source
  - Location code (mapped to CDC location codes)
  - Isolate identifier (unique isolate ID in the electronic laboratory report based upon the isolate being reported with its own AST results)
  - Organism (Appendix F)

- Antimicrobial susceptibility data
  - Antimicrobial (Appendix F)
  - Penicillin-binding protein 2a-agglutination (PBP2a) (required only if *Staphylococcus aureus*)
  - Polymerase chain reaction (PCR) *mec*-gene (required only if *Staphylococcus aureus*)
  - E-test sign
  - E-test value & unit of measure
  - Interpretation of E-test
  - Minimum Inhibitory Concentration (MIC) sign
  - MIC value & unit of measure

- Interpretation of MIC test
- Disk diffusion (Kirby-Bauer or KB) test sign
- Disk diffusion (KB) test value & unit of measure
- Interpretation of disk diffusion (KB) test
- Final interpretation result

Notes:

- While many of these fields are required in the CDA report, facilities unable to electronically obtain the results of the individual laboratory tests (specifically, E-test, MIC, Disk diffusion [KB]) may still report AR Option data by using "NA" to indicate "Not Tested" for these specific tests as long as the final interpretation result can be provided for each antimicrobial tested.
- Only the lab tests listed above can be included in the CDA report. However, if your lab uses additional tests like the cefoxitin screen or inducible clindamycin test and uses the results of the additional test to change/amend the final interpretation for a given drug included in our panel, we'd like you to report the same result you sent to the clinician to NHSN. For example, if the lab updated the result for erythromycin based on the result of the inducible clindamycin test, you should report the changed erythromycin result (same result reported to clinician) to NHSN.
- Facilities unable to electronically obtain the results of the PBP2a-agglutination and/or PCR *mec*-gene tests for *Staphylococcus aureus* may report "Unknown" for these specific tests.
- Facilities should not employ manual means of data collection to report AR Option data to NHSN.

D. Reporting Guidelines

- Interpretation of phenotypic test results (E-test, MIC test, Disk diffusion [KB] test) includes the following results:
  - S = Susceptible
  - S-DD = Susceptible-Dose Dependent
  - I = Intermediate
  - R = Resistant
  - NS = Non-Susceptible
  - NA = Not Tested or no discrete data available
    - Note: After upload into NHSN, Not Tested values appear as "N".
  - Specific to Gentamicin and Streptomycin results for *Enterococcus* testing high-level resistance:
    - S = Susceptible/Synergistic
    - R = Resistant/Not Synergistic
- Facilities should only report final or corrected susceptibility testing to NHSN. Do not report preliminary laboratory results for NHSN AR Option reporting.
- In circumstances where different breakpoints are required, rely on the specimen source to determine which susceptibility results to report.
  - If the specimen source is CSF, report the meningitis breakpoint susceptibility.
  - If the specimen source is anything other than CSF, report the non-meningitis breakpoint susceptibility.
- Facilities should report results based on clinical, not epidemiological, breakpoints.

- All organisms listed in the AR Option Pathogen Roll-up Workbook found in the Antimicrobial Resistance Toolkit are eligible for submission. Facilities/vendors should first perform the roll-up of organisms before applying subsequent reporting rules.

E. Removal of Same Day Duplicates

Multiple isolates of the same organism from the same specimen may produce conflicting results. Facilities should only report one isolate to NHSN, retaining the unique nature of the test results. Facilities must follow the rules listed below to ensure removal of duplicate isolate reports. Duplicates are defined as same species or genus, when identification to species level is not provided, isolated from the same source type (specifically, invasive or non-invasive) from the same patient on the same day. For example, if a patient has a blood specimen and urine specimen collected on the same day and *E.coli* is isolated from both, because the specimens are from two different source types (invasive vs non-invasive), they are not considered duplicates.

Select the isolate to report to NHSN based on these rules (see Figure 3):

- For invasive source isolate selection, select CSF isolates over blood isolates.
- For non-invasive source isolate selection, select isolates based on the order specified: 1) lower respiratory, 2) urine, 3) skin, soft tissue, wound, and musculoskeletal.
    - If two or more isolates are identified from skin, soft tissue, wound and/or musculoskeletal on the same day, use the Figure 3 flow chart to assess which isolate has higher amount of drug resistance based on the number of antimicrobials testing first "NS", if equal amount of "NS" then move to the amount of "R", then "I", then "S-DD" then "S". If it cannot be determined which is most resistant, then report the isolate that was the first entered into the LIS.
- Eliminate isolates on same day without phenotypic susceptibility test results. Only report isolates with complete/final laboratory testing to NHSN.
- Do not merge test results across multiple isolates (specifically, don't summarize results across different isolates tested on same day).
- If two isolates from the same day have conflicting phenotypic susceptibilities to the panel of antimicrobials tested, report the isolate with the most resistant final interpretation (NS > R > I > S-DD > S > NA).
    - If the lab validated susceptibility results of both isolates but did not provide a final interpretation, report the isolate with the higher amount of drug resistance based on the number of antimicrobials testing first "NS", if equal amount of "NS" then move to the amount of "R", then "I", then "S-DD" then "S".
        - For example, a facility isolated *Candida albicans* from two blood specimens collected from the same patient on the same calendar day and the lab validated susceptibility results from both isolates. The first isolate tested "R" to three of the seven antimicrobials and the second isolate tested "R" to four of the seven antimicrobials. The facility should report the second isolate to NHSN because it showed the higher amount of resistance.
    - If two or more isolates have the same number of antimicrobials testing "NS", "R", "I", "S-DD" and "S" and it cannot be determined which is most resistant, then report the isolate that was the first entered into the LIS.
    - Do not consider results from drugs that are outside of the NHSN-specified drug panels when determining which isolate to report.

- If the lab performs the same test on the same isolate but the two tests produce conflicting results, report the final interpretation provided by the lab.
    - If the lab did not provide a final interpretation, then report the most resistant interpretation (NS > R > I > S-DD > S > NA) for that specific antimicrobial.
        - For example, if a facility performs two E-tests for the same drug on the same isolate and one produces “Intermediate” while the other produces “Susceptible”, report “Intermediate” as the final interpretation for that specific drug susceptibility.
- If the lab performs specific antimicrobial tests on the same isolate that produce conflicting susceptibility interpretations, and the laboratory did not provide a final summary interpretation, report the most resistant specific test interpretation as the final interpretation (NS > R > I > S-DD > S > NA) for that specific antimicrobial.
    - For example, if drug susceptibility results produced MIC = Resistant and E-Test = Intermediate but the lab did not provide a final interpretation, report “Resistant” as the final interpretation for that specific antimicrobial susceptibility.

Denominator Data

For each month, report combined denominator data for all inpatient locations within the facility (facility-wide inpatient [FacWideIN]): (See Appendix H for details)

1. Patient Days: Number of patients present in the facility at the same time on each day of the month, summed across all days in the month.
2. Admissions: Number of patients admitted to an inpatient location in the facility each month.
    a. A patient is counted as an admission when they arrive in an NHSN designated inpatient location regardless of patient status (for example, inpatient, observation).
    b. A patient admitted to an inpatient unit would be counted as an admission even if they were discharged that same calendar day.
    c. If in the ADT system a patient appears to move from an inpatient to an outpatient ED, pediatric ED or 24-hour observation location then back to an inpatient location, it should be counted as two separate admissions.
    d. Please note, the admissions definition used in the AUR Module is different than the definition used in the NHSN MDRO/CDI Module.

Note: Neither the patient days nor admissions denominators should include the counts from outpatient locations (ED, pediatric ED, and 24-hour observation area).

Report outpatient encounters for the three select outpatient locations: ED, Pediatric ED, and 24-hour Observation Area:

1. Encounters: A visit to an eligible outpatient location counts as a single encounter. The patient can contribute an encounter as soon as they have had an initial interaction with a medical professional (for example, the beginning of triage). The patient can contribute an encounter regardless of whether the patient is placed in a bed.
    a. If the patient’s stay in any eligible outpatient location continues into subsequent calendar days, that patient should still be counted as 1 encounter. For example:
        i. If the patient arrives in the ED on Monday and remains in the ED until Wednesday, that patient should be counted as 1 encounter within the ED.

b. If the patient transfers from one outpatient location to another within the same facility, that patient should be counted as 1 encounter for the first outpatient location and should not be counted as an encounter for the receiving location (specifically, a patient should not contribute two encounters when transferring between outpatient locations in the same facility). For example:
    i. If the patient arrives in the ED on Monday then is transferred to the 24-hour Observation Area on Tuesday, the patient should be counted only as 1 encounter within the ED and zero encounters within the 24-hour Observation Area.
c. If the patient is discharged, or leaves, then returns to that outpatient unit during the same calendar day, that patient should be counted as 2 encounters. For example:
    i. If the patient arrives in the ED at 07:00 on Monday, is discharged at 11:00 on Monday then returns to the ED at 18:00 on Monday, that patient counts as two separate encounters for the ED.
d. If the patient transfers from outpatient to inpatient, then to outpatient, the second outpatient stay (assuming it's in an eligible location) would be considered a new encounter because there was time spent in an inpatient location. For example:
    i. If the patient arrives in the ED on Monday, is admitted or transferred to the medical ICU on Monday then is transferred to the 24-hour Observation Unit on Tuesday and admitted or transferred back to the medical ward on Tuesday, the patient contributes 1 encounter to the ED location and 1 encounter to the 24-hour Observation Unit since there was time spent in an inpatient location (medical ward) in between the outpatient stays.
e. If the patient's stay in the facility crosses calendar months, the patient will contribute an encounter to the first month the patient was in an outpatient location. For example:
    i. If patient is in outpatient location on January 31 and February 1 then count as 1 encounter to January and zero to February.
f. Please note, the encounters count will not be a direct match to the AU Option days present count for these location types.

Minimizing Bias & Bypassing Suppression

The hospital LIS is the ultimate source of antimicrobial susceptibility test results, but in some healthcare facilities not all susceptibility results are readily available in the LIS for reporting to NHSN. Concerted efforts are needed to obtain antimicrobial susceptibility data for the purposes of reporting to NHSN. Due to a practice referred to as selective reporting or cascade reporting, some antimicrobial susceptibility results might be withheld from clinical end users. This practice can serve to control costs or to prevent overuse of some antimicrobial agents, but it also can exert an adverse impact on the completeness of antimicrobial susceptibility results reporting to public health surveillance systems and infection control programs.[4] This can lead to significant biases in the calculation of cumulative antibiograms available for surveillance or infection control. Facilities should make every effort to submit all antimicrobial susceptibility data that meet the NHSN protocol requirements, regardless of whether those data are suppressed from clinical end users.

Data Analyses

Facilities and groups can analyze all AR Option data reported to NHSN immediately after data upload. After generating analysis datasets within NHSN, users can view all reported data in the NHSN analysis reports. The data in NHSN can be visualized and analyzed in many ways. For example, descriptive analysis reports such as line lists and bar charts are available. In addition, measures of antimicrobial resistance are available in rate tables, antibiogram, Standardized Resistant Infection Ratio (SRIR) and Pathogen-specific Standardized Infection Ratio (pSIR) reports.

Types of AR Option Analysis Reports

Standardized Resistant Infection Ratio (SRIR):

The Standardized Resistant Infection Ratio (SRIR) is a metric developed by CDC to enable facilities to compare their rates of hospital-onset (HO) drug-resistant infection events to a national benchmark. The SRIR adjusts for various facility level factors that contribute to AR risk within each facility. It compares the actual number of resistant infections to the number predicted, given the standard population (specifically, the 2019 NHSN baseline), adjusting for several risk factors that have been found to be statistically significantly associated with rates of resistant infections. The SRIR is calculated by dividing the number of observed resistant infections by the number of predicted resistant infections.

$$\text{SRIR} = \frac{\text{\# Observed Resistant Infections}}{\text{\# Predicted Resistant Infections}}$$

The observed resistant infections are the number of HO AR Events that meet NHSN-specific resistance definitions (for example, CRE, MRSA, multi-drug resistant *Pseudomonas aeruginosa*). The predicted resistant infections are calculated using predictive models developed by CDC and applied to nationally aggregated 2019 AR data reported to NHSN. Separate predictive models are developed for each specific resistant organism definition and specimen source (blood, urine, and lower respiratory).

The SRIR can be generated for 7 drug-resistant phenotypes from 3 specimen sources (blood, urine, and lower respiratory), for a total of 21 possible SRIRs (see Appendix J). The resistant organisms eligible for SRIR calculation were determined by CDC with input from external experts, including adult, pediatric, and neonatal infectious disease physicians and pharmacists. The drug-resistant phenotypes are listed below (see Appendix I for definitions).

- Carbapenem-resistant Enterobacterales
- Extended-spectrum cephalosporin-resistant Enterobacterales
- Fluoroquinolone-resistant Enterobacterales
- Vancomycin-resistant *Enterococcus*
- Fluoroquinolone-resistant *Pseudomonas aeruginosa*
- Multi-drug-resistant *Pseudomonas aeruginosa*
- Methicillin-resistant *Staphylococcus aureus*

At present, SRIRs are available to facilities that have submitted at least one hospital-onset isolate of the specific organism in the given specimen source during the time period of interest. For example, a

Vancomycin-resistant *Enterococcus* blood SRIR can be generated for the facilities that submitted at least one HO *Enterococcus* blood event in the given time period.

A SRIR greater than 1.0 indicates that more resistant infections were observed than predicted. A SRIR less than 1.0 indicates that fewer resistant infections were observed than predicted. An SRIR of 0 indicates a facility reported the organism of interest from the specimen source of interest during the correct time period, but the organism was not resistant to the drug(s) specified. For example, using the example of HO VRE in urine, if a hospital reports 10 hospital-onset *Enterococcus* isolates from urine during the time of interest, and all 10 are reported to be susceptible to vancomycin, the HO VRE SRIR would be 0 because there were 0 observed resistant infection events.

A SRIR value may be missing when no HO isolates of the organism of interest were reported from the given specimen source during the time period, or an HO organism of interest was reported for the specimen source but <0.3 events were predicted (minimum precision criterion was not met). Using the example of HO VRE in urine, a facility would receive a missing value for a SRIR if:

1) No HO *Enterococcus* was reported in a urine specimen or,
2) HO *Enterococcus* was reported from urine during the correct time period but there were <0.3 HO VRE events predicted for the time period of interest.

SRIRs can be produced by quarter, half-year, year, or cumulative time periods.

SRIR Report: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-Option-SRIR-Report_QRG_FINAL.pdf

Pathogen-specific Standardized Infection Ratio (pSIR):
The Pathogen-Specific Standardized Infection Ratio (pSIR) is a metric developed by CDC to enable facilities to compare their rates of HO culture-positive infections of specific pathogen to a national benchmark. It compares the actual number of events (pathogens isolated) to the number predicted, given the standard population (specifically, the 2019 NHSN baseline), adjusting for several risk factors that have been found to be statistically significantly associated with differences in infection incidence. The pSIR is calculated by dividing observed infections of specific pathogens by predicted infections.

$$\text{pSIR} = \frac{\text{\# Observed Infections of Specific Pathogens}}{\text{\# Predicted Infections of Specific Pathogens}}$$

The observed infections are the number of HO events reported to NHSN. The predicted infections are calculated using predictive models developed by CDC and applied to nationally aggregated 2019 AR data reported to NHSN. Separate predictive models are developed for each pathogen and specimen source (blood, urine, and lower respiratory).

The pSIR can be generated for 4 pathogens/pathogen groups from 3 specimen sources (blood, urine, and lower respiratory), for a total of 12 possible pSIRs (see Appendix J).

- Enterobacterales: includes *Escherichia coli, Klebsiella aerogenes, Klebsiella oxytoca, Klebsiella pneumoniae, or Enterobacter* spp.

- *Enterococcus*: includes all *Enterococcus* spp.
- *Staphylococcus aureus*
- *Pseudomonas aeruginosa*

At present, pSIRs are available to facilities that have submitted at least one HO pathogen in the correct specimen source during the specified time period of interest.

A pSIR greater than 1.0 indicates that more infections were observed than predicted. A pSIR less than 1.0 indicates that fewer infections were observed than predicted. A pSIR value of 0 indicates a facility reported at least one HO isolate from the specimen source of interest during the correct time period, but the pathogen of interest was not isolated. For example, for hospital-onset *Enterococcus* in urine, if a facility reported one or more HO isolates (any organism) from urine during the time period of interest, but no HO *Enterococcus* was isolated, the facility would receive a pSIR of 0.

A pSIR value may be missing when no positive culture grew reportable AR organisms from the given specimen source during the time period, or an HO organism of interest was reported for the specimen source but <0.3 events were predicted (minimum precision criterion was not met). Using the example of HO *Enterococcus* in urine, a facility would receive a missing value for a pSIR if:

1) No HO positive culture from a urine specimen grew Enterobacterales, *Enterococcus*, *Staphylococcus aureus*, or *Pseudomonas aeruginosa*
2) At least one HO pathogen of interest was isolated from urine during the correct time period but there were <0.3 HO *Enterococcus* events predicted for that time period

pSIRs can be produced by quarter, half-year, year, or cumulative time periods.

pSIR Report: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-Option-pSIR-Report_QRG_FINAL.pdf

Facility-wide Antibiogram:
The facility-wide antibiogram table displays the calculated percent susceptible (see Table 2) for each organism-antimicrobial combination. Users can stratify the antibiogram table by specimen source, time period, and/or by specific antimicrobial or organism. By default, the facility-wide antibiogram will include isolates collected in eligible outpatient locations (ED, pediatric ED and 24-hour observation area) if the facility reports those to NHSN. Note: A facility must have tested and reported the antimicrobial susceptibility results for at least 30 isolates for a specific organism/antimicrobial combination in the given time period for results to appear in the Percent Susceptible table of NHSN antibiogram report.

In addition to the facility-wide antibiogram, within the same report, NHSN creates a table displaying the calculated percent tested (see Appendix F) for each organism-antimicrobial combination reported from all locations (inpatient and outpatient) to the AR Option.

Antibiogram and Percent Tested: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-antibiogram-508.pdf

Table 2. Facility-wide Antibiogram

Facility-wide: standard report for facility and group user
% susceptible is calculated for each organism-antimicrobial pairing: $$\%S = \frac{\text{Total \# of isolates S}}{\text{Total \# of isolates tested}}$$

Antimicrobial Resistance Option (AR) Events

Five reports list all events reported into the NHSN AR Option regardless of susceptibility results.

Line List: Users can generate a line list to show all AR Events reported into NHSN for a given time period. The line list is the most customizable type of AR Option analysis report. The line list is also the most helpful AR Option report for data validation.

Line List: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-QRG-LineList.pdf

Bar Chart: Users can generate a bar chart to show all AR Events reported into NHSN for a given time period. By default, the bar chart will show the number of AR Events by organism over the most recent 12-month time period. Users can modify the bar chart to show the number of Antimicrobial Resistant Organisms based on the AR Option phenotype definitions (Appendix I).

Bar Chart: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-barchart-508.pdf

Incidence Rate Table: Users can generate an incidence rate table that includes hospital-onset (HO) events by individual specimen type and a combined all specimen type rate for select pathogen groups.

$$\text{HO incidence: } \frac{\text{\# HO AR Events}}{\text{\# patient days}} \times 10{,}000$$

Incidence Rate Table: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-Incidence-by-Pathogen.pdf

Prevalence Rate Table: Users can generate two prevalence rate tables that include community-onset (CO) events by individual specimen type and a combined all specimen type rate for select pathogen groups.

$$\text{CO prevalence: } \frac{\text{\# CO AR Events from inpt and outpt locations}}{\text{\# admissions}} \times 10{,}000$$

$$\text{Outpatient CO prevalence: } \frac{\text{\# CO AR Events from outpt locations}}{\text{\# encounters}} \times 10{,}000$$

Prevalence Rate Tables:
Inpatient and outpatient: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-CO-Prevalence-by-Pathogen.pdf
Outpatient only: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-Outpatient-Prevalence-by-Pathogen.pdf

Antimicrobial Resistant Option (AR) Drug-resistant Organisms (AR Organisms)

Six reports use the AR Option phenotype definitions (Appendix I) to determine Antimicrobial Resistant Organisms. Specifically, only events with susceptibility results meeting the phenotype definitions will be included in these reports.

Line List: Users can generate a line list to show all AR Organisms that meet the AR Option phenotype definitions for a given time period. The default line list shows each AR Organism reported to NHSN, patient information, specimen collection date, and the location where the specimen was collected.

AR Organisms Line List: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-organisms-linelist-508.pdf

Frequency Table: Users can generate a frequency table to show the number of AR Events meeting the AR Option phenotype definitions in a given time period. While the table default is to display events by month, modifications can be made to display the data by quarter, half-year, year, or cumulative time periods.

AR Organisms Frequency Table: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-freq-508.pdf

Rate Table: Users can generate a rate table to display the percent of resistant isolates by AR Option phenotype. The percent resistant is calculated by dividing the number of resistant isolates over the number of isolates tested multiplied by 100.

$$\frac{\#\ isolates\ resistant}{\#\ isolates\ tested} \times 100$$

AR Organisms Rate Table: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-qrg-ratetable-508.pdf

Incidence Rate Table: Users can generate an incidence rate table that includes hospital-onset (HO) events that meet AR Option phenotype definitions by individual specimen type and a combined all specimen type rate.

$$\text{HO incidence: } \frac{\#\ HO\ AR\ Events}{\#\ patient\ days} \times 10{,}000$$

Incidence Rate Table: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-Incidence-by-Phenotype.pdf

Prevalence Rate Table: Users can generate two prevalence rate tables that include community-onset (CO) events that meet AR Option phenotype definitions by individual specimen type and a combined all specimen type rate.

$$\text{CO prevalence: } \frac{\#\ CO\ AR\ Events\ from\ inpt\ and\ outpt\ locations}{\#\ admissions} \times 10{,}000$$

$$\text{Outpatient CO prevalence: } \frac{\#\ CO\ AR\ Events\ from\ outpt\ locations}{\#\ encounters} \times 10{,}000$$

Prevalence Rate Tables:
Inpatient and outpatient: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-CO-Prevalence-by-Phenotype.pdf
Outpatient only: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AR-Outpatient-Prevalence-by-Phenotype.pdf

Users can also export AR Option data from NHSN in various formats including Excel, CSV, and SAS.

Additional analysis reports will be available in future releases. Requests for additional reports can be sent to: NHSN@cdc.gov.

NHSN Group Analysis:
NHSN Group users can visualize and analyze AR data shared with them by member facilities using NHSN analysis reports. In addition to the Analysis Quick Reference Guides (QRGs) available in the Antimicrobial Use and Resistance Module Reports section of the Patient Safety Analysis Quick Reference Guide page. Groups can find Group-specific resources on the NHSN Group Users page.

Additional Analysis Resources:
Users can also find recorded training sessions and Quick Learn videos highlighting AR Option analysis reports on the AUR Training page.

Figure 1. Test Result Algorithm for Invasive Specimen Reporting

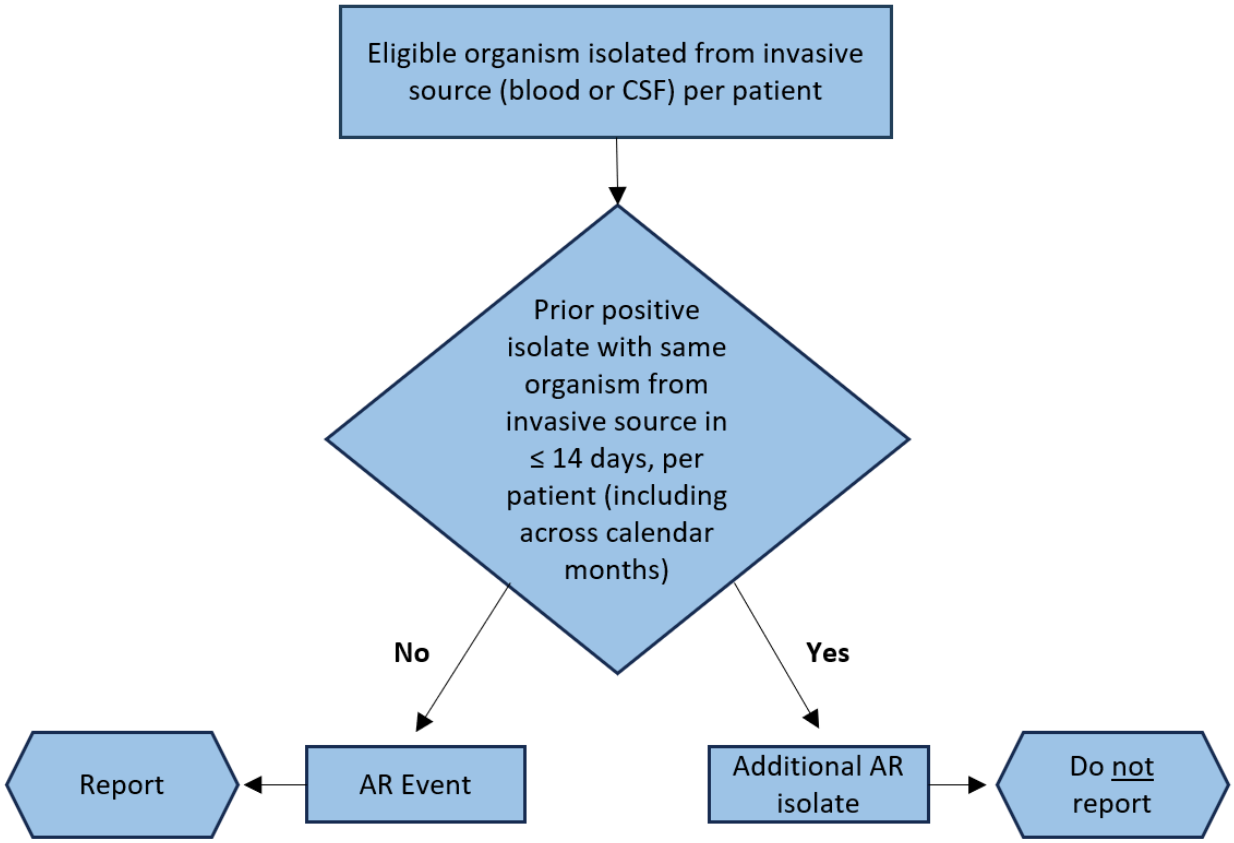


Figure 2. Test Result Algorithm for Non-Invasive Specimen Reporting

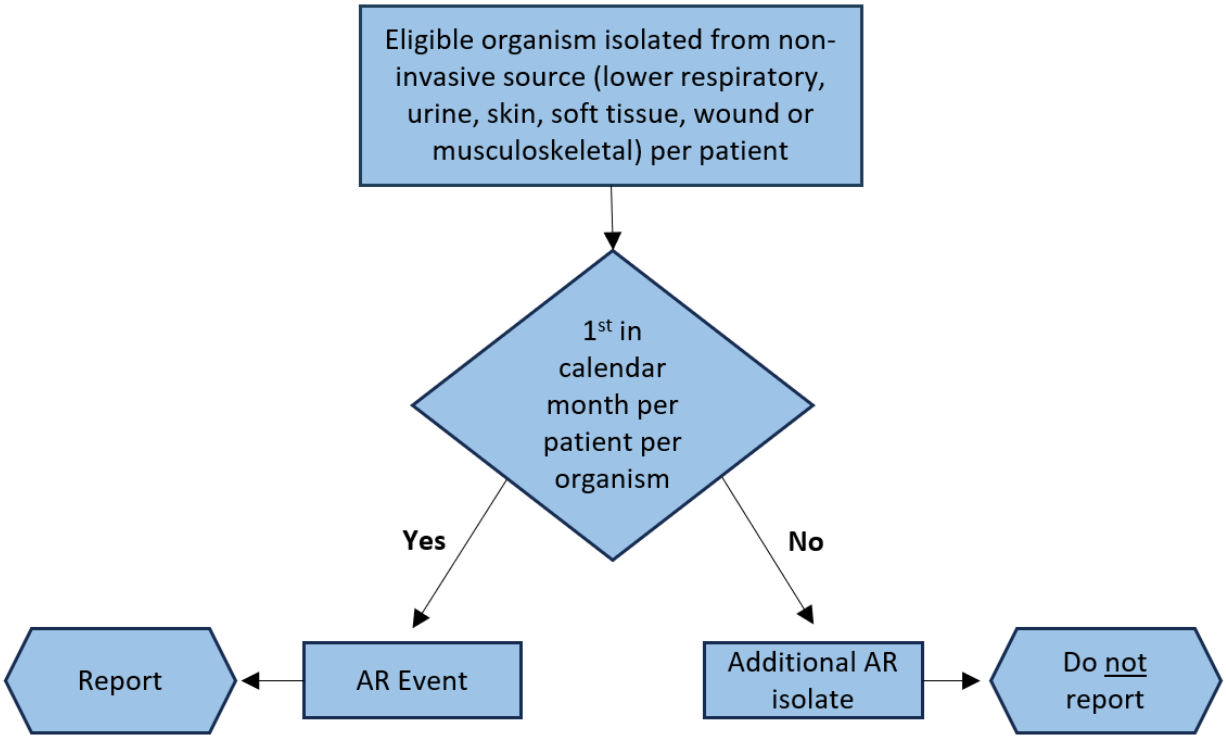
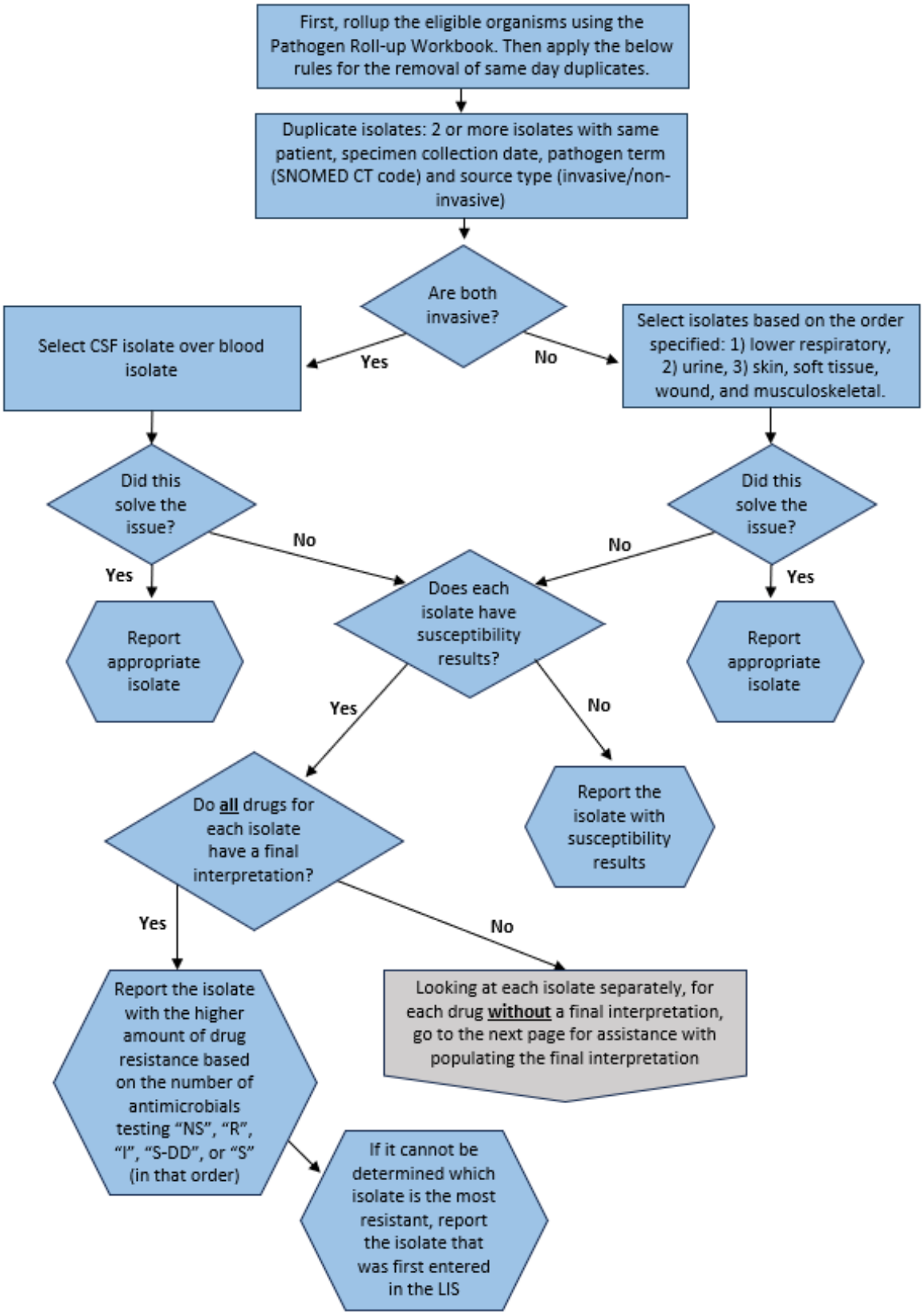
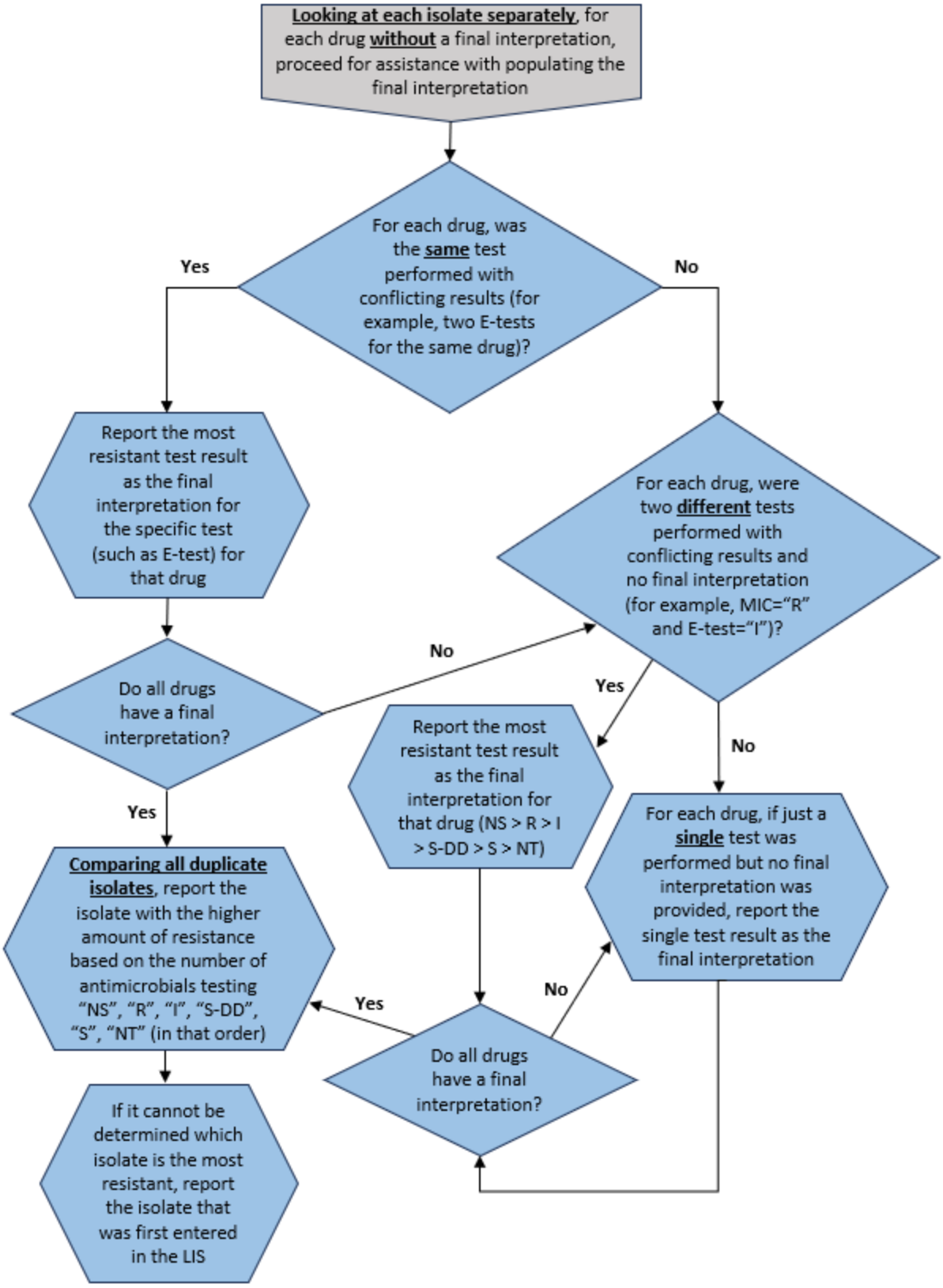


Figure 3. Reporting Algorithm for Same Day Duplicates




Looking at each isolate separately, for each drug without a final interpretation, proceed for assistance with populating the final interpretation
For each drug, was the same test performed with conflicting results (for example, two E-tests for the same drug)?
Yes
No
Report the most resistant test result as the final interpretation for the specific test (such as E-test) for that drug
For each drug, were two different tests performed with conflicting results and no final interpretation (for example, MIC="R" and E-test="I")?
Do all drugs have a final interpretation?
No
Yes
Report the most resistant test result as the final interpretation for that drug (NS > R > I > S-DD > S > NT)
No
Yes
Comparing all duplicate isolates, report the isolate with the higher amount of resistance based on the number of antimicrobials testing "NS", "R", "I", "S-DD", "S", "NT" (in that order)
For each drug, if just a single test was performed but no final interpretation was provided, report the single test result as the final interpretation
Yes
No
Do all drugs have a final interpretation?
If it cannot be determined which isolate is the most resistant, report the isolate that was first entered in the LIS

References

1. Schwaber MJ, De-Medina T, and Carmeli Y. Epidemiological interpretation on antibiotic resistance studies – what are we missing? Nat Rev Microbiol 2004;2:979-83.
2. National Healthcare Safety Network (NHSN) Patient Safety Component: Clinical Document Architecture. http://www.cdc.gov/nhsn/cdaportal/index.html
3. CLSI. Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data; Approved Guideline – Third Edition. CLSI document M39-A3. Wayne, PA: Clinical and Laboratory Standards; 2009.
4. Council of State and Territorial Epidemiologists (CSTE). Recommendations for strengthening public health surveillance of antimicrobial resistance in the United States. https://cdn.ymaws.com/www.cste.org/resource/resmgr/PS/13-SI-01.pdf. Accessed October 1, 2015.

Appendix F. List of Eligible Organisms and Corresponding Antimicrobial Susceptibility Panels for the NHSN AR Option

Please note that standardized terminology (SNOMED & LOINC) mappings are provided in the Antimicrobial Resistance Toolkit. Facilities and vendors should refer to the AR Option Pathogen Roll-up Workbook found in the Antimicrobial Resistance Toolkit for the eligible organisms for AR Option reporting and the complete list of their associated SNOMED codes. The Roll-up Workbook provides a mapping from eligible pathogen terms (those terms that, if identified, should be reported) to accepted pathogen terms (the SNOMED terms accepted by the NHSN application). The toolkit also provides a Quick Reference Guide containing examples of how to use the Roll-up Workbook. Testing methods should follow most recent CLSI guidance as appropriate.

Organism	Specimen Type	Antimicrobial Agents tested for Susceptibility
Acinetobacter (All *Acinetobacter* species noted in the AR Option Pathogen Roll-up Workbook)	Blood, CSF, Lower Respiratory, Skin, Soft Tissue, Wound, Musculoskeletal, Urine	Amikacin Ampicillin-sulbactam[a] Cefepime Cefiderocol Cefotaxime Ceftazidime Ceftriaxone Ciprofloxacin Colistin Doxycycline Gentamicin Imipenem Levofloxacin Meropenem Minocycline Piperacillin-tazobactam[a] Polymyxin B Tobramycin Trimethoprim-sulfamethoxazole[a]
	Additional Agents for Urine	Tetracycline
Candida *Nakaseomyces glabratus (Candida glabrata)* *Pichia kudriavzevii (Candida krusei)* (All *Candida* species noted in the AR Option Pathogen Roll-up Workbook)	Blood, CSF, Skin, Soft Tissue, Wound, Musculoskeletal, Urine Note: Lower respiratory will not be collected for Candida spp.	Amphotericin B Anidulafungin Caspofungin Fluconazole Micafungin Posaconazole Voriconazole
	Additional Agents for Urine	None

Continued on the next page

Organism	Specimen Type	Antimicrobial Agents tested for Susceptibility
Citrobacter *(*All *Citrobacter* species noted in the AR Option Pathogen Roll-up Workbook) *Enterobacter* *(*All *Enterobacter* species noted in the AR Option Pathogen Roll-up Workbook) *Escherichia coli* *Klebsiella* *(*All *Klebsiella* species noted in the AR Option Pathogen Roll-up Workbook) *Morganella morganii* *Proteus* *(*All *Proteus* species noted in the AR Option Pathogen Roll-up Workbook) *Serratia marcescens*	Blood, CSF, Lower Respiratory, Skin, Soft Tissue, Wound, Musculoskeletal, Urine	Amikacin Amoxicillin-clavulanic acid[a] Ampicillin Ampicillin-sulbactam[a] Aztreonam Cefazolin (urine or non-urine breakpoints)[b, c] Cefepime Cefiderocol Cefotaxime Cefotetan Cefoxitin Ceftaroline Ceftazidime Ceftazidime-avibactam[a] Ceftolozane-tazobactam[a] Ceftriaxone Cefuroxime Ciprofloxacin Colistin Ertapenem Gentamicin Imipenem Imipenem-relebactam[a] Levofloxacin Meropenem Meropenem-vaborbactam[a] Piperacillin-tazobactam[a] Plazomicin Tetracycline Trimethoprim-sulfamethoxazole[a] Tobramycin
	Additional Agents for Urine	Ceftibuten Fosfomycin Nitrofurantoin

Continued on the next page

Organism	Specimen Type	Antimicrobial Agents tested for Susceptibility
Enterococcus *(*All *Enterococcus* species noted in the AR Option Pathogen Roll-up Workbook) *Enterococcus faecalis* *Enterococcus faecium*	Blood, CSF, Lower Respiratory, Skin, Soft Tissue, Wound, Musculoskeletal, Urine	Ampicillin Dalbavancin Daptomycin Gentamicin Gentamicin high potency Linezolid Oritavancin Penicillin[d] Streptomycin Streptomycin high potency Tedizolid Telavancin Vancomycin Note: For Gentamicin and Streptomycin only: Synergistic = Susceptible Non-synergistic = Resistant
	Additional Agents for Urine Note: Exclude Gentamicin and Streptomycin	Ciprofloxacin Fosfomycin Levofloxacin Nitrofurantoin Tetracycline

Continued on the next page

Organism	Specimen Type	Antimicrobial Agents
Pseudomonas aeruginosa	Blood, CSF, Lower Respiratory, Skin, Soft Tissue, Wound, Musculoskeletal, Urine	Aztreonam Cefepime Cefiderocol Ceftazidime Ceftazidime-avibactam[a] Ceftolozane-tazobactam[a] Ciprofloxacin Colistin Imipenem Imipenem-relebactam[a] Levofloxacin Meropenem Piperacillin-tazobactam[a] Polymyxin B Tobramycin
	Additional Agents for Urine	Amikacin
Staphylococcus aureus	Blood, CSF, Lower Respiratory, Skin, Soft Tissue, Wound, Musculoskeletal, Urine	Azithromycin Cefoxitin Ceftaroline Ciprofloxacin Clarithromycin Clindamycin Dalbavancin Daptomycin Doxycycline Erythromycin Gentamicin Lefamulin Levofloxacin Linezolid Minocycline Moxifloxacin Oritavancin Oxacillin or Nafcillin[e] Penicillin[d] Rifampin Tedizolid Telavancin Tetracycline Trimethoprim-sulfamethoxazole[a] Vancomycin
	Additional Agents for Urine	Nitrofurantoin

Continued on the next page

Organism	Specimen Type	Antimicrobial Agents
Stenotrophomonas maltophilia	Blood, CSF, Lower Respiratory, Skin, Soft Tissue, Wound, Musculoskeletal, Urine	Cefiderocol Levofloxacin Minocycline Trimethoprim-sulfamethoxazole[a]
	Additional Agents for Urine	None
Streptococcus agalactiae *Streptococcus pyogenes*	Blood, CSF, Lower Respiratory, Skin, Soft Tissue, Wound, Musculoskeletal, Urine	Ampicillin Azithromycin Cefepime Cefotaxime Ceftaroline Ceftriaxone Clarithromycin Clindamycin Dalbavancin Daptomycin Erythromycin Levofloxacin Linezolid Oritavancin Penicillin[d] Tedizolid Telavancin Tetracycline Vancomycin
	Additional Agents for Urine	None

Continued on the next page

Organism	Specimen Type	Antimicrobial Agents
Streptococcus pneumoniae	Blood, CSF, Lower Respiratory, Skin, Soft Tissue, Wound, Musculoskeletal, Urine	Amoxicillin Amoxicillin-clavulanic acid[a] Azithromycin Cefepime (meningitis or non-meningitis breakpoints)[f] Cefotaxime (meningitis or non-meningitis breakpoint)[f] Ceftaroline Ceftriaxone (meningitis or non-meningitis breakpoint)[f] Cefuroxime (parenteral breakpoint) Clarithromycin Clindamycin Doxycycline Ertapenem Erythromycin Imipenem Lefamulin Levofloxacin Linezolid Meropenem Moxifloxacin Penicillin[d] (meningitis or non-meningitis breakpoint)[f] Penicillin V[d] (oral breakpoint) Rifampin Tetracycline Trimethoprim-sulfamethoxazole Vancomycin
	Additional Agents for Urine	None

[a] When reporting the MIC value of combination agents (for example, ampicillin-sulbactam), report the first value in the lab result as the MIC value since NHSN cannot accept the forward slash in the CDA AR Event file.

[b] If the LIS produces urine and non-urine breakpoint results, rely on the specimen source to determine which susceptibility results to report. If the specimen source is urine, report the urine breakpoint susceptibility. If the specimen source is blood, CSF, lower respiratory, skin, soft tissue, wound or musculoskeletal report the non-urine breakpoint susceptibility.

[c] For Enterobacterales, if the specimen source is urine, report uncomplicated urinary tract infection breakpoints.

[d] If the LIS does not differentiate between Penicillin G and Penicillin V, list susceptibility results under Penicillin G and indicate that Penicillin V was not tested (NA).

[e] For *Staphylococcus aureus* susceptibility testing, if the LIS tests Nafcillin instead of Oxacillin, report Nafcillin susceptibility results as Oxacillin.

[f] If the LIS produces meningitis and non-meningitis breakpoint results, rely on the specimen source to determine which susceptibility results to report. If the specimen source is CSF, report the meningitis breakpoint susceptibility. If the specimen source is blood, urine, lower respiratory, skin, soft tissue, wound or musculoskeletal report the non-meningitis breakpoint susceptibility.

Appendix G. Technical and Isolate Based Report Variables

Facility, Patient, and Specimen sections

Name	Description of Field	Code Value List	Level of Requirement in CDA file
Facility OID[a]	Must be assigned to facility and included in the importation file prior to submission to NHSN		Required
Vendor (Application) OID[b]	Must be assigned to a vendor's software application and included in the AR CDA data file prior to submission to NHSN. The Vendor (Application) OID should be obtained by the software vendor and is distinct from the Facility OID.		Required
SDS Validation ID[b]	The Synthetic Data Set (SDS) Validation ID will be provided to the AR CDA vendor by the AUR Module Team upon confirmation that the AR SDS Excel files pass validation as part of the AR SDS initiative.[c]		Required
Vendor Software Name	Vendor software name is the name of the software application that generates the AR CDA file. NHSN collects this information to more effectively troubleshoot CDA files when needed.		Optional
Software Version	Software version is the version of the software application that generates the AR CDA file. NHSN collects this information to more effectively troubleshoot CDA files when needed.		Optional
Vendor Name	Vendor name is the name of the vendor that owns the software application that generates the AR CDA file. NHSN collects this information to more effectively troubleshoot CDA files when needed.		Optional
Patient ID	Alphanumeric patient ID assigned by the hospital and may consist of any combination of numbers and/or letters. This ID remains the same for the patient across all visits and admissions for all NHSN reporting.		Required
Date of Birth	The date of the patient's birth including month, day, and year.		Required
Sex	The sex of the person.	F (Female), M (Male)	Required
Race	The patient's race	American Indian/	Optional

Name	Description of Field	Code Value List	Level of Requirement in CDA file
		Alaska Native, Asian, Black or African American, Native Hawaiian/ Other Pacific Islander, White	
Ethnicity	The patient's ethnicity.	Hispanic or Latino, or Not Hispanic or Not Latino.	Optional
Admission status	Whether the patient was admitted to the facility during the encounter. Notes: • Report True (Yes) if the specimen was collected in an inpatient location. • Report True (Yes) if the specimen was collected in an outpatient location (for example, ED) and the patient was transferred to an inpatient location. • Report True (Yes) if the specimen was collected in an outpatient location and the facility discharges from the ED or 24-hour observation area, then admits to inpatient (*instead of transferring*), when less than 24 hours between ED or 24-hour observation area discharge and inpatient admit (at the same hospital). • Report False (No) if the specimen was collected in an outpatient location and the patient was transferred to another facility or discharged and did not return within 24 hours.	True/False	Required

Name	Description of Field	Code Value List	Level of Requirement in CDA file
Date admitted to facility	The date admitted to the facility is the calendar date that the patient physically locates to an inpatient location. Notes: • If the specimen was collected in an inpatient location, use the date of admission for this field • If the specimen was collected in an outpatient location, use the admission status variable as a guide: ○ If the admission status variable is True (Yes), then use the date the patient was admitted to the inpatient location for this field ○ If the admission status variable is False (No), then use the encounter date (the date the patient arrived in the first outpatient location) for this field ▪ If the specimen was collected on day 2 in an outpatient location, report the date of the first day in the outpatient location ▪ If patient is transferred to a subsequent outpatient location and specimen is collected in the second outpatient location, report the date the patient entered the first outpatient location		Required
Specimen collection date	Date the specimen was collected including month, day, and year.		Required
Specimen source	Specimen source from which the isolate was recovered (blood, CSF, urine, lower respiratory, skin, soft tissue, musculoskeletal, wound).	SNOMED	Required
Location	Patient care area where patient was located when the laboratory specimen was collected. Use patient location obtained from administrative data system (ADT).	CDC Location Codes	Required

Organism and Antimicrobial Susceptibility Testing Results sections

Name	Description of Field	Code Value List	Data element required for CDA file?	"NA" allowed?
Isolate identifier	Isolate identifier unique for each isolate within laboratory based upon the isolate being reported with its own AST results. For example, a urine specimen yields an *E. coli* isolate and a *K. pneumoniae* isolate and both have AST performed and reported; each isolate should be reported with a unique isolate identifier. Discuss with the facility's lab or LIS personnel to determine which identifier in the LIS can be used as the unique isolate ID for the purposes of AR Option reporting.		Y	N
Organism	Organism identified from specimen (Appendix F).	SNOMED	Y	N
Antimicrobial	Antimicrobial(s) tested for susceptibility (Appendix F defines agents by organism and specimen source)	LOINC	Y	N
PBP2a-agglutination	Result for PBP2a-agglutination (only if SA)	Positive, Negative, or Unknown	Y (Required only for *Staph aureus*)	N
PCR mec-gene	Result for PCR mec-gene (only if SA)	Positive, Negative, or Unknown	Y (Required only for *Staph aureus*)	N
E-test sign[d]	E-test sign Note: Instead of "NA", use "=" to express an exact value.		Y	Y (Recommend reporting sign if test value is reported)

E-test value/units of measure	E-test (Value in micrograms/liter). Use '.' as decimal delimiter, for example, 0.25		Y	Y (Recommend reporting value if test sign is reported)
Interpretation of E-test	Interpretation result of the E-test susceptibility test performed		Y	Y
MIC sign[d]	MIC sign Note: Instead of "NA", use "=" to express an exact value.		Y	Y (Recommend reporting sign if test value is reported)
MIC value/units of measure	MIC (Value in micrograms/liter). Use '.' as decimal delimiter, for example, 0.25		Y	Y (Recommend reporting value if test sign is reported)
Interpretation of MIC test	Interpretation result of the MIC susceptibility test performed		Y	Y
Disk diffusion (KB) sign[d]	Disk diffusion (KB) sign Note: Instead of "NA", use "=" to express an exact value.		Y	Y (Recommend reporting sign if test value is reported)
Disk diffusion (KB) value/units of measure	Disk diffusion (KB) value in millimeters		Y	Y (Recommend reporting value if test sign is reported)
Interpretation of Disk diffusion (KB) test	Interpretation result of the disk diffusion (KB) susceptibility test performed		Y	Y
Final Interpretation result	Final interpretation result of all different susceptibility tests performed		Y	Y

[a] Facilities interested in submitting data to NHSN via CDA must obtain a Facility OID (object identifier). More information on how to obtain an OID for your facility can be found on the CDA Submission Support Portal.

[b] AR CDA files are required to include a Vendor (Application) OID (object identifier) as part of the AR Option Synthetic Data Set initiative. More information on how to obtain a Vendor (Application) OID can be found on the Vendor (Application) Object Identifier page.

[c] More detailed information about the AR Synthetic Data Set validation process can be found on the CDA Submission Support Portal's Innovation Tools page.
[d] Refer to the HL7 Implementation Guide for specifics on how to code these values in the CDA report. Note: While many of these specific test results (specifically, E-test, MIC, Disk diffusion [KB]) are required in the CDA report, facilities unable to electronically obtain these results may still participate by using 'NA' to signify 'Not Tested'. Facilities should not employ manual means of data collection.

Appendix H. Denominator Data Variables

Name	Description of Field	Level of Requirement
Facility OID[a]	Must be assigned to facility and included in the importation file prior to submission to NHSN.	Required
Vendor (Application) OID[b]	Must be assigned to a vendor's software application and included in the AR CDA data file prior to submission to NHSN. The Vendor (Application) OID should be obtained by the software vendor and is distinct from the Facility OID.	Required
SDS Validation ID[b]	The Synthetic Data Set (SDS) Validation ID will be provided to the AR CDA vendor by the AUR Module Team upon confirmation that the AR SDS Excel files pass validation as part of the AR SDS initiative.[c]	Required
Vendor Software Name	Vendor software name is the name of the software application that generates the AR CDA file. NHSN collects this information to more effectively troubleshoot CDA files when needed.	Optional
Software Version	Software version is the version of the software application that generates the AR CDA file. NHSN collects this information to more effectively troubleshoot CDA files when needed.	Optional
Vendor Name	Vendor name is the name of the vendor that owns the software application that generates the AR CDA file. NHSN collects this information to more effectively troubleshoot CDA files when needed.	Optional
Location	FacWideIN, ED, Pediatric ED, 24-hour Observation Area	Required
Month	2-Digit month	Required
Year	4-Digit year	Required
Patient Days	For facility wide inpatient locations enter the total number of patient days collected at the same time each day combined for the month. All the facility's inpatient acute care locations should be included where denominators can be accurately collected.	Required for FacWideIN

Name	Description of Field	Level of Requirement
Admission Count	Enter the total number of admissions for all facility inpatient locations combined for the month. • A patient is counted as an admission when they arrive in an NHSN designated inpatient location regardless of patient status (for example, inpatient, observation). • A patient admitted to an inpatient unit would be counted as an admission even if they were discharged that same calendar day. • If in the ADT system a patient appears to move from an inpatient to an outpatient ED, pediatric ED or 24-hour observation location then back to an inpatient location, it should be counted as two separate admissions. • Please note, the admissions definition used in the AUR Module is different than the definition used in the NHSN MDRO/CDI Module.	Required for FacWideIN
Encounters for outpatient locations	Enter the total number of patient visits to the given outpatient location (specifically, ED, Pediatric ED, 24-hour Observation Area). A visit to an eligible outpatient location counts as a single encounter. The patient can contribute an encounter as soon as they have had an initial interaction with a medical professional (for example, the beginning of triage). The patient can contribute an encounter regardless of whether the patient is placed in a bed. • If the patient's stay in any eligible outpatient location continues into subsequent calendar days, that patient should still be counted as 1 encounter. For example: o If the patient arrives in the ED on Monday and remains in the ED until Wednesday, that patient should be counted as 1 encounter within the ED. • If the patient transfers from one outpatient location to another within the same facility, that patient should be counted as 1 encounter for the first outpatient location and should not be counted as an encounter for the receiving location (specifically, a patient should not contribute two encounters when transferring between outpatient locations in the same facility). For example: o If the patient arrives in the ED on Monday, then is transferred to the 24-hour Observation Area on Tuesday, the patient should be counted only as 1 encounter within the ED and zero encounters within the 24-hour Observation Area.	Required for ED, Pediatric ED, and 24-hour Observation Area

Name	Description of Field	Level of Requirement

	• If the patient is discharged, or leaves, then returns to that outpatient unit, that patient should be counted as 2 encounters, even when the movements were during the same calendar day. For example:
	  ○ If the patient arrives in the ED at 07:00 on Monday, is discharged at 11:00 on Monday then returns to the ED at 18:00 on Monday, that patient counts as two separate encounters for the ED.
	• If the patient transfers from outpatient to inpatient, then to outpatient, the second outpatient stay (assuming it's in an eligible location) would be considered a new encounter because there was time spent in an inpatient location. For example:
	  ○ If the patient arrives in the ED on Monday, is admitted or transferred to the medical ICU on Monday then is transferred to the 24-hour Observation Unit on Tuesday and admitted or transferred back to the medical ward on Tuesday, the patient would contribute 2 encounters (the first in the ED and the second to the 24-hour Observation Unit) since there was time spent in an inpatient location (medical ward) in between the outpatient stays.
	• If the patient's stay in the facility crosses calendar months, the patient will contribute an encounter to the first month the patient was in an outpatient location. For example:
	  ○ If patient is in outpatient location on January 31 and February 1 then count as 1 encounter to January and zero to February.
	• Please note, the encounters count will not be a direct match to the AU Option days present count for these location types.	

[a] Facilities interested in submitting data to NHSN via CDA must obtain a Facility OID (object identifier). More information on how to obtain an OID for your facility can be found on the CDA Submission Support Portal.

[b] AR CDA files are required to include a Vendor (Application) OID (object identifier) as part of the AR Option Synthetic Data Set initiative. More information on how to obtain a Vendor (Application) OID can be found on the Vendor (Application) Object Identifier page.

[c] More detailed information about the AR Synthetic Data Set validation process can be found on the CDA Submission Support Portal's Innovation Tools page.

Appendix I. NHSN AR Option Phenotype Definitions

Note: The phenotypes defined here for the AR Option only and may not match phenotype definitions used in other NHSN Modules. Additionally, the drug classes listed below are specific to laboratory testing and, in some cases, do not match to the specific class defined in the AU Option. The drugs included in each phenotype definition are specific to those included in the reportable drug panel for that organism. Please refer to Appendix F of the AUR Module Protocol for the complete list of drug panels for each organism.

Phenotype Name	Phenotype Code	Phenotype Definition[a]
Methicillin-resistant *Staphylococcus aureus*[b]	MRSA_AR	*Staphylococcus aureus* that has tested Resistant (R) to at least one of the following: oxacillin or cefoxitin
Carbapenem-resistant Enterobacterales (expanded)	CREexpanded_AR	Any *Citrobacter* spp., *Enterobacter* spp., *E. coli*, *Klebsiella* spp., and *Serratia marcescens* that has tested Resistant (R) to at least one of the following: imipenem, meropenem, doripenem[d], ertapenem, meropenem/vaborbactam, or imipenem/relebactam OR Any *Proteus* spp.*,* and *Morganella morganii* that has tested Resistant (R) to at least one of the following: meropenem, doripenem[d], ertapenem, or meropenem/vaborbactam Note: Beginning in January 2022, this phenotype was expanded to include meropenem/vaborbactam and imipenem/relebactam. Note: Beginning in January 2023, this phenotype was expanded to add *Citrobacter braakii*, *Citrobacter freundii* complex, and *Citrobacter youngae*. Prior to January 2023, this phenotype only included *Citrobacter amalonaticus*, *Citrobacter freundii*, and *Citrobacter koseri*. Note: Beginning in January 2025, this phenotype was expanded to all species within the *Citrobacter*, *Klebsiella*, and *Proteus* genus.
Carbapenem-resistant Enterobacterales[b] (*E. coli, Klebsiella,* or *Enterobacter*)	CREall_AR	Any *Escherichia coli, Klebsiella aerogenes, Klebsiella oxytoca, Klebsiella pneumoniae, or Enterobacter* spp. that has tested Resistant (R) to at least one of the following: imipenem, meropenem, doripenem[d], ertapenem, meropenem/vaborbactam, or imipenem/relebactam

Phenotype Name	Phenotype Code	Phenotype Definition[a]
		Note: Beginning in January 2022, this phenotype was expanded to include meropenem/vaborbactam and imipenem/relebactam.
Carbapenem-resistant *E. coli*	CREecoli_AR	Any *Escherichia coli* that has tested Resistant (R) to at least one of the following: imipenem, meropenem, doripenem[d], ertapenem, meropenem/vaborbactam, or imipenem/relebactam Note: Beginning in January 2022, this phenotype was expanded to include meropenem/vaborbactam and imipenem/relebactam.
Carbapenem-non-susceptible *Pseudomonas aeruginosa*	carbNS_PA_AR	*Pseudomonas aeruginosa* that has tested either Intermediate (I) or Resistant (R) to at least one of the following: imipenem, meropenem, doripenem[d], or imipenem/relebactam Note: Beginning in January 2022, this phenotype was expanded to include imipenem/relebactam.
Extended-spectrum cephalosporin-resistant Enterobacterales[b]	ESCEall_AR	Any *Escherichia coli, Klebsiella aerogenes, Klebsiella oxytoca, Klebsiella pneumoniae, or Enterobacter* spp. that has tested Resistant (R) to at least one of the following: cefepime, ceftriaxone, cefotaxime, ceftazidime, ceftazidime-avibactam, or ceftolozane-tazobactam
Extended-spectrum cephalosporin-resistant *E. coli*	ESCecoli_AR	Any *Escherichia coli* that has tested Resistant (R) or Intermediate (I) to at least one of the following: cefepime, ceftriaxone, cefotaxime, ceftazidime, ceftazidime-avibactam, or ceftolozane-tazobactam Note: Beginning in January 2022, this phenotype was expanded to include ceftazidime-avibactam and ceftolozane-tazobactam. Note: Beginning in January 2023, this phenotype was expanded to include isolates testing Intermediate (I) in addition to those testing resistant (R) to align with NHSN HAI phenotypes.

Phenotype Name	Phenotype Code	Phenotype Definition[a]
Extended-spectrum cephalosporin-resistant *Klebsiella* spp.	ESCklebsiella_AR	Any *Klebsiella spp. (except Klebsiella aerogenes)* that has tested Resistant (R) or Intermediate (I) to at least one of the following: cefepime, ceftriaxone, cefotaxime, ceftazidime, ceftazidime-avibactam, or ceftolozane-tazobactam Note: Beginning in January 2022, this phenotype was expanded to include ceftazidime-avibactam and ceftolozane-tazobactam. Note: Beginning in January 2023, this phenotype was expanded to include isolates testing Intermediate (I) in addition to those testing resistant (R) to align with NHSN HAI phenotypes. Note: Beginning in January 2025, this phenotype was expanded to include all species within the *Klebsiella* genus except *Klebsiella aerogenes*.
Fluoroquinolone-resistant Enterobacterales[b]	FQE_AR	Any *Escherichia coli, Klebsiella aerogenes, Klebsiella oxytoca, Klebsiella pneumoniae, or Enterobacter* spp. that has tested Resistant (R) to at least one of the following: ciprofloxacin, levofloxacin, or moxifloxacin
Fluoroquinolone-resistant Enterobacterales	FQE_AR_2025	Any *Escherichia coli, Klebsiella* spp.*, or Enterobacter* spp. that has tested Resistant (R) to at least one of the following: ciprofloxacin, levofloxacin, or moxifloxacin
Fluoroquinolone-resistant *Pseudomonas aeruginosa*[b]	FQPA_AR	*Pseudomonas aeruginosa* that has tested Resistant (R) to at least one of the following: ciprofloxacin or levofloxacin

Phenotype Name	Phenotype Code	Phenotype Definition[a]
Multidrug-resistant *Pseudomonas aeruginosa*[b]	MDR_PA_AR	*Pseudomonas aeruginosa* that has tested either Intermediate (I) or Resistant (R) to at least one drug in at least three of the following six categories[c]: 1. Extended-spectrum cephalosporin (cefepime, ceftazidime, ceftazidime-avibactam, ceftolozane-tazobactam) 2. Fluoroquinolones (ciprofloxacin, levofloxacin) 3. Aminoglycosides (amikacin[d], gentamicin[d], tobramycin) 4. Carbapenems (imipenem, meropenem, doripenem[d], imipenem/relebactam) 5. Piperacillin/tazobactam 6. Cefiderocol Note: Beginning in January 2022, this phenotype was expanded to include ceftazidime-avibactam, ceftolozane-tazobactam, imipenem/relebactam and cefiderocol.
Carbapenem-non-susceptible *Acinetobacter* spp.	carbNS_Acine_AR	Any *Acinetobacter* spp. that has tested either Intermediate (I) or Resistant (R) to at least one of the following: imipenem, meropenem, or doripenem[d]
Multidrug-resistant *Acinetobacter* spp.	MDR_Acine_AR	Any *Acinetobacter* spp. that has tested either Intermediate (I) or Resistant (R) to at least one drug in at least three of the following seven categories[c]: 1. Extended-spectrum cephalosporin (cefepime, ceftazidime, ceftriaxone, cefotaxime) 2. Fluoroquinolones (ciprofloxacin, levofloxacin) 3. Aminoglycosides (amikacin, gentamicin, tobramycin) 4. Carbapenems (imipenem, meropenem, doripenem[d]) 5. Piperacillin/tazobactam 6. Ampicillin/sulbactam 7. Cefiderocol Note: Beginning in January 2022, this phenotype was expanded to include cefiderocol.

Phenotype Name	Phenotype Code	Phenotype Definition[a]
Vancomycin-resistant *Enterococcus faecalis*	VREfaecalis_AR	*Enterococcus faecalis* that has tested Resistant (R) to vancomycin
Vancomycin-resistant *Enterococcus faecium*	VREfaecium_AR	*Enterococcus faecium* that has tested Resistant (R) to vancomycin
Vancomycin-resistant *Enterococcus*[b]	VREgeneral_AR	Any *Enterococcus* spp. that has tested Resistant (R) to vancomycin
Fluconazole-resistant *Candida* spp., *Nakaseomyces glabratus* (*Candida glabrata*), *Pichia kudriavzevii* (*Candida krusei*)	FR_Candi_AR	Any *Candida* spp., *Nakaseomyces glabratus* (*Candida glabrata*), and *Pichia kudriavzevii* (*Candida krusei*) that has tested Resistant (R) to fluconazole Note: Beginning in January 2025, this phenotype was expanded to include all species within the *Candida* genus and continue to include *Nakaseomyces glabratus* (*Candida glabrata*), and *Pichia kudriavzevii* (*Candida krusei*). Prior to January 2025, this phenotype only included *Candida albicans*, *Candida auris*, *Candida glabrata*, *Candida parapsilosis*, and *Candida tropicalis*.
Drug-resistant *Streptococcus pneumoniae*	DR_SP_AR	*Streptococcus pneumoniae* that has tested either Intermediate (I) or Resistant (R) to at least one of the antimicrobials listed in the NHSN AR Option defined drug panel Note: Beginning in January 2023, this phenotype was expanded to include isolates testing Intermediate (I) in addition to those testing resistant (R) to align with CDC's Antibiotic Threats Report.

[a] Adapted from CLSI M100

[b] A SRIR is available for these phenotypes.

[c] The category names are for grouping purposes and are not inclusive of all drugs in that drug class.

[d] Beginning in January 2025, the denoted drugs are no longer required to report for the given pathogen and therefore are not considered when determining whether the isolate meets NHSN AR Option phenotype definitions.

Appendix J. List of SRIRs and pSIRs

Table 1. Hospital-onset SRIRs

SRIR	Specimen Source	SRIR Type in NHSN
Hospital-onset Carbapenem-resistant Enterobacterales	Blood	HO_CREall_Blood
	Lower Respiratory Tract	HO_CREall_LRT
	Urine	HO_CREall_Urine
Hospital-onset Extended-spectrum cephalosporin-resistant Enterobacterales	Blood	HO_ESCEall_Blood
	Lower Respiratory Tract	HO_ESCEall_LRT
	Urine	HO_ESCEall_Urine
Hospital-onset Fluoroquinolone-resistant Enterobacterales	Blood	HO_FQE_Blood
	Lower Respiratory Tract	HO_FQE_LRT
	Urine	HO_FQE_Urine
Hospital-onset Vancomycin-resistant *Enterococcus*	Blood	HO_VRE_Blood
	Lower Respiratory Tract	HO_VRE_LRT
	Urine	HO_VRE_Urine
Hospital-onset Fluoroquinolone-resistant *Pseudomonas aeruginosa*	Blood	HO_FQPA_Blood
	Lower Respiratory Tract	HO_FQPA_LRT
	Urine	HO_FQPA_Urine
Hospital-onset Multidrug-resistant *Pseudomonas aeruginosa*	Blood	HO_MDR_PA_Blood
	Lower Respiratory Tract	HO_MDR_PA_LRT
	Urine	HO_MDR_PA_Urine
Hospital-onset Methicillin-resistant *Staphylococcus aureus*	Blood	HO_MRSA_Blood
	Lower Respiratory Tract	HO_MRSA_LRT
	Urine	HO_MRSA_Urine

Table 2. Hospital-onset pSIRs

pSIR	Specimen Source	pSIR Type in NHSN
Hospital-onset Enterobacterales	Blood	HO_Enterobacterales_Blood
	Lower Respiratory Tract	HO_Enterobacterales_LRT
	Urine	HO_Enterobacterales_Urine
Hospital-onset *Enterococcus*	Blood	HO_Enterococcus_Blood
	Lower Respiratory Tract	HO_Enterococcus_LRT
	Urine	HO_Enterococcus_Urine
Hospital-onset *Staphylococcus aureus*	Blood	HO_SA_Blood
	Lower Respiratory Tract	HO_SA_LRT
	Urine	HO_SA_Urine
Hospital-onset *Pseudomonas aeruginosa*	Blood	HO_PA_Blood
	Lower Respiratory Tract	HO_PA_LRT
	Urine	HO_PA_Urine

Change Log

The Change Log outlines the changes made to the AUR Module Protocol compared to the previous version.

February 2025

- Updated variable name and value set for Patient Sex.

January 2025

Antimicrobial Use

- Updates for required antimicrobials (Appendices B and E)
  - Add: CEFEPIME/ENMETAZOBACTAM, CEFTOBIPROLE MEDOCARIL, and PIVMECILLINAM
  - Remove: CHLORAMPHENICOL
- Days present definition updated to state the patient can contribute an encounter as soon as they have had an initial interaction with a medical professional (for example, the beginning of triage) when in an eligible outpatient location. (page 6, Appendix A)

Antimicrobial Resistance

- Updates for required organisms (page 40-41, Appendices F and I)
  - Add: genus and all species level terms for *Candida*, *Citrobacter*, *Klebsiella*, and *Proteus*
    - Remember to report the species level code if provided by the lab to prevent over de-duplication of AR Events.
  - Add: *Streptococcus pyogenes* (Group A *Streptococcus*)
  - Updated AR Option Pathogen Roll-up Workbook (AR CDA Toolkit)
- Updates for required specimens (pages 41, 42, 44, 54, 55 and Appendices F and G)
  - Add: skin, soft tissue, wound and musculoskeletal as non-invasive specimens
  - Add: indwelling catheter specimen as non-invasive specimen
- Updates for required antimicrobial susceptibility testing panels (Appendix F)
  - *Acinetobacter* urine and non-urine panels: remove Doripenem
  - *Candida* panel: add Amphotericin B
  - *Enterobacterales* panels:
    - Non-urine panel: add Plazomicin, remove Chloramphenicol, Doripenem, Doxycycline, Minocycline, Polymyxin B
    - Urine panel: add Ceftibuten, Plazomicin, remove Chloramphenicol, Doripenem, Doxycycline, Minocycline, Polymyxin B, Sulfisoxazole, Trimethoprim
  - *Enterococcus* panels urine and non-urine panels: remove Quinupristin-dalfopristin
  - *Pseudomonas aeruginosa* panels:
    - Non-urine panel: remove Amikacin, Doripenem, Gentamicin
    - (New panel) urine panel: add Amikacin, Aztreonam, Cefepime, Cefiderocol, Ceftazidime/Avibactam, Ceftazidime, Ceftolozane/Tazobactam, Ciprofloxacin, Colistin, Imipenem, Imipenem-relebactam, Levofloxacin, Meropenem, Polymyxin B, Piperacillin with Tazobactam and Tobramycin
  - *Staphylococcus aureus* panels:

        - Non-urine panel: remove Chloramphenicol
        - Urine panel: remove Chloramphenicol, Sulfisoxazole, Trimethoprim
    - *Stenotrophomonas maltophilia* panel: remove Ceftazidime, Chloramphenicol
    - *Streptococcus pneumoniae* panel: remove Chloramphenicol, Gemifloxacin
    - *Streptococcus agalactiae* and *Streptococcus pyogenes* panel: add Tetracycline, remove Chloramphenicol
- Updates to phenotype definitions assigned by NHSN for AR Option Events. Added notes to indicate changes in phenotype definitions over time. (Appendix I)
- Candida isolates without antimicrobial susceptibility testing are eligible for AR Option reporting. (pages 37 and 39)
- Admission status definition clarified for the scenario referencing transfer to another facility. (Appendix G)
- Admission definition updated to match AU Option. Specifically, transfer from an inpatient to an outpatient ED, pediatric ED, or 24-hour observation location then back to an inpatient location is counted as two separate admissions. (Appendix H)
- Encounter definition updated to state the patient can contribute an encounter as soon as they have had an initial interaction with a medical professional (for example, the beginning of triage). (page 45, Appendix H)