Antimicrobial Use and Resistance (AUR) Module

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Introduction
This module contains two options, one focused on antimicrobial usage 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 laboratory and/or pharmacy information software providers to configure their system to enable the generation of standard formatted file(s) to be imported into NHSN. The format provided for data submission follows the Health Level (HL7) Clinical Document Architecture (CDA).[7] Manual data entry is not available for the AUR Module.

Purpose:
The goal of this National Healthcare Safety Network (NHSN) AUR Module is to provide a mechanism for facilities to report and analyze antimicrobial use and/or resistance as part of local or regional efforts to reduce antimicrobial resistant infections through antimicrobial stewardship efforts or interruption of transmission of resistant pathogens at their facility.[6]

1. Antimicrobial Use (AU) Option

Introduction

Rates of resistance to antimicrobial agents continue to increase at hospitals in the United States.[1] The two main reasons for this increase are patient-to-patient transmission of resistant organisms and selection of resistant organisms because of antimicrobial exposure.[2] Previous studies have shown that feedback of reliable reports of rates of antimicrobial use and resistance to clinicians can improve the appropriateness of antimicrobial usage.[3-5]

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

Methodology: The primary antimicrobial usage metric reported to this module is antimicrobial days per 1000 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 record (BCMA) (refer to Numerator Data Section); 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 to a patient-care location or facility anytime throughout a day during a calendar month (refer to Denominator Data Section). For each facility, the numerator (i.e., antimicrobial days) is aggregated by month for each patient-care location and overall for inpatient areas facility-wide (i.e., facility-wide-inpatient). Similarly, the denominator (i.e., days present) is calculated for the corresponding patient-care-location-month or facility-wide-inpatient-month. A secondary antimicrobial usage metric for facility-wide-inpatient also reported to this module is antimicrobial days per 1000 admissions. The numerator and denominators are further defined below and must adhere to the data format prescribed by the HL7 CDA Implementation Guide developed by the CDC and HL7.[7]

Settings: NHSN encourages submission of all NHSN-defined inpatient locations, facility-wide-inpatient, and select outpatient acute-care settings (i.e., outpatient emergency department, pediatric emergency department, 24-hour observation area) at each facility (Table 1). The patient-care areas may include adult, pediatric, or neonatal units as defined by NHSN Codes (Chapter 15 CDC Locations and Descriptions). A comprehensive submission will enable a facility to optimize inter- and/or intra-facility comparisons among specific wards, combined wards, and hospital-wide data. The optional and minimal requirements for participation in the Antimicrobial Use option are listed in Table 1.

The minimal requirement for participation is submission of data for all four of the following locations (if applicable to facility): 1) all medical critical care units(s) and surgical critical care units(s) [if combined units, then report as medical/surgical critical care unit(s)]; 2) all medical ward(s) and surgical ward(s) [if combined wards, then report as medical/surgical ward(s)]; 3) at least one specialty care area; and 4) facility-wide-inpatient (both days present and admissions must be reported for this location).

Table 1. ***CDC Location[a]: Optional and Minimal Requirements for AU Option***

Inpatient Locations	Minimal Submission Requirements (if applicable for facility)
Adult Critical Care Units	**Requirement**: For facilities with only adult critical care unit(s): submit all medical critical care unit(s) and surgical critical care units(s) [if combined units, then report as medical/surgical critical care unit(s)]. For facilities with adult and pediatric critical care unit(s), the minimum requirement is the submission of data from all adult and pediatric critical care locations.
Pediatric Critical Care Units	**Requirement**: For facilities with only pediatric critical care unit(s): submit all medical critical care unit(s) and surgical critical care units(s) [if combined units, then report as medical/surgical critical care unit(s)]. For facilities with adult and pediatric critical care unit(s), the minimum requirement is the submission of data from all adult and pediatric critical care locations.
Neonatal Units	Optional (i.e., no minimal submission requirement)
Inpatient Specialty Care Areas	**Requirement:** At least one Specialty Care Area
Inpatient Adults Wards	**Requirement:** For facilities with only adult medical and surgical ward(s), submit all medical ward(s) and surgical ward(s) [if combined wards, then report as medical/surgical ward(s)]. For facilities with adult and pediatric medical and surgical ward(s), the minimum requirement is the submission of data from all adult and pediatric medical and surgical ward locations.
Inpatient Pediatric Wards	**Requirement:** For facilities with only pediatric medical and surgical ward(s), submit all medical ward(s) and surgical ward(s) [if combined wards, then report as medical/surgical ward(s)]. For facilities with adult and pediatric medical and surgical ward(s), the minimum requirement is the submission of data from all adult and pediatric medical and surgical ward locations.
Step Down Units	Optional (i.e., no minimal submission requirement)
Operating Rooms	Optional (i.e., no minimal submission requirement)
Long Term Care	Optional (i.e., no minimal submission requirement)
Facility-Wide	**Minimal Submission Requirements (if applicable for facility)**
Facility-wide-inpatient	**Requirement:** Facility-wide-inpatient

Inpatient Locations	Minimal Submission Requirements (if applicable for facility)
Outpatient Locations	**Minimal Submission Requirements (if applicable for facility)**
Select Acute Care Settings Outpatient Emergency Department Pediatric Emergency Department 24-Hour Observation Area	Optional (i.e., no minimal submission requirement)

[a]**CDC Location:** A CDC-defined designation given to a patient-care area housing patients who have similar disease conditions or who are receiving care for similar medical or surgical specialties. Each facility location that is monitored is "mapped" to one CDC Location. The specific CDC Location code is determined by the type of patients cared for in that area according to the **80% Rule**. That is, if 80% of patients are of a certain type (e.g., pediatric patients with orthopedic problems), then that area is designated as that type of location (in this case, an Inpatient Pediatric Orthopedic Ward). See Locations chapter for more information regarding location mapping.

Requirements:

An acceptable minimal month of data includes:

a. Data submitted for all four of the following locations (if applicable to facility): 1) all medical critical care unit(s) and surgical critical care unit(s) [if combined units, then report as medical/surgical critical care unit(s)]; 2) all medical ward(s) and surgical ward(s) [if combined wards, then report as medical/surgical ward(s)]; 3) at least one specialty care area; and 4) facility-wide-inpatient (both days present and admissions must be reported for this location).

b. Each month, the facility must choose to monitor antimicrobial use data on the *Patient Safety Monthly Reporting Plan* (CDC 57.106)

c. All data fields outlined in the *Table of Instructions* (Appendix A) for the AU option are completed via CDA for each location.

Numerator Data (Antimicrobial Days):

Antimicrobial Days (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 a list of antimicrobial agents. Aggregate antimicrobial days are reported monthly for inpatient locations, facility-wide-inpatient, and select outpatient acute-care settings (e.g., outpatient emergency department, pediatric emergency department, 24-hour observation area) for select antimicrobial agents and stratified by route of administration (e.g., intravenous, intramuscular, digestive and respiratory). Refer to Table 2 and Table 3 for definitions of drug-specific antimicrobial days and stratification based on route of administration. For example, a patient to whom 1 gram vancomycin is administered

intravenously twice daily for three days will be attributed three "Vancomycin Days (total)" and three "Vancomycin Days (IV)" when stratified by intravenous route of administration. Appendix C provides additional examples for the calculation of antimicrobial days. Table 4 summarizes the data elements for numerator calculation. Please note that "zero" should be recorded when no aggregate usage occurred during a given reporting period for a specific antimicrobial agent at a facility in which the agent is used, while "not applicable" should be recorded when data are not available for a specific antimicrobial agent at a facility (e.g., the agent can't be electronically captured at that facility). A value (e.g., a specific number, "zero", or "not applicable") should be reported for every antimicrobial agent listed in Appendix B.

Table 2. ***Classification and Definitions of Route of Administrations for Antimicrobial Days***

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

[a] Other routes of administration are excluded in this module (e.g., antibiotic locks, intraperitoneal, intraventricular, irrigation, topical).
[b] Definitions per SNOMED Reference Terminology

Table 3. ***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)

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

Table 4. ***Data Elements for Antimicrobial Days***

Data Element	Antimicrobial Days
Antimicrobial Agents	Defined as select antimicrobial agents and stratified by route of administration (i.e., intravenous, intramuscular, digestive and respiratory). Refer to Appendix B for a complete list of antimicrobial agents. The list of select antimicrobial agents will evolve with time as new agents become commercially available. *Topical antimicrobial agents are not included in this module option.*
Data source	Antimicrobial days are derived from administered data documented in the eMAR and/or BCMA only. Usage derived from other data sources (e.g., pharmacy orders, doses dispensed, doses billed) cannot be submitted.
Location	Antimicrobial days are aggregated for inpatient locations, facility-wide-inpatient, and select outpatient acute-care settings (i.e., outpatient emergency department, pediatric emergency department, 24-hour observation area) per 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 denominator of days present and also admissions for facility-wide-inpatient only. The denominators are further defined below.

Days present: Defined as time period during which a given patient is at risk for antimicrobial exposure for a given patient location. The definition of days present differs from conventional definition of patient days used in other NHSN modules and that recommended by the SHEA/HIPAC guidance for surveillance of multidrug-resistant organisms.[12] 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 patient-care location compared to facility-wide-inpatient.

For patient-care location-specific analyses, days present is calculated as the number of patients who were present for any portion of each day of a calendar month for a patient-care location; the aggregate measure is calculated by summing up all of the days present for that location and month. The day of admission, discharge, and transfer to and from locations will be included in days present. For example, a patient admitted to the medical ward on Monday and discharged two days later on Wednesday will be attributed three days present on that medical ward. Another example, on the day a patient is transferred from a medical critical-care unit to a medical ward; the patient will be attributed one day present on the medical critical care unit as well as one day present on the medical ward. Similarly, a patient's exposure to the operating room or emergency department will be included in days present for these types of units. However, one patient can account for only one day present for a specific location per calendar day (e.g., one patient cannot contribute more than 1 day present to any one unique location on the same day, but 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 analyses, days present is calculated as the number of patients who were present for any portion of each day of a calendar month at the facility-wide-inpatient location; the aggregate measure is calculated by summing up all of 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, because transfers between wards can account for multiple location "days present" for a given patient. Therefore, the individual summing of days present for location-specific analyses to achieve facility-wide-inpatient is not permissible. The calculation must be a separate summation for facility-wide-inpatient analyses.

Admissions: Admissions are defined as the aggregate number of patients admitted to the facility (i.e., facility-wide-inpatient) starting on first day of each calendar month through the last day of the calendar month. This is the same definition for admissions utilized in the NHSN MDRO/CDI Module. In the AU option, admissions are reported only for facility-wide-inpatient.

Table 5. ***Location-specific and Facility-wide-inpatient Metrics***

Metric Collected	Metric Definition	Comments
Inpatient Care Location-Specific Analyses		
Antimicrobial Days/Days present	Drug-specific antimicrobial days per patient-care location per month/Days present per patient-care location per month	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 measure (reflecting transfers between locations).
Facility-wide-inpatient Analyses		
Antimicrobial Days/Days present	Drug-specific antimicrobial days for a facility per month/Days present per facility-wide-inpatient per month	One patient can contribute only one day present per calendar day for a facility. Thus, one denominator is obtained for an entire facility. The day present measure for facility-wide-inpatient may be lower when compared to sum total from location-specific comparison.
Antimicrobial Days/Admissions	Drug-specific antimicrobial days for a facility per month/Admissions per facility-wide-inpatient per month	Only calculated for facility-wide-inpatient for AU Option.

Data Analyses:
Antimicrobial use data are expressed as incidence density rates of antimicrobial days per days present stratified by patient-care location and facility-wide-inpatient. Antimicrobials may be grouped during analysis by route of administration, spectrum of activity, therapeutic indication, or drug classification.
A secondary metric, antimicrobial days per admissions, will also be analyzed for facility-wide-inpatient.

References

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Appendix A. Table of Instructions: Antimicrobial Use

Data Field	Instructions for CDA of Antimicrobial Use Data
Facility identifier	Required. Must be assigned to facility and included in the importation file prior to submission to CDC.
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. Record location; must be (if applicable to facility): 1) all medical critical care unit(s) and surgical critical care unit(s) [if combined units, then report as medical/surgical critical care unit(s)]; 2) all medical ward(s) and surgical ward(s) [if combined wards, then report as medical/surgical ward(s)]; 3) at least one specialty care area; and 4) facility-wide-inpatient
Numerator: Antimicrobial days per month per location	Required. Antimicrobial days are defined as the aggregate sum of the days of exposure for which a specific antimicrobial was administered. These are required to be extracted from electronic medication administration record (eMAR) and/or bar coding medication record (BCMA). Antimicrobials days will be collected for select antimicrobial agents (refer to Appendix B) and stratified by route of administration.
Denominator: Days present Admissions	Required. Days present is defined as risk for antimicrobial exposure per time unit of analysis 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 of a calendar month for a patient-care location. For facility-wide-inpatient analyses, days present is calculated as the number of patients who were present for any portion of each day of a calendar month at the facility-wide-inpatient location Admissions are defined as the aggregate number of patients admitted to the facility (i.e., facility-wide-inpatient) starting on first day of each calendar month through the last day of the calendar month. In the AUR Use Option, admissions are only reported for facility-wide-inpatient.

Appendix B. List of Antimicrobials

Please note that mapping of standardized terminology (RXNORM) are provided via PHIN Vocabulary Access and Distribution System (VADS).

Antimicrobial Agent	Antimicrobial Category	Antimicrobial Class[a]	Antimicrobial Subclass[a]
AMANTADINE	Anti-influenza	M2 ion channel inhibitors	
AMIKACIN	Antibacterial	Aminoglycosides	
AMOXICILLIN	Antibacterial	Penicillins	Aminopenicillin
AMOXICILLIN/ CLAVULANATE	Antibacterial	Penicillins	B-lactam/ B-lactamase inhibitor combination
AMPHOTERICIN B	Antifungal	Polyenes	
AMPHOTERICIN B LIPOSOMAL	Antifungal	Polyenes	
AMPICILLIN	Antibacterial	Penicillins	Aminopenicillin
AMPICILLIN/ SULBACTAM	Antibacterial	Penicillins	B-lactam/ B-lactamase inhibitor combination
ANIDULAFUNGIN	Antifungal	Echinocandins	
AZITHROMYCIN	Antibacterial	Macrolides	
AZTREONAM	Antibacterial	Monobactams	
CASPOFUNGIN	Antifungal	Echinocandins	
CEFACLOR	Antibacterial	Cephalosporins	Cephalosporin 2rd generation
CEFADROXIL	Antibacterial	Cephalosporins	Cephalosporin 1st generation
CEFAZOLIN	Antibacterial	Cephalosporins	Cephalosporin 1st generation
CEFDINIR	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFDITOREN	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFEPIME	Antibacterial	Cephalosporins	Cephalosporin 4th generation
CEFIXIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFOTAXIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFOTETAN	Antibacterial	Cephalosporins	Cephamycin
CEFOXITIN	Antibacterial	Cephalosporins	Cephamycin
CEFPODOXIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFPROZIL	Antibacterial	Cephalosporins	Cephalosporin 2rd generation
CEFTAROLINE	Antibacterial	Cephalosporins	Cephalosporin 5th generation
CEFTAZIDIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFTIBUTEN	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFTIZOXIME	Antibacterial	Cephalosporins	Cephalosporin 3rd generation

Antimicrobial Agent	Antimicrobial Category	Antimicrobial Class[a]	Antimicrobial Subclass[a]
CEFTOLOZANE/ TAZOBACTAM	Antibacterial	Penicillins	B-lactam/ B-lactamase inhibitor combination
CEFTRIAXONE	Antibacterial	Cephalosporins	Cephalosporin 3rd generation
CEFUROXIME	Antibacterial	Cephalosporins	Cephalosporin 2rd generation
CEPHALEXIN	Antibacterial	Cephalosporins	Cephalosporin 1st generation
CHLORAMPHENICOL	Antibacterial	Phenicols	
CIPROFLOXACIN	Antibacterial	Fluoroquinolones	
CLARITHROMYCIN	Antibacterial	Macrolides	
CLINDAMYCIN	Antibacterial	Lincosamides	
COLISTIMETHATE	Antibacterial	Polymyxins	
DALBAVANCIN	Antibacterial	Glycopeptides	Lipoglycopeptide
DAPTOMYCIN	Antibacterial	Lipopeptides	
DICLOXACILLIN	Antibacterial	Penicillins	Penicillinase-stable penicillins
DORIPENEM	Antibacterial	Carbapenems	
DOXYCYCLINE	Antibacterial	Tetracyclines	
ERTAPENEM	Antibacterial	Carbapenems	
ERYTHROMYCIN	Antibacterial	Macrolides	
ERYTHROMYCIN/ SULFISOXAZOLE	Antibacterial	Folate pathway inhibitors/ Sulfonamides	
FIDAXOMICIN	Antibacterial	Macrocyclic	
FLUCONAZOLE	Antifungal	Azoles	
FOSFOMYCIN	Antibacterial	Fosfomycins	
GEMIFLOXACIN	Antibacterial	Fluoroquinolones	
GENTAMICIN	Antibacterial	Aminoglycosides	
IMIPENEM/ CILASTATIN	Antibacterial	Carbapenems	
ITRACONAZOLE	Antifungal	Azoles	
LEVOFLOXACIN	Antibacterial	Fluoroquinolones	
LINEZOLID	Antibacterial	Oxazolidinones	
MEROPENEM	Antibacterial	Carbapenems	
METRONIDAZOLE	Antibacterial	Nitroimidazoles	
MICAFUNGIN	Antifungal	Echinocandins	
MINOCYCLINE	Antibacterial	Tetracyclines	
MOXIFLOXACIN	Antibacterial	Fluoroquinolones	

Antimicrobial Agent	Antimicrobial Category	Antimicrobial Class[a]	Antimicrobial Subclass[a]
NAFCILLIN	Antibacterial	Penicillins	Penicillinase-stable penicillins
NITROFURANTOIN	Antibacterial	Nitrofurans	
ORITAVANCIN	Antibacterial	Glycopeptides	Lipoglycopeptide
OSELTAMIVIR	Anti-influenza	Neuraminidase inhibitors	
OXACILLIN	Antibacterial	Penicillins	Penicillinase-stable penicillins
PENICILLIN G	Antibacterial	Penicillins	Penicillin
PENICILLIN V	Antibacterial	Penicillins	Penicillin
PIPERACILLIN	Antibacterial	Penicillins	Ureidopenicillin
PIPERACILLIN/ TAZOBACTAM	Antibacterial	Penicillins	B-lactam/ B-lactamase inhibitor combination
POLYMYXIN B	Antibacterial	Polymyxins	
POSACONAZOLE	Antifungal	Azoles	
QUINUPRISTIN/ DALFOPRISTIN	Antibacterial	Streptogramins	
RIFAMPIN	Antibacterial	Rifampin	
RIMANTADINE	Anti-influenza	M2 ion channel inhibitors	
SULFAMETHOXAZOLE / TRIMETHOPRIM	Antibacterial	Folate pathway inhibitors	
SULFISOXAZOLE	Antibacterial	Folate pathway inhibitors	
TEDIZOLID	Antibacterial	Oxazolidinones	
TELAVANCIN	Antibacterial	Lipo-glycopeptides	
TELITHROMYCIN	Antibacterial	Ketolides	
TETRACYCLINE	Antibacterial	Tetracyclines	
TICARCILLIN/ CLAVULANATE	Antibacterial	Penicillins	B-lactam/ B-lactamase inhibitor combination
TIGECYCLINE	Antibacterial	Glycylcyclines	
TINIDAZOLE	Antibacterial	Nitroimidazoles	
TOBRAMYCIN	Antibacterial	Aminoglycosides	
VANCOMYCIN	Antibacterial	Glycopeptides	
VORICONAZOLE	Antifungal	Azoles	
ZANAMIVIR	Anti-influenza	Neuraminidase inhibitors	

[a] Adapted from CLSI January 2010

Appendix C. Example Calculations of Antimicrobial Days

Example 1. Example eMAR and Calculation of Antimicrobial Days

This example illustrates the calculation of antimicrobial days from a patient receiving meropenem 1gram intravenously every 8 hours and amikacin 1000mg 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 drug-specific (total) and stratified by route of administration based upon 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 1gram 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 by Stratification of Route of Administration	Meropenem Days (IV) = 1 Amikacin Days (IV) = 1	Meropenem Days (IV) = 1 Amikacin Days (IV) = 1	Meropenem Days (IV) = 1 Amikacin Days (IV) = 0

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 Calculation for Patient-Care Location and Facility-Wide-Inpatient for a Patient Transferred Between Patient-Care Locations

This example illustrates the calculation of antimicrobial days from a patient receiving vancomycin 1gram 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 drug-specific (total) and stratified by route of administration based upon the administered doses of vancomycin documented in eMAR. Table 3 illustrates the contribution of this patient's vancomycin days to the aggregate monthly report per patient-care location and facility-wide-inpatient.

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 1gram 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 by Stratification of 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 calculation of antimicrobial days from a patient receiving ceftriaxone 1gram 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 drug-specific (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.

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

eMar	**Thursday December 31 Location: Surgical Ward**	**Friday January 1 Location: Surgical Ward**
Ceftriaxone gram 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 by Stratification of 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

2. Antimicrobial Resistance (AR) Option

Introduction

Common measures of antimicrobial resistance include the proportion of isolates resistant to specific antimicrobial agents. This proportion resistant (%R) is used to aid in clinical decision making (hospital antibiograms) as well as for assessing impact of cross transmission prevention success or antimicrobial stewardship success, although the measure may not be very sensitive to measuring success of efforts in the short term. An additional value of measuring the proportion resistant includes a local or regional assessment of progression or improvement of a particular resistance problem, to guide local or regional cross-transmission prevention efforts. By utilizing standard methodology of aggregating proportion resistant, local and regional assessments of the magnitude of a particular resistance phenotype will be more valid.

Objectives:

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

Methodology:

Antimicrobial resistance data are reported as a proportion and rate in this module.[1] The proportion resistant is defined as the number of resistant isolates divided by the number of isolates tested for the specific antimicrobial agent being evaluated. In comparison, the antimicrobial resistance rate is defined as the number of resistant isolates per 1000 patient days. For each facility, the numerator (i.e., number of resistant isolates) is derived from isolate-level reports submitted. The denominators of patient days and admissions can be obtained from the ADT system. The numerator and denominator are further defined below and must adhere to the data format prescribed by the HL7 CDA Implementation Guide developed by the CDC and HL7.[2]

Settings:

NHSN encourages reporting specimens from all NHSN-defined inpatient locations and select outpatient acute-care settings (i.e., outpatient emergency department, pediatric emergency department, 24-hour observation area) at each facility. The denominators of patient days and admissions are only reported at the facility-wide inpatient level (FacWideIN). Eligible facilities include any facility using the Patient Safety Component of NHSN.

Requirements:

Each month:

1. The facility must choose to monitor antimicrobial resistance data on the *Patient Safety Monthly Reporting Plan* (CDC 57.106).
2. Two record types must be reported for each month of surveillance.
   - One for each isolate-based report
   - One for the denominator data report (facility-wide inpatient-FacWideIN)

Specimen sources

1. Eligible non-invasive specimen sources include lower respiratory (e.g., sputum, endotracheal, bronchoalveolar lavage) and urine specimens.
2. Eligible invasive specimen sources include cerebrospinal fluid (CSF) and blood specimens.

Isolate-based report

Report all required data each month for each eligible isolate-based report (See Appendix A). Eligible isolate-based reports must have had susceptibility testing performed. This should be consistent with CLSI M39 Guidance on reporting cumulative susceptibility test results. Two distinct events should be reported.

1. **Each** eligible organism isolated from invasive source per patient, per 14 day period even across calendar months (i.e., report all *unique* invasive sources).
   a. There should be 14 days with no positive culture result from the laboratory for the patient and organism before another invasive source Antimicrobial Resistance (AR) Event is entered into NHSN for the patient and 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, another positive culture from an invasive source with that organism can be reported as an AR Event.
2. **First** eligible organism isolated from any eligible non-invasive culture source, per patient, per month.

A. Eligible organisms include:
   - *Acinetobacter*
   - *Candida albicans*
   - *Candida glabrata*
   - *Citrobacter freundii*
   - *Enterobacter*
   - *Enterococcus faecalis*
   - *Enterococcus faecium*

- *Enterococcus* spp. (when not specified to the species level)
- *Escherichia coli*
- Group B *Streptococcus*
- *Klebsiella oxytoca*
- *Klebsiella pneumoniae*
- *Morganella morganii*
- *Proteus mirabilis*
- *Pseudomonas aeruginosa*
- *Serratia marcescens*
- *Staphylococcus aureus*
- *Stenotrophomonas maltophilia*
- *Streptococcus pneumoniae*

B. Specimen Sources (Appendix B)

- Eligible non-invasive sources (one per patient, per organism, per month) include:
    - Lower respiratory (e.g., sputum, endotracheal, bronchoalveolar lavage)
    - Urine

- Unique invasive source (one per patient, per organism, per >14 days) (i.e., should be 14 days with no positive culture result from the laboratory for the patient and organism before another invasive source AR Event is entered into NHSN for the patient and organism):
    - Cerebrospinal fluid (CSF)
    - Blood

    - Important:
        - Report blood or CSF cultures growing same eligible organism with no intervening positive blood or CSF culture (with same eligible organism) within 14 days.
        - In a patient who already has a blood or CSF culture isolate-based report for a specific organism, only report an additional blood or CSF culture if there is no prior positive blood or CSF culture for the same genus/species within 14 days, even across calendar months.
        - There should be a full 14 days with no positive blood or CSF culture result with the same genus/species from the same patient before another unique invasive source is reported (e.g., there should be >14 days since previous isolation).

        - EXAMPLE: On January 1, a patient has a positive MRSA blood culture which is entered into NHSN. On January 4, the same patient has another MRSA positive blood culture which is not entered into NHSN because it has not been 14 days since the original positive MRSA blood culture. On January 16, the same patient has another positive MRSA blood culture. While it has been more than 14 days since the initial positive MRSA blood

culture from the same patient was entered into NHSN (January 1), it has not been >14 days since the patient's most recent positive MRSA blood culture (January 4). Therefore, the positive blood culture for January 16 is not entered into NHSN. On January 31, the patient has another positive MRSA blood culture. Since it has been >14 days since the patient's most recent positive culture (January 16), this event is entered into NHSN.

All isolate test results are evaluated using either the algorithm in Figure 1 (Non-invasive specimens) or Figure 2 (Invasive specimens) to determine reportable AR events for each calendar month. For eligible non-invasive specimens, all first non-invasive isolates (chronologically) per patient, per month, per organism are reported as an AR event (Figure 1). For eligible invasive specimens, there should be 14 days with no positive culture result from the laboratory for the patient and organism before another invasive source AR Event is entered into NHSN for the patient and organism (Figure 2). As a general rule, at a maximum, there should be no more than 3 invasive isolates reported per patient per month, which would be very rare. Report each AR Event individually.

Use SNOMED codes to identify eligible specimen types to be included in identification of isolate-based report. (Appendix B)

C. Required Data

Required data includes mostly data available from the laboratory information system and some from administrative data systems. The set of variables for each isolate consists of a variable to identify the NHSN facility, isolate/patient related data, and antimicrobial susceptibility data as outlined below. For additional information on each variable please see Appendix C.

- Facility identifier
  - NHSN Facility ID (facility identifier, unique to NHSN)

- Isolate / Patient related data
  - Patient identifier
  - Date of birth
  - Gender
  - Date admitted to facility
  - Specimen collection date
  - Specimen source (SNOMED)
  - Location code – (mapped to CDC location codes)
  - Isolate identifier (unique isolate ID)
  - Organism (Appendix A)

- Antimicrobial susceptibility data
  - Antimicrobial (Appendix A)
  - PBP2a-agglutination (only if *Staphylococcus aureus*)

- PCR mec-gene (only if *Staphylococcus aureus*)
- E-test sign
- E-test value
- Interpretation of E-test
- MIC sign
- MIC value
- Interpretation of MIC test
- Zone sign
- Zone value
- Interpretation of zone test (disk diffusion)
- Final interpretation result

Reporting Guidelines

- Interpretation of test results (E-test, MIC test, Zone test) includes the following results: S = Susceptible, S-DD = Susceptible-Dose Dependent, I = Intermediate, R = Resistant, NS = Non-Susceptible, N = Not Tested.
  - Specific to Gentamicin and Streptomycin results for *Enterococcus* testing: S = Susceptible/Synergistic and R = Resistant/Not Synergistic.
- On a single isolate if no final interpretation, first double check with the lab to ensure testing is complete. Clarify with the lab why a final interpretation was not provided. Then prioritize test results for "E-test interpretation > MIC interpretation > Zone Interpretation."
- 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 blood, urine, or lower respiratory report the non-meningitis breakpoint susceptibility.

D. Remove Same Day Duplicates

The goal of this option to capture the first isolate per patient per month from a non-invasive specimen source and in addition, every unique invasive isolate per patient per 14 day period (maximum of three per month per patient). However, frequently multiple isolates of the same species are processed on the same day, often with conflicting results. Only one isolate should be chosen, retaining the unique nature of the test results. Rules must be in place to ensure duplicate isolate reports are removed. Duplicates are defined as same species or same genus, when identification to species level is not provided, from same patient on same day. Isolates must be of the same source type (i.e., invasive or non-invasive) to be considered duplicates. Identify observations reflecting multiple isolates within the same day and select the isolate to report to NHSN based on these rules:

- For non-invasive source isolate selection, lower respiratory isolates should be selected over urine isolates.
- For invasive source isolate selection, CSF isolates should be selected over blood isolates.
- Eliminate isolates on same day without susceptibility test results.

- If the same test is performed the same isolate but they produce conflicting results, report the most resistant result (i.e., R > I > S).
- If two different tests on the same date are performed on the same isolate and produce conflicting susceptibility interpretations, the individual test results should be reported for the separate tests. However, the final interpretation should be populated based on the final laboratory interpretation of the results.
- Do not merge test results across multiple isolates (i.e., don't summarize results across different isolates tested on same day).
- If testing results are indistinguishable or the same test is conducted with the same results, choose isolate test with more complete fields for other variables.
- If two isolates from the same day have conflicting susceptibilities to the panel of antimicrobials tested, considering the protocol states not to merge the susceptibility results of isolates if they are different, pick the first in the sequence of the encounter recorded in the laboratory information system (LIS).

Denominator data report

For each month, report facility-wide denominator data: (See Appendix D)

1. Patient Days: Number of patients present in the facility at the same time period on each day of the month, summed across all days in the month.
2. Admissions: Number of patients admitted to the facility each month.

   Further information on counting patient days and admissions can be found in Appendix 2 of the NHSN MDRO & CDI Module Protocol: http://www.cdc.gov/nhsn/pscManual/12pscMDRO_CDADcurrent.pdf.

Minimizing Bias
The source of test results should be from the hospital laboratory information system (LIS). Efforts should be made to reduce selection bias sometimes inherent in systems that have suppression rules in place which prevent test results from being available in the LIS. For example, efforts should be made to obtain resistant results that are withheld from clinicians.

Data Analyses:
Antimicrobial resistance data will be expressed using several metrics at the monthly, quarterly, semi-annual, or annual time frame depending on how rare the isolates occurred. (See Table 1) A facility-wide antibiogram table is available in NHSN that displays the calculated percent non-susceptible for each organism-antimicrobial combination. The antibiogram table can be stratified by specimen source, time period, and/or by specific antimicrobial or organism.
A line list of antimicrobial resistant events is also currently available. Additional reports and analysis output options will be available in future releases. Requests for additional reports can be sent to: NHSN@cdc.gov.

Figure 1. ***Test Result Algorithm for Non-Invasive Specimen Reporting***

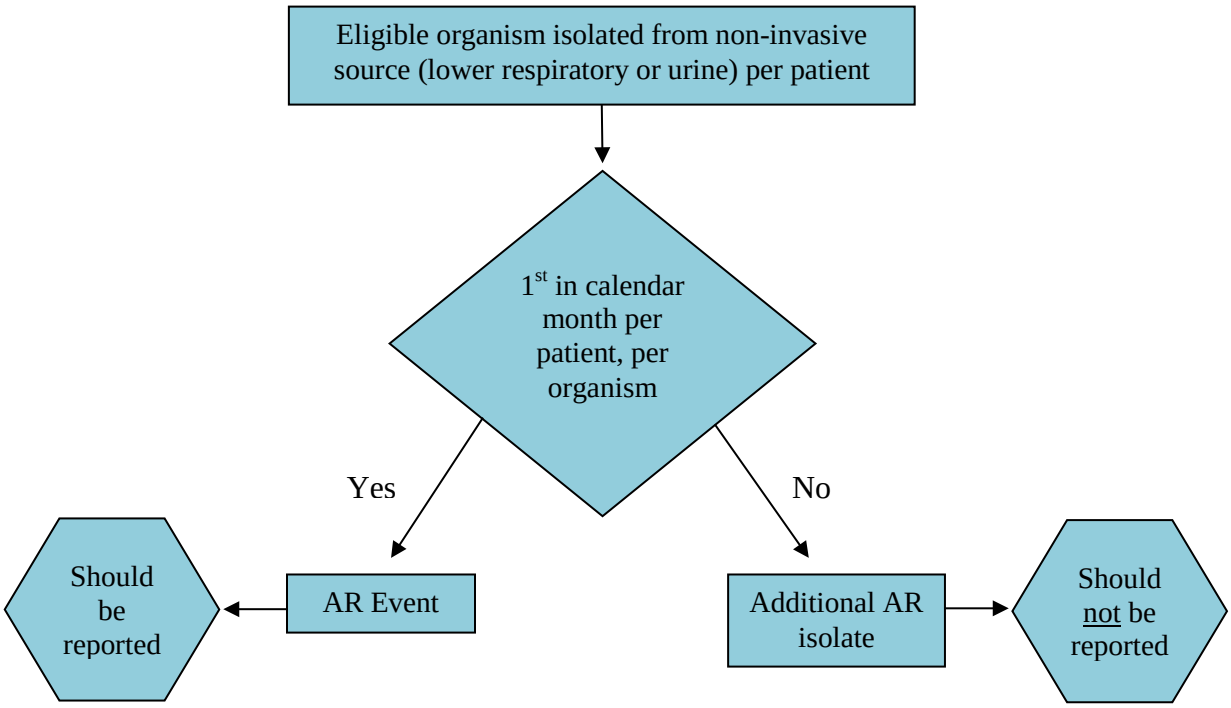

Figure 2. ***Test Result Algorithm for Invasive Specimen Reporting***

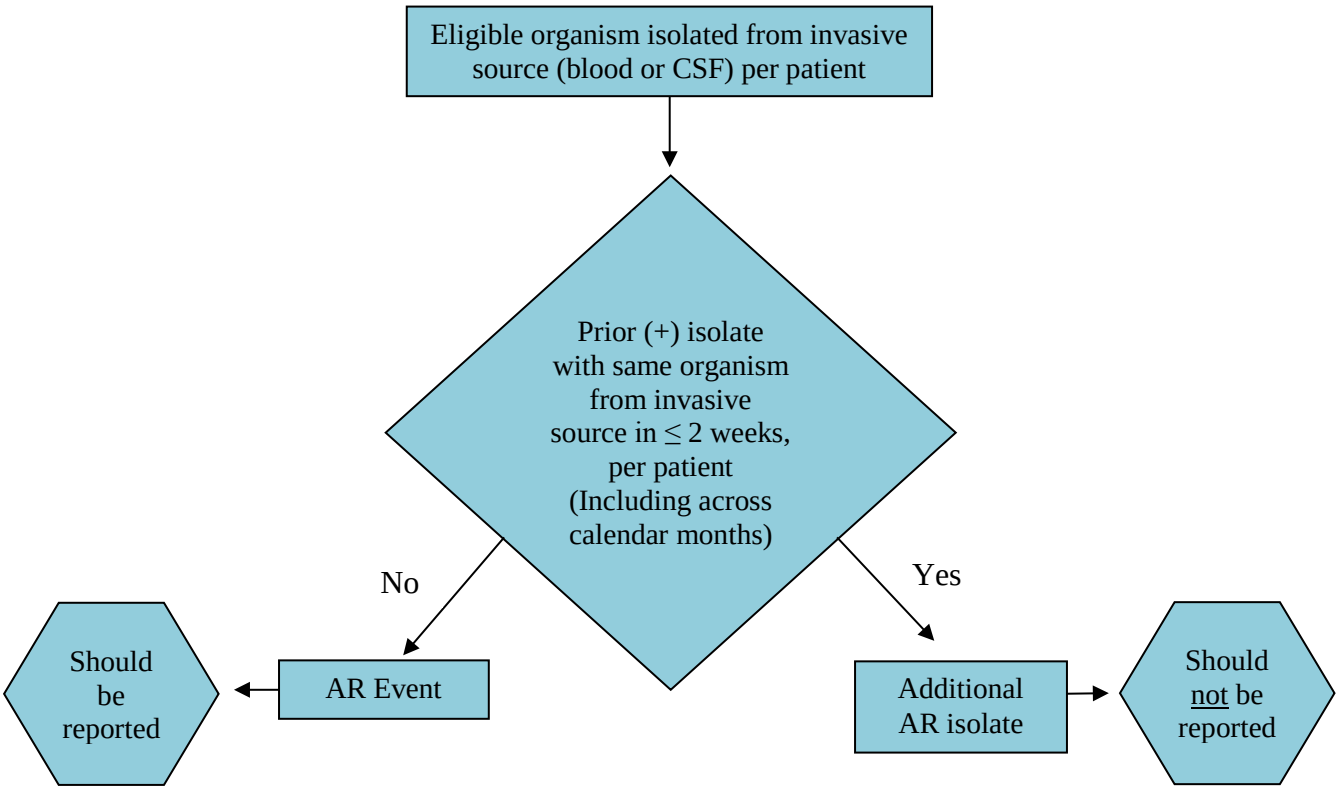

Table 1. ***Current Resistance Metrics***

Metric	Definition
Facility-wide-inpatient: standard output for facility and group user.	
% non-susceptible	Calculated for each* organism-antimicrobial pairing: (Total # of organisms that tested resistant or intermediate for a pathogen / Total # of organisms tested for that pathogen) *exceptions 1. *Staphylococcus aureus* test results for Oxacillin or Cefoxitin: non-susceptible isolates are only those that tested resistant. 2. *Enterococcus faecalis*, *Enterococcus faecium*, and *Enterococcus spp.* tested for Vancomycin: non-susceptible isolates for this pairing are only those that tested resistant. 3. *Escherichia coli*, *Klebsiella oxytoca*, *Klebsiella pneumonia*, *Enterobacter spp.* test results for Cefepime: non-susceptible isolates for these pairings include those isolates that tested resistant, intermediate, susceptible dose-dependent (S-DD) or non-susceptible (NS).

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/CDA/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.

Appendix A. List of Organisms for Antimicrobial Resistance[3]

Please note that mapping of standardized terminology (SNOMED) are provided upon request to the NHSN CDA Team at NHSNCDA@cdc.gov. Testing methods should follow most recent CLSI guidance as appropriate.

Organism	Specimen Type	Antimicrobial Agents
Acinetobacter	Blood, Urine, Lower Respiratory, CSF	Amikacin Ampicillin-sulbactam Cefepime Cefotaxime Ceftazidime Ceftriaxone Ciprofloxacin Doxcycline Gentamicin Imipenem with Cilastatin Levofloxacin Meropenem Minocycline Piperacillin Piperacillin-tazobactam Tetracycline Ticarcillin-clavulanate Tobramycin Trimethoprim-sulfamethoxazole
	Additional Agents for Urine	None
Candida albicans *Candida glabrata*	Blood, Urine, CSF Note: Lower respiratory will not be collected for Candida spp.	Anidulafungin Caspofungin Fluconazole Flucytosine Itraconazole Micafungin Posaconazole Voriconazole
	Additional Agents for Urine	None

Organism	Specimen Type	Antimicrobial Agents
Citrobacter freundii *Enterobacter* *Escherichia coli* *Klebsiella oxytoca* *Klebsiella pneumoniae* *Morganella morganii* *Proteus mirabilis* *Serratia marcescens*	Blood, Urine, Lower Respiratory, CSF	Amikacin Amoxicillin-clavulanic acid Ampicillin Ampicillin-sulbactam Aztreonam Cefazolin Cefepime Cefotaxime Cefoxitin Ceftazidime Ceftriaxone Cefuroxime Chloramphenicol Ciprofloxacin Doripenem Ertapenem Gentamicin Imipenem with Cilastatin Levofloxacin Meropenem Piperacillin Piperacillin-tazobactam Tetracycline Ticarcillin-clavulanic acid Trimethoprim-sulfamethoxazole Tobramycin
	Additional Agents for Urine	Cephalothin Lomefloxacin Nitrofurantoin Norfloxacin Ofloxacin Sulfisoxazole Trimethoprim

Organism	Specimen Type	Antimicrobial Agents
Enterococcus faecalis *Enterococcus faecium* *Enterococcus* spp. (when not otherwise specified) (excluding *E. faecalis*, *E. faecium*, and other identified species)	Blood, Urine, Lower Respiratory, CSF	Ampicillin Daptomycin Gentamicin Linezolid Penicillin[a] Quinupristin/dalfopristin Rifampin Streptomycin Vancomycin Note: For Gentamicin and Streptomycin only: Synergistic = Susceptible Non-synergistic = Resistant
	Additional Agents for Urine Note: Exclude Gentamicin and Streptomycin	Ciprofloxacin Levofloxacin Nitrofurantoin Norfloxacin Tetracycline
Pseudomonas aeruginosa	Blood, Urine, Lower Respiratory, CSF	Amikacin Aztreonam Cefepime Ceftazidime Ciprofloxacin Gentamicin Imipenem with Cilastatin Levofloxacin Meropenem Piperacillin Piperacillin-tazobactam Ticarcillin Tobramycin
	Additional Agents for Urine	Lomefloxacin Norfloxacin Ofloxacin

Organism	Specimen Type	Antimicrobial Agents
Staphylococcus aureus	Blood, Urine, Lower Respiratory, CSF	Azithromycin Cefoxitin Chloramphenicol Ciprofloxacin Clarithromycin Clindamycin Daptomycin Doxycycline Erythromycin Gentamicin Levofloxacin Linezolid Minocycline Moxifloxacin Ofloxacin Oxacillin or Nafcillin[b] Penicillin[a] Quinupristin-dalfoprisin Rifampin Telithromycin Tetracycline Trimethoprim-sulfamethoxazole Vancomycin
	Additional Agents for Urine	Lomefloxacin Nitrofurantoin Norfloxacin Sulfisoxazole Trimethoprim
Stenotrophomonas maltophilia	Blood, Urine, Lower Respiratory, CSF	Ceftazidime Chloramphenicol Levofloxacin Minocycline Ticarcillin-clavulanate Trimethoprim-sulfamethoxazole
	Additional Agents for Urine	None

Organism	Specimen Type	Antimicrobial Agents
Streptococcus pneumoniae	Blood, Urine, Lower Respiratory, CSF	Amoxicillin Amoxicillin-clavulanic acid Azithromycin Cefepime Cefotaxime (meningitis or non-meningitis breakpoint)[c] Ceftriaxone (meningitis or non-meningitis breakpoint)[c] Cefuroxime Chloramphenicol Clindamycin Ertapenem Erythromycin Gemifloxacin Imipenem with Cilastatin Levofloxacin Linezolid Meropenem Moxifloxacin Ofloxacin Penicillin[a] (meningitis or non-meningitis breakpoint)[c] Penicillin V[a] (oral breakpoint) Rifampin Telithromycin Tetracycline Trimethoprim-sulfamethoxazole Vancomycin
	Additional Agents for Urine	None
Group B *Streptococcus*	Blood, Urine, Lower Respiratory, CSF	Ampicillin Cefazolin Cefotaxime Cefoxitin Ciprofloxacin Clindamycin Daptomycin Erythromycin Levofloxacin Linezolid Penicillin[a] Tetracycline Vancomycin
	Additional Agents for Urine	None

[a] 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 (N).
[b] For *Staphylococcus aureus* susceptibility testing, if the LIS tests Nafcillin instead of Oxacillin, report Nafcillin susceptibility results as Oxacillin.
[c] 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, or lower respiratory report the non-meningitis breakpoint susceptibility.

Appendix B. SNOMED Codes to Identify Eligible Specimen Types

Please note that mapping of standardized terminology for specimen type are provided upon request to the NHSN CDA Team at NHSNCDA@cdc.gov.

Specimen Type	Description	SNOMED CT Code
Blood	Blood specimen (specimen)	119297000
Urine	Urinary specimen (specimen)	122575003
Cerebral Spinal Fluid	Cerebrospinal fluid sample (specimen)	258450006
Lower Respiratory Specimens	coughed sputum specimen (specimen)	119335007
	specimen from trachea (specimen)	119390000
	specimen from lung obtained by bronchial washing procedure (specimen)	122609004
	specimen from lung obtained by biopsy (specimen)	122610009
	specimen from lung obtained by fiberoptic bronchoscopic biopsy (specimen)	122611008
	upper respiratory fluid specimen obtained by tracheal aspiration (specimen)	122877000
	tissue specimen from bronchus (specimen)	128158009
	tissue specimen from trachea (specimen)	128173005
	bronchial fluid sample (specimen)	258446004
	sputum specimen obtained by aspiration (specimen)	258608003
	sputum specimen obtained by aspiration from trachea (specimen)	258609006
	sputum specimen obtained by sputum induction (specimen)	258610001
	sputum specimen obtained from sputum suction trap (specimen)	258611002
	lower respiratory tissue sample (specimen)	309170008
	lower respiratory fluid sample (specimen)	309171007
	transbronchial lung biopsy sample (specimen)	309173005
	bronchial biopsy sample (specimen)	309174004
	bronchial brushings sample (specimen)	309176002
	tissue specimen from lung (specimen)	399492000
	specimen obtained by bronchial aspiration (specimen)	441903006
	specimen obtained by bronchioloalveolar lavage procedure (specimen)	441917002
	specimen from trachea obtained by aspiration (specimen)	445447003
	specimen obtained by bronchial trap (specimen)	446838005
	bronchial fluid specimen obtained from bronchial trap (specimen)	447345009
	sputum specimen (specimen)	119334006
	specimen from bronchus (specimen)	119391001

Specimen Type	Description	SNOMED CT Code
	specimen from lung (specimen)	127458004
	lower respiratory sample (specimen)	258606004
	bronchoalveolar lavage fluid sample (specimen)	258607008
	tracheal biopsy sample (specimen)	309169007

Appendix C. Isolate Based Report Variables

NAME	DESCRIPTION OF FIELD	CODE VALUE LIST	LEVEL OF REQUIREMENT
Facility ID	NHSN-assigned facility ID number	NHSN	Required
Patient ID	Alphanumeric patient ID assigned by the hospital and may consist of any combination of numbers and/or letters. This should be an ID that remains the same for the patient across all visits and admissions.		Required
Date of Birth	The date of the patient's birth including month, day, and year.		Required
Gender	M (Male), F (Female), O (Other) to indicate the gender of the patient.		Required
Date admitted to facility	Date patient was admitted to an inpatient facility including month, day, and year. If the laboratory specimen is reported from an outpatient location enter a null value.		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 (e.g. urine, lower respiratory, blood, CSF).	SNOMED	Required
Location	Patient care area where patient was when the laboratory specimen was collected. Use patient location obtained from administrative data system (ADT).	CDC Location Codes	Required
Isolate identifier	Isolate identifier unique for each isolate within laboratory and year.		Required
Organism	Organism identified from specimen collected (Appendix A).	SNOMED	Required
Antimicrobial	Antimicrobial(s) tested for susceptibility (Appendix A will define agents by organism and specimen source)	RxNorm	Required
PBP2a-agglutination	Result for PBP2a-agglutination (only if SA) Pos/Neg/Unk		Conditional (for Staph aureus)
PCR mec-gene	Result for PCR mec-gene (only if SA) Pos/Neg/Unk		Conditional (for Staph aureus)
E-test sign	E-test sign (> < =).		Conditional
E-test value	E-test (Value in micrograms/liter). Use '.' as decimal delimiter, e.g. 0.25		Conditional
Interpretation of E-test	Interpretation result of the E-test susceptibility test performed		Conditional

NAME	DESCRIPTION OF FIELD	CODE VALUE LIST	LEVEL OF REQUIREMENT
MIC sign	MIC sign (> < =).		Conditional
MIC value	MIC (Value in micrograms/liter). Use '.' as decimal delimiter, e.g. 0.25		Conditional
Interpretation of MIC test	Interpretation result of the MIC susceptibility test performed		Conditional
Zone sign	Zone sign (> < =).		Conditional
Zone value	Zone value in millimeters		Conditional
Interpretation of Zone test	Interpretation result of the zone susceptibility test performed		Conditional
Final Interpretation result	Final interpretation result of all different susceptibility tests performed		Required

Appendix D. Denominator Data Variables

	DESCRIPTION OF FIELD	CODE VALUE LIST	LEVEL OF REQUIREMENT
Facility Wide Denominator			
Facility ID	NHSN –assigned facility ID number	NHSN	Required
Location	FacWideIN		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 of the facility's inpatient locations with an overnight stay should be included where denominators can be accurately collected.		Required
Admission Count	For facility wide inpatients, enter the total number of admissions for all facility inpatient locations combined for the month. All the facility's inpatient locations with an overnight stay should be included where denominators can be accurately collected.		Required