Antimicrobial Use and Resistance Module Data Quality Validation

Laura Blum, MPH

NHSN Antimicrobial Use and Resistance Team

March 2024

Objectives

By the end of this lesson, you will be able to:

- Describe Antimicrobial Use and Resistance (AUR) Module data quality validation resources provided by NHSN
- Determine when to use Antimicrobial Use (AU) Implementation Validation Protocol, Annual Data Quality Validation Protocol, and Data to Review line list
- Run and interpret the AU Data to Review line list
- Summarize concepts examined in the Antimicrobial Resistance (AR) Data Validation Protocol

Three Distinct Types of Validation

1. Data quality validation
   - Conducted by the individual facility/system
   - Validates data are accurate and complete (e.g., calculations for antimicrobial days, days present, and patient days)

2. Clinical Document Architecture (CDA) test file validation
   - Part of the Centers for Medicare and Medicaid Services (CMS) Promoting Interoperability (PI) Program process
   - Validates that AUR files pass NHSN business rules (e.g., files include all required fields)

Three Distinct Types of Validation (continued)

3. Vendor software validation
    a) NHSN Synthetic Data Set (SDS) validation
        - Validates vendor software can correctly apply rules from the AUR Module Protocol
        - Required for all vendors submitting data to AUR Module: https://www.cdc.gov/nhsn/cdaportal/sds/index.html

Three Distinct Types of Validation (continued)

3. Vendor software validation
    b) Office of the National Coordinator for Health Information Technology (ONC) certification
        - Validates vendor software can generate AUR files that meet format requirements
        - Required for all vendors for the CMS PI Program: https://chpl.healthit.gov/#/search

A Note About Today's Presentation

- This session will only cover **data quality validation**

- We will **not** go over validation for the CMS PI Program, CDA test file validation, SDS Validation, or ONC certification for vendors
  - Please save questions about the CMS PI Program for the Q&A session later today

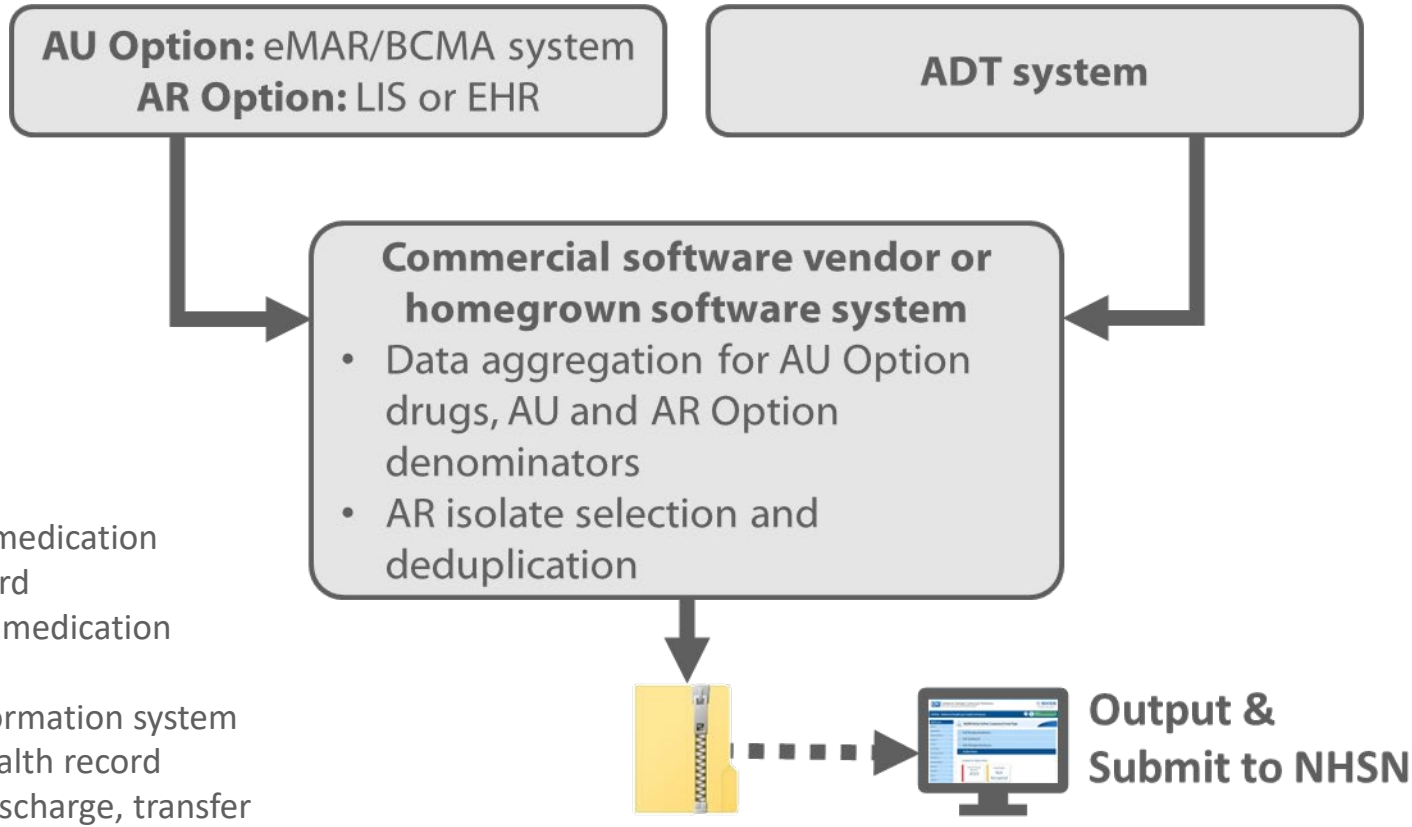
    or

  - Send CMS PI Program questions to **NHSN Help Desk** (use NHSN Customer Support Portal or email NHSN@cdc.gov) or **CMS CCSQ Help Desk** (use CMS Q&A Tool, email QnetSupport@cms.hhs.gov, or call 1-866-288-8912)

Importance of Data Quality Validation

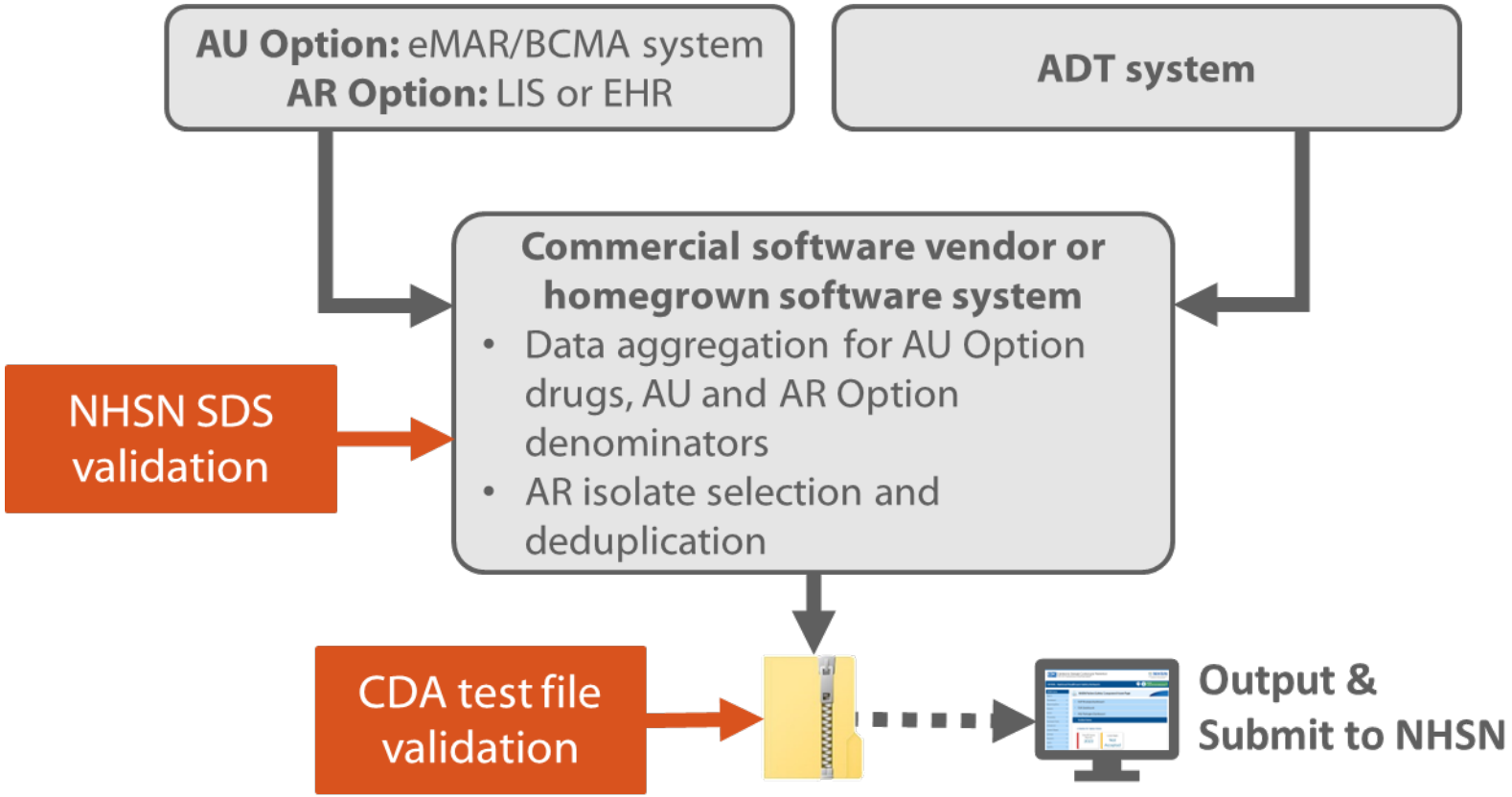
- Entire process of AUR Module reporting (data capture, aggregation, and submission) is electronic
  - No manual data entry due to the amount of data submitted each month
  - Many connections to be made prior to successful submission
- You get out of NHSN what you put in!
  - Accurate data produce more meaningful metrics and insights
- Data quality validation examines AUR data accuracy and can help guide discussions with your vendor in case of data discrepancy

NHSN AUR Module Reporting Process

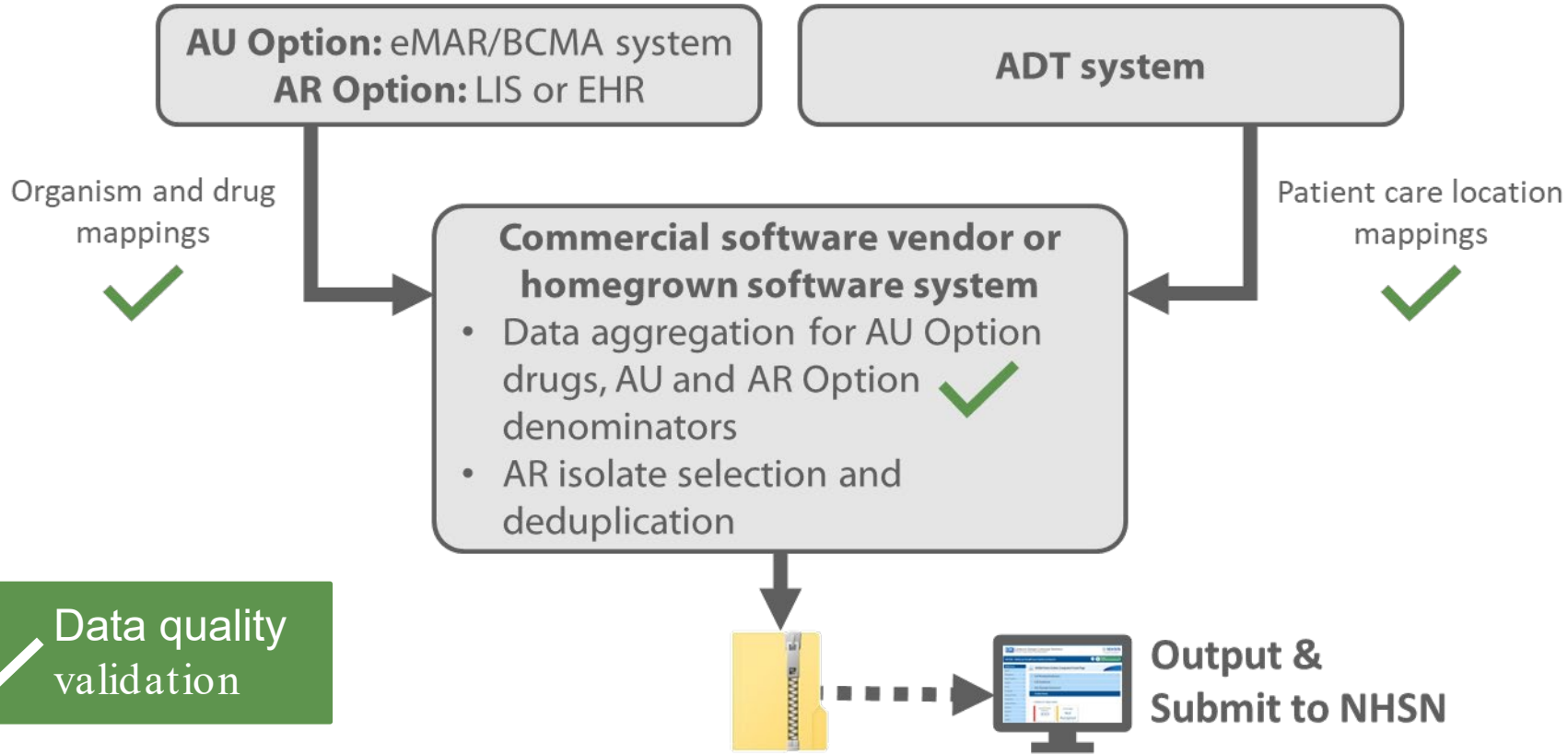


Acronyms:
eMAR = electronic medication administration record
BCMA = bar-coding medication administration
LIS = laboratory information system
EHR = electronic health record
ADT = admission, discharge, transfer

NHSN SDS and CDA Test File Validation Checks



Data Quality Validation Checks

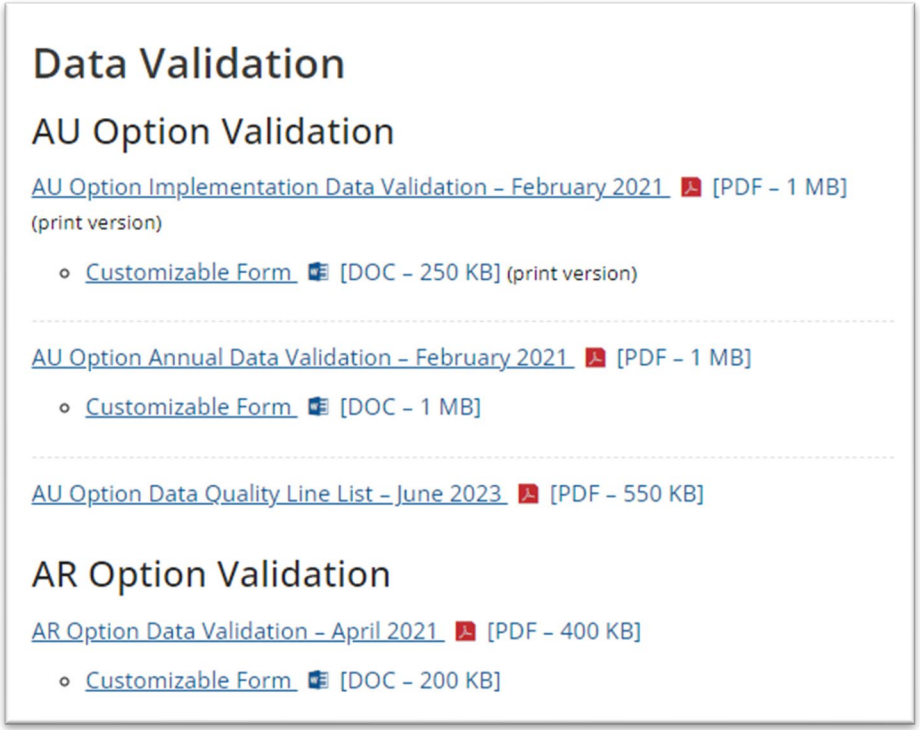


Data Quality Validation Recommendations

- All data quality validation efforts are voluntary—results do not need to be sent to NHSN
- Recommend reviewing AUR data quality during and after implementation
- Not a “set and forget” system!
  - Recommend reviewing AUR data quality at least annually after initial implementation and every time software is updated
- Work validation into implementation timeline or yearly activities as time and resources allow
  - If low resources/time, pick the activities most relevant for your facility’s data

AUR Module Data Quality Validation Resources

- Located in “Data Validation” section on AUR Module webpage
  - AU Option Implementation Data Validation
  - AU Option Annual Data Validation
  - AU Option Data Quality Line List (aka AU Data to Review Line List)
  - AR Option Data Validation



Data Validation

AU Option Validation

AU Option Implementation Data Validation – February 2021 [PDF – 1 MB] (print version)

- Customizable Form [DOC – 250 KB] (print version)

AU Option Annual Data Validation – February 2021 [PDF – 1 MB]

- Customizable Form [DOC – 1 MB]

AU Option Data Quality Line List – June 2023 [PDF – 550 KB]

AR Option Validation

AR Option Data Validation – April 2021 [PDF – 400 KB]

- Customizable Form [DOC – 200 KB]

Initial AU Implementation: AU Implementation Data Validation Protocol

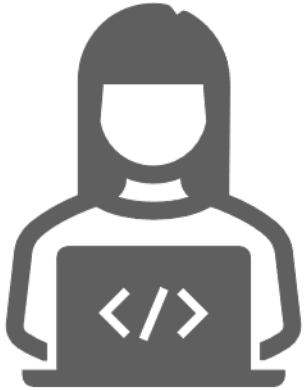
Laura Blum, MPH

Overview

- Use during initial AU Option implementation
  - Recommend when you first begin reporting to AU Option
  - Recommend again if you switch vendor systems
- Focuses on AUR Module Protocol definitions and requirements, including potential sources of error
- Three sections
  - Section A: Manual Validation of eMAR/BCMA Data Feeds to Vendor Software
  - Section B: Validation of Data Aggregations & Calculations
  - Section C: Spot Check Data Submitted to NHSN

Who to collaborate with

Vendor representative



Pharmacy

NHSN healthcare-associated infections (HAI) reporter

Section A: Manual Validation of eMAR/BCMA Data Feeds to Vendor Software

- Review line list for agents & routes of administration
- Spot check for unusual routes of administration
- Compare data in eMAR/BCMA to data in vendor software
- Review patient-level scenarios
- Confirm appropriate use of N/A versus zero

Section A: Manual Validation of eMAR/BCMA Data Feeds to Vendor Software

- **Review line list for agents & routes of administration**
- Spot check for unusual routes of administration
- Compare data in eMAR/BCMA to data in vendor software
- Review patient-level scenarios
- Confirm appropriate use of N/A versus zero

Review line list for agents & routes of administration

- Guides you through comparing AU Line List to antimicrobial administrations recorded in source eMAR/BCMA
  - Rarely used or off-formulary agents
  - Routes of administration
    - Example: Intramuscular (IM) ceftriaxone, which is typically used in emergency department (ED)
    - Example: Respiratory zanamivir, which is typically used during flu season

Section A: Manual Validation of eMAR/BCMA Data Feeds to Vendor Software

- Review line list for agents & routes of administration
- **Spot check for unusual routes of administration**
- Compare data in eMAR/BCMA to data in vendor software
- Review patient-level scenarios
- Confirm appropriate use of N/A versus zero

Spot check for unusual routes of administration

- Guides you through confirming your system accurately captures rare or unusual routes of administration
- Examples:
  - Continuous or extended infusions like piperacillin-tazobactam
  - Rectal vancomycin administration
  - Parenteral formulation of vancomycin administered orally for *Clostridioides difficile*
  - Nasogastric administrations like ciprofloxacin, levofloxacin, moxifloxacin, or posaconazole

Section A: Manual Validation of eMAR/BCMA Data Feeds to Vendor Software

- Review line list for agents & routes of administration
- Spot check for unusual routes of administration
- **Compare data in eMAR/BCMA to data in vendor software**
- **Review patient-level scenarios**
- Confirm appropriate use of N/A versus zero

Compare data in eMAR/BCMA to data in vendor software & review patient-level scenarios

- Guide you through verifying that system accurately captures AU data and attributes it to the correct location
  - Attribute antimicrobial days and days present to location where patients are physically present for AU Option reporting
- Examples:
  - Patients in an inpatient location with “observation” status
  - Patients admitted to an inpatient location via ED or 24-hour observation area
  - Patients transferred to/from operating room (OR) or interventional radiology
  - Newborns housed in their mother’s room

Section A: Manual Validation of eMAR/BCMA Data Feeds to Vendor Software

- Review line list for agents & routes of administration
- Spot check for unusual routes of administration
- Compare data in eMAR/BCMA to data in vendor software
- Review patient-level scenarios
- **Confirm appropriate use of N/A versus zero**

Confirm appropriate use of N/A versus zero

- Guides you through checking that system correctly uses not applicable (“N/A”) and zero (“0”)
  - “N/A” is used when an antimicrobial can’t be electronically captured from eMAR/BCMA
  - “0” is used when there were no patients administered the drug and/or route(s) during a given month
- Note: Use “NA” for non-formulary agents when those agents, if administered, cannot be accurately electronically captured by your eMAR/BCMA system

Section B: Validation of Data Aggregations & Calculations

- Review locations mapped in NHSN
- Review aggregations
- Compare AU & HAI denominators

Section B: Validation of Data Aggregations & Calculations

- **Review locations mapped in NHSN**
- Review aggregations
- Compare AU & HAI denominators

Review locations mapped in NHSN

- Guides you through confirming locations are mapped accurately in NHSN and correct locations are included in AUR Module reporting
  - NHSN encourages submission from all NHSN-defined inpatient locations (including procedural areas like operating rooms), facility-wide inpatient (FacWideIN), and select outpatient acute care settings (outpatient ED, pediatric ED, and 24-hour observation area) from which **numerator and denominator data can be accurately electronically captured**
  - AUR Module does not accept data from other outpatient locations, such as outpatient clinics

Section B: Validation of Data Aggregations & Calculations

- Review locations mapped in NHSN
- **Review aggregations**
- Compare AU & HAI denominators

Review aggregations

- Guides you through verifying that system aggregates data according to the AUR Module Protocol
  - Routes of administration
  - Antimicrobial days
  - FacWideIN
    - Antimicrobial days
    - Days present

Review aggregations

- Guides you through verifying that system aggregates data according to the AUR Module Protocol
  - **Routes of administration**
  - **Antimicrobial days**
  - FacWideIN
    - Antimicrobial days
    - Days present

Example: Reviewing antimicrobial day aggregations

- Compare total antimicrobial days to the sum of the antimicrobial days for the routes of administration

Remember: Antimicrobial Days & Sum of Routes

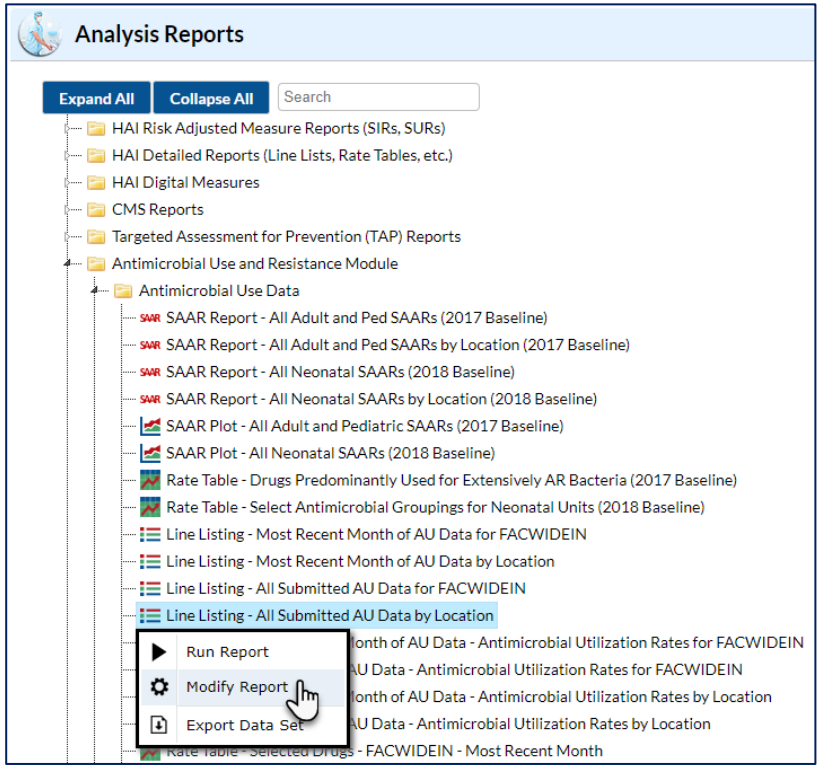
- 1 patient can attribute 1 antimicrobial day to **multiple** routes in the same calendar day
- Routes **cannot** be summed to calculate the total antimicrobial days
- For drugs given more than once daily via multiple routes:
  Total antimicrobial days ≤ sum of routes

	Monday	Tuesday	Wednesday
Ciprofloxacin twice daily	*Admitted*: 1200 Given IV: 2300	Given IV: 1100 Given oral: 2300	Given oral: 1100 *Discharged*: 1500
Antimicrobial Day Counts	**Cipro Total**: 1 Cipro IV: 1 Cipro Digestive: 0	**Cipro Total**: 1 Cipro IV: 1 Cipro Digestive: 1	**Cipro Total**: 1 Cipro IV: 0 Cipro Digestive: 1

Acronym:
IV = intravenous

Example: Check usage with modified AU Line List

- Modify AU Line List to check total antimicrobial days and sum of routes for ciprofloxacin
  - Filter Antimicrobial agent = Ciprofloxacin
  - Display by Summary Year/Month
  - *Remove Display Variables not needed for comparison (optional)*



How to Modify a Report quick reference guide (QRG): https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/howtomodifyreport.pdf

Note: Data are fictitious and for demonstration purposes only.

Example: Line List Output

National Healthcare Safety Network
Line Listing - All Submitted AU Data by Location

As of: September 24, 2019 at 10:10 PM
Date Range: SUMMARYAU summaryYM After and Including 2018M07
if (((drugIngredient = CIPRO)

Summary Year/Month=2018M07

Facility Org ID	Antimicrobial Agent Description	Summary Year/Month	Location	Antimicrobial Days	Route: IM	Route: IV	Route: Digestive	Route: Respiratory
13860	CIPRO - Ciprofloxacin	2018M07	5GNORTH	45	0	20	25	0
13860	CIPRO - Ciprofloxacin	2018M07	ICU-C	31	0	12	21	0
13860	CIPRO - Ciprofloxacin	2018M07	MICU	44	0	24	20	0
13860	CIPRO - Ciprofloxacin	2018M07	PEDMED	27	0	7	20	0
13860	CIPRO - Ciprofloxacin	2018M07	SICU	38	0	18	20	0
13860	CIPRO - Ciprofloxacin	2018M07	STEP_AU	36	0	6	30	0

Note: Data are fictitious and for demonstration purposes only.

Example: Line List Output (continued)

National Healthcare Safety Network
Line Listing - All Submitted AU Data by Location

As of: September 24, 2019 at 10:10 PM
Date Range: SUMMARYAU summaryYM After and Including 2018M07
if (((drugIngredient = CIPRO)

Summary Year/Month=2018M07

Facility Org ID	Antimicrobial Agent Description	Summary Year/Month	Location	Antimicrobial Days	Route: IM	Route: IV	Route: Digestive	Route: Respiratory	Sum of Routes
13860	CIPRO - Ciprofloxacin	2018M07	5GNORTH	45	0	20	25	0	45
13860	CIPRO - Ciprofloxacin	2018M07	ICU-C	31	0	12	21	0	33
13860	CIPRO - Ciprofloxacin	2018M07	MICU	44	0	24	20	0	44
13860	CIPRO - Ciprofloxacin	2018M07	PEDMED	27	0	7	20	0	27
13860	CIPRO - Ciprofloxacin	2018M07	SICU	38	0	18	20	0	38
13860	CIPRO - Ciprofloxacin	2018M07	STEP_AU	36	0	6	30	0	36

Note: Data are fictitious and for demonstration purposes only.

Example: Line List Output (continued)

National Healthcare Safety Network
Line Listing - All Submitted AU Data by Location
As of: September 24, 2019 at 10:10 PM
Date Range: SUMMARYAU summaryYM After and Including 2018M07
if (((drugIngredient = CIPRO)

Summary Year/Month=2018M07

Facility Org ID	Antimicrobial Agent Description	Summary Year/Month	Location	Antimicrobial Days	Route: IM	Route: IV	Route: Digestive	Route: Respiratory	Sum of Routes
13860	CIPRO - Ciprofloxacin	2018M07	5GNORTH	45	0	20	25	0	45
13860	CIPRO - Ciprofloxacin	2018M07	ICU-C	31	0	12	21	0	33
13860	CIPRO - Ciprofloxacin	2018M07	MICU	44	0	24	20	0	44
13860	CIPRO - Ciprofloxacin	2018M07	PEDMED	27	0	7	20	0	27
13860	CIPRO - Ciprofloxacin	2018M07	SICU	38	0	18	20	0	38
13860	CIPRO - Ciprofloxacin	2018M07	STEP_AU	36	0	6	30	0	36

- Total antimicrobial days and sum of routes were equal for all but surgical intensive care unit (ICU-C)
  - Sum of routes was greater, which is expected based on ciprofloxacin dosing

Section B: Validation of Data Aggregations & Calculations

- Review locations mapped in NHSN
- Review aggregations
- **Compare AU & HAI denominators**

Compare AU & HAI denominators

- Guides you through comparing AU Option days present to patient days in NHSN Central Line-Associated Bloodstream Infection (CLABSI)/Catheter-Associated Urinary Tract Infection (CAUTI) reporting
  - Different definitions for days present and patient days – do not expect an exact match!
  - Expected differences found in question #2 in “Days Present & Admissions” section of AU Option FAQ

Section C: Spot Check Data Submitted to NHSN

- Use the AU Option Data Quality Line List within NHSN
- Review unusual routes of administration
- Evaluate location specific expected patterns
- Evaluate drug specific expected patterns
- Review aggregations
- Compare AU & HAI denominators

Section C: Spot Check Data Submitted to NHSN

- **Use the AU Option Data Quality Line List within NHSN**
- Review unusual routes of administration
- Evaluate location specific expected patterns
- Evaluate drug specific expected patterns
- Review aggregations
- Compare AU & HAI denominators

Use the AU Option Data Quality Line List within NHSN

- Stay tuned – we'll go over this later in the presentation

Section C: Spot Check Data Submitted to NHSN

- Use the AU Option Data Quality Line List within NHSN
- **Review unusual routes of administration**
- **Evaluate location specific expected patterns**
- **Evaluate drug specific expected patterns**
- **Review aggregations**
- **Compare AU & HAI denominators**

Note: Section C vs. Sections A & B

- Section C re-checks items from Sections A & B
  - If not enough resources/time for entire protocol, start with Section C and do Sections A & B if you identify issues

Summary

- Detailed, comprehensive, and time-intensive
  - If low resources/time, start with Section C
- Time to complete varies substantially and depends on:
  - Vendor availability and responsiveness
  - Familiarity with running reports in source system
  - Familiarity with running reports in NHSN

Annual Data Quality Checks: AU Annual Data Validation Protocol

Laura Blum, MPH

Overview

- Use as part of regular data quality activities each year
  - Recommend at least 12 months of data to review
  - Can also guide investigation efforts for unexpected Standardized Antimicrobial Administration Ration (SAAR) values
- Focuses on updates to your facility in NHSN and common data errors
- Four sections
  - NHSN Location Mapping
  - Monthly Reporting Plan
  - NHSN AU Option Users
  - AU Option Data

Who to collaborate with

NHSN Location Mapping & Monthly Reporting Plan (First & Second Sections)

- NHSN Location Mapping
  - Review for changes in patient mix
  - Add brand new locations
  - Inactivate permanently closed locations
- Monthly Reporting Plan
  - Check for inactive locations
  - Add brand new locations
  - Review calendar year for completeness

NHSN Location Mapping & Monthly Reporting Plan (First & Second Sections)

- NHSN Location Mapping
  - **Review for changes in patient mix**
  - **Add brand new locations**
  - **Inactivate permanently closed locations**
- Monthly Reporting Plan
  - **Check for inactive locations**
  - **Add brand new locations**
  - **Review calendar year for completeness**

Review NHSN Locations and Monthly Reporting Plans

- Locations can change due to additions, closures, construction, or changes in patient mix
  - Location mappings follow CDC Locations and Descriptions and Instructions for Mapping Patient Care Locations
  - Contact the NHSN Help Desk with “Locations assistance” in the subject for help (use NHSN Customer Support Portal or email NHSN@cdc.gov)
- Monthly reporting plans should include all active, eligible locations
  - Remove inactive locations from the plan

NHSN AU Option Users (Third Section)

- Confirm two active AU users
- Deactivate former AU users

NHSN AU Option Users (Third Section)

- Confirm two active AU users
- Deactivate former AU users

Confirm NHSN users

- Recommend at least two AUR-specific users within each NHSN facility
  - Generally, pharmacist or physician champion in charge of:
    - Uploading data
    - Reviewing/validating submitted data
    - Running reports/analyzing data
  - If Infection Prevention and Control will upload data, you may only need one additional AUR-specific user
- Remove users who no longer work for your facility to avoid unauthorized access to data

AU Option Data (Fourth Section)

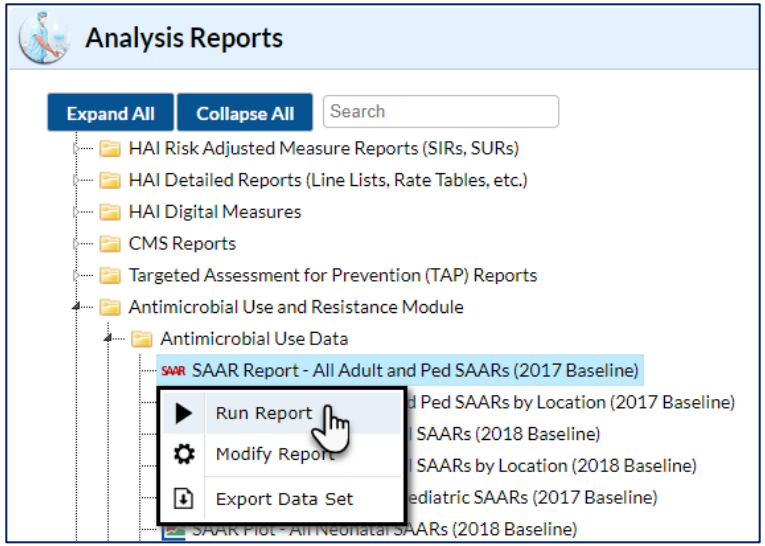
- Review location specific SAARs
- Examine drug specific trends
- Use the data quality line list
- Perform a spot check of the data
- Check and compare denominators

AU Option Data (Fourth Section)

- **Review location specific SAARs**
- Examine drug specific trends
- Use the data quality line list
- Perform a spot check of the data
- Check and compare denominators

Example: Reviewing SAARs

- Annual AU Validation Protocol can help guide investigation efforts for unexpected SAAR values
- Run default SAAR Report – All Adult and Ped SAARs (2017 Baseline)



Note: Data are fictitious and for demonstration purposes only.

Example: SAAR output

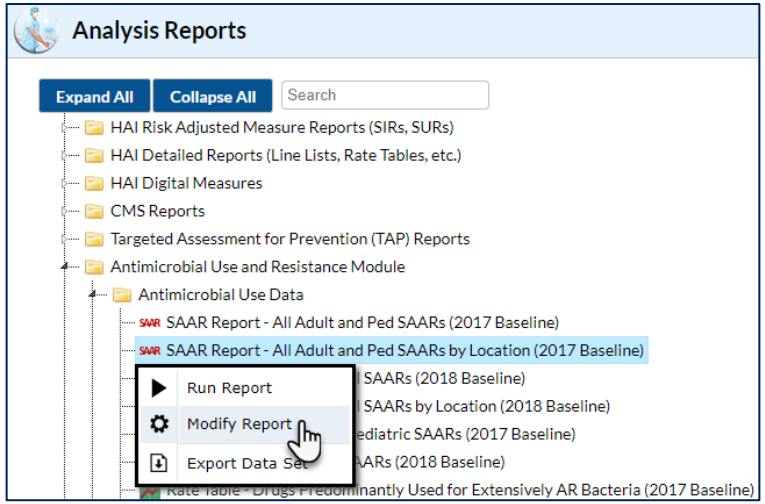
- During the review of all SAARs, adult broad spectrum antibacterial agents predominantly used for hospital-onset infections (BSHO) ICU SAARs seemed suspiciously low during 4th quarter of 2018 (2018Q4)

Broad spectrum antibacterial agents predominantly used for hospital-onset infections used in adult SAAR ICUs

Facility Org ID	Summary Year/Month	SAAR Type 2017 Baseline	Antimicrobial Days	Predicted Antimicrobial Days	Days Present	SAAR	SAAR p-value	95% Confidence Interval
13860	2018M07	Adult_BSHO_ICU_2017	411	268.873	927	1.529	0.0000	1.386, 1.682
13860	2018M08	Adult_BSHO_ICU_2017	120	96.776	348	1.240	0.0249	1.033, 1.477
13860	2018M09	Adult_BSHO_ICU_2017	120	113.740	409	1.055	0.5815	0.879, 1.257
13860	2018M10	Adult_BSHO_ICU_2017	200	197.705	668	1.012	0.8892	0.879, 1.159
13860	2018M11	Adult_BSHO_ICU_2017	195	215.789	729	0.904	0.1638	0.783, 1.037
13860	2018M12	Adult_BSHO_ICU_2017	210	228.863	774	0.918	0.2226	0.800, 1.048

Example: Reviewing SAARs by location

- Modify SAAR Report – All Adult and Ped SAARs by Location (2017 Baseline)
  - Time Period = 2018Q4
  - Filter SAAR Type = BSHO



Note: Data are fictitious and for demonstration purposes only.

Example: SAARs by location output

- BSHO SAAR low in medical ICU (MICU) compared to surgical ICU (ICU-C)

National Healthcare Safety Network

SAARs Table - All Adult and Pediatric Standardized Antimicrobial Administration Ratios (SAARs) High-Level Indicators and High-Value Targets by Location (2017 Baseline)

As of: October 17, 2019 at 10:14 AM
Date Range: AU_SAAR_2017 summaryYQ 2018Q4 to 2018Q4
if (((SAARType_2017 = "Adult_BSHO_ICU_2017")))

Broad spectrum antibacterial agents predominantly used for hospital-onset infections used in adult SAAR ICUs

Facility Org ID	SAAR Type 2017 Baseline	Location	Summary Year/Month	CDC Location	Antimicrobial Days	Predicted Antimicrobial Days	Days Present	SAAR	SAAR p-value	95% Confidence Interval
13860	Adult_BSHO_ICU_2017	ICU-C	2018M10	IN:ACUTE:CC:S	120	96.776	348	1.240	0.0249	1.033, 1.477
13860	Adult_BSHO_ICU_2017	ICU-C	2018M11	IN:ACUTE:CC:S	120	105.397	379	1.139	0.1736	0.948, 1.357
13860	Adult_BSHO_ICU_2017	ICU-C	2018M12	IN:ACUTE:CC:S	120	113.740	409	1.055	0.5815	0.879, 1.257
13860	Adult_BSHO_ICU_2017	MICU	2018M10	IN:ACUTE:CC:M	80	100.929	320	0.793	0.0322	0.633, 0.981
13860	Adult_BSHO_ICU_2017	MICU	2018M11	IN:ACUTE:CC:M	75	110.392	350	0.679	0.0004	0.538, 0.847
13860	Adult_BSHO_ICU_2017	MICU	2018M12	IN:ACUTE:CC:M	90	115.123	365	0.782	0.0157	0.632, 0.956

Example: Review Drug Distributions

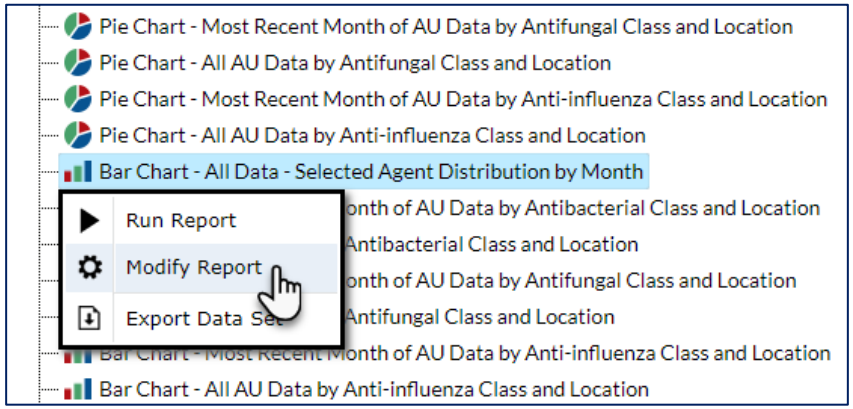
- Review rates for drugs included in adult BSHO SAAR to see which drugs are driving the low SAAR
- Check Appendix E: Antimicrobial Groupings for SAAR & Rate Table Calculations in AUR Module Protocol

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)

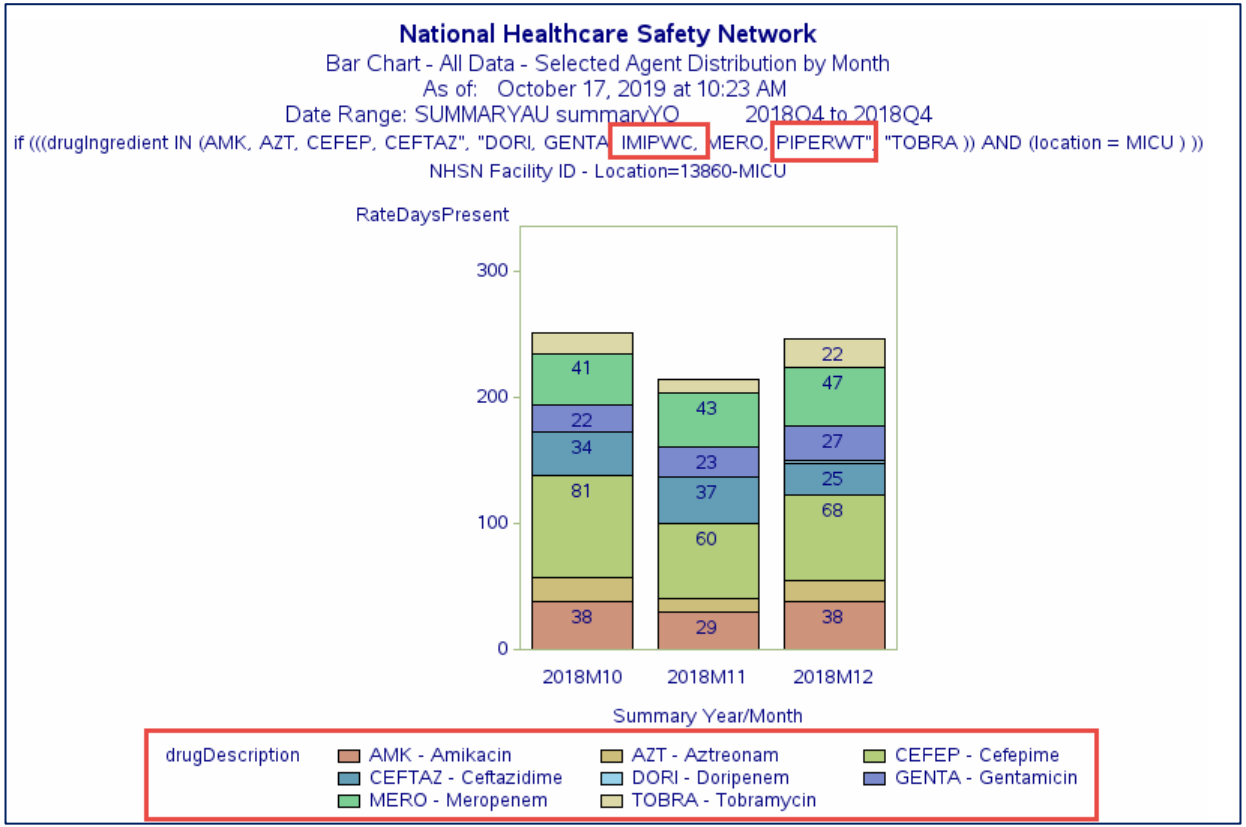
Example: Drug distributions using Bar Chart

- Modify Bar Chart – All Data – Selected Agent Distribution by Month
  - Time Period = 2018Q4
  - Filter:
    - Antimicrobial Agents = drugs included in BSHO SAAR
    - Location = MICU



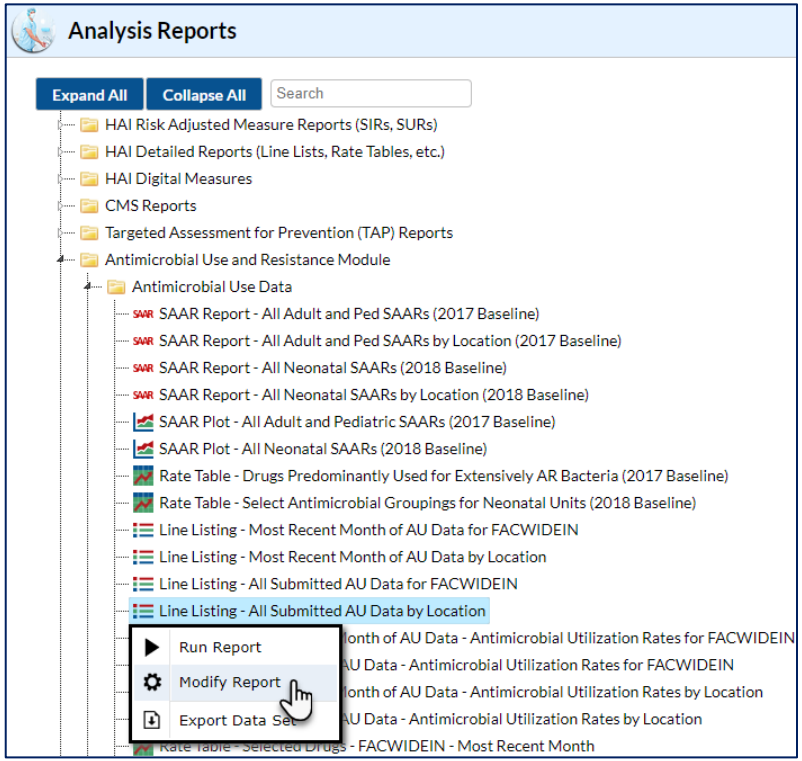
Note: Data are fictitious and for demonstration purposes only.

Example: Bar Chart Output



Example: Review Individual Drug Counts

- Modify Line Listing – All Submitted AU Data by Location
  - Time Period = 2018Q4
  - Filter:
    - Antimicrobial Agents = drugs included in BSHO SAAR
    - Location = MICU
  - *Remove Display Variables not needed for comparison (optional)*



Example:
Line List Output

Facility Org ID	Antimicrobial Agent Description	Summary Year/Month	Location	Antimicrobial Days	Route: IV	Days Present
13860	AMK - Amikacin	2018M10	MICU	12	12	320
13860	AMK - Amikacin	2018M11	MICU	10	10	350
13860	AMK - Amikacin	2018M12	MICU	14	14	365
13860	AZT - Aztreonam	2018M10	MICU	6	6	320
13860	AZT - Aztreonam	2018M11	MICU	4	4	350
13860	AZT - Aztreonam	2018M12	MICU	6	6	365
13860	CEFEP - Cefepime	2018M10	MICU	26	26	320
13860	CEFEP - Cefepime	2018M11	MICU	21	21	350
13860	CEFEP - Cefepime	2018M12	MICU	25	25	365
13860	CEFTAZ - Ceftazidime	2018M10	MICU	11	11	320
13860	CEFTAZ - Ceftazidime	2018M11	MICU	13	13	350
13860	CEFTAZ - Ceftazidime	2018M12	MICU	9	9	365
13860	DORI - Doripenem	2018M10	MICU	0	0	320
13860	DORI - Doripenem	2018M11	MICU	0	0	350
13860	DORI - Doripenem	2018M12	MICU	1	1	365
13860	GENTA - Gentamicin	2018M10	MICU	7	7	320
13860	GENTA - Gentamicin	2018M11	MICU	8	8	350
13860	GENTA - Gentamicin	2018M12	MICU	10	10	365
13860	IMIPWC - Imipenem with Cilastatin	2018M10	MICU	0	0	320
13860	IMIPWC - Imipenem with Cilastatin	2018M11	MICU	0	0	350
13860	IMIPWC - Imipenem with Cilastatin	2018M12	MICU	0	0	365
13860	MERO - Meropenem	2018M10	MICU	13	13	320
13860	MERO - Meropenem	2018M11	MICU	15	15	350
13860	MERO - Meropenem	2018M12	MICU	17	17	365
13860	PIPERWT - Piperacillin with Tazobactam	2018M10	MICU	0	0	320
13860	PIPERWT - Piperacillin with Tazobactam	2018M11	MICU	0	0	350
13860	PIPERWT - Piperacillin with Tazobactam	2018M12	MICU	0	0	365
13860	TOBRA - Tobramycin	2018M10	MICU	5	5	320
13860	TOBRA - Tobramycin	2018M11	MICU	4	4	350
13860	TOBRA - Tobramycin	2018M12	MICU	8	8	365

Note: Data are fictitious and for demonstration purposes only.

Note: Data are fictitious and for demonstration purposes only.

Example: Line List Output (continued)

- Review piperacillin/tazobactam and piperacillin usage to ensure they are reported correctly
  - Note: Piperacillin is no longer eligible for AU Option reporting
  - This is just an example – you could check other combination drugs for the same issue instead

National Healthcare Safety Network
Line Listing - All Submitted AU Data by Location
As of: October 17, 2019 at 10:37 AM
Date Range: SUMMARYAU summaryYQ 2018Q4 to 2018Q4
if (((location = MICU) AND (drugIngredient IN (PIPER, PIPERWT))))

Location=MICU

Facility Org ID	Antimicrobial Agent Description	Summary Year/Month	Location	Antimicrobial Days	Route: IV	Days Present
13860	PIPER - Piperacillin	2018M10	MICU	87	87	320
13860	PIPER - Piperacillin	2018M11	MICU	92	92	350
13860	PIPER - Piperacillin	2018M12	MICU	96	96	365
13860	PIPERWT - Piperacillin with Tazobactam	2018M10	MICU	0	0	320
13860	PIPERWT - Piperacillin with Tazobactam	2018M11	MICU	0	0	350
13860	PIPERWT - Piperacillin with Tazobactam	2018M12	MICU	0	0	365

AU Option Data (Fourth Section)

- Review location specific SAARs
- **Examine drug specific trends**
- Use the data quality line list
- Perform a spot check of the data
- Check and compare denominators

Examine drug specific trends

- Guides you through checking that high-level antimicrobial usage trends* at your facility make sense
- Examples:
  - Most used antibacterials at your facility
  - Antifungals used in expected locations
  - Anti-influenza drugs used mostly during flu season

*Drug shortages may affect drug-specific trends

AU Option Data (Fourth Section)

- Review location specific SAARs
- Examine drug specific trends
- **Use the data quality line list**
- Perform a spot check of the data
- Check and compare denominators

Use the data quality line list

- Stay tuned – we'll go over this later in the presentation

AU Option Data (Fourth Section)

- Review location specific SAARs
- Examine drug specific trends
- Use the data quality line list
- **Perform a spot check of the data**
- **Check and compare denominators**

Perform a spot check of the data & check and compare denominators

- Re-check key items from AU Implementation Data Validation Protocol

Summary

- Shorter than Implementation Validation Protocol
- Work from high-level overview to specific data point review
- Time to complete varies substantially and depends on:
  - Availability of NHSN Facility Administrator and Infection Preventionists
  - Familiarity with running reports in NHSN

AU Option Data Quality Line List

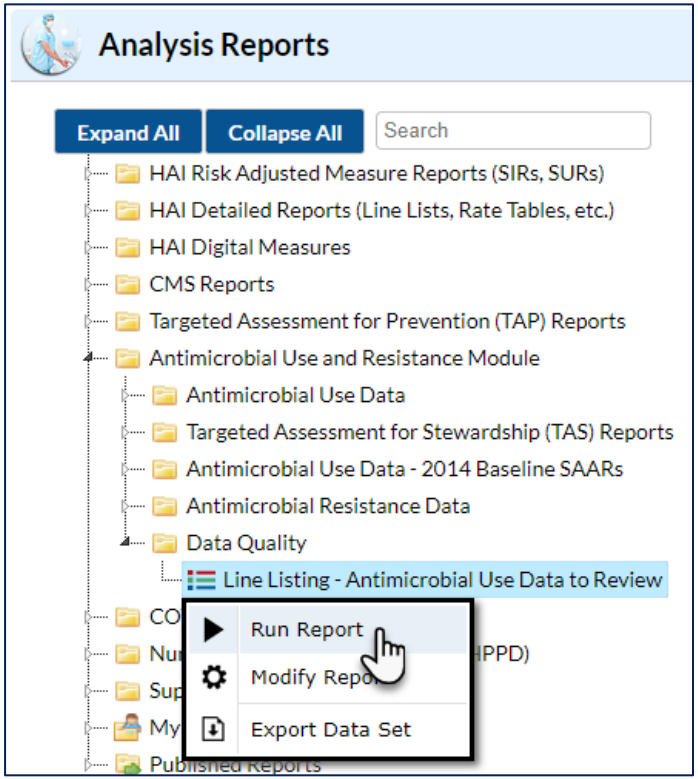
Laura Blum, MPH

Overview

- Report within NHSN available to both facilities and groups
- Provides six tables showing potential data quality issues:
  1. Zero or missing antimicrobial days
  2. Antimicrobial days reported when patients were not present
  3. Antimicrobial days greater than or equal to days present
  4. Sum of routes of administration less than total antimicrobial days
  5. FacWideIN antimicrobial days greater than sum of antimicrobial days for all inpatient locations
  6. FacWideIN days present greater than sum of days present for all inpatient locations

Running the Report

- Found in Antimicrobial Use and Resistance Module > Data Quality
- Can run, modify, and export report like all other NHSN reports
- AU Data Quality Line List QRG: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-dataquality-linelist-508.pdf



Note: Data are fictitious and for demonstration purposes only.

Table 1: Zero or missing antimicrobial days

- Antimicrobial days for every drug is zero or missing (“.”)
  - Not always an error but unlikely to have zero antimicrobial administrations if patients were present during a calendar month

National Healthcare Safety Network
Line Listing for Antimicrobial Use Data to Review
Zero and/or "." antimicrobial days for all drugs in a specific location or FacWideIN

As of: December 4, 2019 at 4:12 PM
Date Range: AU_DATAQUALITY summaryYM After and Including 2019M01

Locations appearing in this table have reported zero or N/A antimicrobial days for all antimicrobials in the given month. Please review these records to ensure data accuracy. In the event that no patients were present in this unit during this month, these data are accurate.

Facility Org ID=13860

Facility Org ID	Summary Year/Month	Location
13860	2019M04	MEDWARD

Items to Review

- Verify whether patients were present in the location
  - If no patients present during the month (e.g., unit was under construction), reporting zero antimicrobial days is accurate
  - If patients were present, review antimicrobial administrations in eMAR/BCMA system and verify no eligible antimicrobial administrations in the location during the month
- Check with your vendor for the next steps on addressing this data quality issue

Note: Data are fictitious and for demonstration purposes only.

Table 2: Antimicrobial days reported when patients were not present

- Antimicrobial days reported for any drug with zero days present
  - Zero days present indicates no patients present in that location for the entire calendar month, so no antimicrobials should be administered

National Healthcare Safety Network
Line Listing for Antimicrobial Use Data to Review
Antimicrobial days reported for any drug when days present are zero for any location or FacWideIN
As of: August 19, 2020 at 11:26 AM
Date Range: All AU_DATAQUALITY

Carefully review this list which includes locations for which zero days are present, meaning zero patients, were reported in the location during the given month; however, antimicrobial days were reported for one or more drugs. If no patients were present in the location, no antimicrobial days should be reported. This is a data quality error that should be addressed.

Facility Org ID=13860

Facility Org ID	Summary Year/Month	Location	Antimicrobial Agent Description	Antimicrobial Days	Days Present
13860	2020M05	NICU IV	PENG - Penicillin G	1	0

Items to Review

- Use ADT system to verify whether patients were present in the location
  - If patients were present in the location during the month, check with your vendor to determine why the vendor system is not accurately reporting the days present
  - If no patients were present in the location during the month, check with your vendor to determine why the vendor system is incorrectly attributing antimicrobial days to the location

Note: Data are fictitious and for demonstration purposes only.

Table 3: Antimicrobial days greater than or equal to days present

- Total antimicrobial days reported for an individual drug > days present
  - Patient can only contribute one antimicrobial day per drug per day
  - Total antimicrobial days should never be > days present
    - Note: Can be equal in rare cases of extremely high use

National Healthcare Safety Network
Line Listing for Antimicrobial Use Data to Review
Antimicrobial days for a single drug greater than or equal to days present for given location or FacWideIN
As of: December 9, 2019 at 2:55 PM
Date Range: AU_DATAQUALITY summaryYM 2019M06 to 2019M06
Carefully review this list which includes individual drugs for which the total number of antimicrobial days are greater than or equal to the number of days present in the given location and month. Since a patient can contribute only one antimicrobial day per drug per location, the total antimicrobial days should never be greater than or equal to days present. This is a data quality error that should be addressed.

Facility Org ID=13860

Facility Org ID	Summary Year/Month	Location	Antimicrobial Agent Description	Antimicrobial Days	Days Present
13860	2019M06	MEDWARD	PENG - Penicillin G	701	700

Items to Review

- Review antimicrobial administrations in eMAR/BCMA system
  - Ensure vendor system attributes only one total antimicrobial day per drug per patient per calendar day, regardless of how many doses administered to the patient during that day
- Review days present in ADT system
  - Ensure vendor system attributes one day present per patient if the patient is in the location for any amount of time during the calendar day
- Check with your vendor for the next steps on addressing this data quality issue

Note: Data are fictitious and for demonstration purposes only.

Table 4: Sum of routes of administration less than total antimicrobial days

- Sum of routes of administration < total antimicrobial day count for an individual drug
  - Some antimicrobials can be administered more than once per day via multiple routes
  - Sum of routes should always be ≥ total antimicrobial days

National Healthcare Safety Network
Line Listing for Antimicrobial Use Data to Review
Sum of routes (IM_Count, IV_Count, Digestive_Count, Respiratory_Count) less than total antimicrobial days for a single drug in any location or FacWideIN
As of: December 9, 2019 at 2:59 PM
Date Range: AU_DATAQUALITY summaryYM 2019M03 to 2019M03
Carefully review this list which includes drugs for which the sum of the routes of administration are less than the total number of antimicrobial days for a given drug. The total antimicrobial day count should only include IV, IM, digestive, and respiratory administrations as outlined in the AU Option protocol. Therefore, the total antimicrobial days should always be less than or equal to the sum of the routes. This is a data quality error that should be addressed.

Facility Org ID=13860

Facility Org ID	Summary Year/Month	Location	Antimicrobial Agent Description	Antimicrobial Days	sumRoutesAdmin
13860	2019M03	MEDWARD	TETRA - Tetracycline	89	85

Items to Review

- Review antimicrobial administrations in eMAR/BCMA system
  - Determine if vendor system is incorrectly including additional routes of administration (e.g., intrapleural, irrigation, topical) in total antimicrobial day counts
  - Ensure vendor system attributes only one antimicrobial day per drug per route per patient per calendar day, regardless of how many doses were administered to the patient during the day
  - *Ensure that antimicrobial days are calculated independently and are not just the sum of the routes of administration (optional)*
- Check with your vendor for the next steps on addressing this data quality issue

Table 5: FacWideIN antimicrobial days > sum of antimicrobial days for all inpatient locations*

- Patient can only contribute one antimicrobial day per drug for FacWideIN
- Patient can contribute >1 antimicrobial day to the sum of locations if antimicrobial was administered in more than one location (e.g., patient transferred from one inpatient unit to another in the same calendar day and was administered antimicrobials in both units)
- FacWideIN antimicrobial day counts should never be > sum of the inpatient locations

*Outpatient locations (ED, pediatric ED, and 24-hour observation) are not included in FacWideIN

Note: Data are fictitious and for demonstration purposes only.

AU Option Data Quality Line List: Table 5 (continued)

National Healthcare Safety Network
Line Listing for Antimicrobial Use Data to Review
Antimicrobial day counts for FacWideIN greater than antimicrobial day counts for the sum of the locations

As of: June 1, 2023 at 8:43 AM
Date Range: AU_DATAQUALITY summaryYM After and Including 2022M02
if (((table = "5") AND (drugIngredientDesc = "AMK")))

Carefully review this list which includes individual drugs where the antimicrobial day count reported in the FacWideIN record is greater than the antimicrobial day count reported for the sum of the location-specific records. Since a patient can contribute only one antimicrobial day per drug for FacWideIN but more than one antimicrobial day per drug to the sum of location-specific records if in more than one location in a given calendar day, the FacWideIN antimicrobial day count should be less than the count for the sum of locations. This is a data quality error that should be addressed.

orgID=33617

Facility OrgID	Summary Year/Month	Antimicrobial Agent Description	FacWideIN Antimicrobial Days	Sum of Locations Antimicrobial Days
33617	2022M02	AMK - Amikacin	600	277

Table 6: FacWideIN days present > sum of days present for all inpatient locations*

- Patient can only contribute one day present per calendar day for FacWideIN
- Patient can contribute >1 day present if they are present in more than one location (e.g., patient transfers between two inpatient units in the same calendar day)
- FacWideIN days present counts should never be > sum of the inpatient locations

*Outpatient locations (ED, pediatric ED, and 24-hour observation) are not included in FacWideIN

Note: Data are fictitious and for demonstration purposes only.

Table 6: FacWideIN days present > sum of days present for all inpatient locations (continued)

National Healthcare Safety Network
Line Listing for Antimicrobial Use Data to Review
Days present counts for FacWideIN greater than days present counts for the sum of the locations

As of: May 25, 2023 at 2:49 PM
Date Range: AU_DATAQUALITY summaryYM After and Including 2021M08
if (((table = "6")))

Carefully review this list which includes months in which the days present count reported in the FacWideIN record is greater than the days present count reported for the sum of the location-specific records. Since a patient can contribute only one day present per calendar day for FacWideIN but more than one present if in more than one location in a given calendar day, the FacWideIN days present count should be less than the count for the sum of locations. This is a data quality error that should be addressed.

orgID=33617

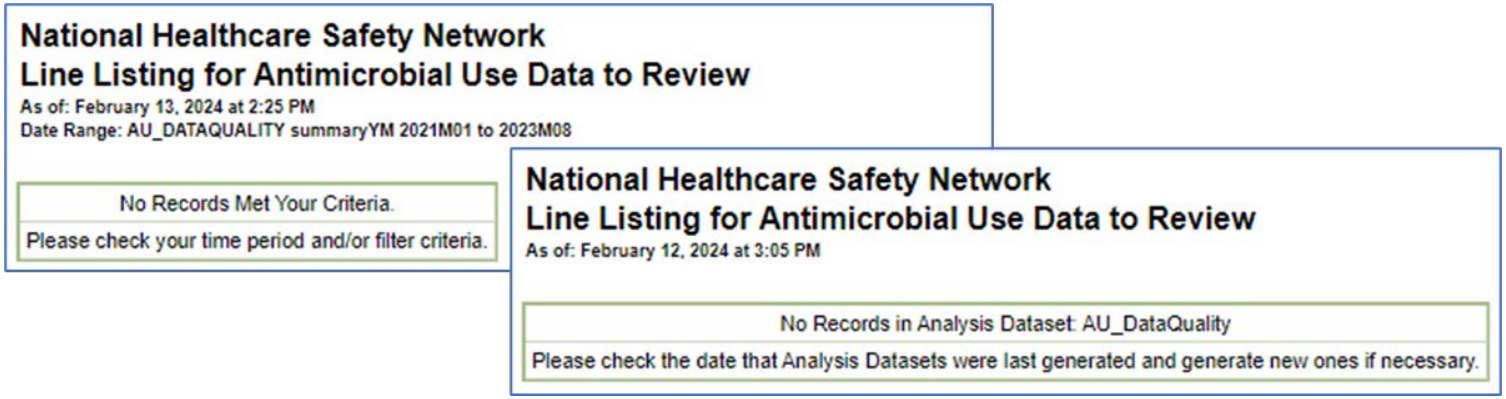
Facility OrgID	Summary Year/Month	FacWideIN Days Present	Sum of Locations Days Present
33617	2021M08	29981	22087

Items to Review

- Ask your vendor to help review inpatient locations in your facility that are included in FacWideIN reporting
  - Outpatient locations (ED, pediatric ED, and 24-hour observation area) should not be included in FacWideIN
- Compare list of locations with the inpatient locations selected in monthly reporting plan
  - Ensure that you're reporting AU data for all individual locations
- Review "Aggregating FacWideIN Antimicrobial days" in Section B of AU Option Implementation Data Validation Protocol for more guidance

Summary

- If no data appear when running this report, then no data have one of the six potential data quality issues previously mentioned!



- If low on resources/time, this report is a good place to focus validation efforts

AR Option Data Validation Protocol

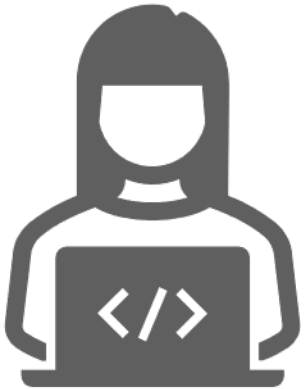
Laura Blum, MPH

AR Data Validation Protocol: Overview

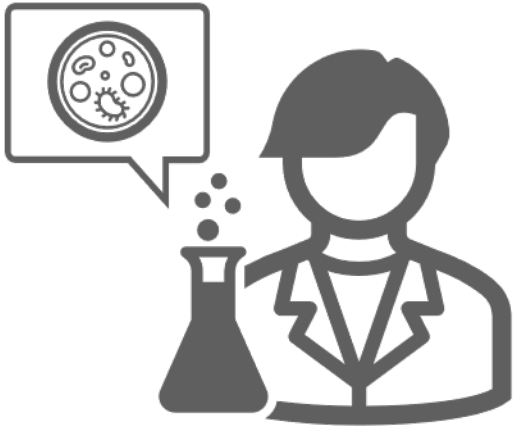
- Can be used during initial implementation and on an annual basis
- Focuses on understanding considerations for AR data, AUR Module Protocol definitions, and common data errors
- Three sections
  - General understanding of AR Data being shared with NHSN
  - Review AR Option Data
  - Compare AR Summary Data with Other NHSN Summary Data

Who to collaborate with

Vendor representative



Laboratory



NHSN HAI reporter

General understanding of AR Data being shared with NHSN (First Section)

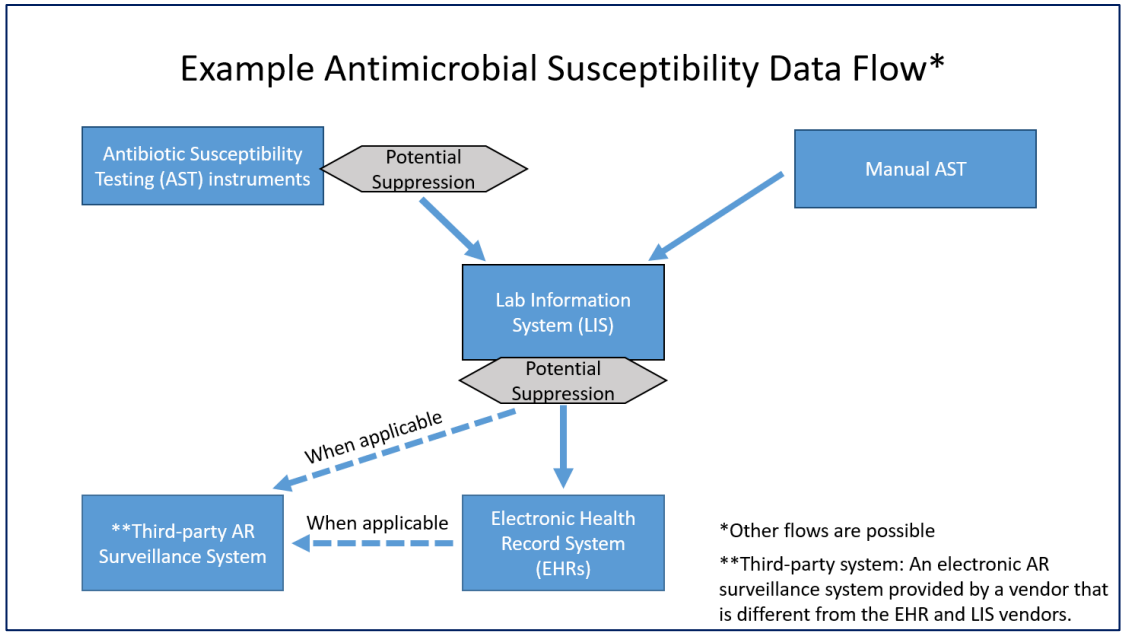
- Data specifics & Data suppression
- *Candida* species susceptibility testing

General understanding of AR Data being shared with NHSN (First Section)

- **Data specifics & data suppression**
- *Candida* species susceptibility testing

Data specifics & data suppression

- Important to know conceptually how your data get to NHSN and whether they are affected by data suppression rules



Acronym:
AST = antimicrobial susceptibility testing

AR data suppression

- Suppression prevents complete susceptibility data from being reported to AR Option
- AR data may be suppressed for multiple reasons
  - Testing instrument suppression for organism-drug combinations that are not supposed to be reported for microbiology purposes
    - Example: Suppressing ampicillin susceptibility for *Pseudomonas aeruginosa* because it is known to be ampicillin resistant
  - Antimicrobial stewardship
    - Example: Suppressing carbapenem susceptibility for *E. coli* susceptible to first, second, or third generation cephalosporins to reduce the use of carbapenems

Which type of suppression to bypass

- Recommend keeping organism-drug combinations that are not supposed to be reported for microbiology purposes suppressed and not submitting them to NHSN
- If feasible, allow lab to release complete AST results to EHR for suppression for the purposes of antimicrobial stewardship
  - Perform data suppression at the EHR-level (as opposed to suppression at the instrument- or LIS-level)
  - Complete data still available in EHR and theoretically should be available for data extraction and submission to NHSN
- If you cannot send suppressed data to the AR Option, NHSN will accept the data your hospital is able to provide

Things to consider for AR reporting

- **Where** does data suppression occur in your systems?
  - Selective reporting/cascade reporting (SR/CR)
  - AST instrument, LIS, EHR
- Is there a way to **bypass** suppression rules to report complete data to NHSN?
  - Can you get data feed from somewhere else?
- How are your AR Option **reports/metrics** being affected by suppression?
  - Antibiogram, AR organism reports, Standardized Resistant Infection Ratio (SRIR) and Pathogen-specific Standardized Infection Ratio (pSIR)

How Data Suppression Affects Your NHSN Reports — %S

- Example: If piperacillin/tazobactam results are suppressed (and not shared with NHSN) in the case that the *E. coli* isolate is identified as extended-spectrum beta-lactamase (ESBL) producing…
  - Within NHSN antibiogram, piperacillin/tazobactam percent susceptible (%S) for *E. coli* would show as being higher than if all *E. coli* piperacillin/tazobactam results were included
- If cefepime is only reported when a *Klebsiella* isolate is not susceptible to ceftriaxone…
  - Within NHSN antibiogram, cefepime %S for *Klebsiella* would show as being lower than if all *Klebsiella* cefepime results were included

How Data Suppression Affects Your NHSN Reports — SRIR/pSIR

- pSIR
  - Unlikely to be biased as the identification of organisms are still reported
- SRIR
  - Underestimated certain situations (for example, if fluoroquinolone results are suppressed for pediatric patients)
  - Less likely to be biased when secondary agents are only reported if an organism is resistant to primary agents
    - AST results of secondary agents are likely to be susceptible when the isolate is susceptible to primary agents in the same class
    - Slight underestimation of SRIR is still possible

General understanding of AR Data being shared with NHSN (First Section)

- Data specifics & Data suppression
- ***Candida*** **species susceptibility testing**

Candida species susceptibility testing

- Determine whether your lab performs susceptibility testing, either on- or offsite, on *Candida* species routinely or on an as-needed basis
- Helps you understand your *Candida* results in AR Option
  - Example: If zero *Candida* events in NHSN, is that because there were zero *Candida* isolates or were isolates not tested due to AST rules?

Review AR Option Data (Second Section)

- Using the AR Option Event-level Line Listings
- Using the AR Option Bar Chart
- Using the AR Option Antibiogram
- Using the AR Option AR Organism Rate Table
- Using the AR Summary Data Line List

Review AR Option Data (Second Section)

- Using the AR Option Event-level Line Listings
- Using the AR Option Bar Chart
- Using the AR Option Antibiogram
- Using the AR Option AR Organism Rate Table
- Using the AR Summary Data Line List

Review AR Option Data

- Guides you through using available NHSN AR Option analysis reports to review your AR data
- Additional resources:
  - AR Event Line List QRG
  - AR Bar Chart QRG
  - AR Facility-wide Antibiogram and Percent Tested QRG
  - AR Organisms Rate Table QRG
  - AR Denominator Line List QRG

Compare AR Summary Data with Other NHSN Summary Data (Third Section)

- Compare denominators

Compare AR Summary Data with Other NHSN Summary Data (Third Section)

- Compare denominators

Compare denominators

- Guides you through comparing FacWideIN patient days and admissions reported to AR Option vs. NHSN Multidrug-Resistant Organism (MDRO)/*Clostridioides difficile* Infection (CDI) reporting
  - Use similar definitions so values should be close
  - May be slightly different if different data sources are used

AR Validation Protocol Summary

- Requires knowledge of laboratory practices at your facility or collaboration with laboratory team
- Time to complete varies substantially and depends on:
  - Vendor availability and responsiveness
  - Familiarity with running reports in source system
  - Familiarity with running reports in NHSN
- We hope to have more AR option data quality materials in the future!

Resources

- AUR Module webpage: https://www.cdc.gov/nhsn/psc/aur/index.html
- AUR Module Protocol: https://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf
- CDC Locations and Descriptions and Instructions for Mapping Patient Care Locations: https://www.cdc.gov/nhsn/pdfs/pscmanual/15locationsdescriptions_current.pdf
- Patient Safety Component Data Quality webpage: https://www.cdc.gov/nhsn/ps-analysis-resources/data-quality/index.html

Resources (continued)

- AU Option Implementation Data Validation: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/AU-Option-Implementation-Data-Validation-P.pdf
- Annual AU Option Data Validation: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/annual-au-data-validation-508.pdf
- AU Option Data Quality Line List QRG: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-dataquality-linelist-508.pdf
- AR Option Data Validation: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-validation-508.pdf

For any questions or concerns, contact the NHSN Help Desk using

NHSN-ServiceNow to submit questions to the NHSN Help Desk. The new portal can be accessed at **https://servicedesk.cdc.gov/nhsncsp**. Users will be authenticated using CDC's Secure Access Management Services (SAMS) the same way you access NHSN. If you do not have a SAMS login, or are unable to access ServiceNow, you can still email the NHSN Help Desk at nhsn@cdc.gov.

For more information please contact Centers for Disease Control and Prevention
1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov