Collaborating with Your Antimicrobial Stewardship Team Using NHSN Data

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APIC 2021 Annual Conference

Tuesday, June 29: 4:15-5:30pm

Objectives

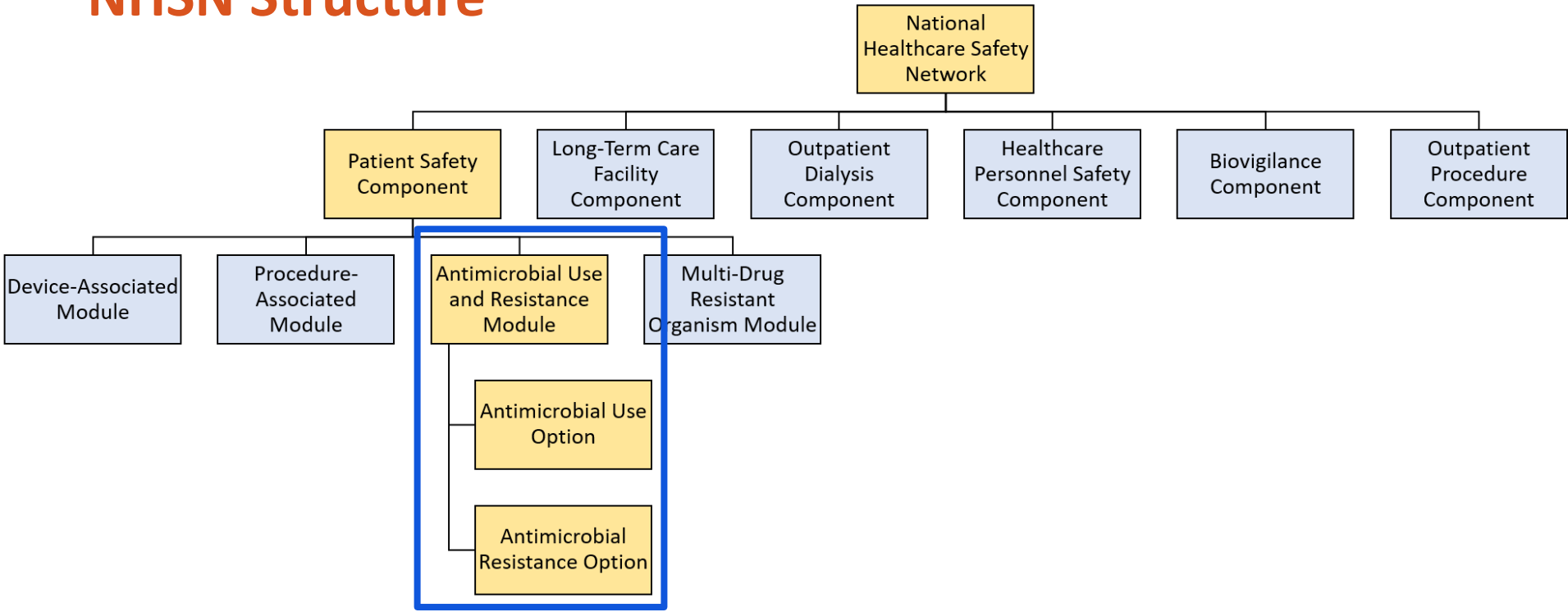
- Describe the required data elements for submission into the NHSN AUR Module
- Identify steps to submit AUR data to NHSN
- Review and interpret key AUR Module analysis reports
- Provide an example of how AUR and HAI data can be used in tandem
- Locate the NHSN AUR Module resources

Overview

- Data elements reported in the AU and AR Options
- Submission of data
- Using AUR and HAI data together

Antimicrobial Use & Resistances (AUR) Module Overview

NHSN Structure



Antimicrobial Use (AU) Option

AU Option

- Purpose:
  - Provide a mechanism for facilities to report and analyze antimicrobial usage as part of antimicrobial stewardship efforts at their facility
- Voluntary reporting
  - Not part of CMS Quality Reporting Programs
  - Included as one option for Public Health Registry reporting for Promoting Interoperability (formerly called Meaningful Use Stage 3)*

*MU 3 Final Rule: https://www.federalregister.gov/documents/2018/08/17/2018-16766/medicare-program-hospital-inpatient-prospective-payment-systems-for-acute-care-hospitals-and-the

*NHSN MU3 page: https://www.cdc.gov/nhsn/cdaportal/meaningfuluse.html

Requirements for AU Data Submission
Who Can Participate?

- Hospitals* that have:
  - Electronic Medication Administration Record (eMAR), or
  - Bar Coding Medication Administration (BCMA) systems and
  - Admission Discharge Transfer (ADT) System

  AND
  - Ability to collect and package data using HL7 standardized format: Clinical Document Architecture (https://www.cdc.gov/nhsn/cdaportal/index.html)
    - Commercial software vendors: http://www.sidp.org/aurvendors
    - "Homegrown" vendors (facility's internal IT/Informatics resources)

*General acute care hospitals, long-term acute care hospitals (LTAC), inpatient rehabilitation facilities (IRF), oncology hospitals, critical access hospitals enrolled in NHSN & participating in the Patient Safety Component

AU Option Data Elements – Numerator

- Numerator: Antimicrobial days (Days of Therapy) – sum of days for which **any** amount of specific agent was administered to a patient
  - 93 antimicrobials – includes antibacterial, antifungal, anti-influenza, and antiviral agents
    - Sub-stratified by route of administration:
      - Intravenous (IV)
      - Intramuscular (IM)
      - Digestive (oral → rectal)
      - Respiratory (inhaled)
  - Only administration data (eMAR/BCMA)

Counting Antimicrobial Days

- 1 antimicrobial day per: 1 patient, 1 drug, 1 location, 1 calendar day
  - Regardless of how many administrations patient receives

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- Example: Patient admitted to 1 South (Medical Ward) Monday 2200 & discharged Wednesday 1200

	Monday	Tuesday	Wednesday
Meropenem 1 gram IV every 8 hours			
Amikacin 1000mg IV every 24 hours			
Total Antimicrobial Days			

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- Example: Patient admitted to 1 South (Medical Ward) Monday 2200 & discharged Wednesday 1200

	Monday	Tuesday	Wednesday
Meropenem 1 gram IV every 8 hours	Given: 2300		
Amikacin 1000mg IV every 24 hours	Given: 2300		
Total Antimicrobial Days	Meropenem = 1 Amikacin = 1		

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- Example: Patient admitted to 1 South (Medical Ward) Monday 2200 & discharged Wednesday 1200

	Monday	**Tuesday**	**Wednesday**
Meropenem 1 gram IV every 8 hours	Given: 2300	Given: 0700 Given: 1500 Given: 2300	
Amikacin 1000mg IV every 24 hours	Given: 2300	Given: 2300	
Total Antimicrobial Days	Meropenem = 1 Amikacin = 1	Meropenem = 1 Amikacin = 1	

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Amikacin 1000mg IV every 24 hours	Given: 2300	Given: 2300	
Total Antimicrobial Days	Meropenem = 1 Amikacin = 1	Meropenem = 1 Amikacin = 1	Meropenem = 1 Amikacin = 0

AU Option Data Elements – Denominators

- Denominators:
  - Days Present – number of days in which a patient spent **any** time in specific unit or facility
    - Reported for all individual locations & FacWideIN
    - Days present ≠ Patient days
    - Used for AU data only
      - Patient days throughout rest of NHSN (including HAI & AR)
  - Admissions – number of patients admitted to an inpatient location in the facility
    - Reported for FacWideIN only
    - Include all patients residing in an inpatient location regardless of patient status

Counting Days Present

	Patient Movement	Days Present	Patient Days (Midnight count)
Patient A	Medical Ward: 00:01-24:00	Medical Ward = 1	Medical Ward = 1
Patient B	Medical ICU: 00:01-24:00	Medical ICU = 1	Medical ICU = 1
Patient C			
Patient D			
Totals:			

Counting Days Present

	Patient Movement	Days Present	Patient Days (Midnight count)
Patient A	Medical Ward: 00:01-24:00	Medical Ward = 1	Medical Ward = 1
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Patient D			
Totals:			

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	Patient Movement	Days Present	Patient Days (Midnight count)
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Patient D	Medical ICU: 00:01-10:00 Step Down: 10:01-15:00 Medical Ward: 15:01-24:00	Medical ICU = 1 Step Down = 1 Medical Ward = 1	Medical ICU = 0 Step Down = 0 Medical Ward = 1
Totals:			

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Totals:		Medical Ward = 3 Medical ICU = 3 Step Down = 1	Medical Ward = 3 Medical ICU = 1 Step Down = 0

AU Option: Summary Data

- Monthly aggregate, summary-level data
  - By location
    - All inpatient locations individually
    - All inpatient locations combined (Facility-wide Inpatient - aka FacWideIN)
    - 3 outpatient locations (ED, pediatric ED, 24 hour observation)
    - **Use same mapped locations throughout the NHSN application**
  - **Important**: Requires accurate/complete electronic capture of both the numerator and denominator for the given location
- Data are aggregated prior to sending to NHSN
- **No patient-level data shared with NHSN for AU Option**

Antimicrobial Resistance (AR) Option

AR Option

- Purpose:
  - Facilitate evaluation of AR data using standardized approach & definitions
  - Provide facilities with improved awareness of AR issues to aid in clinical decision making and prioritize transmission prevention efforts
- Voluntary reporting
  - Not part of CMS Quality Reporting Programs
  - Included as one option for Public Health Registry reporting for Promoting Interoperability (formerly called Meaningful Use Stage 3)*

*MU 3 Final Rule: https://www.federalregister.gov/articles/2015/10/16/2015-25595/medicare-and-medicaid-programs-electronic-health-record-incentive-program-stage-3-and-modifications

*NHSN MU3 page: https://www.cdc.gov/nhsn/cdaportal/meaningfuluse.html

Requirements for AR Data Submission
Who Can Participate?

- Hospitals* that have:
  - Electronic Laboratory Information System (LIS) and
  - Admission Discharge Transfer (ADT) System
  - *Or electronic access to required data elements*

AND

  - Ability to collect and package data using HL7 standardized format: Clinical Document Architecture (https://www.cdc.gov/nhsn/cdaportal/index.html)
    - Commercial software vendors: http://www.sidp.org/aurvendors
    - "Homegrown" vendors (facility's internal IT/Informatics resources)

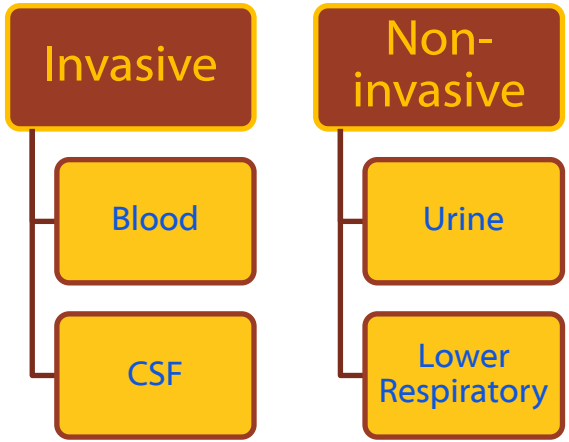
*General acute care hospitals, long-term acute care hospitals (LTAC), inpatient rehabilitation facilities (IRF), oncology hospitals, critical access hospitals enrolled in NHSN & participating in the Patient Safety Component

AR Data Elements
What Data Are Collected?

- Two separate file types (similar to MDRO FacWideIN LabID reporting):
  - AR Event files – contain all information associated with the individual isolate
    - Each AR Event is a separate, individual file
    - Reported from:
      - All inpatient locations
      - 3 outpatient location types: ED, pediatric ED & 24-hour observation area
  - AR Summary files – contain summary-level patient day and admission counts
    - Reported for FacWideIN only
    - Not submitted for individual inpatient or outpatient locations (yet)

AR Events – What Qualifies?

- Event data: Isolate-level susceptibility results for specific organisms
- Qualifying isolate criteria for an AR Event:
  1. Collected from one of four specimen types:
     - Blood
     - Cerebral spinal fluid (CSF)
     - Urine
     - Lower respiratory
  2. One of over 20 organisms identified
     - See list on next slide
  3. Antimicrobial susceptibility testing must be completed
     - Qualifies for submission regardless of susceptibility results



Eligible Organisms

- All *Acinetobacter* species
- *Candida albicans; auris; glabrata; parapsilosis; tropicalis*
- *Citrobacter amalonaticus; freundii; koseri*
- All *Enterobacter* species
- *Enterococcus faecalis; faecium*
- *Enterococcus* spp. (when not specified to the species level)
- *Escherichia coli*
- *Streptococcus Agalactiae*
- *Klebsiella aerogenes; oxytoca; pneumoniae*
- *Morganella morganii*
- *Proteus mirabilis; penneri; vulgaris*
- *Pseudomonas aeruginosa*
- *Serratia marcescens*
- *Staphylococcus aureus*
- *Stenotrophomonas maltophilia*
- *Streptococcus pneumoniae*

Organism/Agent Combinations

- Selected antimicrobial agents are required to be reported/included in the CDA file for each of the organisms per specimen type
  - Full list (i.e., drug panels) can be found in the NHSN AUR Module Protocol: http://www.cdc.gov/nhsn/PDFs/pscManual/11pscAURcurrent.pdf

Organism	Specimen Type	Antimicrobial Agents
Acinetobacter (All *Acinetobacter* species noted in the AR Option Pathogen Roll-up Workbook)	Blood, Urine, Lower Respiratory, CSF	Amikacin Ampicillin-sulbactam Cefepime Cefotaxime Ceftazidime Ceftriaxone Ciprofloxacin Colistin Doripenem Doxycycline Gentamicin Imipenem with Cilastatin Levofloxacin Meropenem Minocycline Piperacillin-tazobactam Polymyxin B Tobramycin Trimethoprim-sulfamethoxazole
	Additional Agents for Urine	Tetracycline

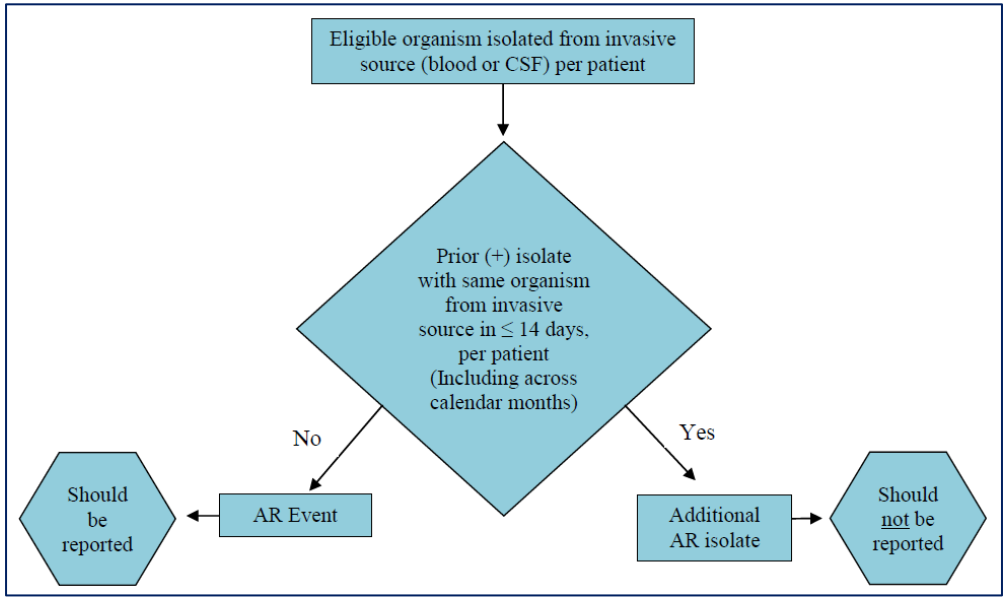
AR Event Required Fields

- Patient information
  - DOB, gender, date admitted to facility, location during specimen collection
- Specimen information
  - Collection date, specimen source
- Organism & antimicrobial susceptibility testing information
  - For each antimicrobial required for the isolated organism/specimen type
  - Sign, value and interpretation for E-test, MIC, and/or Disk diffusion (KB)*
  - Final lab interpretation
    - Susceptible, Susceptible-Dose Dependent, Intermediate, Resistant, Non-Susceptible, Not Tested

*If available

Reporting Rules – Invasive Sources

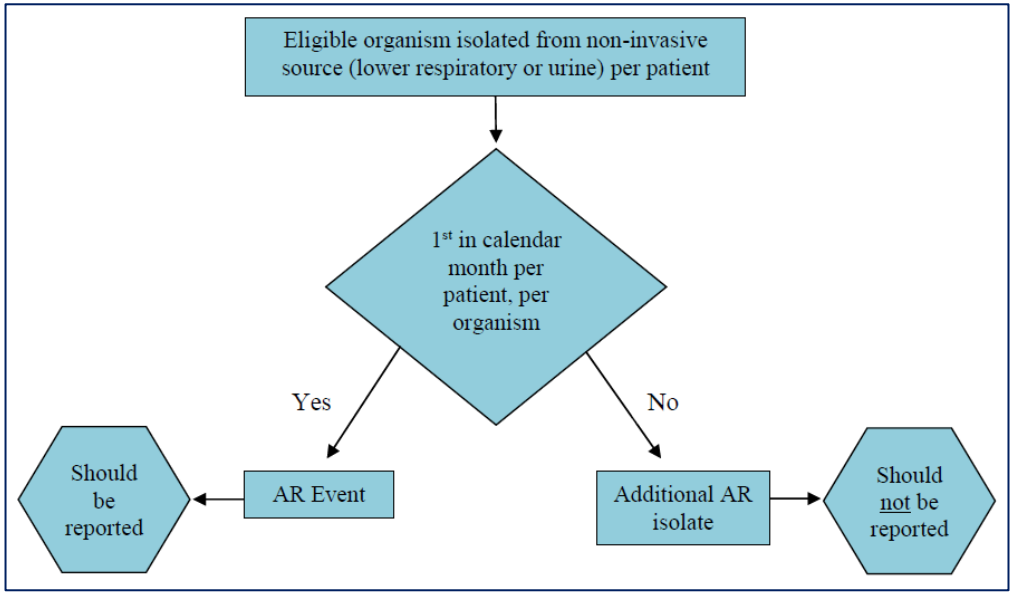
- Per 14-day period: Same organism from invasive specimen source (blood & CSF) reported once per patient



Please see NHSN AUR Module Protocol for further details: http://www.cdc.gov/nhsn/PDFs/pscManual/11pscAURcurrent.pdf

Reporting Rules – Non-Invasive Sources

- Per calendar month: Same organism from non-invasive source (urine & lower respiratory) reported once per patient



Please see NHSN AUR Module Protocol for further details: http://www.cdc.gov/nhsn/PDFs/pscManual/11pscAURcurrent.pdf

AR Summary Files

- Summary record: patient days & admissions
  - Submitted for facility-wide only (aka FacWideIN)
  - Summary records are not submitted for:
    - Individual inpatient locations
    - Individual or combined outpatient locations
      - Note: Individual outpatient locations will be accepted after August 2021 NHSN release
  - Only 1 AR Summary file submitted per facility, per month

Antimicrobial Resistance Data in NHSN

	AR Option	MDRO Module	Device & Procedure-Associated Modules
Events reported	AR Events from blood, CSF, urine, & lower respiratory specimens	Laboratory Identified (LabID) & Infection Surveillance Events	CLABSI, CAUTI, pedVAP, pedVAE VAE, SSI Events
Type of susceptibility data	Over 20 specific organisms; detailed lab test results & final interpretation	Positive specimens (i.e., MRSA, CDI, CRE) defined by NHSN criteria	Susceptibility results for specific antibiotics
Denominator; Metric(s)	# Isolates tested; facility antibiogram with %NS; resistance percentages	# Patient days; rates # Predicted; SIRs (LabID Only)	# Isolates tested; facility & national %R
Benefits	Wide-spread, 'whole-house' coverage; all specimens with identified organism; no manual entry	Simplified reporting; LabID MRSA & CDI national benchmarks	Infection control software; data can be manually entered; national AR data published (%R)
Drawbacks	Requires set-up by vendor/homegrown system	Small number of organisms followed	Only get susceptibility info for events that meet NHSN definitions

Submitting AUR Data into NHSN

Clinical Document Architecture (CDA)

- Data must be uploaded via CDA
  - Too much data to enter by hand!
- Health Level 7 (HL7) standard
- Provides facilities with standardized way to package & upload data
  - AU, AR, & HAI
- CDA ≠ CSV (Excel)
  - CDA uses XML

```
</participant>
<!-- Number of Patient-present Days -->
<entryRelationship typeCode="COMP">
  <observation classCode="OBS" moodCode="EVN">
    <templateId root="2.16.840.1.113883.10.20.5.6.69"/>
    <code codeSystem="2.16.840.1.113883.6.277"
          codeSystemName="cdcNHSN"
          code="2525-4"
          displayName="Number of Patient-present Days"/>
    <statusCode code="completed"/>
    <value xsi:type="PQ" unit="d" value="700"/>
  </observation>
</entryRelationship>
<!-- the Drug, aggregate data, no specified route of administration -->
<entryRelationship typeCode="COMP">
  <observation classCode="OBS" moodCode="EVN">
    <templateId root="2.16.840.1.113883.10.20.5.6.69"/>
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          codeSystemName="cdcNHSN"
          code="2524-7"
          displayName="Number of Therapy Days"/>
    <statusCode code="completed"/>
    <value xsi:type="PQ" unit="d" value="3"/>
    <participant typeCode="CSM">            <!-- antimicrobial Drug -->
      <participantRole classCode="MANU">
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              displayName="Amantadine"/>
      </participantRole>
    </participant>
  </observation>
</entryRelationship>
<!-- stratified data: Drug + route -->
```

Monthly AU Data Submission

- Recommend: Upload within 30 days following the completion of the month
- One CDA file per location & one CDA file for FacWideIN
  - Each single CDA file contains numerator and denominator(s) for given location
  - All CDA files can be uploaded within one Zip file
    - Maximum: 1000 CDAs or file size of 2 MB per zip file
- Encourage reporting data from **ALL** applicable inpatient and select outpatient locations

Monthly AR Data Submission

- Recommend: Upload within 30 days following the completion of the month
- 1 CDA file per AR Event & 1 CDA file for summary data
  - Example:
    - 50 separate CDA files for 50 separate AR Events identified per NHSN definitions in the month
    - 1 CDA for facility-wide summary (patient days and admissions for all inpatient locations combined)
  - All CDA files can be uploaded within 1 Zip file
    - Maximum: 1000 CDAs or file size of 2 MB per zip file

Monthly Reporting Plans

- Add locations to monthly reporting plan prior to uploading data
- AU Reporting
  - Along with FacWideIN, each inpatient and outpatient location is listed separately
- AR Reporting
  - Selecting FacWideIN allows AR Events to be reported from all mapped inpatient locations
  - Each outpatient location is listed separately
- **Same monthly reporting plan used for HAI reporting**

Monthly Reporting Plans continued

Device-Associated Module

	Locations	CLABSI	VAE	CAUTI	CLIP	PedVAP (<18 years)
🗑	5MEDWARD - MEDICAL WARD ON THE 5TH FLOOR	☑	☐	☑	☐	☐
🗑	ICU - MED/SURG	☑	☐	☑	☐	☐
🗑	NICU - NICU-2/3	☑	☐	☐	☐	☐
🗑	ONCGEN - ONC-HEM- GENERAL WARD	☑	☐	☑	☐	☐

Add Row | Clear All Rows | Copy from Previous Month

Procedure-Associated Module

	Procedures	SSI
🗑		IN: ☐ OUT: ☐

Add Row | Clear All Rows | Copy from Previous Month

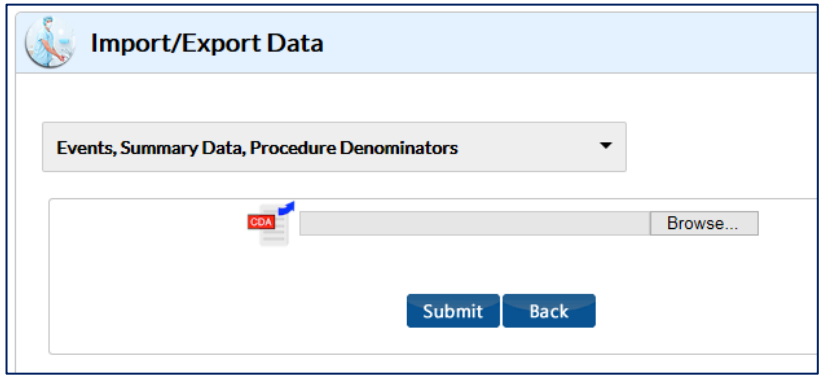
Antimicrobial Use and Resistance Module

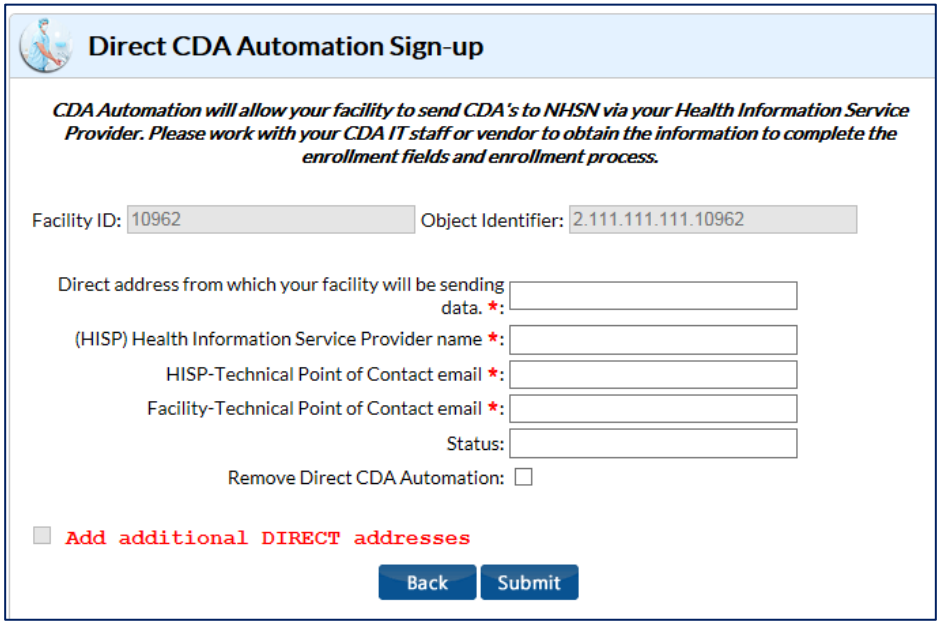
	Locations	Antimicrobial Use	Antimicrobial Resistance
🗑	FACWIDEIN - Facility-wide Inpatient (FacWIDEIn)	☑	☑
🗑	5MEDWARD - MEDICAL WARD ON THE 5TH FLOOR	☑	☐
🗑	ICU - MED/SURG	☑	☐
🗑	NICU - NICU-2/3	☑	☐
🗑	ONCGEN - ONC-HEM- GENERAL WARD	☑	☐
🗑	24HROBS - 24-HR OBS.	☑	☑
🗑	EMERG - EMERGENCY DEPT	☑	☑

Add Row | Clear All Rows | Copy from Previous Month

Importing CDA Files into NHSN

- Manual upload
- Automatic upload from vendor/IT solution using DIRECT CDA Automation

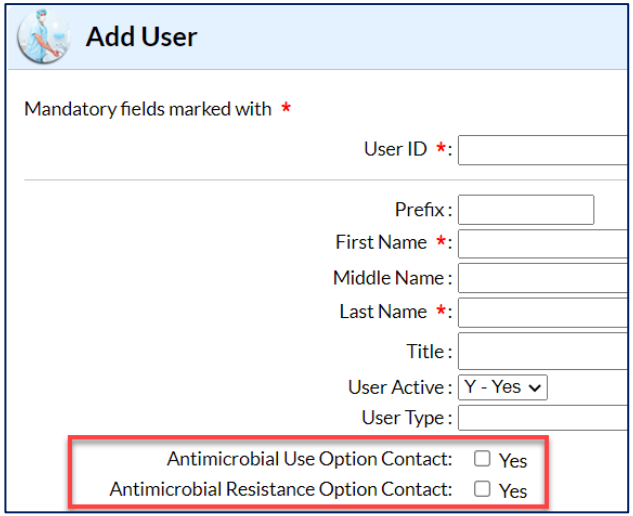




Quick Learn Video - Uploading CDA Files into NHSN:
https://www.youtube.com/watch?v=T4DLtimpB5M

Adding AUR Users

- AUR User Rights overview: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/nhsn-au-user-rights.pdf
- Think about what tasks these users will be doing
  - Editing reporting plans?
  - Uploading data?
  - Reviewing AUR data?
  - Reviewing AUR data & HAI data?
- Recommend two AUR users per NHSN facility
- **Please indicate they are AU and/or AR users on the Add User screen!**



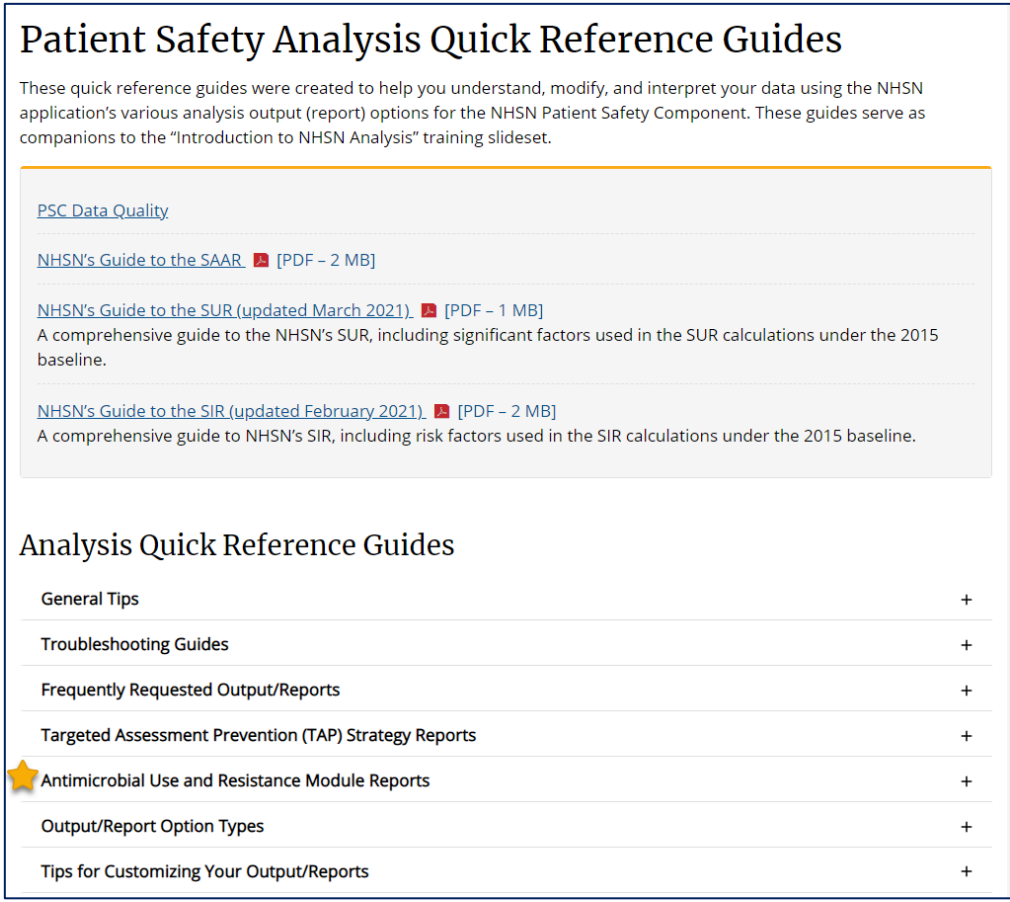
AUR Module – IP Facilitation Steps

- Identify facility lead(s)/champion(s) for AUR Module
- Discuss roles and responsibilities within NHSN
  - Who will update the reporting plans?
  - Who will upload the data?
  - Who will run analysis reports?
- Add AUR users to your NHSN facility so they can start SAMS process
- NHSN 101
  - Discuss location mapping
  - What other data are being submitted to NHSN?
- Monthly submission & review of data
- Assist with HAI/AUR data comparison requests during validation process

Using AUR and HAI Data Together

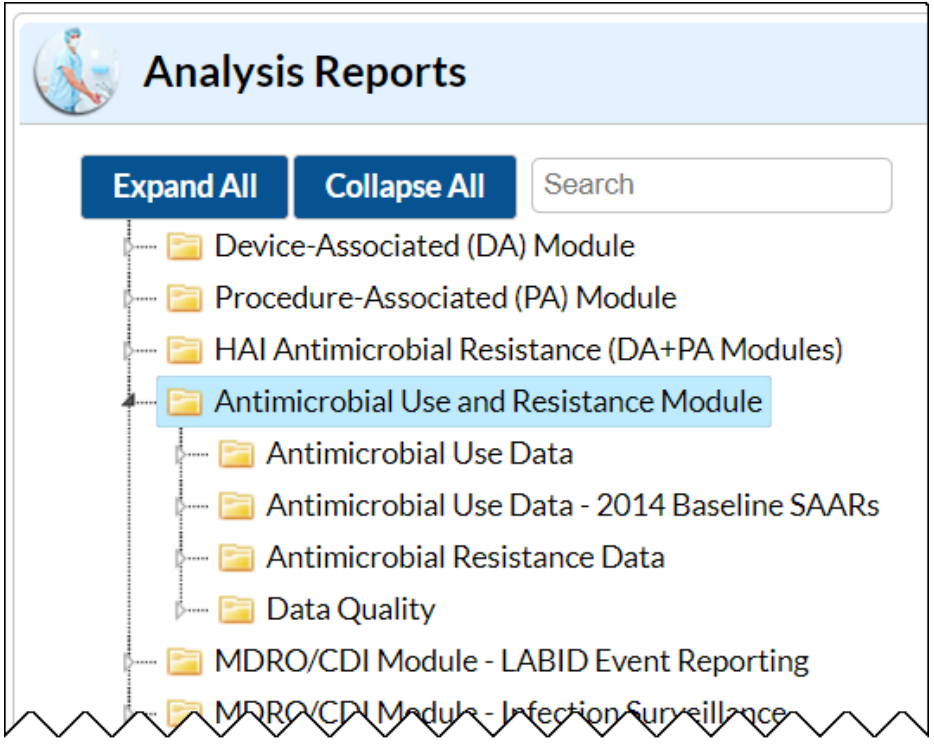
Disclaimers

- Won't be spending time on how to find HAI data
  - https://www.cdc.gov/nhsn/ps-analysis-resources/reference-guides.html
- Large number of AUR reports won't be covered today
- Many of these visualizations cannot be created *within* NHSN; data export is needed



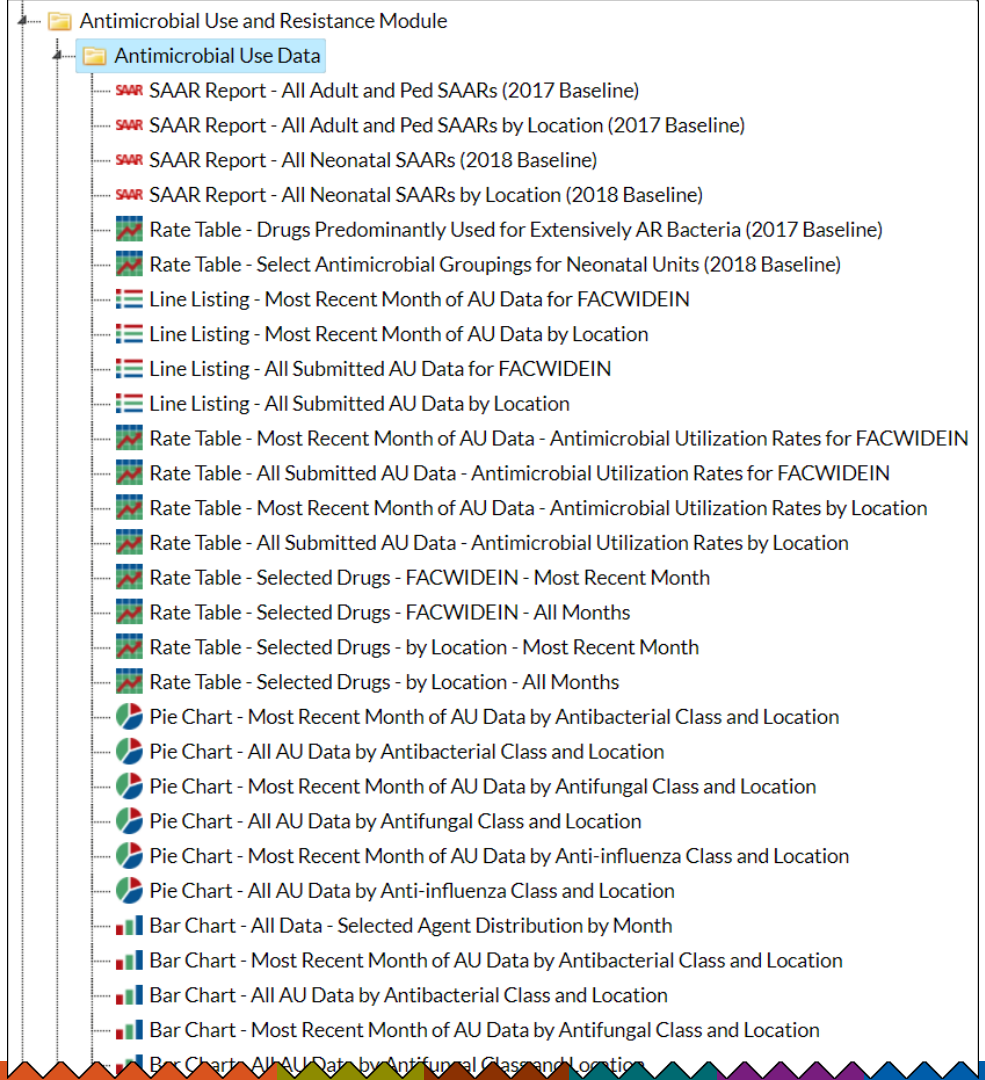
AUR Module Reports

- Listed on the same Analysis Reports page as HAI reports
- Separate sub folders for AU and AR reports



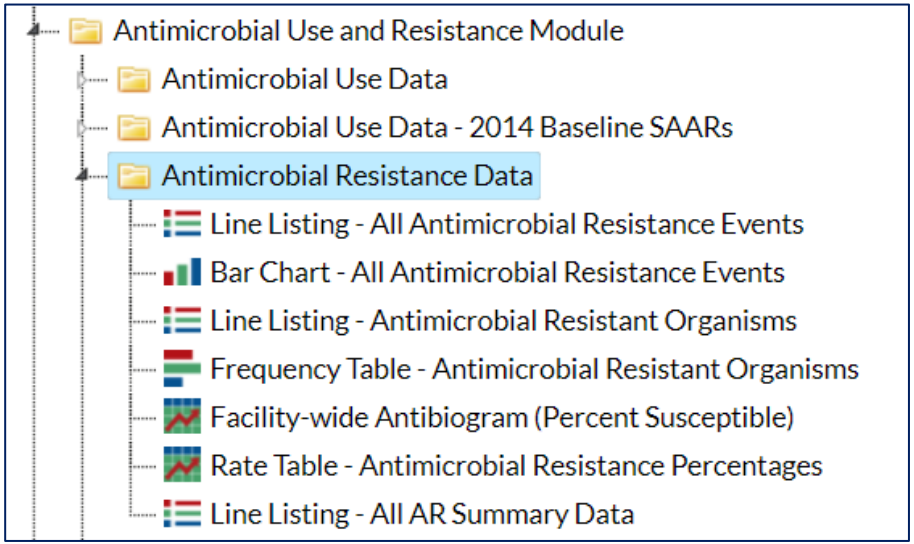
AU Option Report Types

- SAARs (Standardized Antimicrobial Administration Ratio)
- Line lists
- Rate tables
- Pie charts
- Bar charts



AR Option Report Types

- AR Event reports
  - Line list, bar chart, antibiogram
- AR Organism reports*
  - Line list, frequency table, rate table
- AR Denominator
  - Line list



*Antimicrobial Resistant Phenotype Definitions for AR Option Data:
https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-phenotype-definitions-508.pdf

Example 1: Investigating CDI

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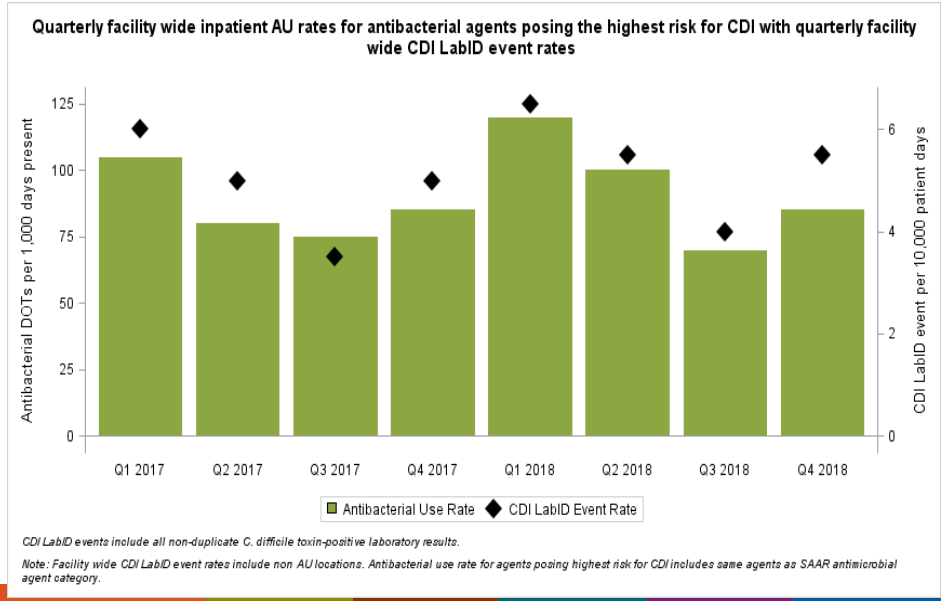
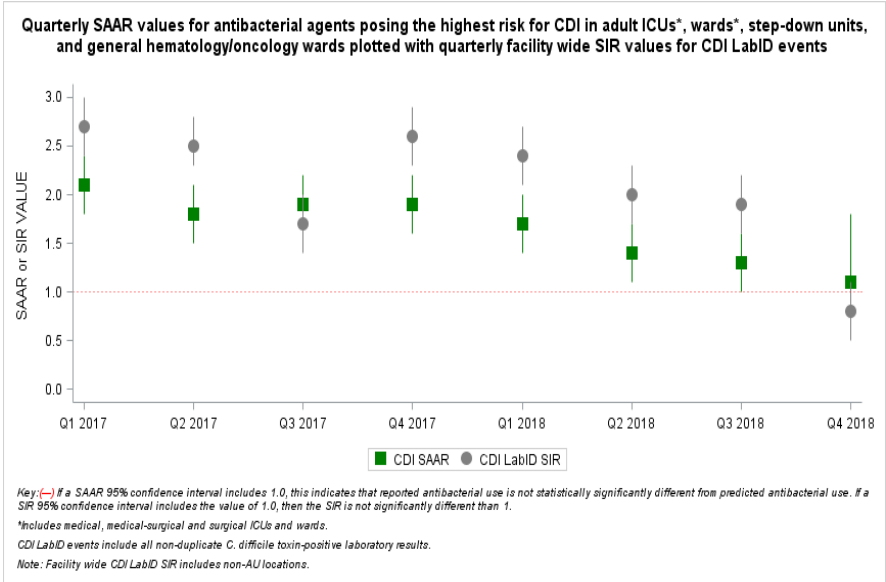
- Review CDI event trends in context of drugs posing the highest risk for CDI
- CDI LabID events are reported for FacWideIN, ED and 24-hr obs
- AU captures use of drugs posing the highest risk for CDI
- Compare CDI rates to AU rates



Data for example only

Example 1: Investigating CDI continued

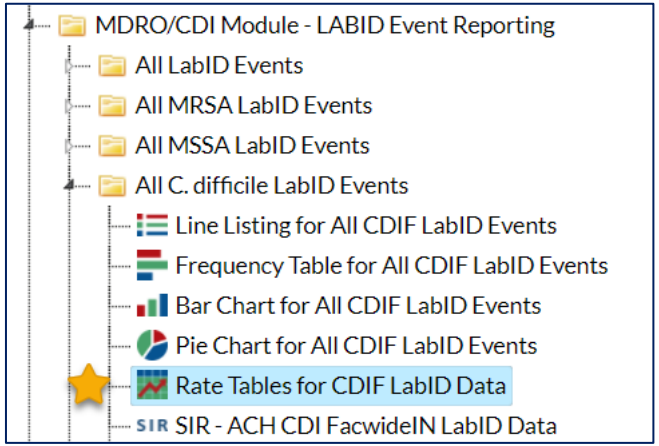
- Review CDI event trends in context of drugs posing the highest risk for CDI
- CDI LabID events are reported for FacWideIN, ED and 24-hr obs
- AU captures use of drugs posing the highest risk for CDI
- Compare CDI rates to AU rates
- Compare CDI SIR to CDI SAAR

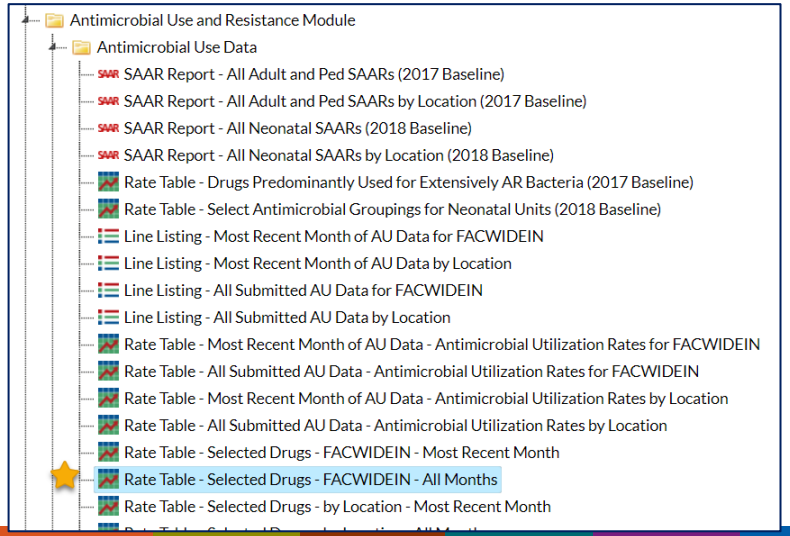


Data for example only

Example 1a: Investigating CDI using Rate Data

- Using rate data for both would allow facilities to use FacWideIN for both sets of data
  - AU SAARs are not available at the FacWideIN level
  - Remember! Rates are not risk adjusted





CDI Drugs

- Locate list of drugs posing the highest risk for CDI
  - Appendix E of AUR Protocol: https://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf

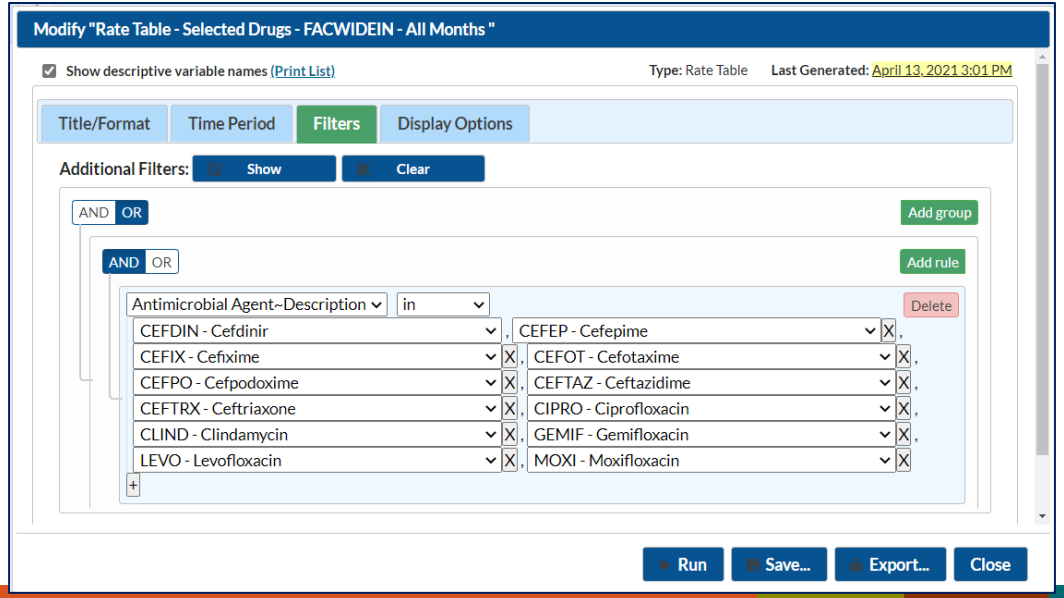
Adult Antibacterial agents posing the highest risk for CDI

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

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

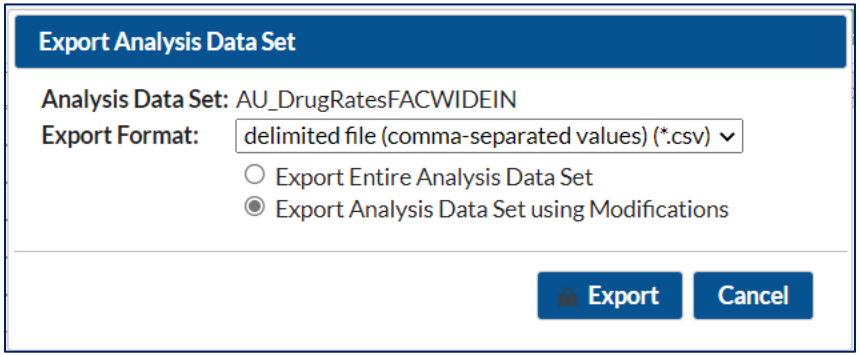
Modifying the AU Selected Drugs Rate Table

- AU: Rate Table – Selected Drugs – FACWIDEIN – All Months
  - Modify the report to get a rate specific to these drugs
    - Remove drugs based on facility guidelines/practices



Exporting the AU Selected Drugs Data

- AU: Rate Table – Selected Drugs – FACWIDEIN – All Months
  - Export using modifications



Reviewing AU Rate Data

- AU: Rate Table – Selected Drugs – FACWIDEIN – All Months

	A	B	C	F	G	H	I	J
1	Facility Org ID	Location	Summary Year/Month	Antimicrobial Days	Days Present	Admissions	Rate per 1000 Days Present	Rate per 100 Admissions
2	13860	FACWIDEIN	2019M01	36	2809	310	12.82	11.61
3	13860	FACWIDEIN	2019M02	42	2854	301	14.72	13.95
4	13860	FACWIDEIN	2019M03	48	2677	289	17.93	16.61
5	13860	FACWIDEIN	2019M04	56	2639	273	21.22	20.51
6	13860	FACWIDEIN	2019M07	52	2532	267	20.54	19.48
7	13860	FACWIDEIN	2019M08	67	2711	312	24.71	21.47
8	13860	FACWIDEIN	2019M11	63	2648	295	23.79	21.36
9	13860	FACWIDEIN	2020M02	75	2958	308	25.35	24.35
10	13860	FACWIDEIN	2020M03	79	2873	300	27.50	26.33
11	13860	FACWIDEIN	2020M07	52	2641	250	19.69	20.80
12	13860	FACWIDEIN	2020M08	57	2785	264	20.47	21.59
13	13860	FACWIDEIN	2020M09	63	2500	275	25.20	22.91
14	13860	FACWIDEIN	2020M12	60	2648	325	22.66	18.46

Data for example only

Interpreting AU Rate Data

- AU: Rate Table – Selected Drugs – FACWIDEIN – All Months

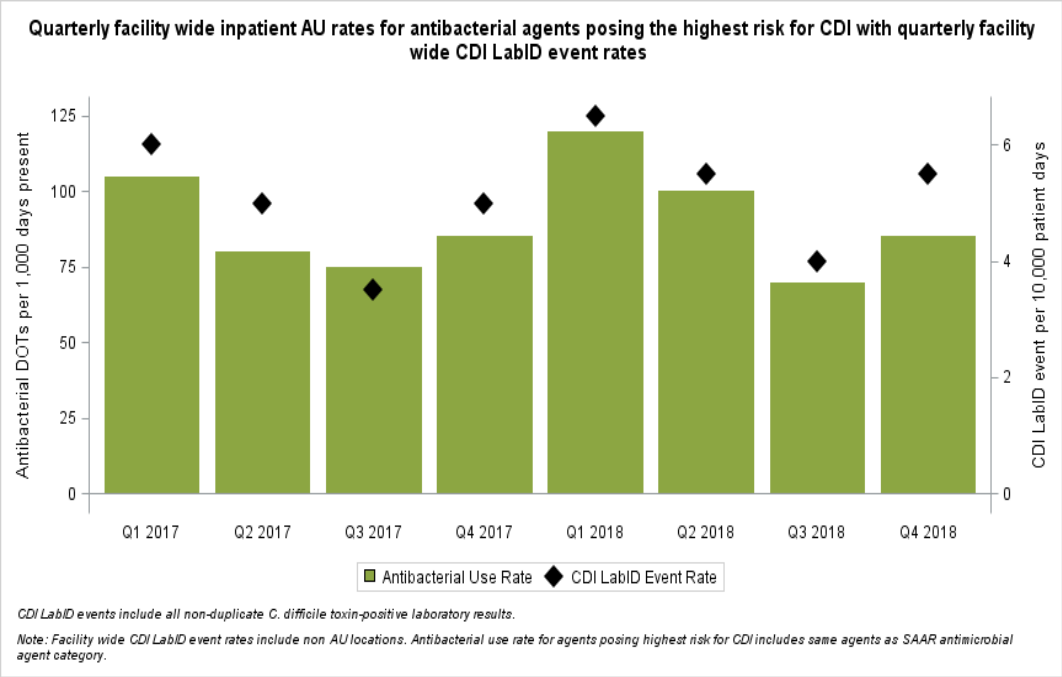
	A	B	C	F	G	H	I	J
1	Facility Org ID	Location	Summary Year/Month	Antimicrobial Days	Days Present	Admissions	Rate per 1000 Days Present	Rate per 100 Admissions
2	13860	FACWIDEIN	2019M01	36	2809	310	12.82	11.61

- The 12 drugs selected were used for 36 antimicrobial days in January 2019.
- That month had 2809 days present and 310 admissions.
- The rate of use was 12.82 per 1000 days present or 11.61 per 100 admissions.

Data for example only

Combining AU and CDI Rate Data

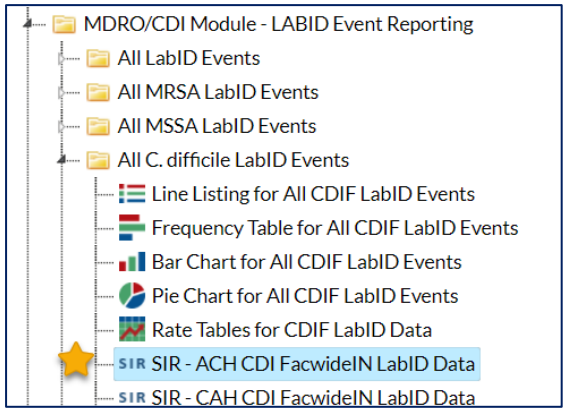
- Combine HAI CDI LabID rates with AU rates into one figure
  - Remember to denote the separate denominators

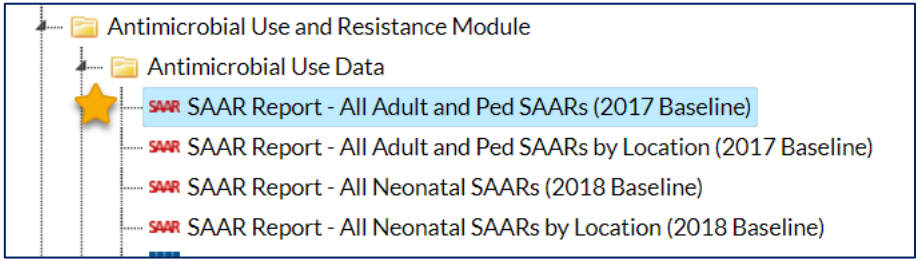


Data for example only

Example 1b: Investigating CDI using SIRs & SAARs

- Using SIR and SAAR reports factors in risk adjustment for both metrics
- However, locations included in both metrics do not match
  - CDI SIR generates for FacWideIN
  - CDI SAAR only includes locations eligible for the SAAR
- Most granular level of CDI SIR is calendar quarter





Standardized Antimicrobial Administration Ratios (SAARs)

- SAAR Definition
  - Standardized risk-adjusted metric of antibacterial use
  - Available to facilities reporting to the AU Option in NHSN
  - Compares observed to predicted days of antimicrobial use

$$\frac{\boldsymbol{Observed}}{\boldsymbol{Predicted}} = \frac{\textbf{100 antimicrobial days observed}}{\textbf{85 antimicrobial days predicted}} = \textbf{1.176}$$

SAAR Definition

1

$$\frac{Observed}{Predicted} = \frac{100\ antimicrobial\ days\ observed}{85\ antimicrobial\ days\ predicted} = 1.176$$

1 The **observed** number of antimicrobial days is how many days the facility administered antimicrobial agents to patients in a given location

SAAR Definition continued

2

$$\frac{Observed}{Predicted} = \frac{100\ antimicrobial\ days\ observed}{85\ antimicrobial\ days\ predicted} = 1.176$$

2 The **predicted** number of antimicrobial days are calculated using statistical models based on nationally aggregated data

SAAR Agent Groupings – Adult & Pediatric

- SAARs are generated for specific agent groupings
  - All antibacterial agents*
  - Broad spectrum agents predominantly used for hospital-onset infections
  - Broad spectrum agents predominantly used for community-acquired infections
  - Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)
  - Narrow spectrum beta-lactam agents
  - Antifungal agents predominantly used for invasive candidiasis
  - Azithromycin (pediatric SAARs only)
  - Antibacterial agents posing the highest risk for CDI*

*Not mutually exclusive

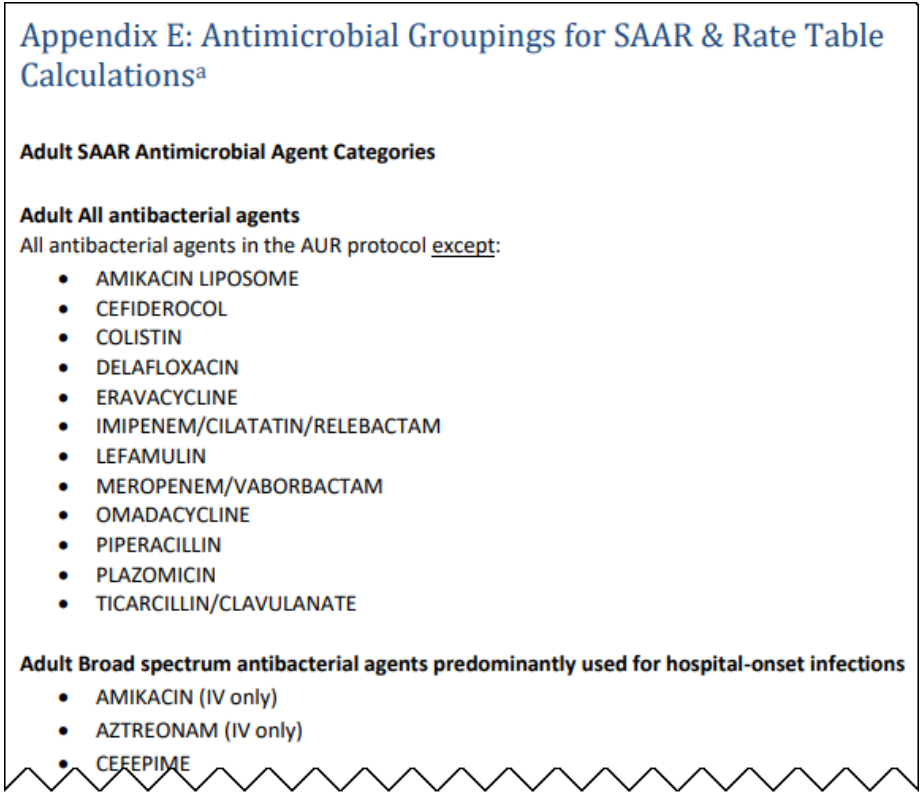
SAAR Agent Groupings – Neonatal

- SAARs are generated for specific agent groupings
  - All neonatal antibacterial agents*
  - Vancomycin predominantly used for treatment of late-onset sepsis
  - Broad spectrum antibacterial agents predominantly used for hospital-onset infections
  - Third generation Cephalosporins
  - Ampicillin predominantly used for treatment of early-onset sepsis
  - Aminoglycosides predominantly used for treatment of early-onset and late-onset sepsis
  - Fluconazole predominantly used for candidiasis

*Not mutually exclusive

SAAR Agent Groupings (continued)

- Full list can be found in Appendix E of the AUR Module Protocol
  - https://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf



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

Adult SAAR Antimicrobial Agent Categories

Adult All antibacterial agents

All antibacterial agents in the AUR protocol except:

- AMIKACIN LIPOSOME
- CEFIDEROCOL
- COLISTIN
- DELAFLOXACIN
- ERAVACYCLINE
- IMIPENEM/CILATATIN/RELEBACTAM
- LEFAMULIN
- MEROPENEM/VABORBACTAM
- OMADACYCLINE
- PIPERACILLIN
- PLAZOMICIN
- TICARCILLIN/CLAVULANATE

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

- AMIKACIN (IV only)
- AZTREONAM (IV only)
- CEFEPIME

SAAR Locations

- SAARs generated per month, quarter, half year, year, or cumulative
- Generated for specific location types for January 2017 (adult & ped) or January 2018 (neonatal) forward

Adult Locations

- Medical Critical Care
- Surgical Critical Care
- Medical-Surgical Critical Care
- Medical Ward
- Surgical Ward
- Medical-Surgical Ward
- Oncology General Hematology-Oncology Ward
- Adult Step Down Unit

Pediatric Locations

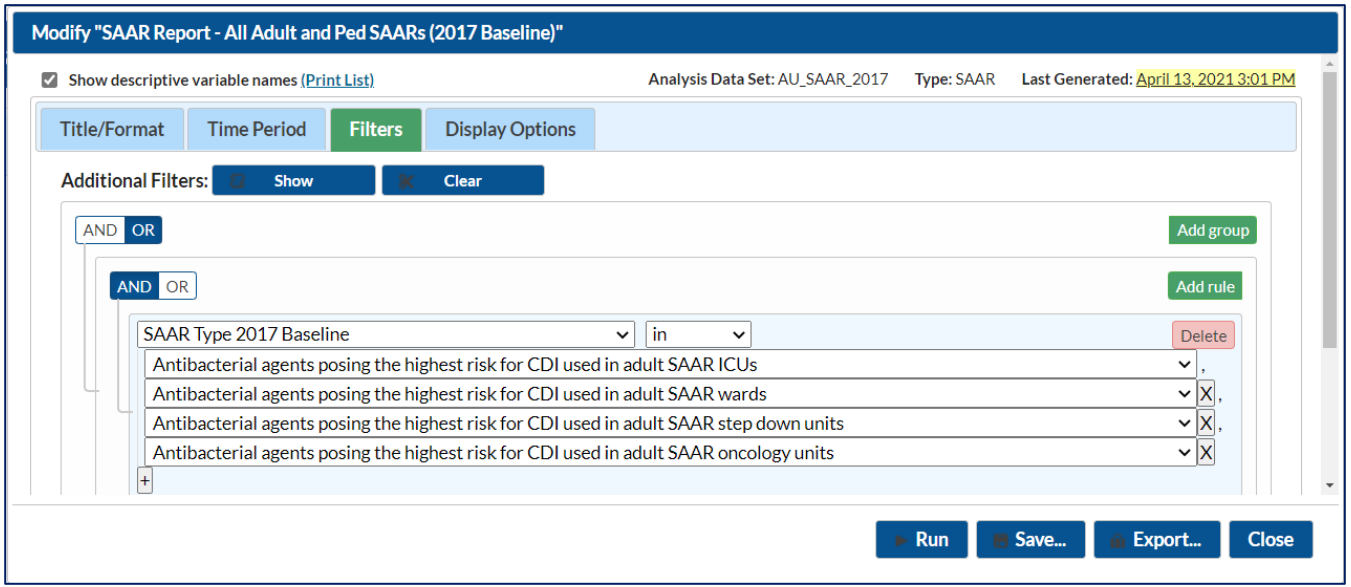
- Pediatric Medical Critical Care
- Pediatric Medical-Surgical Critical Care
- Pediatric Medical Ward
- Pediatric Surgical Ward
- Pediatric Medical-Surgical Ward

Neonatal Locations

- Step Down Neonatal Nursery
- Neonatal Critical Care (Level II/III)
- Neonatal Critical Care (Level III)
- Neonatal Critical Care (Level IV)

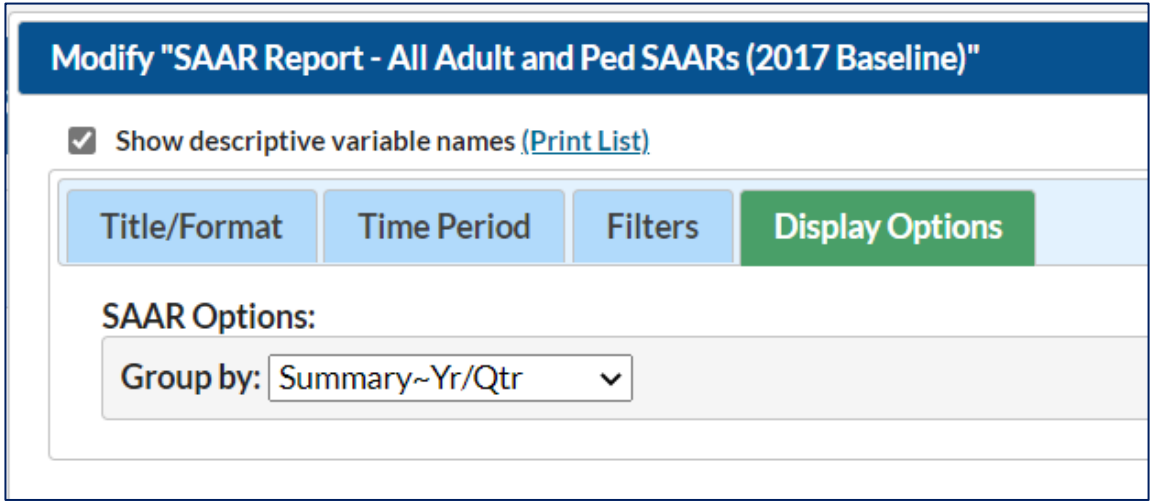
Modifying the AU SAAR Report

- AU: SAAR Report – All Adult and Ped SAARs (2017 Baseline)
  - Modify the report to show only CDI SAARs
    - Adjust based on the location types in your facility



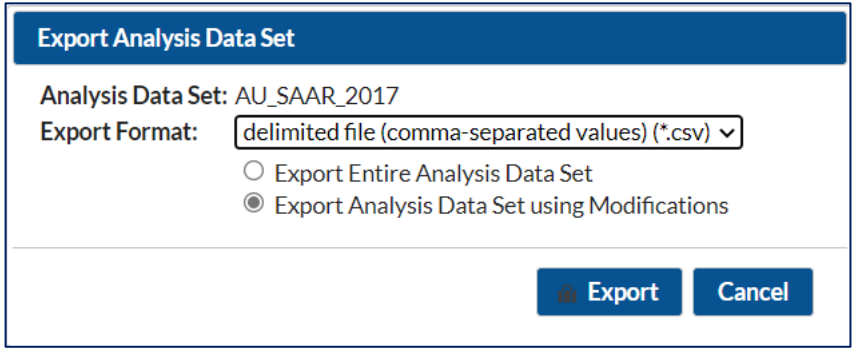
Modifying the AU SAAR Report continued

- AU: SAAR Report – All Adult and Ped SAARs (2017 Baseline)
  - Change Group by variable to “Summary~Yr/Qtr to match the CDI SIR



Exporting the AU SAAR Data

- AU: SAAR Report – All Adult and Ped SAARs (2017 Baseline)
  - Export using Modifications



Reviewing SAAR Data

- AU: SAAR Report – All Adult and Ped SAARs (2017 Baseline)

	A	B	C	D	E	F	G	H	I
1	Facility Org ID	Summary ~Yr/Qtr	SAAR Type 2017 Baseline	Antimicrobial Days	Predicted Antimicrobial Days	Days Present	SAAR	SAAR p-value	95% Confidence~Interval
2	13860	2018Q1	Adult_CDI_ICU_2017	58	65.148	500	0.89	0	0.613, 0.924
3	13860	2018Q1	Adult_CDI_Ward_2017	39	33.258	421	1.173	0	1.036, 1.204
4	13860	2018Q2	Adult_CDI_ICU_2017	62	60.587	513	1.023	0.01	0.989, 1.068
5	13860	2018Q2	Adult_CDI_Ward_2017	28	30.654	498	0.913	0.004	0.847, 0.963
6	13860	2018Q3	Adult_CDI_ICU_2017	66	60.369	522	1.093	0	1.068, 1.124
7	13860	2018Q3	Adult_CDI_Step_2017	12	15.159	256	0.792	0	0.714, 0.855
8	13860	2018Q3	Adult_CDI_Ward_2017	24	24.225	541	0.991	0.02	0.984, 1.058
9	13860	2018Q4	Adult_CDI_ICU_2017	72	68.144	582	1.057	0.03	0.994, 1.137
10	13860	2019Q1	Adult_CDI_ICU_2017	64	60.346	596	1.061	0.03	0.977, 1.107
11	13860	2019Q1	Adult_CDI_Ward_2017	31	32.678	467	0.949	0.05	0.874, 0.988
12	13860	2019Q2	Adult_CDI_ICU_2017	66	70.118	544	0.941	0.05	0.893, 0.978
13	13860	2019Q2	Adult_CDI_Ward_2017	38	36.558	488	1.039	0.06	1.032, 1.844
14	13860	2019Q3	Adult_CDI_ICU_2017	59	51.481	561	1.146	0	1.112, 1.233
15	13860	2019Q3	Adult_CDI_Ward_2017	37	36.663	495	1.009	0.02	0.993, 1.085
16									

Data for example only

Interpreting SAAR Data

- AU: SAAR Report – All Adult and Ped SAARs (2017 Baseline)

	A	B	C	D	E	F	G	H	I
1	Facility Org ID	Summary ~Yr/Qtr	SAAR Type 2017 Baseline	Antimicrobial Days	Predicted Antimicrobial Days	Days Present	SAAR	SAAR p-value	95% Confidence~Interval
2	13860	2018Q1	Adult_CDI_ICU_2017	58	65.148	500	0.89	0	0.613, 0.924
3	13860	2018Q1	Adult_CDI_Ward_2017	39	33.258	421	1.173	0	1.036, 1.204

- In Q1 2018, there were 58 reported antimicrobial days while 65.148 antimicrobial days were predicted.
- Results in an ICU CDI SAAR of 0.89.
  - Remember! Only includes Med, Surg, and Med-Surg ICUs
- SAAR of 0.89 is statistically different from 1.0.

Data for example only

Aggregating SAARs

- SAARs are at the “location group” level (ICUs, wards, etc.)
- Aggregate them to create a combined SAAR for all SAAR locations in your facility
- Pooled CDI SAAR=

$$\frac{Observed\ ICU\ DOT + Observed\ Ward\ DOT + Observed\ StepDown\ DOT + Observed\ ONC\ DOT}{Predicted\ ICU\ DOT + Predicted\ Ward\ DOT + Predicted\ StepDown\ DOT + Predicted\ ONC\ DOT}$$

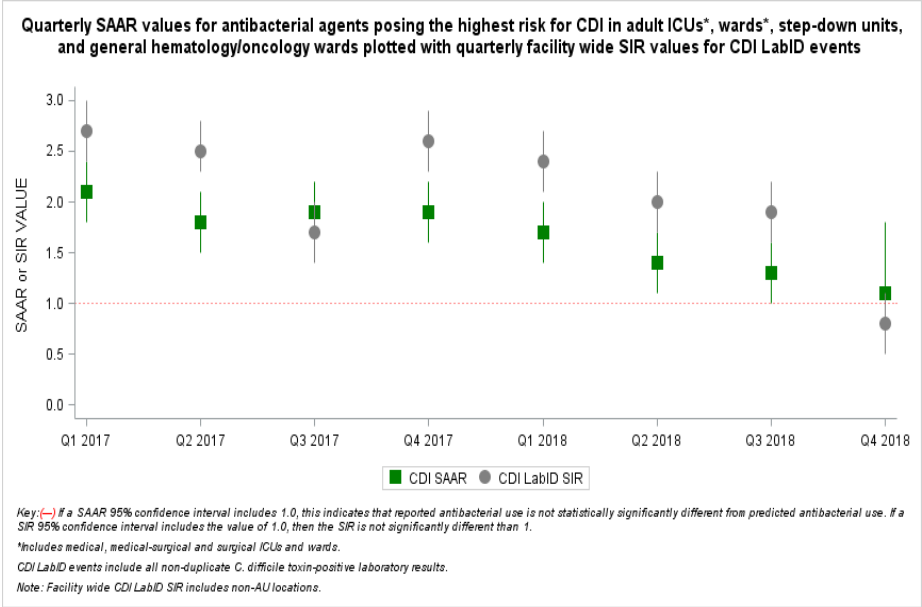
$$\frac{58+39}{65.148+33.258} = \frac{97}{98.406} = 0.986$$

- Pooled CDI SAAR for Q1 2018 = 0.986

Data for example only

Combining SAAR and SIR Data

- Combine pooled SAARs and LabID SIRs onto one figure
  - Remember to add footnotes about the location differences!
    - CDI SIR: Includes all inpatient locations
    - CDI SAAR: Includes only locations included in SAAR calculations

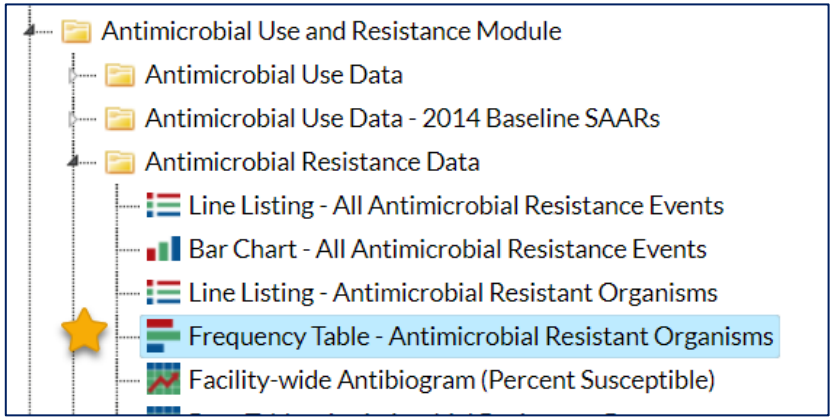


Data for example only

Example 2: Telling a Story of HAI Reduction

Example 2: Telling a Story of HAI Reduction

- Initiative to reduce HAIs began in September 2019
- Investigate whether AU has been reduced and/or resistant AR events are fewer
- Consider using:
  - HAI rates, SIRs
  - AU rates, SAARs
  - AR Organisms frequency table



AR Option Phenotypes

- AR Option Phenotypes: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-phenotype-definitions-508.pdf
  - Pre-defined phenotypes
  - Similar but not identical to the HAI Phenotype definitions

Antimicrobial Resistant Phenotype Definitions

NHSN Analysis Reports for AR Option data

Phenotype Name	Phenotype Code	Phenotype Definition
Methicillin-resistant *Staphylococcus aureus*	MRSA_AR	*Staphylococcus aureus* that has tested Resistant (R) to at least one of the following: oxacillin or cefoxitin
Carbapenem-resistant Enterobacteriaceae (expanded)	CREexpanded_AR	Any *Citrobacter amalonaticus, Citrobacter freundii, Citrobacter koseri, Enterobacter* spp., *E. coli, Klebsiella aerogenes, Klebsiella oxytoca, Klebsiella pneumoniae*, and *Serratia marcescens* that has tested Resistant (R) to at least one of the following: imipenem, meropenem, doripenem, or ertapenem OR Any *Proteus mirabilis, Proteus penneri, Proteus vulgaris,* and *Morganella morganii* that has tested Resistant (R) to at least one of the following: meropenem, doripenem, or ertapenem
Carbapenem-resistant Enterobacteriaceae (*E. coli, Klebsiella,* or *Enterobacter*)	CREall_AR	Any *Escherichia coli, Klebsiella aerogenes, Klebsiella oxytoca, Klebsiella pneumoniae, or Enterobacter* spp. that has tested Resistant (R) to at least one of the following: imipenem, meropenem, doripenem, or ertapenem
Carbapenem-resistant *E.coli*	CREecoli_AR	Any *Escherichia coli* that has tested Resistant (R) to at least one of the

Reviewing AR Organism Data

- AR: Frequency Table – Antimicrobial Resistant Organisms
  - Default shows data by month
    - Modify if you'd like a different time period
  - Export if you'd like to make a figure with the data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**Row Labels**	**2019M05**	**2019M06**	**2019M07**	**2019M08**	**2019M09**	**2019M010**	**2019M11**	**2019M12**	**2020M01**	**2020M02**	**2020M03**	**2020M04**	**Grand Total**
2	carbNS_Acine_AR	4	0	4	1	1	1	0	0	1	2	1	1	**16**
3	carbNS_PA_AR	3	2	7	4	4	2	2	3	5	4	4	3	**43**
4	CREexpanded_AR	7	8	10	11	10	8	7	7	6	5	5	4	**88**
5	DR_SP_AR	1	1	1	0	0	0	0	1	1	0	0	0	**5**
6	ESCecoli_AR	10	8	10	9	4	6	6	8	10	9	6	7	**93**
7	ESCklebsiella_AR	4	3	4	2	2	1	1	3	2	2	1	0	**25**
8	FR_Candi_AR	0	0	0	0	0	0	0	2	1	0	0	0	**3**
9	MDR_Acine_AR	3	0	2	1	1	0	0	0	1	1	1	1	**11**
10	MDR_PA_AR	2	0	4	3	2	2	2	2	4	3	2	2	**28**
11	MRSA_AR	5	4	4	4	3	3	2	4	2	1	1	0	**33**
12	VREfaecalis_AR	3	2	4	4	2	1	1	2	4	5	6	5	**39**
13	VREfaecium_AR	1	0	1	0	0	0	3	3	5	3	2	2	**20**
14	**Grand Total**	**43**	**28**	**51**	**39**	**29**	**24**	**24**	**35**	**42**	**35**	**29**	**25**	**404**
15														

Data for example only

Interpreting AR Organism Data

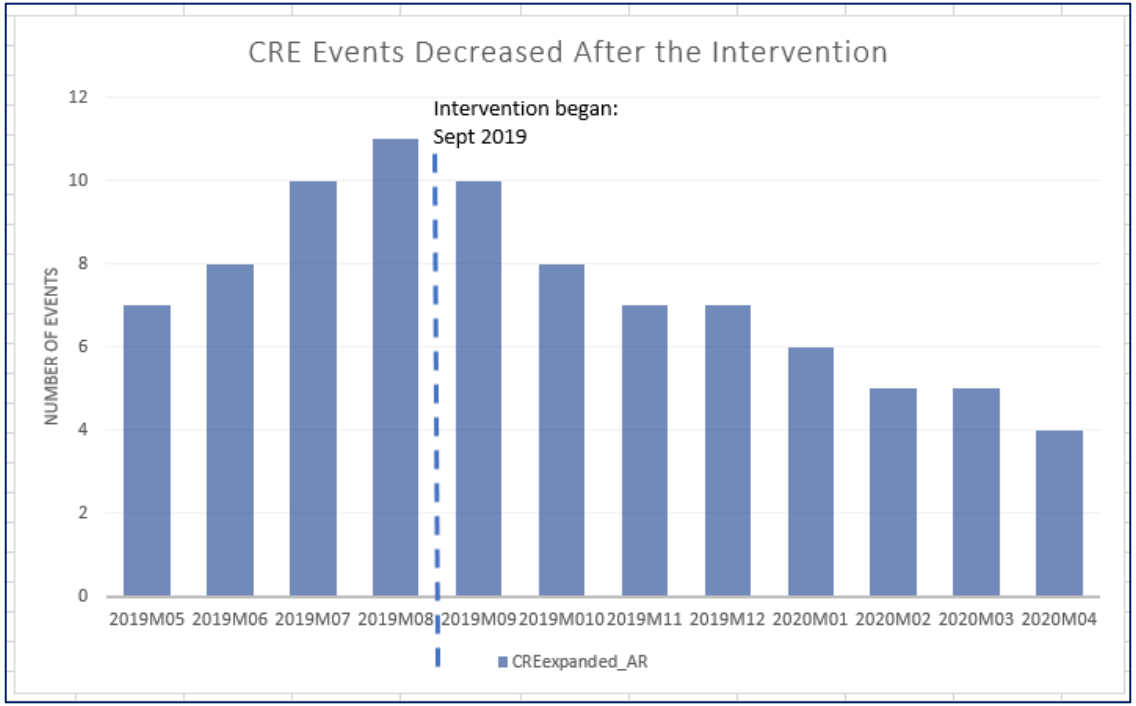
- CRE events were increasing prior to the Sept 2019 intervention
  - Highest number of CRE events in August 2019 (n=11)
- CRE events decreased after the intervention
  - Lowest number of CRE events in April 2020 (n=4)
- 88 total CRE events identified from May 2019-April 2020

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**Row Labels**	**2019M05**	**2019M06**	**2019M07**	**2019M08**	**2019M09**	**2019M010**	**2019M11**	**2019M12**	**2020M01**	**2020M02**	**2020M03**	**2020M04**	**Grand Total**
2	carbNS_Acine_AR	4	0	4	1	1	1	0	0	1	2	1	1	**16**
3	carbNS_PA_AR	3	2	7	4	4	2	2	3	5	4	4	3	**43**
4	CREexpanded_AR	7	8	10	11	10	8	7	7	6	5	5	4	**88**
5	DR_SP_AR	1	1	1	0	0	0	0	1	1	0	0	0	**5**

Data for example only

Visualizing AR Organism Data

- Plot event counts over time using a chart



Data for example only

AUR Module Reporting Resources

NHSN AUR Module Resources

- NHSN AUR Module homepage:
  - https://www.cdc.gov/nhsn/psc/aur/index.html
- NHSN AUR Protocol:
  - http://www.cdc.gov/nhsn/PDFs/pscManual/11pscAURcurrent.pdf
- AU Option Case Examples:
  - https://www.cdc.gov/nhsn/au-case-examples/index.html
- NHSN Analysis Quick Reference Guides:
  - http://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html

AUR Module Resources continued

- AU Data report
  - https://www.cdc.gov/nhsn/pdfs/datastat/2019-AU-Report-508.pdf
- SAAR guide
  - https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-saar-guide-508.pdf
- CDC Core Elements of Hospital Antibiotic Stewardship Programs
  - https://www.cdc.gov/antibiotic-use/healthcare/pdfs/hospital-core-elements-H.pdf

Thank you!

NHSN Helpdesk

(protocol & submission questions)

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NHSN CDA Helpdesk

(technical CDA related questions)

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For more information, contact CDC
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TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.