NHSN Antimicrobial Resistance (AR) Option: Analysis

Annual NHSN Training – March 24, 2022

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Objectives

- Describe the analysis reports currently available within the NHSN AR Option
- Explain the utility of each report
- Interpret the output produced in each report
AR Option Analysis
Remember: Always Generate Data Sets!

- When new data have been uploaded, generate new data sets within NHSN
- Click Analysis then Generate Data Sets
- Specify the beginning & ending dates or leave blank to include all data ever entered into NHSN
- Click Generate Reporting Data Sets
AR Option Reports

- Once data sets are finished generating, click Analysis then Reports
- Various reports within the AR Data folder
  - AR Event reports
    • Line list, bar chart, antibiogram
  - AR Organism reports
    • Line list, frequency table, rate table
  - AR Summary (aka Denominator)
    • Line list
Run/Modify/Export

- Three options exist for viewing data that’s been uploaded to NHSN:
  1. Run Report
     - Generates the report using default settings
  2. Modify Report
     - Allows user to make changes to the default settings
  3. Export Data Set
     - Allows user to take AR data out of NHSN and analyze in a different software (e.g., Excel, SAS)
Run/Modify/Export continued

- This presentation covers mostly default output.
- Modifying reports:
  - How to Modify a Report: [https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/howtomodifyreport.pdf](https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/howtomodifyreport.pdf)
- Exporting data:
  - How to Export data from NHSN: [https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/exportdata.pdf](https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/exportdata.pdf)
AR Event Reports

Line List, Bar Chart, & Antibiogram
AR Event Line List

- A detailed list of all AR Events uploaded into your NHSN facility
  - Includes patient, specimen, organism, & susceptibility testing variables
  - One row per drug for each event

- Due to the number of AR Events, you’ll likely reach the maximum number of rows for a line list within a few months of reporting. Workarounds include:
  - Make modifications to narrow selections
  - Export data
AR Event Line List – Example of Default Report

- 1 AR Event with susceptibility results for 6 drugs

<table>
<thead>
<tr>
<th>Pathogen Description</th>
<th>Facility Org ID</th>
<th>Event ID</th>
<th>Patient ID</th>
<th>Fac Admission Date</th>
<th>Date Specimen Collected</th>
<th>Location</th>
<th>Isolate ID</th>
<th>Specimen Group</th>
<th>Drug Description</th>
<th>Final Interpretation Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>33617</td>
<td>50199744</td>
<td>CA_BLOOD_IMP</td>
<td>11/18/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Bloods_Blood_2022</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>ANID - Andalafungin - R - Resistant</td>
</tr>
<tr>
<td>CA</td>
<td>33617</td>
<td>50199744</td>
<td>CA_BLOOD_IMP</td>
<td>11/18/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Bloods_Blood_2022</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>CASPO - Caspofungin - R - Resistant</td>
</tr>
<tr>
<td>CA</td>
<td>33617</td>
<td>50199744</td>
<td>CA_BLOOD_IMP</td>
<td>11/18/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Bloods_Blood_2022</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>FLUOC - Fluconazole - R - Resistant</td>
</tr>
<tr>
<td>CA</td>
<td>33617</td>
<td>50199744</td>
<td>CA_BLOOD_IMP</td>
<td>11/18/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Bloods_Blood_2022</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>MICA - Micafungin - R - Resistant</td>
</tr>
<tr>
<td>CA</td>
<td>33617</td>
<td>50199744</td>
<td>CA_BLOOD_IMP</td>
<td>11/18/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Bloods_Blood_2022</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>POSAC - Posaconazole - R - Resistant</td>
</tr>
<tr>
<td>CA</td>
<td>33617</td>
<td>50199744</td>
<td>CA_BLOOD_IMP</td>
<td>11/18/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Bloods_Blood_2022</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>VORI - Voriconazole - R - Resistant</td>
</tr>
</tbody>
</table>

This line list shows a limited number of variables by default. To expand the number of variables shown, export the data out of NHSN or use the "modify" option to edit the line list. Sorted by PathogenDesc specimenDate

Data contained in this report were last generated on February 9, 2022 at 3:22 PM to include data beginning January 2018.

*All data presented are fictitious and used for illustrative purposes only*
AR Event Line List – Example Modifications

- Line lists can be modified to show additional variables included in the AR Event
  - Examples: individual lab test sign, value and interpretation

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AR Event Line List – Interpreting the Output

- *Candida albicans* was isolated from a blood specimen collected in the ED

<table>
<thead>
<tr>
<th>Facility Org ID</th>
<th>Event ID</th>
<th>Patient ID</th>
<th>Fac Admission Date</th>
<th>Date Specimen Collected</th>
<th>Location</th>
<th>Isolate ID</th>
<th>Specimen Group</th>
<th>Pathogen Description</th>
<th>Drug Description</th>
<th>Final Interpretation Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>33617</td>
<td>50199744</td>
<td></td>
<td>11/10/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Blood</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>ANID - Amikacin</td>
<td>R - Resistant</td>
</tr>
<tr>
<td>33617</td>
<td>50199744</td>
<td></td>
<td>11/10/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Blood</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>CASPO - Caspofungin</td>
<td>R - Resistant</td>
</tr>
<tr>
<td>33617</td>
<td>50199744</td>
<td></td>
<td>11/10/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Blood</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>FLUCO - Fluconazole</td>
<td>R - Resistant</td>
</tr>
<tr>
<td>33617</td>
<td>50199744</td>
<td></td>
<td>11/10/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Blood</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>MICA - Micafungin</td>
<td>R - Resistant</td>
</tr>
<tr>
<td>33617</td>
<td>50199744</td>
<td></td>
<td>11/10/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Blood</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>POSAC - Posaconazole</td>
<td>R - Resistant</td>
</tr>
<tr>
<td>33617</td>
<td>50199744</td>
<td></td>
<td>11/10/2021</td>
<td>01/02/2022</td>
<td>ED</td>
<td>CA_Blood</td>
<td>Blood</td>
<td>Candida albicans - CA</td>
<td>VORI - Voriconazole</td>
<td>N - Not Tested</td>
</tr>
</tbody>
</table>

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Data contained in this report were last generated on February 9, 2022 at 3:22 PM to include data beginning January 2018.
AR Event Line List – Interpreting the Output

- *Candida albicans* was isolated from a blood specimen collected in the ED
- This isolate was resistant to anidulafungin, caspofungin, fluconazole, micafungin, and posaconazole; the isolate was not tested against voriconazole
AR Event Bar Chart

- Graphically displays the number of AR Events submitted by location over time
- Defaults to display monthly AR Events by pathogen & location
- Shows a maximum of 12 bars
AR Event Bar Chart – Interpreting the Output

- In April 2021, 7 AR Events were reported from the MSICU

*All data presented are fictitious and used for illustrative purposes only*
AR Event Bar Chart – Interpreting the Output

- In April 2021, 7 AR Events were reported from the MSICU
- 4 total *Pseudomonas aeruginosa* events were reported from this location
  - April 2021
  - August 2021
  - November 2021
  - December 2021

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AR Facility-wide Antibiogram

- Provides a table based on AR Events reported in NHSN
- Displays the calculated percent susceptible (%S) for each organism-antimicrobial combination reported from all locations (inpatient and outpatient)
- Defaults to show by month but can roll up to additional time groupings
- Available to both facilities and groups
- Filters allow for customization of the output
AR Facility-wide Antibiogram – Percent Susceptible

- The %S is calculated for each organism-antimicrobial pairing using the following formula:

\[
\frac{\text{Number isolates tested susceptible}}{\text{Number of isolates tested}} = \%S
\]

- %S only calculated if at least 30 isolates are tested for the specific antimicrobial
AR Facility-wide Antibiogram – Default Settings

- Tables by month
- Isolates from:
  - all specimen types (blood, cerebrospinal fluid, urine, and lower respiratory)
  - all patient ages
  - all locations
- All isolates regardless of organism category (gram negative, gram positive, or fungal)
- Both healthcare facility and community onset
AR Facility-wide Antibiogram – Table Details

- Percent susceptible shown for January 2022

*All data presented are fictitious and used for illustrative purposes only*
AR Facility-wide Antibiogram – Organism category

- Organisms are grouped by category:
  - Gram-negative
  - Gram-positive
  - Fungal

*All data presented are fictitious and used for illustrative purposes only*
AR Facility-wide Antibiogram – Drug Class

- Drugs are sorted into drug classes organized alphabetically

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**Full drug names can be found here: [https://www.cdc.gov/nhsn/xls/aur/aur-eligible-antimicrobial-agents.xlsx](https://www.cdc.gov/nhsn/xls/aur/aur-eligible-antimicrobial-agents.xlsx)
AR Facility-wide Antibiogram – Non-valid Combinations

- Cells shaded in grey represent non-valid pathogen/drug combinations – susceptibility tests for those drugs are not reported for those pathogens
- Refer to the AUR Module protocol for all valid pathogen/drug combinations.

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AR Facility-wide Antibiogram – Interpretation

- Of *Acinetobacter* spp. isolates tested, 54% were susceptible to amikacin (AMK) and 96% were susceptible to tobramycin (TOBRA)

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AR Facility-wide Antibiogram – Interpretation

- Of *Acinetobacter* spp. isolates tested, 54% were susceptible to amikacin (AMK) and 96% were susceptible to tobramycin (TOBRA)
- Of *Enterobacter* spp. isolates tested, 64% were susceptible to amikacin (AMK)
  - Less than 30 isolates were tested for tobramycin (TOBRA) susceptibility so %S is not calculated

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AR Organism Reports

Line List, Frequency Table, Rate Table
Antimicrobial Resistant Phenotype Definitions

- Reported AR Events are assigned a phenotype if they meet the NHSN-defined susceptibility testing criteria
  

<table>
<thead>
<tr>
<th>Phenotype Name</th>
<th>Phenotype Code</th>
<th>Phenotype Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methicillin-resistant <em>Staphylococcus aureus</em></td>
<td>MRSA_AR</td>
<td><em>Staphylococcus aureus</em> that has tested Resistant (R) to at least one of the following: oxacillin or cefoxitin</td>
</tr>
</tbody>
</table>
| Carbapenem-resistant Enterobacterales (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, ertapenem, meropenem/vaborbactam, or imipenem/relebactam  
  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, ertapenem, or meropenem/vaborbactam |
AR Organisms Line List

- Lists all AR Events that meet an AR Organism phenotype definition
- Includes patient & specimen information
AR Organisms Line List – Interpretation

- 4 AR Events met the NHSN AR Option definition for CRE
- 2 specimens were *E. coli* and 2 were *K. oxytoca*

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**National Healthcare Safety Network**

**Line Listing - Antimicrobial Resistant Organisms**

**CREall_AR - Carbapenem-resistant Enterobacterales (E. coli, Klebsiella, or Enterobacter)**

- **As of February 10, 2022 at 2:39 PM**
- **Date Range:** ANTIBIOMGRAM_AR specDateYr After and Including 2022
- **if** (((phenotype_AR IN (("MRSA_AR", "ESCEcoli_AR", "ESCKlebsiella_AR", "carbNS_Acine_AR", "carbNS_PA_AR", "MDR_Acine_AR", "MDR_PA_AR", "VREteclium_AR", "VREfaecalis_AR", "CRExpanded_AR", "FR_Cand_AR", "DR_SP_AR", "CREall_AR"))))

<table>
<thead>
<tr>
<th>Facility Org ID</th>
<th>Patient ID</th>
<th>Date of Birth</th>
<th>Gender</th>
<th>Fac Admission Date</th>
<th>Event ID</th>
<th>Date Specimen Collected</th>
<th>Event Type</th>
<th>Location</th>
<th>Pathogen Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13860</td>
<td>ECOLL_10067</td>
<td>01/25/1968</td>
<td>M</td>
<td>01/01/2022</td>
<td>104365</td>
<td>01/01/2022</td>
<td>AR</td>
<td>MSICU</td>
<td>Escherichia coli - EC</td>
</tr>
<tr>
<td>13860</td>
<td>KLEBOXY_10067</td>
<td>07/25/1998</td>
<td>M</td>
<td>01/01/2022</td>
<td>104366</td>
<td>01/02/2022</td>
<td>AR</td>
<td>MSICU</td>
<td>Klebsiella oxytoca - KO</td>
</tr>
<tr>
<td>13860</td>
<td>ECOLI_2022B</td>
<td>01/25/1974</td>
<td>M</td>
<td>10/23/2021</td>
<td>104569</td>
<td>01/13/2022</td>
<td>AR</td>
<td>MSICU</td>
<td>Escherichia coli - EC</td>
</tr>
<tr>
<td>13860</td>
<td>KLEBOXY_2022B</td>
<td>07/25/1989</td>
<td>M</td>
<td>10/20/2021</td>
<td>104570</td>
<td>01/14/2022</td>
<td>AR</td>
<td>MSICU</td>
<td>Klebsiella oxytoca - KO</td>
</tr>
</tbody>
</table>


Sorted by orgID specimenDate

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AR Organisms Frequency Table

- Table displaying counts of AR Events meeting NHSN-defined phenotype definitions
- Defaults to show totals by month
AR Organisms Frequency Table – Interpretation

- From Oct 2021-Jan 2022, 11 AR Events met the definition of multidrug-resistant Acinetobacter.
  - 7 events met the criteria in Oct 2021
  - 4 events met the criteria in Jan 2022

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1. Please find the document containing Phenotype_AR definitions at https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/ar-phenotype-definitions-508.pdf
AR Organism Percentages

- Displays # isolated, # tested, and # resistant by month
- Displays % of organisms that tested non-susceptible or resistant to certain antimicrobials for each defined phenotype
  - If at least 30 isolates were tested

\[
\frac{\text{# organisms NS or R to specific antimicrobials}}{\text{# organisms tested for susceptibility to specific antimicrobials}} \times 100
\]
AR Organism Percentages – Interpretation

- In October 2021: 44 *Staphylococcus aureus* AR Events were reported

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National Healthcare Safety Network
Rate Table - Antimicrobial Resistance Percentages

As of: February 10, 2022 at 2:42 PM
Data Range: All ANTIBIOTIC_RATESAR

Facility Org ID=13860 Phenotype Description=Methicillin-resistant *Staphylococcus aureus*

<table>
<thead>
<tr>
<th>Facility Org ID</th>
<th>Resistant Organism</th>
<th>Spec Collected Yr/Mon</th>
<th>Number Isolated</th>
<th>Number Tested</th>
<th>Number Resistant</th>
<th>Percent Resistant</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>13860 MRSA_AR</td>
<td>2021M10</td>
<td>44</td>
<td>39</td>
<td>36</td>
<td>92.3</td>
<td>80.5, 98.0</td>
<td></td>
</tr>
<tr>
<td>13860 MRSA_AR</td>
<td>2021M11</td>
<td>148</td>
<td>146</td>
<td>97</td>
<td>66.4</td>
<td>56.5, 73.7</td>
<td></td>
</tr>
</tbody>
</table>

1. MRSA includes any *Staphylococcus aureus* that has tested Resistant (R) to oxacillin or cefoxitin.
2. Percent resistant is only calculated when at least 30 isolates have been tested.
3. If the percent of isolates tested is less than 70%, caution should be used when interpreting the percent resistant.

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AR Organism Percentages – Interpretation

- In October 2021: 44 *Staphylococcus aureus* AR Events were reported
- 39 of those were tested and 36 were resistant to oxacillin or cefoxitin

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AR Organism Percentages – Interpretation

- In October 2021: 44 *Staphylococcus aureus* AR Events were reported
- 39 of those were tested and 36 were resistant to oxacillin or cefoxitin
- 92.3% (36 resistant/39 tested) of the SA events reported met the NHSN AR Option definition for MRSA

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AR Denominator Report

Line List
AR Denominator Line List

- Lists the summary AR data by month & location
  - FacWideIN: Patient Days & Admissions
  - Outpatient locations: Encounters
- Includes the “Report No Events” variable
AR Denominator Line List – Interpretation

- In Oct 2021, there were 5,350 total patient days and 368 admissions for FacWideIN (all inpatient locations combined) and AR Events were reported (No AR Events = N)

*All data presented are fictitious and used for illustrative purposes only*
AR Denominator Line List – Interpretation

- In Oct 2021, there were 5,350 total patient days and 368 admissions for FacWideIN (all inpatient locations combined) and AR Events were reported (No AR Events = N)
- In Dec 2021, there were 422 total encounters in ED and the “Report No Events” box was clicked (No AR Events = Y)

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AR Denominator Line List – Interpretation

- The facility has not yet reported AR Events for Sept 2021 and has not clicked the “Report No Events” box for that month (No AR Events = (blank))

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AR Option Reporting Resources
AUR Module Webpage

- Direct link: https://www.cdc.gov/nhsn/psc/aur/index.html
- One-stop shop for:
  - Protocol
  - Validation material
  - Link to training resources
  - Link to Analysis Quick Reference Guides
  - Link to FAQs
  - Link to CDA Toolkits
AR Option Analysis Resources

- NHSN AUR Protocol:

- NHSN Analysis Quick Reference Guides:

- NHSN AUR Training (recordings and Quick Learns):

- NHSN Helpdesk:
  - NHSN@cdc.gov