Antimicrobial Resistance (AR)

Agenda

- **Introduction**
- Overview of the Antimicrobial Resistance Module
- AR Data Requirements
- NHSN Metrics and Benchmarks
- CDA and the NHSN HAI IG
- Our Support
- Resources

Speaker

KP Sethi

- Director of Information Analysis and Technology
- Lead Analyst
- Quality and public health reporting expert

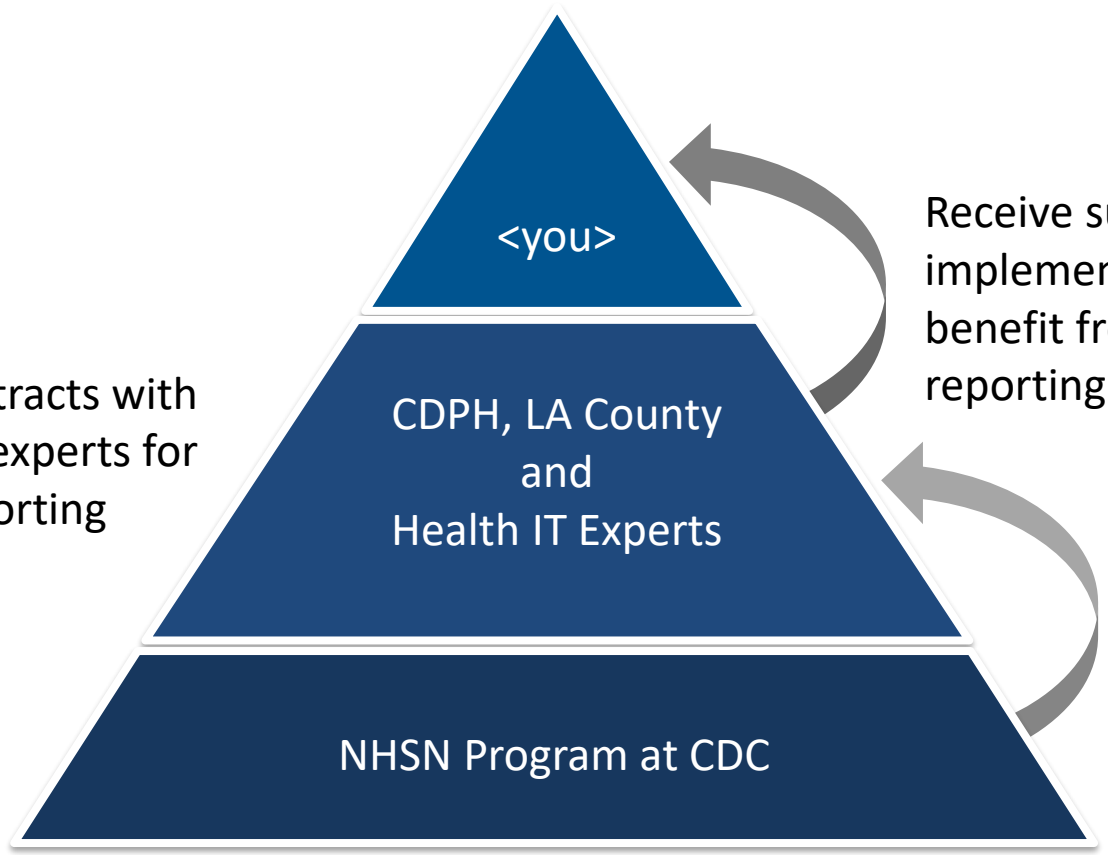
Project Background

- Project Goal

  Provide technical assistance to the CDPH HAI Program and California hospitals implementing National Healthcare Safety Network (NHSN) Antimicrobial Use and Resistance Reporting

- Background
  - CDPH distributed two surveys in 2015 to identify California hospitals with sufficient informatics capabilities to monitor AU and AR data with NHSN
  - Progress requires assistance in implementing AUR reporting

Organizations Involved



CDPH contracts with Health IT experts for NHSN reporting support

Receive support to implement and benefit from AR reporting

CDC funds CDPH to provide AR Reporting support

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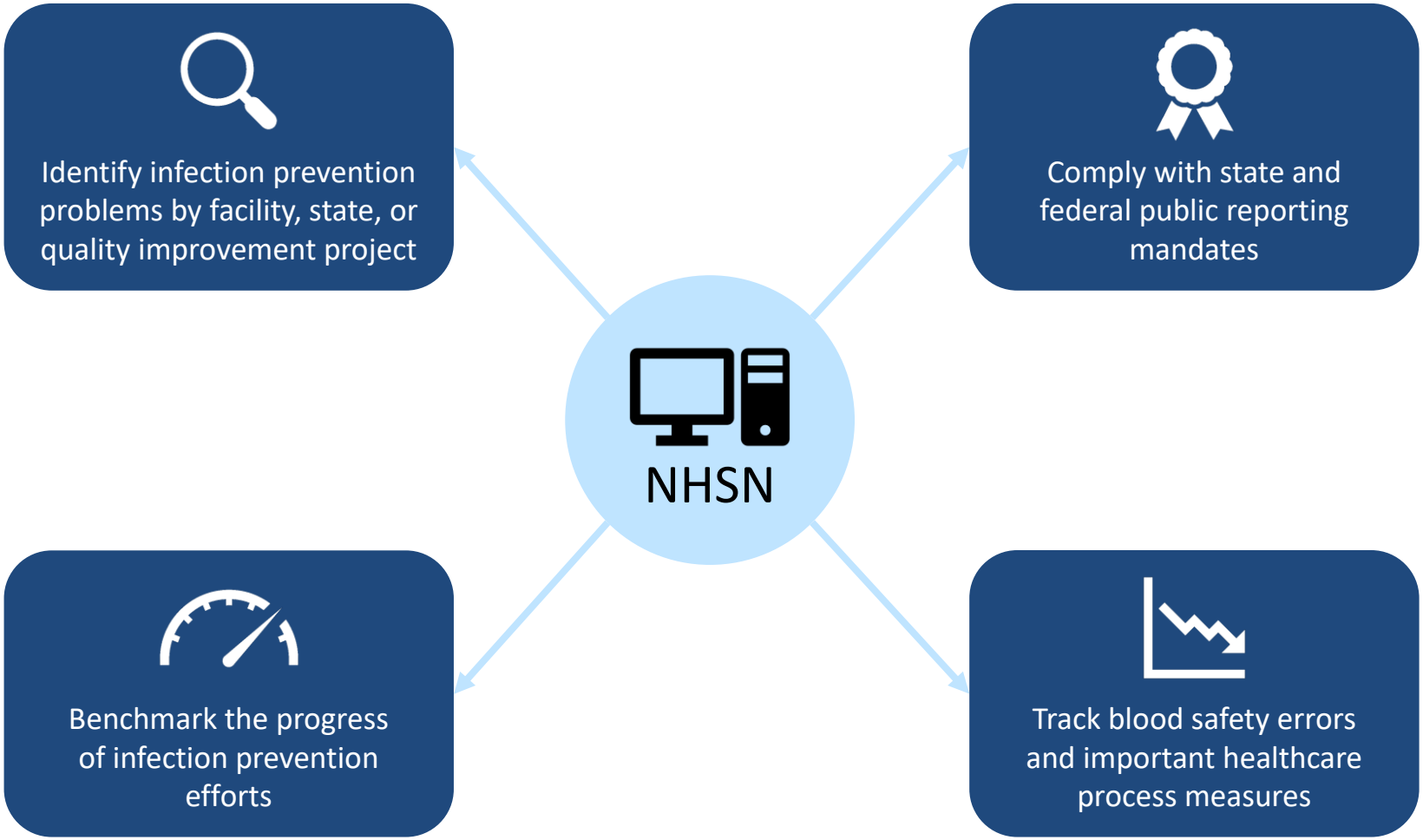
NHSN Goals



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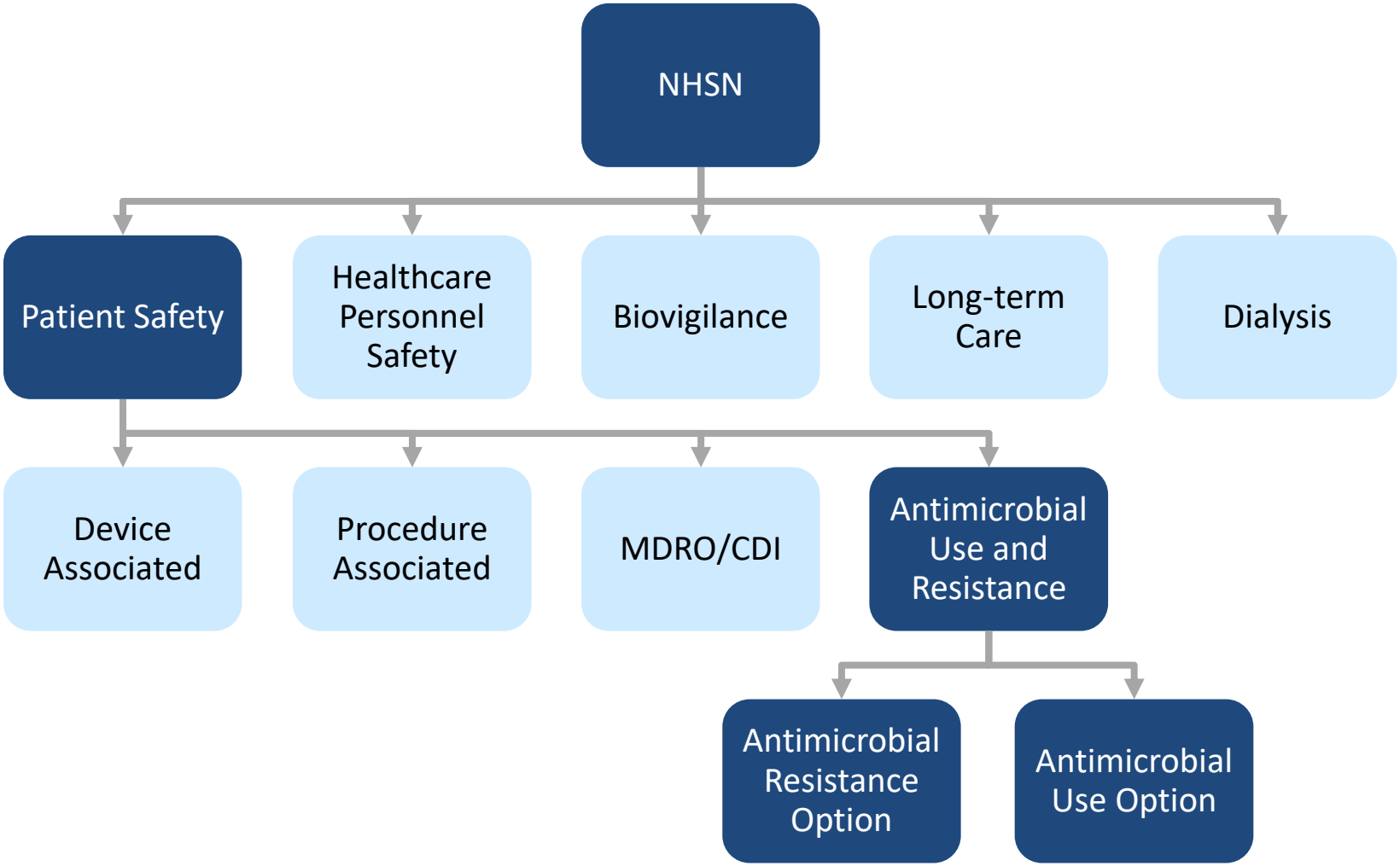
CDC NHSN Structure



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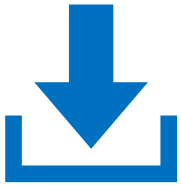
Antimicrobial Use and Resistance Reporting

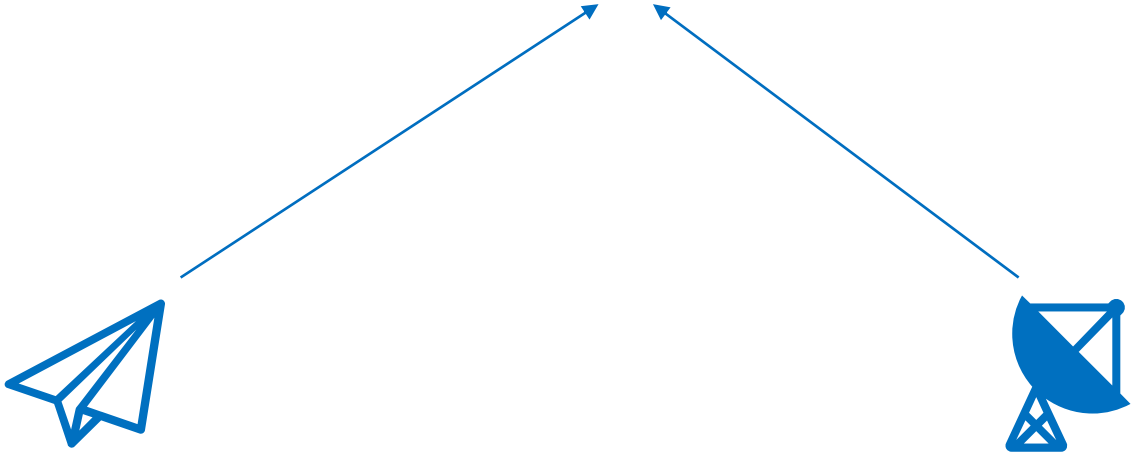
Antimicrobial Use Option	Antimicrobial Resistance Option
Tracks usage of antimicrobials across inpatient locations	Tracks the resistance of antimicrobials across inpatient locations

AUR Module allows choice of AU, AR, or both

Data Submission



NHSN Data Submission



Manual Data Entry
All Modules other than AUR allow manual data entry.

Electronic Data Submission
All modules can submit electronic data, which is a requirement for the AUR module.

Electronic Data Submission

Electronic Submission requires the HL7 Clinical Document Architecture (CDA) format.

Hospitals submit data via the NHSN Portal.

Submitted data are analyzed and benchmarked.

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NHSN CDA Submission Format

- HL7 Clinical Document Architecture (CDA)
  - Standard for electronic clinical documents
  - Used in Meaningful Use
  - Generic format for all NHSN HAI Modules
  - Specific document types per reporting option

AR Option

Objectives

- Evaluate AR data with a standardized approach
- Facilitate regional and national AR assessment

Benefits

- Improve awareness of AR problems
- Aid decision making and prioritize transmission prevention efforts
- Provide benchmarking to aid regional and national tracking

Meaningful Use and AUR Reporting

- (f)(6) Transmission to Public Health Agencies – Antimicrobial Use and Resistance Reporting
- Create antimicrobial use and resistance reporting information for electronic transmission in accordance with the standard in § 170.205(r)(1).

§170.315(f)(7)	Transmission to public health agencies — health care surveys	Guide	06-04-2018	Test Procedure	10-06-2016	Testing

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Minimum Requirements to Report AR

- Facilities enrolled in NHSN are:
  - General acute care hospitals
  - Critical access hospitals
  - Oncology hospitals
  - Long term acute care hospitals
  - Inpatient rehabilitation facilities
- NHSN does not support data submission for the AR Option from long term care facilities (i.e., skilled nursing facilities, nursing homes) or outpatient dialysis facilities.
- Collect the numerator and denominator data electronically.
- Upload data into NHSN with CDA specifications.

AR Data Elements

- Facilities report 2 types of data each month:
  - Numerator (Multiple files)
  - Denominator (Single file)
- Numerator: Patient-level susceptibility results for specific organisms
- Denominator: Patient days and admissions (facility-wide only)

System Requirements

- Denominator: Patient Days and Admissions
  - Admission Discharge Transfer System
  - Tracking patient flow by location, and time
- Numerator: Patient-level Isolate Report
  - Lab Information System
  - Isolate Susceptibility report including organism, source, time and location where collected, and antimicrobial susceptibility test results.

NHSN AR Denominator

- Typically calculated using ADT data
- Counts are collected at the Facility Level
- NHSN AUR Module guide suggests reporting from all patient care locations is technically easier than from selected locations.

Denominator Data Elements

Facility-Level Data

- Unique NHSN Facility ID
- Location
- Month
- Year

Patient Days

Admission Count

Denominator Data

- Each month, across all inpatient units:
  - Patient Days:
    - Number of patients present in the facility at a specific time on each day
    - Usually, midnight census (AKA butts in bed)
  - Admissions:

    Number of patients admitted to an inpatient location in the facility
- Calculated from A/D/T Data
- No denominator data for outpatient locations

Calculating Patient Days

	Patient Movement	Patient Days (Census Count)
Patient A	Medical Ward: 00:01-24:00	Medical Ward = 1
Patient B	Medical ICU: 00:01-24:00	Medical ICU = 1
Patient C	Medical ICU: 00:01-08:30 Medical Ward: 08:31-24:00	Medical ICU = 0 Medical Ward = 1
Patient D	Medical ICU: 00:01-10:00 Step Down: 10:01-15:00 Medical Ward: 15:01-24:00	Medical ICU = 0 Step Down = 0 Medical Ward = 1
Totals:		Medical Ward = 3 Medical ICU = 1 Step Down = 0

NHSN AR Numerator

- Patient-level susceptibility results for specific organisms
  - Patient data:
    - DOB, gender, date admitted to facility, location
  - Specimen data:
    - Collection date, Source
  - Susceptibility data:
    - Organism
    - Antimicrobial susceptibility data
      - For each antimicrobial required for the isolate organism/specimen type
    - Final lab interpretation
- Hospitals use LIS to gather this data.

Numerator Data Elements

Facility Identifier

Unique NHSN Facility ID (i.e., Object Identifier [OID] in the CDA)

Patient Data

- Patient identifier
- Date of birth
- Gender
- Date admitted to facility (use the encounter date if the event occurred in outpatient location)

Specimen Data

- Specimen collection date
- Specimen source
- Location code (mapped to CDC location codes)
- Isolate identifier (unique isolate ID in the electronic laboratory report)
- Organism

Numerator Data Elements

Antimicrobial Susceptibility Data

- Antimicrobial
- PBP2a-agglutination (only if Staphylococcus aureus)
- PCR mec-gene (only if Staphylococcus aureus)
- E-test sign
- E-test value and unit of measure
- Interpretation of E-test
- MIC sign
- MIC value and unit of measure
- Interpretation of MIC test
- Disk diffusion (KB) test sign
- Disk diffusion (KB) test value and unit of measure
- Interpretation of disk diffusion (KB) test
- **Final interpretation result**

AR vs AU Reporting

- Denominator:
  - AU: Days Present count
  - AR: Patient Days count
- Numerator:
  - AU: Days of Therapy for 90 antimicrobials, for each location
  - AR: Isolate Reports for Organisms in any inpatient location
- Location Data:
  - AU: All collected, and reported by location
  - AR: Facility-wide for inpatient locations

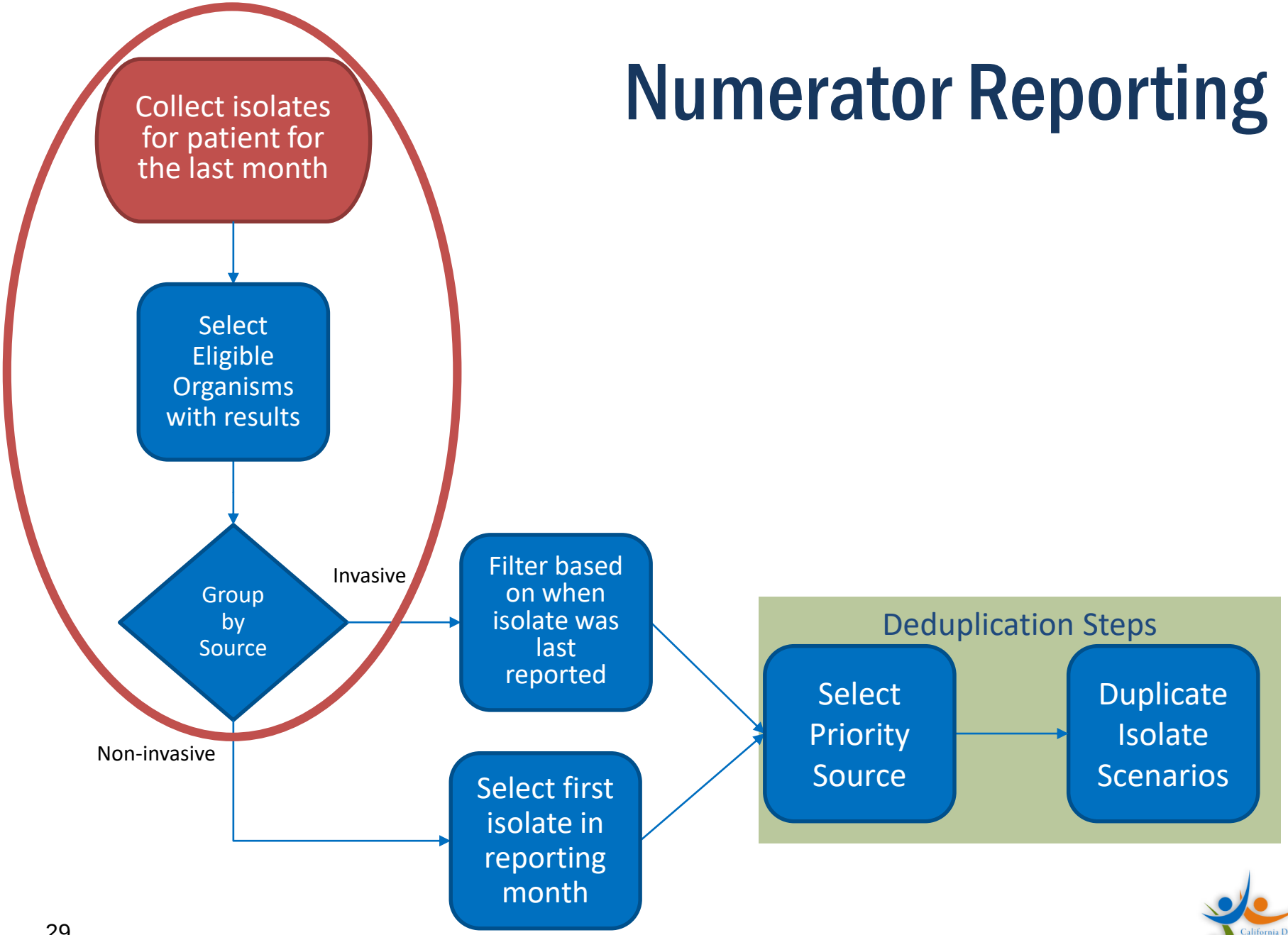
AR vs AU Reporting

- Different Source Systems:
  - AU requires data from ADT and eMAR systems
  - AR requires data from LIS and ADT systems
- Data Sensitivity:
  - AU is summary data, with no PHI
  - AR reports contain patient level data
- CDA Reports:
  - AU reporting requires 1 file per location
  - Each files contain numerator and denominator
  - AR reporting requires 1 file per isolate
  - Denominator is a separate file, for entire facility

Location Mapping in AR

- Hospitals reporting HAI have Inpatient Locations mapped in NHSN.
- AUR uses same location mapping to identify locations.
- Hospitals do not report Antimicrobial Resistance by location.
- Isolate reports derive from all inpatient locations or select outpatient locations.

Numerator Reporting



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Eligible Organisms

- Full List: Appendix A, NHSN AUR Guide
- Antimicrobials required for resistance testing

Organism	Specimen Type	Antimicrobial Agents
Acinetobacter (All *Acinetobacter* species noted in the IDM/Pathogen Codes tab listed in the ARO Pathogen column)	Blood, Urine, Lower Respiratory, CSF	Amikacin Ampicillin-sulbactam Cefepime Cefotaxime Ceftazidime Ceftriaxone Ciprofloxacin Doxcycline Gentamicin Imipenem with Cilastatin Levofloxacin Meropenem Minocycline Piperacillin Piperacillin-tazobactam Tetracycline Ticarcillin-clavulanate Tobramycin Trimethoprim-sulfamethoxazole
	Additional Agents for Urine	None

Eligible Isolates

- Report all required data each month for each eligible isolate-based report
- Inpatient or specific outpatient locations (i.e., ED, pediatric ED, and 24-hour observation)
- Regardless of antimicrobial resistance
  - Even if susceptible to all required antimicrobials

Lab Reporting Guidelines

- Interpretation of test results (i.e., E-test, MIC test, Disk diffusion [KB] test):
  - S = Susceptible
  - S-DD = Susceptible-Dose Dependent
  - I = Intermediate
  - R = Resistant
  - NS = Non-Susceptible
  - N = Not Tested
- Specific to Gentamicin and Streptomycin results for Enterococcus testing:
  - S = Susceptible/Synergistic
  - R = Resistant/Not Synergistic
- Facilities should only report final or corrected susceptibility testing.

Electronic Calculation Requirement

- Facilities should not employ manual data collection to report AR.
- Facilities that cannot electronically obtain the results of the individual laboratory tests should:
  - Use ‘Unknown’ or ‘Not Tested’
  - Provide the final interpretation result

Specimen Types

- Two distinct sources are reported:
  - Invasive Specimen: Blood or cerebrospinal fluid
  - Non-Invasive Specimen: Lower respiratory or urine
- Different sources, different “AR Events”

Reporting Rules for Specimen Sources

- Invasive Sources

  Each eligible organism isolated from an invasive source (i.e., blood or CSF) per patient, per 14-day period, across calendar months

- Non-Invasive Sources

  First eligible organism isolated from an eligible non-invasive culture source (i.e., lower respiratory or urine), per patient, per month

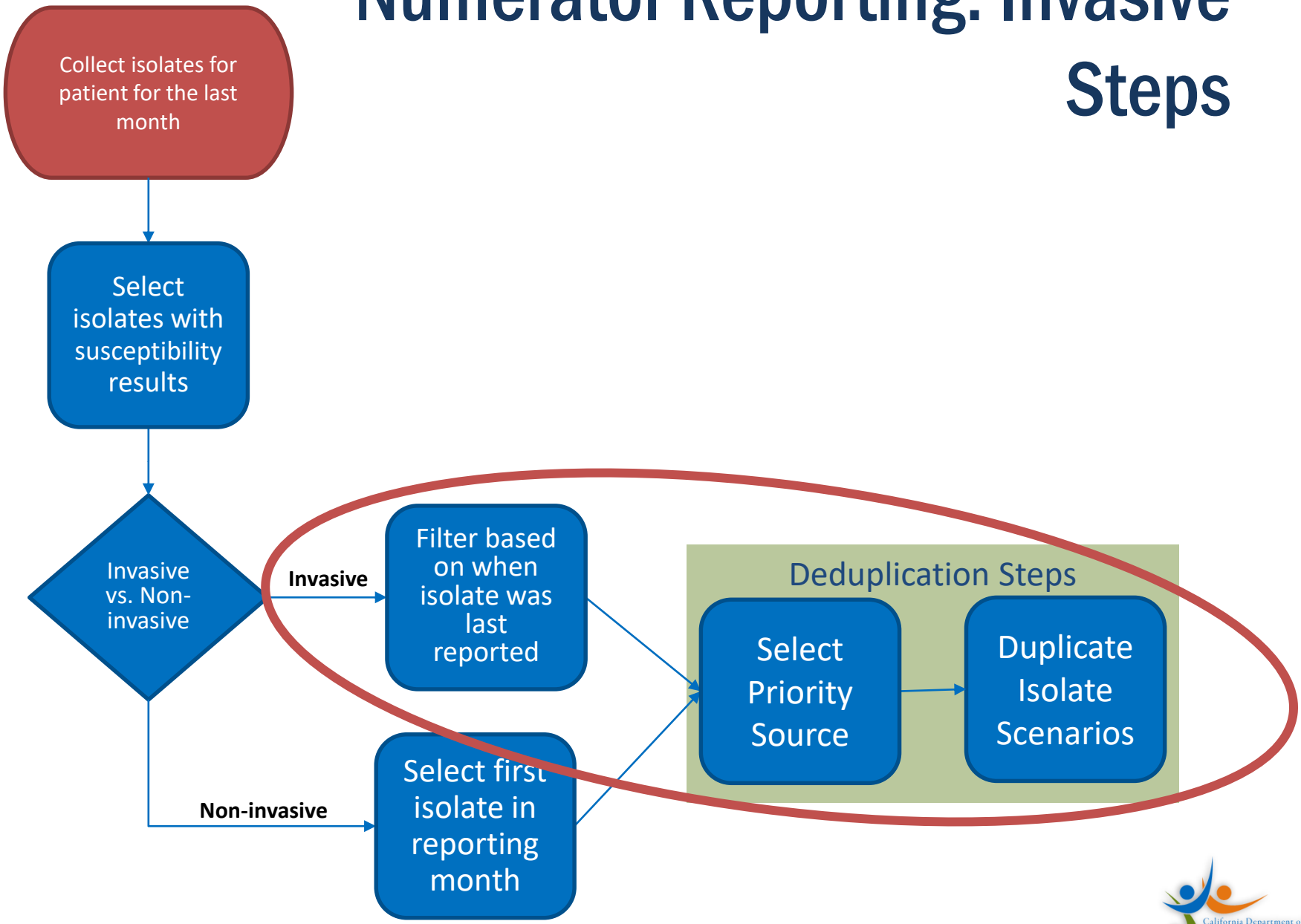
Edge Case: Report Non-Required Drugs

- Isolate is eligible for reporting even if:
  - All of the *NHSN required* antimicrobials were not tested
  - At least one non-required drug is eligible
- Example:
  - Oritavancin is not a required antimicrobial for the *Staphlococcus aureus* isolate
  - None of the 23 required antimicrobials were tested
  - Isolate is still considered eligible for reporting

Reporting for Non-Required Drugs

- For such an isolate, the facility will:
  - Report the specimen.
  - Report “Not Tested” for all required drugs.
  - Exclude the susceptibility information for Oritavancin because it not in the drug panel for that organism.

Numerator Reporting: Invasive Steps



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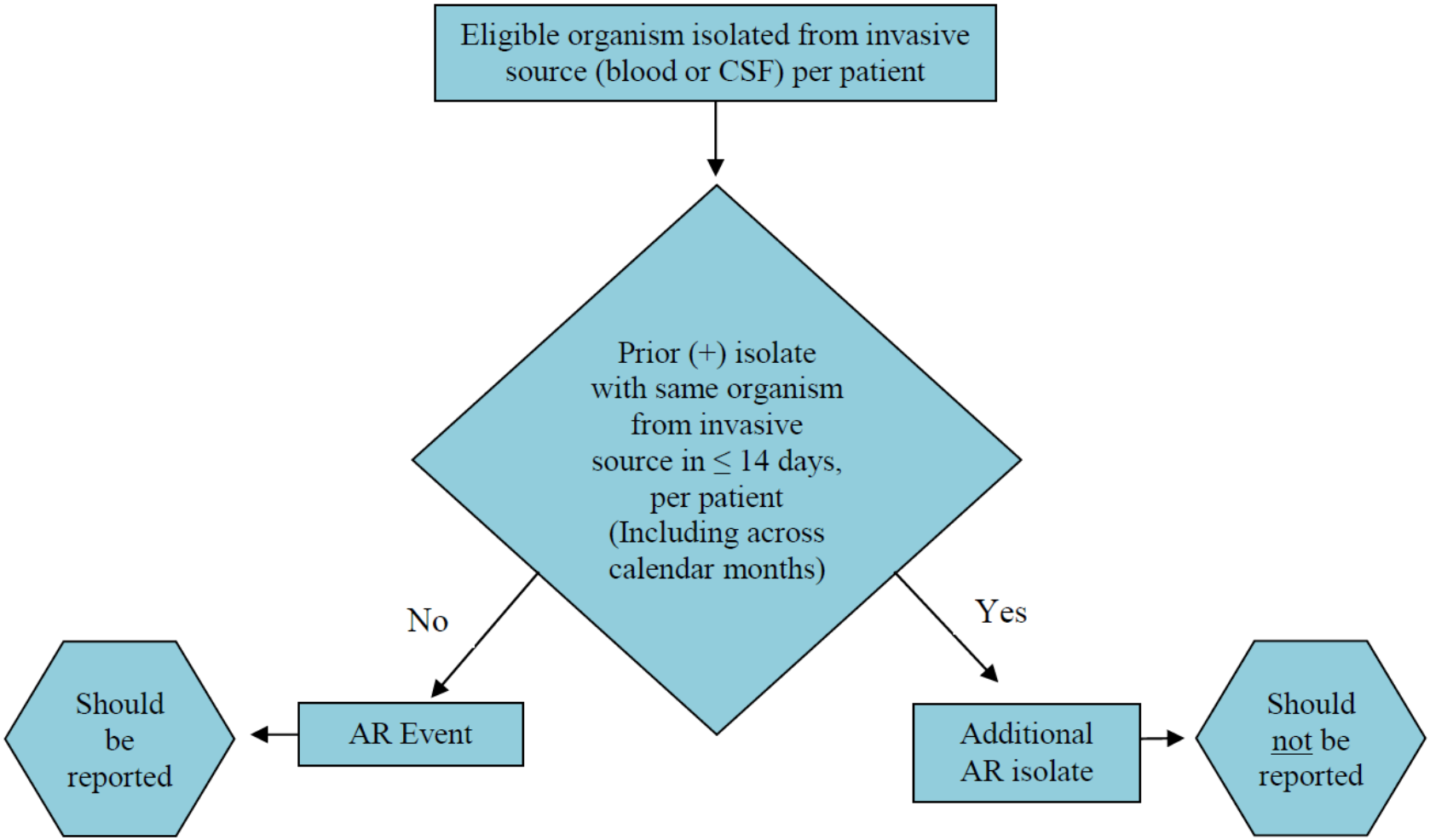
Invasive Specimen Reporting

- The 14-day Rule for Invasive Specimens:
  - Record an AR Event after 14 days with no positive culture result from the laboratory if the patient and specific organism pass.
- Record an AR Event for:
  - Each eligible organism isolated from an invasive source (i.e., blood or CSF)
  - Per patient
  - Per 14-day period
  - Across Calendar Months

14 Day Rule

- Additional Guidance for the 14 day Rule:
  - Count starts on the day of specimen collection
  - Only applies to those specimens from an inpatient location or select outpatient location (i.e., ED, pediatric ED, or 24-hour observation area)
  - Exclude cultures from other healthcare facilities
- At a maximum, there will be no more than three invasive isolates per specific organism per patient per month.

Algorithm for Invasive Specimen



Walkthrough: 14 Day Rule

Date	Source	Antimicrobial Agent	Test	Results	Antimicrobial agent	Test	Results
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Greater than 5.0 ug/ml Resistant	Ceftazidime	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffu			Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate
			Minimum concentra			Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible
			Final Inte			**Final Interpretation**	**Susceptible**
2018-02-24	CSF	Chloramphenicol	E-test	Susceptible	vofloxacin	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	N/A		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Susceptible**
2018-03-16	Blood	Minocycline	E-test	Less than 0.1 ug/ml Susceptible	Ceftazidime	E-test	Greater than 5.0 ug/ml Resistant
			Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Resistant**

Apply 14 day rule when sources are invasive

Walkthrough: 14 Day Rule

Date	Source	Antimicrobial Agent	Test	Results	Antimicrobi l agent	Test	Results
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test		eftazidime	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diff			Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate
			Mini mur concentration (MIC			Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible
			Final Interpretation	**Resistant**		**Final Interpretation**	**Susceptible**
2018-02-24	CSF	Chloramphenicol	E-test	Less than 0.1 ug/ml Susceptible	Levofloxacin	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	N/A		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Susceptible**
2018-03-16	Blood	Minocycline	E-test	Less than 0.1 ug/ml Susceptible	Ceftazidime	E-test	Greater than 5.0 ug/ml Resistant
			Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Resistant**

Report to NHSN

This is the first blood culture collected for this patient

Walkthrough: 14 Day Rule

Date	Source	Antimicrobial Agent	Test	Results	Antimicrobial agent	Test	Results
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Greater than 5.0 ug/ml Resistant	Ceftazidime	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate
			Minimum inhibitory concenti	N/A		Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible
			Final Int			**Final Interpretation**	**Susceptible**
2018-02-24	CSF	Chloramphenicol	E-test		evofloxacin	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diff			Disk Diffusion (KB)	N/A
			Minimu concentration (MIC)			Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Susceptible**
2018-03-16	Blood	Minocycline	E-test	Less than 0.1 ug/ml Susceptible	Ceftazidime	E-test	Greater than 5.0 ug/ml Resistant
			Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Resistant**

Do not report to NHSN

It has been less than 14 days since the last positive culture (Feb/20)

Walkthrough: 14 Day Rule

Date	Source	Antimicrobial Agent	Test	Results	Antimicrobial agent	Test	Results
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Greater than 5.0 ug/ml Resistant	Ceftazidime	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate
			Minimum inhibitory concentration (MIC	N/A		Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible
			Final Interpretation	**Resistant**		**Final Interpretation**	**Susceptible**
2018-02-24	CSF	Chloramphenicol	E-test	Less than 0.1 ug/ml Susceptible	Levofloxacin	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	N/A		Minimum inhibitory concentration (MIC)	N/A
			Final Int			**Final Interpretation**	**Susceptible**
2018-03-16	Blood	Minocycline	E-test		Ceftazidime	E-test	Greater than 5.0 ug/ml Resistant
			Disk Diff			Disk Diffusion (KB)	N/A
			Mini mu concentration (MIC)	0.1 ug/ml Susceptible		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Resistant**

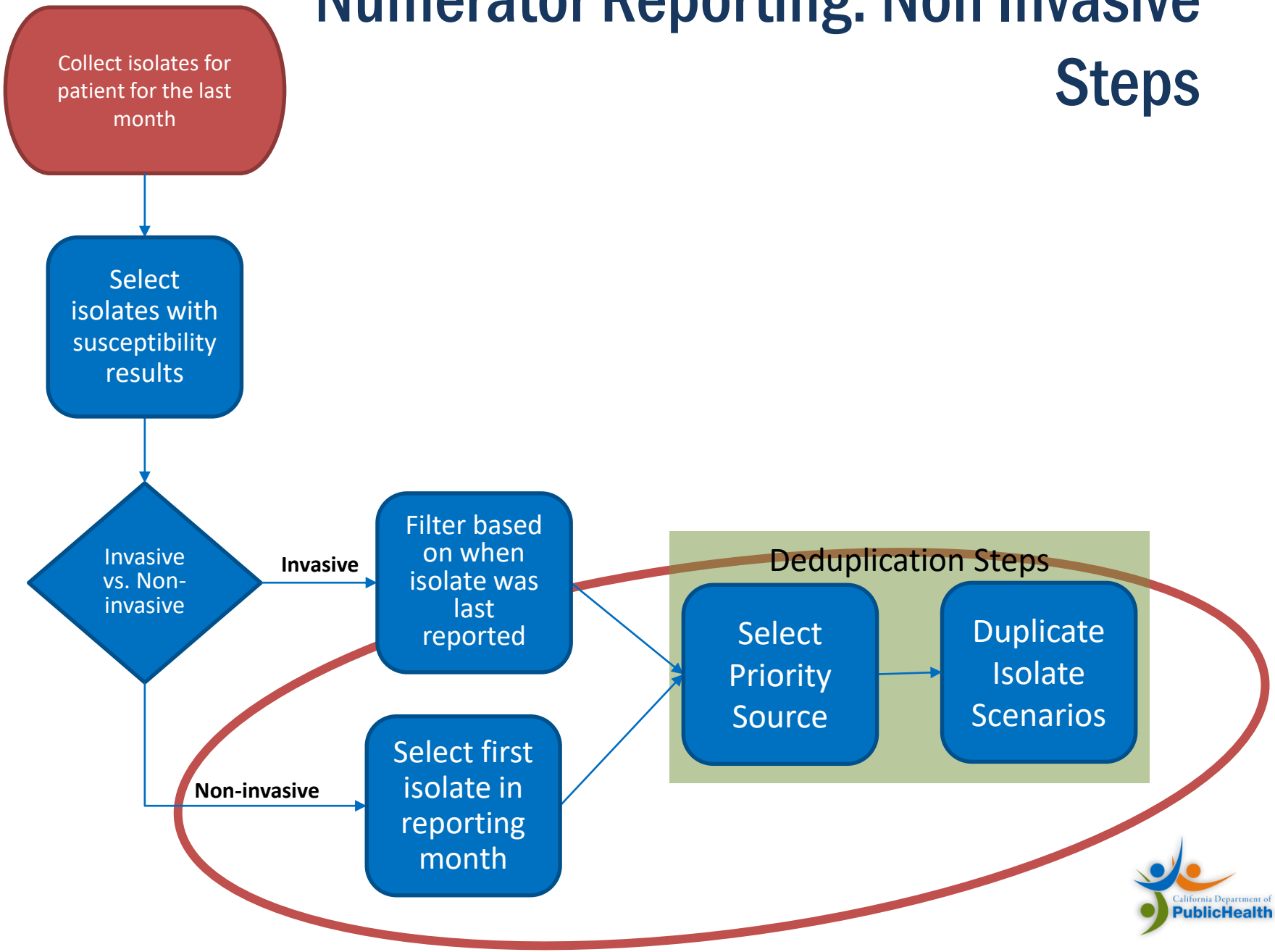
Report to NHSN

It has been more than 14 days since the last positive culture (Feb/24)

Walkthrough: 14 Day Rule Data Reported

Date	Source	Antimicrobial Agent	Test	Results	Antimicrobial agent	Test	Results
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Greater than 5.0 ug/ml Resistant	Ceftazidime	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate
			Minimum inhibitory concentration (MIC	N/A		Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible
			Final Interpretation	**Resistant**		**Final Interpretation**	**Susceptible**
~~2018-02-24~~	~~CSF~~	~~Chloramphenicol~~	~~E-test~~	~~Less than 0.1 ug/ml Susceptible~~	~~Levofloxacin~~	~~E-test~~	~~Less than 0.1 ug/ml Susceptible~~
			~~Disk Diffusion (KB)~~	~~N/A~~		~~Disk Diffusion (KB)~~	~~N/A~~
			~~Minimum inhibitory concentration (MIC)~~	~~N/A~~		~~Minimum inhibitory concentration (MIC)~~	~~N/A~~
			~~**Final Interpretation**~~	~~**Susceptible**~~		~~**Final Interpretation**~~	~~**Susceptible**~~
2018-03-16	Blood	Minocycline	E-test	Less than 0.1 ug/ml Susceptible	Ceftazidime	E-test	Greater than 5.0 ug/ml Resistant
			Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Resistant**

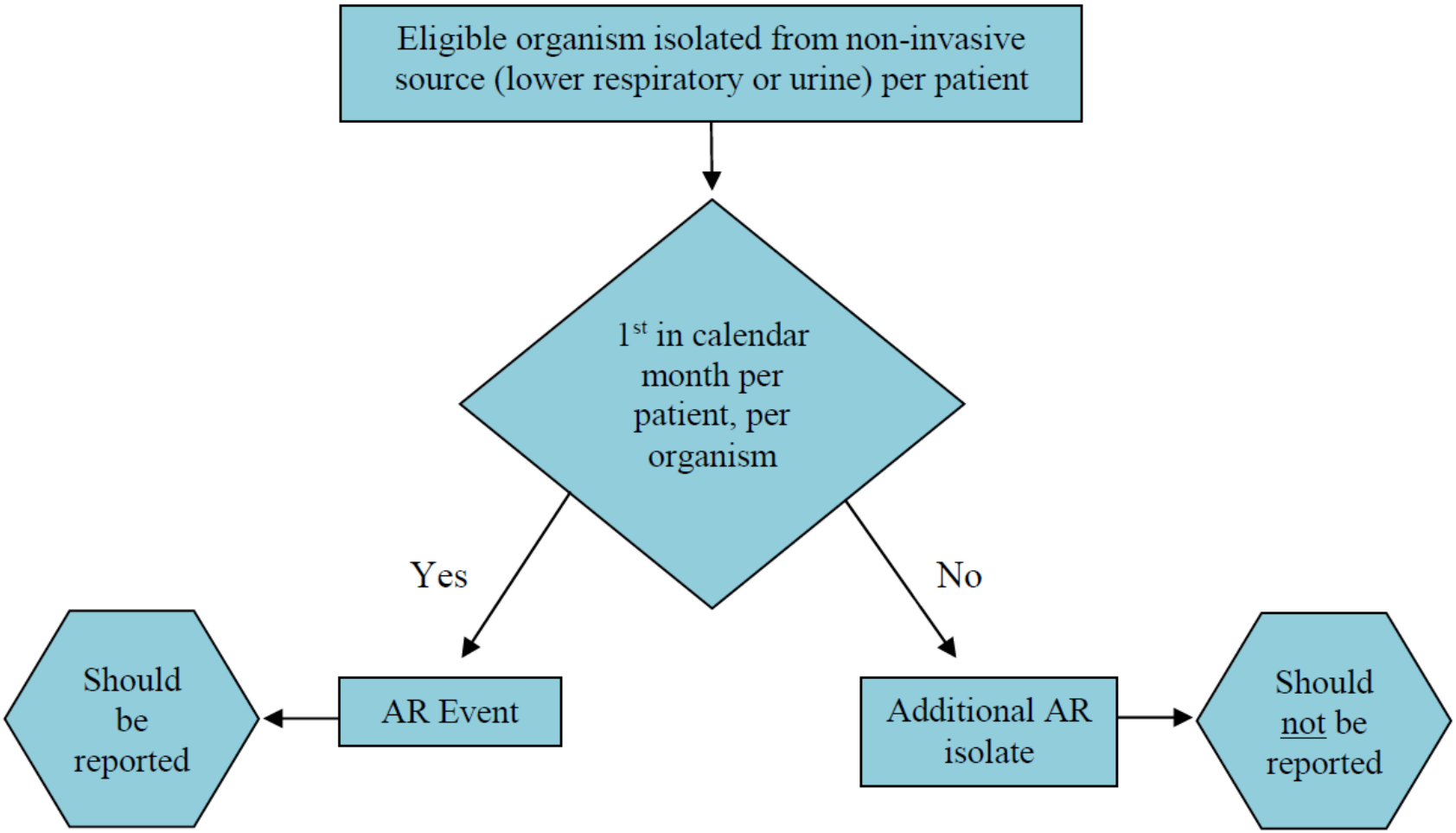
Numerator Reporting: Non Invasive Steps



Non-Invasive Specimen Reporting

- Record an AR Event for:
  - First eligible organism isolated from an eligible non-invasive culture
  - Each patient
  - Each month
- NHSN only allows one AR event for lower respiratory or urine specimens per month per patient, per organism.

Non Invasive Specimen Algorithm



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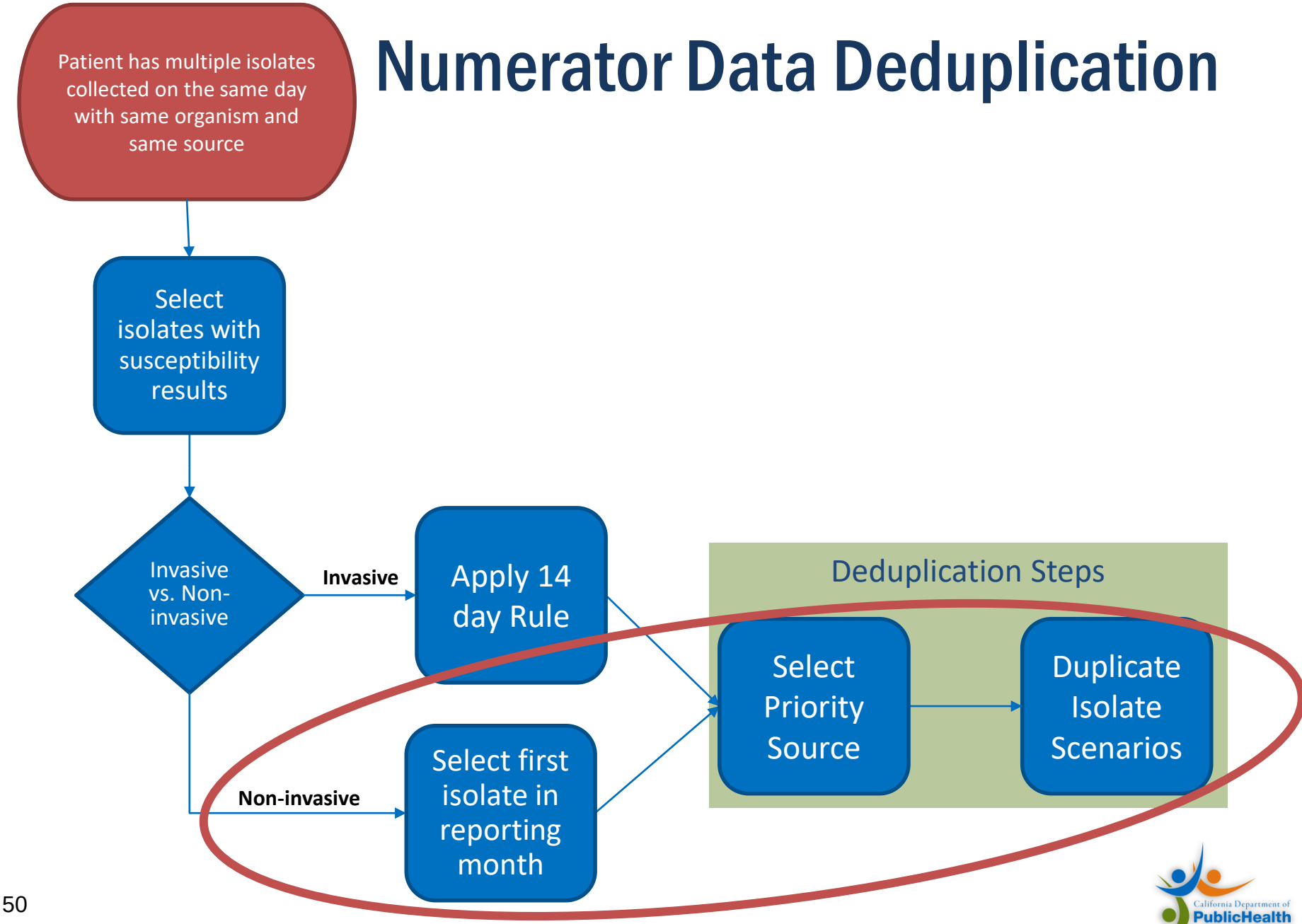
Numerator Data Deduplication



Duplicate Isolates

- Duplicate Isolates
  - Defined as same species or same genus from same patient on same day
  - Isolates must have the same source type (i.e., invasive or non-invasive)
- Handling multiple isolates of the same organism
  - Isolates may produce conflicting results
  - Facilities should only report one isolate to NHSN
  - NHSN has rules for removing duplicates

Duplicate Isolate Removal Rules

- General rules:
  - Do not merge test results across multiple isolates
  - Don't summarize results across different isolates tested on same day
  - Eliminate isolates on same day without susceptibility test results
  - For Invasive Specimens:
    - CSF isolates > blood isolates
  - For Non-Invasive Specimens:
    - lower respiratory isolates > urine isolates

Duplicate Isolate Scenarios: Conflicting Results

1. Same isolate tested using the same test, with conflicting results
2. Same isolate tested using different tests, with conflicting results
3. Two isolates collected on the same day return conflicting results from a panel of antimicrobial tests

Duplicate Isolate Removal Rules

- Same isolate, same specific test, conflicting results:
  - If available, report the final interpretation
  - Without a final interpretation, report the most resistant interpretation (i.e., NS > R > I > S-DD > S > NT)
- Example:
  - Interpretation of E-test 1 = Intermediate
  - Interpretation of E-test 2 = Susceptible
  - Report E-test 1/ Intermediate as final interpretation

Duplicate Isolate Removal Rules

- Same isolate, different specific tests, conflicting results:
  - If available, report the final interpretation
  - If no final interpretation is provided, report the most resistant interpretation (i.e., NS > R > I > S-DD > S > NT).
- Example:
  - Interpretation of MIC test = Resistant
  - Interpretation of E-Test = Intermediate
  - No final interpretation was provided
  - Report “Resistant” as the final interpretation

Duplicate Isolate Removal Rules

- Different isolates, specific tests, conflicting results:
  - If available, report isolate with the most resistant final interpretation.
  - If no final interpretation, report the isolate with the higher amount of drug resistance based on the number antimicrobials testing “NS” or “R”.
  - If all else fails, report first isolate entered into LIS
- Example: *Candida albicans,* isolated from two blood specimens, same patient, same calendar day, no final interpretation
  - First isolate tested “R” to 3 of 8 antimicrobials
  - Second isolate tested “R” to 4 of 8 antimicrobials
  - The facility reports the second isolate to NHSN because it showed greater resistance

Walkthrough: Deduplication

Date	Source	Antimicrobial Agent	Test	Results	Antimicrobial agent	Test	Results
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Greater than 5.0 ug/ml Resistant	Ceftazidime	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate
			Minimum inhibitory concentration (MIC	N/A		Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible
			Final Interpretation	**Resistant**		**Final Interpretation**	**Susceptible**
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Less than 0.1 ug/ml Susceptible	Ceftazidime	E-test	Greater than 5.0 ug/ml= Non-susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	N/A		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Non-Susceptible**

Scenario:

Two isolates from same day, conflicting results to panel of antimicrobials

Walkthrough: Deduplication

Date	Source	Antimicrobial Agent	Test	Results	Antimicrobial agent	Test	Results
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim		) ug/ml	Ceftazidime	E-test	Less than 0.1 ug/ml Susceptible
						Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate
						Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible
			Final Interpretation	**Resistant**		**Final Interpretation**	**Susceptible**
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Less than 0.1 ug/ml Susceptible	Ceftazidime	E-test	Greater than 5.0 ug/ml= Non-susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	N/A		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Non-Susceptible**

Collected on the same day

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Verification Walkthrough: Deduplication

Conflicting Results

			Test	Results	Antimicrobial agent	Test	Results
			E-test	Greater than 5.0 ug/ml Resistant	Ceftazidime	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate
			Minimum inhibitory concentration (MIC	N/A		Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible
			Final Interpretation	**Resistant**		**Final Interpretation**	**Susceptible**
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Less than 0.1 ug/ml Susceptible	Ceftazidime	E-test	Greater than 5.0 ug/ml= Non-susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	N/A		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Non-Susceptible**

Verification Walkthrough: Deduplication

Date	Source	Antimicrobial Agent	Test	Results	Antimicrobial agent	Test	Results
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Greater than 5.0 ug/ml Resistant	Ceftazidime	E-test	Less than 0.1 ug/ml Susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	Exactly equal to 2.5 mm Intermediate
			Minim... conce...	N/A		Minimum inhibitory concentration (MIC)	Less than or equal to 0.1 ug/ml Susceptible
			Final			**Final Interpretation**	**Susceptible**
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test		Ceftazidime	E-test	Greater than 5.0 ug/ml= Non-susceptible
			Disk D...			Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	N/A		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Non-Susceptible**

Report most resistant result

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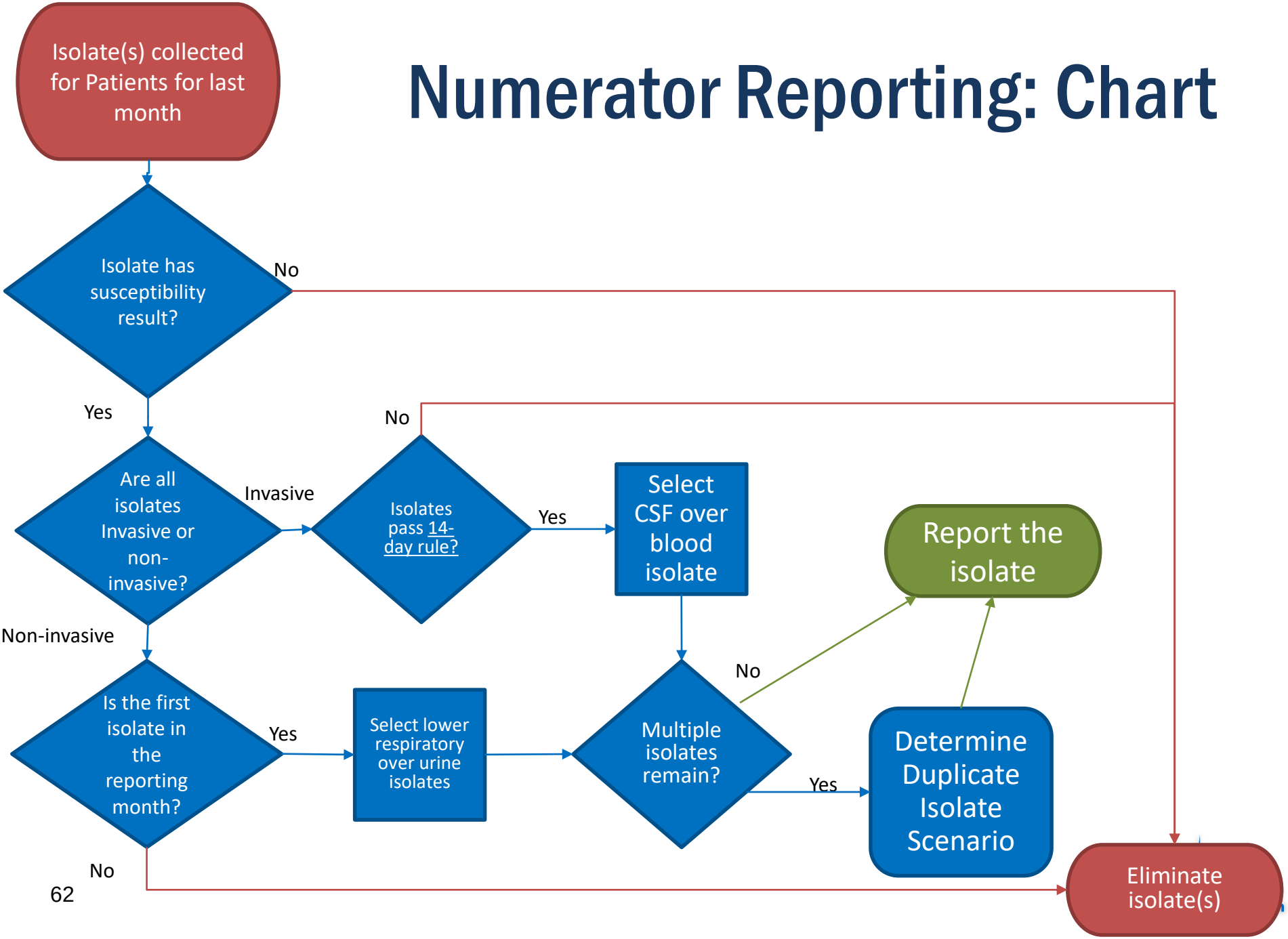
Verification Walkthrough: Deduplication Data Reported

Date	Source	Antimicrobial Agent	Test	Results	Antimicrobial agent	Test	Results
~~2018-02-20~~	~~Blood~~	~~Sulfamethoxazole with Trimethoprim~~	~~E-test~~	~~Greater than 5.0 ug/ml Resistant~~	~~Ceftazidime~~	~~E-test~~	~~Less than 0.1 ug/ml Susceptible~~
			~~Disk Diffusion (KB)~~	~~N/A~~		~~Disk Diffusion (KB)~~	~~Exactly equal to 2.5 mm Intermediate~~
			~~Minimum inhibitory concentration (MIC~~	~~N/A~~		~~Minimum inhibitory concentration (MIC)~~	~~Less than or equal to 0.1 ug/ml Susceptible~~
			~~**Final Interpretation**~~	~~**Resistant**~~		~~**Final Interpretation**~~	~~**Susceptible**~~
2018-02-20	Blood	Sulfamethoxazole with Trimethoprim	E-test	Less than 0.1 ug/ml Susceptible	Ceftazidime	E-test	Greater than 5.0 ug/ml= Non-susceptible
			Disk Diffusion (KB)	N/A		Disk Diffusion (KB)	N/A
			Minimum inhibitory concentration (MIC)	N/A		Minimum inhibitory concentration (MIC)	N/A
			Final Interpretation	**Susceptible**		**Final Interpretation**	**Non-Susceptible**

Numerator Reporting: Chart



AR Monthly Data Submission

- Locations and Timeline:
  - Submit data from all NHSN-defined inpatient locations

    Beginning January 1, 2017, facilities can submit AR specimens from three outpatient locations: ED, pediatric ED, and 24-hour observation area
  - Upload within 30 days of completion
- Submit:
  - One CDA file per organism (AR Event)
  - One CDA file for denominator
  - Example:
    - 50 separate CDA files for 50 separate AR Events
    - One CDA for facility-wide denominators
    - All CDA files are uploaded in one Zip file
    - Max: 1000 CDAs or file size of 2 MB per zip file

Agenda

- Introduction
- Overview of the Antimicrobial Resistance Module
- AR Data Requirements
- **NHSN Metrics and Benchmarks**
- CDA and the NHSN HAI IG
- Our Support
- Resources

Benchmarks for AR Reporting

- AR Option Metrics:
  - Metrics at the monthly, quarterly, semi-annual, or annual period depend on the frequency the isolates occur.
  - Facility-wide antibiogram
  - Stratified by specimen source, time period, specific antimicrobial, and organism

Facility Wide Antibiogram

For each organism-antimicrobial pairing*

Percentage of Non-susceptible =

Total # of organisms resistant or intermediate for a pathogen

Divided By

Total # of organisms tested for that pathogen

*exceptions based on organism species

Benchmarks for AR Reporting

- AR Option Line List:
  - Show all AR Events for a given time period
  - Most customizable report
  - Displays:
    - AR Event
    - Patient ID
    - Date of birth
    - Gender
    - NHSN assigned Event ID
    - Specimen type
    - Organism identified.
  - Customizations show specific months, locations, organisms, and test results.
  - Helpful when validating the data after upload.
- NHSN can export all AR Option data in various formats (CSV etc…)

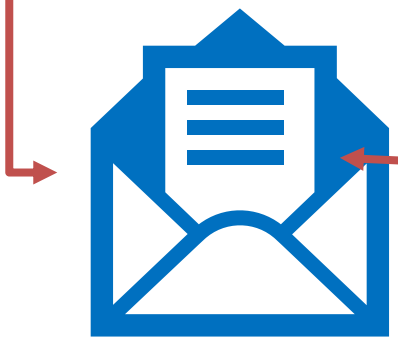
Agenda

- Introduction
- Overview of the Antimicrobial Resistance Module
- AR Data Requirements
- NHSN Metrics and Benchmarks
- **CDA and the NHSN HAI IG**
- Our Support
- Resources

CDA R2

- Clinical Document Architecture (CDA)
- Common model defining the structure and semantics of clinical documents
- Developed by Health Level Seven
- XML syntax
- First released in 2005

CDA Body and Header



- Header
  - Facility OID
  - Authoring vendor
  - Patient Information
- Body
  - Report Data:
    - Specimen Type
    - Date Specimen Collected
    - In-Facility location of patient
    - Pathogen Isolate
    - Specific Tests
    - Results

Object Identifier (OID)

- A unique identifier that represents an object:
  - A tree of nodes and edges (i.e., branches and leaves, sometimes called OID arcs)
  - A positive integer is assigned to each edge in the tree.
- OIDs in CDA:
  - Add global uniqueness to identifiers in clinical documents.
  - Identify the Facility submitting data to NHSN
  - Identify the vocabulary terminology systems in a document.

HL7 V3 Data Types: R1 in CDA

Organism Codes
Antimicrobial Agents
Drug Susceptibility Tests

OIDs

Patient Days

BASIC DA		CODED VALUES	
ANY		CS	Coded Simple
BL		CE	Code Value
ED	Encapsulated data	CD	Coded with Equivalence
ST	Character String		
NAMES		ADDRESSES	
PN		ADXP	Address Part
ON		AD	Postal Address
COLLECTIONS		IDENTIFIERS	
SET	Set	II	Instance Identifier
LIST	List	COMMUNICATIONS	
IVL	Interval	TEL	Telecommunication Address
QUANTITIES		TIME	
INT	Integer	TS	P
PQ	Physical Quantity	PIVL	P
REAL	Real	IVL	In
RTO	Ratio	GTS	General Timing Specification

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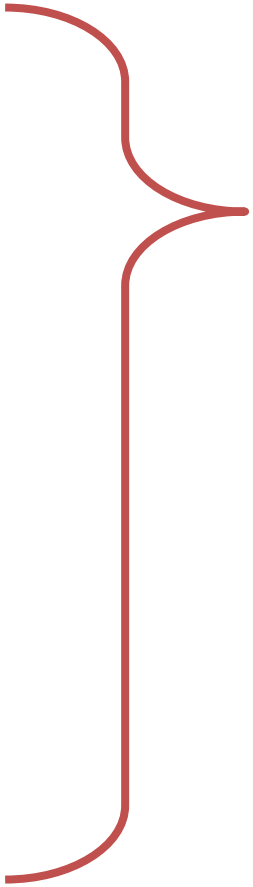
Value Sets and Code Systems

- Code – a sequence of characters assigned meaning by some formal system

  Expression, Symbol
- Code System – formal definitions that define the meaning of a set of concepts, with codes
  - Terminology, Ontology, Enumeration, Classification…
  - SNOMED, LOINC, RxNorm
  - Drive meaning/analysis off code systems
- Value Set – a group of code/codeSystem pairs
  - Doesn't define it's own codes
  - Picks codes from multiple code systems
  - AR examples:
    - Isolate Codes
    - Specific Tests performed

Example of Code System Vs. Value Sets

- Ice Cream flavors code system
  - Chocolate
  - Vanilla
  - Strawberry
  - Mango
  - Pear
  - Rocky Road
  - Cookie Dough
  - Cake
  - Caramel
  - Coffee
  - Blueberry
  - Raspberry



- "Berry Flavors" Value Set
  - Strawberry
  - Blueberry
  - Raspberry

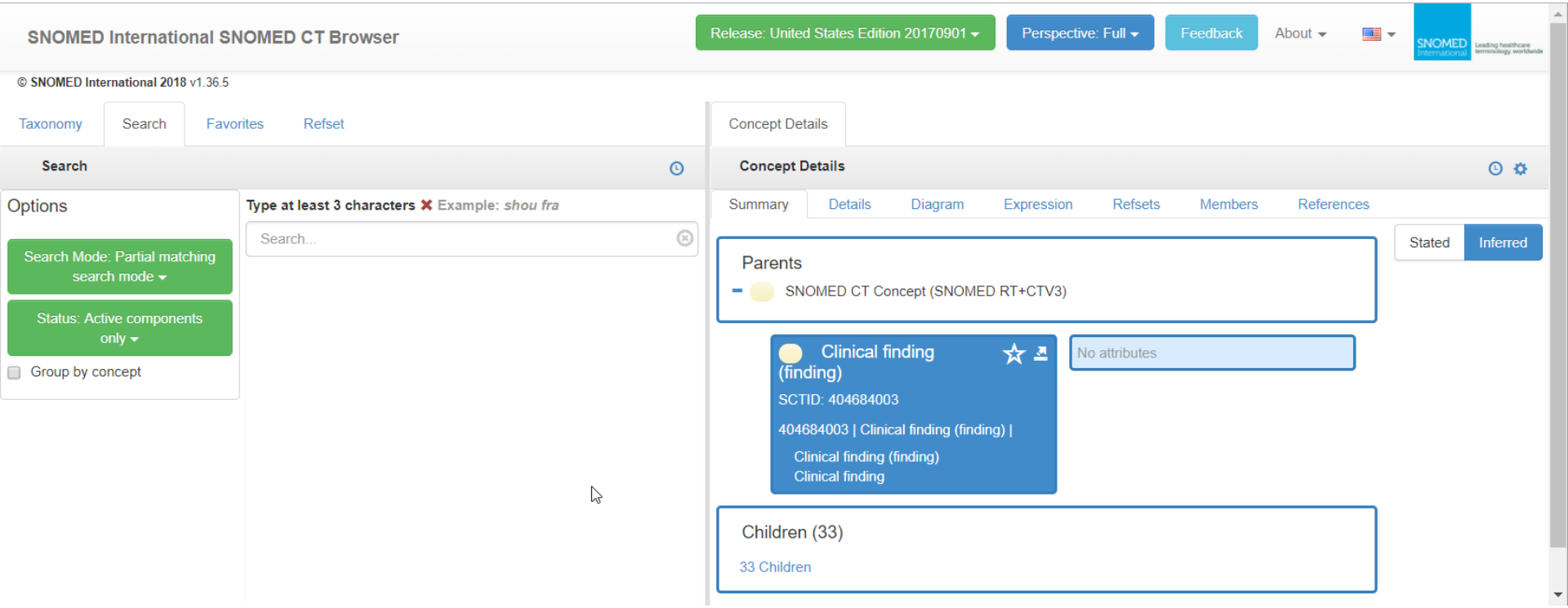
Code Systems

- **SNOMED-CT:** Systematized Nomenclature Of Medicine Clinical Terms
  - Specimen Type (codes for invasive/non-invasive)
  - Pathogen Identified
- **LOINC:** Logical Observation Identifiers Names and Codes
  - Document and section codes
  - Antibiotic susceptibility tests
- **RxNorm**: RxNorm provides normalized names for clinical drugs
  - Antimicrobial ingredients

Tools

- Tools find codes from the three hierarchies:
  - SNOMED Browser
  - LOINC on-line (LOINC.org)
  - RxNorm's RxNav
- Finding value sets:
  - Value Set Authority Center (VSAC): https://vsac.nlm.nih.gov
    - General Source of truth for most (all) Value Sets
  - HAI Specific Values Sets Excel Spreadsheet https://gforge.hl7.org/gf/project/strucdoc/scmsvn/?action=browse&path=/*checkout*/trunk/HAI/HAI-R1-Normative_XML_Support_Files/hai_voc.xls&revision=182

SNOMED Browser



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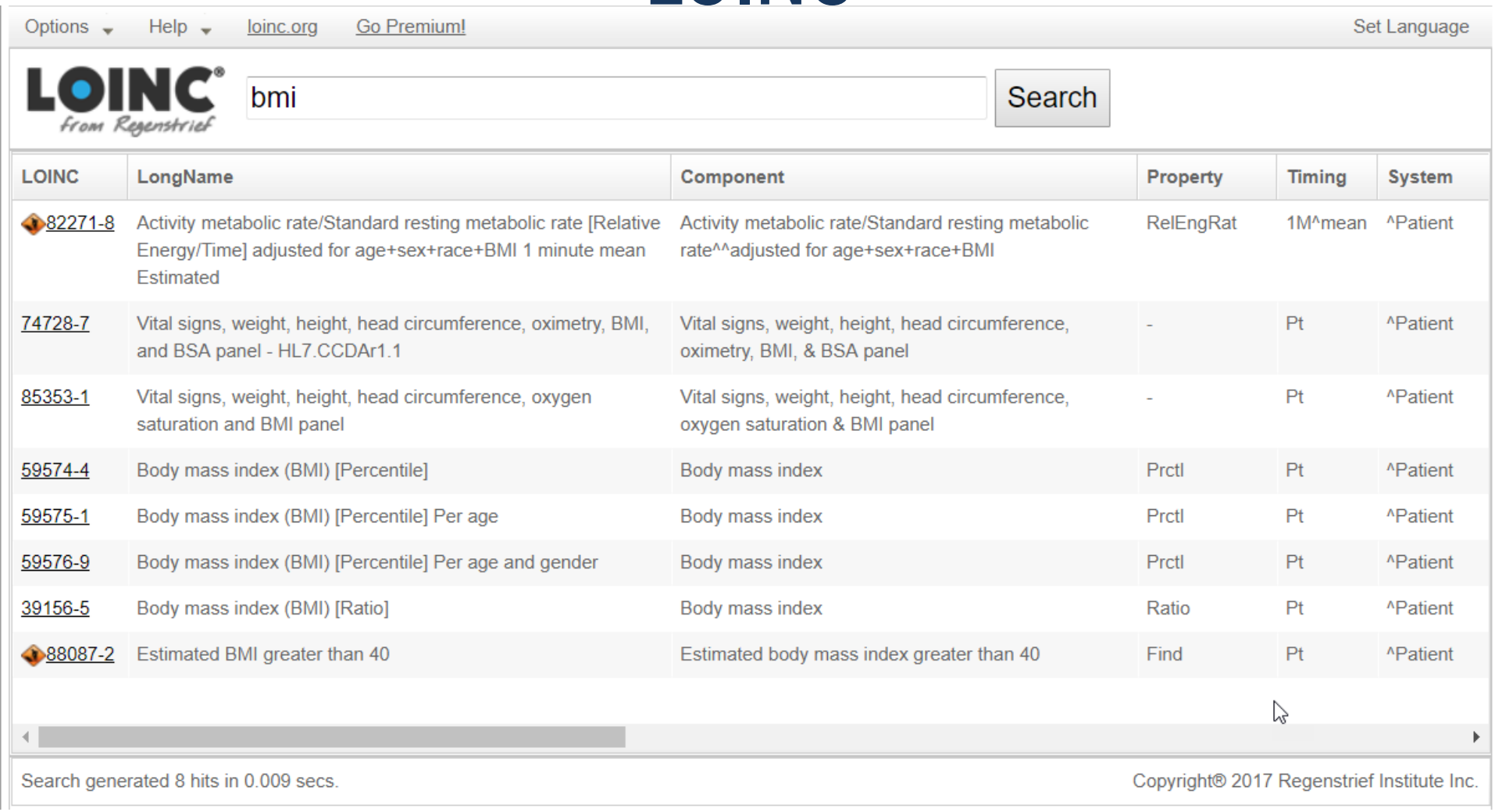
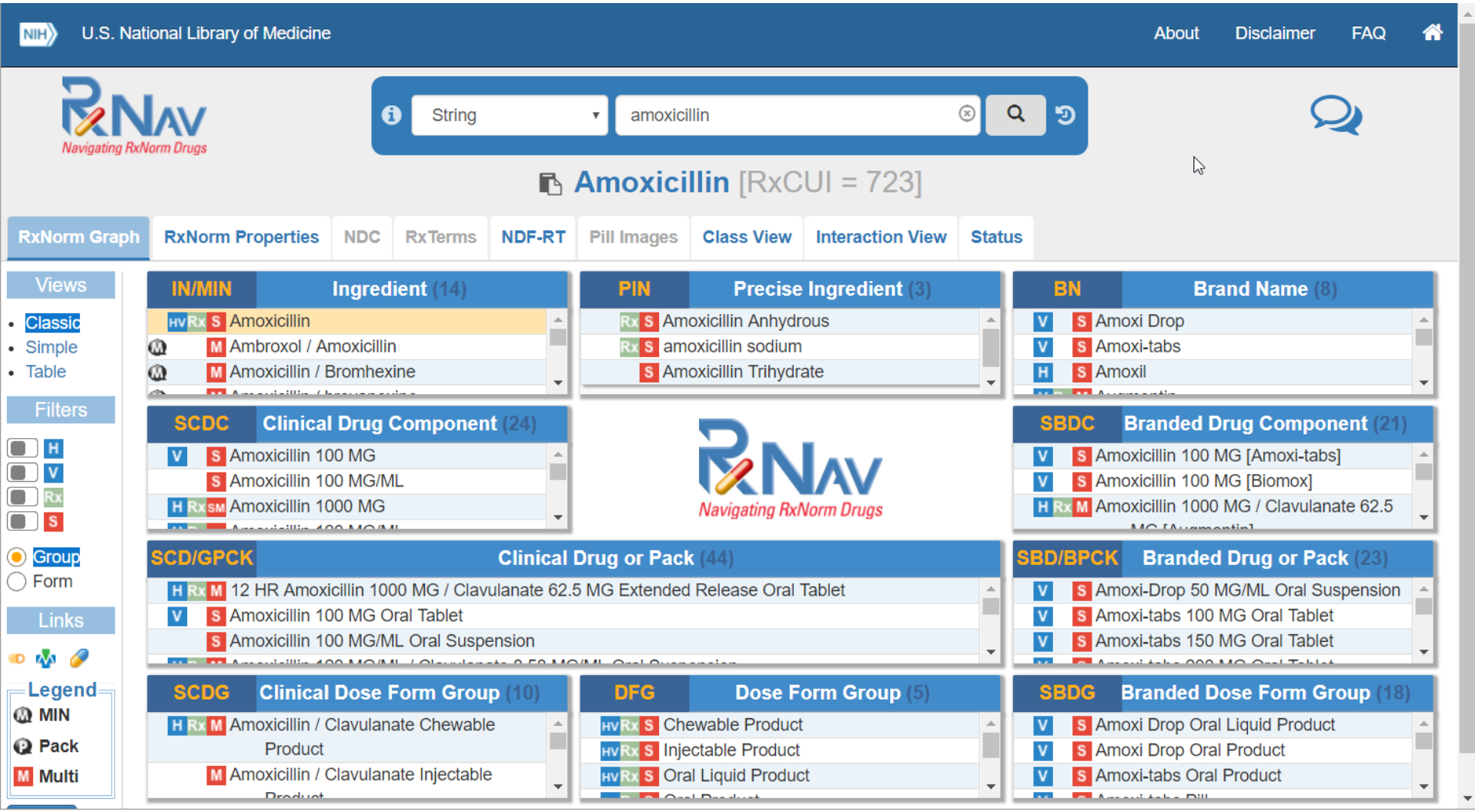
LOINC



LOINC	LongName	Component	Property	Timing	System
82271-8	Activity metabolic rate/Standard resting metabolic rate [Relative Energy/Time] adjusted for age+sex+race+BMI 1 minute mean Estimated	Activity metabolic rate/Standard resting metabolic rate^^adjusted for age+sex+race+BMI	RelEngRat	1M^mean	^Patient
74728-7	Vital signs, weight, height, head circumference, oximetry, BMI, and BSA panel - HL7.CCDAr1.1	Vital signs, weight, height, head circumference, oximetry, BMI, & BSA panel	-	Pt	^Patient
85353-1	Vital signs, weight, height, head circumference, oxygen saturation and BMI panel	Vital signs, weight, height, head circumference, oxygen saturation & BMI panel	-	Pt	^Patient
59574-4	Body mass index (BMI) [Percentile]	Body mass index	Prctl	Pt	^Patient
59575-1	Body mass index (BMI) [Percentile] Per age	Body mass index	Prctl	Pt	^Patient
59576-9	Body mass index (BMI) [Percentile] Per age and gender	Body mass index	Prctl	Pt	^Patient
39156-5	Body mass index (BMI) [Ratio]	Body mass index	Ratio	Pt	^Patient
88087-2	Estimated BMI greater than 40	Estimated body mass index greater than 40	Find	Pt	^Patient

RxNav



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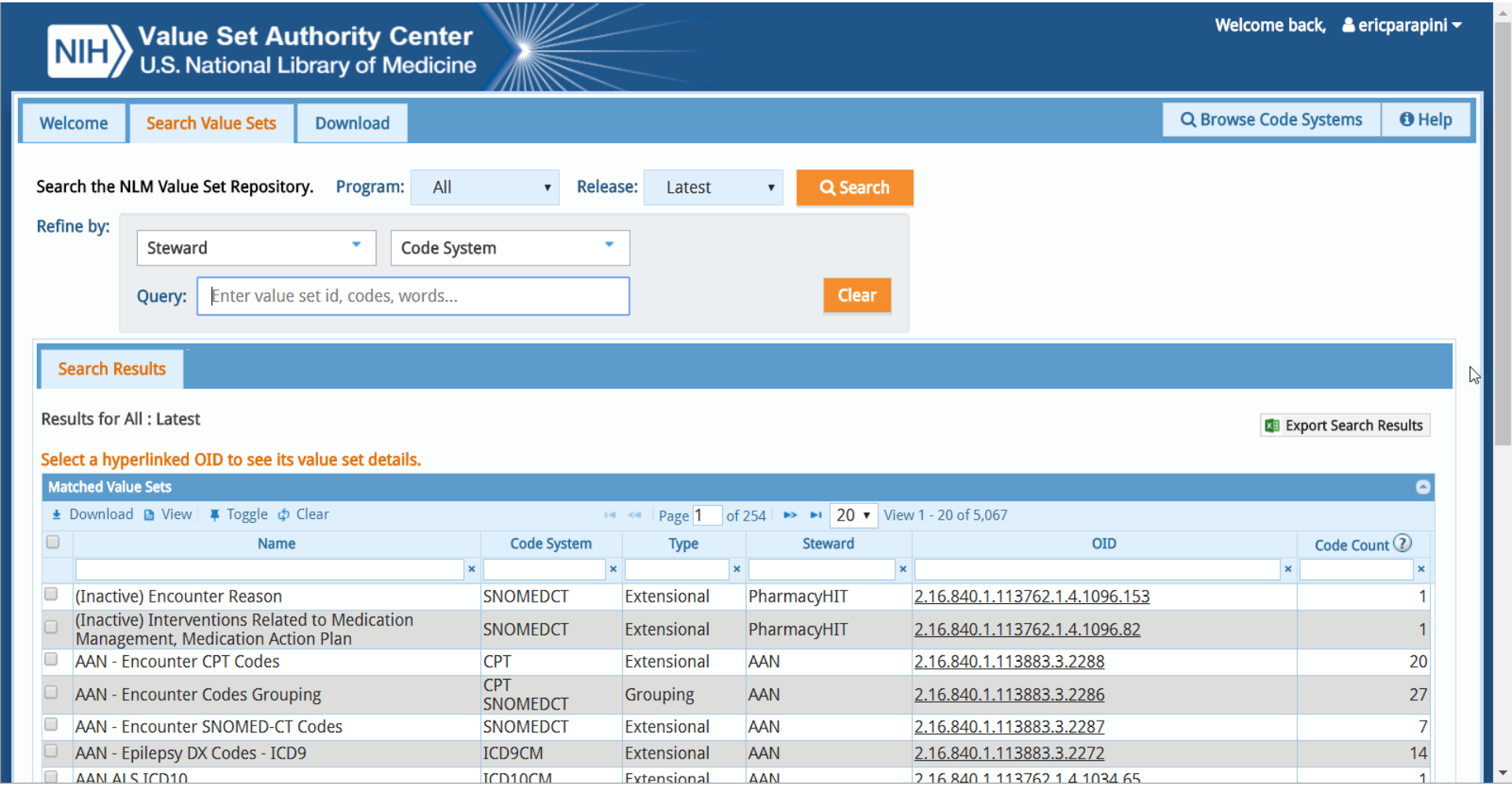
VSAC



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HAI_VOC.XLS

	A	B	C	D	E	F
1	**Healthcare Associated Infection (HAI) Reports, Normative Release 1, vocabulary**					
2						
3	Each tab in this Workbook contains an HAI value set or list of single-value bindings; the index below provides links to each tab. Three large					
4						
5	The top row of each worksheet indicates value set name, OID, and binding. A list of code system OIDS and names is at the bottom of this					
6						
7	Each worksheet contains the codes and standard displayNames for the value set (arranged by code). Additional columns may also give					
8						
9	**Special character strings are used in some instances to permit proper coding for the Schematron:**					
10	**Character string**	**Represents**				
11	®	® (Registered)				
12	™	™ (Trademark)				
13	>	>				
14	>=	>=				
15	<	<				
16	<=	<=				
17						
18	**Large Value Sets Not Included in this Spreadsheet**					
19	**External Link**	**Value Set Name**	**Value Set OID**	**Value Set Binding**	**codeSystemName**	**codeSystemOID**
20	http://phinvads.cdc.gov	NHSNBloodProductCodabarCode	2.16.840.1.114222.4.11.3335	STATIC	ABC Codabar	2.16.840.1.113883.6.290
21	http://phinvads.cdc.gov	NHSNBloodProductISBTCode	2.16.840.1.114222.4.11.3334	DYNAMIC	ISBT-128	2.16.840.1.113883.6.18
22	http://www.wpc-edi.com/taxonon	NHSNClinicalSpecialtyCode	2.16.840.1.114222.4.11.3191	DYNAMIC	NUCCProviderCodes	2.16.840.1.113883.6.101
23						
24	**Index of Tabs / Value Sets -- Single-Value Bindings (SVBs) are listed at the end**					
25	**Tab Name**	**Value Set Name**	**Value Set OID**	**Value Set Binding**	**Note**	
26	Administration Location Type	NHSNAdministrationLocationTypeCode	2.16.840.1.114222.4.11.3188	STATIC		
27	AntibioticSuscTest	NHSNAntibioticSuscTest	2.16.840.1.114222.4.11.7161	STATIC		
28	Anitmicrobial Agent AURP	NHSNAntimicrobialAgentAURPCode	2.16.840.1.114222.4.11.3360	DYNAMIC		

Introduction | AdministrationLocationType | AntimicrobialAgentAURP | AntibioticSuscTest | ASAClass | BSIE ...

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Null Flavor

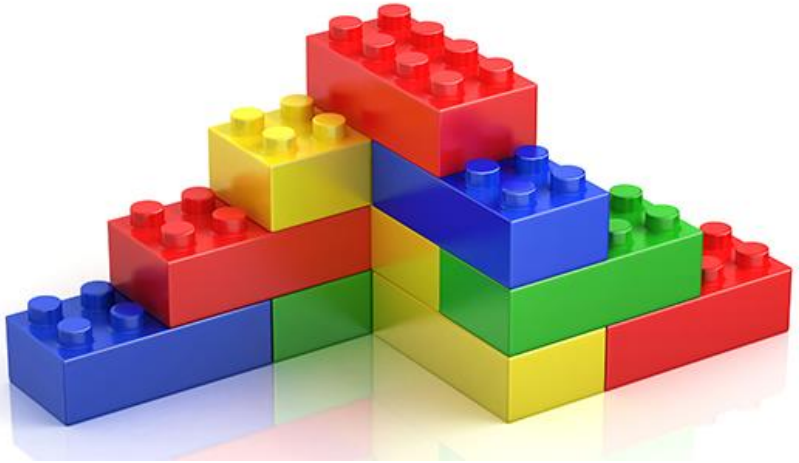
Expresses details about a lack of value

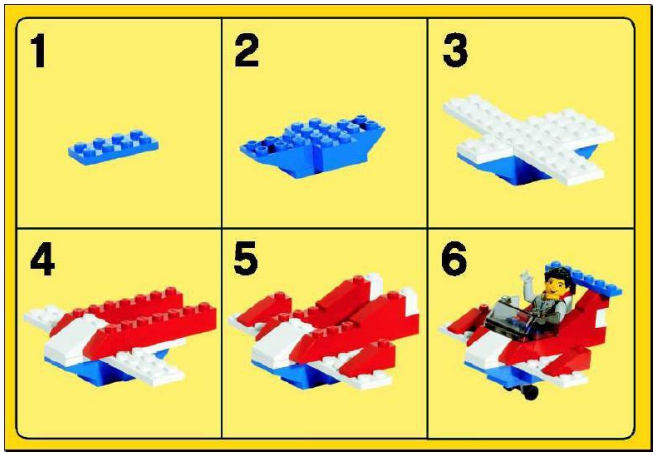
VALUE	MEANING
NI	No Information (default NULL)
OTH	It is not in the domain for the variable.
NINF	Negative infinite
PINF	Positive infinite
UNK	Unknown
ASKU	It was asked, but it is unknown
NASK	It was not asked
NAV	Temporarily not available. Can be known later.
TRC	Content is greater than zero but cannot be quantified.
MSK	The information exists but cannot be revealed based on business rules (policy, privacy, etc.)
NA	Not applicable

CDA Templates and HAI Reports

Templates: The Lego Analogy

CDA





Templates

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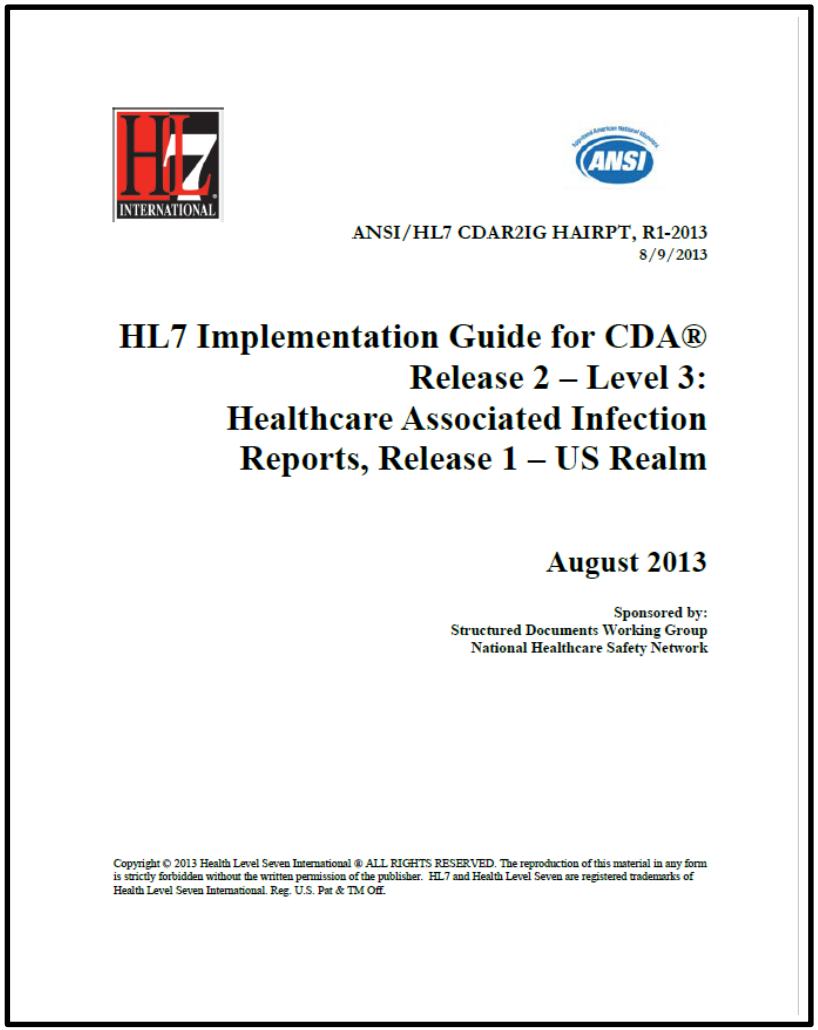
HAI Reports

The HL7 Implementation Guide for Healthcare Associated Infection Reports is a collection of documents for NHSN reporting

- Population Summary Reports
  - ARO Reporting
  - AUP Summary Report
  - ICU Summary Report
  - …
- Single Person Reports
  - HAI AUR Antimicrobial Resistance Option
  - HAI Bloodstream Infection Report
  - …



ANSI/HL7 CDAR2IG HAIRPT, R1-2013
8/9/2013

**HL7 Implementation Guide for CDA®
Release 2 – Level 3:
Healthcare Associated Infection
Reports, Release 1 – US Realm**

August 2013

Sponsored by:
Structured Documents Working Group
National Healthcare Safety Network

California Department of PublicHealth

Evolution of the HAI IG

- HAI Reporting has moved through several releases – most notably:
- Early Releases (2008 – 2013)
  - R1 -> R9
  - Incremental changes, draft standard
- First Normative Release (2013)
  - AU/AUR Reporting is Introduced
- Second Normative Release (2015)

Troubleshooting Scenario

Using the HAI IG

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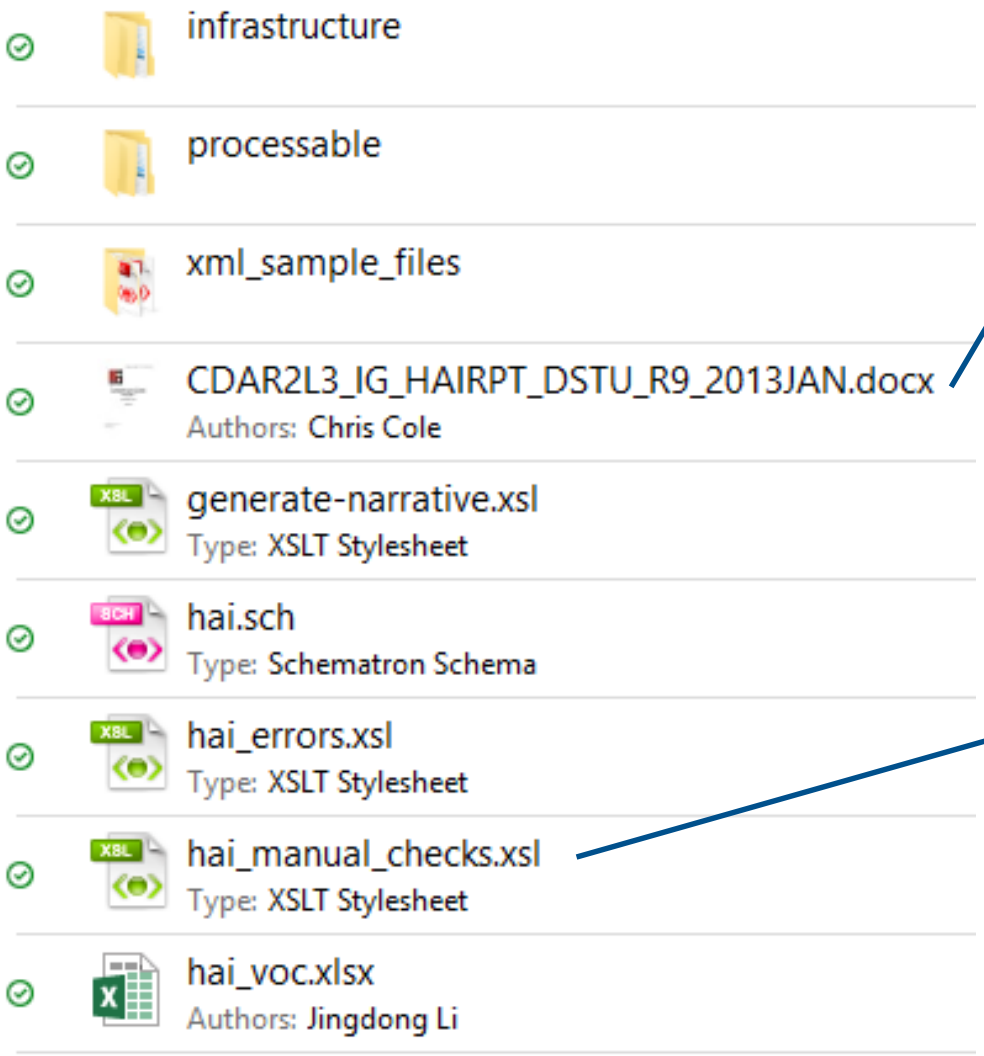
Materials



The NHSN HAI Implementation Guide

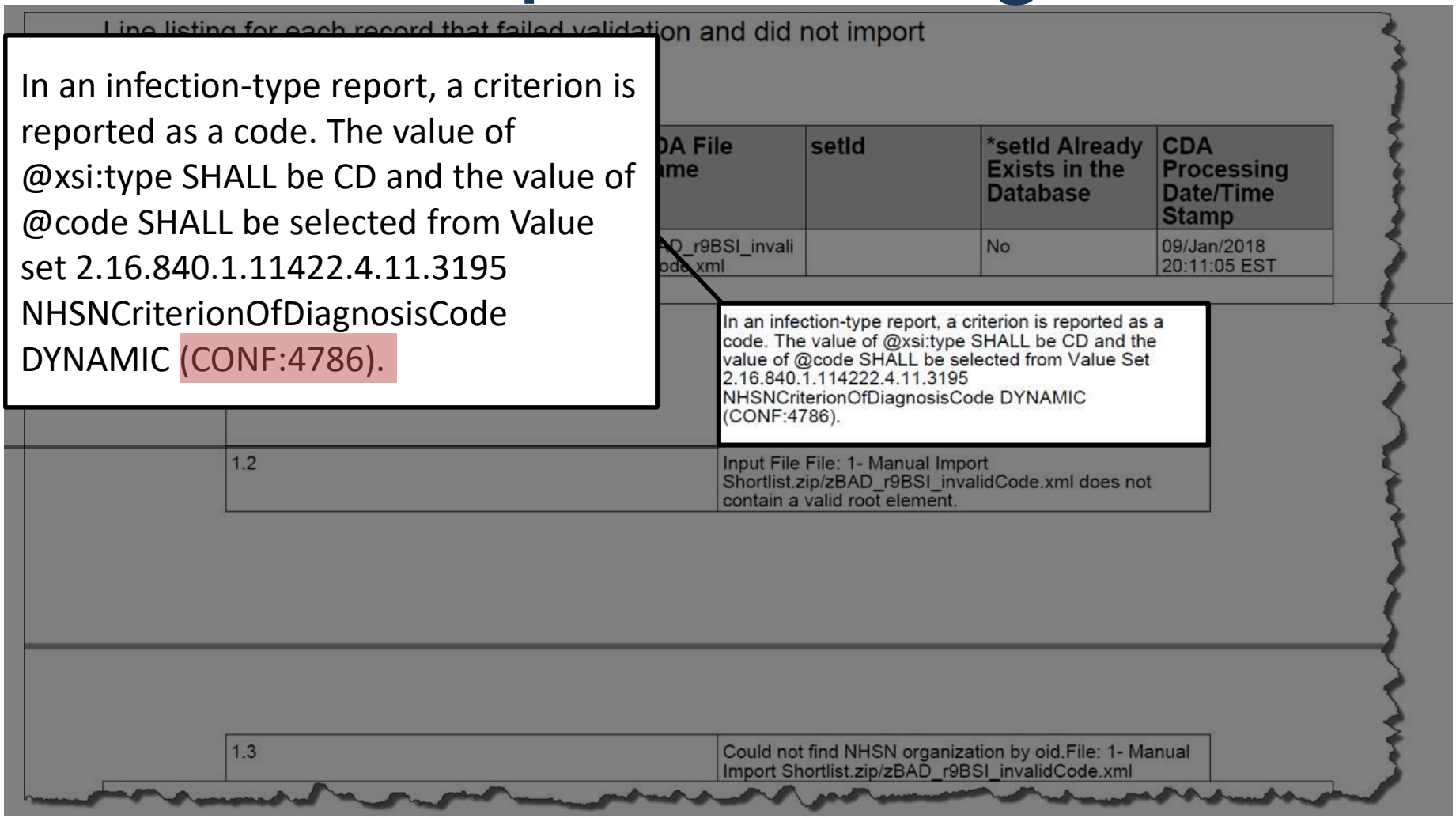
Source of truth for HAI value sets

Troubleshooting Scenario

- The CDA zip file that was obtained from the vendor system contained some CDA files that were rejected by NHSN on import.
- Received an error output PDF file.

Output Walkthrough

In an infection-type report, a criterion is reported as a code. The value of @xsi:type SHALL be CD and the value of @code SHALL be selected from Value set 2.16.840.1.11422.4.11.3195 NHSNCriterionOfDiagnosisCode DYNAMIC (CONF:4786).



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Output Walkthrough

- CONF: 4786

5. **SHALL** contain exactly one [1..1] **statusCode** (CONF:11338).
    a. This statusCode **SHALL** contain exactly one [1..1] **@code="completed"** Completed (CodeSystem: ActStatus 2.16.840.1.113883.5.14 **STATIC**) (CONF:2062).
6. **SHALL** contain exactly one [1..1] **value** (CONF:2063).
    a. In an infection-type report, a criterion is reported as a code. The value of @xsi:type **SHALL** be CD and the value of @code **SHALL** be selected from Value Set 2.16.840.1.114222.4.11.3195 NHSNCriterionOfDiagnosisCode **DYNAMIC** (CONF:4786).
    b. In an Evidence of Infection (Dialysis) Report, (CONF:10908).
        i. To record a criterion of diagnosis as a code, the value of @xsi:type **SHALL** be CD and the value of @code **SHALL** be selected from Value Set 2.16.840.1.114222.4.11.3195 NHSNCriterionOfDiagnosisCode **DYNAMIC** (CONF:10909).
        ii. To record a criterion not included in the NHSNCriterionOfDiagnosisCode value set, the value of @xsi:type **SHALL** be ST and a text value **SHALL** be present (CONF:10910).

Output Walkthrough

a. In an infection-type report, a criterion is reported as a code. The value of @xsi:type **SHALL** be CD and the value of @code **SHALL** be selected from Value Set 2.16.840.1.114222.4.11.3195 NHSNCriterionOfDiagnosisCode **DYNAMIC** (CONF:4786).

- The value in the report must be selected from the NHSNCriterionOfDiagnosisCode value set

Locate in HAI_VOC.xlsx

	A	B	C	D
22	http://www.wpc-edi.com/taxonor	NHSNClinicalSpecialtyCode	2.16.840.1.114222.4.11.3191	DYNAMIC
23				
24	**Index of Tabs / Value Sets -- Single-Value Bindings (SVBs) are listed at the end**			
25	**Tab Name**	**Value Set Name**	**Value Set OID**	**Value Set Binding**
26	Administration Location Type	NHSNAdministrationLocationTypeCode	2.16.840.1.114222.4.11.3188	STATIC
27	AntibioticSuscTest	NHSNAntibioticSuscTest	2.16.840.1.114222.4.11.7161	STATIC
28	Anitmicrobial Agent AURP	NHSNAntimicrobialAgentAURPCode	2.16.840.1.114222.4.11.3360	DYNAMIC
29	ASA Class	NHSNASAClassCode	2.16.840.1.113883.13.10	STATIC
30	BSI Evidence Type	NHSNBloodstreamInfectionEvidenceType	2.16.840.1.113883.13.7	DYNAMIC
31	Catheter Type	NHSNCatheterTypeCoce	2.16.840.1.114222.4.11.3185	STATIC
32	Certainty	NHSNCertaintyCode	2.16.840.1.114222.4.11.3387	STATIC
33	Closure Technique	NHSNClosureTechniqueCode	2.16.840.1.114222.4.11.6051	STATIC
34	Criterion of Diagnosis	NHSNCriteriaOfDiagnosisCode	2.16.840.1.114222.4.11.3195	DYNAMIC
35	Drug Susceptibility Finding	NHSNDrugSusceptibilityFindingCode	2.16.840.1.113883.13.13	STATIC
36	Drug Susceptibility Tests	NHSNDrugSusceptibilityTestsCode	2.16.840.1.113883.13.15	DYNAMIC
37	Eligibility	NHSNEligibilityCode	2.16.840.1.114222.4.11.3248	DYNAMIC
38	Encounter Type	NHSNEncounterTypeCode	2.16.840.1.113883.13.1	STATIC
39	EthnicityGroup	CDC Ethnicity Group	2.16.840.1.114222.4.11.837	STATIC
40	Healthcare Service Location	NHSNHealthcareServiceLocationCode	2.16.840.1.113883.13.19	DYNAMIC
41	Hip Replacement	NHSNHipReplacementCode	2.16.840.1.113883.13.3	STATIC
42	Imputability	NHSNImputabilityCode	2.16.840.1.114222.4.11.3388	STATIC
43	Infection Condition	NHSNInfectionConditioncode	2.16.840.1.114222.4.11.3196	DYNAMIC
44	Infection Risk Factors	NHSNInfectionRiskFactorsCode	2.16.840.1.113883.13.6	STATIC
45	Infection Type	NHSNInfectionTypeCode	2.16.840.1.113883.13.20	DYNAMIC
46	Insertion Site	NHSNInsertionSiteCode	2.16.840.1.114222.4.11.3180	DYNAMIC
47	Knee Replacement	NHSNKneeReplacementCode	2.16.840.1.113883.13.4	STATIC
48	Occasion of Detection	NHSNOccassionOfDetectionCode	2.16.840.1.113883.13.12	DYNAMIC
49	Organism AST	NHSNOrganismASTCode	2.16.840.1.114222.4.11.3283	DYNAMIC
50	Outcome Type	NSHNOutcomeTypeCode	2.16.840.1.114222.4.11.3386	STATIC

Introduction | AdministrationLocationType | AntimicrobialAgentAURP | AntibioticSuscTest | ASAClass | BSIEvide

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Validation

Validation

Implementation Guide

Is it CDA?
Tested by Schema

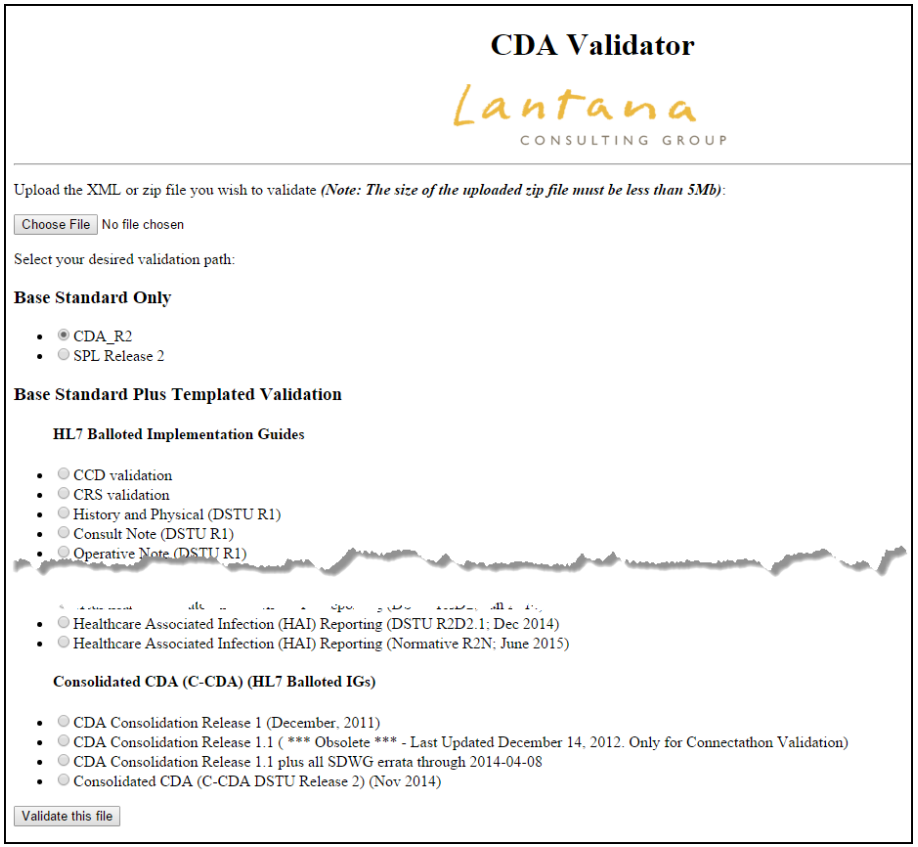
Is it a Car?
(4 wheels, seats, headlights, steering)

Is it HAI?
Tested by Schematron

Is it a Ford Mustang?
(powerful engine, muscular body, big wheels)

Validation: Sample Implementation

- Online CDA Validator
  - Implements a basic multi-stage validation pipeline
  - Freely available
  - Validation for most SDWG-developed IGs
  - http://www.lantanagroup.com/validator



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Validation vs. Verification

Validation:

Ensure the report format and structure is correct.

Verification:

Ensure the information found within the report is accurate.

Rendering

NHSN Transformation and Stylesheet

- Developed by NHSN
- Creates CDA Narrative from machine readable entries
  - Recreates the forms they are representing

Example

Antimicrobial Resistance Option (ARO) report

Patient	Ned Nuclear		
Admission Date	January 15, 2009		
Date of birth	November 25, 1954	**Sex**	Male
Race	Information not available	**Ethnicity**	Not Hispanic or Latino
Contact info	address not available Telecom information not available	**Patient IDs**	123456 (2.16.840.1.113883.3.117.1.1.5.1.1.1)
Document Id	20202201 (2.16.840.1.113883.3.117.1.1.5.2.1.1.2)		
Document Created	August 7, 2008		
Author	anAuthorID (2.16.840.1.113883.3.117.1.1.5.1.1.2)		
Encounter Date	From January 15, 2009		
Encounter Location	2.16.840.1.113883.3.117.1.1.5.1.1		
Document maintained by	2.16.840.1.114222.4.3.2.11		
Legal authenticator	aLegalAuthenticatorID (2.16.840.1.113883.3.117.1.1.5.1.1.2) signed date/time: August 7, 2008		

Findings

Specimen type	Date Specimen Collected	In-facility location of patient when specimen was drawn
Blood specimen	January 21, 2009	9W Medical/Surgical critical care unit

Microbiology Studies: Pathogen Isolate

Staphylococcus aureus

Staph Aureus Specific Test	Result
Oxacillin Resistant Staphylococcus sp isolate [Presence] in Isolate by Latex agglutination	Negative
Bacterial methicillin resistance (mecA) gene [Presence] by Probe and target amplification method	Positive

Department of cHealth

Agenda

- Introduction
- Overview of the Antimicrobial Resistance Module
- AR Data Requirements
- NHSN Metrics and Benchmarks
- CDA and the NHSN HAI IG
- **Our Support**
- Resources

Our Support

- Implementation Support
- Verification of reporting outputs
- Customized resources and trainings
- Learning collaborative

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AR Toolkit

- The AR toolkit provides implementers with the specific identifiers, locations, vocabulary, constraints, etc. required in the CDA.
- AR Option Overview for Vendors.docx
  - A Review of AR Option.
- Information Data Module(IDM) for Vendors
  - Includes business rules, coding information and codes used during development of the CDA.
- 57.123_AUR Micro Electronic Upload Tables
  - View of the AR Option form to offer a visual of data elements required for submission.
- ARO organism mapping.xlsx
  - Lists the valid AR Option pathogens.
  - Refer to AntiP tab in the IDM for details.
- AR_CDA_Vendor Samples

  Contains Antimicrobial Resistance (AR) xml samples of various AR-numerator CDAs.

Important Links

- National Healthcare Safety Network (NHSN):
  http://www.cdc.gov/nhsn/
- Surveillance for Antimicrobial Use (AU) and Antimicrobial Resistance (AR) Options:
  http://www.cdc.gov/nhsn/acute-care-hospital/aur/index.html
- Direct link to AUR Module protocol:
  https://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf
- NHSN CDA Submission Support Portal (CSSP)
  https://www.cdc.gov/nhsn/cdaportal/index.html
- HL7 Implementation Guide for CDA® Release 2: Healthcare Associated Infection (HAI) Reports, Release 1 – US Realm , August 2013
  http://www.hl7.org/implement/standards/product_brief.cfm?product_id=20

Questions