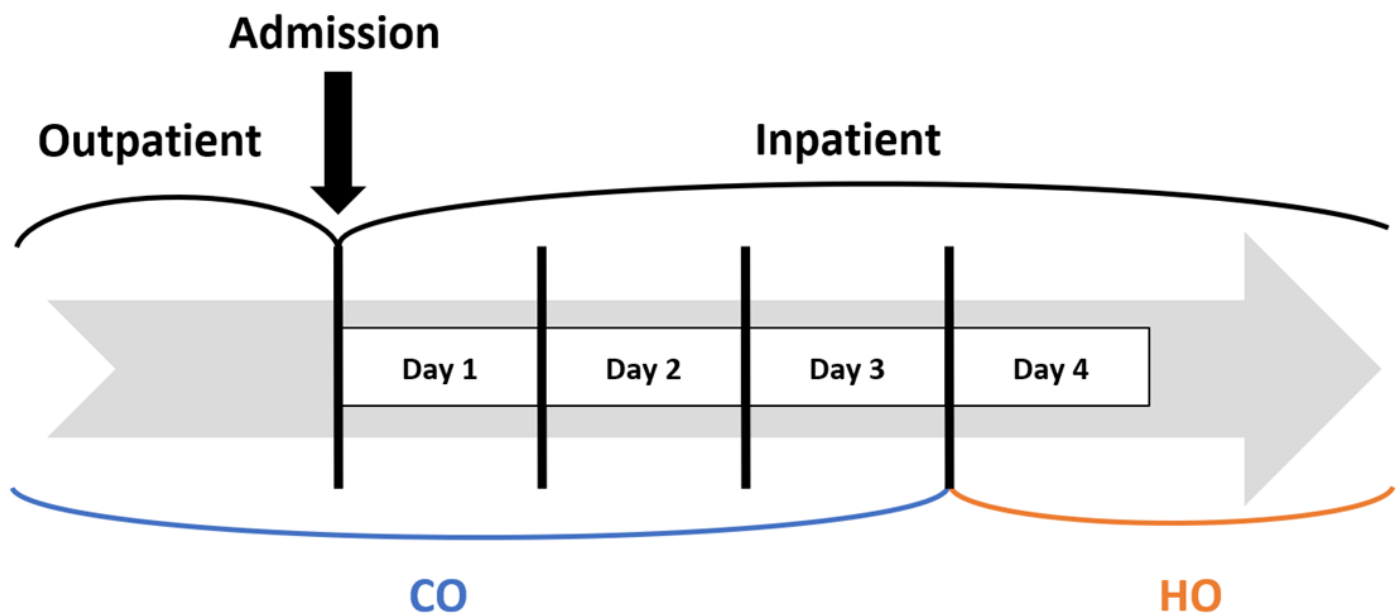# AR Option Standardized Resistant Infection Ratio (SRIR) Report

Description

The Antimicrobial Resistance (AR) Option Standardized Resistant Infection Ratio (SRIR) is a metric developed by CDC to enable facilities to compare their rates of hospital-onset drug-resistant infection events to a national benchmark. It compares the actual number of resistant infections to the number predicted, given the standard population (specifically, the 2019 NHSN baseline), adjusting for several risk factors that have been found to be statistically significantly associated with rates of resistant infections. This report includes a set of tables that display the SRIR by AR phenotype (hospital-onset AR Events that meet NHSN-specific resistance definitions) and specimen source (blood, lower respiratory tract, and urine). SRIRs are not available for the cerebrospinal fluid (CSF) specimen source. The AR phenotype definitions can be found in Appendix I of the AUR Module Protocol. NHSN classifies AR Events as hospital-onset (HO) or community-onset (CO) based on the specimen collection date and date of admission (see screenshot below). Facility admission date is considered Day 1. If the specimen was collected in an outpatient location or in an inpatient location on Days 1, 2, or 3, the AR Event is classified as CO. If the specimen was collected in an inpatient location on Day 4 or after, the AR Event is classified as HO.

NHSN calculates the SRIR for each AR phenotype and specimen source using the following formula:

$$\text{SRIR} = \frac{\text{\# Observed Resistant Infections}}{\text{\# Predicted Resistant Infections}}$$
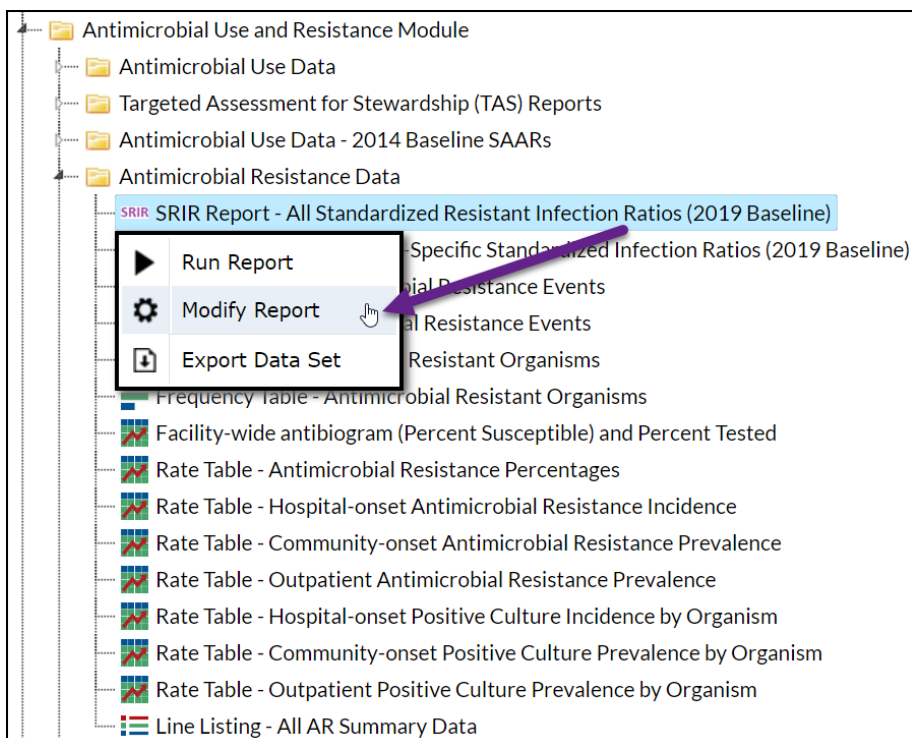
The default settings for the SRIR report produce a report by quarter, but users can make modifications to display the data by half-year, year, or cumulative time periods. Users do not have the option to run the report by month. The SRIR report can be generated for specimen collection dates 2019 and forward. The default option will include 21 tables, one for each combination of AR phenotype and specimen source, though users can modify the report to display only certain tables.

Example

Suppose you want to review the SRIR for hospital-onset extended-spectrum cephalosporin-resistant Enterobacterales in urine specimens for 2020-2022 by quarter for your facility.

After generating data sets, to run the report, click Analysis > Reports > Antimicrobial Use and Resistance Module > Antimicrobial Resistance Data. After selecting the report, "SRIR Report – All Standardized Resistant Infection Ratios (2019 Baseline)" in this case, a pop-up box will appear that will allow you to "Run Report," "Modify Report," or "Export Data Set." Select "Modify Report" to customize your report.

Modifying the Report

For a general, step-by-step explanation of the NHSN modification screen, please refer to this document: https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/howtomodifyreport.pdf.

When you choose to modify the report, the modification screen appears showing multiple tabs containing available modifications for the given report. The "Title/Format" tab allows you to update the report title and select the format in which you want the report displayed, such as HTML or PDF. To filter the data by time period, choose the "Time Period" tab at the top of the page. To display data for 2020-2022, select Summary~Yr with a beginning date of 2020 and an ending date of 2022.

Tip: *For more descriptive variable labels on your report, check the box "Show descriptive variable names" that appears near the top of the modification window (recommended).*

The "Filters" tab allows you to filter the data displayed in the report. For our example, we want to filter the report to show the SRIR for hospital-onset extended-spectrum cephalosporin-resistant Enterobacterales in urine specimens. Select SRIR Type as the variable and use the "equal" operator. Use the drop-down menu to select "Hospital-onset (HO) Extended-spectrum cephalosporin-resistant Enterobacterales in urine specimens".

The "Display Options" tab allows you to pick how you'd like the tables displayed in your final report. For this example, we'd like the tables to display by quarter, which is the default option. Make sure Summary~Yr/Qtr is selected as the "Group by" value.

Final Report

The example rate table shown below is the result of the modifications shown in this document. In this example, because we specified a single SRIR of interest, we will only see one table. The output below shows the SRIR for hospital-onset extended-spectrum cephalosporin-resistant Enterobacterales in urine specimens collected in 2020-2022 by quarter.

Note: This example uses fictitious data for illustrative purposes only.

National Healthcare Safety Network
SRIR Table - All Standardized Resistant Infection Ratios (2019 Baseline)
As of: September 7, 2023 at 5:33 PM
Date Range: AR_ALL_SRIR_2019 summaryYr 2020 to 2022
if (((SRIR_Type = "HO_ESCEall_Urine")))

① Hospital-onset (HO) Extended-spectrum cephalosporin-resistant Enterobacterales in urine specimens

Facility Org ID	Summary Yr/Qtr ②	SRIR Type ③	Resistant Hospital-Onset Isolates ④	Predicted Resistant Hospital-Onset Isolates ⑤	Patient days from AR Summary ⑥	SRIR ⑦	SRIR p-value ⑧	95% Confidence Interval ⑨
13860	2020Q1	HO_ESCEall_Urine	0	0.339	7226	0.000 (A)	0.713	., 8.837
13860	2020Q3	HO_ESCEall_Urine	0	0.902	19208	. (B)	.	
13860	2020Q4	HO_ESCEall_Urine	0	0.170	3618	. (C)	.	
13860	2021Q2	HO_ESCEall_Urine	0	0.221	4700	.	.	
13860	2021Q3	HO_ESCEall_Urine	0	0.615	13100	0.000	0.541	., 4.871
13860	2021Q4	HO_ESCEall_Urine	2	0.355	7550	5.634	0.056	0.945, 18.613
13860	2022Q1	HO_ESCEall_Urine	0	0.103	2200	.	.	
13860	2022Q2	HO_ESCEall_Urine	0	0.119	2525	.	.	
13860	2022Q3	HO_ESCEall_Urine	0	0.110	2350	.	.	
13860	2022Q4	HO_ESCEall_Urine	0	0.317	6750	.	.	

1. Includes data from January 2019 forward.
2. SRIR=0 indicates the facility reported HO isolates for this organism/group from the specimen source of interest, but none were found to meet resistance criteria (see footnote 4).
⑩ 3. SRIR may be null when: a) no HO isolates of the organism of interest were reported from the given specimen source during the time period, or b) an HO organism of interest was reported for the specimen source but <0.3 events were predicted.
4. See Appendix I of the AUR Module Protocol for phenotype definitions: https://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf.
5. Predicted values and SRIRs for CRE and ESCR will not generate for facilities that answered 'N' to the applicable NHSN Annual Hospital Survey breakpoint questions.

1. The table heading specifies which AR phenotype and specimen source is being displayed in each table. In this example, the table includes the observed and predicted resistant infections for hospital-onset extended-spectrum cephalosporin-resistant Enterobacterales in urine specimens.

2. The second column in the table specifies the time period. In the modifications screen, we filtered the time period to only include data from 2020 through 2022, and we specified the report to group the data by quarter. Each row in the table represents one quarter starting with 2020Q1 and ending with 2022Q4. Quarters within the range specified that have no AR Option data do not appear in the table (2020Q2 and 2021Q1 in this example).

3. The third column specifies the abbreviation for the SRIR model type being displayed; this should align with the table heading.

4. Each table will include the number of hospital-onset AR Events isolated from the specified specimen source that met the resistance definition for the specified AR phenotype. In this example as shown in the purple box, there were 2 hospital-onset extended-spectrum cephalosporin-resistant Enterobacterales isolated from urine in 2021Q4.

5. NHSN calculates predicted resistant hospital-onset isolates by risk-adjusting for several risk factors found to be statistically significantly associated with differences in infection incidence among the SRIR referent population. The referent population comes from nationally aggregated AR data reported to NHSN during the baseline time period (2019). As shown in the purple box, NHSN calculated 0.355 predicted hospital-onset extended-spectrum cephalosporin-resistant Enterobacterales urine isolates for this facility in 2021Q4.

6. The table includes the patient days reported for all facility inpatient locations (FacWideIN) to the AR Option since patient days is used in the calculation of the predicted resistant hospital-onset isolates. Data from outpatient locations are not included in SRIR risk adjustment. As shown in the purple box, patients contributed 7,550 patient days for all facility inpatient locations in 2021Q4.

7. The SRIR is calculated by dividing observed resistant hospital-onset isolates by predicted resistant hospital-onset isolates. As shown in the purple box, the SRIR was calculated by dividing 2 by 0.355, which equals 5.634. The SRIR for hospital-onset extended-spectrum cephalosporin-resistant Enterobacterales isolated from urine specimens in 2021Q4 is 5.634. A SRIR greater than 1.0 indicates that more resistant infections were observed than predicted. A SRIR less than 1.0 indicates that fewer resistant infections were observed than predicted. A SRIR of 0 indicates a facility reported the pathogen of interest from the specimen source of interest during the time period, but the pathogen was not resistant to the drug(s) specified.

8. The SRIR p-value is a statistical measure that tells you if observed resistant infections are significantly different from predicted resistant infections. A p-value less than 0.05 (an arbitrary and conveniently used cut point) indicates that the number of observed resistant infections is statistically significantly different (higher or lower) than the number of predicted resistant infections. In this example, a p-value of 0.056 indicates that observed infections are not statistically significantly different than predicted infections.

9. The 95% Confidence Interval (CI) is a range of values in which we have a high degree of confidence that the true SRIR lies; however, the SRIR reported under the SRIR column is the most likely value. If the CI includes the value of 1, then the SRIR is not statistically significant (observed resistant infections are not statistically significantly different from predicted resistant infections, using the same convenient cut point). In this example, the 2021Q4 SRIR 95% CI contains 1, so we can conclude that the 2021Q4 SRIR is not statistically signficantly different than 1.

Important Note: Users should interpret p-values and 95% CI with caution, as statistical significance does not necessarily translate into clinical significance. For example, a rapid increase of resistant infection events compared to the facility's baseline or a cluster of events in a short period of time and patient care locations may already warrant investigation even if the SRIR is not statistically significantly higher than the national benchmark.

10. The SRIR footnotes are the same across all tables.
    a. The report only includes data from January 2019 forward.
    b. When the SRIR equals 0, this indicates the facility reported HO isolates for the organism of interest from the given specimen source, but none were found to meet resistance criteria.
        i. An example of SRIR=0 can be seen by the orange teardrop (A).
    c. The SRIR will be null when no HO isolates of the organism of interest were reported from the given specimen source during the time period, or an HO organism of interest was reported for the specimen source but <0.3 events were predicted (minimum precision criteria was not met).
        i. Examples of null SRIRs can be seen by the orange teardrops (B) and (C).
    d. See Appendix I of the AUR Module Protocol for phenotype definitions: https://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf.
    e. If a facility answered 'N' to the NHSN Annual Hospital Survey question, "Has the laboratory implemented revised breakpoints recommended by CLSI" for cephalosporin and monobactam breakpoints for Enterobacterales in 2010 or carbapenem breakpoints for Enterobacterales in 2010, then the predicted values and SRIRs for extended-spectrum cephalosporin-resistant Enterobacterales and/or carbapenem-resistant Enterobacterales, respectively, will be suppressed for that year.

Note: If denominator data (*i.e.*, patient days) are missing (data not submitted) for a month, but AR Events were reported for that month, then the AR Events for that month will be excluded from the observed counts for the rollup (*i.e.*, quarter, half-year, year, cumulative). If denominator data (*i.e.*, patient days) are missing or reported as zero for all three months in a quarter, all six months in a half-year, all 12 months in a year, or all months (cumulative), but AR Events were reported for that time period, then the AR Events will be included in the counts, but both the denominator and SRIR will be suppressed/appear missing ('.').

Additional Resources

How to Export Data from NHSN: http://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/exportdata.pdf

AUR Module Protocol: https://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf

- AR Option Phenotype Definitions: Appendix I of the AUR Module Protocol

AUR Training: https://www.cdc.gov/nhsn/training/patient-safety-component/aur.html

NHSN Analysis Quick Reference Guides: http://www.cdc.gov/nhsn/PS-Analysis-resources/reference-guides.html