2023 National Healthcare Safety Network (NHSN) Antimicrobial Use (AU) Option Report

Centers for Disease Control and Prevention

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Division of Healthcare Quality Promotion

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Executive Summary

Monitoring antimicrobial use (AU) is an important component of antimicrobial stewardship programs (ASPs). AU data delivered to ASPs allow stewards to develop, select, and assess interventions aimed at optimizing antimicrobial prescribing[1]. These interventions, in turn, serve to improve the effectiveness of antimicrobial treatment, protect patients from harms caused by unnecessary antimicrobial exposure, and curb antimicrobial resistance associated with prophylactic and therapeutic excess[2-4].

Since its launch in 2012, the Centers for Disease Control and Prevention's (CDC) National Healthcare Safety Network (NHSN) Antimicrobial Use Option has become a central resource for monitoring AU in US hospitals and supporting hospital antibiotic stewardship program implementation. Hospitals submit AU data electronically to NHSN, where the data are aggregated, analyzed, and used to produce inpatient AU benchmarks. The Standardized Antimicrobial Administration Ratio (SAAR) is NHSN's risk-adjusted AU metric. The SAAR is available to hospitals reporting to NHSN's AU Option from select patient-care locations. Data from the NHSN AU Option have been used by individual hospitals, health systems and health departments to inform and support efforts to improve antibiotic use[5-7].

The 2023 NHSN AU Option Report summarizes SAAR distributions and antimicrobial use within each SAAR antimicrobial agent category among adult, pediatric, and neonatal patient care locations (specified in Table 1). The report includes data from acute care hospitals that reported at least nine months of data in 2023 from SAAR locations: 2,311 hospitals reported from eligible adult SAAR locations, 404 reported from pediatric SAAR locations, and 801 reported from neonatal SAAR locations. The distributions of SAARs among all reporting hospitals inform stewardship efforts by enabling hospitals and group users to compare their SAARs with the national distribution. Hospital antibiotic stewardship staff can consider the distributions to set facility-specific targets when using the NHSN Targeted Assessment for Antimicrobial Stewardship (TAS) Strategy. The percentage of AU by class and drug within a SAAR antimicrobial agent category provides insight into prescribing practices across different patient care locations, such as medical critical care units (also known as intensive care units, or ICUs) compared to medical wards. Facility stewardship staff may evaluate usage patterns in the context of their local treatment guidelines, penicillin allergy algorithms, antimicrobial resistance rates, and formulary. For more information and resources related to TAS, refer to the TAS Guide[8].

Standardized Antimicrobial Administration Ratio (SAAR)

The SAAR is a ratio of observed antimicrobial days to predicted antimicrobial days. We developed each SAAR predictive model included in this report by applying negative binomial regression to AU data from eligible adult and pediatric locations reporting data in 2017 and eligible neonatal locations reporting data in 2018 (the "baseline years", respectively). Eligible locations were determined based on availability of data in the baseline year and clinical relevance. The SAAR categories and agents within those categories were defined by CDC based on published and presented reports on stewardship efforts as well as discussions with antibiotic stewardship experts. In this report, we include location-level SAAR distributions and we calculate pooled mean SAAR values by pooling observed and predicted antimicrobial days across

SAAR eligible location types. All predicted antimicrobial days were calculated using the 2017 adult and pediatric SAAR baseline models and 2018 neonatal SAAR baseline models. Table 1 and Table 2 list SAAR patient care locations and antimicrobial agent categories, respectively.

$$SAAR = \frac{\textbf{Observed}\ antimicrobial\ days\ of\ therapy}{\textbf{Predicted}\ antimicrobial\ days\ of\ therapy}$$

The SAAR can be used to track AU changes over time for individual hospitals and as a benchmarking metric for comparing AU among similar patient care locations nationally. While the SAAR is not a measure of appropriateness of AU, it allows ASPs to compare their AU to a national benchmark. These analyses allow facilities to assess whether they are using antimicrobials at higher rates than predicted (specifically, SAAR values > 1), which can prompt them to further evaluate prescribing practices and intervene, if necessary, to optimize AU. The SAAR Guide[9] and Antimicrobial Use and Resistance (AUR) Module Protocol[10] contain more information on the SAAR.

Table 1. Eligible SAAR patient care locations (2017 adult and pediatric baseline, 2018 neonatal baseline)

Adult SAAR Locations	Pediatric SAAR Locations	Neonatal SAAR Locations
• Medical critical care units • Medical-surgical critical care units • Surgical critical care units • Medical wards • Medical-surgical wards • Surgical wards • Step down units • General hematology-oncology wards	• Medical critical care units • Medical-surgical critical care units • Medical wards • Medical-surgical wards • Surgical wards	• Level II special care nurseries • Level II/III critical care units • Level III critical care units • Level IV critical care units

The CDC Locations and Descriptions and Instructions for Mapping Patient Care Locations document contains the NHSN patient care location definitions.
Abbreviations: Standardized Antimicrobial Administration Ratio (SAAR).

Table 2. SAAR antimicrobial agent categories (2017 adult and pediatric baseline, 2018 neonatal baseline)

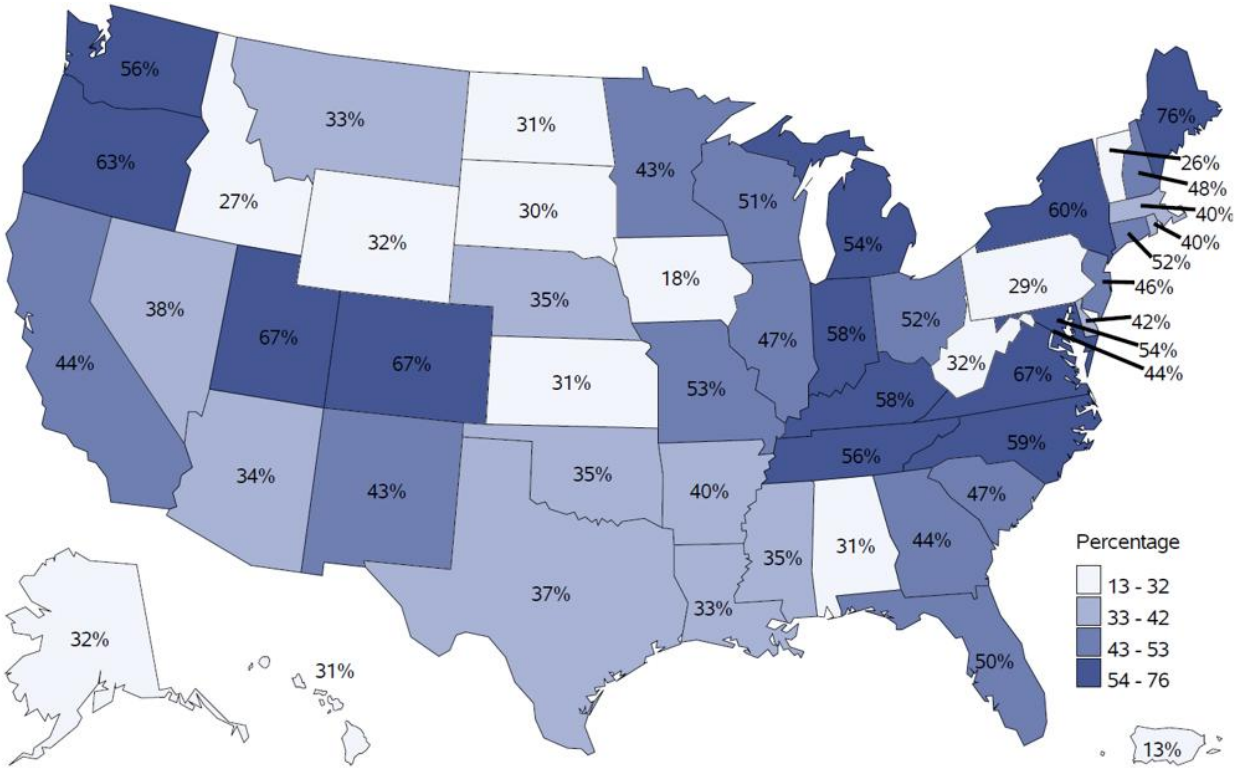
Adult SAAR Categories	Pediatric SAAR Categories	Neonatal SAAR Categories
• All antibacterial agents (All)	• All antibacterial agents (All)	• All antibacterial agents (All)
• Broad spectrum antibacterial agents predominantly used for hospital-onset infections (BSHO)	• Broad spectrum antibacterial agents predominantly used for hospital-onset infections (BSHO)	• Vancomycin predominantly used for treatment of late-onset sepsis (Vanc)
• Broad spectrum antibacterial agents predominantly used for community-acquired infections (BSCA)	• Broad spectrum antibacterial agents predominantly used for community-acquired infections (BSCA)	• Broad spectrum antibacterial agents predominantly used for hospital-onset infections (BSHO)
• Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA) (GramPos)	• Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA) (GramPos)	• Third generation cephalosporins (Cephs)
• Narrow spectrum beta-lactam agents (NSBL)	• Narrow spectrum beta-lactam agents (NSBL)	• Ampicillin predominantly used for treatment of early-onset sepsis (Amp)
• Antibacterial agents posing the highest risk for CDI (CDI)	• Antibacterial agents posing the highest risk for CDI (CDI)	• Aminoglycosides predominantly used for treatment of early-onset and late-onset sepsis (Amino)
• Antifungal agents predominantly used for invasive candidiasis (Antifungal)	• Antifungal agents predominantly used for invasive candidiasis (Antifungal)	• Fluconazole predominantly used for candidiasis (Fluco)
	• Azithromycin (Azith)	

For the list of specific agents included in each SAAR category, refer to Appendix E of the AUR Module protocol[10].
Abbreviations: Standardized Antimicrobial Administration Ratio (SAAR).

The Antimicrobial Use Option and the Medicare Promoting Interoperability Program

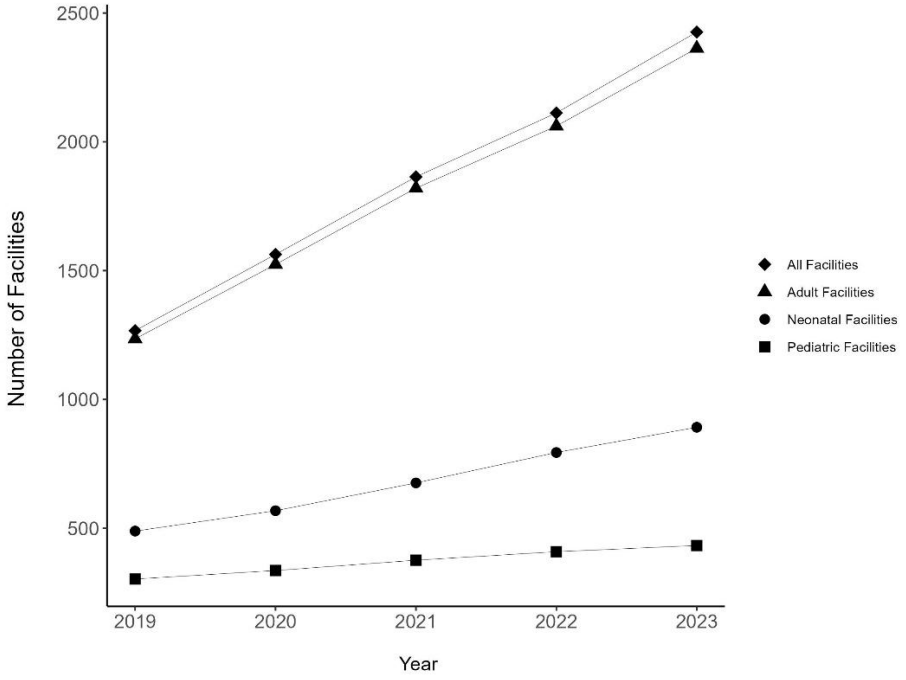
In 2017, Centers for Medicare & Medicaid Services (CMS) and the Assistant Secretary for Technology Policy/Office of the National Coordinator for Health Information Technology (ASTP/ONC) identified NHSN AUR Module reporting as one option to meet the Public Health Registry reporting element within the CMS Medicare Promoting Interoperability Program (formerly the Meaningful Use Program) for eligible hospitals and critical access hospitals (CAHs). In August 2022, CMS published the 2023 Final Rule for the Medicare Promoting Interoperability Program for eligible hospitals and CAHs that required the AUR Surveillance measure under the Public Health and Clinical Data Exchange Objective[11]. Although no federal AU reporting mandates were in effect during the period covered by this report, the publication of CMS' Final Rule contributed to increased AU Option enrollment at the end of 2023. As of January 1, 2024, 3,236 facilities reported at least one month of data to the AU Option. Participation, by state, among facilities eligible to report ranged from 13% in Puerto Rico to 76% in Maine **(Figure 1)**. The numbers of reporting hospitals and SAAR-eligible locations increased over time **(Figures 2a and 2b)**.

Figure 1. Percentage of hospitals reporting at least one month of data to the Antimicrobial Use Option among National Healthcare Safety Network acute care hospitals* by state/jurisdiction as of January 1, 2024



**Acute care hospitals include critical access, children's, general acute care, long-term acute care, military, oncology, orthopedic, psychiatric, inpatient rehabilitation, surgical, Veterans Affairs, women's, and women's and children's hospitals.*

Figure 2a. Numbers of reporting hospitals* over time — National Healthcare Safety Network Antimicrobial Use Option, 2019–2023

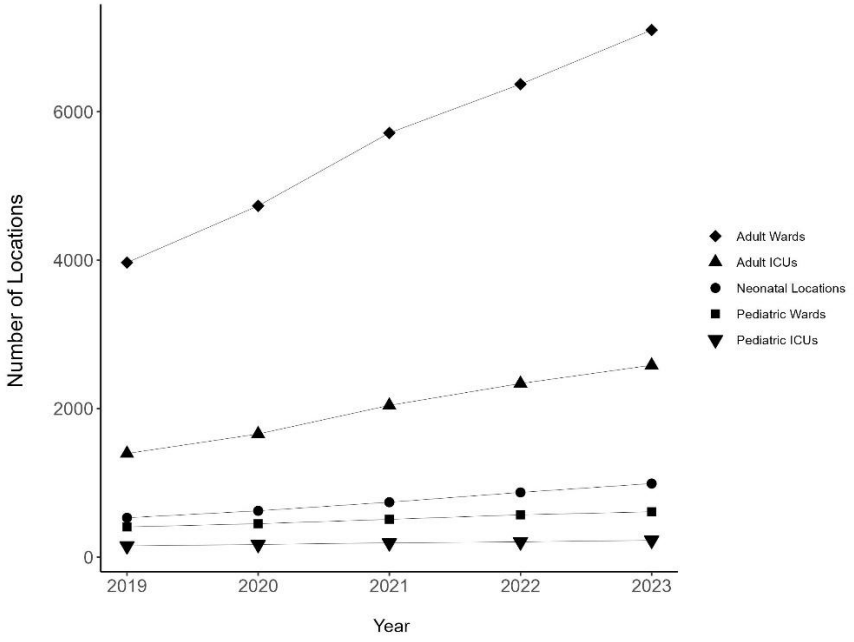


Year	All Facilities	Adult Facilities	Pediatric Facilities	Neonatal Facilities
2019	1267	1235	303	489
2020	1563	1524	336	568
2021	1864	1820	376	676
2022	2112	2061	409	794
2023	2426	2363	433	892

** "All Facilities" in Figure2a includes hospitals with one or more adult (excluding oncology and step-down), pediatric, or neonatal SAAR-eligible locations reporting ≥9 months in 2023. Adult facilities are hospitals reporting ≥9 months for at least one SAAR-eligible adult location type. Pediatric facilities are hospitals reporting ≥9 months for at least one SAAR-eligible pediatric location type. Neonatal facilities are hospitals reporting ≥9 months for at least one SAAR-eligible neonatal location type. These three distinctions are not mutually exclusive, meaning the same hospital can be represented in all three groups.*

Abbreviation: Standardized Antimicrobial Administration Ratio (SAAR)

Figure 2b. Numbers of reporting SAAR-eligible locations* over time — National Healthcare Safety Network Antimicrobial Use Option, 2019–2023



Year	Adult Wards	Adult ICUs	Pediatric Wards	Pediatric ICUs	Neonatal Locations
2019	3968	1396	407	151	530
2020	4732	1659	450	170	624
2021	5714	2044	509	192	740
2022	6371	2339	570	205	872
2023	7101	2585	611	227	991

**Adult Wards and ICUs: medical, medical-surgical, and surgical. Pediatric Wards: medical, medical-surgical, and surgical. Pediatric ICUs: medical, medical-surgical. Neonatal locations: Level II, II/III, III and IV units. Only locations reporting ≥9 months are included.*

Abbreviations: Standardized Antimicrobial Administration Ratio (SAAR), Intensive Care Unit (ICU).

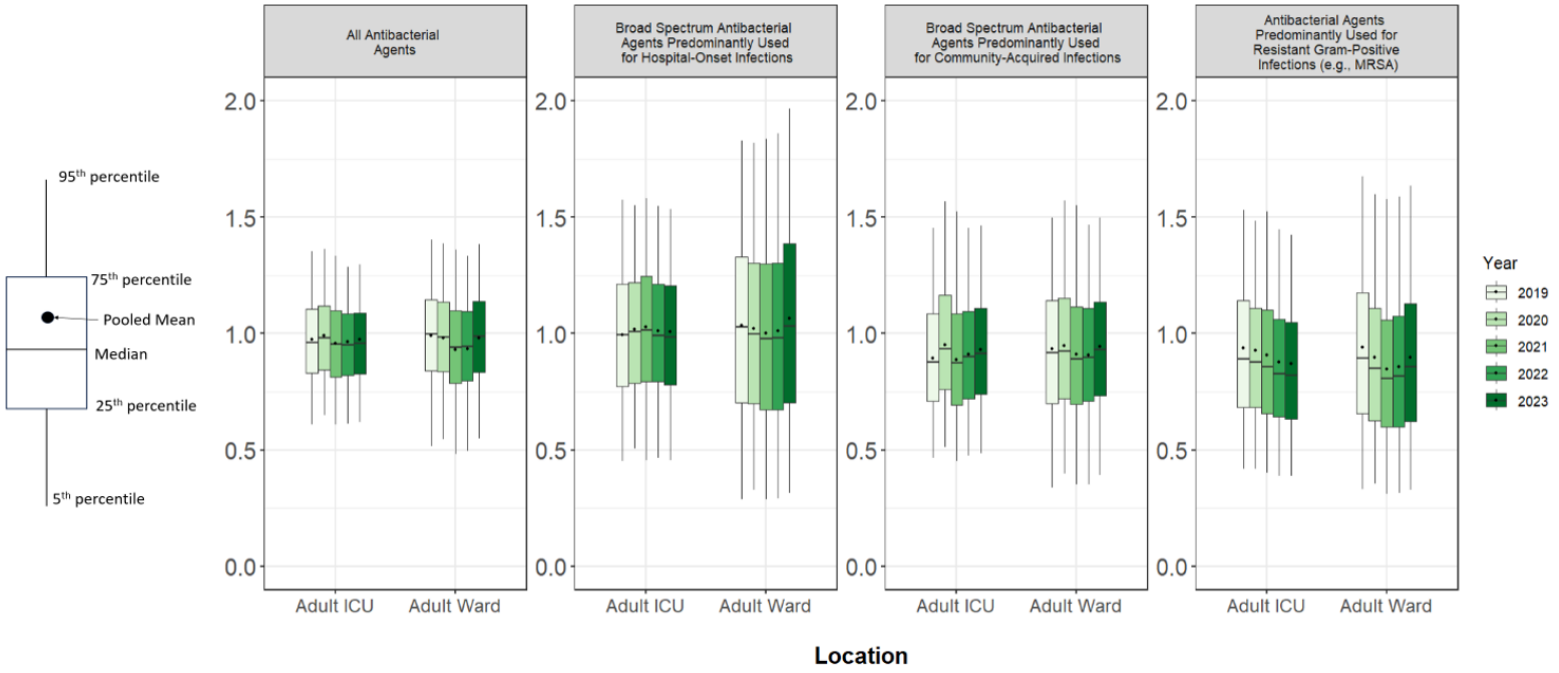
High-level SAAR comparison, 2019–2023

The following **Figures 3a-c** represent select SAAR distributions among hospitals reporting during 2019–2023 by antimicrobial agent category for select location types. The SAAR distributions vary across years, locations, and antimicrobial categories. The 2023 AU Report data tables provide full SAAR distributions and the percentage of AU by class and drug within each SAAR antimicrobial agent category. A full summary of methods, including inclusion/exclusion criteria, can be found in the Technical Appendix of the AU Report data tables. The pooled mean SAARs and distributions in the Excel data tables display can be leveraged by ASPs to assess how their facility's AU compares to others. The AU Report shows data aggregated to the annual level; therefore, we recommend pooling SAARs over an entire year within the

NHSN analysis reports before comparing to the national values in the report.

Visual comparisons of SAAR distributions year to year are subjective and may not represent statistically significant or clinically meaningful changes. There are multiple potential explanations for the variation in SAARs between years, including but not limited to: 1) the COVID-19 pandemic, which led to changes in characteristics of inpatient populations[12]; 2) changes to prescribing practices due to antimicrobial stewardship efforts; 3) changes to the composition of hospitals submitting data to NHSN AU Option; 4) availability of antimicrobial agents; and 5) activities of diseases that could impact antimicrobial use. For example, Broad spectrum antibacterial agents predominantly used for community-acquired infections (BSCA) SAARs were higher in 2023 than 2022 in pediatric ICUs and wards. Among the hospitals with a significant increase of BSCA SAARs, the uptick was mainly driven by β-lactam/β-lactamase inhibitor agents (specifically, amoxicillin/clavulanate and ampicillin/sulbactam). This increase coincides with the surge of respiratory illness[13] and national amoxicillin shortage[14] that started in late 2022. This may have contributed to more use of amoxicillin/clavulanate as an alternative for amoxicillin among pediatric patients[14].

Figure 3a. SAAR distributions among reporting locations, by select antimicrobial agent category, for adult SAAR-eligible intensive care units and wards — National Healthcare Safety Network Antimicrobial Use Option, 2019–2023



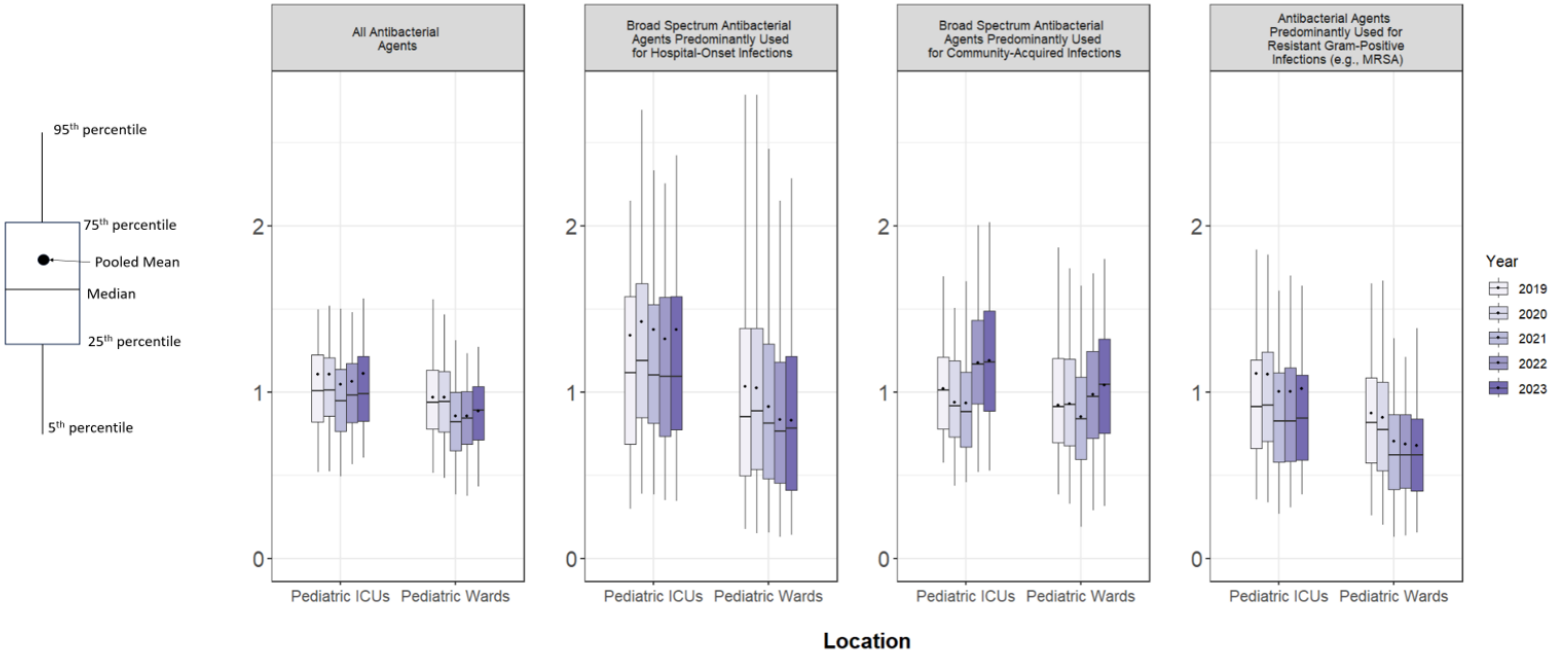
Year	All antibacterial agents		Broad spectrum antibacterial agents predominantly used for hospital-onset infections		Broad spectrum antibacterial agents predominantly used for community-acquired infections		Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)	
	ICUs	Wards	ICUs	Wards	ICUs	Wards	ICUs	Wards
2019	0.962	0.997	0.993	1.028	0.878	0.916	0.892	0.896
2020	0.980	0.983	1.007	0.997	0.935	0.925	0.877	0.851
2021	0.955	0.942	1.014	0.979	0.875	0.891	0.859	0.808
2022	0.951	0.944	0.993	0.982	0.902	0.899	0.826	0.817
2023	0.959	0.989	0.986	1.031	0.913	0.932	0.822	0.858

The table shows the median SAAR value for each selected SAAR antimicrobial agent category and location type.

Figure 3a notes:

- *Adult ICUs include medical critical care units, medical-surgical critical care units, and surgical critical care units. Adult wards include medical wards, medical-surgical wards, and surgical wards. Step-down units and adult general hematology-oncology units are not included in pooled means or SAAR distributions.*
- *Data are from locations reporting ≥9 months of data for the given calendar year. This does not represent a continuous cohort of reporters.*
- *Predicted use (the SAAR denominator) is based on antimicrobial use rates in 2017 among the adult SAAR referent population.*
- *A SAAR <1.0 does not necessarily mean antimicrobial use and prescribing is clinically appropriate and a SAAR >1.0 does not necessarily mean antimicrobial use and prescribing is clinically inappropriate.*
- *Abbreviations: Standardized Antimicrobial Administration Ratio (SAAR), intensive care unit (ICU).*

Figure 3b. SAAR distributions among reporting locations, by select antimicrobial agent category, for pediatric SAAR-eligible intensive care units and wards — National Healthcare Safety Network Antimicrobial Use Option, 2019–2023



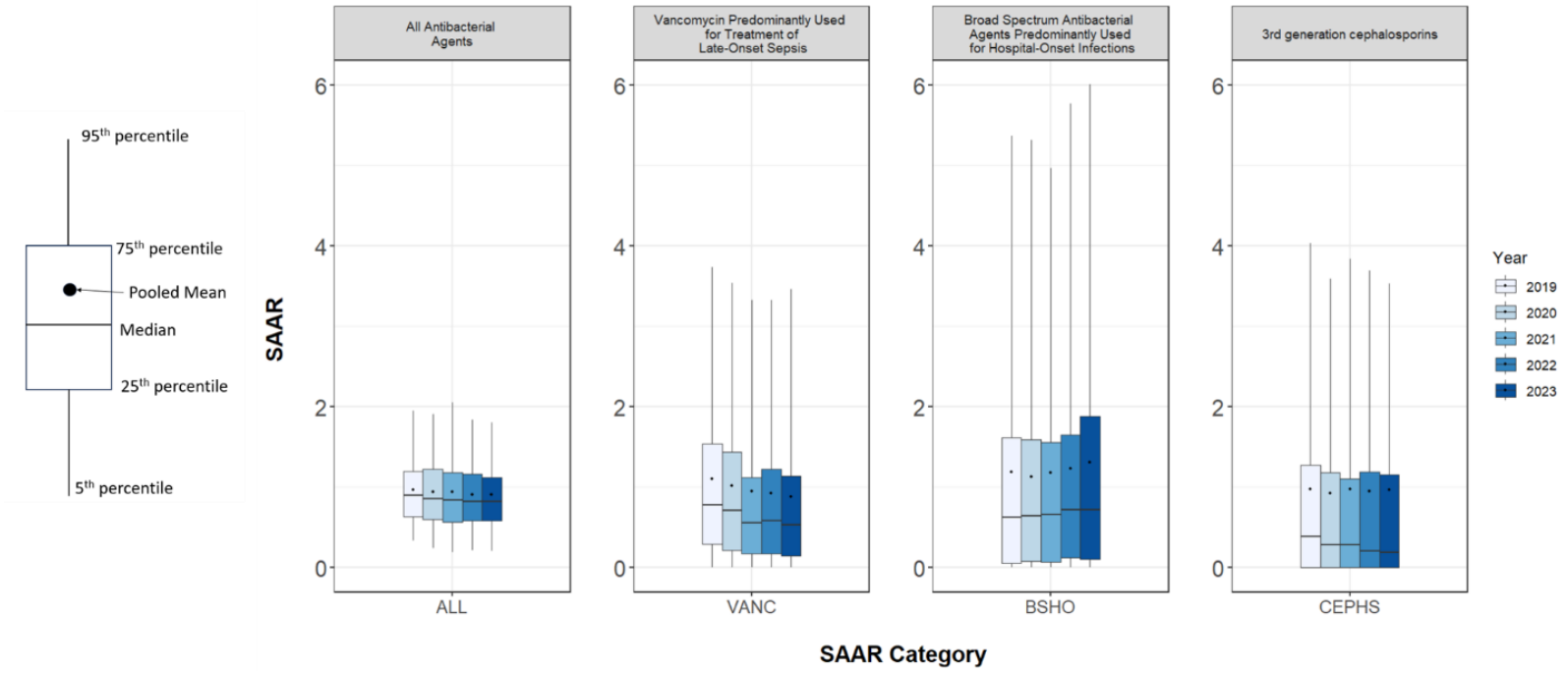
Year	All antibacterial agents		Broad spectrum antibacterial agents predominantly used for hospital-onset infections		Broad spectrum antibacterial agents predominantly used for community-acquired infections		Antibacterial agents predominantly used for resistant Gram-positive infections (e.g., MRSA)	
	ICUs	Wards	ICUs	Wards	ICUs	Wards	ICUs	Wards
2019	1.005	0.938	1.115	0.850	1.012	0.913	0.910	0.818
2020	1.013	0.942	1.190	0.884	0.917	0.925	0.921	0.775
2021	0.945	0.819	1.102	0.813	0.880	0.837	0.826	0.623
2022	0.980	0.842	1.095	0.766	1.167	0.974	0.824	0.622
2023	0.991	0.890	1.095	0.781	1.179	1.045	0.844	0.621

The table shows the median SAAR value for each selected SAAR antimicrobial agent category and location type.

Figure 3b notes:

- *Pediatric ICUs include medical critical care units and medical-surgical critical care units. Pediatric wards include medical wards, medical-surgical wards, and surgical wards.*
- *Data are from locations reporting ≥9 months of data for the given calendar year. This does not represent a continuous cohort of reporters.*
- *Predicted use (the SAAR denominator) is based on antimicrobial use rates in 2017 among the pediatric SAAR referent population. A SAAR <1.0 does not necessarily mean antimicrobial use and prescribing is clinically appropriate and a SAAR >1.0 does not necessarily mean antimicrobial use and prescribing is clinically inappropriate.*
- *Abbreviations: Standardized Antimicrobial Administration Ratio (SAAR), intensive care unit (ICU).*

Figure 3c. SAAR distributions among reporting locations, by select antimicrobial agent category, for SAAR-eligible neonatal location types — National Healthcare Safety Network Antimicrobial Use Option, 2019–2023



Year	All antibacterial agents	Vancomycin predominantly used for treatment of late-onset sepsis	Broad spectrum antibacterial agents predominantly used for hospital-onset infections	3rd generation cephalosporins
2019	0.898	0.783	0.631	0.384
2020	0.862	0.714	0.642	0.282
2021	0.843	0.555	0.658	0.289
2022	0.828	0.585	0.724	0.209
2023	0.827	0.537	0.717	0.188

The table shows the median SAAR value for each selected SAAR antimicrobial agent category.

Figure 3c notes:

- *Neonatal locations include step down neonatal nurseries (Level II), Level II/III NICUs, Level III NICUs, and Level IV NICUs.*
- *Data from locations reporting ≥9 months of data for the given calendar year. This does not represent a continuous cohort of reporters.*
- *Predicted use (the SAAR denominator) is based on antimicrobial use rates in 2018 among neonatal SAAR referent populations.*
- *A SAAR <1.0 does not necessarily mean antimicrobial use and prescribing is clinically appropriate and a SAAR >1.0 does not necessarily mean antimicrobial use and prescribing is clinically inappropriate.*
- *Abbreviations: Standardized Antimicrobial Administration Ratio (SAAR)*

2023 Antimicrobial Use Data

The 2023 AU Data Report provides a summary of median and pooled mean SAARs and percentages of use within SAAR antimicrobial agent categories for adult, pediatric, and neonatal locations in the following sections. The 2023 AU Report data tables provide more detailed information about SAAR distributions and the percentage of AU by class and drug within a SAAR antimicrobial agent category. The 2023 AU Report Excel data tables include the following:

- Scope of Report and Table of Contents
- Characteristics of NHSN acute care hospitals reporting for adult, pediatric, and neonatal SAAR locations for ≥9 months in 2023
- SAAR distributions for adult, pediatric, and neonatal SAAR antimicrobial agent category by location type
- Percentage of antimicrobial use by class and drug for each SAAR antimicrobial agent category by location type
- SAAR distributions for adult, pediatric, and neonatal SAAR antimicrobial agent categories, by state

Adult SAAR Antimicrobial Agent Categories

In 2023, 2,311 facilities reported ≥9 months of AU data from 10,419 adult SAAR-eligible patient care locations (AU Report Excel Data Table 1a). The pooled mean SAAR values differ across location type and SAAR category (Table 3).

Table 3. Pooled mean SAAR values with 95% confidence limits by adult location type and SAAR antimicrobial agent category—National Healthcare Safety Network Antimicrobial Use Option, 2023

	Adult SAAR Antimicrobial Agent Categories						
Adult SAAR Location Type	**All antibacterial agents**	**Broad spectrum antibacterial agents predominantly used for hospital-onset infections**	**Broad spectrum antibacterial agents predominantly used for community-acquired infections**	**Antibacterial agents predominantly used for resistant Gram-positive infections**	**Narrow spectrum beta-lactam agents**	**Antibacterial agents posing the highest risk for *Clostridioides difficile* infection**	**Antifungal agents predominantly used for invasive candidiasis**
Medical ICUs	1.016 (1.015, 1.018)	1.027 (1.025, 1.029)	0.985 (0.982, 0.987)	0.973 (0.971, 0.976)	1.027 (1.023, 1.031)	1.273 (1.270, 1.276)	0.903 (0.898, 0.908)
Medical-Surgical ICUs	0.960 (0.960, 0.961)	1.009 (1.007, 1.010)	0.904 (0.902, 0.906)	0.838 (0.837, 0.840)	0.997 (0.994, 0.999)	1.039 (1.037, 1.040)	0.876 (0.873, 0.880)
Surgical ICUs	0.939 (0.938, 0.941)	0.969 (0.966, 0.972)	0.973 (0.968, 0.978)	0.816 (0.813, 0.820)	0.808 (0.805, 0.812)	1.159 (1.155, 1.163)	1.054 (1.048, 1.060)
Medical Wards	0.959 (0.959, 0.960)	0.968 (0.967, 0.969)	0.942 (0.941, 0.943)	0.866 (0.864, 0.867)	1.078 (1.076, 1.080)	0.998 (0.997, 0.999)	0.848 (0.845, 0.851)
Medical-Surgical Wards	0.992 (0.992, 0.992)	1.121 (1.120, 1.122)	0.928 (0.928, 0.929)	0.870 (0.869, 0.871)	1.073 (1.071, 1.074)	1.007 (1.006, 1.007)	0.890 (0.888, 0.893)
Surgical Wards	0.991 (0.990, 0.992)	1.123 (1.121, 1.125)	1.033 (1.031, 1.035)	0.898 (0.897, 0.899)	0.830 (0.829, 0.832)	1.094 (1.093, 1.096)	0.998 (0.994, 1.002)
Step Down Units	0.959 (0.959, 0.960)	0.983 (0.982, 0.985)	0.937 (0.936, 0.939)	0.873 (0.870, 0.877)	0.986 (0.983, 0.988)	1.018 (1.017, 1.019)	0.860 (0.856, 0.863)
General Hematology-Oncology Wards	1.005 (1.004, 1.006)	0.993 (0.990, 0.995)	1.042 (1.039, 1.045)	0.974 (0.971, 0.976)	1.063 (1.058, 1.068)	1.097 (1.095, 1.100)	0.798 (0.794, 0.801)

Abbreviations: Standardized Antimicrobial Administration Ratio (SAAR), intensive care unit (ICU)

Highlights of percentage of AU by class and drug for each adult SAAR antimicrobial agent category are outlined below (table 2):

- Within the **All antibacterial SAAR** category, the top 10 antibacterial agents represented 78.8%–87.0% of use, depending on the SAAR location. In most SAAR location types, the three most commonly used agents included vancomycin, piperacillin/tazobactam, and either ceftriaxone or cefepime. An exception to this was surgical ICUs and surgical wards, where cefazolin was included in the top three. (AU Report Excel Data Table 2a2)

- Within the Broad spectrum antibacterial agents predominantly used for hospital-onset infections **(BSHO) SAAR** category, piperacillin/tazobactam was the most commonly used agent in ICUs, non-oncology wards, and step down units, followed by cefepime and meropenem. Cefepime was the most often used agent in general hematology-oncology wards, followed by piperacillin/tazobactam and meropenem. Piperacillin/tazobactam represented 39.8%–60.2% of antimicrobial use in all SAAR locations. Carbapenems (meropenem and imipenem/cilastatin) represented 11.7%–20.1% of use depending on the location types. (AU Report Excel Data Table 2b2)
- Within the Broad spectrum antibacterial agents predominantly used for community-acquired infections **(BSCA) SAAR** category, ceftriaxone had the highest use across all location types, ranging from 48.0% in hematology-oncology wards to 79.8% in medical-surgical ICUs. The next most used agents were levofloxacin and ciprofloxacin. Surgical ICUs and wards had a higher proportion of ertapenem use (range of 6.2%–6.8%) compared to other SAAR locations (range of 3.5%–4.6%). (AU Report Excel Data Table 2c2)

- Within the Antibacterial agents predominantly used for resistant Gram-positive infections **(GramPos) SAAR** category, intravenous vancomycin was the predominant agent used in all SAAR location types, representing 78.0%–83.2% of use across location types, followed by linezolid and daptomycin. (AU Report Excel Data Table 2d2)

- Within the Narrow spectrum beta-lactam agents **(NSBL) SAAR** category, cefazolin had the highest use across all SAAR location types. (AU Report Excel Data Table 2e2)

- Within the Antibacterial agents posing the highest risk for *Clostridioides difficile* infection **(CDI) SAAR** category, third and fourth generation cephalosporins had the highest use across all SAAR location types. General hematology-oncology wards had a higher proportion of fluoroquinolone use among antimicrobials in this category (28.2%) compared to other SAAR location types (range of 7.7%–15.8%). Surgical ICUs (5.5%) and surgical wards (5.6%) had a higher proportion of clindamycin use compared to other SAAR locations (range of 1.6%–3.8%) (AU Report Excel Data Table 2f2)

- Within the Antifungal agents predominantly used for invasive candidiasis **(Antifungal) SAAR** category, echinocandins represented approximately half (range of 49.7%–57.7%) of use in ICUs and one-third (31.5%) of use in step down units. Wards had a higher proportion of fluconazole use (range of 71.6%–78.7%) than echinocandin use (range of 21.3%–28.5%) (AU Report Excel Data Table 2g2)

Pediatric SAAR Antimicrobial Agent Categories

More hospitals reported from pediatric locations in 2023 than 2022 (404 hospitals contributed pediatric data in 2023 compared to 369 hospitals in 2022). The significant increase in reporting enabled us to calculate location-specific percentiles among pediatric medical ICUs for all SAAR types for the first time (AU Report Excel Data Tables 3a1, 3b1, 3c1, 3d1, 3e1, 3f1, 3g1, and 3h1). The pooled mean SAAR values differ across location type and SAAR category (Table 4).

Compared to 2022, we observed higher pooled mean pediatric Broad spectrum antibacterial agents predominantly used for community-acquired infections (BSCA) SAARs in 2023. Among the 780 locations that submitted ≥9 months of data in 2022 and 2023 and had a significant increase in pediatric BSCA SAAR, the use of β-lactam/β-lactamase inhibitors (specifically, amoxicillin/clavulanate and ampicillin/sulbactam) increased significantly from 353.0 to 435.3 per 1,000 days-present while cephalosporins increased slightly from 786.8 to 798.9 per 1000 days-present.

Table 4. Pooled mean SAAR values with 95% confidence limits by pediatric location type and SAAR antimicrobial agent category—National Healthcare Safety Network Antimicrobial Use Option, 2023

	Pediatric SAAR Antimicrobial Agent Categories							
Pediatric SAAR Location Type	**All antibacterial agents**	**Broad spectrum antibacterial agents predominantly used for hospital-onset infections**	**Broad spectrum antibacterial agents predominantly used for community-acquired infections**	**Antibacterial agents predominantly used for resistant Gram-positive infections**	**Narrow spectrum beta-lactam agents**	**Azithromycin**	**Antibacterial agents posing the highest risk for *Clostridioides difficile* infection**	**Antifungal agents predominantly used for invasive candidiasis**
Medical ICUs	1.192 (1.180, 1.204)	2.369 (2.318, 2.420)	1.153 (1.129, 1.177)	0.875 (0.853, 0.897)	1.074 (1.047, 1.101)	0.876 (0.834, 0.919)	1.083 (1.065, 1.102)	1.075 (1.023, 1.130)
Medical-Surgical ICUs	1.109 (1.106, 1.111)	1.347 (1.341, 1.354)	1.193 (1.187, 1.200)	1.029 (1.023, 1.035)	0.767 (0.762, 0.772)	0.774 (0.764, 0.784)	1.292 (1.286, 1.297)	1.608 (1.593, 1.624)
Medical Wards	0.849 (0.847, 0.852)	0.696 (0.691, 0.701)	1.045 (1.039, 1.052)	0.640 (0.634, 0.645)	0.896 (0.890, 0.902)	0.676 (0.666, 0.687)	0.851 (0.846, 0.856)	1.658 (1.631, 1.686)
Medical-Surgical Wards	0.893 (0.891, 0.895)	0.848 (0.844, 0.852)	1.033 (1.029, 1.037)	0.703 (0.699, 0.706)	0.990 (0.986, 0.994)	0.495 (0.489, 0.501)	0.843 (0.840, 0.846)	1.544 (1.527, 1.561)
Surgical Wards	0.970 (0.964, 0.976)	1.453 (1.434, 1.472)	1.150 (1.135, 1.165)	0.572 (0.561, 0.584)	0.760 (0.751, 0.768)	1.252 (1.178, 1.330)	0.751 (0.742, 0.761)	1.065 (1.023, 1.108)

Abbreviations: Standardized Antimicrobial Administration Ratio (SAAR), intensive care unit (ICU)

Highlights of percentage of AU by class and drug for each pediatric SAAR antimicrobial agent category (for categories with more than one agent) are outlined below:

- Within the **All antibacterial SAAR** category, the top ten antibacterial agents represented 61.8%–76.6% of use, depending on the SAAR location type. For all SAAR location types, ceftriaxone had the highest antibacterial use. An exception to this was surgical wards, where cefazolin (instead of ceftriaxone) was the highest. (AU Report Excel Data Table 3a2)

- Within the Broad spectrum antibacterial agents predominantly used for hospital-onset infections **(BSHO) SAAR** category, cefepime and piperacillin/tazobactam were the top agents used (in varying order) in all SAAR location types. Carbapenems (meropenem, ertapenem, and imipenem/cilastatin) represented 9.5%–15.7% of use for different SAAR location types in this category. Medical wards had a higher proportion of aminoglycoside use (6.2%) than other SAAR location types (range of 0.5%–1.9%). (AU Report Excel Data Table 3b2)

- Within the Broad spectrum antibacterial agents predominantly used for community-acquired infections **(BSCA) SAAR** category, ceftriaxone was the predominant agent used across all SAAR location types, ranged from 51.5% in surgical wards to 73.5% in medical ICUs. Ampicillin-sulbactam and amoxicillin-clavulanate use were the next highest (range of 21.7%–46.8%, depending on location type). (AU Report Excel Data Table 3c2)

- Within the Antibacterial agents predominantly used for resistant Gram-positive infections **(GramPos) SAAR** category, most commonly used antimicrobials were IV vancomycin (range of 46.7%–71.6%) and clindamycin (range of 15.7%–42.7%), followed by linezolid (range of 5.6%–11.9%). (AU Report Excel Data Table 3d2)

- Within the Narrow spectrum beta-lactam agents **(NSBL) SAAR** category, cefazolin, ampicillin, and amoxicillin were the top agents used in all SAAR location types. Surgical wards were an exception, where the top three agents were cefazolin, amoxicillin, and cephalexin. (AU Report Excel Data Table 3e2)

- Within the Antibacterial agents posing the highest risk for *Clostridioides difficile* infection **(CDI) SAAR** category, ceftriaxone, cefepime, and clindamycin (in varying order) were the most commonly used agents across SAAR location types. Among antimicrobial agents in this category, medical and medical-surgical ICUs had a higher proportion of third and fourth generation cephalosporins use (84.2% and 83.6%, respectively) than other SAAR location types (range of 72.3%–73.8%), where clindamycin made up the difference. (AU Report Excel Data Table 3g2)

- Within the Antifungal agents predominantly used for invasive candidiasis **(Antifungal) SAAR** category, fluconazole was the top agent for all SAAR location types except medical ICUs. Medical ICUs were the only SAAR location type where echinocandins were used more frequently than azoles (53.0% compared to 47.0%, respectively). In other SAAR location types, azoles accounted for 54.2%–79.9% of use. (AU Report Excel Data Table 3h2)

Neonatal SAAR Antimicrobial Agent Categories

In 2023, 801 hospitals reported ≥9 months of AU data from 878 neonatal patient care locations (AU Report Excel Data Table 1c). The pooled mean SAAR values varied by location type and SAAR category (Table 5).

Table 5. Pooled mean SAAR values with 95% confidence limits by neonatal location type and SAAR antimicrobial agent category—National Healthcare Safety Network Antimicrobial Use Option, 2023

	Neonatal SAAR Antimicrobial Agent Categories						
Neonatal SAAR Location Type	**All 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 [a]**
Step Down Neonatal Nursery (Level II)	0.630 (0.625, 0.635)	1.173 (1.105, 1.244)	2.571 (2.439, 2.709)	0.292 (0.276, 0.309)	0.639 (0.632, 0.646)	0.617 (0.609, 0.625)	–
Level II/III Neonatal ICU	0.812 (0.809, 0.815)	0.825 (0.814, 0.836)	1.667 (1.645, 1.689)	0.807 (0.793, 0.821)	0.790 (0.785, 0.794)	0.721 (0.716, 0.725)	0.943 (0.927, 0.959)
Level III Neonatal ICU	0.956 (0.953, 0.959)	1.135 (1.123, 1.147)	1.381 (1.367, 1.395)	0.997 (0.983, 1.010)	0.939 (0.934, 0.943)	0.877 (0.871, 0.882)	1.199 (1.184, 1.215)
Level IV Neonatal ICU	1.053 (1.050, 1.057)	0.928 (0.919, 0.937)	1.216 (1.207, 1.226)	1.136 (1.123, 1.149)	0.839 (0.835, 0.844)	0.696 (0.691, 0.701)	1.249 (1.233, 1.265)

[a] *Neonatal fluconazole SAARs are not available for Level II step-down neonatal nurseries.*

Abbreviations: Standardized Antimicrobial Administration Ratio (SAAR), intensive care unit (ICU).

Highlights of percentage of AU by class and drug for each neonatal SAAR antimicrobial agent category (for categories with more than one agent) are outlined below.

- Within the **All antibacterial SAAR** category, the top two antibacterial agents, ampicillin and gentamicin, represented the largest portion (range of 42.0%–85.1%) of antibacterial use in all SAAR location types. Vancomycin was the next most commonly used antibacterial in all SAAR locations except Level II step down nurseries, for which it was penicillin G. (AU Report Excel Data Table 4a2)

- Within the Broad spectrum antibacterial agents predominantly used for hospital-onset infections **(BSHO) SAAR** category, the proportions of intravenous cefepime use (range of 51.7%–60.7%) and intravenous piperacillin/tazobactam use (range of 31.3%–33.4%) were similar across all SAAR location types. (AU Report Excel Data Table 4c2)

- Within the **3rd generation cephalosporins SAAR** category, intravenous ceftazidime accounted for the majority of use (76.0%–91.8%) in all SAAR location types. (AU Report Excel Data Table 4d2)

- Within the **Aminoglycosides SAAR** category, intravenous gentamicin accounted for almost all use in each SAAR location type (range of 94.2%–98.5%). (AU Report Excel Data Table 4f2)

Conclusion

The NHSN AU Option provides actionable data for antibiotic stewardship programs, including risk-adjusted AU benchmarks and other AU summary statistics. Due to increased facility participation, the 2023 NHSN AU Data Report includes more data and patient care locations compared to past reports. Given additional data from pediatric locations, we were able to provide more details about pediatric antimicrobial use in 2023 NHSN AU Data Report, adding SAAR distributions by location type and the proportion of individual antimicrobial agents among pediatric units.

Facilities, healthcare systems, and health departments can compare their AU to national SAAR distributions and state-specific SAAR distributions, which can help inform goal setting for the NHSN TAS Strategy. Stewards can also explore and visualize state-level SAAR distributions on the Antimicrobial Resistance & Patient Safety Portal.

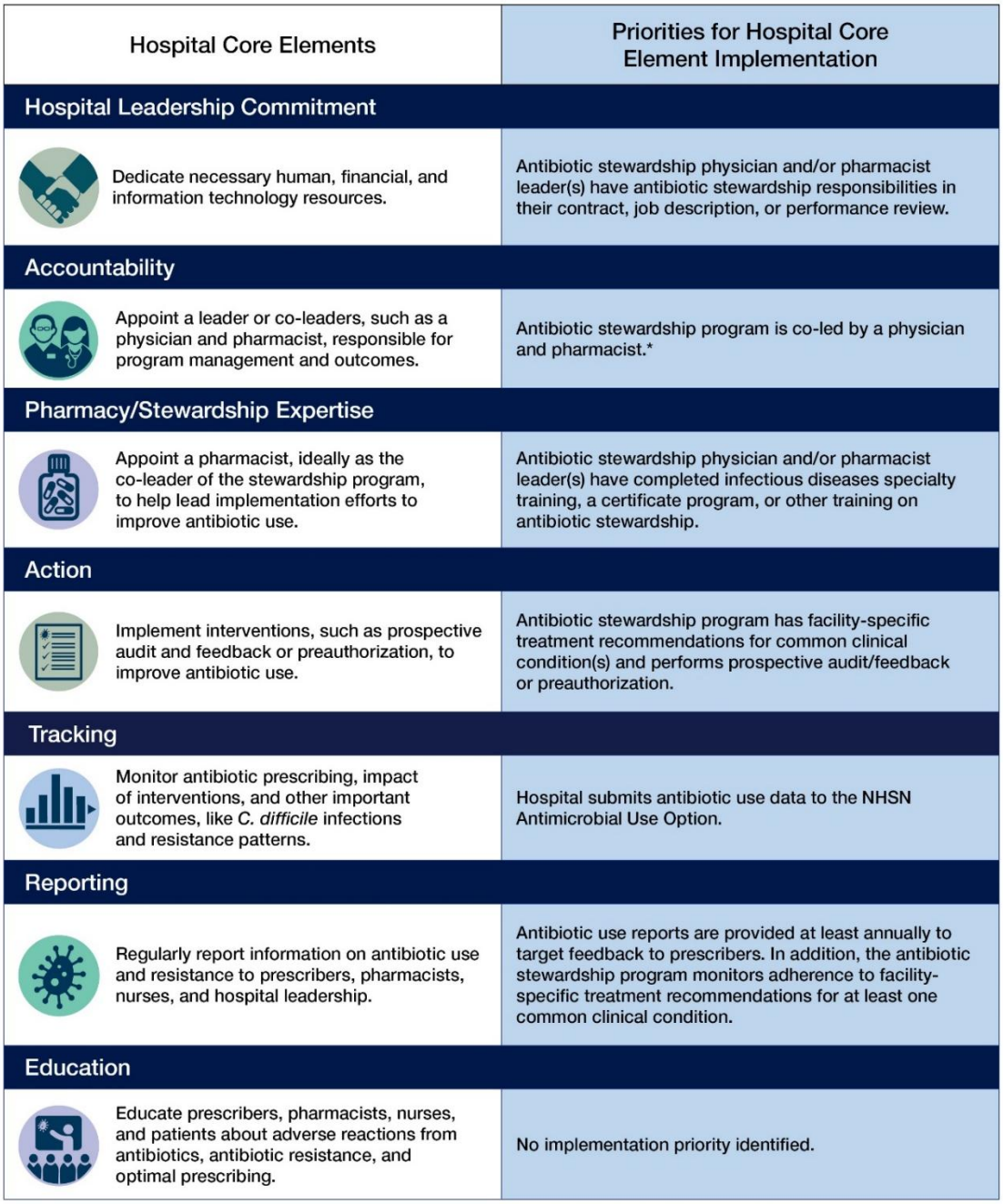
Released in 2022, CDC's Priorities for Hospital Core Element Implementation highlight a subset of implementation approaches that are highly effective or prioritized by stewardship experts **(Figure 5)**. NHSN AU Option can serve as a tool for ASP monitoring and benchmarking antimicrobial use in their facilities. Discussions with AU Option users suggest the following lessons learned for using AU data to inform action:

- Submit monthly hospital AU data to the NHSN AU Option to guide tracking and reporting for ASPs.
- To ensure the accuracy of the AU data, run the AU Option data quality line list available in the NHSN application regularly and perform more extensive data quality checks following the NHSN AUR data validation protocol annually or during implementation of a new EHR system or surveillance software.
- Review NHSN AU data at least quarterly and track SAAR and AU data over time to inform stewardship interventions. Use SAAR distributions by location and percentage of antimicrobials by class or drug for additional information about prescribing practices at your facility.

- Report SAAR and AU data on a regular basis to senior leadership, hospital board, hospital committees (for example, antimicrobial stewardship, infection control, Pharmacy & Therapeutics), and providers.
- Establish facility-specific SAAR target goals for quality improvement using AU-CAD in the TAS reports and dashboards. Reassess your SAAR target at least annually and take national and state-level distribution of SAARs into consideration.
- As part of a healthcare system, health department, or collaborative, participate in the NHSN AU Option Group Function for tracking the uptake of core elements and antimicrobial use.

Figure 5. The Core Elements of Hospital Antibiotic Stewardship Programs and the Priorities for Hospital Core Element Implementation

Hospitals that have implemented the Hospital Core Elements of Antibiotic Stewardship can implement the Priorities for Hospital Core Element Implementation to further enhance their stewardship program.



Hospital Core Elements	Priorities for Hospital Core Element Implementation
Hospital Leadership Commitment	
Dedicate necessary human, financial, and information technology resources.	Antibiotic stewardship physician and/or pharmacist leader(s) have antibiotic stewardship responsibilities in their contract, job description, or performance review.
Accountability	
Appoint a leader or co-leaders, such as a physician and pharmacist, responsible for program management and outcomes.	Antibiotic stewardship program is co-led by a physician and pharmacist.*
Pharmacy/Stewardship Expertise	
Appoint a pharmacist, ideally as the co-leader of the stewardship program, to help lead implementation efforts to improve antibiotic use.	Antibiotic stewardship physician and/or pharmacist leader(s) have completed infectious diseases specialty training, a certificate program, or other training on antibiotic stewardship.
Action	
Implement interventions, such as prospective audit and feedback or preauthorization, to improve antibiotic use.	Antibiotic stewardship program has facility-specific treatment recommendations for common clinical condition(s) and performs prospective audit/feedback or preauthorization.
Tracking	
Monitor antibiotic prescribing, impact of interventions, and other important outcomes, like *C. difficile* infections and resistance patterns.	Hospital submits antibiotic use data to the NHSN Antimicrobial Use Option.
Reporting	
Regularly report information on antibiotic use and resistance to prescribers, pharmacists, nurses, and hospital leadership.	Antibiotic use reports are provided at least annually to target feedback to prescribers. In addition, the antibiotic stewardship program monitors adherence to facility-specific treatment recommendations for at least one common clinical condition.
Education	
Educate prescribers, pharmacists, nurses, and patients about adverse reactions from antibiotics, antibiotic resistance, and optimal prescribing.	No implementation priority identified.

* For critical access hospitals (CAHs), this criterion can be met if the hospital has a physician leader with a pharmacist involved in stewardship (recognizing that some CAHs do not have pharmacists on staff, so co-leadership is not possible).

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An accessible version of "The Core Elements of Hospital Antibiotic Stewardship Programs and the Priorities for Hospital Core Element Implementation" is available at https://www.cdc.gov/antibiotic-use/hcp/core-elements/hospital-implementation.html.

Abbreviations: Clostridioides difficile *(*C. difficile*), National Healthcare Safety Network (NHSN), critical access hospital (CAH).*

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