



# 2020 National Healthcare Safety Network Antimicrobial Use Option Report

Centers for Disease Control and Prevention  
National Center for Emerging and Zoonotic Infectious Diseases  
Division of Healthcare Quality Promotion

November 2021

**Suggested citation:** CDC. 2020 National Healthcare Safety Network Antimicrobial Use Option Report. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2021. Available at: <https://www.cdc.gov/nhsn/pdfs/datastat/2020-au-report-508.pdf>

## Table of Contents

Executive Summary .....	3
The Coronavirus Disease 2019 (COVID-19) Pandemic .....	3
National Healthcare Safety Network (NHSN) Antimicrobial Use (AU) Option Standardized Antimicrobial Administration Ratio (SAAR) .....	4
Table 1. Eligible SAAR patient care locations (2017 baseline adult and pediatric, 2018 baseline neonatal) .....	4
Table 2. SAAR antimicrobial agent categories (2017 baseline adult and pediatric, 2018 baseline neonatal) .....	5
Figure 1. Percentage of active NHSN acute care facilities reporting at least one month of data to the AU Option as of December 1, 2020. ....	6
High-level SAAR comparison, 2019 vs. 2020 .....	6
Figure 2. Select 2019 and 2020 pooled mean SAARs, by antimicrobial agent category and quarter for a) adult ICUs and wards b) pediatric ICUs and wards. ....	7
2020 Antimicrobial Use Data.....	8
Table 3. Pooled mean SAAR values by adult location type and SAAR antimicrobial agent category. ....	8
Table 4. Pooled mean SAAR values by pediatric location type and SAAR antimicrobial agent category. ....	9
Table 5. Pooled mean SAAR values by neonatal location type and SAAR antimicrobial agent category. ....	11
Conclusion .....	11
Figure 3. Core Elements of Hospital Antibiotic Stewardship Programs .....	12
Acknowledgements .....	13
References.....	13



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

The benefits of monitoring AU for patient care and public health are most likely to be achieved when data collection and analysis are systematic and standardized. Leveraging electronic medication administration records and automating AU data submissions from hospitals reduces reporting burden and facilitates reuse of AU data. These AU surveillance principles and practices are fundamental to CDC's National Healthcare Safety Network (NHSN) AU Option. 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, available to hospitals reporting to NHSN's AU Option from select patient care locations.

The 2020 NHSN AU Option Report (2020 AU Report) provides a summary of SAAR distributions and percentages of use within the SAAR antimicrobial agent categories in adult, pediatric, and neonatal patient care locations (specified below). The report includes data from acute care hospitals reporting at least 9 months of data in 2020 from SAAR locations—1,467 hospitals reporting eligible adult SAAR locations, 305 reporting pediatric SAAR locations, and 544 reporting neonatal SAAR locations. The SAAR distributions can help inform stewardship efforts by enabling hospitals to see how their SAARs compare to the national distribution. Facilities can use the distributions as one of the considerations to set facility-specific SAAR target goals. The percentage of AU by class and drug within a SAAR antimicrobial agent category provides insight into prescribing practices across differing patient locations such as medical critical care units (ICUs) compared to medical wards. Facilities may evaluate these usage patterns in context of their local treatment guidelines, antimicrobial resistance rates, and formulary.

### **The Coronavirus Disease 2019 (COVID-19) Pandemic**

Coronavirus Disease 2019 (COVID-19) has presented unprecedented challenges for US hospitals, including for antibiotic stewardship. Hospital AU has fluctuated with COVID-19 incidence. A CDC analysis exploring COVID-19 hospital incidence on AU from the Premier Healthcare dataset has been published,<sup>5</sup> and data on unadjusted pooled antibiotic use and resistance have been presented at The Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria (PACCARB) meetings. These presentations can be found in the "Past Meetings" section at the following webpage: <https://www.hhs.gov/ash/advisory-committees/paccarb/index.html>. These analyses found that inpatient azithromycin and ceftriaxone use increased during the pandemic. Ceftriaxone is included in the broad-spectrum antibiotics predominantly used for community-acquired infections (BSCA) SAAR agent category. Readers may notice increases in BSCA SAARs for most adult location types between 2019 and 2020. However, these increases may appear less dramatic than expected, given the sharp rise in ceftriaxone use in 2020. Because SAAR agent

categories include many antibiotics, changes in the use of a single agent might not result in changes to SAAR values. Further, changes in rates of one antimicrobial may be muted by changes in rates of other antimicrobials within the same SAAR agent category. For example, since 2017, adult inpatient fluoroquinolone use has decreased nationally. Fluoroquinolones are also included in the adult BSCA SAAR. If fluoroquinolone use is decreasing and ceftriaxone use is increasing, overall BSCA SAARs may appear not to change markedly from year to year. To assess changes in a specific antimicrobial over time (e.g., trend analyses), we suggest using unadjusted rates for the individual antimicrobial, rather than SAARs. For more information on how to assess AU data over time, please refer to the SAAR Guide (<https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-saar-guide-508.pdf>).

NHSN does not have hospital-level data on COVID-19 incidence and thus, the data presented in the 2020 AU Report are not adjusted for COVID-19 rates. It is also possible that NHSN patient care locations changed function during the COVID-19 pandemic (e.g., surgical wards changing to medical wards). These changes may not be reflected in 2020 AU Report since hospitals may not have remapped their patient care locations within NHSN.

### NHSN AU Option Standardized Antimicrobial Administration Ratio (SAAR)

The SAAR is a ratio of observed antimicrobial days to predicted antimicrobial days. Each SAAR predictive model included in this report was developed using negative binomial regression applied to AU data from eligible adult and pediatric locations (2017 data) and eligible neonatal locations (2018 data). SAAR patient care locations and antimicrobial agent categories are listed in Tables 1 and 2, respectively.

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

The SAAR can be used to track AU changes over time at individual healthcare facilities and as a benchmarking metric for comparison of AU in similar patient care locations nationally. While the SAAR is not a measure of appropriateness of AU, it enables ASPs to compare their AU to a national baseline. These types of analyses enable facilities to assess whether they are using antimicrobials at higher rates than predicted (i.e., SAAR values >1), which can prompt hospitals to further evaluate prescribing practices and ultimately intervene if necessary, to optimize AU. More information on the SAAR can be found in the SAAR Guide<sup>6</sup> and AUR Module Protocol<sup>7</sup>.

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

Adult SAAR Locations (N=8)	Pediatric SAAR Locations (N=5)	Neonatal SAAR Locations (N=4)
- Medical critical care units	- Medical critical care units	- Level II special care nurseries
- Medical-surgical critical care units	- Medical-surgical critical care units	- Level II/III critical care units
- Surgical critical care units	- Medical wards	- Level III critical care units
- Medical wards	- Medical-surgical wards	- Level IV critical care units
- Medical-surgical wards	- Surgical wards	
- Surgical wards		
- Step down units		
- General hematology-oncology wards		

NHSN patient care location definitions can be found here:

[https://www.cdc.gov/nhsn/pdfs/psmanual/15locationsdescriptions\\_current.pdf](https://www.cdc.gov/nhsn/pdfs/psmanual/15locationsdescriptions_current.pdf)

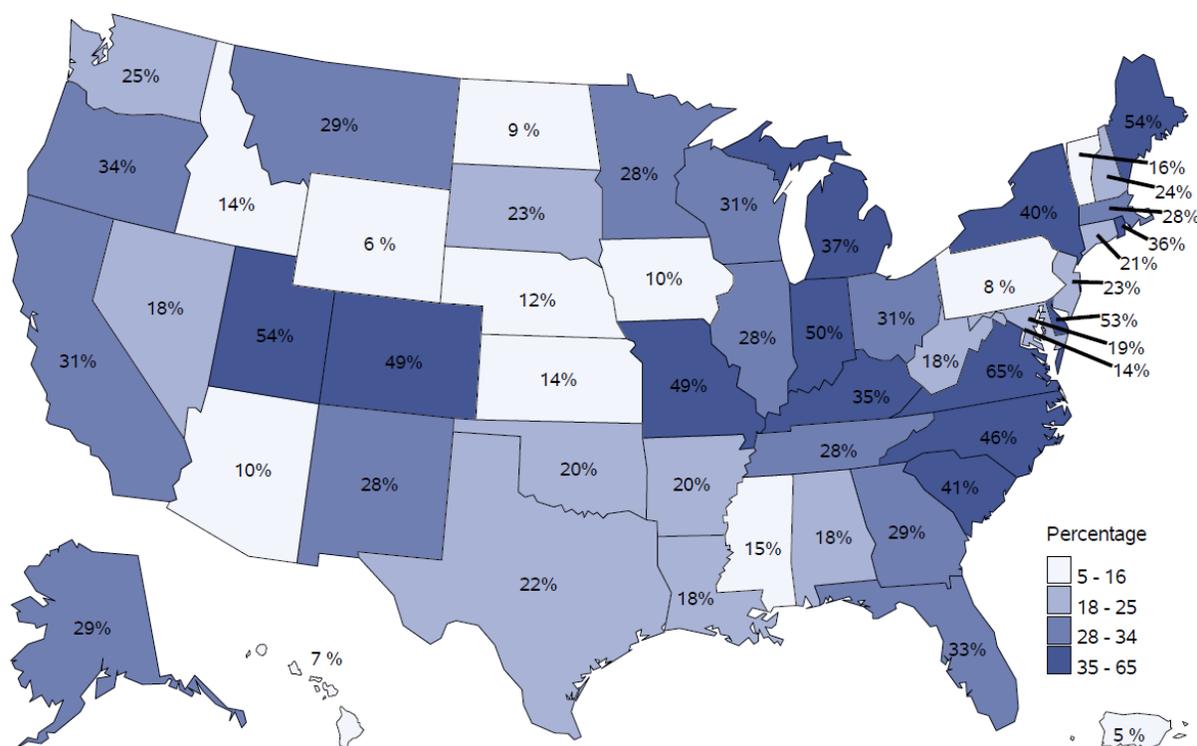
**Table 2.** SAAR antimicrobial agent categories (2017 baseline adult and pediatric, 2018 baseline neonatal)

<b>Adult SAAR Categories (N=7)</b>	<b>Pediatric SAAR Categories (N=8)</b>	<b>Neonatal SAAR Categories (N=7)</b>
All antibacterial agents	All antibacterial agents	All antibacterial agents
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 (3 <sup>rd</sup> gen Ceph)
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	

For the list of specific agents included in each SAAR category please reference Appendix E of the AUR Module protocol: <https://www.cdc.gov/nhsn/PDFs/pscManual/11pscAURcurrent.pdf>.

Facility data submissions to the NHSN AU Option are voluntary. No state or federal AU reporting requirements were in effect during the period covered by this report. However, the SAAR is the statistical centerpiece of the NHSN AU measure endorsed by the National Quality Forum in 2015 (NQF #2720) and re-endorsed by NQF in 2019 for surveillance and quality improvement purposes.<sup>8</sup> This endorsement, coupled with NHSN's collaboration with ASPs and other partners, has prompted an increase in voluntary AU reporting to NHSN. As of December 1, 2020, 1,934 facilities had reported at least one month of data to the AU Option. Participation by state among facilities eligible to report ranges from 5% in Puerto Rico to 65% in Virginia (Figure 1).

**Figure 1.** Percentage of active NHSN acute care facilities reporting at least one month of data to the AU Option as of December 1, 2020.



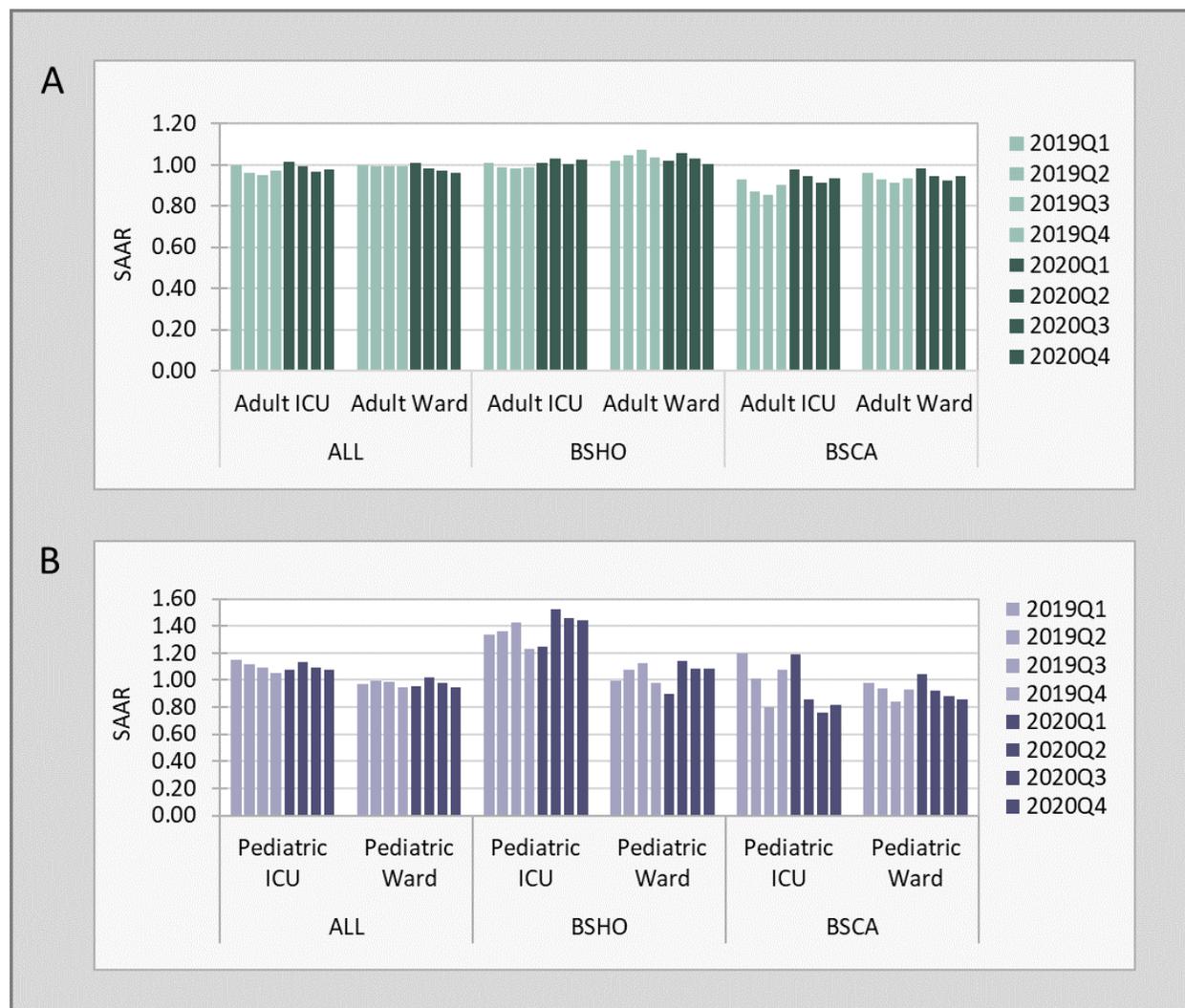
### High-level SAAR comparison, 2019 vs. 2020

When looking at adult pooled mean SAARs for All, BSHO, and BSCA categories (Figure 2a), we see an increase in SAAR values in quarter one of 2020 compared to quarter four of 2019 for all groups except BSHO SAARs in adult wards. When comparing the same quarter across years, we see an increase in All antibacterial agents SAARs for adult ICUs in all quarters. In adult wards, on the other hand, we see little change in the All SAAR in 2019, but a gradual decrease across 2020. Pooled mean BSCA SAARs are slightly higher for adult ICUs in 2019 compared to 2020, but similar for adult wards.

Pooled mean SAARs in pediatric units are more variable over time (Figure 2b). In pediatric ICUs, we see the mean All antibiotic SAAR decrease across 2019 but increase in the first two quarters of 2020. For the BSHO SAAR agent category, we see large increase in pooled mean SAARs in quarter two of 2020 for both ICUs and wards. For the BSCA SAAR agent category, we see an increase earlier in the year, with pooled mean SAAR values higher in quarter one of 2020 compared to the end of 2019.

We cannot say how much variation in SAARs between years and across quarters is related to COVID-19 versus normal seasonal variation or changes to prescribing practices due to antibiotic stewardship efforts. We do hope that pooled means and distributions displayed in data tables help ASPs assess how their facility's AU compares to others.

**Figure 2.** Select 2019 and 2020 pooled mean SAARs, by antimicrobial agent category and quarter for **a)** adult ICUs and wards **b)** pediatric ICUs and wards.



Adult ICUs (intensive care units) include medical critical care units, medical-surgical critical care units, surgical critical care units. Adult wards include medical wards, medical-surgical wards, surgical wards. Step-down units and adult general hematology-oncology units are not included in pooled means.

Pediatric ICUs (intensive care units) include medical critical care units, medical-surgical critical care units. Pediatric wards include medical wards, medical-surgical wards, surgical wards.

SAAR agent category abbreviations are defined in Table 2 above.

Additional notes:

- Predicted use (the SAAR denominator) is based on antimicrobial use rates in 2017 among adult and pediatric 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.

## 2020 Antimicrobial Use Data

The [2020 AU Report data tables](#) include the following:

- Overview and Table of Contents
- Characteristics of NHSN acute care hospitals reporting for adult, pediatric, and neonatal SAAR locations for  $\geq 9$  months in 2020
- SAAR distributions for adult, pediatric, and neonatal SAAR agent category by location type
- Percentage of AU by antimicrobial class and drug for each SAAR agent category by location type

### Adult SAAR antimicrobial agent categories

Over 1,400 acute care hospitals had adult SAAR patient care locations reporting  $\geq 9$  months in 2020. The pooled mean SAAR values differ across location type and SAAR category (Table 3). The SAAR values in this report were derived using pooled observed antimicrobial days from 2020 divided by pooled predicted days calculated using the 2017 baseline SAAR model.

**Table 3.** Pooled mean SAAR values by adult location type and SAAR antimicrobial agent category.

Adult SAAR Location Type	Adult SAAR Antimicrobial Agent Categories						
	All Antibacterial	BSHO	BSCA	GramPos	NSBL	CDI	Antifungal
Medical ICUs	1.008	1.011	0.976	1.010	0.906	1.255	0.888
Medical-Surgical ICUs	0.975	1.014	0.918	0.892	0.851	1.055	0.883
Surgical ICUs	1.007	1.052	1.020	0.949	0.765	1.262	1.145
Medical Wards	0.965	0.955	0.944	0.883	1.016	0.997	0.844
Medical-Surgical Wards	0.986	1.065	0.930	0.885	1.039	0.993	0.903
Surgical Wards	0.995	1.086	1.037	0.962	0.831	1.090	1.027
Step Down Units	0.956	0.949	0.932	0.883	0.971	0.998	0.813
General Hematology-Oncology Wards	0.975	0.970	0.963	0.889	1.032	1.046	0.832

While most pooled mean SAARs are centered around 1.0, there are small differences by location type and across SAAR antimicrobial agent categories. For example, on average, in 2020 surgical ICUs used only 0.765 NSBL antimicrobial days for each 1.000 antimicrobial day predicted. Highlights of percentage of AU by class and/or drug for each adult SAAR antimicrobial agent category are below:

- Within the **All antibacterial SAAR** category, the top 10 antibacterial agents represented 78.6% - 87.3% of use, depending on the SAAR location. In most SAAR locations, the three most commonly used agents include vancomycin, piperacillin-tazobactam and either ceftriaxone or cefepime. In the surgical wards, cefazolin instead of ceftriaxone or cefepime is included in top three.
- Within the **BSHO SAAR**, piperacillin-tazobactam was the most commonly used agent in ICUs, non-oncology wards, and step down units, followed by anti-pseudomonal cephalosporins (cefepime,

ceftazidime). Anti-pseudomonal carbapenems had higher percentages of use in ICUs compared to wards. The percentage of piperacillin-tazobactam (40.0%) and anti-pseudomonal cephalosporins (44.7%) were similar in hematology-oncology wards.

- Within the **BSCA SAAR**, ceftriaxone had the highest use in in all location types. For general hematology-oncology wards, the percentage of ceftriaxone and fluoroquinolones were comparable. Ertapenem had higher use in the surgical units compared to other SAAR locations.
- Within the **GramPos SAAR**, vancomycin was the predominant agent used in all SAAR locations followed by linezolid and daptomycin. In ICUs and step down units, linezolid had slightly higher use than other SAAR locations.
- Within the **NSBL SAAR**, cefazolin had the highest use across all SAAR locations with the highest percentage of use in surgical units. Use of  $\beta$ -lactam/ $\beta$ -lactamase inhibitor combination drugs was higher in medical and hematology-oncology units compared to med-surg and surgical units.
- Within the **CDI SAAR**, the 3<sup>rd</sup> and 4<sup>th</sup> generation cephalosporins had the highest use across all SAAR locations. Fluoroquinolones, the next most commonly used agents, contributed to higher percentages in wards and general hematology-oncology compared to ICUs and step down units. Clindamycin accounted for 6.6% for surgical ICUs and 8.8% for surgical wards compared to lower percentages in other locations (range: 2.9% - 6.1%).
- Within the **Antifungal SAAR**, echinocandins contributed close to half (47.1% - 55.4%) of use in ICUs. Fluconazole use was higher than echinocandins in other location types (73.1% - 82.7%).

#### **Pediatric SAAR antimicrobial agent categories**

A lower number of hospitals (n=305) contributed data for pediatric SAAR locations compared to adult SAAR locations. The pooled mean SAAR values differ across location type and SAAR category (Table 4).

**Table 4.** Pooled mean SAAR values by pediatric location type and SAAR antimicrobial agent category.

Pediatric SAAR Location Type	Pediatric SAAR Antimicrobial Agent Categories							
	All Antibacterial	BSHO	BSCA	GramPos	NSBL	Azithromycin	CDI	Anti-fungal
Medical ICUs	1.196	2.738	0.888	0.983	1.025	0.637	0.947	1.997
Medical-Surgical ICUs	1.085	1.357	0.923	1.108	0.869	0.625	1.159	1.582
Medical Wards	0.956	0.916	1.010	0.887	0.876	0.683	1.058	2.492
Medical-Surgical Wards	0.967	1.032	0.903	0.842	1.012	0.639	0.938	2.126
Surgical Wards	1.014	1.724	0.960	0.764	0.834	1.209	0.885	1.223

Variability in SAARs appears greater in pediatric locations compared to adult locations, which may relate to both the smaller pediatric sample sizes and possibly greater variability in pediatric AU overall. In 2020, on average, pediatric BSHO use in medical ICUs and surgical wards was 2.738 and 1.724 times higher, respectively, than predicted by the 2017 national baseline. However, sample sizes for these two location types were quite low, with just 17 medical ICUs and 17 surgical wards contributing data to 2020 SAAR distributions. With small sample sizes, even one location with a high number of days present can greatly impact the overall pooled mean SAAR.

Highlights of percentage of AU by class and/or drug for each pediatric SAAR antimicrobial agent category (if more than one agent is included) are outlined below:

- Within the **All antibacterial SAAR** category, the top 10 antibacterial agents represented 63.8% - 77.1% of use in pediatric SAAR locations, depending on the location type. In medical and medical-surgical ICUs, vancomycin, ceftriaxone, and cefepime were the three most commonly used antibacterial agents. In medical wards, ceftriaxone, vancomycin, and clindamycin were included in the top three. In medical-surgical and surgical wards, ceftriaxone, piperacillin-tazobactam, and cefazolin (in varying order) were the top three.
- Within the **BSHO SAAR**, cefepime and piperacillin-tazobactam were the top agents used (in varying order) in most SAAR locations (in surgical wards, meropenem was in the top two rather than cefepime). Antipseudomonal cephalosporins (cefepime, ceftazidime) had highest percentage use in the medical ICUs, medical-surgical ICUs, and medical wards while piperacillin-tazobactam had higher use in medical-surgical and surgical wards.
- Within the **BSCA SAAR**, ceftriaxone was the predominant agent used in all SAAR locations. Ampicillin-sulbactam and amoxicillin-clavulanate were the next most commonly used agents.
- Within the **GramPos SAAR**, vancomycin and clindamycin combined represented 90.8% - 96.3%, depending on the SAAR location. Vancomycin had higher use in ICUs while clindamycin had higher use in wards.
- Within the **NSBL SAAR**, cefazolin, ampicillin, and amoxicillin were the top agents used in all SAAR locations except surgical wards. Cefazolin, cefoxitin, and ampicillin were the top agents used in surgical wards.
- Within the **CDI SAAR**, the 3<sup>rd</sup> and 4<sup>th</sup> generation cephalosporins had the highest use for all SAAR locations. Clindamycin, the next commonly used agent, contributed higher percentages in wards compared to ICUs. Fluoroquinolones accounted for lowest usage across all SAAR locations.
- Within the **Antifungal SAAR**, fluconazole was the most commonly used agent for all SAAR locations, with highest percentage of use in surgical wards and medical-surgical wards.

### **Neonatal SAAR antimicrobial agent categories**

Five hundred and forty-four acute care hospitals reported data from eligible neonatal SAAR locations. The pooled mean SAAR values differ across location type and SAAR category (Table 5).

**Table 5.** Pooled mean SAAR values by neonatal location type and SAAR antimicrobial agent category.

Neonatal SAAR Location Type	Neonatal SAAR Antimicrobial Agent Categories						
	All Antibacterial	VANC	BSHO	3 <sup>rd</sup> gen CEPHS	AMP	Amino-glycosides	FLUCO <sup>a</sup>
Step Down Neonatal Nursery (Level II)	0.684	1.175	2.272	0.294	0.656	0.668	--
Level II/III Neonatal ICU	0.891	0.813	1.394	0.849	0.876	0.883	0.994
Level III Neonatal ICU	0.982	1.113	1.087	1.016	0.890	0.901	1.133
Level IV Neonatal ICU	1.037	1.022	1.163	0.988	0.894	0.794	1.486

<sup>a</sup>Neonatal fluconazole SAARs are not available for Level II neonatal step down nurseries.

Highlights of percentage of AU by class and/or drug for each neonatal SAAR antimicrobial agent category (if more than one agent is included) are outlined below.

- Within the **All antibacterial SAAR**, the top 2 antibacterial agents, ampicillin and gentamicin, represented a large portion of antibacterial use in all SAAR locations (83.7% in Level II nurseries, 71.9% in Level II/III NICUs, 57.6% in Level III NICUs, and 48.1% in Level IV NICUs).
- Within the **BSHO SAAR**, similar usage patterns were seen in Level II and Level II/III locations with cefepime contributing approximately 50% followed by piperacillin-tazobactam and meropenem. In Level III and Level IV locations, both cefepime and piperacillin-tazobactam contributed approximately 40%, and meropenem contributed approximately 16%.
- Within the **3<sup>rd</sup> generation cephalosporins SAAR**, ceftazidime represented the majority of use (approximately 71.5% - 85.0% in all SAAR locations) followed by cefotaxime and ceftriaxone.
- Within the **Aminoglycosides SAAR**, gentamicin accounted for almost all use for each SAAR location.

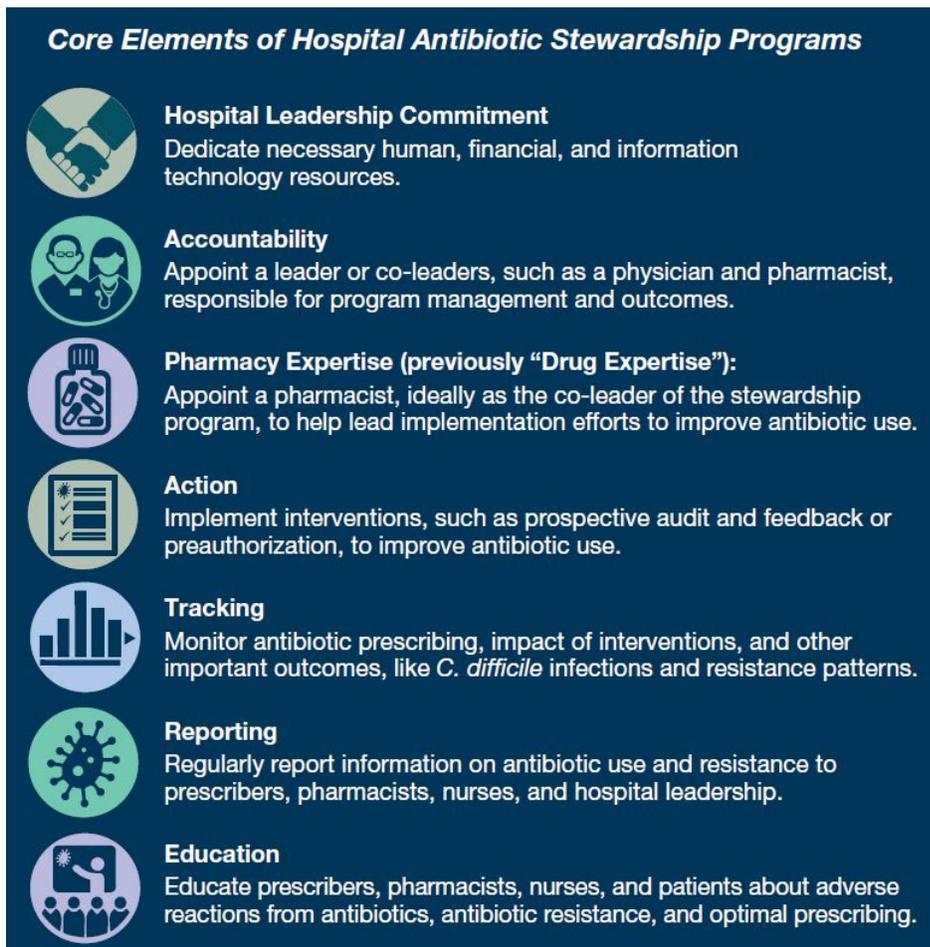
## Conclusion

NHSN serves as a source system for risk-adjusted AU benchmarks and other AU summary statistics that hospital ASPs can use in their efforts to monitor and improve antimicrobial prescribing. The 2019 NHSN AU Report provided the first national summary of SAAR distributions and AU within each SAAR antimicrobial agent category by location, and this 2020 AU Report provides an update on those data. It is likely that the COVID-19 pandemic heavily influenced antibiotic use in 2020. However, NHSN does not have hospital level COVID-19 data that would enable adjustment on the impact of COVID-19. The AU data provide quantitative indicators of differential use of antimicrobial agents across facilities for common clinical scenarios, including treatment of hospital-onset and community-acquired infections. Facilities can compare their AU to national SAAR distributions, which can help inform stewardship efforts including goal setting. Many facilities have integrated monitoring and benchmarking from NHSN AU Option into the 7 Core Elements of Hospital Antibiotic Stewardship Programs to optimize antibiotic use (Figure 3) at their facility and/or healthcare system.<sup>1</sup>

Discussions with AU Option users suggest the following best practices for using AU data for action:

- 1) Submit monthly hospital AU data to the NHSN AU Option to guide tracking and reporting for ASPs.
- 2) Review NHSN AU data at least quarterly to track SAAR/AU data over time to both inform and assess stewardship interventions. Use SAAR distributions by location and percentage of antimicrobials by class and/or drug for additional context of prescribing practices at your facility.
- 3) Report SAAR/AU data on a regular basis to senior leadership, hospital board, hospital committees (e.g., antibiotic stewardship, infection control, Pharmacy & Therapeutics) and providers.
- 4) Establish facility-specific SAAR target goals for quality improvement using AU-cumulative attributable differences in the Targeted Assessment for Stewardship reports and dashboards.
- 5) Create and/or participate in the NHSN AU Option Group Function as part of a healthcare system, health department and/or collaborative.

**Figure 3. Core Elements of Hospital Antibiotic Stewardship Programs**



Accessible version of “Core elements of hospital antibiotic stewardship programs”:

<https://www.cdc.gov/antibiotic-use/core-elements/hospital.html>

## Acknowledgements

We thank the antibiotic stewards, infection preventionists, hospital epidemiologists, and other dedicated hospital and health department staff who work to support AU surveillance and antibiotic stewardship. This report was prepared by the CDC's National Center for Emerging and Zoonotic Infectious Diseases, Division of Healthcare Quality Promotion staff.

## References

1. Centers for Disease Control and Prevention. The core elements of hospital antibiotic stewardship programs: 2019. <https://www.cdc.gov/antibiotic-use/healthcare/pdfs/hospital-core-elements-H.pdf>. Accessed October 1, 2020.
2. Davey P, Marwick CA, Scott CL, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. The Cochrane database of systematic reviews. 2017 Feb;2:Cd003543.
3. Karanika S, Paudel S, Grigoras C, et al. Systematic Review and Meta-analysis of Clinical and Economic Outcomes from the Implementation of Hospital-Based Antimicrobial Stewardship Programs. *Antimicrobial Agents and Chemotherapy*. 2016 Aug;60(8):4840-52.
4. Baur D, Gladstone BP, Burkert F, et al. Effect of antibiotic stewardship on the incidence of infection and colonisation with antibiotic-resistant bacteria and *Clostridium difficile* infection: a systematic review and meta-analysis. *The Lancet Infectious diseases*. 2017 Sep;17(9):990-1001.
5. Rose AN, Baggs J, Wolford H, et al. Trends in Antibiotic Use in United States Hospitals During the Coronavirus Disease 2019 Pandemic. *Open Forum Infect Dis*. 2021 Jun;8(6):ofab236.
6. Centers for Disease Control and Prevention. Standardized Antimicrobial Administration Ratio. <https://www.cdc.gov/nhsn/pdfs/ps-analysis-resources/aur/au-saar-guide-508.pdf>. Accessed October 28, 2020.
7. Centers for Disease Control and Prevention. Antimicrobial Use and Resistance (AUR) Module. <https://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf>. Accessed October 1, 2020.
8. National Quality Forum. National Healthcare Safety Network (NHSN) antimicrobial use measure. National Quality Forum measure #2720. <http://www.qualityforum.org/QPS>. Accessed October 9, 2020.