DEPARTMENT OF HEALTH

Antibiotic Use and Stewardship in Minnesota

2025 UPDATE ON PROGRESS AND OPPORTUNITIES

Antibiotic Use and Stewardship in Minnesota
2025 Update on Progress and Opportunities

Minnesota Department of Health
Infectious Disease Epidemiology, Prevention and Control
PO Box 64975
St. Paul, MN 55164-0975
651-201-5414
health.stewardship@state.mn.us
www.health.state.mn.us

5/19/2025

To obtain this information in a different format, call: 651-201-5414.

Contents

Executive Summary

The *Antibiotic Use and Stewardship in Minnesota* report summarizes data that the Minnesota Department of Health (MDH) uses to describe the state of antibiotic use and stewardship in Minnesota. The report includes current and past measures of outpatient and hospital antibiotic use and metrics, and presents who prescribes and receives antibiotics in Minnesota. Also outlined is what we know about prescribing disparities at the national level and an exploration of trends in Minnesota data. The antibiotic stewardship program data show trends in hospital and nursing home core element implementation, as well as data on outpatient stewardship practices.

This report aims to inform public health education initiatives and partner-driven statewide objectives around antibiotic use by outlining opportunities for the agency and clinical partners to improve antibiotic prescribing (Opportunities to Use Data to Improve Antibiotic Use) and opportunities to improve antibiotic stewardship programs (Opportunities to Improve Antibiotic Stewardship Programs).

2025 highlights and additions

- IQVIA™ Outpatient Antibiotic Prescribing Data was updated to include data for 2023.
- Outpatient Antibiotic Prescribing for Medicare Beneficiaries, 2022 was updated to include data for 2022, as well as a description of feedback letters that were distributed to high-volume antibiotic prescribers in late 2024.
- The Minnesota All Payer Claims Database – Prescribing for Outpatient Respiratory Conditions and Urinary Tract Infections, 2018 - 2021 includes prescribing for acute respiratory infection (ARI) claims and the addition of urinary tract infection claims through 2021. The percent of ARI events prescribed at least one antibiotic decreased overall in 2021 compared to 2018-2019. Additionally, in 2021, Minnesota health care providers prescribed first line antibiotics for 52% of uncomplicated urinary tract infection events, a 12% increase from 2018.
- Antibiotic Administration in Minnesota Hospitals includes new hospital antimicrobial administration data from 2023.
- Part 2: Implementation of Health Care Antibiotic Stewardship Programs includes 2023 updates for hospitals and nursing homes, as well as data from 2024 on both outpatient and dental clinic adoption of stewardship core elements.

Background

Tracking and reporting are core elements of clinical antibiotic stewardship programs and are critical to operationalizing health department-led antibiotic stewardship efforts. By monitoring antibiotic prescribing, we can define current practice, identify opportunities for improvement, set targets for progress, and assess the impact of programming and interventions. The availability of antibiotic use data, and the capacity of MDH to summarize them, has grown in recent years which has been beneficial given the growing emphasis on routinely collecting and assessing comprehensive data on prescribing and patient characteristics. In recent years, studies have revealed lapses in prescribing appropriateness for our most common outpatient conditions, including acute respiratory and urinary tract infections (1–4). Equally important, researchers have demonstrated that variation in appropriate prescribing is not only associated with clinical considerations but is often influenced by patient factors. Race, ethnicity, location of residence, and access to health care are embedded in the complex pathway from patient presentation to antibiotic prescription (5–8). MDH will continue using existing and new data sources to explore where prescribing disparities exist in Minnesota, share those findings with prescribers and health care organizations, and inform educational initiatives.

Data on the implementation of antibiotic stewardship programs within health care facilities are also critical to the goal of prescribing improvement. MDH uses facility-level data available from the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN) to establish the percent of Minnesota hospitals and nursing homes that have implemented stewardship core elements. MDH has also collected its own data to more fully detail implementation successes and challenges in nursing homes and outpatient settings. MDH uses these findings to connect lagging facilities with stewardship expertise and professional engagement.

In this document, Minnesota-specific data are summarized and, where possible, comparisons are made to national data. MDH has access to several sources of antibiotic use data, each of which reflects prescribing at a specific level of detail and for a specific care setting. Because the time lag between prescription and when data are available for analysis varies by source, sections of this report may reflect different time periods, as noted, and some will be more up to date than others.

The *Antibiotic Use and Stewardship in Minnesota* report is intended to provide actionable data for MDH stewardship activities and for our health care partners. We look forward to engaging with partners about these data and potential targets for progress.

Part 1: Antibiotic Use in Health Care

MDH has access to outpatient prescribing data from IQVIA™, Centers for Medicaid and Medicare (CMS) Medicare Part D Public Use Files, and the Minnesota All Payer Claims Database (MN APCD), in addition to hospital antimicrobial administration data from NHSN. Analysis methodologies are described at the end of this report.

Outpatient Antibiotic Prescribing

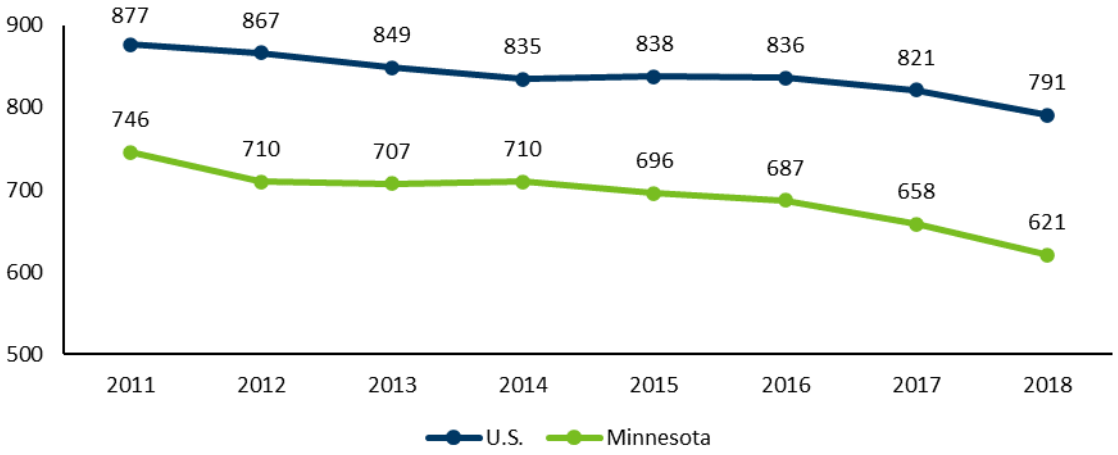
Over 80% of antibiotics used in the U.S. are prescribed in an outpatient setting (9). Outpatient prescribing presents a valuable opportunity to reduce the overall volume of antibiotic use and the resulting selective pressure on bacterial pathogens.

IQVIA™ Outpatient Antibiotic Prescribing Data, 2011–2023

IQVIA™ data provide an opportunity to track state and national trends in overall antibiotic prescribing. Measurement of overall antibiotic use helps us to understand the impact of efforts to improve prescribing behaviors and identify opportunities for improvement. Assuming infection rates remain steady over time, a decline in unnecessary use will be reflected in a decline in overall antibiotic use measured at the state level. In the U.S., the contract research organization IQVIA™ tracks outpatient oral antibiotic prescriptions filled in community pharmacies. Estimates in this section are generated from these IQVIA™ data, made available to MDH by the CDC.

During 2011–2018, outpatient antibiotic prescriptions per 1,000 persons declined 9.8% nationally and 16.8% in Minnesota (Figure 1). The decline in prescribing during 2015–2018 was especially notable in Minnesota, falling nearly 11%. The decline in prescribing was influenced by a reduction in the prescribing rate for two important drug classes: fluoroquinolones and macrolides. The state rate of outpatient fluoroquinolone prescribing decreased from 71 prescriptions/1,000 people in 2015 to 45/1,000 in 2018, a drop of 36.6%. Researchers have demonstrated a potential association between the decline in fluoroquinolone prescribing and the 2016 FDA black box warnings on fluoroquinolone antibiotics, likely supported by directed clinical efforts to reduce use (10). The rate of macrolide prescribing decreased by 23% during 2015–2018, from 118 prescriptions/1,000 people to 91/1,000. Over 90% of macrolide prescriptions in Minnesota are for one of the broad-spectrum drugs azithromycin or clarithromycin (based on 2016 and 2018 data, not shown).

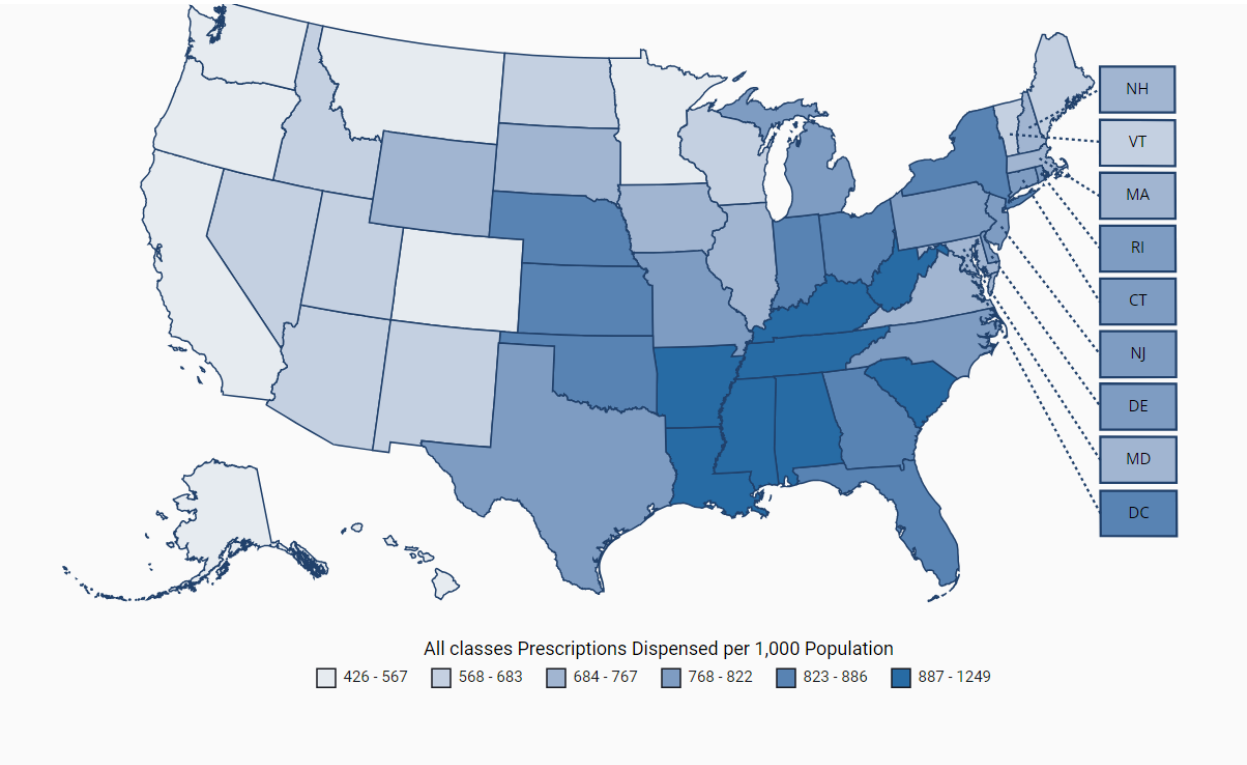
Figure 1. Number of outpatient antibiotic prescriptions per 1,000 persons in the U.S. and Minnesota, 2011–2018.



An IQVIA™ methodology change prevents us from directly comparing 2011–2018 prescribing rates to those estimated in 2019 and later. Findings from those most recent years are discussed in the remainder of this section.

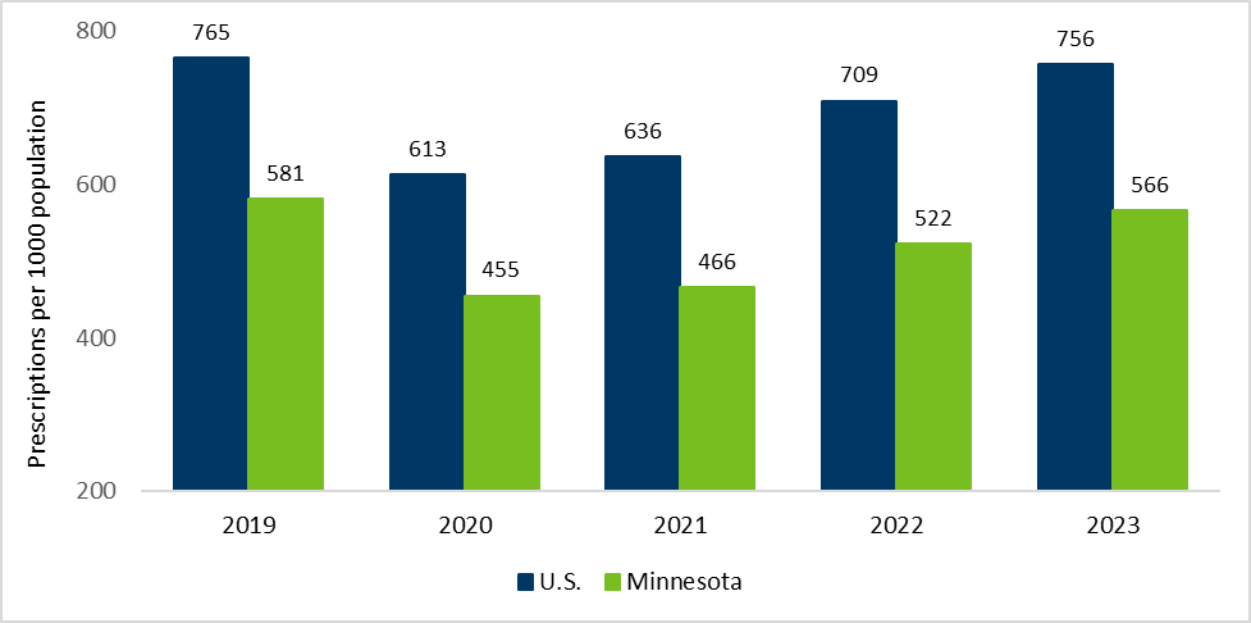
In 2023, Minnesotans received fewer outpatient antibiotics than the U.S. overall and Minnesota's state-level prescribing rate is lower than that of many other states (Figures 2 & 3).

Figure 2. U.S. outpatient antibiotic prescribing rates (prescriptions/1,000 persons) by state, 2023.



Source: Centers for Disease Control and Prevention. Outpatient Antibiotic Use: Retail Pharmacy Prescription Data (https://arpsp.cdc.gov/profile/antibiotic-use/all-classes#rate-map)

Figure 3. U.S. and Minnesota outpatient antibiotic prescribing rates per 1,000 persons, 2019–2023.



Like the national trend, overall outpatient antibiotic prescribing rates in Minnesota decreased from 2019 to 2020, falling 19.8% in the first year of the COVID-19 pandemic (Figure 3). Overall rates began to rise in 2021 and, in 2023, returned much closer to pre-pandemic levels.

The rate of prescribing for penicillin, cephalosporin, and macrolide antibiotics increased in 2023, while fluoroquinolone prescribing rates declined slightly (Table 1, Figure 4). Contribution of each drug class to overall 2023 prescribing is shown in Figure 5.

Table 1. Minnesota outpatient antibiotic rates (prescriptions/1,000 persons) by drug class, 2019–2023, and percent change compared to the previous year.

Drug Class	2019	2020 (% change)	2021 (% change)	2022 (% change)	2023 (% change)
All classes	581	455 (-22%)	466 (+2%)	522 (+12%)	566 (+8%)
Penicillins	146	102 (-30%)	106 (+4%)	125 (+18%)	151 (+21%)
Cephalosporins	93	78 (-16%)	82 (+5%)	92 (+12%)	99 (+8%)
Macrolides	84	53 (-37%)	49 (-8%)	60 (+22%)	62(+3%)
Fluoroquinolones	35	29 (-17%)	27 (-7%)	26 (-4%)	25 (-4%)

Figure 4. Minnesota outpatient antibiotic rates per 1,000 persons by drug class, 2019–2023.

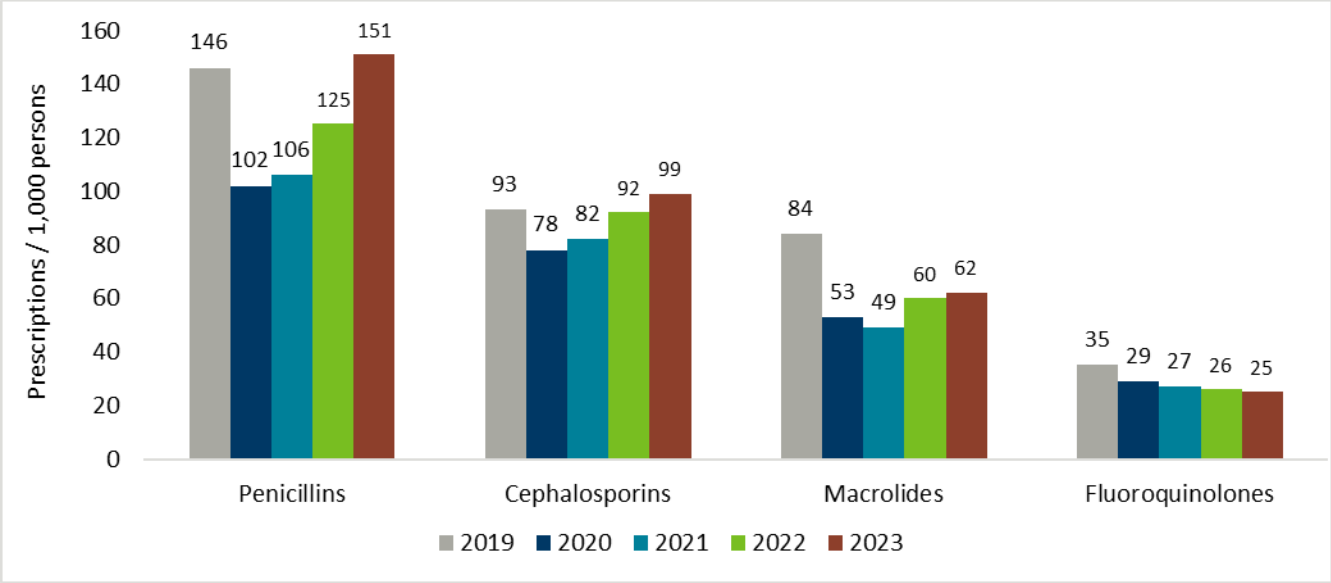
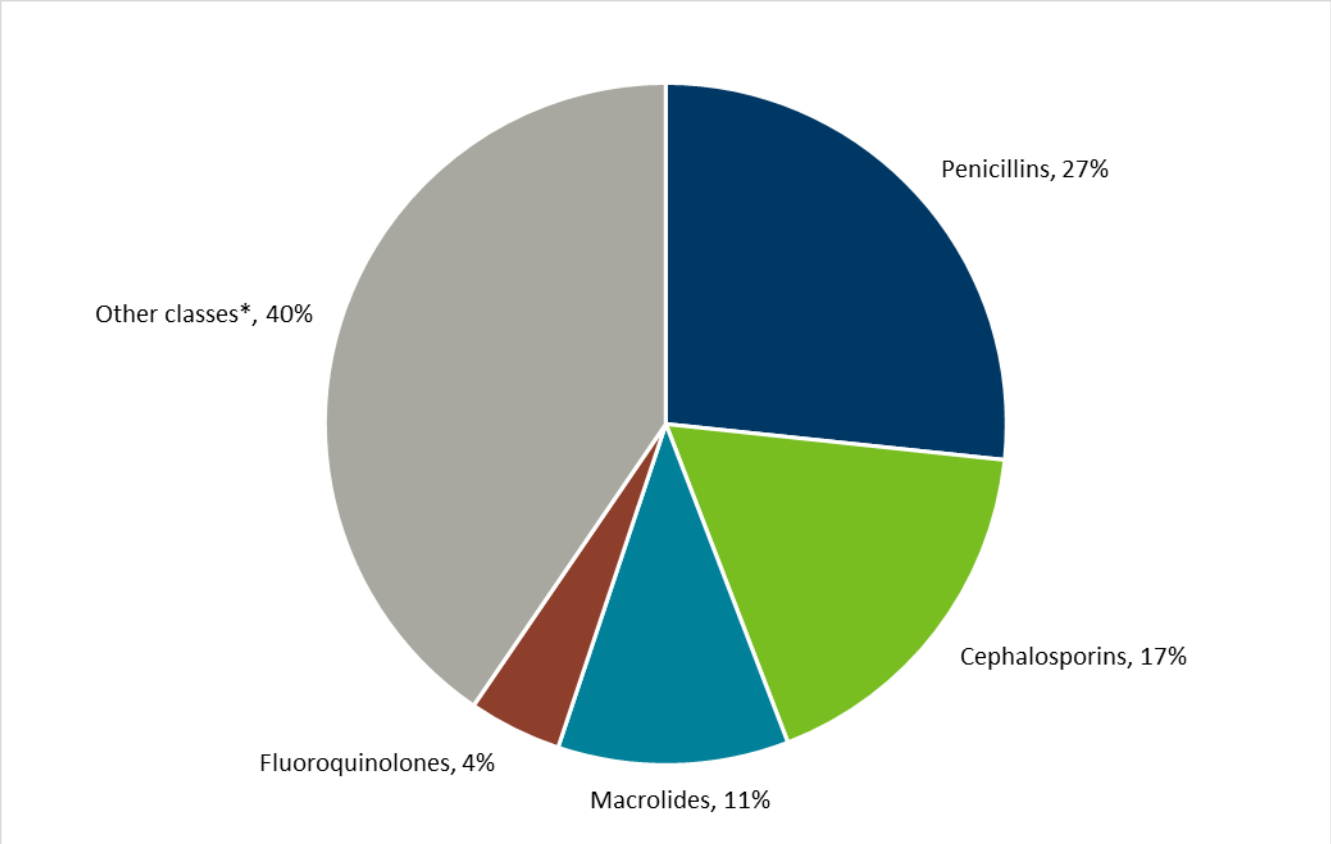


Figure 5. Contribution of antibiotic drug classes to overall Minnesota outpatient antibiotic prescribing, 2023.



**Includes amoxicillin/clavulanate, tetracycline, doxycycline, trimethoprim-sulfamethoxazole, nitrofurantoin, and clindamycin*

Outpatient Antibiotic Prescribing for Medicare Beneficiaries, 2022

This section summarizes data from the CMS Medicare Part D Prescriber Public Use Files and describes the practices of high-volume antibiotic prescribers (the highest 10% of prescribers by antibiotic volume) in outpatient settings compared with low-volume prescribers (the lower 90% of prescribers by antibiotic volume) (11). Because CDC and others have shown an association between total antibiotic prescribing and unnecessary prescribing, assessment of overall prescribing patterns can provide a more accessible option to prescribers who might benefit from feedback-motivated behavior change (12-15). Data analyzed for each year include antibiotic prescriptions by Minnesota health care providers who wrote ≥11 antibiotic prescriptions in that year.

Figure 6. Median antibiotic prescribing rate in Minnesota for high-volume prescribers compared to low-volume and all prescribers, 2013-2022.

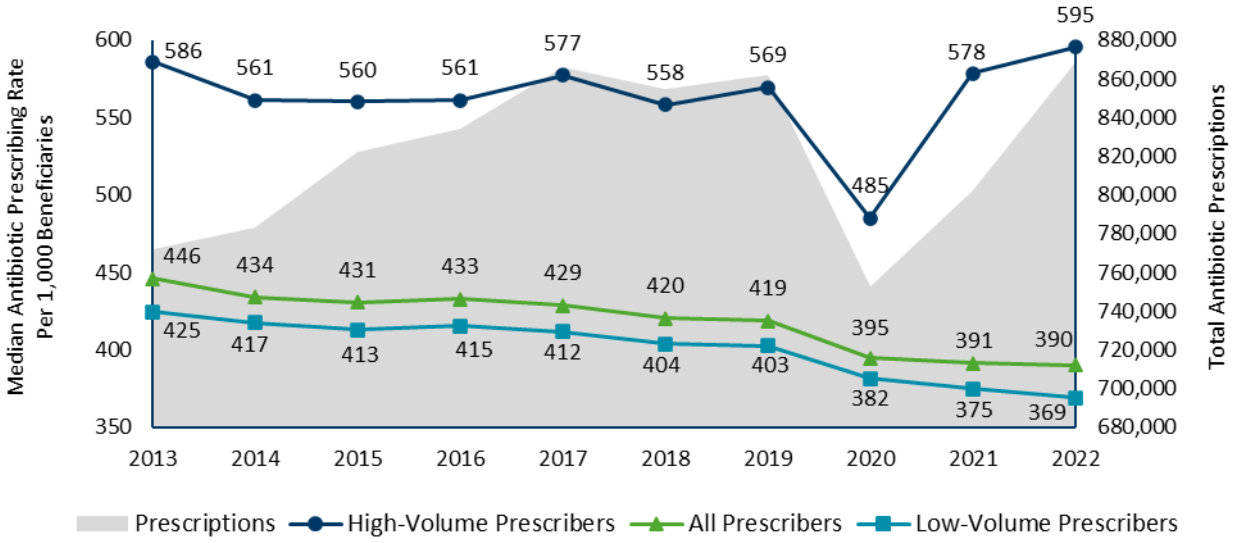


Figure 6 above visualizes the median antibiotic prescribing rate from 2013 through 2022 in Minnesota for high-volume prescribers compared to low-volume and all prescribers using the Medicare data. The figure also includes the total number of antibiotic prescriptions each year in the shaded background. Across all prescribers and low-volume prescribers, the antibiotic prescribing rate per 1,000 Medicare beneficiaries has slowly decreased over time, whereas the prescribing rate among high-volume prescribers has stayed more consistent and reached a peak in 2022. The total antibiotic prescriptions and prescribing rates all saw a decline in 2020, similar to trends in other datasets.

Table 2. Summary of antibiotic prescribing for Minnesota Medicare beneficiaries in 2022, including all, high, and low-volume prescribers.

Antibiotic Prescribing for Minnesota Medicare Beneficiaries	All Prescribers	High-Volume Prescribers	Low-Volume Prescribers
Number of prescribers	13,555	1,368	12,187
Number of prescriptions (% of total volume)	870,330	302,817 (35%)	567,513 (65%)
Number of prescriptions per prescriber, median (IQR)	42 (22–81)	188 (160–240)	37 (20-65)
Prescribing rate (scripts/1,000 beneficiaries), median (IQR)	390 (216–659)	595 (380–803)*	369 (202–627)

High-volume prescribers are defined as the highest 10% of prescribers by volume.
The prescribing rate of high-volume prescribers is significantly higher than the rate of low-volume prescribers (p<0.001).

Table 2 summarizes the 2022 Medicare analysis. High-volume prescribers prescribed 35% of the total antibiotic volume in 2022 and had a significantly higher prescribing rate than other prescribers, similar to previous years (Table 2). The prescribing rate for high-volume prescribers in 2022 was significantly higher than the rate for low-volume prescribers.

38% of Minnesota's high-volume prescribers in 2022 maintained their status in the high-volume prescribing category consistently from 2018 through 2021. Moreover, most high-volume prescribers (68%) in 2022 were also high-volume prescribers in 2021.

The specialties of high-volume prescribers are described in Table 3. Family medicine providers made up 26% of the high-volume prescribers in 2022 but only 17% of prescribers overall. Internal medicine physicians, physician assistants, and urologists also were more common in the high-volume group than in the overall prescriber dataset.

Table 3. Specialties of high-volume prescribers, 2022.

Specialty	All Prescribers, Count (%) (n=13,555)	High-Volume Prescribers, Count (%) (n=1,368)	% of Specialty in High-Volume Category
Family Medicine*	2,332 (17%)	356 (26%)	15%
Physician Assistant	1,887 (14%)	237 (17%)	13%
Nurse Practitioner	2,174 (16%)	211 (15%)	10%
Internal Medicine*	1,389 (10%)	160 (12%)	12%
Urology*	190 (1%)	78 (6%)	41%
Dental**	1,900 (14%)	59 (4%)	3%
Other	3,474 (26%)	241 (18%)	7%

**Family medicine, internal medicine, and urology represent prescribing by physicians.*
***Dental represents prescribing by dentists.*

In late 2024, MDH distributed feedback letters by mail to 995 high-volume antibiotic prescribers in Minnesota across all specialties to notify them of their high-volume prescriber status and provide resources to optimize their antibiotic prescribing. The group that received letters was narrower than the group of high-volume prescribers described above because prescribers in the

bottom 50th percentile of prescribing rate for their specialty were removed. Prescribers with specialties of infectious disease, oral and maxillofacial surgery, and pulmonary disease were excluded due to the nature of their specialty. MDH plans to continue exploring avenues to leverage the Medicare Part D dataset using this feedback program model.

Minnesota All Payer Claims Database — Prescribing for Outpatient Respiratory Conditions and Urinary Tract Infections, 2018–2021

The MN APCD systematically collects medical claims, pharmacy claims, and eligibility files from private and public health care payers. MDH used MN APCD data to describe antibiotic prescribing for acute respiratory infections (ARI) and urinary tract infections (UTI) from 2018 through 2021. MDH analyzed 6,821,972 ARI and 3,097,271 UTI events experienced by 2,392,682 and 1,352,865 insurance plan members respectively. Antibiotics are usually indicated for Tier 1 diagnoses, sometimes indicated for Tier 2, and rarely indicated for Tier 3. Overall, number of claims for ARI and UTI declined in 2020 and remained low through 2021 (Table 4).

When an antibiotic was prescribed for uncomplicated UTI events in 2020 or 2021, 49.5% received a first-line antibiotic. Compared to uncomplicated UTI events in 2018 and 2019, events in 2020 and 2021 were more likely to receive a first-line antibiotic (OR 1.38, 99.99% CI, 1.35-1.41).

Table 4. Minnesota urinary tract infection (UTI) and acute respiratory infection (ARI) diagnoses by antibiotic prescribing, 2018-2021 MN APCD.

	2018-2019		2020-2021	
Diagnoses	**Total, Count (%)**	**≥1 Antibiotic Prescribed, Count (%)**	**Total, Count (%)**	**≥1 Antibiotic Prescribed, Count (%)**
All UTI	2,261,163	370,408 (16%)	1,981,453	309,599 (16%)
Uncomplicated UTI	223,935 (10%)	111,130 (50%)	189,144 (10%)	88,536 (47%)
All ARI	3,934,196	1,296,161 (33%)	2,887,776	629,026 (22%)
Tier 1 ARI (Usually indicated)	465,552 (12%)	360,080 (77%)	242,380 (8%)	176,348 (73%)
Tier 2 ARI (Sometimes indicated)	1,136,753 (29%)	576,974 (51%)	672,644 (23%)	421,563 (63%)
Tier 3 ARI (Rarely indicated)	2,331,891 (59%)	376,302 (16%)	1,972,752 (68%)	201,597 (10%)

Of all UTI events in 2020 and 2021, 16% had at least one associated antibiotic prescription. Approximately half of uncomplicated UTI events in 2021 (47%, 43,332/92,995) were associated with an antibiotic, but only 52% (48,367) of those uncomplicated UTI events were treated with a first-line antibiotic drug (i.e., nitrofurantoin, trimethoprim-sulfamethoxazole, or fosfomycin). When a first-line antibiotic was not chosen, Penicillins were the most common class chosen (Table 5).

Of all ARI events in 2020 and 2021, 22% had at least one associated antibiotic prescription, including 73% of Tier 1, 63% of Tier 2, and 10% of Tier 3 ARI (Table 4). Diagnosis-specific prescribing rates were conducted for adult acute sinusitis, pediatric otitis, and uncomplicated UTI. Most adult acute sinusitis events from 2018 through 2021 (83%, 350,959/423,608) were associated with an antibiotic, but only 42% (148,696) of those sinusitis events were treated with a first-line antibiotic drug (i.e., amoxicillin or amoxicillin-clavulanic acid). Most pediatric otitis media events (82%, 320,578/391,570) were associated with an antibiotic, and a first-line drug was selected in 65% (209,564) of those events. Macrolides were often chosen as a non-first line drug for these diagnoses (data not shown). For all diagnoses, when a macrolide was prescribed, azithromycin was the most common drug chosen (data not shown).

Table 5. Drug classes selected to treat uncomplicated urinary tract infection when a first-line drug was not selected, 2018-2019 and 2020-2021 MN APCD.

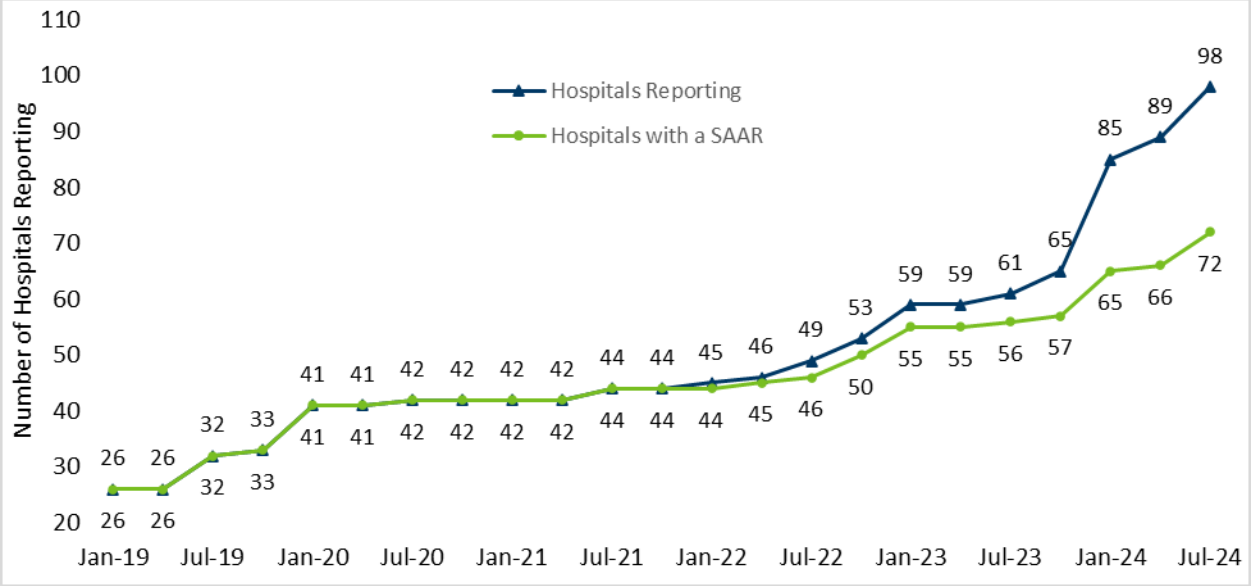
Non-First Line Classes for Uncomplicated UTI	2018-2019 Claims Count (%) (n=66,948)	2020-2021 Claims Count (%) (n=47,379)
Penicillins	18,970 (28%)	10,200 (22%)
Fluoroquinolones	15,668 (23%)	13,759 (29%)
Cephalosporins	9,719 (15%)	9,592 (20%)
Tetracyclines	6,529 (10%)	3,899 (8%)
Macrolides	6,316 (9%)	3,102 (7%)
Nitroimidazoles	3,768 (6%)	2,701 (6%)
Other	5,978 (9%)	4,126 (9%)

Prescribing by first-line status was also analyzed by patient characteristics, including location of residence. Members living in non-metro ZIP codes received antibiotics more often for both Tier 2 (OR 1.20, 99.9% CI 1.18–1.21) and Tier 3 (OR 1.28, 99.9% CI 1.26–1.29) diagnoses from 2018 to 2021. Non-metro Minnesotans received first-line antibiotics less often for both adult acute sinusitis (OR 0.94, 99.9% CI, 0.92–0.96) and pediatric otitis media (OR 0.85, 99.9% CI, 0.83–0.87), and uncomplicated UTI diagnoses (OR 0.73, 99.9% CI, 0.71–0.75).

Antibiotic Administration in Minnesota Hospitals

CDC uses the NHSN Antimicrobial Use Option to track inpatient antimicrobial use in hospitals. Deidentified data are automatically pulled from hospital electronic medication administration records, compiled in a standardized format, and sent to CDC. The standardized antibiotic administration ratio (SAAR) is a NHSN-derived measure that facilitates comparison of a hospital's actual antimicrobial administration rate to an expected rate, estimated from a national baseline dataset. The expected administration rate is adjusted for factors likely to influence antimicrobial use, including care unit type, teaching hospital status, and pediatric vs. adult care. A SAAR value of greater than 1 indicates more antimicrobials than predicted had been administered during the timeframe of interest, and a SAAR value less than 1 indicates that fewer antimicrobials than predicted were administered. The SAAR metric does not indicate whether antimicrobial use is appropriate or inappropriate, even if it varies considerably from the baseline of 1. The metric is used by hospital antimicrobial stewardship staff as an indicator of when a more detailed review of prescribing (e.g., medication use evaluation) might be indicated. Because CDC has developed multiple SAAR metrics, each reflecting a clinically specific group of antimicrobials, the system provides multiple useful indicators for antimicrobial stewards. Through a data use agreement, these data are available to MDH, allowing us to look at overall trends and provide hospitals with reports benchmarking them to similar facilities.

Figure 7. Number of Minnesota hospitals and units reporting antimicrobial use data and hospitals with SAAR output to the CDC NHSN AU Option by quarter, January 2019–July 2024.



As of July 2024, 73% (98/134) of acute care facilities, including 46 acute care hospitals and 49 critical access hospitals in Minnesota, have reported at least one month of adult AU data to the NHSN Antimicrobial Use Option (Figure 7).

A growing proportion of CAH and other low resource Minnesota facilities do not output SAAR benchmarking values due to lack of included reporting CDC location types. Facilities without the ability to perform advanced analysis of AU data and without SAAR values are disadvantaged to perform internal and statewide benchmarking to inform antibiotic stewardship activities. Characteristics of reporting hospitals are shown in Table 6. Figure 8 shows the most recently available national summary of the percent of hospitals reporting antimicrobial use to NHSN.

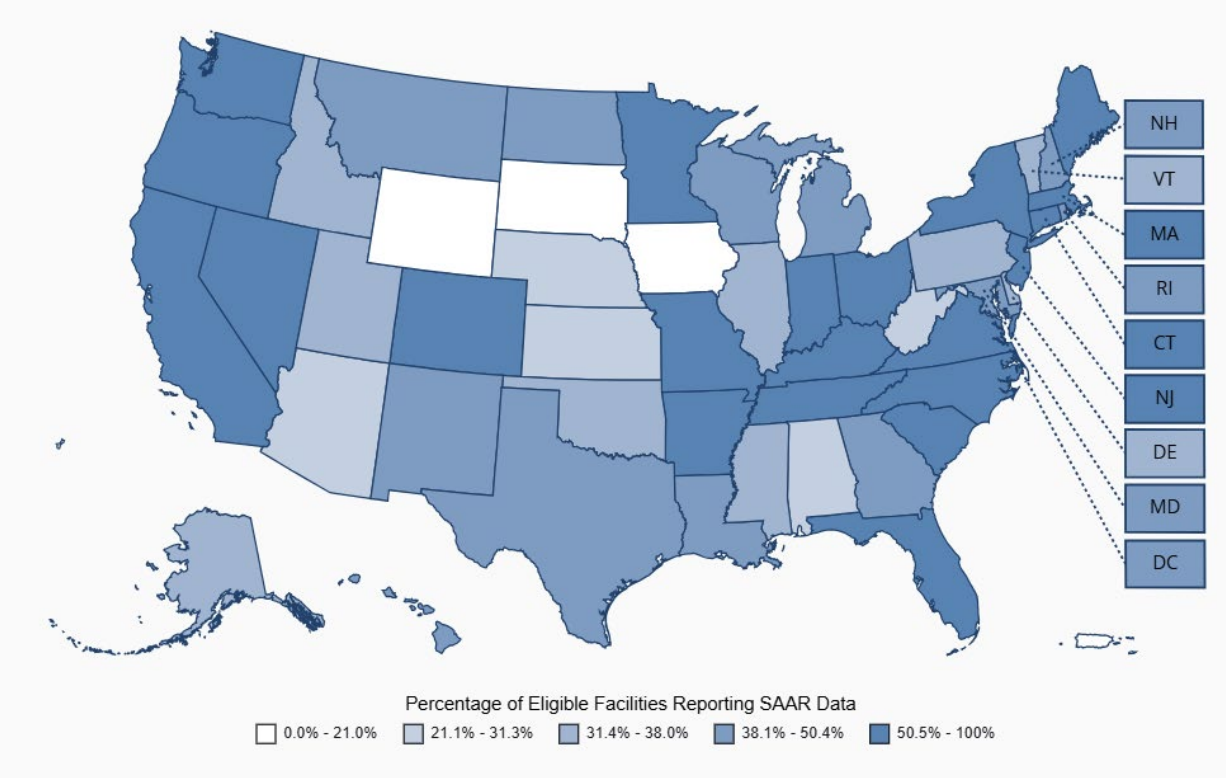
Table 6. Characteristics of Minnesota hospitals reporting at least one month of antimicrobial use data to CDC NHSN AU Option, July 2024.

Hospital Type	n (%)
General Acute Care	46 (47%)
Critical Access	49 (50%)
Children's	2 (2%)

Teaching Status	n (%)
None/Undergrad	54 (55%)
Major/Graduate	43 (44%)

Bed Size	n (%)
0-24 beds	50 (51%)
25-149 beds	30 (31%)
150-299 beds	8 (8%)
≥300 beds	10 (10%)

Figure 8. Percentage of eligible facilities reporting adult SAAR data by state, 2023.



Source: Centers for Disease Control and Prevention. Inpatient Antibiotic Use (https://arpsp.cdc.gov/profile/inpatient-antibiotic-use/all)

** Eligible adult facilities include: any critical access, general acute care, military, oncology, surgical, VA, women's or women and children's facilities actively participating in NHSN, with a recent annual hospital survey and at least one active adult SAAR location mapped in NHSN to that facility.*

Minnesota's statewide "all antibacterial agents" SAAR, which summarizes administration across all hospitals into a statewide summary metric, has remained just below 1 since NHSN Antimicrobial Use Option implementation (Figure 9). During 2023, two adult SAAR metrics remained above the null value of 1, "narrow-spectrum beta-lactam agents" (NSBL) and "antifungal agents predominantly used for invasive candidiasis" (Antifungal) (Figure 10).

An elevated statewide NSBL SAAR value may indicate a movement to select narrow spectrum antibiotics over broad spectrum antibiotics in Minnesota hospitals.

Figure 9. All antibacterial agents SAAR, Minnesota adult locations, 2017–Quarter 1 of 2024.

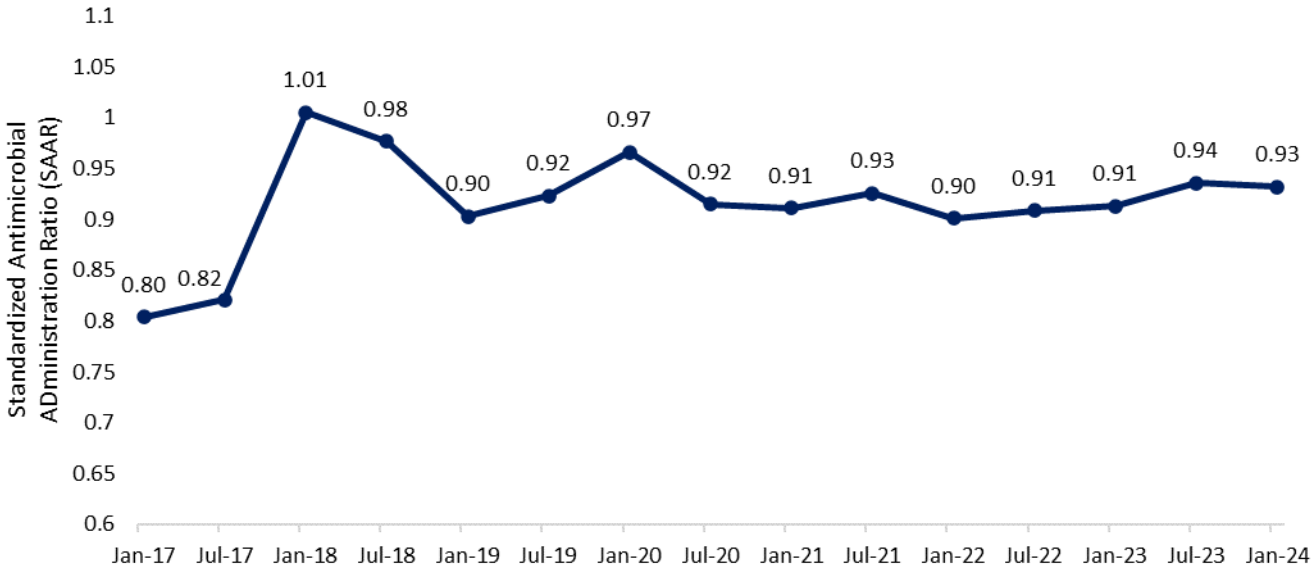
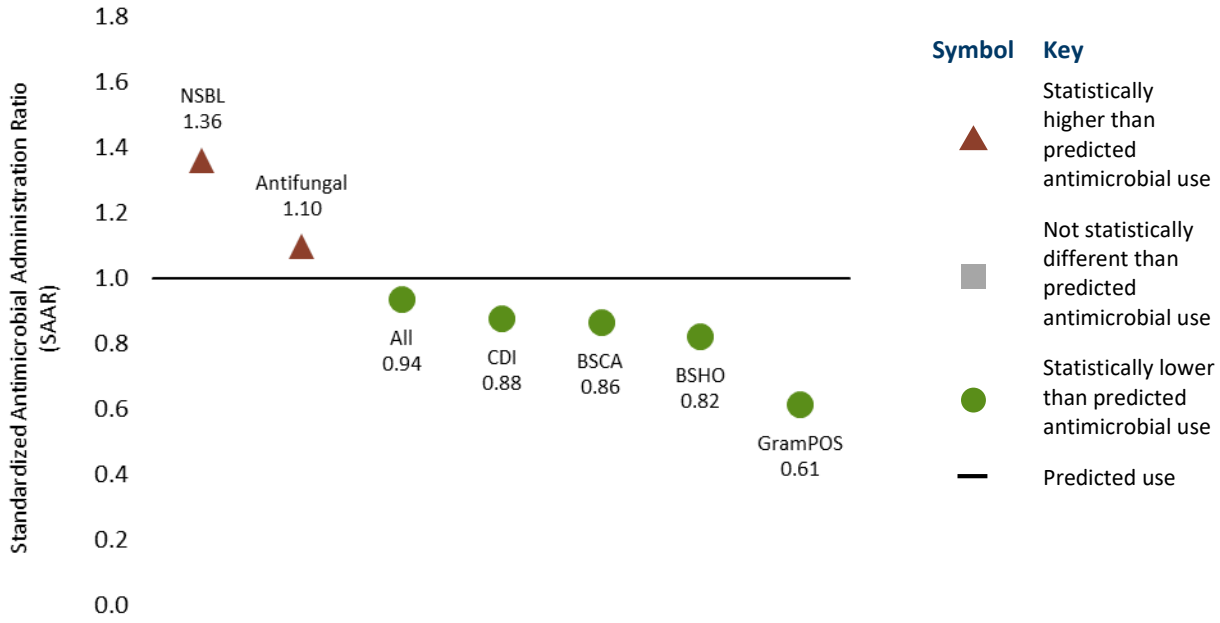


Figure 10. SAAR summary for Minnesota adult hospital wards, 2023



SAAR types are defined as follows: NSBL, narrow-spectrum beta-lactam agents; antifungal, antifungal agents predominantly used for invasive candidiasis; CDI, antibacterial agents posing the highest risk for Clostridioides difficile infection; BSCA, broad-spectrum antibacterial agents predominantly used for community-acquired infections; BSHO, broad-spectrum antibacterial agents predominantly used for hospital-onset infections; GramPOS, antibacterial agents predominantly used for resistant Gram-positive infections.

Adult hospital wards include Medical, Medical-Surgical, Surgical Wards

Opportunities to Use Data to Improve Antibiotic Use in Minnesota

Based on review of the data above, we have outlined areas of opportunity at both the state level and the health care facility level to support improved antibiotic use, including:

Identify quantitative or qualitative targets for overall antibiotic prescribing improvement.

MDH: Continue to communicate overall rates of macrolides, specifically azithromycin use, as well as fluoroquinolone use and rates for Minnesotans age 65 and older, focused on year-on-year reductions of these powerful drug classes. Advocate for updated national prescribing improvement targets to further guide stewardship program efforts.

Health care facilities: Consider the reduction targets (e.g., appropriate use for community-acquired pneumonia, urinary tract infection; azithromycin selection for pediatric patients; reduction in fluoroquinolone and intravenous vancomycin use) identified by national professional organizations and identify those which are relevant to your organization (16).

Focus on using rich datasets to explore prescribing in relation to diagnosis, prescriber type, and patient demographic factors.

MDH: Maintain routine (e.g., annual) use of the MN APCD and Medicare public use files to explore variables associated with health care or prescribing differences.

Health care facilities: Harness medical record data to establish baselines and track progress in specific prescribing improvement initiatives.

Address important prescribing gaps by targeting individual measurement and feedback to prescribers.

MDH: Utilize the established model for alerting high-volume outpatient Medicare prescribers of their oversized contribution to Minnesota's antibiotic prescribing volume and explore the potential for additional targeted interventions based on drug type.

Health care facilities: Gather prescriber-level data on priority conditions and provide individual benchmarking reports (i.e., audit with feedback).

Engage with other professionals using data to improve antibiotic prescribing.

MDH: Discuss analysis methodologies with CDC and other public health jurisdictions. Continue to seek out and share examples of how antibiotic prescribing data is being used for action.

Health care facilities: Attend MDH NHSN Antimicrobial Use Option User Group calls, get involved in the Minnesota Antimicrobial Stewardship Network for Pharmacists, and join the Minnesota One Health Antibiotic Stewardship Collaborative (https://redcap.health.state.mn.us/redcap/surveys/?s=XMHL3W4L8HWRKMD8).

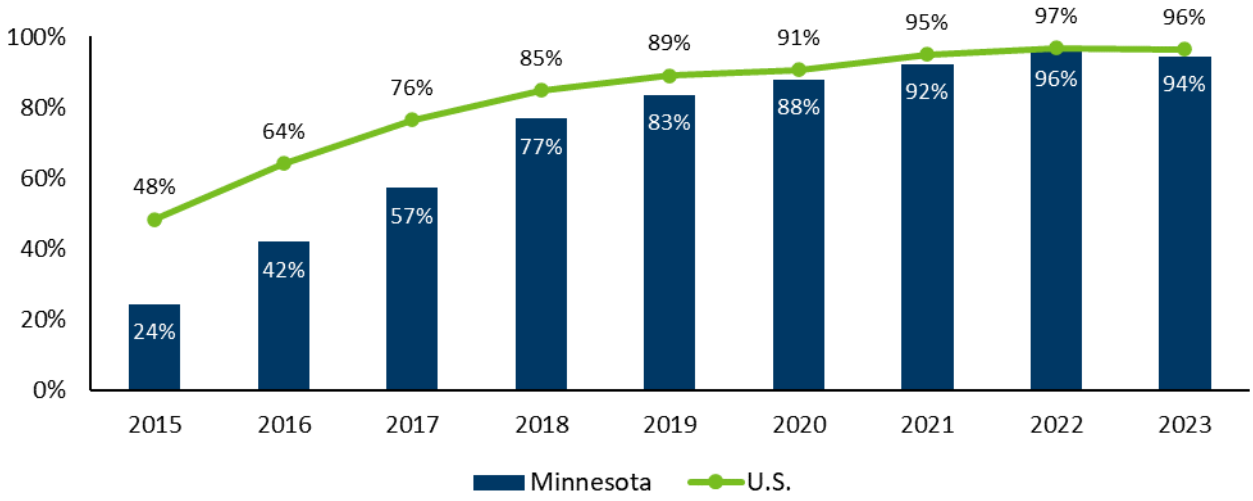
Part 2: Implementation of Health Care Antibiotic Stewardship Programs

Hospital Core Elements of Antibiotic Stewardship

Hospital antibiotic stewardship programs (ASPs) improve prescribing and treatment practices and reduce negative impacts of antibiotic use. In 2014, CDC released the Core Elements of Hospital Antibiotic Stewardship Programs and recommended that all acute care hospitals implement an ASP (17). Recognizing that hospitals differ in terms of organizational structure, care provided, and available resources, the core elements are intended to provide flexible guidance to implement the most essential components of an ASP.

Implementation of ASP core elements in acute care hospitals is tracked annually by CDC through the NHSN Patient Safety Component Annual Hospital Survey. Through a data use agreement, ASP data for Minnesota hospitals are available to MDH. In Minnesota, the proportion of hospitals meeting all seven core elements has consistently increased since 2015 and, in 2023, was slightly below (94%) the national implementation average (96%), (Figure 11).

Figure 11. Proportion of Minnesota and U.S. hospitals meeting all seven stewardship core elements by year, according to NHSN.



This difference is influenced by Minnesota's relatively greater proportion of critical access hospitals (CAHs) than the wider U.S. As defined by CMS, CAHs are small, serve non-urban populations, and tend to have fewer available operational resources, which can impact the implementation of program changes. In 2023, 91% of CAHs met all seven core elements compared to 100% of general acute care hospitals (Figure 12). Tracking was the least implemented core element (93%) in CAHs (Figure 13).

Figure 12. Proportion of Minnesota Hospitals Meeting All Seven Antibiotic Stewardship Program Core Elements by Year and Hospital Type.

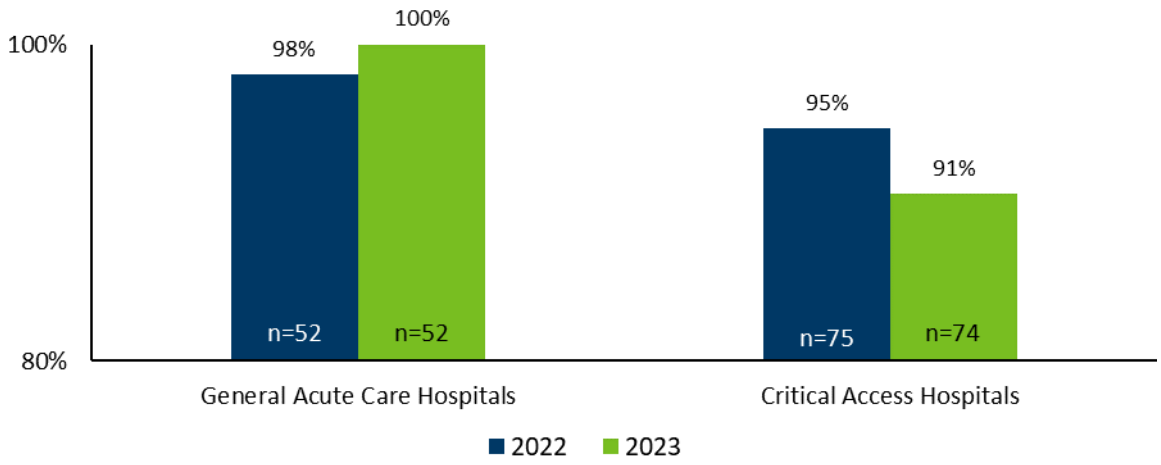
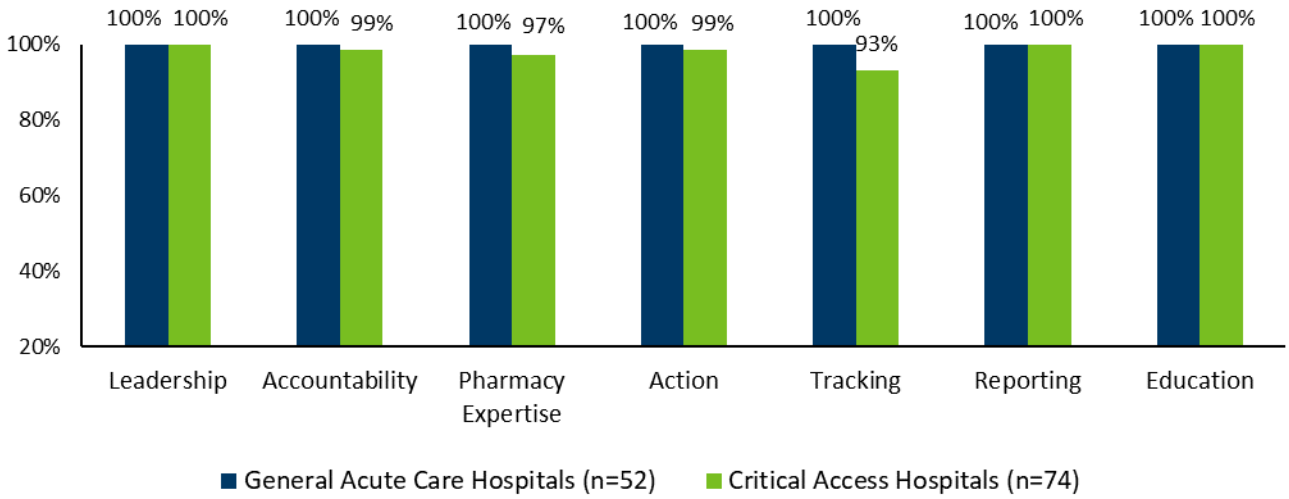


Figure 13. Proportion of Minnesota hospitals meeting each stewardship core element in 2023 by Hospital Type, according to NHSN.

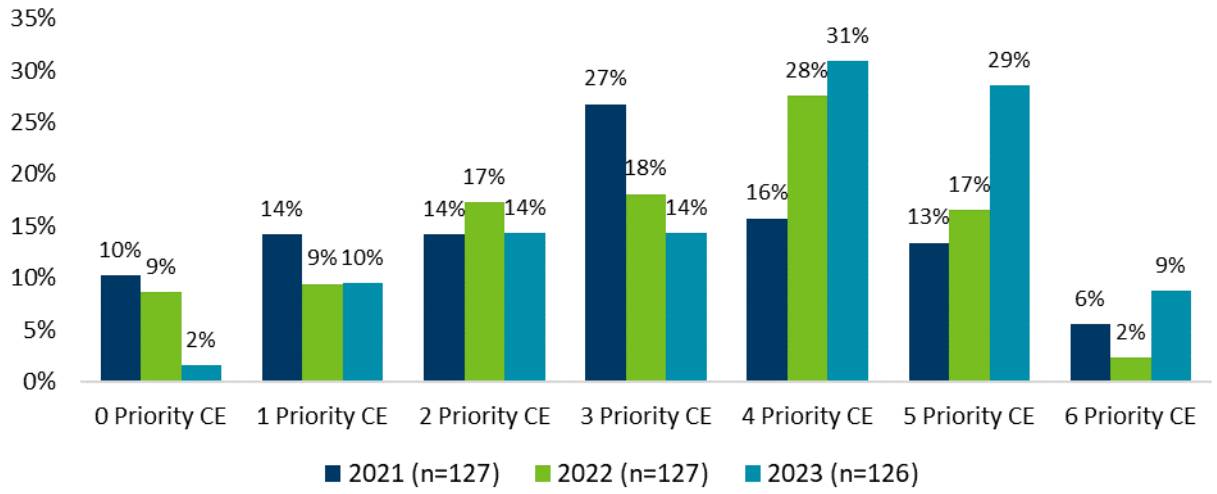


Priorities for Hospital Core Element Implementation

In 2022, as a result of widespread national implementation of the seven hospital core elements, CDC identified and published the Priorities for Hospital Antibiotic Stewardship Core Element Implementation (18). The priorities are derived from six of the seven original hospital core elements (the education section does not identify a priority element) and are intended to help enhance the quality and impact of ASPs by highlighting highly effective implementation strategies as supported by evidence and stewardship experts. Responses to the annual hospital survey were used to determine if a hospital meets one or more of the priority elements, except for tracking. A hospital meets the tracking priority element by submitting at least one month of data to the NHSN Antimicrobial Use Option in the calendar year for which the survey was conducted.

In Minnesota, 69% of acute care hospitals implemented four or more priority core elements in 2023, an increase from 35% in 2021 (Figure 14).

Figure 14. Proportion of Minnesota Hospitals meeting Priority Core Elements in 2021 - 2023, according to NHSN.



Pharmacy expertise was the most implemented priority core element (79%) while reporting was the least (32%) (Figure 15). General acute care hospitals performed better than CAH on each of the priority core elements (Figure 16). No CAH reported implementation of all six priority core elements, with only 46% meeting four or more priority core elements compared to 80% of acute care hospitals.

Figure 15. Proportion of Minnesota and U.S. Hospitals meeting each Priority Core Element in 2023, according to NHSN.

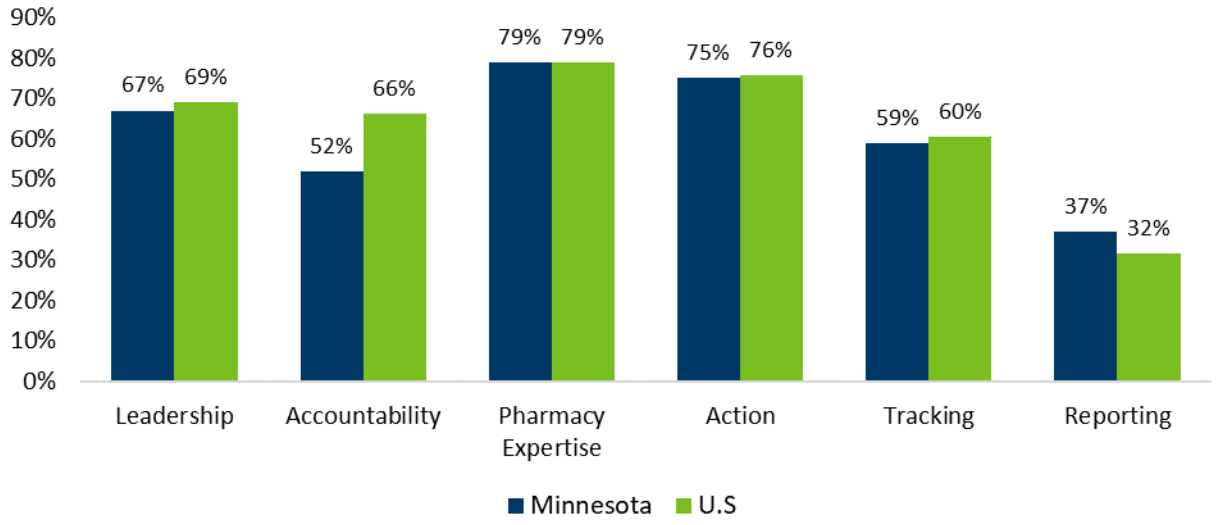
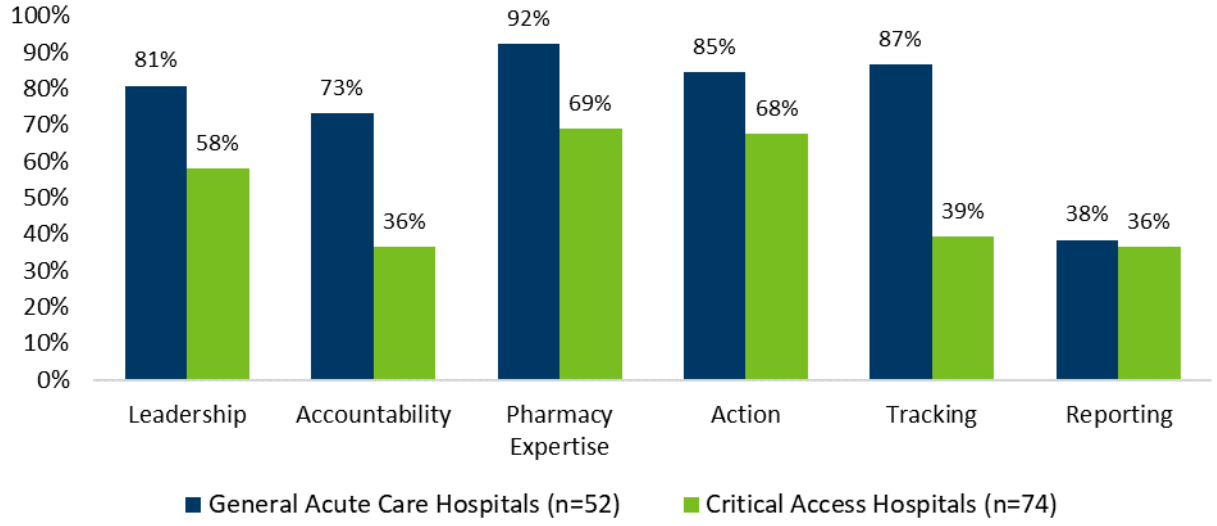


Figure 16. Proportion of Minnesota Hospitals meeting each Priority Core Element in 2023 by Hospital Type, according to NHSN.



Barriers and Facilitators to Priority Core Element Implementation in Critical Access Hospitals

In 2024, MDH disseminated a survey to antibiotic stewardship (AS) leaders in Minnesota CAHs to gather information on perceived barriers and facilitators to priority core element implementation. 48% (n=36) of Minnesota CAHs responded to the survey. Among CAH not yet implementing the reporting priority core element, key barriers included limited staff time (67%) and insufficient technology or IT support (42%) (Figure 17). For accountability, the main barrier was a low volume of physicians available (45%) (Figure 18). Lack of staff time was identified as a major barrier for the implementation of prospective audit & feedback, prior authorization, and common clinical pathways.

Figure 17. Barriers to Monitoring Adherence to Common Clinical Pathways & Providing Feedback on Antibiotic Use Data (Reporting)

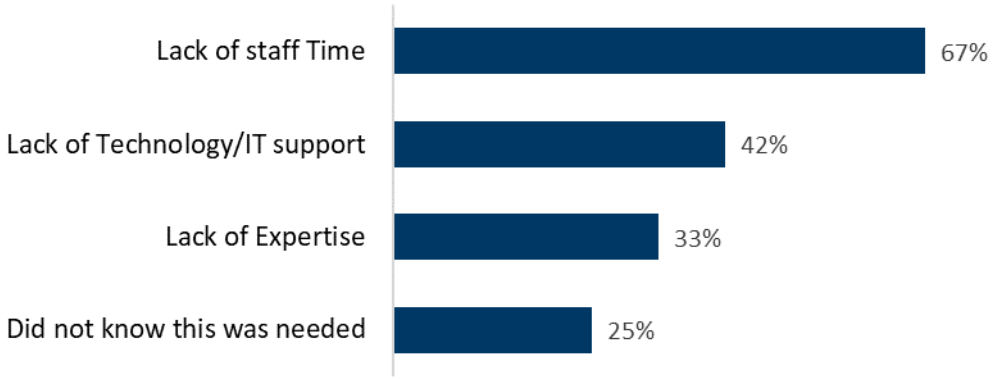
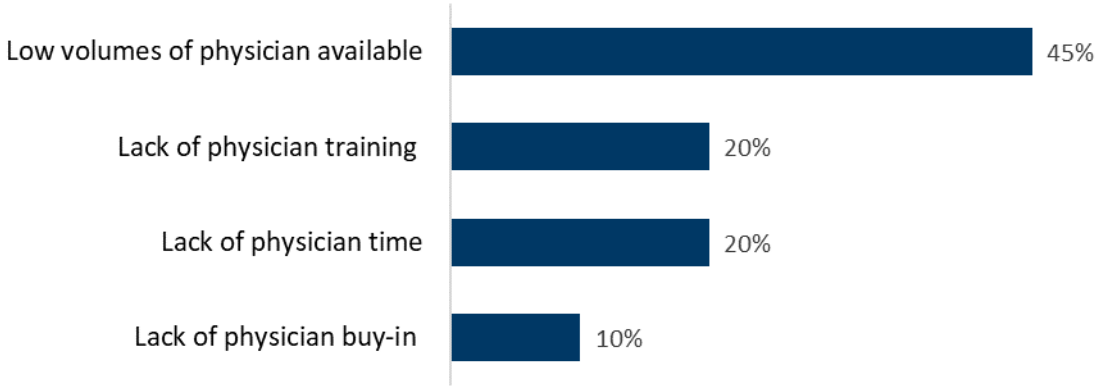
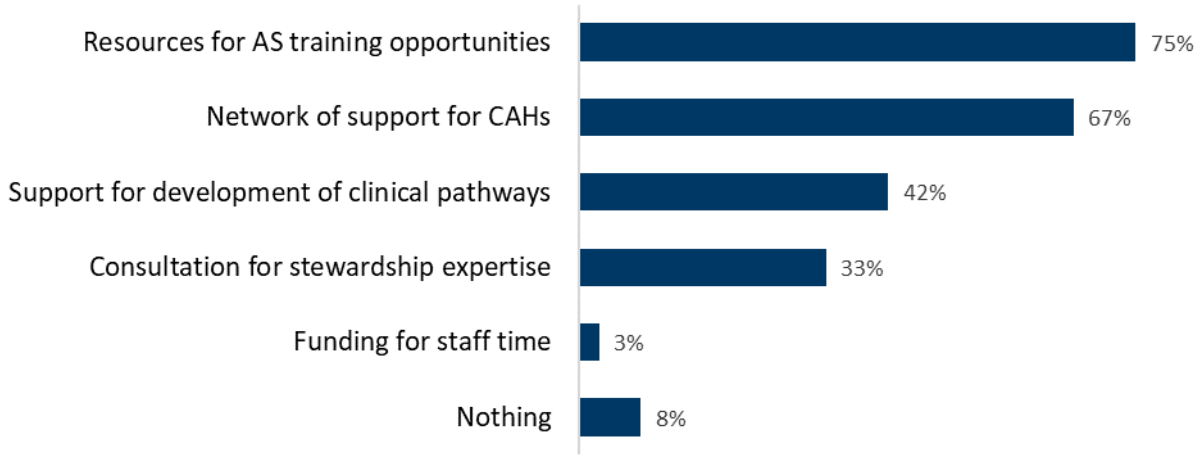


Figure 18. Barriers to having a Physician co-lead the ASP at CAH (Accountability)



Enhanced stewardship training (75%) and the establishment of a collaborative network for discussing core stewardship topics (67%) were reported facilitators to advancing antibiotic stewardship practices (Figure 19).

Figure 19. Activities to Help CAHs in Implementing the Priority Core Elements



Nursing Home Core Elements of Antibiotic Stewardship

Studies have shown that up to 70% of nursing home residents have received antibiotics during the prior year and that 40-75% of antibiotics prescribed may be unnecessary or inappropriate (19). The CDC recommends that all nursing homes take steps to implement stewardship activities. Implementing the CDC's Core Elements of Antibiotic Stewardship for Nursing Homes is expected to reduce adverse events, prevent emergence of resistance, and lead to better outcomes for nursing home residents (19, 20).

NHSN annual survey data on core element implementation in Minnesota reveals an increase during 2016–2019 (Figure 20); these increases mirrored national improvements in implementation (21). In 2020, the first year of the COVID-19 pandemic, the percentage of nursing homes that implemented all seven core elements declined, likely a result of strained staffing and resources. The reporting and education core elements experienced the greatest drop in implementation in 2020 (Figure 21). While most of the core elements had demonstrated progress with implementation from 2020 to 2023, several core elements saw declines in implementation in 2023 including reporting (dropped from 88% to 79%), action (dropped from 100% to 98%), and leadership (dropped from 100% to 99%).

Figure 20. Proportion of Minnesota and national nursing homes that implemented all seven core elements by year, according to NHSN.

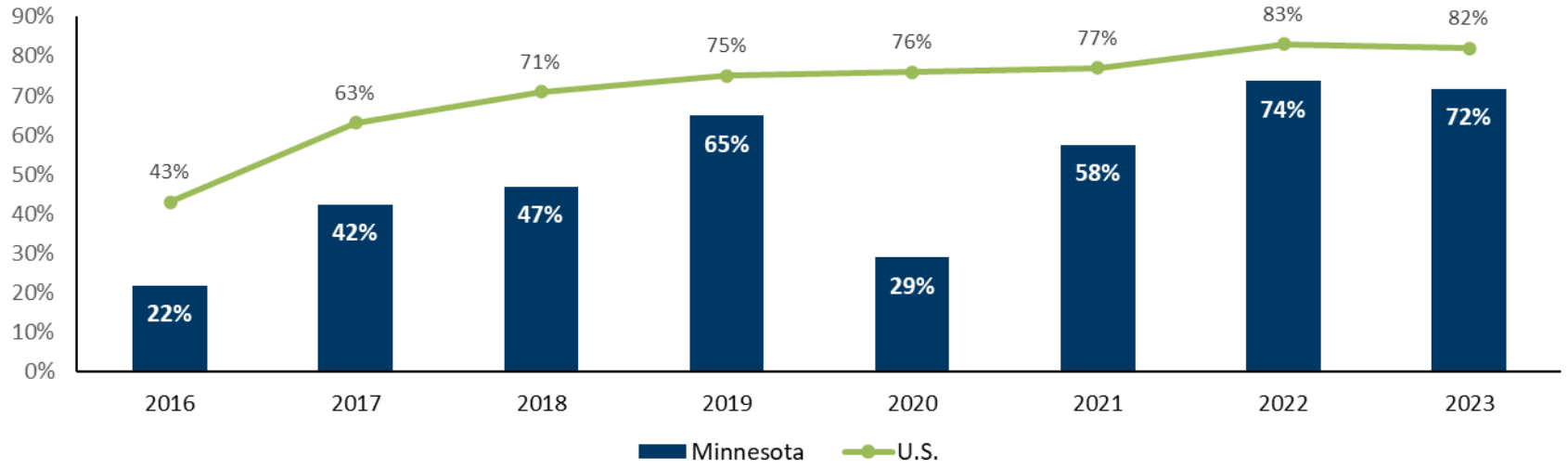
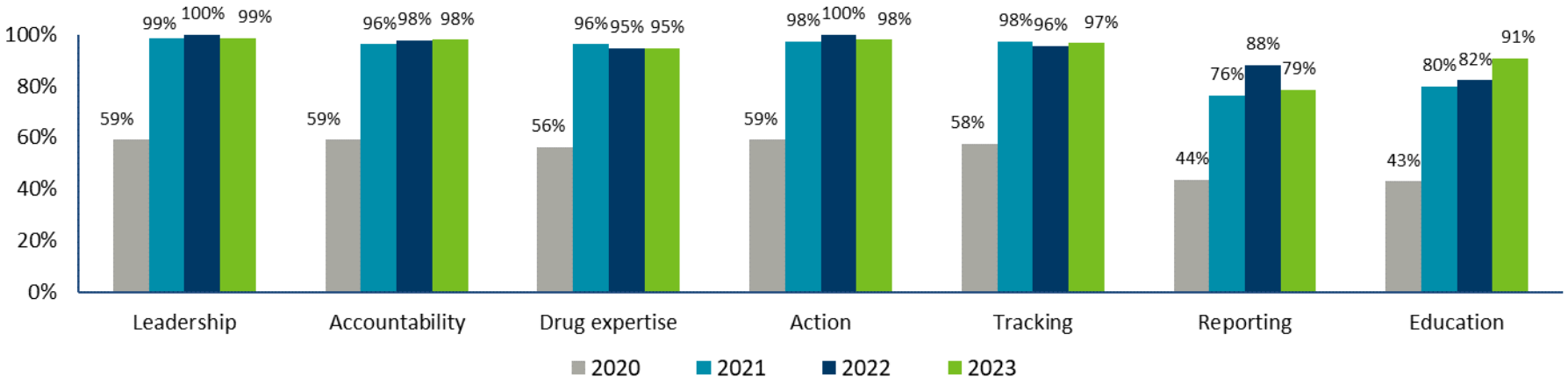


Figure 21. Proportion of Minnesota nursing homes meeting each stewardship core element by year, according to NHSN.



Outpatient Core Elements of Antibiotic Stewardship

In 2016, the CDC released the Core Elements of Outpatient Antibiotic Stewardship which provides guidance for AS in outpatient settings and a framework for establishing effective AS interventions for clinicians and facilities that routinely provide antibiotic treatment. The four core elements of outpatient antibiotic stewardship are commitment, action for policy and practice, tracking and reporting, and education and expertise (22).

Outpatient Antibiotic Stewardship Core Elements in Minnesota Clinics

During December 2024 – January 2025, MDH surveyed Minnesota outpatient clinics to learn about clinic antibiotic stewardship practices. Completed surveys were analyzed from 101 unique clinics. MDH previously surveyed outpatient clinics in 2022 and 2017 using the same methodology, with minor modifications to mapping of the core elements. In the 2024 MDH survey, 74% of the respondents were physicians and 23% were pharmacists. 56% of the clinics indicated that they have an ASP and 72% said they belong to a health system. The survey revealed that 37% of clinics implemented all four core elements, increasing from 25% in 2022 and 9% in 2017. Implementation of all four core elements except action for policy and practice, increased from 2017 and 2022 (Figure 22). Action for policy and practice was the most implemented core element (96%) while education and expertise (42%) was the least implemented (Figure 23).

Figure 22. Percent of clinics implementing each of the CDC core elements of antibiotic stewardship for outpatient settings in 2017,2022, & 2024 MDH surveys.

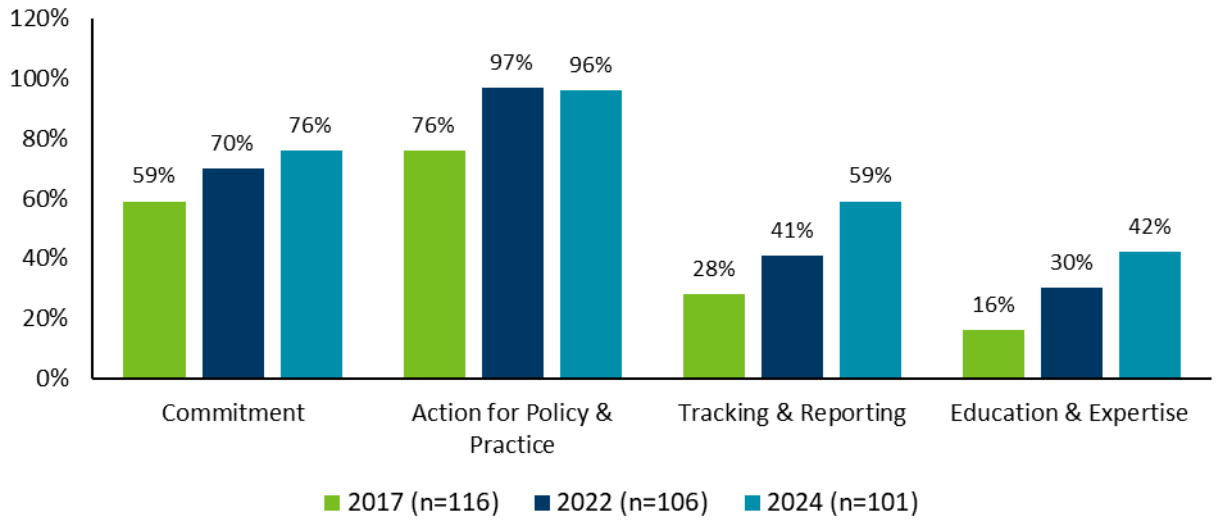
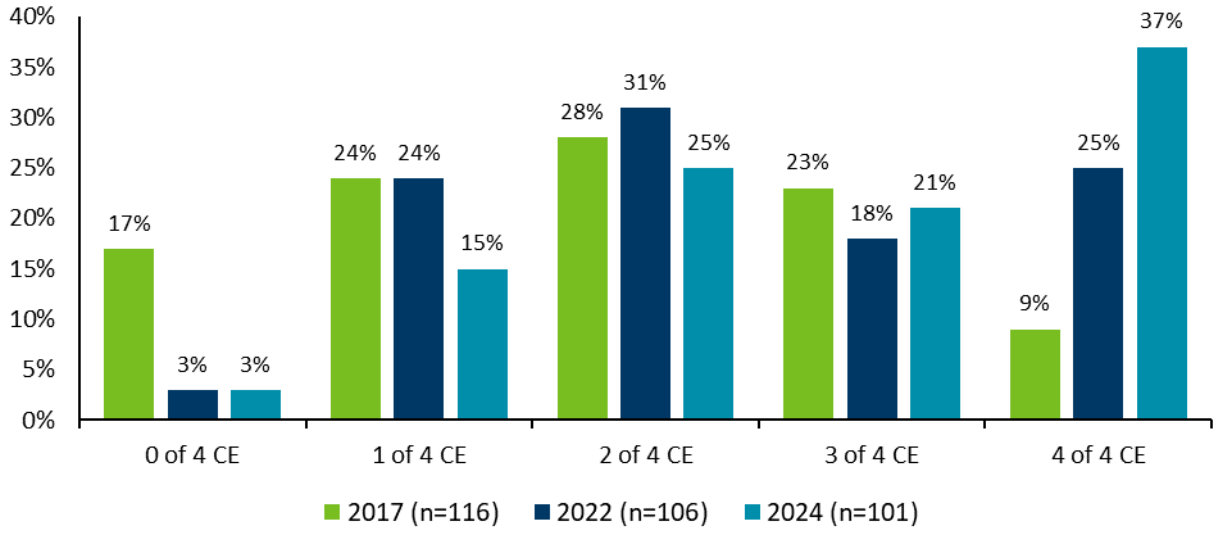
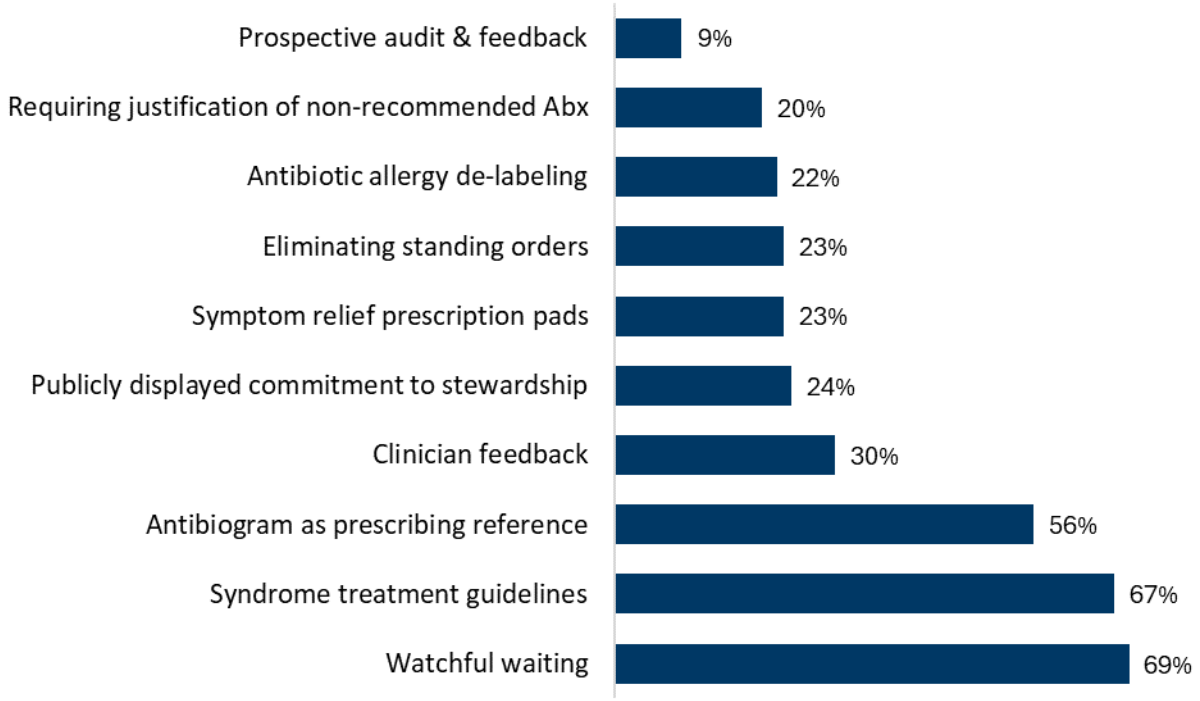


Figure 23. Percent of clinics meeting the 4 CDC core elements (CE) of antibiotic stewardship for outpatient settings in 2017,2022, & 2024 MDH surveys.



When respondents were asked about clinic policies or actions to promote appropriate antibiotic prescribing, just over two thirds (69%) stated practicing delayed prescribing or watchful waiting period when appropriate and using evidence-based diagnostic criteria and syndrome-specific treatment guidelines (67%). The least implemented action was the use of a prospective audit with feedback system for clinician prescribing (9%) (Figure 24).

Figure 24. Stewardship policies or actions to promote appropriate antibiotic prescribing reported by Minnesota outpatient clinics in 2024 MDH survey.



Survey respondents were asked about perceived barriers to AS in their clinics and what type of support they thought would facilitate AS activities. About half (51%) of the respondents mentioned lack of staff time for stewardship work, and 41% said pressure from patients to prescribe antibiotics as the major barriers (Figure 25). 65% of clinics mentioned that patient education about proper antibiotic use would help their clinic in implementing AS activities (Figure 26). When respondents were asked "What one thing could the Minnesota Department of Health do that would be most beneficial to your clinic's antimicrobial stewardship practices?" the most common action identified was public and patient education regarding the role of antibiotics, appropriate use, and risks associated with inappropriate use (data not shown).

Figure 25. Barriers to stewardship implementation reported by Minnesota outpatient clinics in 2024 MDH survey.

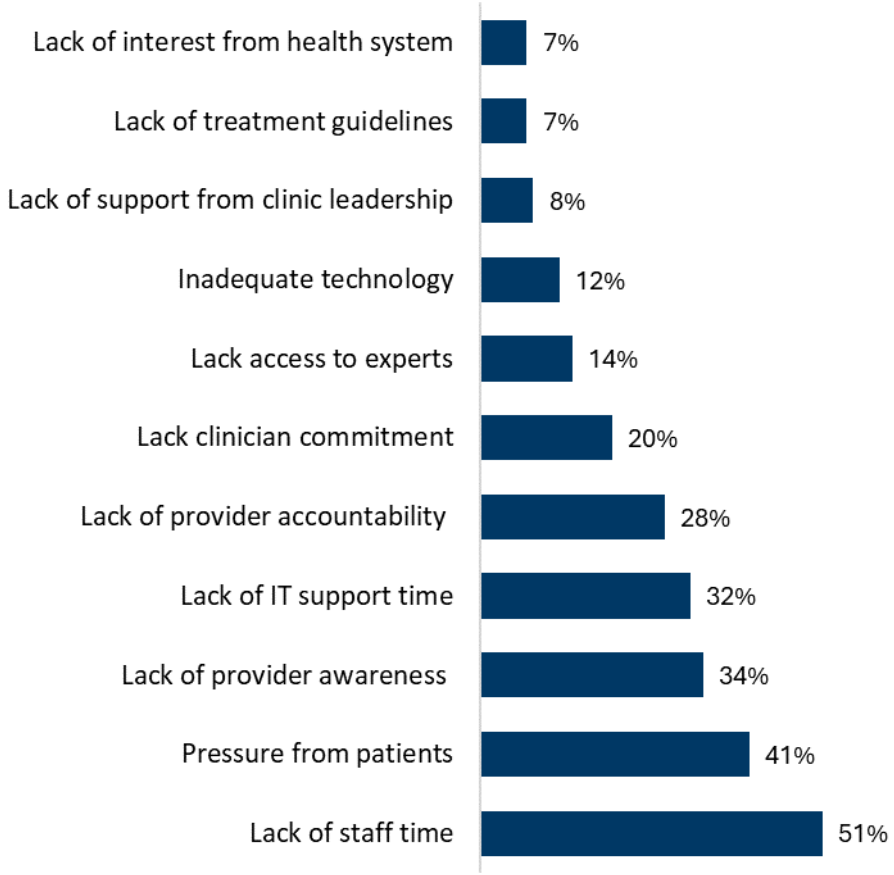
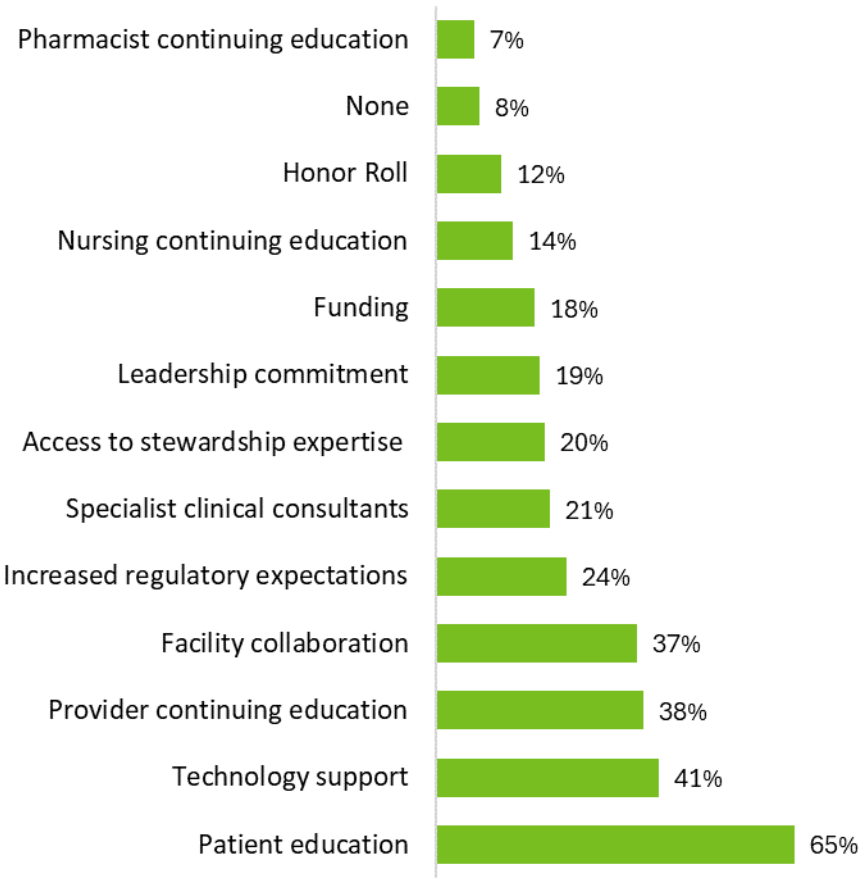


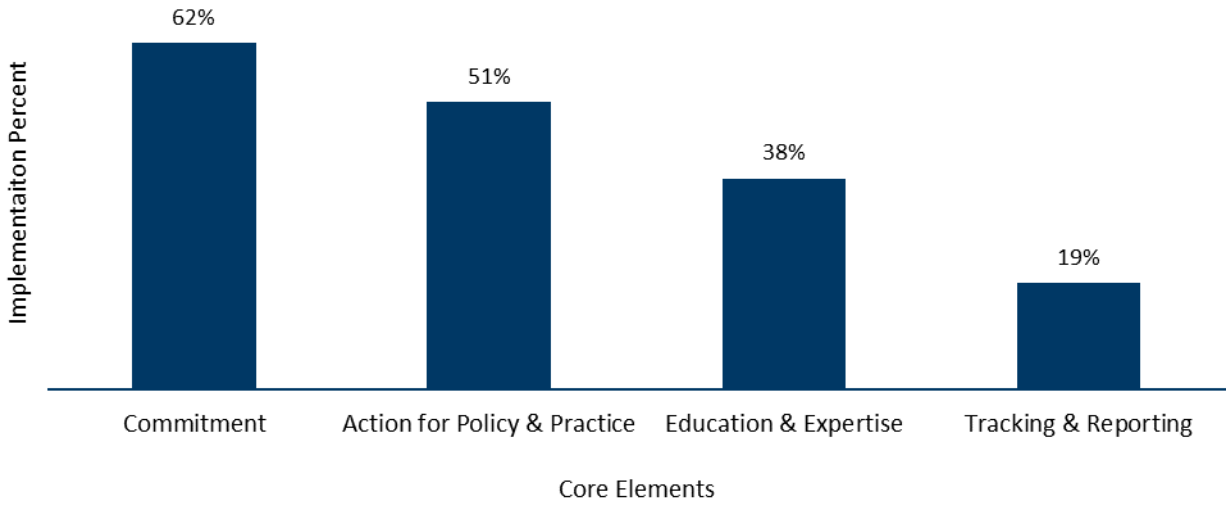
Figure 26. Facilitators to stewardship implementation reported by Minnesota outpatient clinics in 2024 MDH survey.



Outpatient Antibiotic Stewardship Core Elements in Minnesota Dental Settings

A 2024 survey of Minnesota dentists (n=468) assessed implementation of the Core Elements of Outpatient Antibiotic Stewardship in dental settings. Over three-quarters (77.8%) of dental practices had implemented at least one core element; however, less than 10% of dentists (9.8%) responded that their practice had implemented all four core elements. Commitment was the most implemented core element (61.8%), while tracking and reporting was the least implemented (18.9%) (Figure 27).

Figure 27. Percent of Minnesota dentists implementing each of the CDC core elements of antibiotic stewardship for outpatient settings in 2024.



For more information on antibiotic stewardship in dental settings, including more data from the 2024 survey of MN dentists, check out this presentation from a November webinar hosted by MDH in collaboration with the MN Board of Dentistry and MN Dental Association: [Data-Driven Dental Antibiotic Stewardship: State Survey Findings and Stewardship Resources (https://www.health.state.mn.us/communities/onehealthabx/event/datadental.pdf)](https://www.health.state.mn.us/communities/onehealthabx/event/datadental.pdf)

Opportunities to Improve Antibiotic Stewardship Programs

Continued improvements in the implementation of stewardship priority core elements can be supported at both the state agency and health care facility level in multiple ways, including:

Provide education and training opportunities for patients and health care professionals.

MDH: Develop and disseminate educational materials to increase public awareness about the risks of antibiotic resistance and responsible antibiotic use. Continue hosting the annual continuing education conference and work with partners across health care settings to offer additional education opportunities and resources as needs are identified.

Health care facilities: Enhance education and training of health care providers and patients regarding appropriate antibiotic prescribing and diagnostic stewardship.

Measure and report antibiotic use and stewardship core element implementation data and provide technical assistance.

MDH: Measure antibiotic stewardship practices in all health care settings, identify barriers to core element implementation, and offer technical assistance to support adoption where appropriate, including through development of setting-specific education and resources. Among hospitals, continue to increase awareness of the priorities for core element implementation and support facility-level implementation, especially among CAH.

Health care facilities: Develop and implement evidence-based guidelines for antibiotic prescribing and use.

Provide platforms for collaboration and engage with health care professionals across all settings.

MDH: Collaborate with facilities, health care professionals, and public health officials to facilitate sharing of best practices and ensure that stewardship efforts are coordinated and effective. Maintain the MDH stewardship network for pharmacists as a quarterly forum for collaboration and sharing of best practices, emphasizing engagement of pharmacists from under-represented clinical settings and areas of Minnesota. Continue public recognition of stewardship programs through the Minnesota Antibiotic Stewardship Honor Roll.

Health care facilities: Promote collaboration and communication with antibiotic stewardship teams and participate in regional and national stewardship collaboratives to share information and best practices with other facilities.

Methods

IQVIA™ Outpatient Antibiotic Use Data

Antibiotic prescriptions filled in community pharmacies are collected by a contract research organization, IQVIA™, accounting for more than 92% of total outpatient antibiotic prescriptions filled at community and nongovernmental mail service pharmacies. The remainder of the prescriptions are estimated from wholesale data by using a patented projection method.

IQVIA™ updated the projection methodology in 2017. Where comparisons to previous years' estimates are presented in this report, rate data generated by pre-2017 methodology are used. Antibiotic prescriptions are attributed to the location of the prescriber's main office or, if not available, the location of the pharmacy. To calculate prescriptions per 1,000 persons, U.S. Census population estimates were used for denominators.

Minnesota-specific rate data for 2018 were obtained from detailed IQVIA™ Xponent® datasets shared with MDH by CDC. National IQVIA™ Xponent® rate data and Minnesota data from earlier years were obtained directly from CDC or from the CDC Antibiotic Resistance & Patient Safety Portal (23). Data downloaded from the CDC website were summarized and visualized using Microsoft Excel.

Centers for Medicare & Medicaid Services Medicare Part D Prescriber Public Use Files

This study analyzed data from the Centers for Medicare & Medicaid Services (CMS) Part D Prescriber Public Use Files (13) to describe higher-volume antibiotic prescribers in outpatient settings compared with lower-volume prescribers (the lower 90% of prescribers by antibiotic volume). Approximately 70% of Medicare beneficiaries nationally are enrolled in Medicare Part D, the prescription drug benefit program for adults aged ≥65 years and persons with disabilities or end-stage renal disease. CMS Medicare Part D Prescribers by Provider is a publicly available data set that contains prescriber-level aggregate counts of outpatient prescription drug events by three drug types (antibiotics, antipsychotics, and opioids) and provider characteristics, including names, National Provider Identifier, specialty (including prescriber type), and ZIP code. There is a 2-year lag in data availability, during which prescription drug claims are finalized. Because beneficiary and antibiotic claim counts fewer than 11 are suppressed, the 2013 through 2022 Medicare Part D Prescribers by Provider data sets were used to assess prescriber-level antibiotic prescriptions among health care providers in the United States who distributed 11 or more antibiotic prescriptions.

Higher-volume prescribers were defined as those in the highest 10th percentile of prescriber-level antibiotic volume (number of antibiotic prescriptions filled) across all Medicare providers nationwide. The cumulative percentage of antibiotic volume prescribed by higher-volume prescribers was assessed overall, and the percentage of higher-volume prescribers in each U.S. Census Bureau region† and specialty were described. To verify that antibiotic volume was not exclusively driven by the number of Medicare beneficiaries attributed to an individual prescriber, the percentage of beneficiaries with an antibiotic prescription and the prescriber's antibiotic volume per 1,000 beneficiaries were calculated. The Wilcoxon rank-sum test was used to compare median prescribing rates among prescribers. All analyses were performed using SAS (version 9.4; SAS Institute).

Minnesota All Payer Claims Database Outpatient Antibiotic Use Data

We compiled 2018–2020 MN APCD outpatient ARI and UTI medical claims, antibiotic pharmacy claims, and member information from all payers into a single analytical file. Member ARI and UTI events were included if payer coverage was in place 30 days before and after the event and it had been at least 28 days since the last included ARI or UTI claim. Pharmacy antibiotic claims occurring on (Day 0) or within three days (i.e., Days -3 to Day 3) of an included ARI or UTI medical claim were analyzed. ARI ICD-10-CM codes were characterized by whether antibiotics are usually (Tier 1), sometimes (Tier 2), or rarely (Tier 3) indicated. Since antibiotics are rarely indicated for acute bronchitis, first-line selection was not described. Amoxicillin and amoxicillin-

clavulanate were considered first-line for acute sinusitis and otitis media in this analysis. Nitrofurantoin, trimethoprim-sulfamethoxazole, and fosfomycin were considered first-line antibiotics for uncomplicated UTI ICD-10-CM code in this analysis. Descriptive statistics were generated across diagnosis tier and member metro status using logistic regression. SAS version 9.4 and SQL Workbench were used for data cleaning and analysis. For more information about the MN APCD, please visit Minnesota All Payer Claims Database (https://www.health.state.mn.us/data/apcd/index.html).

National Healthcare Safety Network Data for Hospital & Nursing Home Core Elements

NHSN is a secure, internet-based HAI surveillance system managed by CDC. MDH accesses NHSN data for Minnesota health care facilities through a data use agreement (DUA) with CDC that was initially established in 2013 and updated in June 2023. The NHSN annual survey includes questions intended to assess implementation of the antibiotic stewardship program core elements in hospitals and nursing homes. MDH analyzes the data yearly to assess and track stewardship improvement over time and identify opportunities to offer support through direct technical assistance and MDH-hosted educational opportunities. National core element implementation data for hospitals are tracked by CDC and publicly reported through the Antibiotic Resistance and Patient Safety Portal (24).

Outpatient Stewardship Survey

During November 2022–January 2023, MDH surveyed Minnesota outpatient clinics to learn about clinic antibiotic stewardship practices. Completed surveys were analyzed from 106 unique clinics. MDH objectives were to understand current clinic commitment to AS, learn about clinic AS activities, detect barriers to AS, and identify clinic AS resource and support needs. Clinics were identified from a MN Clinic Registry and were eligible if located in MN and listed as primary care or multispecialty clinics, or if internal medicine (IM), family medicine (FM), or pediatric medicine (PM) specialties were present. Additionally, individual clinicians were identified to receive the survey by using the Board of Medical Practice practitioner list and were eligible if they resided in MN, were in IM, FM, or PM specialties, and had an email address recorded. MDH previously surveyed outpatient clinics in 2017 using the same methodology with minor modifications to mapping of the core elements.

Dental Stewardship Survey

In May 2024, MDH launched an electronic survey to assess Minnesota dentists' knowledge, attitudes, and practices regarding antibiotic use and stewardship. The survey was distributed via email to 4,320 licensed dentists in Minnesota in collaboration with the Minnesota Board of Dentistry. The survey was open for seven weeks and received 468 responses, which is a 10.8% response rate. A set of eight questions on the survey acted as a proxy to measure implementation of the four CDC Core Elements of Outpatient Antibiotic Stewardship.

References

1. Fleming-Dutra K, et al. Prevalence of inappropriate antibiotic prescriptions among US ambulatory care visits, 2010-2011. JAMA. 2016;315(17):1864-1873.
2. Palms D, et al. First-Line Antibiotic Selection in Outpatient Settings. Antimicrob Agents Chemother. 2019 Oct 22;63(11):e01060-19.
3. King LM, et al. Antibiotic Therapy Duration in US Adults With Sinusitis. JAMA Intern Med. 2018 Jul 1;178(7):992-994.
4. Fleming-Dutra K, et al. Variations in Antibiotic and Azithromycin Prescribing for Children by Geography and Specialty—United States, 2013. Pediatric Infectious Disease Journal. 2018; 37(1):52-58.
5. Gerber JS, et al. Racial differences in antibiotic prescribing by primary care pediatricians. Pediatrics. 2013 Apr;131(4):677-84.
6. Okunseri C, et al. Trends and racial/ethnic disparities in antibiotic prescribing practices of dentists in the United States. J Public Health Dent. 2018 Mar; 78(2): 109–117.
7. Fleming-Dutra, et al. Race, otitis media, and antibiotic selection. Pediatrics. 2014. 134(6):1059-1066.
8. Kissler SM, et al. Childhood Respiratory Outpatient Visits Correlate With Socioeconomic Status and Drive Geographic Patterns in Antibiotic Prescribing. J Infect Dis. 2021 Jun 15;223(12):2029-2037.
9. Public Health England. English Surveillance Programme for Antimicrobial Utilisation and Resistance (ESPAUR): report 2014 [Internet]. London, England: Public Health England; 2014. Available at https://webarchive.nationalarchives.gov.uk/ukgwa/20181130125613/https://www.gov.uk/government/publications/english-surveillance-programme-antimicrobial-utilisation-and-resistance-espaur-report.
10. Yarrington ME, et al. Impact of FDA black box warning on fluoroquinolone and alternative antibiotic use in southeastern US hospitals. Infect Control Hosp Epidemiol. 2019 Nov;40(11):1297-1300
11. Centers for Medicare & Medicaid Services (CMS) Part D Prescriber Public Use Files. Available at https://data.cms.gov/provider-summary-by-type-of-service/medicare-part-d-prescribers/medicare-part-d-prescribers-by-provider.
12. King LM, et al. Advances in optimizing the prescription of antibiotics in outpatient settings. BMJ 2018;363:k3047.
13. Schwartz KL, et al. Effect of antibiotic-prescribing feedback to high-volume primary care physicians on number of antibiotic prescriptions: a randomized clinical trial. JAMA Intern Med 2021;181:1165–73.
14. Hallsworth M, et al. Provision of social norm feedback to high prescribers of antibiotics in general practice: a pragmatic national randomised controlled trial. Lancet 2016;387:1743–52.
15. Kitano T, et al. The association between high and unnecessary antibiotic prescribing: a cohort study using family physician electronic medical records. Clin Infect Dis 2021;72:e345–51.
16. Pew Charitable Trusts. Health Experts Establish Targets to Improve Hospital Antibiotic Prescribing. 2021. Available at https://www.pewtrusts.org/en/research-and-analysis/reports/2021/03/health-experts-establish-targets-to-improve-hospital-antibiotic-prescribing.
17. CDC. (2014). The Core Elements of Hospital Antibiotic Stewardship Programs. Atlanta, GA: US Department of Health and Human Services, CDC. Retrieved from CDC website: https://www.cdc.gov/antibiotic-use/healthcare/pdfs/core-elements.pdf.
18. CDC. Priorities for Hospital Core Element Implementation. Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Healthcare Quality Promotion (DHQP). Retrieved from CDC website: https://www.cdc.gov/antibiotic-use/hcp/core-elements/hospital-implementation.html.
19. CDC. The Core Elements of Antibiotic Stewardship for Nursing Homes. Atlanta, GA: US Department of Health and Human Services, CDC; 2015. Available at: https://www.cdc.gov/antibiotic-use/hcp/core-elements/nursing-homes-antibiotic-stewardship.html

20. Lim CJ, et al. Reducing inappropriate antibiotic prescribing in the residential care setting: current perspectives. Clin Interven Aging. 2014; 9: 165-177; Nicolle LE, Bentley D, Garibaldi R, et al. Antimicrobial use in long-term care facilities. Infect Control Hosp Epidemiol 2000; 21:537–45.
21. Gouin et al. Implementation of core elements of antibiotic stewardship in nursing homes—National Healthcare Safety Network, 2016–2018. Infection Control & Hospital Epidemiology (2021), 1–5.
22. Sanchez, G.V., Fleming-Dutra, K.E., Roberts, R.M., Hicks, L.A. Core Elements of Outpatient Antibiotic Stewardship. MMWR Recomm Rep 2016;65(No. RR-6):1–12.
23. CDC Antibiotic Resistance & Patient Safety Portal. Available at https://arpsp.cdc.gov/profile/antibiotic-use?tab=outpatient-antibiotic-use.
24. CDC Antibiotic Resistance & Patient Safety Portal. Available at https://arpsp.cdc.gov/profile/geography/united-states#antibiotic-stewardship.