



Antibiotic Use and Stewardship in Minnesota

2024 UPDATE ON PROGRESS AND OPPORTUNITIES

Antibiotic Use and Stewardship in Minnesota 2024 Update on Progress and Opportunities

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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, presenting 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](#)).

2024 highlights and additions

- [IQVIA™ Outpatient Antibiotic Prescribing Data](#) demonstrated an increase in overall outpatient antibiotic prescribing rates in Minnesota in 2022, moving closer to pre-pandemic levels.
- [Outpatient Antibiotic Prescribing for Medicare Beneficiaries, 2021](#) was updated to include data for 2021, and a new visualization of the median antibiotic prescribing rate in Minnesota among high-volume, low-volume, and all prescribers was added.
- The [Minnesota All Payer Claims Database – Prescribing for Outpatient Respiratory Conditions, 2018 - 2020](#) was updated to include 2020 data. The percent of events prescribed at least one antibiotic decreased overall in 2020 compared to 2018-2019. Additionally, in 2020, Minnesota health care providers prescribed antibiotics for 11% of acute respiratory infection events where antibiotics were not needed, a 5% decline from 2018-2019.
- [Antibiotic Administration in Minnesota Hospitals](#) includes new hospital antimicrobial administration data from 2023. As a result of reporting requirements from CMS's Promoting Interoperability Program for 2024, ten additional Minnesota hospitals began reporting antimicrobial administration data to CDC's NHSN AU Option in 2023.
- [Part 2: Implementation of Health Care Antibiotic Stewardship Programs](#) includes 2022 updates for hospitals and nursing homes, as well as new data and visualizations of Minnesota hospitals' implementation of the Centers for Disease Control & Prevention's (CDC) [Priorities for Core Element Implementation](#).

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), and summarizes hospital antimicrobial administration data from NHSN. Analysis [methodologies](#) can be found later in the document.

Outpatient Antibiotic Prescribing

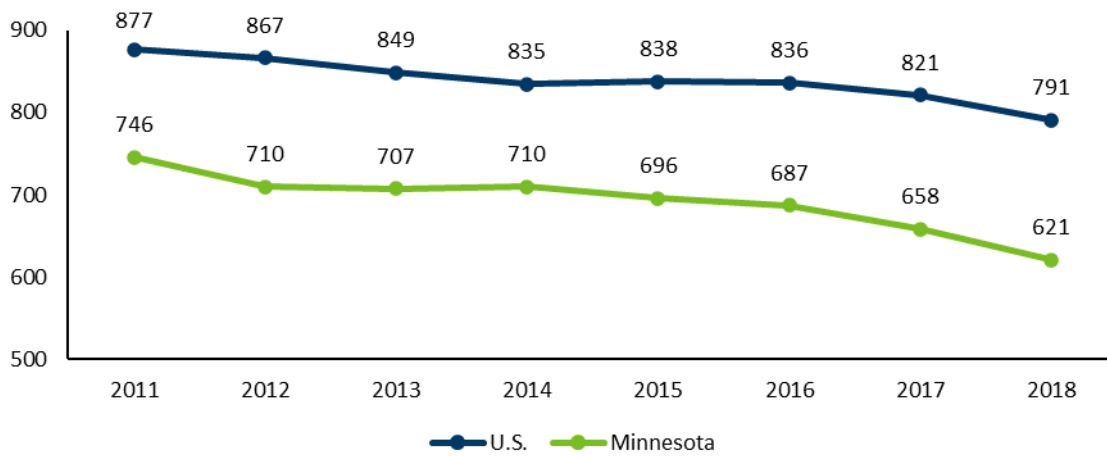
Over 80% of antibiotics used in the U.S. are prescribed in an outpatient setting (9). Outpatient prescribing presents a valuable opportunity to reduce the overall volume of antibiotic use and the resulting selective pressure on bacterial pathogens.

IQVIA™ Outpatient Antibiotic Prescribing Data, 2011–2022

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).

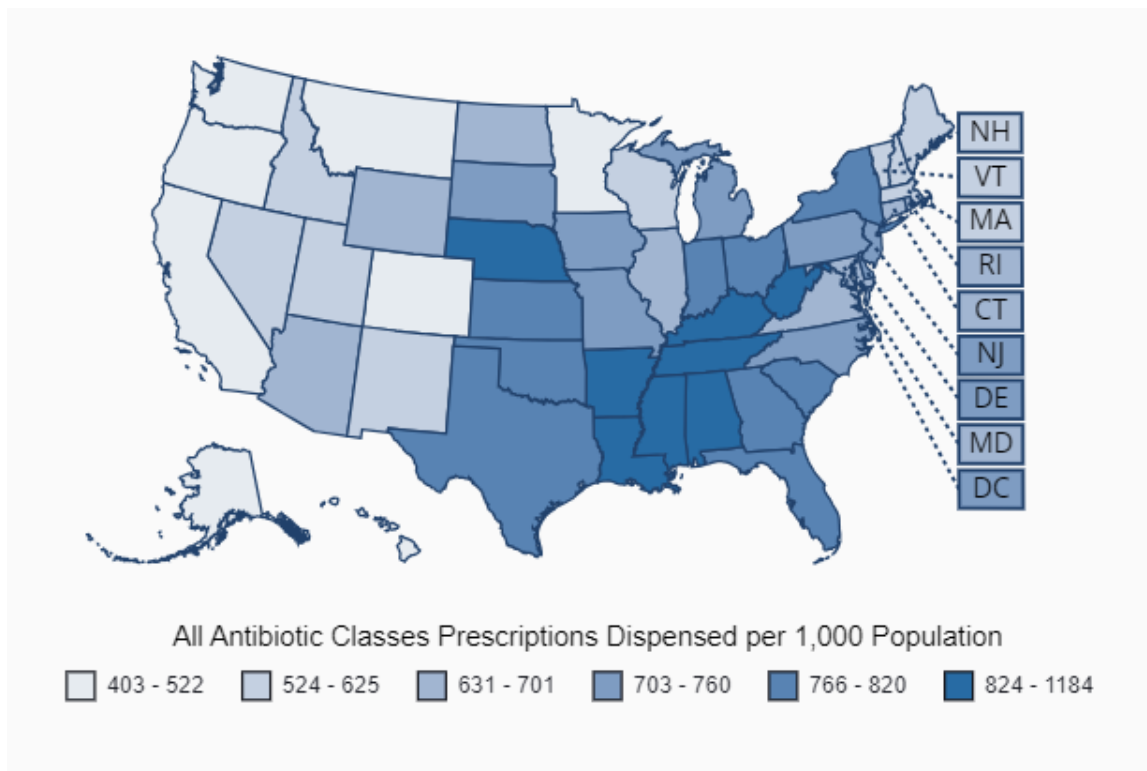
Figure 1. Number of outpatient antibiotic prescriptions per 1,000 persons in the U.S. and Minnesota, 2011–2018.



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 2022, 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 and 3).

Figure 2. U.S. outpatient antibiotic prescribing rates (prescriptions/1,000 persons) by state, 2022.



Source: Centers for Disease Control and Prevention. <https://arpsp.cdc.gov/profile/antibiotic-use/all-classes#rate-map>

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 2022, returned much closer to pre-pandemic levels. Prescription rates also decreased from 2019 to 2020 for individual drug classes (Table 1, Figure 4). The rate of prescribing for penicillin, cephalosporin, and macrolide antibiotics increased in 2022, while fluoroquinolone prescribing rates declined slightly. Future analysis of MN APCD data will help expand our understanding of these prescribing patterns, as it will allow us to associate specific diagnoses with antibiotic prescriptions. Contribution of each drug class to overall 2022 prescribing is shown in Figure 5.

Figure 3. U.S. and Minnesota outpatient antibiotic prescribing rates per 1,000 persons, 2019–2022.

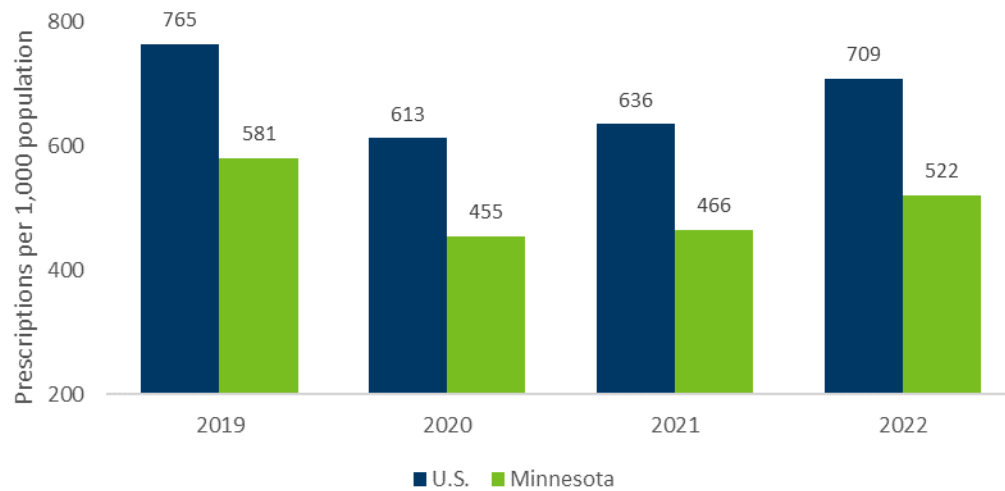


Table 1. Minnesota outpatient antibiotic rates (prescriptions/1,000 persons) by drug class, 2019–2022, and percent change compared to the previous year.

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

Figure 4. Minnesota outpatient antibiotic rates per 1,000 persons by drug class, 2019–2022.

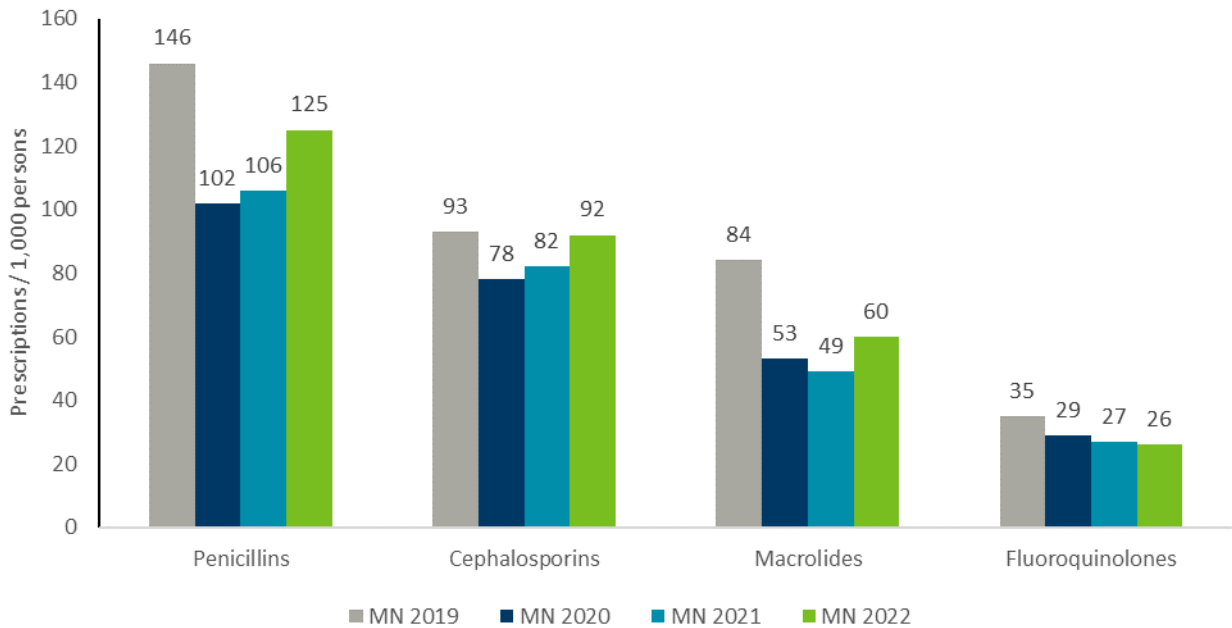
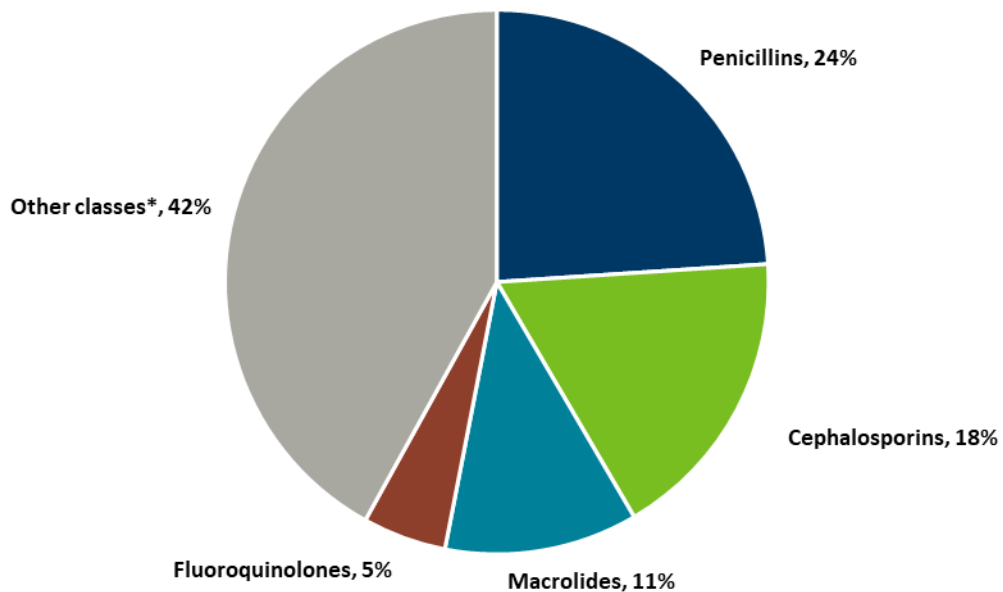


Figure 5. Contribution of antibiotic drug classes to overall Minnesota outpatient antibiotic prescribing, 2022.



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

Outpatient Antibiotic Prescribing for Medicare Beneficiaries, 2021

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, 2013-2021.

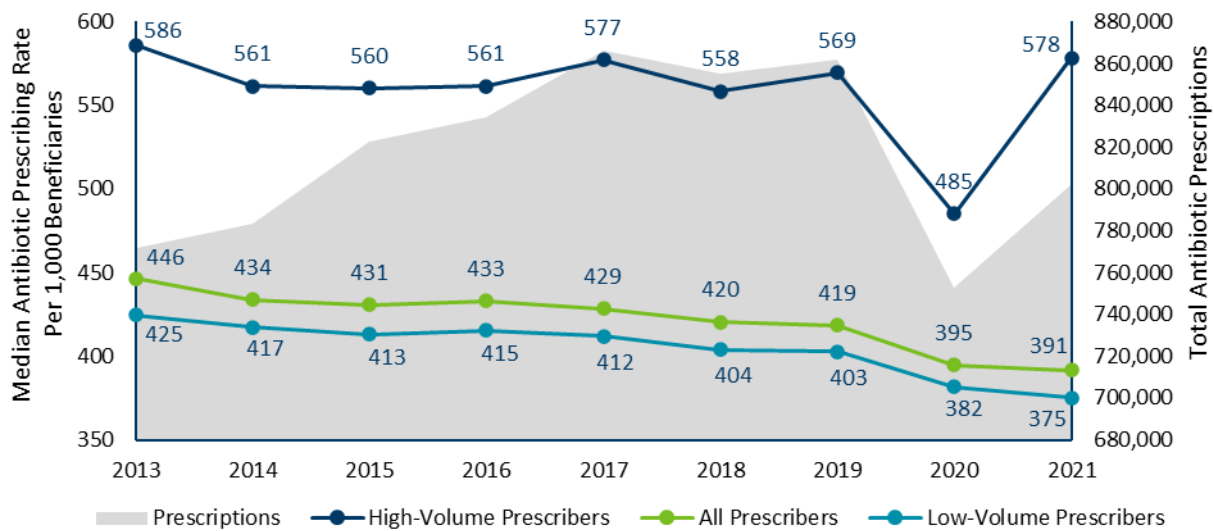


Figure 6 above visualizes the median antibiotic prescribing rate from 2013 through 2021 in Minnesota for high-volume prescribers compared to low-volume and all prescribers using the Medicare data. The figure also includes the total number of antibiotic prescriptions each year in the shaded background. 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. 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 2021, including all, high, and low-volume prescribers.

Antibiotic Prescribing for Minnesota Medicare Beneficiaries	All Prescribers	High-Volume Prescribers	Low-Volume Prescribers
Number of prescribers	13,153	1,317	11,836
Number of prescriptions (% of total volume)	802,580	276,852 (34%)	525,728 (66%)
Number of prescriptions per prescriber, median (IQR)	40 (22–76)	176 (147–225)	36 (20–62)
Prescribing rate (scripts/1,000 beneficiaries), median (IQR)	391 (217–670)	578 (356–819)*	375 (205–644)

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 2021 Medicare analysis. High-volume prescribers prescribed 34% of the total antibiotic volume in 2021 and had a significantly higher prescribing rate than other prescribers, similar to previous years. The prescribing rate for high-volume prescribers in 2021 was significantly higher than the rate for low-volume prescribers.

Nearly half (47%) of Minnesota’s high-volume prescribers in 2021 maintained their status in the high-volume prescribing category consistently from 2018 through 2020. Moreover, most high-volume prescribers (71%) in 2021 were also high-volume prescribers in 2020.

The specialties of high-volume prescribers are described in Table 3. Family medicine providers made up 28% of the high-volume prescribers in 2021 but only 18% of prescribers overall. Internal medicine physicians and urologists also were more common in the high-volume group than in the overall prescriber dataset.

Table 3. Specialties of high-volume prescribers, 2021.

Specialty	All Prescribers, Count (%) (n=13,153)	High-Volume Prescribers, Count (%) (n=1,317)	% of Specialty in High-Volume Category
Family Medicine*	2,346 (18%)	368 (28%)	16%
Nurse Practitioner	1,960 (15%)	180 (14%)	9%
Internal Medicine*	1,365 (10%)	162 (12%)	12%
Physician Assistant	1,722 (13%)	189 (11%)	12%
Urology*	196 (1%)	89 (7%)	45%
Dental**	1,911 (15%)	71 (5%)	4%
Other	3,653 (28%)	258 (20%)	7%

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

**Dental represents prescribing by dentists.

Minnesota All Payer Claims Database — Prescribing for Outpatient Respiratory Conditions, 2018–2020

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) from 2018 through 2020. MDH analyzed 4,860,662 ARI events experienced by 1,963,326 insurance plan members, stratifying the events into three tiers based on antibiotic indication. Antibiotics are usually indicated for Tier 1 diagnoses, sometimes indicated for Tier 2, and rarely indicated for Tier 3.

The percent of events prescribed at least one antibiotic decreased overall in 2020 compared to 2018-2019. In 2020, Minnesota health care providers prescribed antibiotics for 11% of ARI events where antibiotics were not indicated, a 5% decline from 2018-2019. The percent of acute bronchitis events prescribed an antibiotic decreased from 60% in 2018-2019 to 54% in 2020.

Table 4. Minnesota acute respiratory infection (ARI) diagnoses by antibiotic indication tier and antibiotic prescribing, 2018-2019 and 2020 MN APCD.

ARI Diagnoses	Total, Count (%), 2018-2019	≥1 Antibiotic Prescribed, Count (%), 2018-2019	Total, Count (%), 2020	≥1 Antibiotic Prescribed, Count (%), 2020	≥1 Antibiotic Prescribed Percent Change
All	3,502,013	1,142,112 (33%)	1,358,649	306,531 (23%)	-30%
Tier 1 (Usually indicated)	412,346 (12%)	317,971 (77%)	114,994 (8%)	81,761 (71%)	-8%
Tier 2 (Sometimes indicated)	992,759 (28%)	488,220 (49%)	309,797 (23%)	124,592 (40%)	-18%
Tier 3 (Rarely indicated)	2,096,908 (60%)	335,921 (16%)	933,858 (69%)	100,178 (11%)	-31%

Of all ARI events in 2020, 23% had at least one associated antibiotic prescription, including 71% of Tier 1, 40% of Tier 2, and 11% of Tier 3 ARI (Table 4). Diagnosis-specific prescribing rates were conducted for acute bronchitis, adult sinusitis, and pediatric otitis. Antibiotics were prescribed for 54% (21,612/40,286) of 2020 acute bronchitis events, despite its categorization as a Tier 3 diagnosis. Most (81%, 54,796/67,634) adult acute sinusitis events were associated with an antibiotic, but only 39% (26,174) of sinusitis diagnoses were treated with a first-line antibiotic drug (i.e., amoxicillin or amoxicillin-clavulanic acid). Most (80%, 45,809/57,323) pediatric otitis media events were associated with an antibiotic, and a first-line drug was selected in 68.4% (31,322) of those events. Macrolides were often chosen as a non-first line drug for these diagnoses (Table 5). 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 acute sinusitis in adults and pediatric otitis media when a first-line drug was not selected, 2020 MN APCD.

Non-First Line Classes for Adult Acute Sinusitis	Count (%) (n= 28,622)	Non-First Line Classes for Pediatric Otitis Media	Count (%) (n= 14,487)
Macrolides	7,367 (26%)	Cephalosporins	10,022 (69%)
Cephalosporins	6,011 (21%)	Macrolides	3,455 (24%)
Fluoroquinolones	2,220 (8%)	TMS	452 (3%)
TMS	1,576 (6%)	Sulfonamides	200 (1%)
Lincosamides	1,037 (4%)	Lincosamides	133 (1%)
Other	1,327 (5%)	Other	225 (2%)

Prescribing by tier 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 1.22, 99.9% CI 1.19, 1.26) and Tier 3 (OR 1.22, 99.9% CI 1.19, 1.25) diagnoses. Non-metro Minnesotans received first-line antibiotics less often for both adult acute sinusitis (OR 0.91, 99.9% CI, 0.86–0.96) and pediatric otitis media (OR 0.83, 99.9% CI, 0.78–0.89). However, non-metro Minnesotans inappropriately received antibiotics more often for bronchitis diagnoses (OR 1.25, 99.9% CI, 1.17–1.33).

Further investigation of MN APCD data will be critical to understand potential prescribing disparities across Minnesota population groups. MDH plans to expand analyses to include antibiotic prescribing for urinary tract infections (UTIs) for all recently available years of data.

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.

As a result of reporting requirements from CMS’s Promoting Interoperability Program for 2024, ten additional Minnesota hospitals began reporting antimicrobial administration data to CDC’s NHSN in 2023.

As of July 2023, 44% (59/134) of acute care facilities, including 40 acute care hospitals and 16 critical access hospitals in Minnesota, have reported at least one month of AU data to the NHSN Antimicrobial Use Option (Figure 7). 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.

Figure 7. Number of Minnesota hospitals and units reporting antimicrobial use data to the CDC NHSN AU Option by month, January 2017–July 2023.

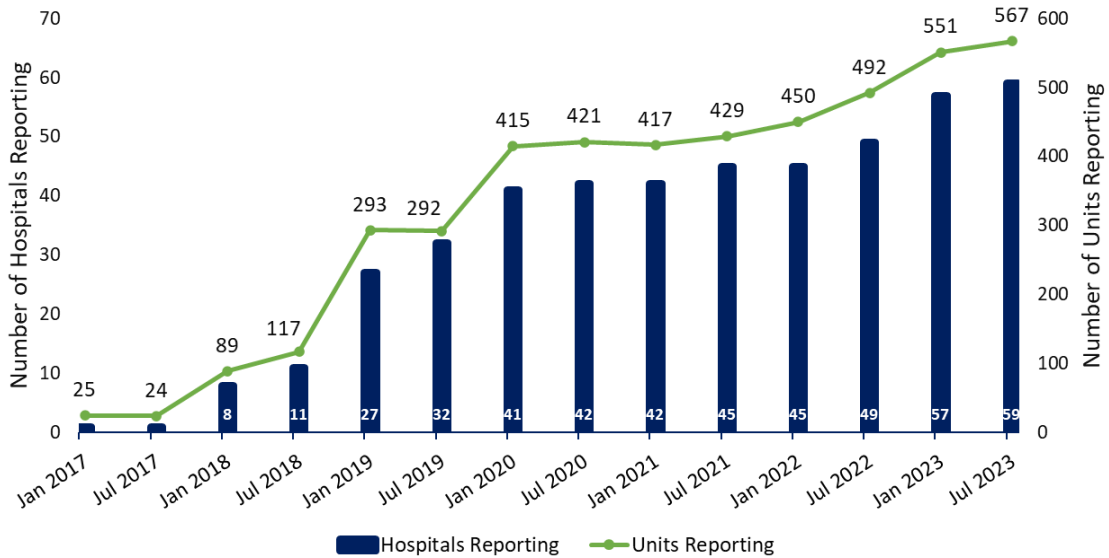


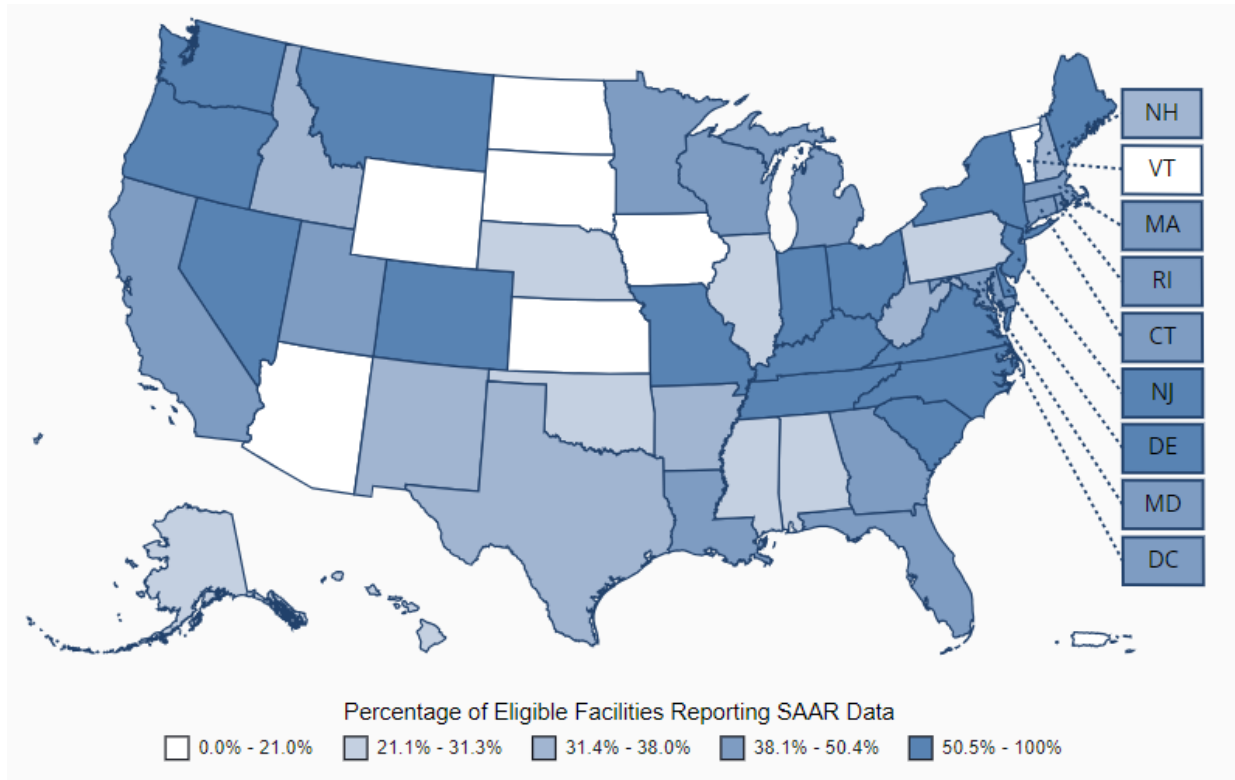
Table 6. Characteristics of Minnesota hospitals reporting antimicrobial use data to CDC NHSN AU Option, July 2023.

Hospital Type	n (%)
General Acute Care	40 (68%)
Critical Access	16 (27%)
Children’s	2 (3%)

Bed Size	n (%)
0-24 beds	17 (29%)
25-149 beds	24 (41%)
150-299 beds	8 (14%)
≥300 beds	10 (17%)

Teaching Status	n (%)
None/Undergrad	31 (53%)
Major/Graduate	27 (46%)

Figure 8. Percentage of eligible facilities reporting adult SAAR data by state, 2022.



Source: Centers for Disease Control and Prevention. <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 2022, two adult SAAR metrics remained above the null value of 1, “narrow-spectrum beta-lactam agents” and “antifungal agents predominantly used for invasive candidiasis” (Figure 10).

Figure 9. All antibacterial agents SAAR, Minnesota adult hospital wards, 2019–Quarter 3 of 2023.

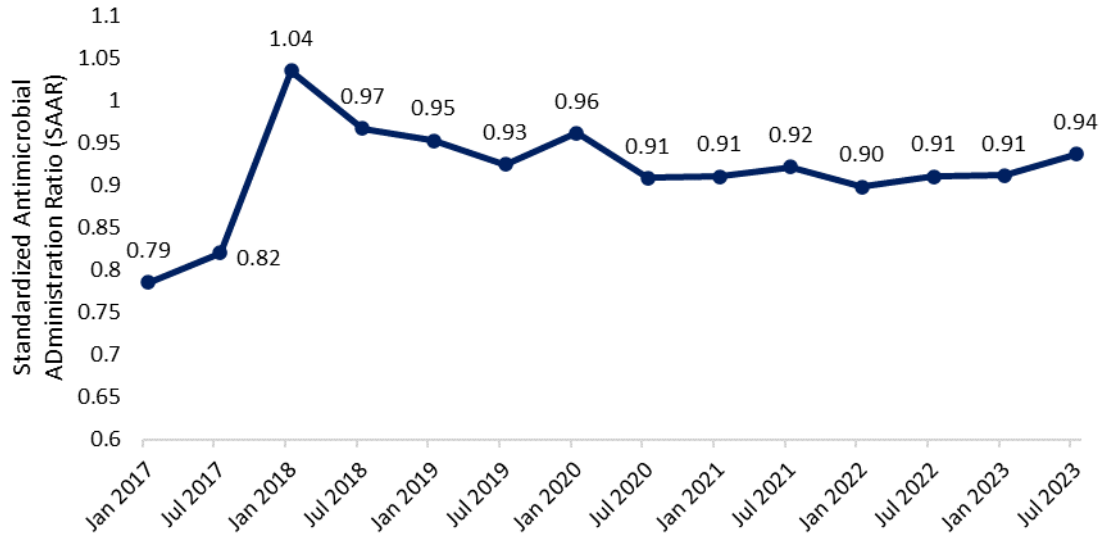
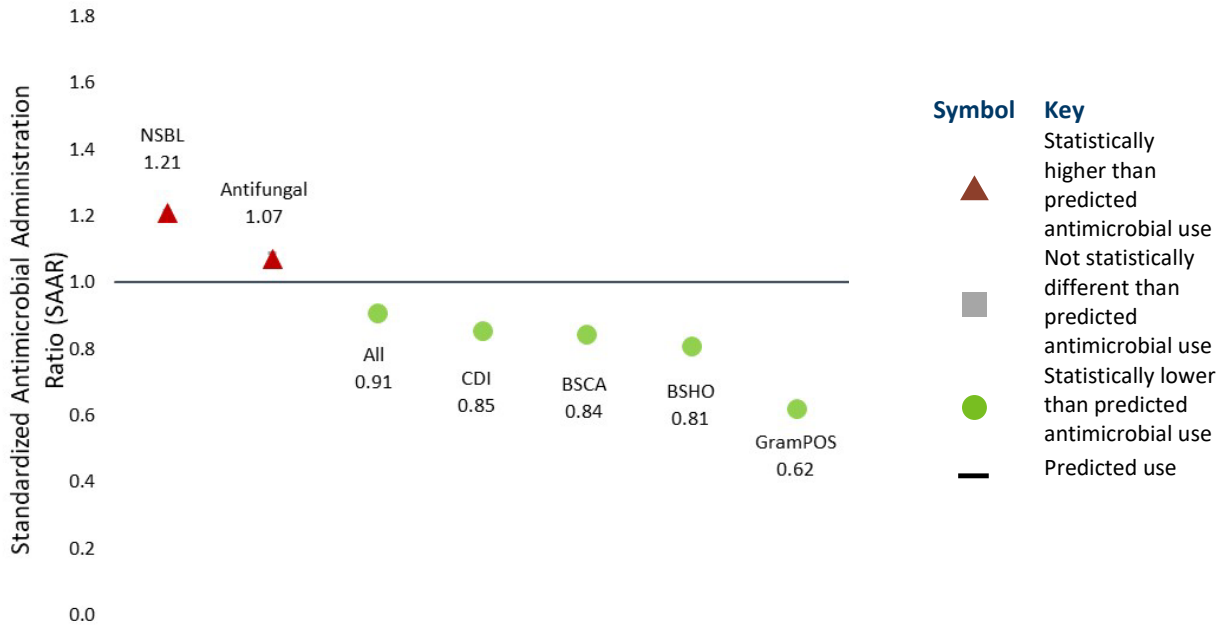


Figure 10. SAAR summary for Minnesota adult hospital wards, 2022.



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.

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: 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.

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: Incorporate routine (e.g., annual) use of the MN APCD and Medicare public use files so that measures include not just overall use but appropriateness and incorporate demographic factors potentially associated with health care or prescribing inequities.

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 Medicare data to alert high-volume outpatient prescribers of their oversized contribution to Minnesota's antibiotic prescribing volume.

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.

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

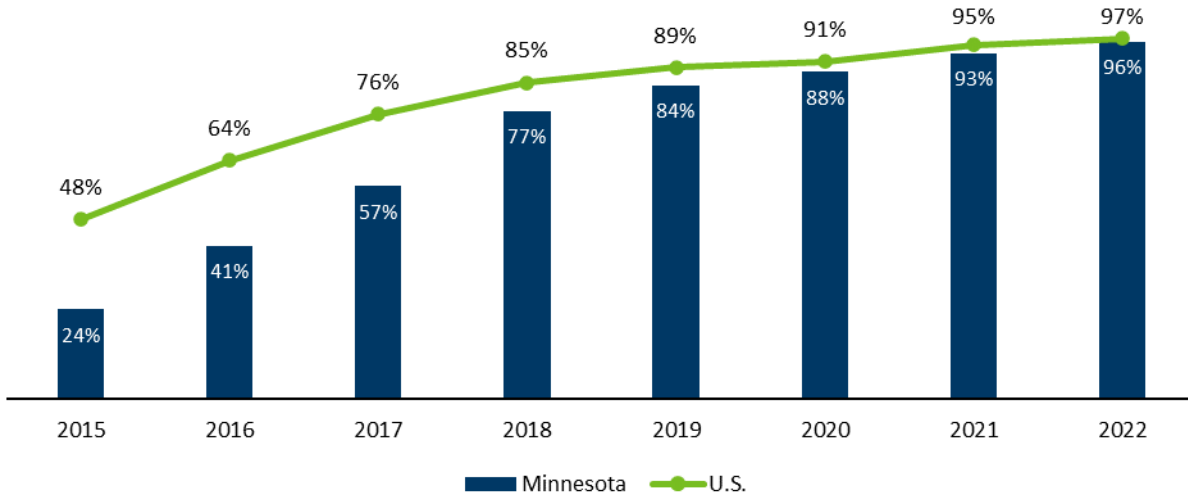
Part 2: Implementation of Health Care Antibiotic Stewardship Programs

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 2022, was slightly below (96%) the national implementation average (97%), (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. In 2022, CAHs represented 58% of the 121 Minnesota hospitals reporting to NHSN compared with 27% CAH among 4,653 hospitals nationwide. CAHs are small, serve non-urban populations, and tend to have fewer available operational resources, which can impact the implementation of program changes. In 2022, 94% of CAHs met all 7 core elements compared to 98% of General Acute Care hospitals (Figure 12).

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

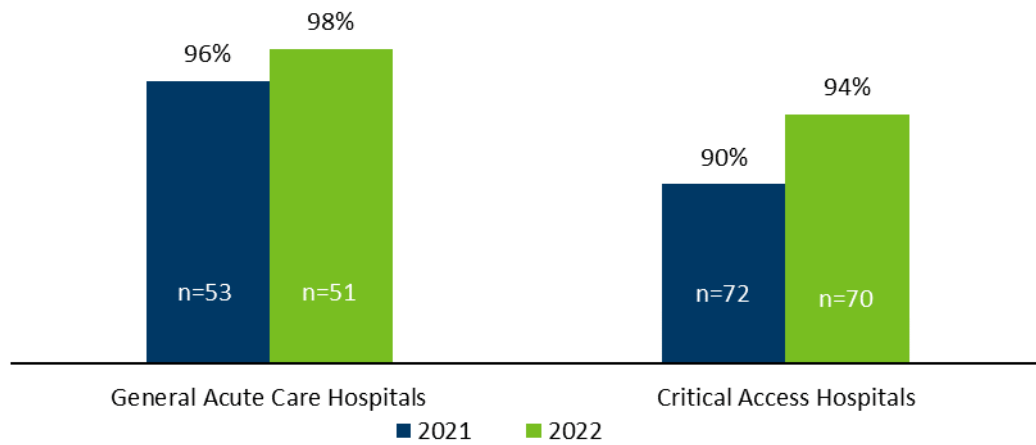
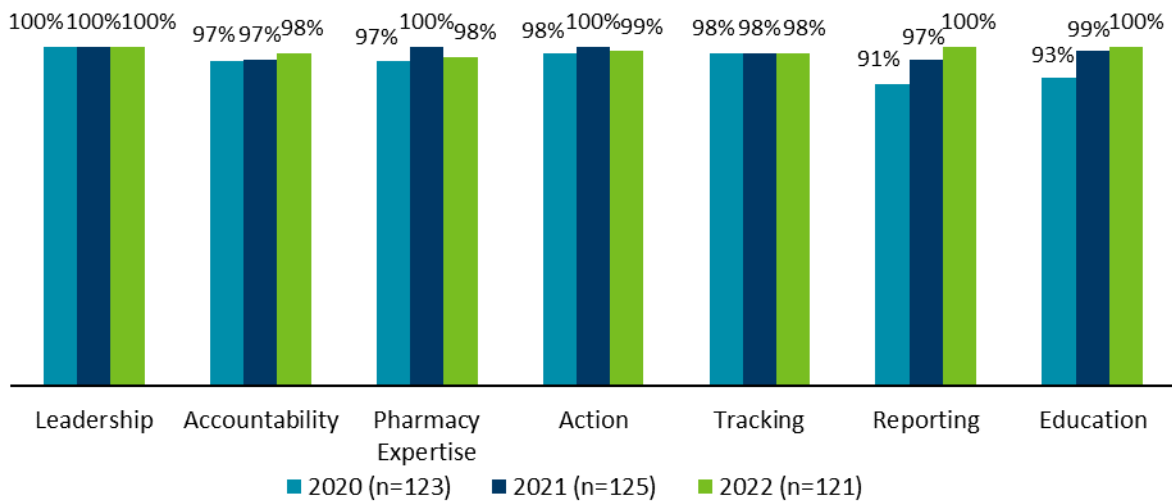


Figure 13. Proportion of Minnesota hospitals meeting each stewardship core element by year, according to NHSN.

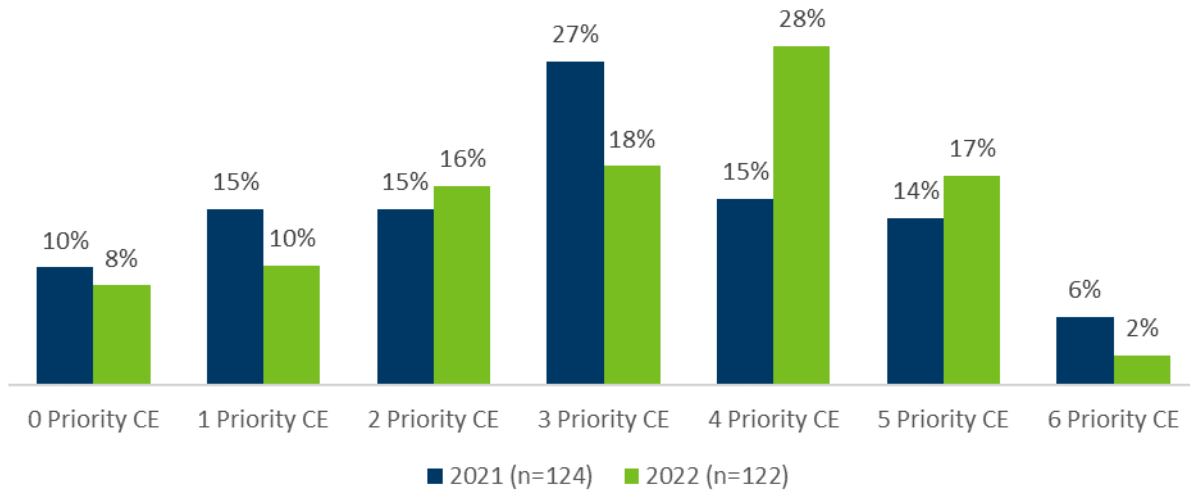


Priorities for Hospital Core Element Implementation

In 2022, as a result of widespread national implementation of the seven hospital core elements, CDC identified and published the Priorities for Hospital 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 antibiotic stewardship programs 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, 47% of acute care hospitals implemented four or more priority core elements in 2022, an increase from 35% in 2021 (Figure 14).

Figure 14. Proportion of Minnesota Hospitals meeting Priority Core Elements in 2021 & 2022, according to NHSN.

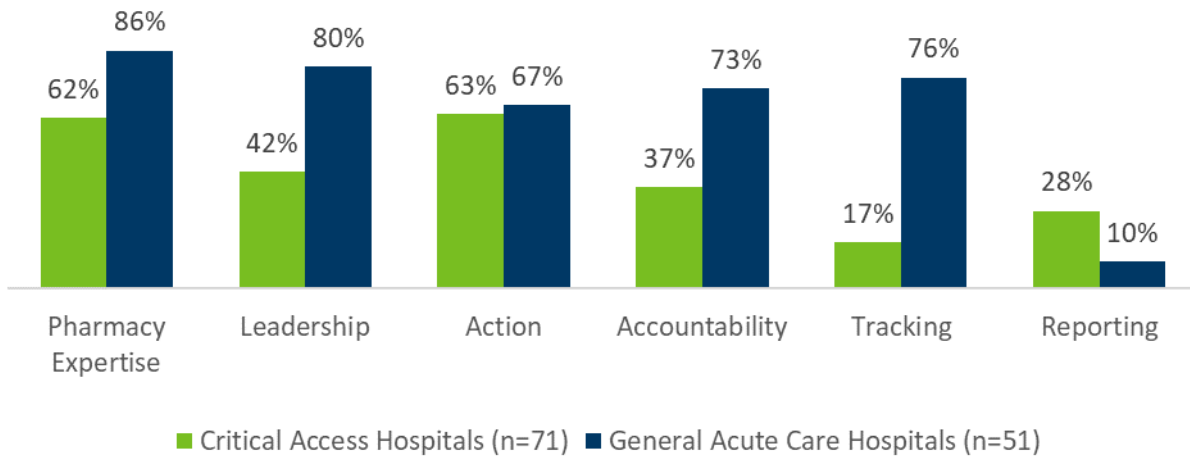


Pharmacy expertise was the most commonly implemented priority core element (72%) while reporting was the least (20%) (Figure 15). General Acute Care hospitals performed better than CAH on each of the priority core elements, except for reporting (Figure 16).

Figure 15. Proportion of Minnesota and U.S. Hospitals meeting each Priority Core Element in 2022, according to NHSN.



Figure 16. Proportion of Minnesota Hospitals meeting each Priority Core Element in 2022 by Hospital Type, according to NHSN.



Nursing Home Core Elements of Antibiotic Stewardship

Studies have shown that up to 70% of nursing home residents have received antibiotics during a 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 17); 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 18). While most of the core elements had demonstrated progress with implementation in 2021 and 2022, several core elements saw slight declines in implementation in 2022 including drug expertise (dropped from 97% to 94%) and tracking (dropped from 99% to 96%).

Figure 17. Proportion of Minnesota and national nursing homes that implemented all seven core elements by year, according to NHSN.

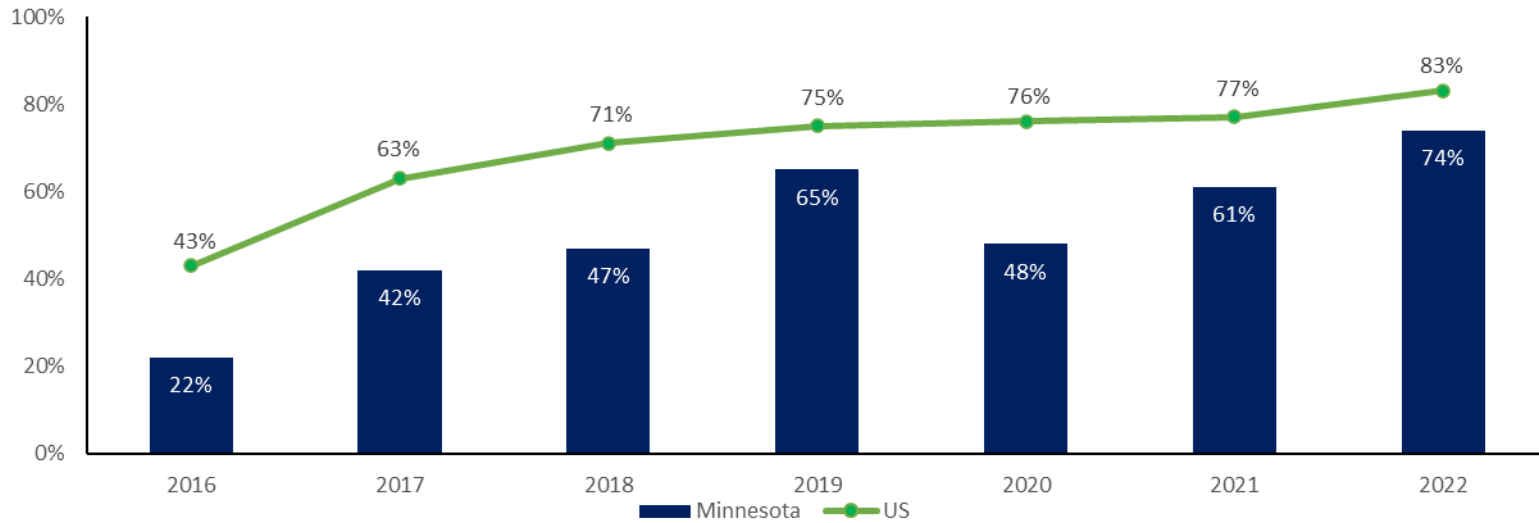
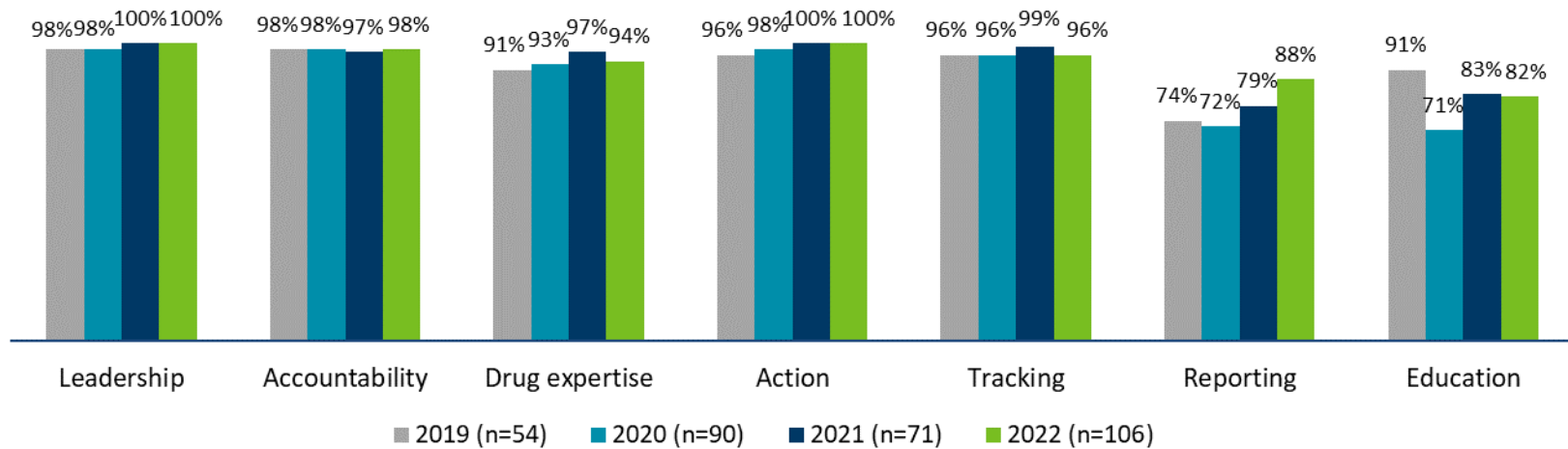
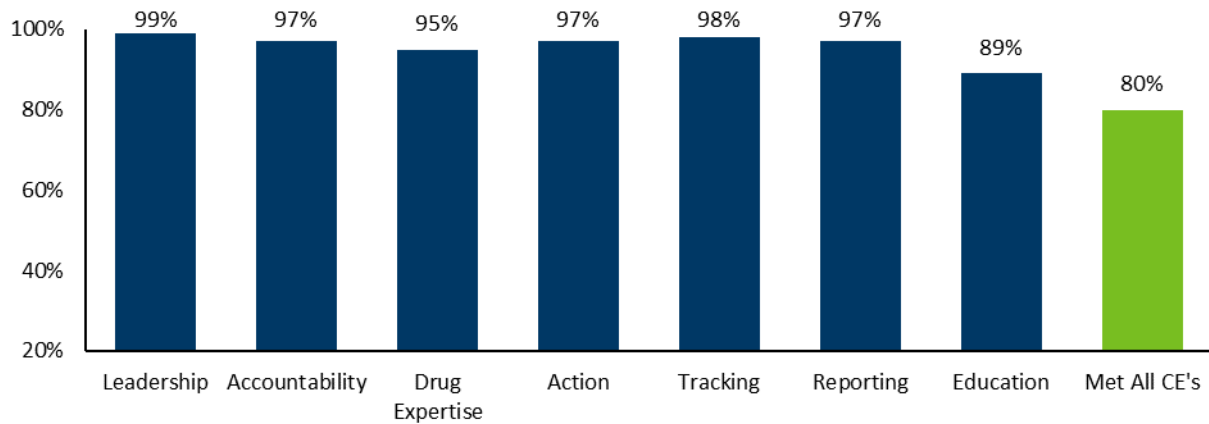


Figure 18. Proportion of Minnesota nursing homes meeting each stewardship core element by year, according to NHSN.



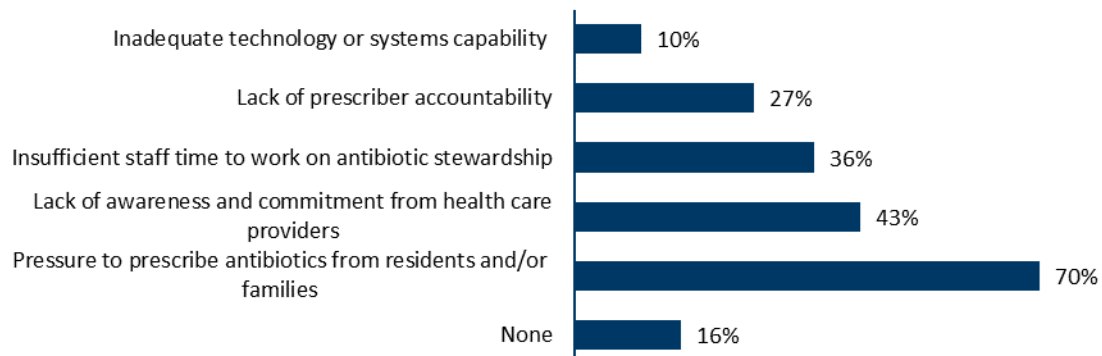
In 2022, MDH conducted a survey of Minnesota skilled nursing facilities to assess stewardship practices and core element implementation in more detail and identify opportunities to offer targeted support. A total of 146 facilities completed the survey, accounting for 40% of CMS-certified facilities in Minnesota. Most (80%) reported implementing all seven core elements (Figure 19). Leadership commitment (145, 99%) and education (130, 89%) were the most and least implemented core elements, respectively. The MDH survey definition of “reporting” (data on antibiotic use, stewardship processes, and/or antibiotic outcomes are shared with facility leadership, providers and/or nursing staff for review on a regular basis) was broader than that used by NHSN (audit with feedback), allowing more facilities to meet that core element.

Figure 19. Proportion of 146 Minnesota nursing homes meeting each antibiotic stewardship core element, and all seven core elements, according to a 2022 MDH facility survey.



The major barrier to stewardship reported by Minnesota facility survey respondents was pressure from residents and family members to prescribe antibiotics even when they are not necessary (Figure 20). This pressure can make it difficult for providers to adhere to stewardship guidelines and can contribute to the overuse of antibiotics. Additionally, the survey revealed that many health care providers lack awareness and commitment when it comes to antibiotic stewardship. This can manifest in a lack of understanding of the appropriate use of antibiotics, as well as a lack of motivation to make changes in prescribing practices. These findings suggest that there is a need for increased education and awareness about antibiotic stewardship among health care providers as well as strategies to address the pressure to prescribe antibiotics from residents and families.

Figure 20. Barriers to stewardship implementation reported by 146 Minnesota nursing homes in a 2022 survey by MDH.



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).

During November 2022–Jan 2023, MDH surveyed Minnesota outpatient clinics to learn about clinic antibiotic stewardship practices. Completed surveys were analyzed from 106 unique clinics. MDH previously surveyed outpatient clinics in 2017 using the same methodology, with minor modifications to mapping of the core elements. In the 2022 MDH survey, 53% of the respondents were physicians and 18% were pharmacists. 46% of the clinics indicated that they have an antimicrobial stewardship program and 74% said they belong to a health system. The survey revealed that 25% of clinics implemented all four core elements, increasing from only 9% in 2017 (Figure 22). Action for policy and practice was the most implemented core element (97%) while education and expertise (30%) was the least implemented (Figure 21). Implementation of all four core elements increased from 2017 to 2022 (Figure 22).

Figure 21. Percent of clinics implementing each of the CDC core elements of antibiotic stewardship for outpatient settings in 2017 & 2022 MDH surveys.

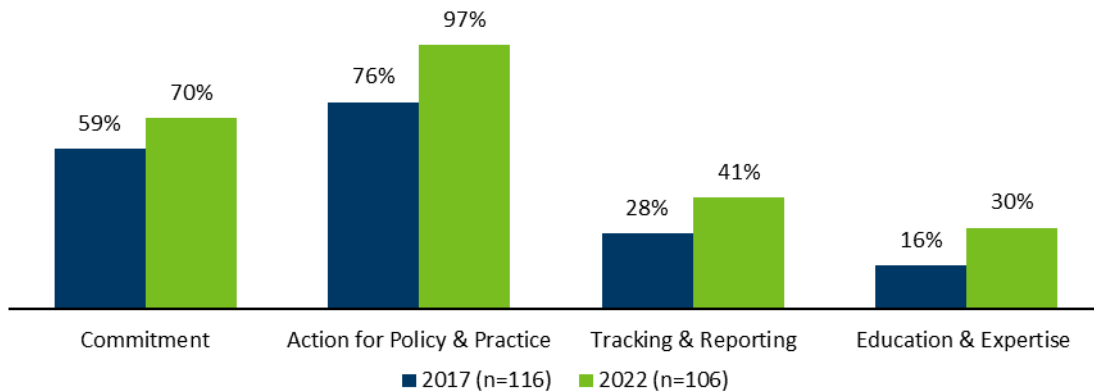
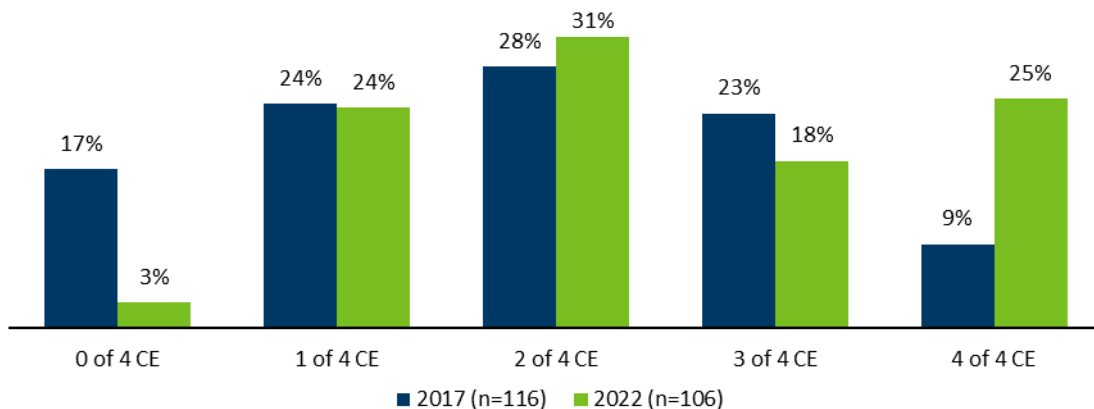
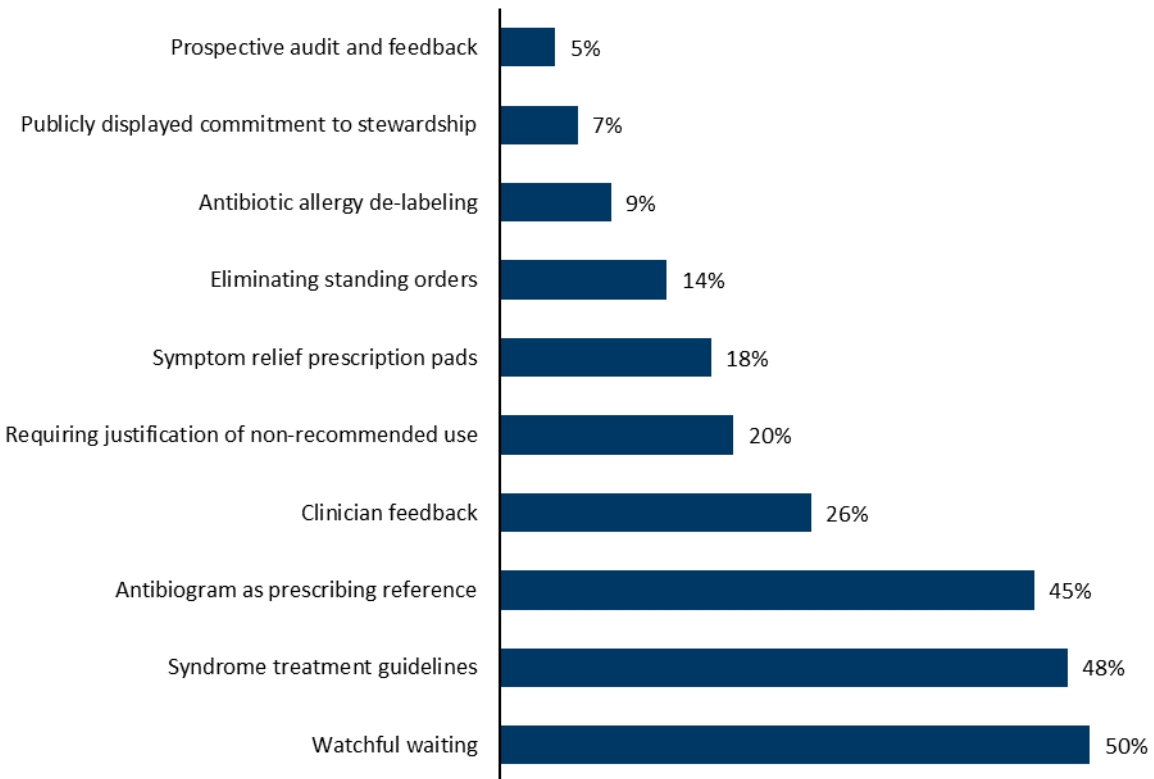


Figure 22. Percent of clinics meeting the 4 CDC core elements (CE) of antibiotic stewardship for outpatient settings in 2017 & 2022 MDH surveys.



When respondents were asked about clinic policies or actions to promote appropriate antibiotic prescribing, approximately half (50%) stated practicing delayed prescribing or watchful waiting period when appropriate and using evidence-based diagnostic criteria and syndrome-specific treatment guidelines (48%). The least implemented action was the use of a prospective audit with feedback system for clinician prescribing (5%) (Figure 23).

Figure 23. Stewardship policies or actions to promote appropriate antibiotic prescribing reported by Minnesota outpatient clinics in 2022 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. Half (50%) of the respondents mentioned lack of staff time for stewardship work, and pressure from patients to prescribe antibiotics (48%) as the major barriers (Figure 20). 66% of clinics mentioned that patient education about proper antibiotic use would help their clinic in implementing AS activities (Figure 25). 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.

Figure 24. Barriers to stewardship implementation reported by Minnesota outpatient clinics in 2022 MDH survey.

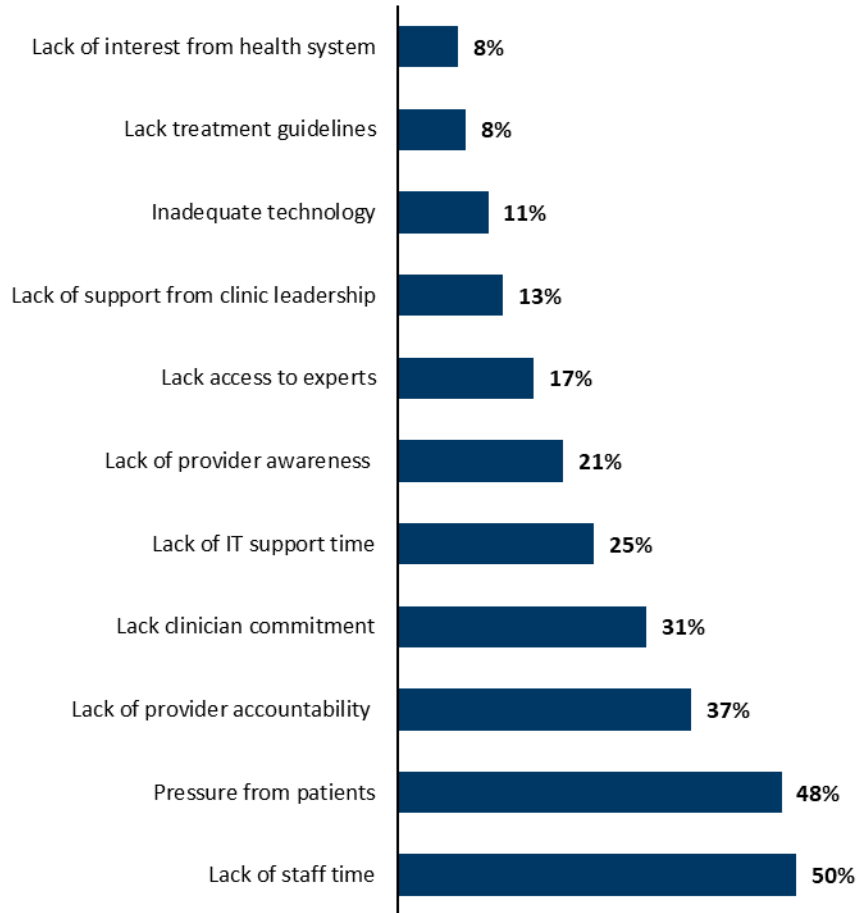
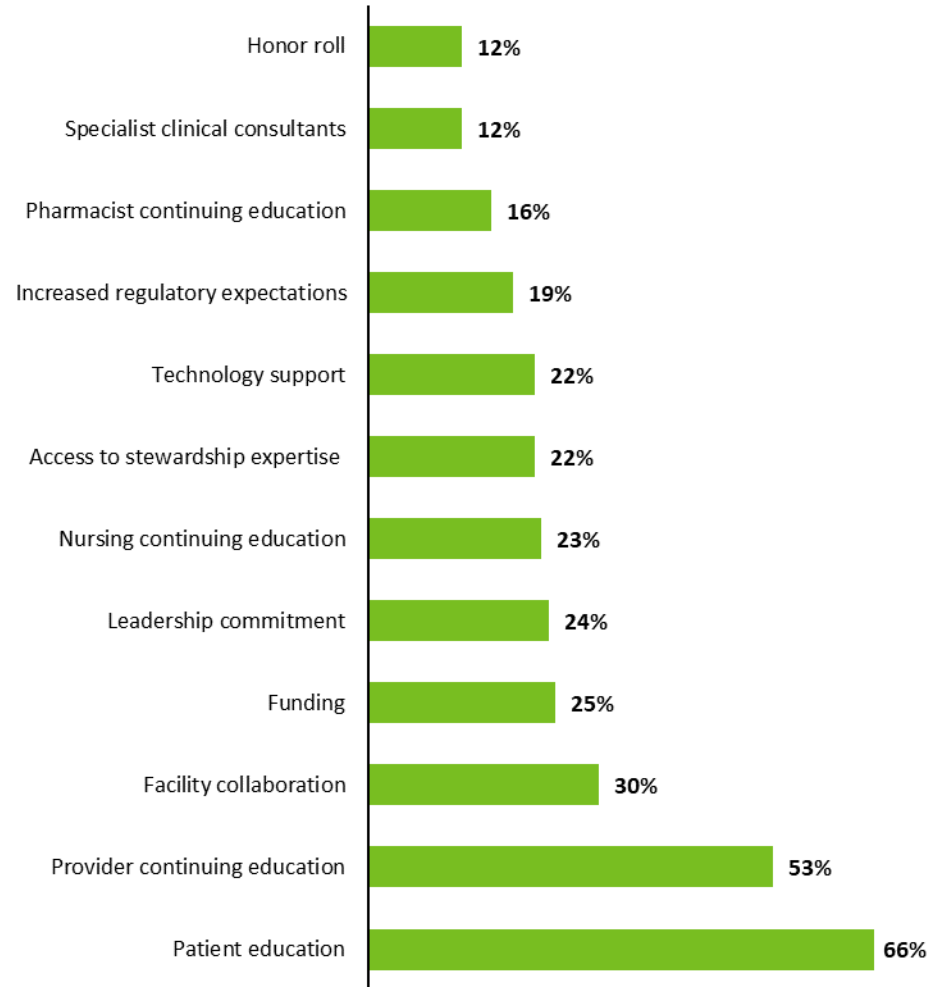


Figure 25. Facilitators to stewardship implementation reported by Minnesota outpatient clinics in 2022 MDH survey.



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 use.

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 develop education and resources to support these settings. Among hospitals, increase awareness of the priorities for core element implementation and support facility-level implementation. Continue to partner with infectious disease trained pharmacists to provide technical assistance to hospitals, nursing homes, and outpatient clinics that have not met all core elements and to those that have requested support from MDH.

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

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. MDH's stewardship network for pharmacists, launched spring 2023, provides a quarterly forum for collaboration and sharing of best practices, with an emphasis on engaging pharmacists from under-represented clinical settings and areas of Minnesota.

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 2021 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 medical claims, antibiotic pharmacy claims, and member information from all payers into a single analytical file. Member ARI 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 claim. Pharmacy antibiotic claims occurring on (Day 0) or within three days (i.e., Days -3 to Day 3) of an included ARI 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. 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 \(https://www.health.state.mn.us/data/apcd/index.html\)](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–Jan 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.

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