

Antibiotic Use and Stewardship in Minnesota

2023 UPDATE ON PROGRESS AND OPPORTUNITIES

Antibiotic Use and Stewardship in Minnesota 2023 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

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

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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 how we must use Minnesota data to explore those realities. The antibiotic stewardship program data show trends in hospital and nursing home implementation over six years and new data on outpatient stewardship collected in a 2022 MDH survey. This MDH report will inform public health education initiatives and partner-driven statewide objectives for prescribing improvement.

Minnesota outpatient antibiotic prescribing rates decreased from 2019 to 2020 ([IQVIA™ Outpatient Antibiotic Prescribing Data, 2011–2021](#)), mirroring the national trend during the first year of the COVID-19 pandemic. Rates of outpatient prescribing rose again in 2021. Early data from the U.S. Centers for Disease Control and Prevention (CDC) indicate that 2022 prescribing was back to pre-pandemic levels nationally, but Minnesota data for 2022 are not yet available. This document also includes the first Minnesota summary of “high-volume prescribers” ([Outpatient Antibiotic Prescribing for Medicare Beneficiaries, 2019](#)). In 2019, Minnesota’s top 10% of antibiotic prescribers by volume prescribed 34% of the total antibiotic volume that year. These prescribers were most commonly family medicine providers. Most high-volume prescribers in 2018 were also high-volume prescribers in 2019. Because high prescribing rates have been associated nationally with inappropriate prescribing, MDH could use these data to alert high-volume prescribers of how their practices compare to others and encourage them to review prescribing protocols and behaviors. The Minnesota All Payer Claims Database has allowed MDH to describe antibiotic prescribing specifically for acute respiratory infections (ARI, [Minnesota All Payer Claims Database — Prescribing for Outpatient Respiratory Conditions, 2018–2019](#)). During 2018–2019, Minnesota health care providers prescribed antibiotics in 16% of ARI situations in which antibiotics are rarely needed, including 60% of acute bronchitis diagnoses. Payer data also revealed that the most vulnerable Minnesotans, as categorized by using the social vulnerability index, may receive antibiotics less often for ARI than did those who are least vulnerable, regardless of whether antibiotics are appropriate for their condition. Additional analyses will be conducted to explore these preliminary findings further.

The proportion of hospitals meeting all seven core elements of antibiotic stewardship has consistently increased since 2015, with 93% of Minnesota hospitals reporting implementation of all elements on the CDC National Healthcare Safety Network (NHSN) 2021 annual survey ([Hospital Core Elements of Antibiotic Stewardship](#)). A growing proportion of organizations are reporting hospital antimicrobial administration data to NHSN as well, with 41% of Minnesota hospitals reporting at least one month of AU data as of July 2022 ([Antibiotic Administration in Minnesota Hospitals](#)). Antibiotic use data, and the standardized administration ratios provided as part of NHSN reporting, allow Minnesota hospitals to identify areas of antibiotic use that need further detailed review and track use trends over time. In 2022, MDH conducted a survey of Minnesota skilled nursing facilities to assess antibiotic stewardship practices and core element implementation, finding that 80% had implemented all seven core elements of antibiotic stewardship ([Nursing Home Core Elements of Antibiotic Stewardship](#)). Leadership commitment and education were the most and least implemented core elements, respectively.

This inaugural MDH report outlines opportunities for the agency and clinical partners to improve antibiotic prescribing, including the following ([Opportunities to Use Data to Improve Antibiotic Use](#)).

- Identify quantitative or qualitative targets for overall antibiotic prescribing improvement.
- Focus on using rich datasets to explore prescribing in relation to diagnosis, prescriber type, and patient demographic factors.
- Address important prescribing gaps by targeting individual measurement and feedback to prescribers.
- Engage with other professionals using data to improve antibiotic prescribing.

Opportunities to improve antibiotic stewardship programs are also identified ([Opportunities to Improve Antibiotic Stewardship Programs](#)).

- Utilize MDH infectious diseases trained pharmacists to provide technical assistance to hospitals and nursing homes.
- Establish a statewide antibiotic stewardship network for pharmacists in all health care settings.

Background

Tracking and reporting are core elements of clinical antibiotic stewardship programs and are also 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. These new realities are fortuitous, because we are only beginning to recognize the importance of 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). In 2023 and coming years, MDH will use 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. In 2023 and coming years, MDH will use 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, and some will be more up to date than others.

This inaugural *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.

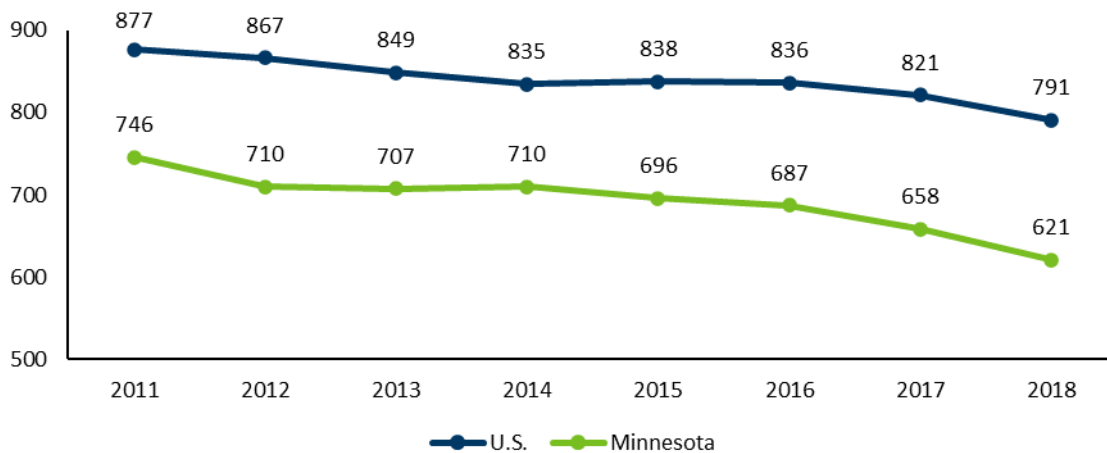
Mirroring the national trend, outpatient antibiotic prescribing rates in Minnesota decreased during 2020, the first year of the COVID-19 pandemic, and rose again in 2021. Early data from CDC indicate 2022 prescribing was back to pre-pandemic levels, but Minnesota-specific data are not yet available (10).

IQVIA™ Outpatient Antibiotic Prescribing Data, 2011–2021

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 (11). 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).

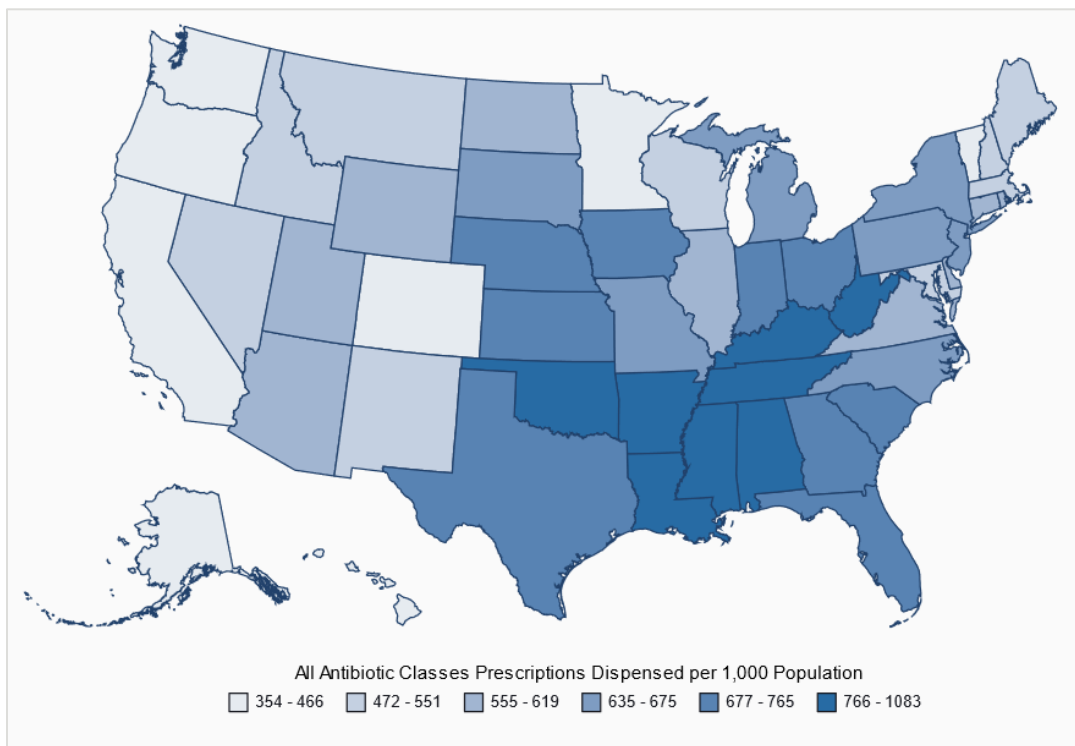
Figure 1. Number of outpatient antibiotic prescriptions per 1,000 persons in the U.S. and Minnesota, 2011–2018.



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 2021, 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, 2021.



Source: Centers for Disease Control and Prevention. *Outpatient antibiotic prescriptions — United States, 2021* (www.cdc.gov/antibiotic-use/pdfs/Annual-Report-2021-H.pdf)

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 rose higher in 2021 but did not return to pre-pandemic levels. Prescription rates also decreased from 2019 to 2020 for individual drug classes (Table 1, Figure 4). While the rate of prescribing for penicillin and cephalosporin antibiotics increased in 2021, fluoroquinolone and macrolide prescribing rates continued to decrease slightly in 2021 (Figure 4). This finding might have been related to the reduction in seasonal acute respiratory illnesses seen during the initial two years of the COVID-19 pandemic (12). A better understanding of these prescribing patterns will come with future analysis of MN APCD data, which allow us to associate specific diagnoses with antibiotic prescriptions. Contribution of each drug class to overall 2021 prescribing is shown in Figure 5.

Figure 3. U.S. and Minnesota outpatient antibiotic prescribing rates, 2019–2021.

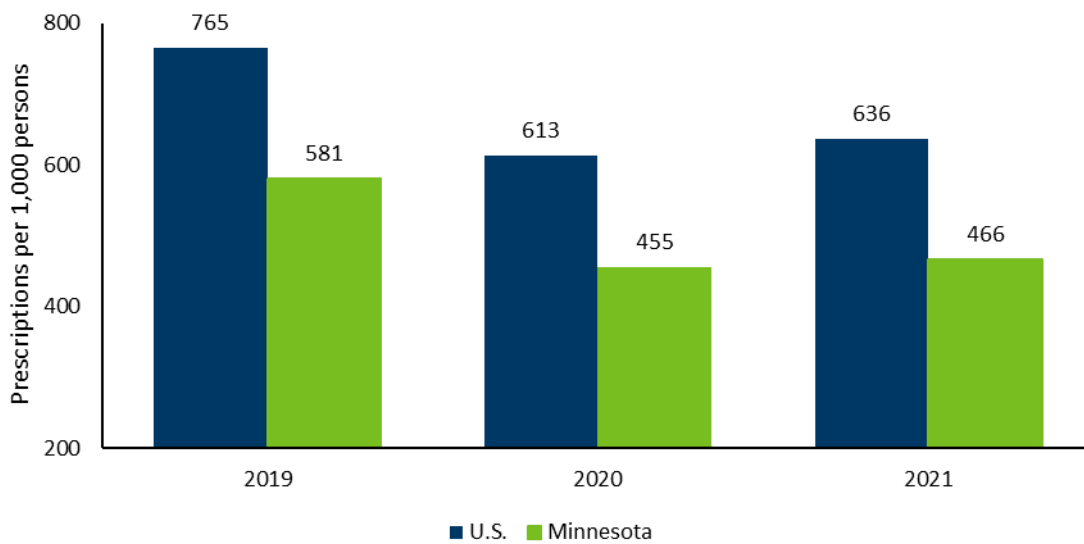


Table 1. Minnesota outpatient antibiotic rates (prescriptions/1,000 persons) by drug class, 2019–2021, and percent change compared to the previous year.

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

Figure 4. Minnesota outpatient antibiotic rates by drug class, 2019–2021.

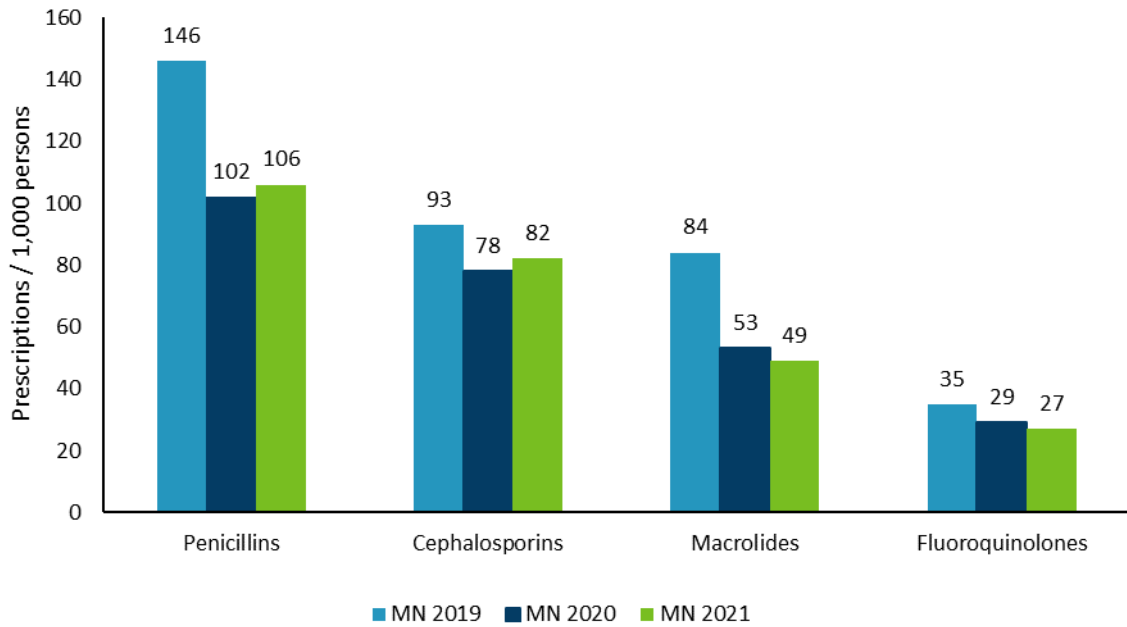
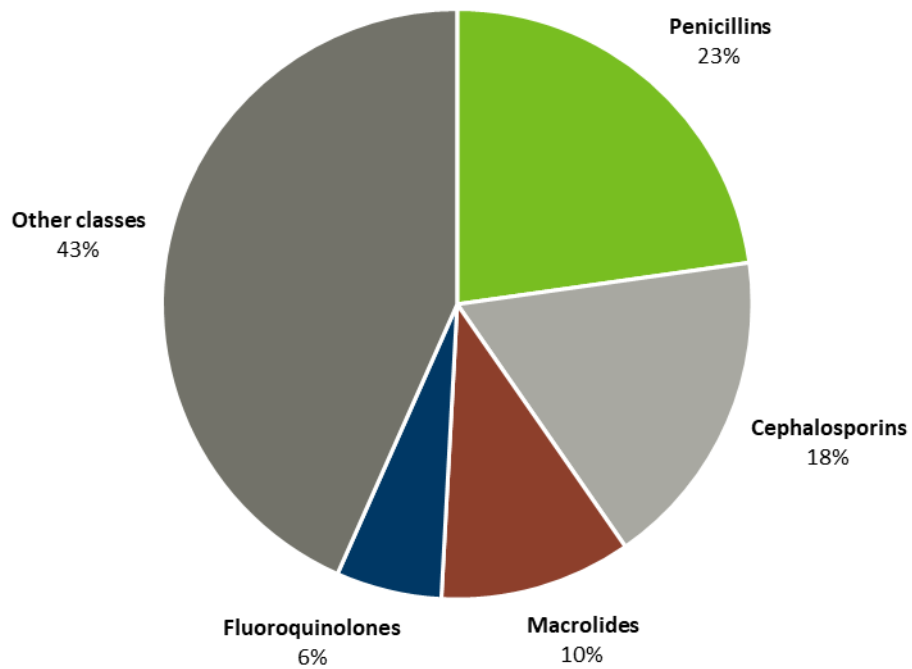


Figure 5. Contribution of antibiotic drug classes to overall Minnesota outpatient antibiotic prescribing, 2021.



Outpatient Antibiotic Prescribing for Medicare Beneficiaries, 2019

This section summarizes 2018 and 2019 data from the CMS Medicare Part D Prescriber Public Use Files and describes the practices of higher-volume antibiotic prescribers (the highest 10% of prescribers by antibiotic volume) in outpatient settings compared with lower-volume prescribers (the lower 90% of prescribers by antibiotic volume) (13). Data analyzed for each year include antibiotic prescriptions by Minnesota health care providers who wrote ≥ 11 antibiotic prescriptions in that year. 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 (14-17).

Table 2. Summary of antibiotic prescribing for Minnesota Medicare beneficiaries in 2019, including all, high, and low-volume prescribers.

Antibiotic Prescribing for Minnesota Medicare Beneficiaries	All Prescribers	High-Volume Prescribers	Low-Volume Prescribers
Number of prescribers	13,131	1,325	11,806
Number of prescriptions (% of total volume)	860,201	296,025 (34%)	564,176 (66%)
Number of prescriptions per prescriber, median (IQR)	43 (22–83)	187 (160–243)	38 (21–67)
Prescribing rate (scripts/1,000 beneficiaries), median (IQR)*	419 (250–676)	569 (387–771)	402 (236–657)

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 ($p < 0.001$).*

Minnesota’s top 10% antibiotic prescribers by volume were responsible for 34% of the total antibiotic volume prescribed in 2019. These prescribers were most commonly family medicine providers.

Table 2 summarizes the 2019 Medicare analysis. The top 10% of prescribers by volume (“high-volume prescribers”) prescribed 34% of the total antibiotic volume in 2019 and had a significantly higher prescribing rate than other prescribers. Most (76.9%) high-volume prescribers in 2018 were also high-volume prescribers in 2019 (2018 data not shown). Family medicine providers made up over 30% of the high-volume prescribers in 2019 but only 19% of prescribers overall (Table 3). Family 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.

Specialty	All Prescribers, Count (%) (n=13,131)	High-Volume Prescribers, Count (%) (n=1,325)	% of Specialty in High-Volume Category
Family Medicine	2,485 (19%)	453 (34%)	18%
Internal Medicine	1,434 (11%)	195 (15%)	14%
Physician Assistant	1,666 (13%)	177 (13%)	11%
Nurse Practitioner	1,963 (15%)	165 (13%)	8%
Urology	189 (1%)	78 (6%)	41%
Dental	1,911 (15%)	56 (4%)	3%
Other	3,483 (27%)	201 (15%)	6%

Except for physician assistant and nurse practitioner, other specialties represent prescribing by physicians (family medicine, internal medicine, urology) or dentists (dental specialty).

Minnesota All Payer Claims Database — Prescribing for Outpatient Respiratory Conditions, 2018–2019

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) during 2018 and 2019. MDH analyzed 3,502,013 ARI events experienced by 1,612,501 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.

During 2018–2019, Minnesota health care providers prescribed antibiotics in 16% of acute respiratory infection cases where antibiotics were not needed. This includes 60% of acute bronchitis diagnoses. Targeting improvement to diagnoses where antibiotics are not likely to help could prevent hundreds of thousands of unnecessary prescriptions annually.

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

ARI Diagnoses	Total, Count (%)	≥1 Antibiotic Prescribed, Count (%)
All	3,502,013	1,142,112 (33%)
Tier 1 (Usually indicated)	412,346 (12%)	317,971 (77%)
Tier 2 (Sometimes indicated)	992,759 (28%)	488,220 (49%)
Tier 3 (Rarely indicated)	2,096,908 (60%)	335,921 (16%)

Of all ARI events, 33% had at least one associated antibiotic prescription, including 77% of Tier 1, 28% of Tier 2, and 16% of Tier 3 ARI (Table 4). Diagnosis-specific prescribing rates were conducted for acute bronchitis, adult sinusitis, and pediatric otitis. Antibiotics were prescribed for 60% (106,338/179,723) of acute bronchitis events, despite its categorization as a Tier 3 diagnosis. Most (84%, 199,445/236,901) adult acute sinusitis events were associated with an antibiotic, but only 45% (89,386) of sinusitis diagnoses were treated with a first-line antibiotic drug (i.e., amoxicillin or amoxicillin-clavulanic acid). Most (82%, 190,962/232,226) pediatric otitis media events were associated with an antibiotic, and a first-line drug was selected in 66.4% (126,859) of those events. Macrolides were often chosen as a non-first line drug for these diagnoses (Table 5). For all ARI events, azithromycin made up 97.6% of macrolide prescribing.

Table 5. Drug classes selected to treat acute sinusitis in adults and pediatric otitis media when a first-line drug was not selected, 2018–2019 MN APCD.

Non-First Line Classes for Adult Acute Sinusitis	Count (%) (n=110,059)	Non-First Line Classes for Pediatric Otitis Media	Count (%) (n=64,103)
Macrolides	31,786 (29%)	Cephalosporins	39,356 (61%)
Tetracyclines	29,459 (27%)	Macrolides	19,607 (31%)
Cephalosporins	22,192 (20%)	TMS	2,107 (3%)
Fluoroquinolones	9,928 (9%)	Sulfonamides	834 (1%)
TMS	6,395 (6%)	Lincosamides	701 (1%)
Other	10,299 (9%)	Other	1,498 (2%)

In an unadjusted analysis, the most vulnerable Minnesotans, categorized by using the social vulnerability index, received antibiotics less often than did the least vulnerable Minnesotans, regardless of the appropriateness of antibiotics for their respiratory diagnosis.

Prescribing by tier was also analyzed by patient characteristics, including location of residence and social vulnerability index (SVI) quartile. For all SVI analyses, the least vulnerable quartile was held as the reference category in an analysis unadjusted for other factors. Insurance plan members in the most vulnerable SVI quartile received antibiotics less often. This was true for both Tier 1 diagnoses (OR 0.92, 99.9% CI 0.90–0.94), where antibiotics are usually indicated, and for Tier 3 diagnoses (OR 0.92, 99.9% CI 0.91–0.94), where antibiotics are rarely needed. Minnesota’s most vulnerable insurance plan members received first-line drugs for sinusitis less often (OR 0.90, 99.9% CI 0.87–0.94) but did receive first-line drugs more often than the least vulnerable members for pediatric otitis media events (OR 1.16, 99.9% CI 1.12–1.21).

Members living in non-metro ZIP codes also received antibiotics less often for both Tier 1 (OR 0.84, 99.9% CI 0.82–0.86) and Tier 3 (OR 1.31, 99.9% CI 1.29–1.32) diagnoses. Non-metro Minnesotans received first-line antibiotics less often for both adult acute sinusitis (OR 0.91, 99.9% CI, 0.88–0.94) and pediatric otitis media (OR 0.83, 99.9% CI, 0.81–0.86).

Further investigation of MN APCD data will be critical to understand potential prescribing disparities across Minnesota population groups. This preliminary investigation did not adjust for other potentially important factors, such as age, geography, and payer type. Additional research is needed to explore whether and why Minnesota’s most vulnerable residents and those living outside of metro areas might receive antibiotics less often when treatment is indicated. Improvement is still needed for prescribers to avoid antibiotics for patients throughout the state when they are not necessary (e.g., diagnosis of acute bronchitis).

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 had been administered during the timeframe of interest, and a SAAR value less than 1 indicates that fewer antimicrobials than expected 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.

An increasing number of Minnesota hospitals report antimicrobial administration data to CDC. 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 of July 2022, 41% of acute care facilities, including 40 acute care hospitals and 10 critical access hospitals in Minnesota, have reported at least one month of AU data to the NHSN Antimicrobial Use Option (Figure 6). Characteristics of reporting hospitals are shown in Table 6. Figure 7 shows the most recently available national summary of the percent of hospitals reporting antimicrobial use to NHSN.

Table 6. Characteristics of Minnesota hospitals reporting antimicrobial use data to CDC NHSN AU Option, July 2022.

Hospital Type	n (%)	Bed Size	n (%)
General Acute Care	40 (80%)	0-24 beds	10 (20%)
Critical Access	10 (20%)	25-149 beds	21 (42%)
		150-299 beds	9 (18%)
		≥300 beds	10 (20%)
Teaching Status	n (%)		
None/Undergrad	26 (52%)		
Major/Graduate	24 (48%)		

Figure 6. Number of Minnesota hospitals and units reporting antimicrobial use data to the CDC NHSN AU Option by month, January 2017–July 2022.

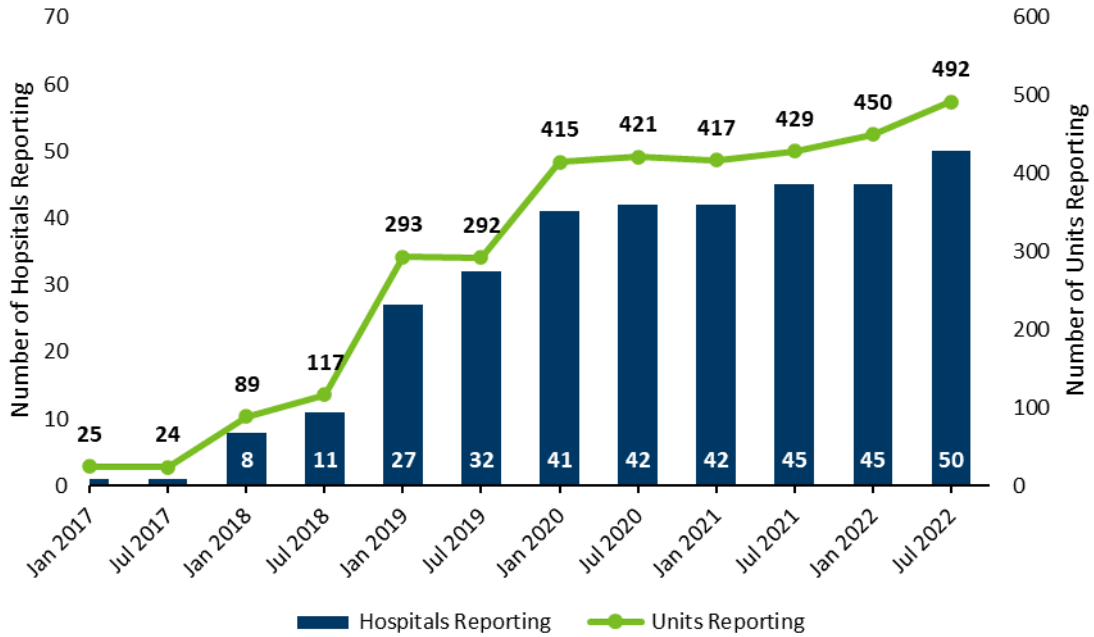
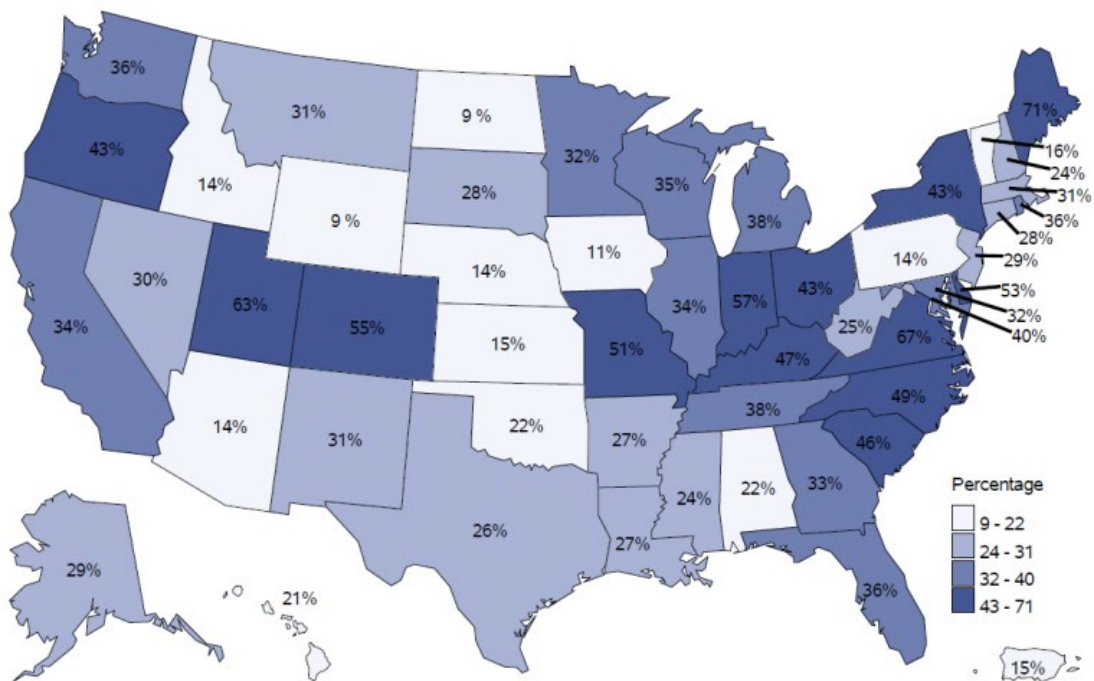


Figure 7. Percentage of acute care facilities* in each state reporting at least one month of antimicrobial use data through CDC NHSN AU Option as of December 2021.



Source: Centers for Disease Control and Prevention. [2021 National Healthcare Safety Network \(NHSN\) Antimicrobial Use \(AU\) Option Report \(www.cdc.gov/nhsn/pdfs/datastat/2021-AU-Report-508.pdf\)](https://www.cdc.gov/nhsn/pdfs/datastat/2021-AU-Report-508.pdf)

*Facility types that have reported at least one month of data to NHSN as of December 1, 2021, include: critical access, children’s, general acute care, long-term acute care, military, oncology, orthopedic, psychiatric, inpatient rehabilitation, surgical, Veterans Affairs, women’s, and women’s and children’s hospitals.

The 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 8). During 2021, 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 9).

Figure 8. All antibacterial agents SAAR, Minnesota adult hospital wards, 2019–Quarter 3 of 2022.

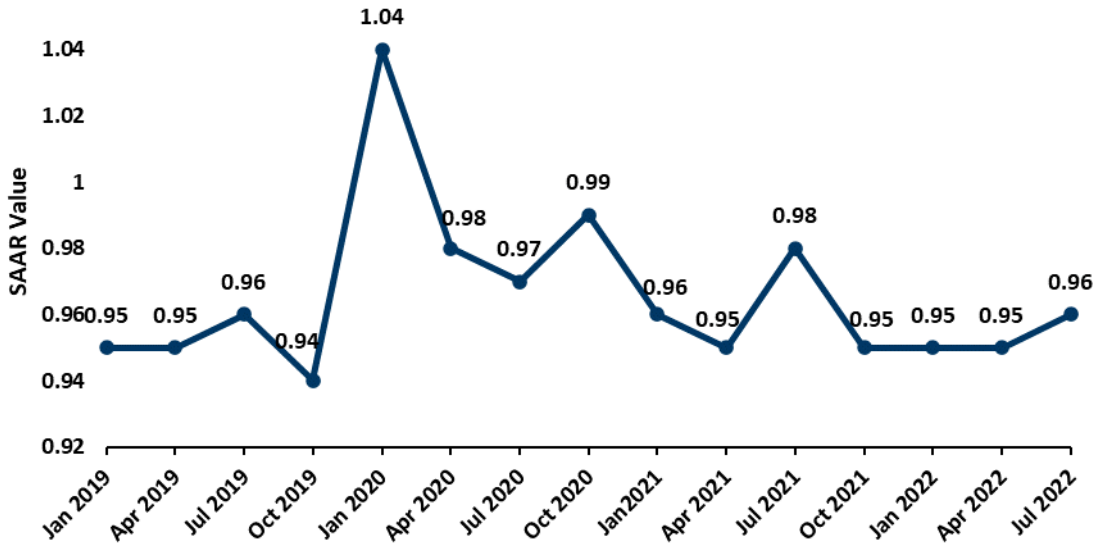
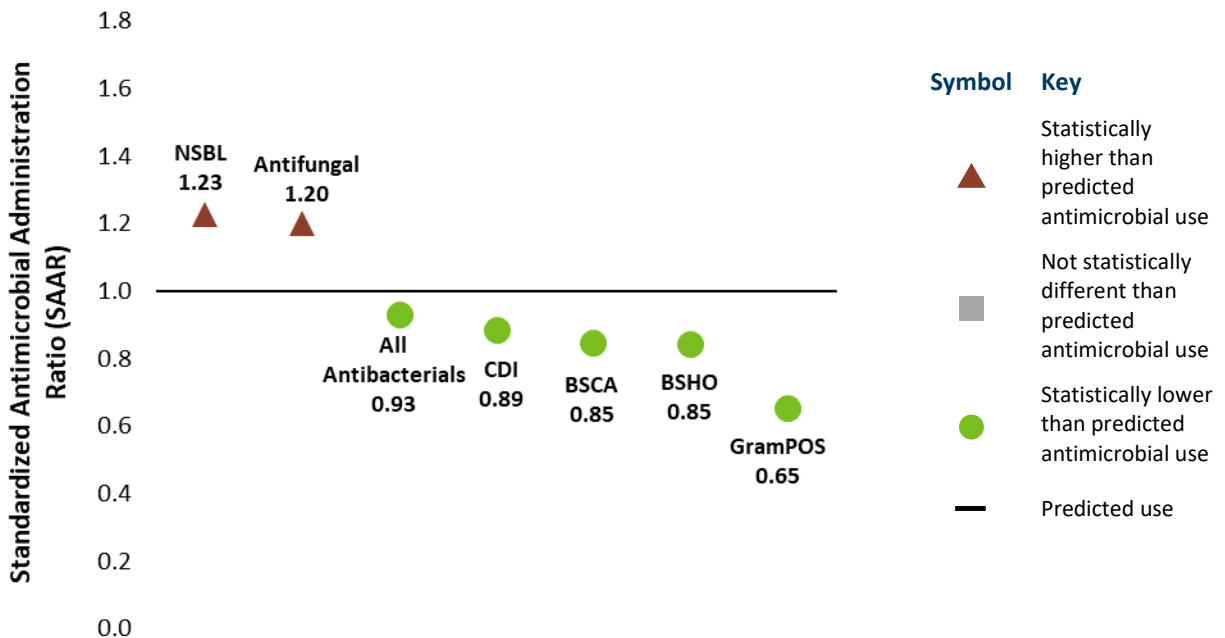
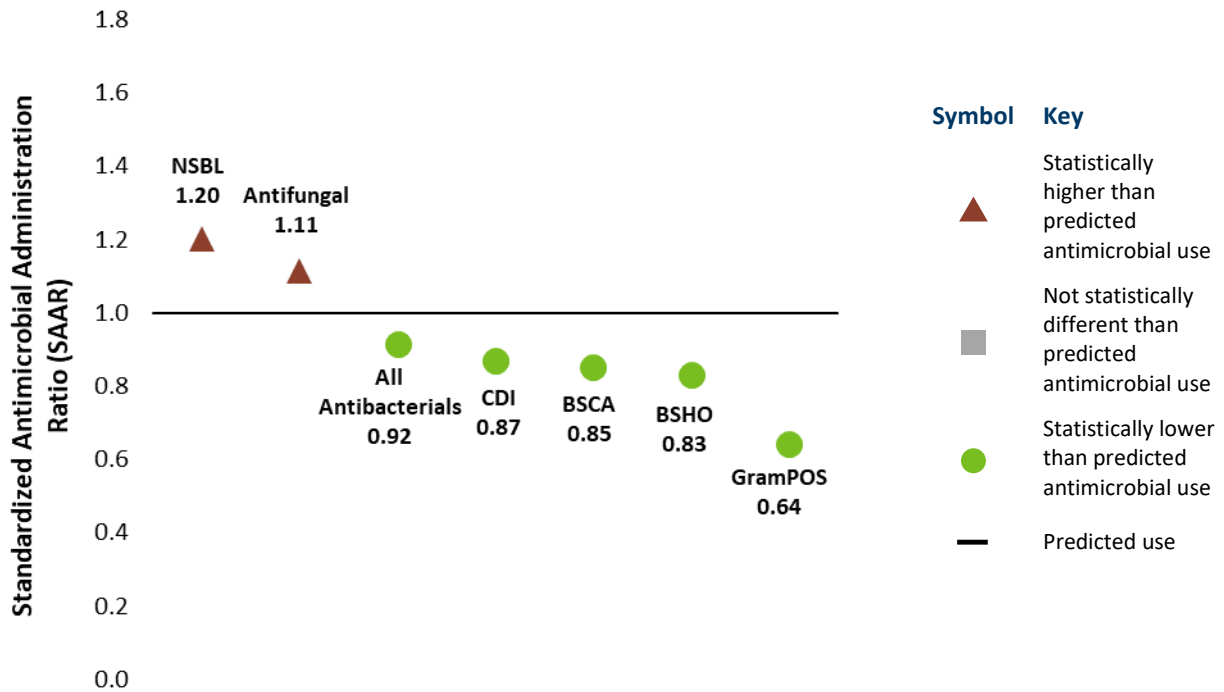


Figure 9. SAAR summary for Minnesota adult hospital wards for the last two full years of data available, 2020 (A) and 2021 (B).

2020 (A)



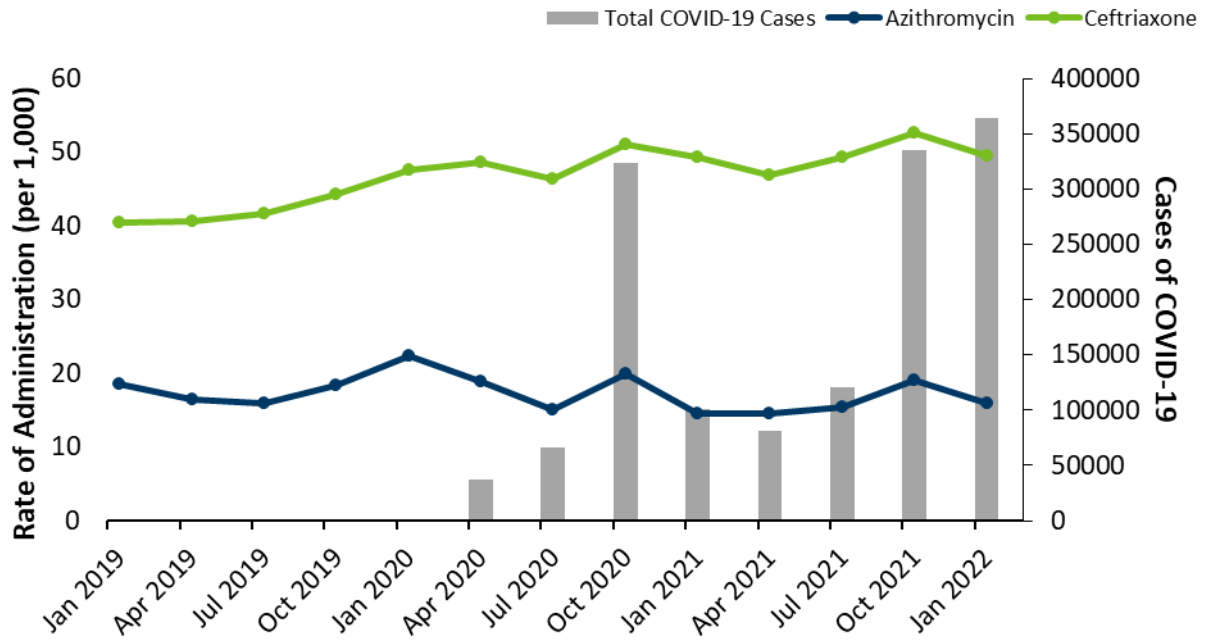
2021 (B)



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.

CDC has described a national increase in overall hospital antibiotic use early in the COVID-19 pandemic. A rise in antibiotic use was seen in Minnesota during the first quarter of 2020, aligning with the start of the COVID-19 pandemic (Figure 8). Increased antibiotic prescribing during this time was likely due to clinical uncertainty and lack of available SARS-CoV-2 therapeutics, despite the infrequency of associated secondary bacterial infections. Antibiotic use remained elevated into the third quarter of 2021. In Minnesota, as was seen nationally, hospital antibiotic use fluctuations appeared to be driven by azithromycin and ceftriaxone use, which increased early in the pandemic and during the winter of 2020–2021, when cases were high in Minnesota (Figure 10).

Figure 10. Hospital use of azithromycin and ceftriaxone during and relationship to COVID-19 cases reported in Minnesota during January 2019–July 2021.



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 (18).

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.

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 (19). 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 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 2021, was slightly below (93%) the national implementation average (95%), (Figure 11). Minnesota has a greater proportion of critical access hospitals (CAHs) than the wider U.S., as defined by CMS. In 2020, CAHs were 57% of 122 hospitals reporting to NHSN compared with 25% of 4,527 nationwide. CAHs are small, serve non-urban populations, and tend to have fewer available operational resources.

ANTIBIOTIC USE AND STEWARDSHIP IN MINNESOTA

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

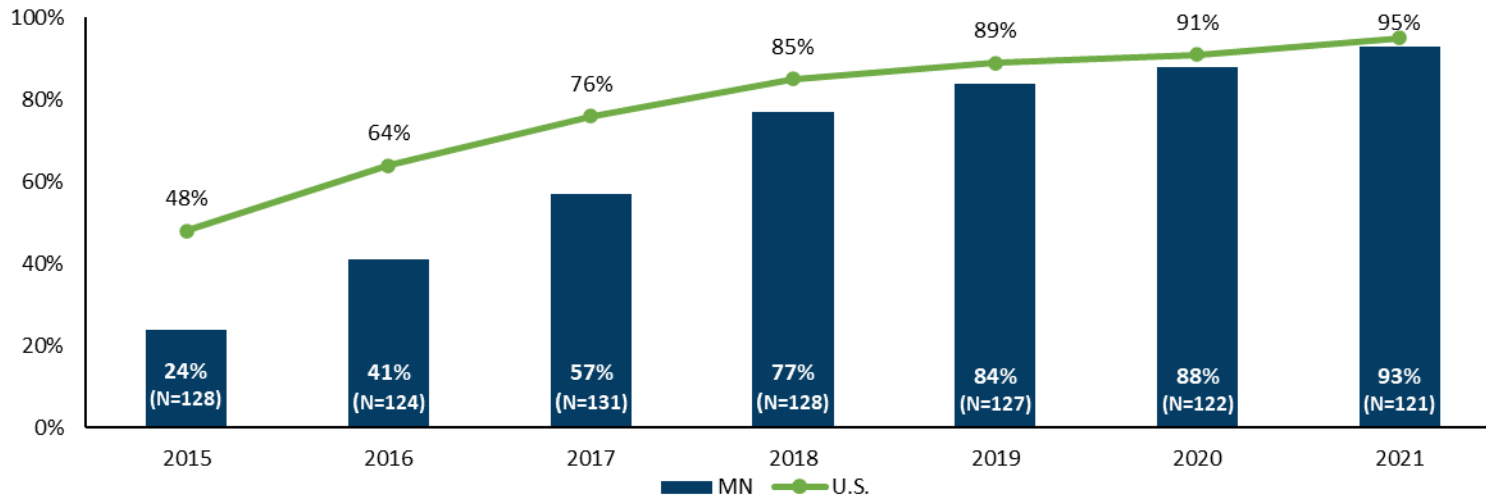
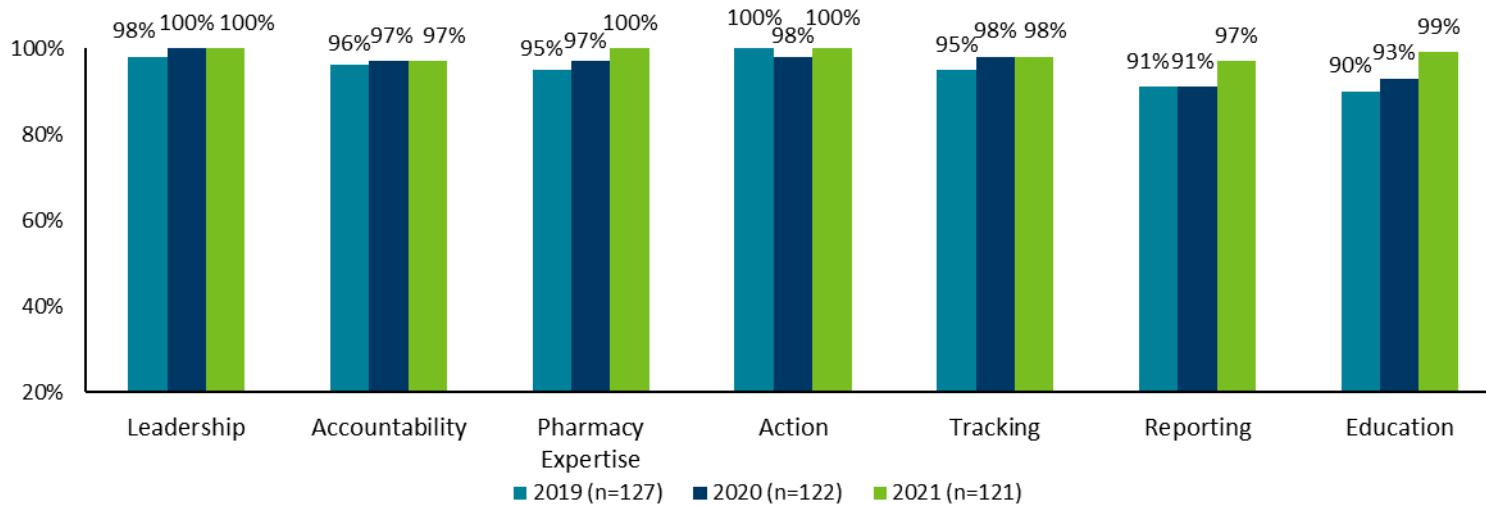


Figure 12. Proportion of Minnesota hospitals meeting each stewardship core element by year, according to NHSN.



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 (20). The CDC recommends that all nursing homes take steps to implement AS 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 (20, 21).

NHSN annual survey data on core element implementation in Minnesota reveals an increase during 2016–2019 (Figure 13); these increases mirrored national improvements in implementation (22). 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. Reporting and education were the core elements that experienced the greatest drop in implementation. In 2021, nursing homes were back on track and progress is being made in implementing the CDC core elements.

ANTIBIOTIC USE AND STEWARDSHIP IN MINNESOTA

Figure 13. Proportion of Minnesota and national nursing homes that implemented all seven core elements by year, according to NHSN.

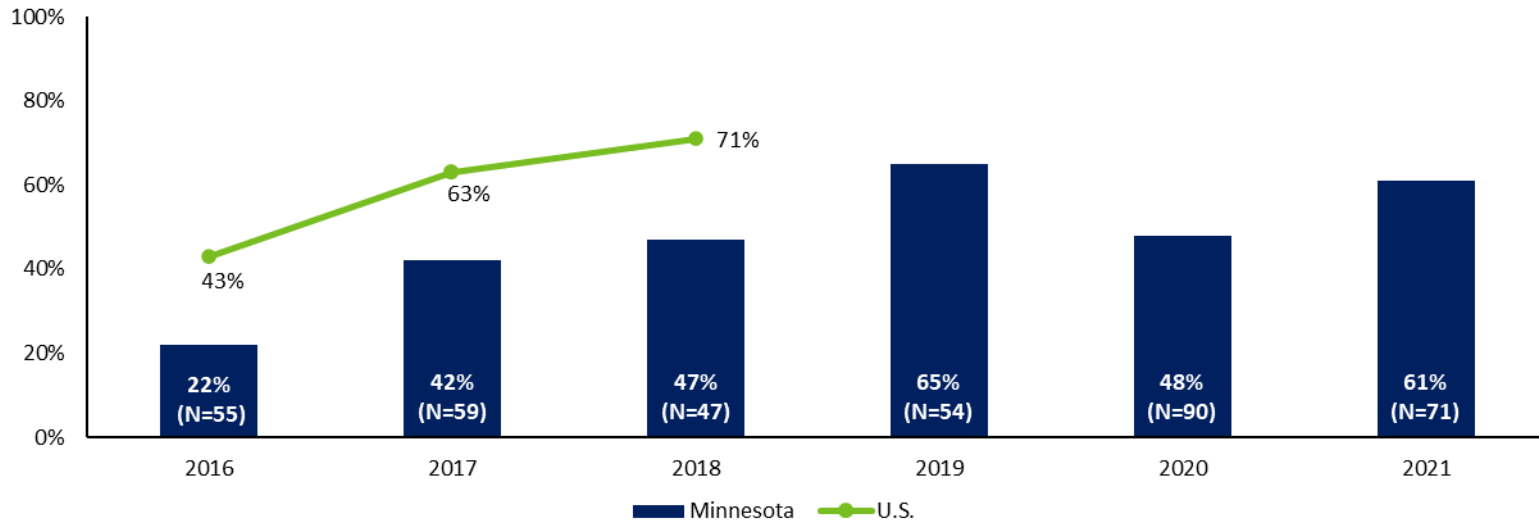
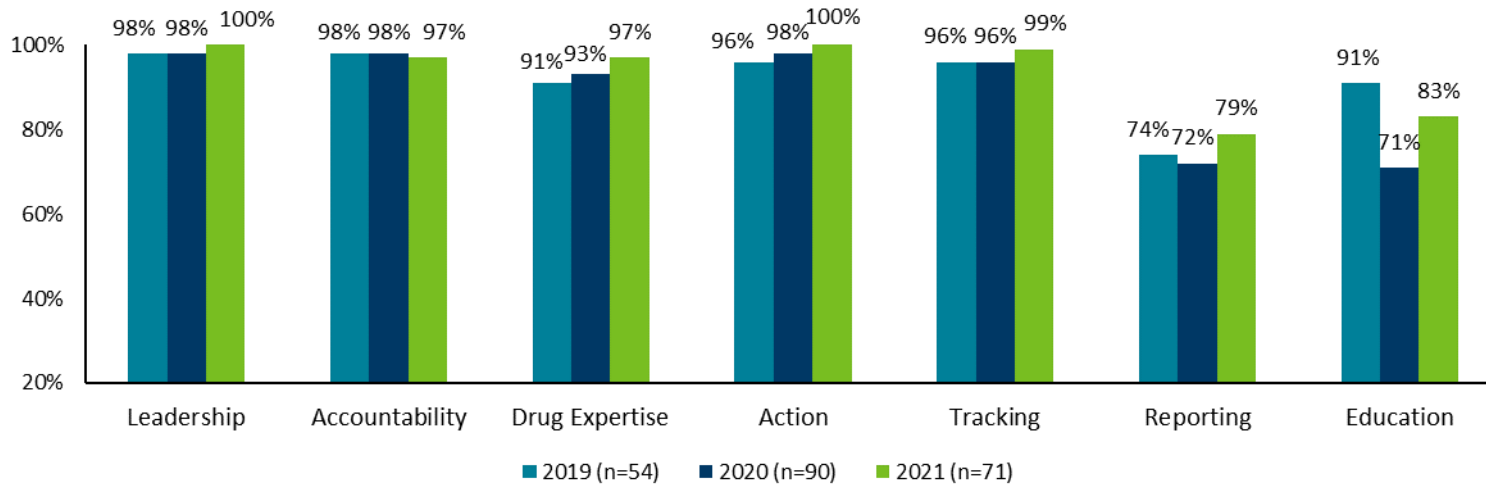
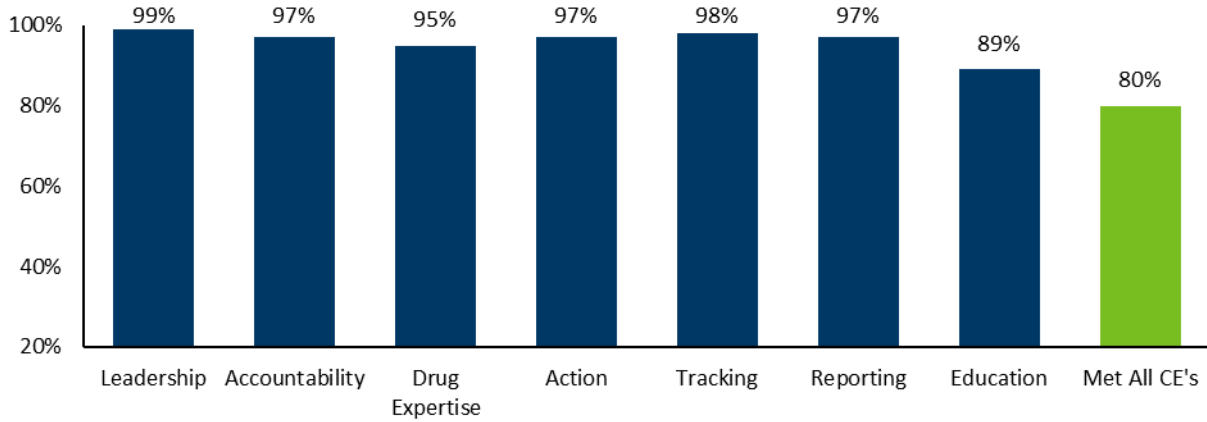


Figure 14. Proportion of Minnesota nursing homes meeting each stewardship core element by year, according to NHSN.



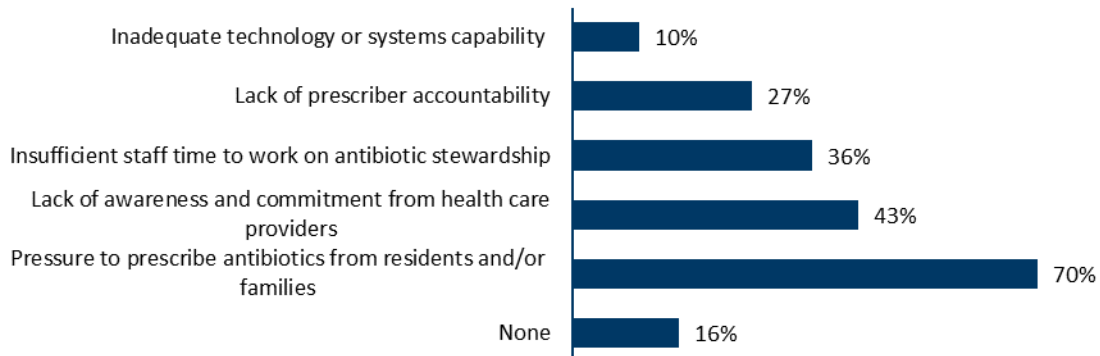
In 2022, MDH conducted a survey of Minnesota skilled nursing facilities to assess AS practices and core element implementation in more detail and to identify opportunities to offer support. A total of 146 facilities completed the survey, accounting for 40% of CMS-certified facilities in Minnesota. Most (80%) reported implementing all seven core elements (Figure 15). 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 15. 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 surveyed Minnesota facilities was pressure from residents and family members to prescribe antibiotics even when they are not necessary (Figure 16). 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 16. 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 (23).

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 18). Action for policy and practice was the most implemented core element (97%) while education and expertise (30%) was the least implemented. Implementation of all four core elements increased from 2017 to 2022 (Figure 18).

Figure 17. Percent of clinics implementing each of the CDC core elements of antibiotic stewardship for outpatient settings in 2017 & 2022 MDH surveys.

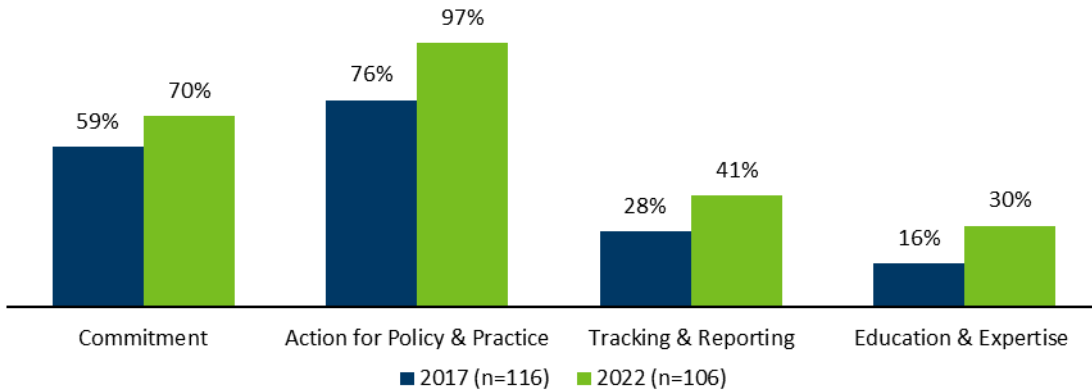
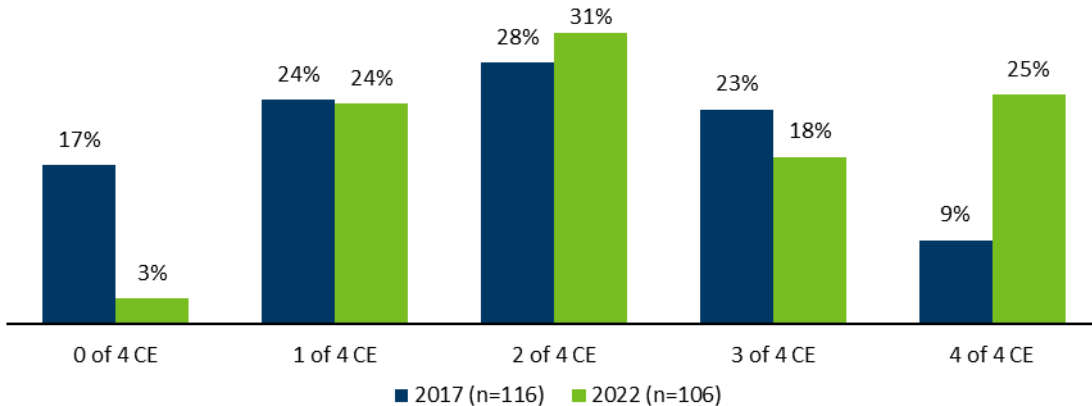
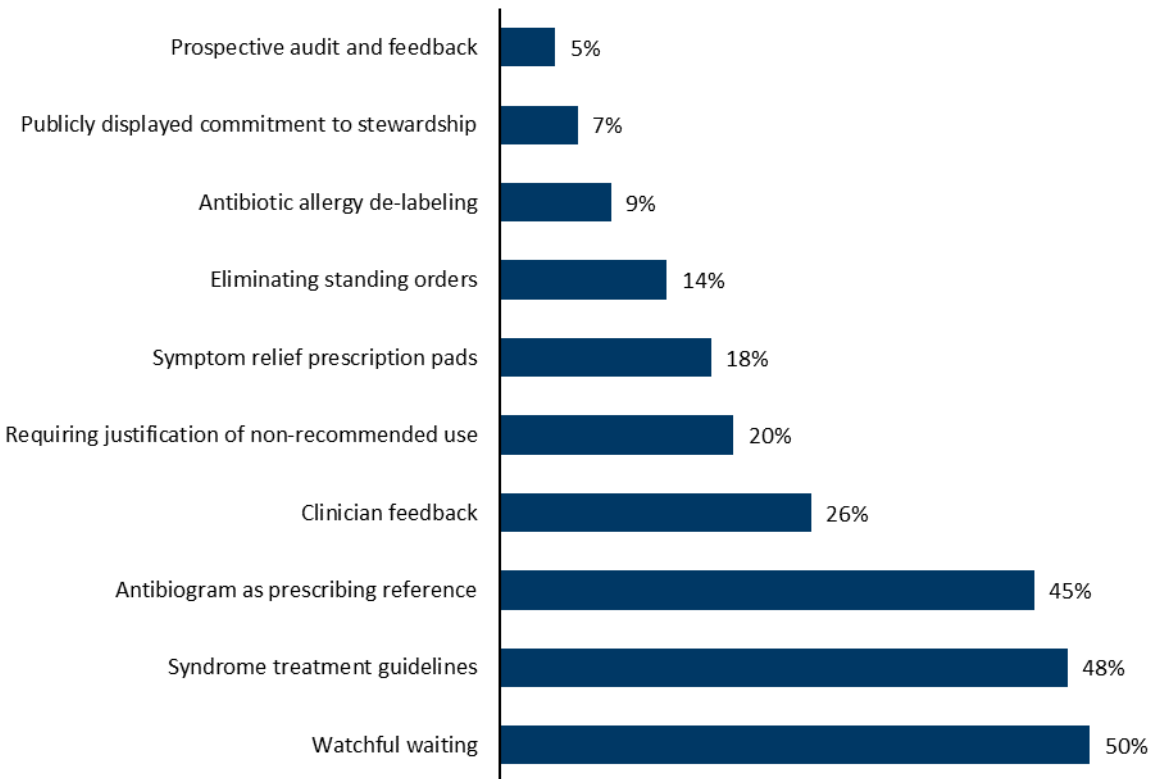


Figure 18. Percent of clinics meeting the 4 CDC core elements (CE) of antibiotic stewardship for outpatient settings in 2017 & 2022 MDH surveys.



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 19).

Figure 19. 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 21). 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 20. Barriers to stewardship implementation reported by Minnesota outpatient clinics in 2022 MDH survey.

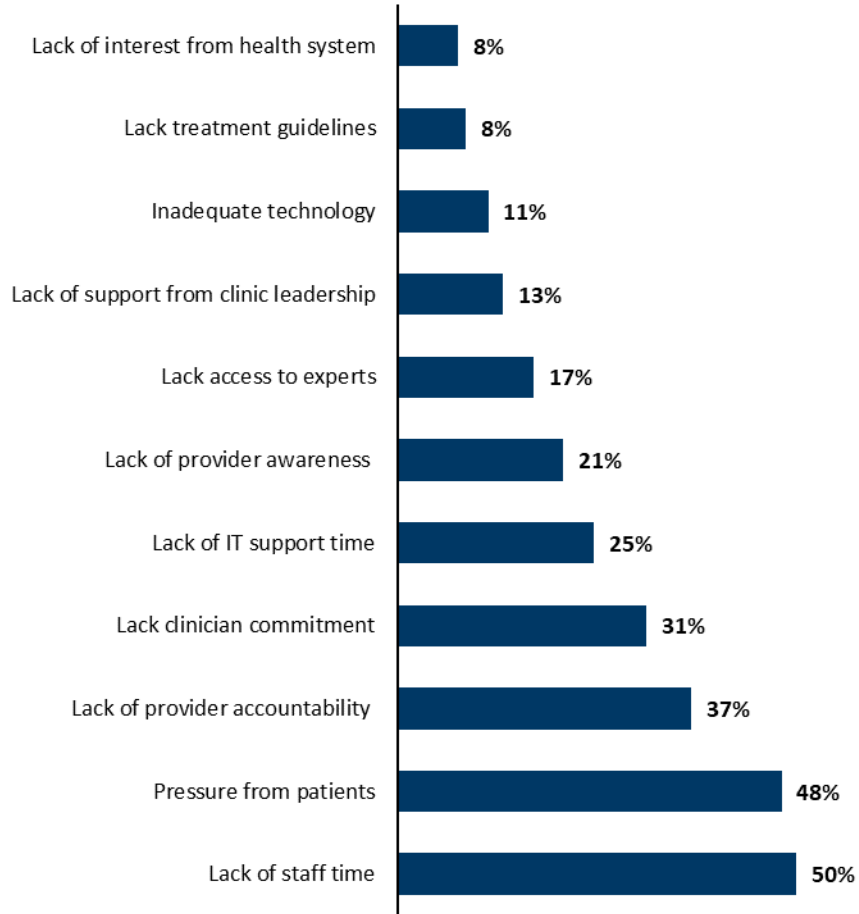
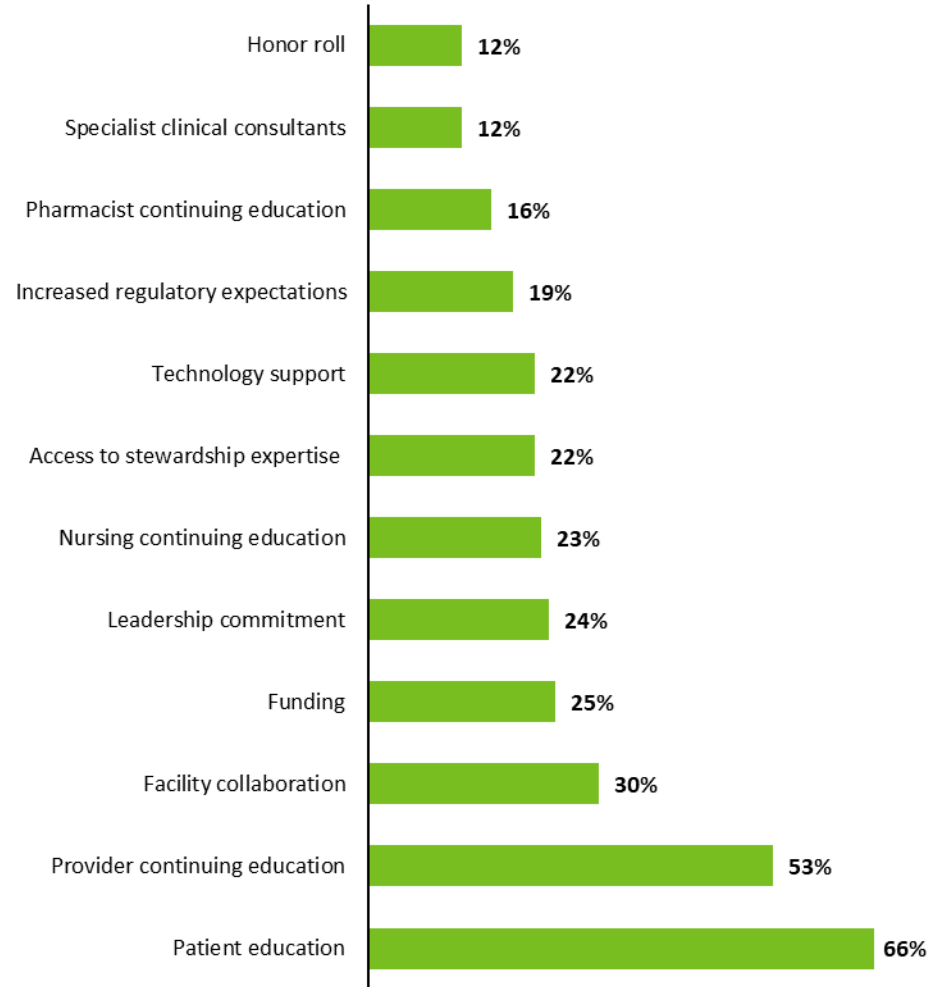


Figure 21. Facilitators to stewardship implementation reported by Minnesota outpatient clinics in 2022 MDH survey.



Opportunities to Improve Antibiotic Stewardship Programs

Continued improvements in the implementation of stewardship 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. After a pandemic-related cancellation in 2020, MDH resumed its annual CME conference in 2022 and offered several webinars with content relevant across several health care settings.

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. In 2022, MDH contracted with two infectious diseases 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 diagnostics 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. In April 2023, MDH pharmacist consultants will launch a stewardship network for pharmacists to provide a forum for collaboration and sharing best practices, especially for 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 (24). Data downloaded from the CDC website were summarized and visualized by 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 2018 and 2019 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 2018–2019 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 ZIP code based SVI 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 November 2022. 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 (25).

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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