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Minnesota One Health Antibiotic Stewardship Collaborative: A Reproducible Approach to Facilitate Antimicrobial Stewardship Progress

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The Minnesota One Health Antibiotic Stewardship Collaborative (MOHASC) was launched in 2016 with the mission of providing a collaborative environment to promote judicious antibiotic use and antibiotic stewardship (AS) and to reduce the impact of antibiotic-resistant pathogens of human, animal, and environmental health importance. MOHASC goals include improving AS programs in healthcare and veterinary medicine, advancing understanding of environmental impacts of antibiotic use, and promoting a One Health (OH) approach to AS. These goals are accomplished through quarterly meetings of 4 work groups, field trips, collaborative research, an annual member meeting, and public education events. This novel OH approach has strengthened multidisciplinary relationships within Minnesota and led to procurement of funding to enhance AS initiatives beyond the Collaborative. This perspective serves as a blueprint for other jurisdictions, and we advocate for use of this reproducible OH strategy to facilitate broad AS goals.

Keywords. antibiotic resistance; One Health; Minnesota; stewardship.

Antimicrobial resistance (AMR) is a critical threat to public health. The use of antibiotics, which are essential to human and veterinary medicine but drive emergence and maintenance of AMR, must be optimized in all sectors. This antibiotic stewardship (AS) imperative can be addressed through One Health (OH)-based initiatives. The OH approach strives to achieve optimal health outcomes through multidisciplinary collaboration recognizing the interconnection of

humans, animals, and their shared environment [1]. There are organizations and institutions focused on AS [2] and OH [3] individually, though few have advanced AS on an action-based OH platform. In 2015 and 2016, respectively, the United States (US) National Action Plan for Combating Antibiotic-Resistant Bacteria [4] and the United Nations General Assembly [5] advocated for a OH approach and stated that AS should be a collaborative cross-discipline effort. However, a literature search revealed just 1 published report of US state-level initiatives promoting AS across OH [6]. Minnesota's approach aligns with priorities set forth by the US government and United Nations [4, 5], and its design could be replicated by other jurisdictions.

agriculture, and environmental protection formed the Minnesota One Health Antibiotic Stewardship Collaborative (MOHASC, <https://health.state.mn.us/onehealthabx>) in 2016 to define AS goals and strategies in a 5-year state strategic plan [7, 8]. Goals of MOHASC include improving AS programs in healthcare and veterinary medicine, exploring environmental impacts of antibiotic use (AU), and communicating the importance of a OH approach. MOHASC acknowledges room for AU improvement in all settings, communicates barriers and opportunities for AS, shares evidence-based AS practices among health fields, establishes setting-specific priorities, engages with industry and the public, and garners state government support. These goals are accomplished through quarterly meetings of 4 work groups (Figure 1), AS field trips (described below), collaborative research, an annual member meeting, and public education events. Each work group includes 16–57 volunteer

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MOHASC STRUCTURE AND HISTORY

To address the need for action-based OH AS, state professionals in public health, human and veterinary medicine,

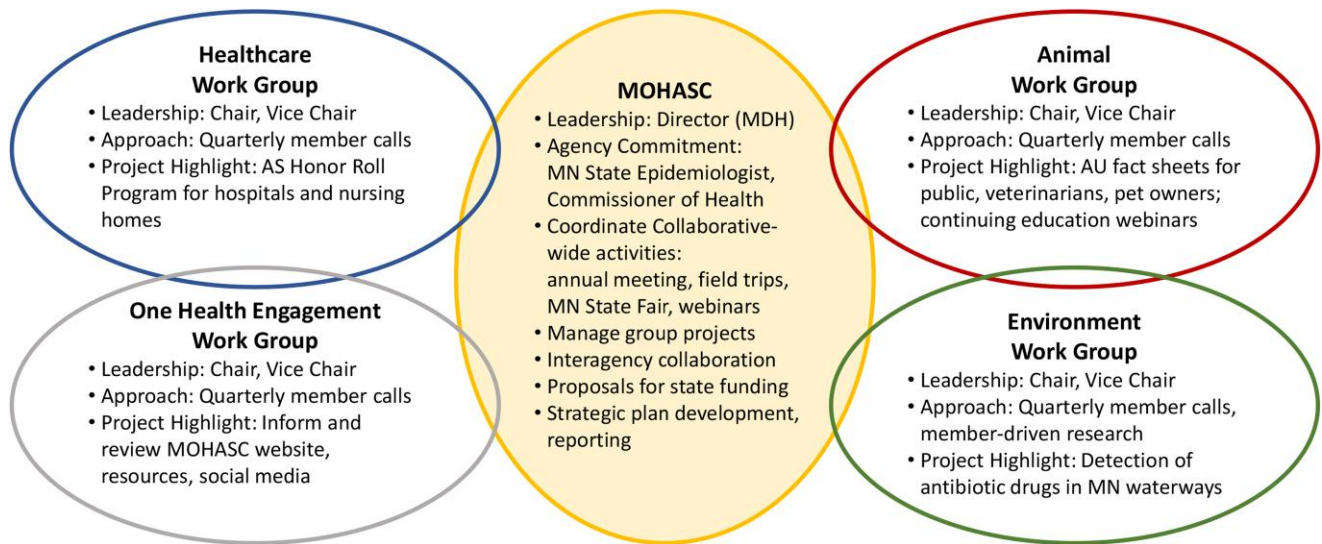


Figure 1. Structure of the Minnesota One Health Antibiotic Stewardship Collaborative (MOHASC), which illustrates the 4 MOHASC work groups, outlines how projects are accomplished, and highlights projects achieved by each work group. Abbreviations: AS, antibiotic stewardship; AU, antibiotic use; MDH, Minnesota Department of Health; MN, Minnesota; MOHASC, Minnesota One Health Antibiotic Stewardship Collaborative.

members, led by a Chair and Vice Chair, with oversight by a MOHASC Director (Figure 1). Membership is open to anyone in Minnesota whose work is related to AU or AS. As of January 2022, MOHASC membership numbered 117. Some members are passive participants whereas others make substantial contributions to MOHASC deliverables and events. Member occupations broadly align with the 3 OH disciplines: humans (76 [65%]), animals (36 [31%]), and environment (5 [4%]), with members representing state government agencies, medicine, pharmacy, veterinary medicine, dentistry, infection prevention, academic research, and food animal, healthcare, and pharmaceutical industries. Like many aspects of public health and clinical medicine, MOHASC operations and initiatives were impacted by the coronavirus disease 2019 pandemic, with fewer partners engaged and activities held during 2020–2021.

MOHASC ACTIVITIES

Inaugural Minnesota Antibiotic Summit and Strategic Planning

The inaugural Minnesota Antibiotic Summit, held in January 2016, brought

together diverse parties, including those who use, study, monitor, or regulate antibiotics across sectors. The event was hosted by the Minnesota Department of Health (MDH), Minnesota Department of Agriculture, Minnesota Board of Animal Health (MBAH), and Minnesota Pollution Control Agency (MPCA). Objectives were to understand AU, AS, and AMR from human, animal, and environmental perspectives; share best practices; and develop priorities to inform a 5-year state strategic plan for OH AS. Attendees were assigned seats to ensure diverse perspectives at each table and facilitate discussion across disciplines. This strategy, selection of a dynamic moderator, and premeeting “homework” to consider AS priorities were considered instrumental to the event’s success. Sector-specific presentations highlighted unique realities and challenges in each setting, while an exercise in which attendees were asked to identify AMR-related hopes and fears underscored shared purpose and consequences of inaction. During the Summit, framework elements for a state OH AS strategic plan were identified, and additional partner input was compiled after the event. Endorsed by Commissioners of Health, Agriculture, and MPCA, and by the

MBAH, the OH Minnesota AS Five-Year Strategic Plan was released in July 2016 [8]. In August 2016, MDH hired the first MOHASC Director, with background in public health, veterinary medicine, and AMR. The Director reports to the State Epidemiologist, and salary is supported through a Centers for Disease Control and Prevention cooperative agreement [9]. The Director’s responsibilities under that funding are not limited to MOHASC operations or activities. Routine updates to agency Commissioners and the MBAH Executive Director and State Veterinarian ensure ongoing engagement.

Ongoing Activities

Information on selected MOHASC strategic activities, operational logistics, use of data, professional and public education efforts, and related grant funding are shown in Table 1. One of the most unique and appreciated MOHASC activities is the AS professional field trip. Field trips, occurring approximately 3 times each year, include on-site tours of settings where antibiotics are used and discussions about the realities of AS implementation in those settings. Field trip locations have included a large acute care hospital, nursing home, small-

Table 1. Summary of Selected Activities of the Minnesota One Health Antibiotic Stewardship Collaborative and Targeted Audience

MOHASC Activity	Brief Description	State Agencies and/or Policymakers	Human, Animal, Environmental Health Professionals	MOHASC Members	Public
Strategic activities					
Minnesota Antibiotic Summit	Inaugural event held in January 2016, hosted by MDH, MDA, MPCA, MBAH; led to 5-year OH AS Strategic Plan.	X	X	X	
OH Minnesota AS Strategic Plan [8]	Direction for state AS activities. Initial 5-year plan covered 2016–2021, with goals: (1) promote OH AS understanding across disciplines; (2) improve human AS; (3) improve animal AS; (4) improve understanding of AU environmental impact. Strategic planning currently underway for 2023–2027 plan.	X	X	X	X
AU and AS data sharing	MDH healthcare AU and AS data and member veterinary AU data discussed annually.	X	X	X	X
Operational logistics					
MOHASC annual meetings	Annual meeting to share sector-specific data, research, AS approaches. Guest speakers expand on intersecting topics (eg, science communication, ethics of AU). Work groups discuss objectives for coming year. Meetings are in person (except 2021–2022).			X	
MOHASC work groups	Four work groups align with strategic plan goals, led by Chair and Vice Chair. Quarterly calls are held to receive member updates, discuss AS implementation, identify priorities, make project progress. Each year, 1 meeting is in person.			X	
AS field trips	On-site tours of settings where antibiotics are used, with discussion about realities of AS implementation.			X	
Synergize with core MDH healthcare AS activities	MDH supports AS implementation across healthcare continuum, summarizes AU (eg, IQVIA, NHSN AU Option), AS (eg, core element implementation) data, and educates the public about AU.	X	X	X	X
Professional resources					
AS honor roll program [10]	Recognizes AS commitment (Bronze), action (Silver), collaboration (Gold) in Minnesota hospitals and nursing homes.	X	X	X	X
Statewide hospital antibiogram [11]	Initiative to compile antibiograms from Minnesota hospitals into state-level weighted summary of the susceptibility of selected pathogens to selected antibiotics.	X	X	X	X
Broad education efforts					
Website [7, 12]	Includes original fact sheets; coloring and crossword sheets; compiled resources for human, animal, environmental health professionals and educators; stories initiative describing impact of AU, AS, AMR; MDH, MOHASC webinar archive.		X	X	X
GovDelivery email listserv	Source of communication about OH AS news and events, new resources, MOHASC contact information. Used annually to promote US Antibiotic Awareness Week.		X	X	X
Public AU education display	Table-top exhibit with general AU and AS information, interactive Q&A display, resource to find pharmaceutical disposal sites. Used at the Minnesota State Fair and available to public libraries year-round.				X
Grant funding of MOHASC collaborators					
Measurement of AU in	Referencing approaches from healthcare, veterinary and public health researchers use federal,	X	X	X	X

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Table 1. Continued

MOHASC Activity	Brief Description	State Agencies and/or Policymakers	Human, Animal, Environmental Health Professionals	MOHASC Members	Public
companion-animal practice [13, 14]	nonprofit, industry, and institutional funds to measure AU in dogs, cats, and horses.				
Measurement of antibiotics, resistance genes in Minnesota waters	With competitive state grant funding, researchers from engineering, chemistry, veterinary medicine, and public health collaborate to measure and explore the impact of antibiotics in Minnesota waterways [15].	X	X	X	X

A subset of data from the IQVIA Xponent database is made publicly available by the Centers for Disease Control and Prevention and can be used by states to track outpatient antibiotic prescribing rates [16].

Abbreviations: AMR, antimicrobial resistance; AS, antibiotic stewardship; AU, antibiotic use; MDAH, Minnesota Board of Animal Health; MDA, Minnesota Department of Agriculture; MDH, Minnesota Department of Health; MPCA, Minnesota Pollution Control Agency; NHSN, National Healthcare Safety Network; OH, One Health.

animal referral hospital, dairy farm, swine farm, animal shelter, thoroughbred racetrack, fish hatchery, and wastewater treatment plant. Attendance averages 15 members from various fields, and each event lasts approximately 2–4 hours. Discussions regarding clinical challenges and evidence-based practices, and sharing of resources and experiences, have been employed to make the OH AS concept actionable. The MOHASC booth at the Minnesota State Fair is the largest public-facing activity. Engaging with >10 000 attendees annually, members highlight the AMR issue, answer questions, and encourage use of disposal sites for unused medications.

IMPACT OF MOHASC

Minnesota Professionals and State Agencies

The OH Minnesota AS Strategic Plan included several metrics by which success could be measured, including number of individuals participating, number of persons reached through communications like email, social media, and the website. There are also unmeasured benefits of a strengthened Minnesota AS community, including collaborative publications [13–15, 17, 18] and routine 2-way communication of AS opportunities and challenges between clinical organizations and state agencies.

In 2019, midway through the 5-year strategic plan period, MOHASC membership was surveyed regarding

collaborative logistics, areas for improvement, and the impact of participation on AS awareness. The anonymous survey was public health practice and exempted from review by MDH Institutional Review Board. All MOHASC members at the time (n = 98) were emailed the survey link, and 81 (83%) completed the survey. Many (41 [51%]) reported being a MOHASC member since its inception. Excluding the MOHASC Director’s time, members contributed, in aggregate, >2000 hours of in-kind service per year (mean, 25 hours per member). Most (63 [78%]) members believed that MOHASC influenced AS practices positively in their health discipline and that their participation facilitated identification of new resources for their own AS practice (59 [73%]), contributed to new or enhanced professional relationships (62 [77%]), and increased awareness of how AS is practiced in their field (72 [89%]). The partner-based approach, which was valued by nearly all (79 [98%]), facilitated sharing of best practices (74 [94%]), provided increased motivation beyond day-to-day work (65 [82%]), and led to mentorship opportunities (39 [49%]). Seventy-six (94%) members reported learning something new about another care setting within their health discipline, and 78 (96%) reported gaining knowledge of AU and AS in other health disciplines. Of those, 71 (91%) believed that this knowledge provided perspective to

their daily work and 67 (83%) had shared knowledge gained through MOHASC with colleagues, patients, and clients.

Future Directions

MOHASC members are drafting a new strategic plan to guide activities during 2023–2027. Previous experience and advancements in knowledge (eg, prescriber behaviors), available data (eg, medical and pharmacy claims data), and regulation (eg, removal of over-the-counter labels for medically important antibiotics used in veterinary medicine) will guide objectives, resource and education development, and measures to assess progress. MOHASC will continue to generate and post statewide hospital antibiograms [11]. Delayed by the pandemic, 2019–2021 antibiograms are currently being compiled. Because MOHASC is an engagement- and project-based initiative, it generates an actual and potential scope of work that often exceeds the capacity of the Director and volunteer members. Additional funding sources will be sought to allow a MOHASC Director to work exclusively on OH AS initiatives and to provide a budget for resources and education activities.

CONCLUSIONS

The Minnesota approach to advancing statewide AS across OH disciplines by using an action-based platform has

strengthened multidisciplinary relationships within the state and facilitated acquisition of funding to enhance and sustain AS beyond the collaborative. Minnesota state agencies and partners believe that understanding the realities, opportunities, and challenges of others can lead to greater transparency and trust among disciplines. We advocate for use of this strategy in other jurisdictions to facilitate broad stewardship goals and combat the global threat of AMR.

Notes

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References

- Centers for Disease Control and Prevention. One Health. 2022. <https://www.cdc.gov/onehealth/index.html>. Accessed 13 October 2022.
- Centers for Disease Control and Prevention. Antibiotic prescribing and use: health department resources. 2022. <https://www.cdc.gov/antibiotic-use/health-department.html>. Accessed 22 November 2022.
- One Health Commission. WHO's WHO in One Health. 2022. https://www.onehealthcommission.org/en/resources_services/whos_who_in_one_health/. Accessed 23 June 2022.
- The White House. National action plan for combating antibiotic-resistant bacteria. 2020. <https://www.hhs.gov/sites/default/files/carb-national-action-plan-2020-2025.pdf>. Accessed 23 June 2022.
- United Nations. Draft political declaration of the high-level meeting of the General Assembly on antimicrobial resistance. 2016. https://www.un.org/pga/71/wp-content/uploads/sites/40/2016/09/DGACM_GAEAD_ESCAB-AMR-Draft-Political-Declaration-1616108E.pdf. Accessed 23 June 2022.
- D'Angeli MA, Baker JB, Call DR, et al. Antimicrobial stewardship through a One Health lens. *Int J Health Gov* 2016; 21:114–30.
- Minnesota Department of Health. Minnesota One Health Antibiotic Stewardship Collaborative. 2022. <https://www.health.state.mn.us/communities/onehealthabx/>. Accessed 23 June 2022.
- Minnesota Department of Health. One Health Minnesota Antibiotic Stewardship Collaborative Five-Year Strategic Plan. 2016. <https://www.health.state.mn.us/communities/onehealthabx/about/plan.pdf>. Accessed 23 June 2022.
- Centers for Disease Control and Prevention. Epidemiology and laboratory capacity for prevention and control of emerging infectious diseases (ELC). 2021. <https://www.cdc.gov/ncezid/dpei/epidemiology-laboratory-capacity.html>. Accessed 29 July 2022.
- Minnesota Department of Health. Minnesota antibiotic stewardship honor roll. 2022. <https://www.health.state.mn.us/communities/onehealthabx/honor/index.html>. Accessed 23 June 2022.
- Minnesota Department of Health. Minnesota antibiotic stewardship data. 2022. <https://www.health.state.mn.us/diseases/antibioticresistance/data.html>. Accessed 23 June 2022.
- Minnesota Department of Health. One Health antibiotic stewardship resources and print materials. 2022. <https://www.health.state.mn.us/communities/onehealthabx/materials.html>. Accessed 23 June 2022.
- Bollig ER, Granick JL, Webb TL, Ward C, Beaudoin AL. A quarterly survey of antibiotic prescribing in small animal and equine practices—Minnesota and North Dakota, 2020. *Zoonoses Public Health* 2022; 69:864–74.
- Hsieh ES, Bollig ER, Beaudoin AL, Morrow A, Granick JL. Serial point-prevalence surveys to estimate antibiotic use in a small animal veterinary teaching hospital, November 2018 to October 2019. *J Vet Intern Med* 2022; 36:244–52.
- Bueno I, Beaudoin A, Arnold WA, et al. Quantifying and predicting antimicrobials and antimicrobial resistance genes in waterbodies through a holistic approach: a study in Minnesota, United States. *Sci Rep* 2021; 11:18747.
- Centers for Disease Control and Prevention. Antibiotic resistance and patient safety portal: antibiotic use and stewardship. 2022. <https://arpsp.cdc.gov/profile/antibiotic-use?tab=antibiotic-use>. Accessed 13 October 2022.
- Gens KD, Singer RS, Dilworth TJ, Heil EL, Beaudoin AL. Antimicrobials in animal agriculture in the United States: a multidisciplinary overview of regulation and utilization to foster collaboration. *Open Forum Infect Dis* 2022; 9:ofac542.
- Bueno I, Rodriguez A, Beaudoin A, et al. Identifying the spatiotemporal vulnerability of soils to antimicrobial contamination through land application of animal manure in Minnesota, United States. *Sci Total Environ* 2022; 832:155050.