Designing AMR solutions

Systems workshop summary report

Canada

DESIGNING AMR SOLUTIONS

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Executive summary

What was the purpose of the systems workshop?

In February 2024, Canadian stakeholders participated in a systems analysis workshop focused on the role of the Canadian food system in the emergence and spread of antimicrobial resistance (AMR). This workshop was undertaken as part of Designing AMR Solutions, a six-country project funded by the Joint Programming Initiative on AMR, focused improving policy and governance for antimicrobial stewardship at national and global levels. The workshop objectives were to:

- Understand the factors influencing the emergence and spread of AMR in Canada;
- Share perspectives across sectors; and
- Identify priority actions to combat antimicrobial resistance in Canada.

Who contributed?

Ten contributors working in different sectors and disciplines attended an online workshop to participate in structured discussions and exercises to articulate the problem; map the system of relevant factors and relationships; and identify priority actions over different time scales. The workshop took a One Health approach, bringing together actors with expertise in human, animal and environmental health and reflecting on interconnections between sectors.

What were the key systems insights and priority actions?

Contributors agreed that the problem of AMR was likely to continue to increase in the future if current conditions remained fixed, though they noted that trends would look different in different sectors and for different resistance strains. Contributors identified a range of factors and relationships across the human, animal and environmental sectors that contributed to this problem. The discussion of ongoing spread of resistant pathogens within and between different environments and populations, as well as similar issues in policy and practice across sectors, highlighted the importance of cross-sectoral collaboration. The importance of economic considerations was also highlighted, with the need for value-for-money being a key driver in food production. Finally, contributors highlighted the cross-border nature of the threat of AMR and some of its drivers – including climate change, global conflict and misinformation – in an increasingly globalised context.

To conclude the workshop, contributors identified a number of priority actions and discussed challenges to implementation including the need for strong political will, public investment and certain evidence gaps around alternative strategies to reduce the need for antimicrobial use.

What are the next steps?

This workshop is one of five happening globally in different countries. Once we have completed these workshops and received feedback from contributors, we will bring together insights from the workshop to support our project goals of strengthening context-appropriate policy and governance for antimicrobial stewardship. We will share cross-country insights with all contributors once the workshops are complete.

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Acknowledgements

We would like to take this opportunity to thank our workshop contributors for generously giving their time to this project and sharing their essential expertise and insights.

We also thank Valentina De Leon for her support in facilitating the workshop and our colleagues in the Global Food System & Policy research group for their input in piloting workshop materials and activities.

If you have any responses, thoughts or additional insights, please get in touch.

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Goals, format and contributors

This report summarises the systems workshop undertaken in Canada as part of the Designing AMR Solutions project. This is a six-country project aiming to strengthen national and global governance for improved antimicrobial stewardship.

The workshop was focused on the role of the food system in driving the emergence and spread of AMR. The workshop objectives were:

- Understand the factors influencing the emergence and spread of AMR in Canada;
- Share perspectives across sectors; and
- Identify priority actions to combat antimicrobial resistance in Canada.

The workshop was informed by a One Health perspective, which "recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) as closely linked and interdependent".

The workshop took place virtually in February 2024 over two two-hour sessions. Attendees participated in structured discussions and exercises to develop a systems map of the problem and identify and discuss priority actions.

Ten stakeholders participated in the workshop, including representatives from industry and professional bodies, civil society, research institutions and government. Contributors were recruited based on their professional roles and expertise and work on topics related to AMR and its drivers in the human health, animal health, environment and food and agriculture sectors.

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Workshop discussion and outputs

Articulating the problem

The beginning of the workshop focused on exploring and describing the emergence of AMR in the Canadian food system. The exercise entailed asking the contributors to think about how they perceived the trends in AMR from past to present. Contributors also subsequently provided insight into how they believed the trends in AMR would change in the future if no change was imposed (status quo), the best-case scenario with immense positive change, and then worst-case scenario with negative change, based on their expertise and knowledge. We then asked each contributor to share their perspectives.
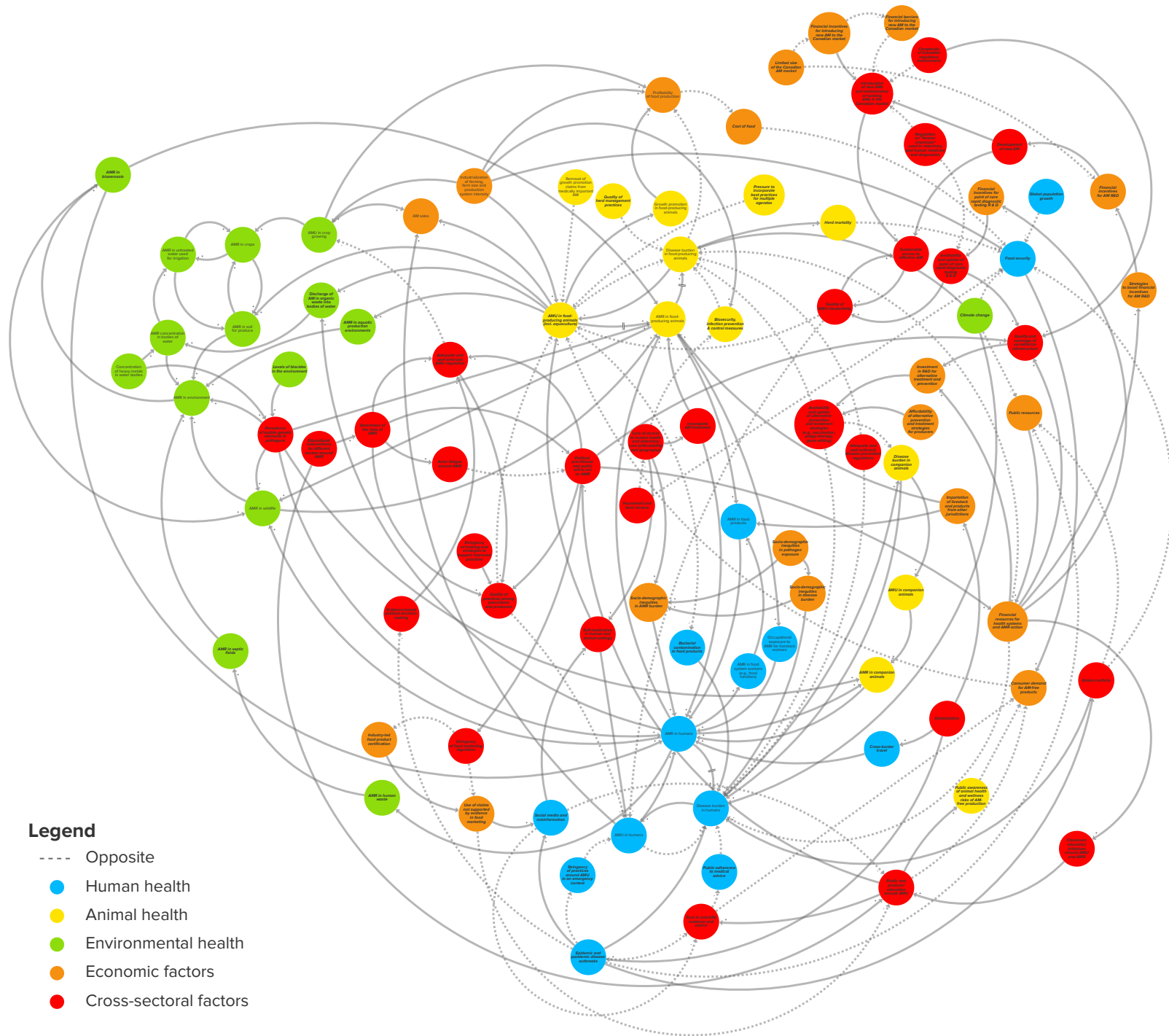
Collectively, all contributors suggested that AMR existed naturally within our ecosystem but was at very low levels. Throughout time, the emergence of AMR increased steadily due to contextual factors like the over prescription and use of antimicrobials. At present day, contributors anticipated the emergence of AMR to continue increasing if minimal changes are made and exponential increase if contextual factors are amplified and regulations are limited. Best-case scenario for contributors involved increased policies, best-practice implementation, and increased awareness on AMR, thus slowing the increase of AMR emergence, then plateauing the rise or moderately decreasing the curve.

Contributors were engaged with the process and took time to consider both their expertise as well as various contextual factors when conceptualizing their timeline. There was strong agreement on the overall progression of AMR emergence. Variability arose when considering the emergence of resistance for specific pathogens as well as antibiotics. Contributors from different sectors and professions also had differences of opinion regarding the intensity of AMR emergence both in the past and future.
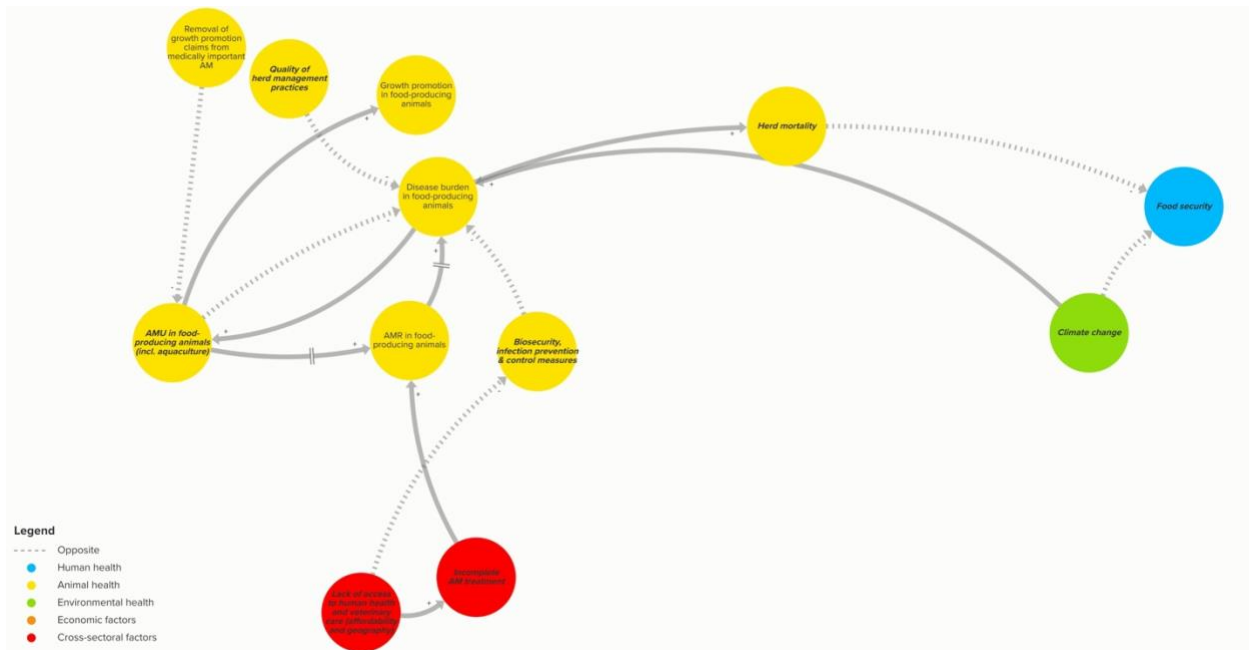
Mapping the system

Workshop contributors developed a systems map to illustrate the role of the food system in the emergence of AMR in Canada. At the start of this exercise, the facilitation team introduced a 'seed structure': a simple model to be used as a starting point for the mapping exercise, which contributors were invited to change and expand. This seed structure was developed based on an ongoing systematic literature review focused on the food system and AMR.

After contributor input and alterations to the seed structure, the finalized systems map was developed. This map contained several key sections, which are summarised below.

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Legend

- - - - Opposite
- Human health
- Animal health
- Environmental health
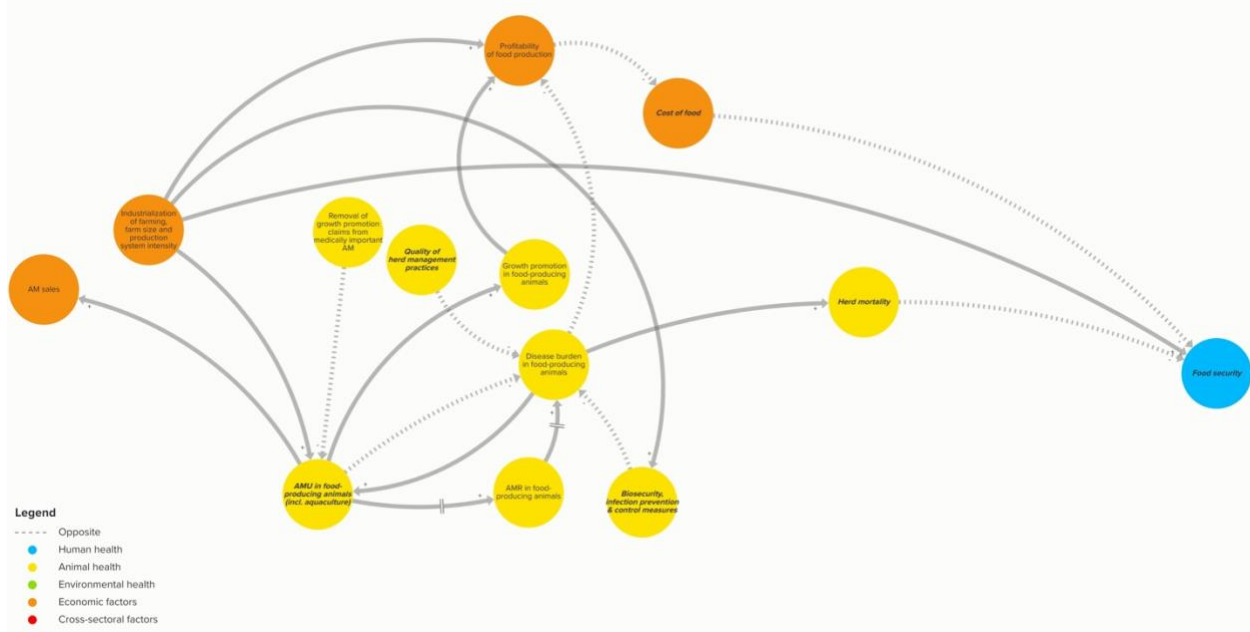- Economic factors
- Cross-sectoral factors

## ANTIMICROBIAL USE IN CROPS AND FOOD-PRODUCING ANIMALS

- When growing crops and rearing livestock (including in aquaculture contexts), antimicrobials are frequently used to reduce the burden of disease

- More use runs the risk of pathogens becoming resistant to them.

- Resistant pathogens can spread to the environment and other populations

- Biosecurity and infection prevention & control measures reduce the burden of disease and the need for AMU

- Lack of access to veterinary care can drive less judicious use of AMU (e.g., incomplete treatment, self-medication)

- High burdens of disease in food-producing animals, driven by evolving conditions such as climate change, can increase herd mortality rates, risking increases in food insecurity

- Implementing quality her management practices and appropriate infection control measures can decrease disease burden in food-producing animals

- Economic factors, production intensification , and claimed related to growth production drive antimicrobial use in livestock and crop production.

- AMU can prevent disease and improve the health of crops and livestock, thereby increasing profitability.

- Increased use also drives the sale of antimicrobials.

- Disease burden in animals and crops reduces production outputs and drives the cost of food, subsequently food insecurity

- Larger-scale farming operations can also have more rigorous practices around IPC and AMU, leading to more judicious AMU
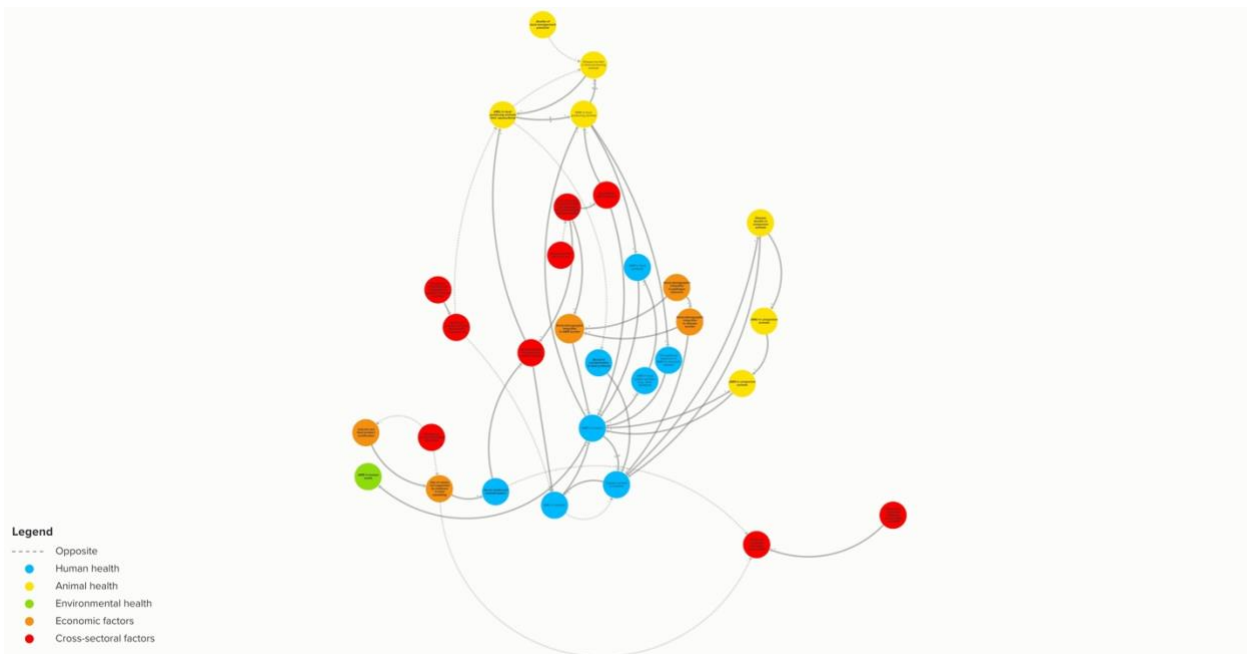
- Antimicrobials reduce the disease burden in humans by reducing illness due to microbials, including by preventing contamination of food products

- However, AMR in the food system can impact humans when they handle or consume livestock, crops and related products

- AMR in the food system coupled with producer and prescriber practices can lead to increased AMU in humans, driving AMR, and thus make human disease harder to treat, needing multiple lines of treatment

- Conversely, as antimicrobials used in human healthcare are coupled with inadequate disease prevention regulations, driving resistance, AMR can spread from humans to animals and the environment, feeding back into this system

- Disease, AMU and AMR in companion animals are also transmitted to humans, given their close interactions

- Misinformation and the increased use of social media also weaken trust in scientific evidence and public adherence to medical advice

- Public and producer education on AMU is impacted by classroom education, stringent food marketing regulations, and misinformation on social media

- Lack of access to healthcare is a socio-demographic inequity that creates barriers to appropriate AMU in the human health sector and exacerbates AMR exposure and burden

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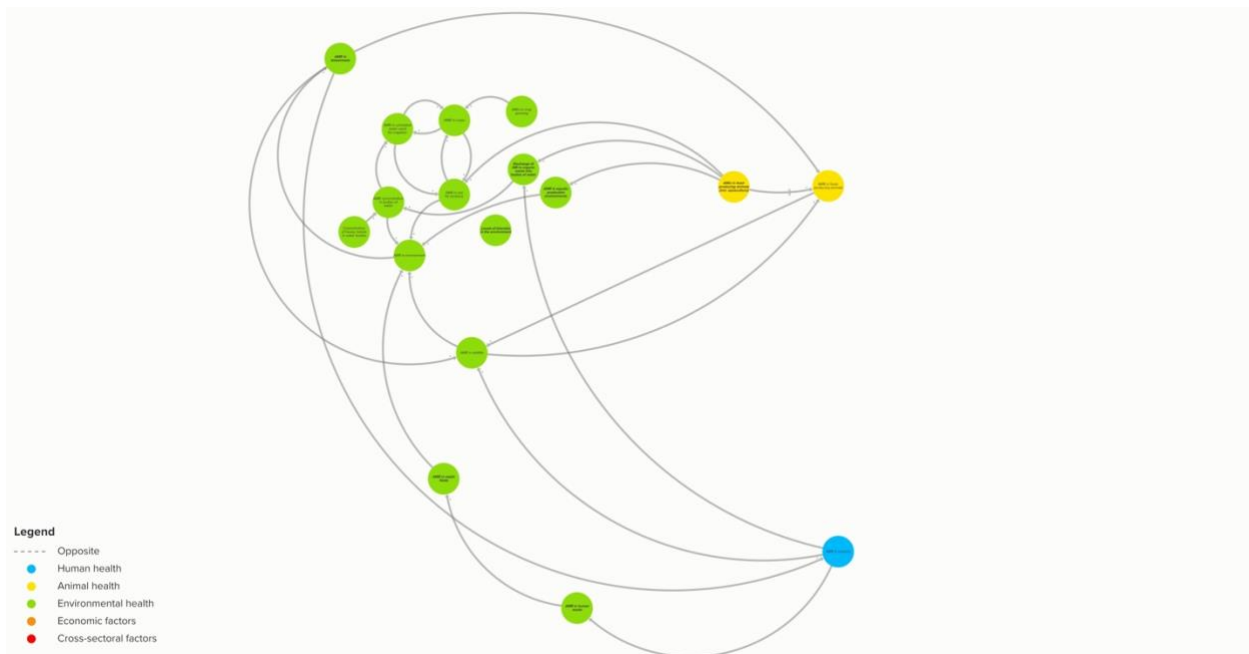
- AMR in livestock and crop production can trickle down into the environment through contact with wildlife or spread into water and soil impacting both aquatic and terrestrial production environments

- AMR in the environment can return to the food system, for example spreading through water used for irrigation

- Meanwhile, environmental drivers such as concentrations of heavy metals in bodies of water, can drive AMR in environmental reservoirs

- AMR in bioaerosols from the environment can spread to humans and animals (food-producing, companion and wildlife)

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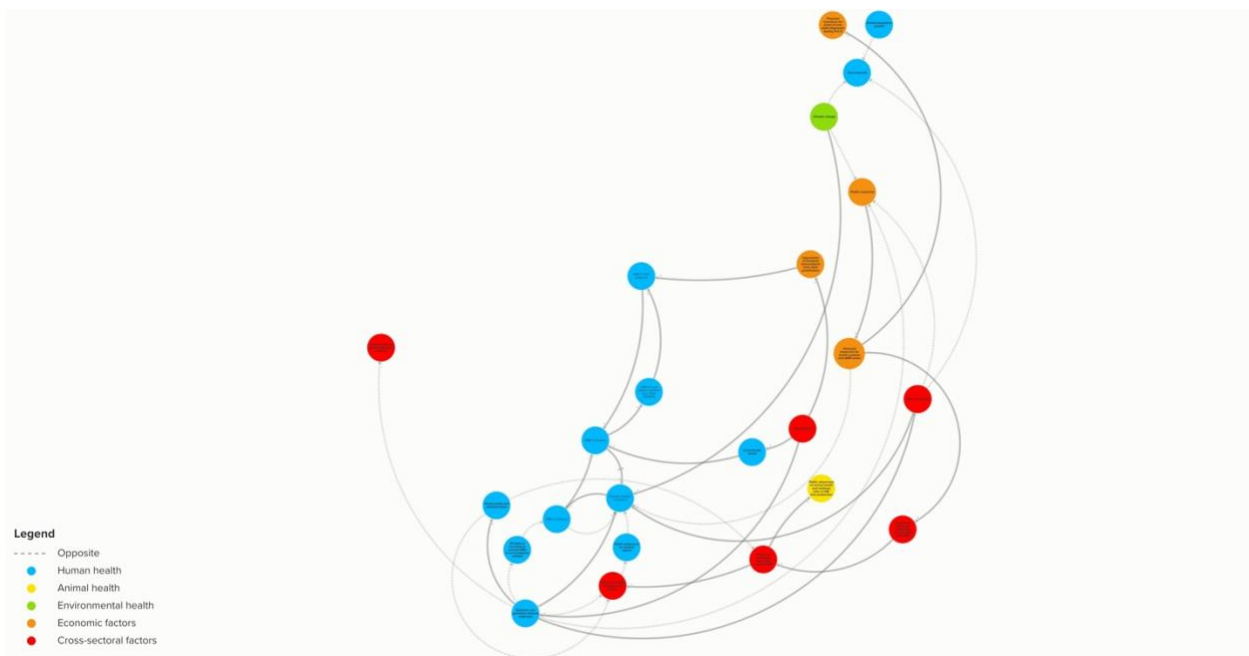
- Globalization has increased AMR in multiple sectors through increased importing of food products and livestock from other jurisdictions, cross-border travel, and spread of disease outbreaks

- Climate change, global conflicts, and epidemic/pandemic disease outbreaks can impact many aspects of this system

- The disruption caused by these crises will reduce public resources available to focus on AMR action such as classroom education initiatives

- Disease outbreaks may reduce public trust in scientific evidence, evidence-based policy decision-making, and normalize increased AMU in a crisis context

- Climate change may also cause an increased burden of disease in different populations, including food-producing animals, crops, and humans, which may impact farming profits, AMU, and food security

- Controlling the increase in AMU depends on adequate and well enforced regulation around AMU and disease prevention

- This will require education and awareness-raising across different sectors around the risks of AMR, while balancing communication strategies to minimize stakeholder fatigue and maximise public and political will to take action on AMR

- Stringency in food marketing regulations can reduce industry led food-product certifications and reduce use of unsupported evidence in food marketing, both of which can improve public and producer education on AMU

- Public and political will directly impacts the financial resources allocated towards actions on AMR

- These factors, combined with appropriate training across sectors, will improve the appropriateness of AMU among prescribers and producers

Legend
- - - - - Opposite
● Human health
● Animal health
● Environmental health
● Economic factors
● Cross-sectoral factors

- Mitigating the risk for AMR will depend on research and development for new antimicrobials, but also for alternative approaches to prevention and treatment (e.g., vaccines, phage therapy, gene editing) for both humans and agriculture use

- As financial incentives are limited for developing new antimicrobials, novel strategies focused on need/demand should be considered to encourage this work

- These efforts will depend on the availability of resources for efforts to combat AMR, which will be impacted by competing global and local crises

- The uptake of alternative approaches to prevention and treatment will depend on affordability for producers, as well as public trust in scientific evidence and advice

- Reduced financial incentives and new AM development coupled with increased financial barriers, regulations on "forever chemicals", and the complex Canadian regulatory environment limits the introduction of new AMs and maintenance of existing AMs in the Canadian market, which is essential for creating sustainable access to effective AMs

- The limited market size in Canada for antimicrobials reduces financial incentive for both AM research & development as well as the introduction of new AM into the Canadian market

- There is also a need for more financial resources and incentive to focus on research & development for point of care rapid diagnostic testing to improve AMU stewardship

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Priority actions to control the emergence and spread of AMR

Contributors identified priority actions to control the emergence and spread of AMR in the Canadian context (Table 1). Contributors individually reflected to identify priority actions over the short- (2 years), medium- (2-5 years) and long-term (5+ years).

Contributors then shared one of their priority actions with the group, discussing the ways in which this action had the potential to transform the system, as well as barriers to implementation.

Within the Canadian context, key challenges for implementation included the need for:

- Strong political will to make AMR action a priority;
- Public investment, for example to expand and strengthen Canada's AMR surveillance infrastructure, including through increased development and use of rapid diagnostics and capacity to assess antimicrobial use with more granularity;
- Coordinated action across provinces and territories, given Canada's governance structures; and
- Additional evidence around value-for-money of herd management strategies that might reduce the need for antimicrobial use.

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Table 1 Priority actions to control the emergence and spread of AMR in Canada

Short Term (2 years)	Medium Term (2-5 years)	Long Term (5+ years)
• Quantify sources of AMR in different parts of the food system	• Support for the translation of Canadian research innovation in AMR to industry in Canada	• Federal strategy implemented to increase Canada's access to new antimicrobials.
• Regularly publish usage patterns of AMU by the various segments of both human and animal-focused users	• Increasing health workforce (veterinary and human) through regulatory changes	• Rapid and verified diagnostic techniques that increase prudent antimicrobial use and valuable alternative practices.
• Improve environmental surveillance of AMR and antimicrobial residues	• Streamlining and harmonizing regulatory procedures with other regulatory agencies to enhance access to novel antimicrobials or alternatives to antimicrobials	• Research and development in diagnostic tools to lead to faster diagnostics for surveillance
• Changes in regulatory fees and regulatory burdens to introduce new products in the Canadian market	• Increased AMU and AMR surveillance across all sectors	• Development of rapid diagnostic tests human/animal health
• Implementation of management practices in human and animal health that reduce AMU without compromising health	• Creating market and incentives for the development and introduction of new antimicrobials and non-antimicrobial alternatives*	• Informed regulatory and policy development
• Science-based education on AMR at every level of schooling	• Mass media campaigns to undo misinformation and educate population on the use of antimicrobials, and on the food systems in Canada	• Investing into the education system to build understanding and public trust towards our food system and how AMR is part of it
• Enhance and further develop educational programs/access to information regarding AM and judicious use		• Broad education for different parties (public, producers, veterinarians, health care workers) on AMR and its impact with a focus on behavioural change.

*Action was proposed as both medium- and long-term solution

Reflections on the mapping process

During the workshop, contributors reflected on the mapping process and highlighted some challenges and limitations of the approach:

- Talking about AMR as an overarching category is challenging: how this is evolving over time is different for different resistance strains and different sectors.
- When articulating the problem, the group reached a consensus on a predicted trend for AMR in the Canadian context: if existing structures are maintained, the group predicted that the emergence and spread of AMR in the Canadian context would continue to increase. However, they reflected that the rate of this change is uncertain and variable across contexts, and that representing this scenario in a deterministic way may not be appropriate given the level of uncertainty around how the problem is likely to evolve.

Contributors also highlighted that, while the workshop was focused on the Canadian context, the problem of AMR varies by country context, both in terms of the size and nature of the problem and in capacity to tackle it.

Contributors also reflected on how the systems map developed in the workshop could be built on and improved. Some contributors highlighted considering these factors in a binary way (i.e., whether or not they mattered) conceals the fact that some factors are more important than others. It would therefore be helpful to build on this work by quantifying or ranking these relationships. This could be done through synthesis of existing data or additional data collection and would help to identify which areas are most important to act on.

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Conclusions and next steps

Contributors identified a range of factors and relationships across the human, animal and environmental sectors that impacted the emergence and spread of AMR in Canada and were likely to contribute to the predicted continued growth of AMR. The discussion of ongoing spread of resistant pathogens within and between different environments and populations highlighted the importance of cross-sectoral collaboration.

The importance of economic considerations was also highlighted, with the need for value-for-money being a key driver in food production. Similarities between issues in human and veterinary medicine were highlighted, including regulatory and financial barriers to introducing and maintaining antimicrobials on the Canadian market, as well as inequities in access to healthcare. Finally, contributors highlighted Canada's membership of a global community, with increasing globalisation and travel of goods, animals and people meaning that resistant pathogens emerging in one jurisdiction may present a risk to others.

Contributors identified a number of priority actions to control AMR in the Canadian context over the short-, medium- and long-term, and discussed challenges to implementation including the need for strong political will, public investment and certain evidence gaps around alternative strategies to reduce the need for antimicrobial use.

Designing AMR Solutions features five case study countries, including Canada. Parallel systems workshops are ongoing across the other country contexts in order to understand context-specific drivers and dynamics. Project outputs and activities will continue to be shared on our website:

https://design.dighr.org/

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