Building an Integrated National One Health Surveillance System for AMR and AMU in Canada

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Executive Summary

Antimicrobial resistance (AMR), when microbes stop responding to antimicrobial treatment, is one of the largest threats to public health today. Thorough AMR surveillance is critical to monitor the spread of AMR and inform evidence-based policy making to respond to this public health threat. Canada has established several databases to collect AMR surveillance data, including the Canadian Integrated Program for Antimicrobial Resistance Surveillance, the Canadian Antimicrobial Resistance Surveillance System, the Antimicrobial Resistance Network, and more. This data is spread across many levels of government and the agricultural, healthcare, and environmental sectors. In order to effectively respond to the threat of AMR it is essential Canada creates a single integrated AMR surveillance program.

We propose establishing a centralized, integrated AMR database, operated by PHAC, where data from across provincial, territorial, and federal jurisdictions and the agricultural, healthcare, and environmental sectors will be collected. This database will be implemented in 4 phases. First, the responsibilities of each stakeholder will be clearly set out to support a more structured system of AMR surveillance. Second, the AMR database will be created. Existing databases will be integrated into the new system. Thirdly, surveillance coverage in underrepresented jurisdictions and sectors will be expanded. Finally, annual AMR surveillance reports will be published to monitor the efficacy of the integrated database.

Key Recommendations

- Establish a centralized integrated AMR database operated by PHAC. This database will be implemented in 4 phases:
    - Phase 1: Implement guidelines for government and surveillance
    - Phase 2: Integrate surveillance data into a single location
    - Phase 3: Fill surveillance gaps
    - Phase 4: Release regular national AMR surveillance reports and evaluate success of policy
- Develop a website to promote the integrated AMR database to stakeholders and share clear and concise information across government levels, portfolios, and other associated groups

Introduction

Antimicrobial Resistance and the Post-Antibiotic Era

In 2014, World Health Organization (WHO) released its first report on global antimicrobial resistance (AMR), cautioning that the world was headed for a post-antibiotic era where minor injuries and infections would be fatal [1]. By 2019, WHO named AMR one of the top 10 threats to global health [2]. AMR occurs when microbes, such as bacteria and fungi, can no longer be treated with antimicrobial medicines [3]. Exposure to antimicrobials facilitates selection for microbes with genetic changes that allow them to be resistant to treatment, making infections increasingly difficult to treat and increasing the risk of infection, severe illness, and death [3]. The spread of antimicrobial resistance makes common minor infections deadlier and routine health-care procedures significantly riskier [3]. In addition, AMR increases the burden on health-care systems by prolonging illness, increasing hospitalization and treatment costs, and limiting the effectiveness of standard therapies. The 2019 report *When Antibiotics Fail* estimated that in 2018 alone, antimicrobial resistant organisms cost the Canadian health care system $1.4 billion CAD [4]. The economic burden and death toll will rise if AMR is left unaddressed, with a projected health care burden of $120 billion by 2050 in Canada [4]. AMR is not an issue limited to human health, however. Animals, agriculture, and the environment are all impacted by the spread of AMR, and as such, a One Health approach to this public health threat is required.

The spread of resistant organisms also threatens the agricultural sector. In 2019, a study by Van Boeckel et al. estimated that 73% of antibiotics used worldwide were used in agriculture [5]. In 2020, 82% of antimicrobials used in Canada were used in food-producing animals or horses [6]. Agricultural practices promoting improper use of antimicrobials, such as prophylactic antibiotic treatment, favours the spread of resistant bacteria, threatening both animal health and the safety of our food supply [7]. Resistant bacteria in animals can also be spread to humans through direct contact and the consumption of animal products [8]. In addition, antibiotics are often used on a large scale to prevent infections in crops [9]. This too can spread AMR directly from food crops to consumers. To combat the spread of AMR in agriculture, the government of Canada has worked with food producers, farmers, veterinarians, and other stakeholders to introduce regulations to improve responsible use of antibiotics in the agricultural sector [8].

AMR may come from environmental sources as well. Antimicrobials enter the environment via runoff, wastewater discharge, or improper disposal of antimicrobials, contaminating the surface water or soil [10, 11]. From these sources, resistant microbes have been able to spread to wildlife populations with no direct exposure to antimicrobials [10]. Monitoring the presence of antimicrobials, AMR, and antimicrobial resistance genes in wildlife and the environment reflect underlying environmental contamination, and will be an essential part of limiting the spread of AMR. Environmental surveillance is therefore important not only for identifying contamination, but also for understanding how resistance may move between human, animal, and ecological systems.

Monitoring the spread of antimicrobial resistant organisms and limiting antimicrobial use (AMU) is essential to slow the spread of resistant microbes and protect the health of Canadians. Integrated surveillance is also necessary to detect emerging resistance trends early, identify high-risk sectors and regions, and support evidence-based public health and agricultural policy decisions.

AMR and AMU Surveillance in Canada

At the federal level, Canada first began AMR and AMU data in 2002 with the creation of the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) [12]. This database focuses on combining clinical, veterinary, and agricultural AMR data from enteric pathogens, such as *Salmonella.* AMR data for CIPARS is collected from four sentinel farms, sites that act as indicators for the spread of AMR [12]. Data from AMU on crops is also collected by CIPARS. In 2015, another AMR database, the Canadian Antimicrobial Resistance Surveillance System (CARSS) was established [13]. CARSS is a database operated by the Public Health Agency of Canada (PHAC) that takes a One Health approach to AMR surveillance, collecting AMR data from a wide variety of sources, including CIPARS [13]. CARSS focuses on 4 main areas for surveillance: AMU in humans, AMU in animals, AMR in human healthcare and communities, and AMR in food production animals. Despite integrating human and animal AMR and AMU data, CARSS still lacks environmental AMR data.

One major challenge in AMR surveillance in Canada is sufficient coverage across all of the provinces and territories [14]. To address this issue, PHAC created the Antimicrobial Resistance Network (AMRNet), which aims to integrate human and veterinary AMR data across provincial and territorial jurisdictions [15]. Data is submitted to AMRnet by laboratories and clinics in participating provinces and territories [15]. Participating provinces are: BC, Alberta, Saskatchewan, Ontario, New Brunswick, Prince Edward Island, and Newfoundland & Labrador [13]. The Northwest Territories are currently the only participating territory. Individual provincial and territorial governments may also have their own AMR and AMU surveillance programs (Table 1). As a result, Canada's current surveillance landscape remains fragmented across sectors and jurisdictions, limiting the country's ability to generate a complete and timely One Health picture of AMR and AMU.

In recent years Canada has made significant progress in limiting AMU. In human healthcare there was a 25% decrease in AMU between 2017 and 2021 and in the agricultural sector there was a 7% reduction in antimicrobial sales within the same time period [22, 23]. However, AMR rates continue to rise and inappropriate use of antimicrobials continues to be a challenge. Vulnerable and remote communities most likely to be affected by the spread of AMR are underrepresented in existing AMR and AMU databases. Current surveillance data in Canada exists in multiple databases across disparate sectors and levels of government, and this lack of integrated data prevents policy makers from reliably assessing drivers of AMR or from assessing the success of any individual policy.

Table 1. AMR and AMU surveillance programs established by Canadian provincial and territorial governments

Province/Territory	Surveillance programs	Submit data to AMRNet (Y/N)
Alberta	No established provincial surveillance system, but participate in the Companion Animal Surveillance Initiative (CASI) [16]	Y
British Columbia	The Provincial Infection Control Network of British Columbia (PICNet) manages province-wide surveillance of major antibiotic resistant organisms [17]. Antimicrobial resistance & utilization dashboards are available on the BC Centre for Disease Control website. BC also participates in the Companion Animal Surveillance Initiative (CASI).	Y
Manitoba	No established provincial surveillance system, but participate in the Companion Animal Surveillance Initiative (CASI) [16]	N
New Brunswick	No established provincial surveillance system	Y
Newfoundland and Labrador	No established provincial surveillance system. The Provincial Infection Control Newfoundland and Labrador (PIC-NL) initiated surveillance of methicillin-resistant *Staphylococcus aureus* (MRSA) infections in 2009 [18].	Y
Nova Scotia	No established provincial surveillance system, antibiograms available	N
Ontario	AMR-AMS Data Tool [19]	Y
Prince Edward Island	No established provincial surveillance system, antibiograms available	Y
Quebec	AntibiotiQC [20, 21]	N
Saskatchewan	No established provincial surveillance system, but participate in the Companion Animal Surveillance Initiative (CASI) [16]	Y
Northwest Territories	No established territorial surveillance system	Y
Nunavut	No established territorial surveillance system, antibiograms are in development [22]	N
Yukon	No established territorial surveillance system	N

Currently Canada lacks a nationally integrated AMR surveillance system that incorporates data from the diverse government agencies that collect AMR surveillance data.To address this issue we propose establishing a national AMR centre, led by PHAC, responsible for integrating AMR data from across Canada. This centre will be implemented in four main phases:

- Phase 1: Implement guidelines for government and surveillance
- Phase 2: Integrate surveillance data into a single location
- Phase 3: Fill surveillance gaps
- Phase 4: Release regular national AMR surveillance reports and evaluate success of policy

Implementation Plan

Phase 1: Governance and standards

The 1st phase of the implementation plan is to set clear government responsibilities. AMU and AMR surveillance in Canada is already taking place at the federal, provincial and territorial levels. However, surveillance systems operate independently, resulting in scattered data and inconsistent methodologies. To support a more structured system, the following responsibilities are recommended:

- Federal government
    - Designate PHAC to lead and coordinate the surveillance system
    - Develop standardized methods for AMU and AMR surveillance
    - Establish common national data standards
    - Continue collecting AMR data in livestock, and retail meats, and AMU data in hospitals and livestock
    - Incorporate AMR data collection in wildlife, aquaculture, national parks, and indigenous communities, and AMU data collection in aquaculture
    - Oversee and manage a single shared national AMR and AMU database
- Provincial and territorial governments
    - Continue collecting AMU and AMR data in hospitals, community settings, and livestock
    - Incorporate AMR data collection in wildlife, companion animals, aquaculture, and provincial parks and AMU data collection in companion animals and aquaculture
- Municipal government
    - Communicate relevant findings to their communities through existing channels
    - Integrate AMR data collection in wastewater

AMU and AMR surveillance would be conducted within existing government-operated sectors and extended to regulated external organizations, such as veterinary clinics, through mandatory monthly AMU reporting and sentinel sampling. Each level of government would be responsible for AMR data collection through established public health laboratory networks or through funding outsourced testing. For example, the Canadian Wildlife Health Cooperative (CWHC), which currently monitors wildlife disease in Canada, could be

supported with dedicated funding to include AMR surveillance into its activities. The federal, provincial, territorial, and municipal governments would ensure the maintenance of standardized methods and data standards. The data would be uploaded directly to a national AMR and AMU database, with editing access for each government and publicly available outputs.

Phase 2: Data integration

Currently, AMR and AMU surveillance data in Canada is spread across many different databases from disparate sectors and government jurisdictions. The current AMRNet database has attempted to address this issue, combining clinical and veterinary data from 7 provinces and 2 territories [15]. However, AMRNet lacks agricultural and environmental data. CARSS also attempts to address this issue, but lacks environmental AMR data. We propose creating a single shared national AMR and AMU database integrating data across the agricultural, clinical, and environmental sectors from the federal government and each province and territory. This database will expand the scope of AMR surveillance and streamline data access into one place.

- Federal, provincial, territorial, and municipal governments will be required to upload their AMR and AMU data monthly.
    - The federal government will ensure all data is up to the standards of the database before it is uploaded.
- Incorporate existing databases into the new comprehensive database. Existing AMR surveillance databases will initially be linked to the new comprehensive database but will eventually be phased out.
    - Data in existing databases will be retroactively uploaded and incorporated into the new comprehensive AMR database. Once their data is fully integrated with the new AMR database, these older databases will be discontinued.
- Present AMR data in a comprehensive and clear way.
    - Data will be presented as a heat map to show the level of resistance.
    - Resistance levels will also be recorded as a sensitivity percentage, with 0% indicating the most resistant and 100% indicating the most sensitive.
    - Select characteristics of the patients/animals/environmental context the data was collected in will also be recorded.These characteristics include:
        - Unique patient identifier
        - Age group
        - Sex
        - Government region of collection
        - Date of isolation or collection

The federal, provincial, and territorial health ministries have existing Multi-Lateral Information Sharing Agreements (MLISAs) which ensure public health data is shared across all levels of government [24]. These agreements establish protocols for ethical, and timely

data exchange, and set out guidelines for data privacy, use and re-use, and disclosure. As part of the establishment of the new AMR database, existing MLISAs will be updated and expanded.

- Create guidelines for accessing the new database.
    - The new AMR database will be accessible by public health officials from each level of government, participating healthcare providers, veterinary clinics, agricultural providers, and other stakeholders. Participants will have a direct link to the AMR database.
    - This database will not be accessible by the general public.
- Establish new MLISAs for other ministries to set up protocols for sharing agricultural and environmental data between governments, using the pre-existing public health MLISAs as a model.
- Modernize and update existing MLISA agreements. Protocols for maintaining privacy and accessing the new AMR database will also be updated.

By the end of Phase 2, Canada will have a single integrated AMR and AMU database collecting data across health, agricultural, and environmental sectors and expanded agreements for sharing data between levels of government. This will provide a larger, more accurate picture of AMR and AMU in Canada that can be used to guide evidence-based policy development.

Phase 3: Fill surveillance gaps

Although Phase 1 and Phase 2 establish the governance structure and shared AMR/AMU database, important surveillance gaps will still remain across jurisdictions and sectors. Canada's Pan-Canadian Action Plan on Antimicrobial Resistance emphasizes the need for a coordinated One Health surveillance system, but current programs still do not provide complete national coverage. In particular, surveillance remains uneven across provinces and territories, and companion-animal and environmental data are still less integrated than human and agricultural data.

- Improve coverage in underrepresented jurisdictions and sectors.
    - Prioritize surveillance expansion in provinces, territories, and regions with limited current participation, especially rural, remote, and northern communities;
    - Where full participation is not yet feasible, use a sentinel-site approach so selected hospitals, laboratories, veterinary sites, and environmental monitoring sites can begin contributing standardized minimum datasets.
    - This phased approach will allow the national database to expand more quickly while still maintaining data quality and comparability across jurisdictions.
- Incorporate more companion-animal and environmental data where feasible.

    - Recruit large veterinary hospitals and veterinary diagnostic laboratories to contribute standardized AMR and AMU indicators for companion animals;
    - Begin environmental surveillance through wastewater and selected environmental sampling sites, consistent with PHAC's Environmental Surveillance Strategic Framework for AMR.
    - Where possible, collect contextual information about animal type, environmental source, and geographic location to improve interpretation of AMR patterns across sectors.
- Provide targeted federal support to reduce participation gaps.
    - Offer funding and technical assistance to jurisdictions and partners with limited infrastructure, staffing, or reporting capacity;
    - Support data extraction, standardization, and submission so that new contributors can be integrated into the national database more efficiently.
    - Provide training and implementation guidance to ensure that newer contributors can meet national data standards and reporting requirements.

By the end of Phase 3, Canada should have broader participation across provinces and territories, initial integration of companion-animal and environmental surveillance, and improved inclusion of underrepresented communities and sectors. This phase will help ensure that the national AMR/AMU system is more representative, equitable, and useful for Phase 4 reporting and evaluation.

Phase 4: Reporting and evaluation

Once the integrated surveillance system is established and major coverage gaps have been addressed, the final phase should focus on reporting, performance monitoring, and long-term evaluation. This phase is intended to ensure that the national AMR/AMU surveillance system remains transparent, policy-relevant, and adaptable over time. Regular reporting and evaluation will also help identify persistent gaps, improve data quality, and determine whether stronger institutional arrangements are needed in the future.

- Publish integrated national reports;
    - Host an annual conference for stakeholders to go over the reports from that year.
    - Release one national One Health AMR/AMU surveillance report monthly.
    - Combine data from human health, animal health, agriculture, food production, and environmental sectors.
    - Summarize national and provincial/territorial trends in AMR and AMU.
    - Identify emerging resistance threats, high-risk sectors, and important surveillance gaps.

    - Provide both a technical report for policymakers and experts, and a simplified public summary for the general public.
    - Make the report available through a public government website to improve transparency and public trust.
- Monitor data quality, participation, and policy relevance;
    - Track whether submitted data are complete, timely, consistent, and comparable across provinces and sectors.
    - Monitor whether all provinces, territories, and partner agencies are regularly contributing data.
    - Assess whether underrepresented areas, such as northern communities, rural regions, environmental sites, and animal sectors, are included.
    - Review whether the data are useful for antimicrobial stewardship, outbreak response, food safety policy, and public health planning.
    - Use clear indicators, such as reporting frequency, missing data rate, sectoral coverage, and response time to emerging threats.
    - Provide feedback to data-contributing partners to improve reporting quality over time.
- Evaluate whether deeper reform is needed later.
    - Conduct annual internal reviews and a larger external evaluation every 3–5 years.
    - Assess whether the current PHAC-led coordination model is effective.
    - Identify barriers such as inconsistent data sharing, limited provincial participation, privacy concerns, or lack of environmental and agricultural data.
    - Decide whether stronger federal-provincial-territorial agreements are needed.
    - Consider whether Canada needs a more formal centralized AMR surveillance authority in the future.
    - Use evaluation results to update governance, data standards, funding priorities, and reporting requirements.

Governance, Accountability, Ethics, and Data Privacy

To ensure the successful implementation of a national integrated AMR/AMU surveillance system, clear governance and accountability structures will be required. We recommend that PHAC, or a PHAC-led interagency coordinating body, serve as the federal lead responsible for setting national standards, coordinating participating agencies, and overseeing reporting quality. Formal data-sharing agreements, should define the roles of federal, provincial, and territorial governments, as well as veterinary and environmental partners, to support timely and consistent data exchange. This governance structure should also establish clear accountability for data reporting, privacy protection, and quality assurance. In addition, protocols for confidentiality, data ownership, and access should be developed so that surveillance data can be shared and used responsibly while maintaining public trust.

Communication Strategy

The communication strategy for our policy will focus on developing a Government of Canada website with an interactive AMR and AMU surveillance dashboard. Our website will promote the new integrated database and share AMR information with stakeholders, such as provinces, territories, municipalities, veterinarians, healthcare providers, and agricultural producers. Since antimicrobial resistance surveillance is highly data-driven and involves multiple sectors, a website and dashboard format will provide a clear, centralized, and accessible way to communicate surveillance findings to key stakeholders.

Currently, information about AMR, AMU, surveillance, and surveillance policies is spread across several websites and databases. This can be confusing, and may deter stakeholders from sharing data and using the existing surveillance databases. Information about AMR, AMU, and surveillance trends will be integrated into a single website. The website will be available in both French and English. Simplified visualizations of AMR and AMU trends across human, animal, and environmental sectors in Canada will be presented, helping users better understand the spread and impact of antimicrobial resistance and the importance of integrated national surveillance. The focus of this website will be to promote the new AMR surveillance policy. While the website would be publicly available, the AMR surveillance database would remain separate and access to the integrated database would be limited to contributing stakeholders.

One of the main goals of the communication strategy is to promote the AMR surveillance policy and support for the proposed surveillance system. A government-operated platform will help increase willingness among provinces, healthcare organizations, laboratories, agricultural producers, and other stakeholders to participate in data sharing initiatives. Using an official Government of Canada website may also help improve the credibility and trustworthiness of the information presented, especially since surveillance and data sharing initiatives may raise concerns related to privacy and government oversight. Since Canada already uses public government websites to communicate national health information and surveillance updates, a similar approach for AMR and AMU reporting would likely be familiar and accessible to the public.

The website would communicate the importance of AMR surveillance as a cost-effective public health investment that supports early detection of emerging resistance trends, helping to prevent larger outbreaks and increased healthcare costs in the future. This is particularly important because surveillance systems are often viewed as an additional financial burden. The communication strategy would therefore emphasize prevention rather than response, highlighting that controlling antimicrobial resistance early is significantly more effective and less costly than managing widespread outbreaks once resistance becomes established. The website could also include simplified explanations and examples showing how AMR increases healthcare costs, prolongs illness, and reduces treatment options for Canadians.

Privacy and data sharing are major concerns associated with surveillance systems. To address these concerns, the website would clearly explain how data is collected, stored, and shared.

Any publicly available information would remain anonymized and aggregated, and no personal identifying information would be accessible to the public.. This would help address concerns regarding the balance between public health surveillance and individual privacy. The website could also include short explanations of existing data-sharing agreements, such as the MLISAs and oversight measures to improve transparency and public confidence in the surveillance system.

The communication strategy would also emphasize that the proposed national AMR and AMU system builds upon and integrates existing programs already established in Canada, such as CARSS, CIPARS, and AMRNet. Positioning the policy as an expansion and integration of current surveillance efforts may improve political and public feasibility by reinforcing that the proposal is practical, collaborative, and cost-effective. The website will additionally include educational sections explaining antimicrobial resistance, antimicrobial use, the One Health approach, and the role of environmental surveillance in limiting the spread of resistant organisms.

The website and dashboard will also support transparency and long-term stakeholder engagement by providing regular updates and summaries of national AMR and AMU surveillance reports. AMR and AMU surveillance trends will be updated monthly, after the monthly reports become available. These updates will include national resistance trends, high-risk sectors, emerging resistance threats, and gaps in surveillance coverage. Simplified summaries will help make technical surveillance findings easier to understand for non-scientific audiences while still allowing researchers, healthcare professionals, and policymakers to access more detailed surveillance information when necessary.

Overall, we propose communicating this policy via a centralized website promoting the new integrated AMR database. This website will support greater awareness, trust, and stakeholder participation in the database, while helping justify the importance of integrated One Health AMR surveillance in Canada.

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