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Indigenizing AMR Governance: towards a more equitable Canadian AMR response

FINAL REPORT

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Executive summary

There is growing attention to the global challenge of antimicrobial resistance (AMR), and an emerging AMR governance response. In Canada, the AMR response is being developed in the context of enduring Indigenous health inequities. These inequities means that drug-resistant diseases are likely to have a distinct and more severe impact on Indigenous people. This impact may also be different across First Nations, Métis and Inuit communities.

Indigenous peoples and organizations have not yet been extensively consulted to determine the extent to which AMR is considered a significant health concern in Indigenous communities, or how or if Indigenous organizations want to be involved in the groups and networks that are forming to address AMR. This means there is a risk that the emerging AMR response may not centre Indigenous needs, priorities and perspectives on health & wellness. Therefore, this project consulted with some national and regional Indigenous (First Nations and Métis) representational organizations in Canada, and a small number of health care providers who work in and with Indigenous communities, to learn about their perspectives on AMR and Canadian AMR governance. **We asked about:**

- the extent to which Indigenous representational organizations see AMR as a health challenge in their communities
- availability of AMR information, and of antimicrobials, in different Indigenous communities and healthcare contexts
- sources of strength and resilience upon which an AMR response could build
- gaps and vulnerabilities in how AMR is currently being addressed in Indigenous communities
- what actions, or involvement in AMR governance responses, would Indigenous representational organizations like to see to ensure an ethical, effective AMR response.

Some important messages we heard:

- For First Nations, Métis and Inuit communities, AMR is one of many health concerns, with mental health, housing, substance use and disasters (fire, flooding) often being more urgent priorities. This points to the importance of recognizing AMR in the larger context of Indigenous wellness and the structural drivers of Indigenous health inequities.
- MRSA and urinary tract infections were identified as drug-resistant infections of particular concern. Participants connected the prevalence of these infections to a lack of access to plentiful, clean water in many communities.
- There is limited surveillance and data on AMR prevalence and impact in Inuit, Métis, and First Nations communities. There are limited or no Nation-specific AMR education or information materials.
- Nation-Crown relations shape access to antimicrobials. All participants said that access to medications and health care is challenging, but the nature of those challenges, and the reason for those challenges, is different for First Nations and the Métis Nation. Challenges in accessing antimicrobials also vary by region. This indicates the importance of a distinctions-based and Nation-specific approach.
- While participants acknowledged that there is the possibility of antibiotic overuse or mis-use, lack of access to medications and health services are a greater concern.

- Participants said that when people share or conserve antibiotics, it is often in the context of caring for other community or family members who cannot afford medications or cannot access health services.
- Strengths identified by participants as starting points for a culturally competent and strengths-based response to AMR include community and culture; the extent of community care for family, especially Elders and children; and a holistic understanding of health and wellness.
- Barriers and challenges vary by Nation, but often include jurisdictional complexity; limited funding and resources; limited access to local, on-site samples testing; inadequate data and surveillance; and the larger context of water, food and housing insecurity. Barriers originate in settler colonialism, structural determinants of health, and ongoing direct and systemic racism.

Based on what we heard, **some preliminary recommendations include:**

- A respectful, ethical response to AMR requires a strengths-based, Nation-specific rather than pan-Indigenous approach, and must be First Nations, Métis & Inuit owned & led. There needs to be time taken to build relations.
- To strengthen the knowledge base, more information needs to be collected about AMR. But data collection and research about AMR needs to centre Indigenous ways of knowing, including traditional knowledge and medicines, and must ensure this knowledge is protected. Surveillance data needs to be owned by Inuit, First Nations and Métis organizations and communities so that data can be effectively shared and used at the community level.
- Strengthening and decentralizing diagnostic and treatment capacity could improve rapid access to diagnostics and the medications needed to treat resistant infections. This might include creating more regional hubs for testing and medication distribution; placing more PCR machines and rapid point of care test in Métis, First Nations and Inuit communities; or using new transportation technologies like drones to distribute medication.
- All of these recommendations require extended, meaningful capacity-building, including funding, for Indigenous representational organizations and communities.
- An effective, ethical response to AMR must be holistic: it needs to occur in tandem with addressing other structural drivers of Indigenous health.

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List of acronyms

AMR: antimicrobial resistance

AMU: antimicrobial use

ARO: antimicrobial resistant organism

CPG: clinical practice guidelines

ESBL: extended spectrum beta-lactamases

IPC: infection prevention and control

MRSA: Methicillin-resistant Staphylococcus aureus

NIHB: Non-Insured Health Benefits

NITHA: Northern Inter-Tribal Health Authority

NML: National Microbiology Laboratory

OCAP ©: Ownership, Control, Access, and Possession

PCR: Polymerase Chain Reaction

PHAC: Public Health Agency of Canada

STBBI: Sexually transmitted and blood-borne infection

UNDRIP: United Nations Declaration on the Rights of Indigenous Peoples

UTI: Urinary tract infection

WASH: Water, Sanitation and Hygiene

WHO: World Health Organization

Introduction: about AMR, about this project

The growing problem of AMR

Antimicrobial resistance (AMR) occurs when bacteria, fungi, viruses, and other microorganisms (e.g. parasites) change over time and are less responsive to existing medicines including antibiotics and antifungals. This makes infections harder to prevent and treat, increasing risk of illness and death.

AMR has been recognized as a growing health threat, globally and within Canada. The World Health Organization (WHO) describes AMR as “a crisis that must be managed with the utmost urgency”, warning that “without harmonized and immediate action on a global scale, the world is heading towards a post-antibiotic era in which common infections could once again kill” (WHO, 2015). In 2019, an estimated 4.95 million deaths globally were associated with bacterial AMR, including an estimated 1.27 million deaths directly attributable to AMR (Antimicrobial Resistance Collaborators, 2021).

In Canada, a report by the Council of Canadian Academies found that “resistant bacterial infections were responsible for the deaths of over 14,000 people in Canada in 2018… of these deaths, 5,400 (or almost 15 a day) could be considered directly attributable to AMR itself.” It further warned that “by 2050, if resistance to all first-line antimicrobials reaches 40%, a scenario [deemed] highly plausible, 13,700 people in Canada would die each year from resistant bacterial infections, and cumulatively Canada’s population decline would reach almost 400,000 by 2050” (Council of Canadian Academies, 2019, p. xvi).

The Public Health Agency of Canada (PHAC) has identified ten priority infection-causing microorganisms in which AMR has been detected in Canada. Most of these are also organisms that the WHO has identified as priorities. These priority organisms include the bacteria that causes tuberculosis, and several bacteria that cause skin/soft tissue infections and urinary tract infections (UTIs).[1]

The structural and political drivers of AMR

Although microorganisms naturally evolve over time to develop resistance to antimicrobials, AMR is also caused in part by over-use and mis-use of antimicrobials in humans, farmed animals and food crops. In this sense, the ultimate drivers of AMR are human behaviours, and result from the ways that human societies are structured and governed. Resistant infections, and transmission of these infections, occur in global, national and local socio-political contexts. These contexts are characterized by racial, gender and other systemic inequities. For example:

- Transmission of air-borne infectious diseases such as tuberculosis occurs more readily in built environments where there is overcrowding, poor ventilation and air quality. These environments include prisons, shelters for street-involved and underhoused people, housing in

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[1] The PHAC priority organisms are: extended-spectrum betalactamase (ESBL)-producing organisms, Carbapenem-resistant organisms, *Enterococcus* spp., *Streptococcus pyogenes* (all of which can cause, among other health issues, UTIs and/or skin/soft tissue infections); *Streptococcus pneumoniae; Mycobacterium tuberculosis*; *Neisseria gonorrhoeae; Salmonella spp.; Campylobacter spp.; C. difficile* (Council of Canadian Academies, 2019, p. 27).

First Nations and northern Inuit communities, and the social housing found in many lower-income neighbourhoods. This overcrowded and poor-quality housing with mold and excessive humidity is also associated with higher incidence of skin and soft tissue infections, including MRSA.

- Skin and soft tissue infections, including MRSA, are also more readily acquired and transmitted in environments where there is limited access to clean water for washing and wound care, including wounds resulting from diabetes-related lesions or abscesses from drug injection. These environments include the many Indigenous communities relying on trucked water or under boil water advisories. Many street-involved and homeless populations also have limited access to clean water.
- STBBIs, including HIV and gonorrhea, are more readily transmitted in environments where access to safer sex or harm reduction materials is limited or criminalized, and in social environments where power differentials make negotiating safer sex difficult or impossible. These environments can include prisons and other carceral environments, and spaces where sex workers and people who inject drugs are policed and/or criminalized.
- Communities in which antimicrobials are scarce, costly or difficult to access can create environments in which people with limited resources may be more likely to save antibiotics for future use, because they do not know if these medications will be available, or affordable, when next needed. These environments include places where there is widespread poverty and/or inadequate health services.

Indigenous peoples are over-represented in many of these structural, socio-political and built environments. Indigenous women, Two-Spirit and LGBTQIA+ peoples also face gender-specific oppression in all of these environments.

In sum, the drivers of AMR, particularly but not exclusively in populations that have experienced and continue to experience colonization, are profoundly structural, social, political and intersectional. These drivers are not merely the result of ‘natural’ evolutionary processes of microbial resistance, but of the political choices that result in inequitable distribution of resources, the marginalization of Indigenous peoples in settler- colonial states, and the institutionalization of these political choices in systems, structures, and organizations.

Therefore, we emphasize that in addition to biomedical, surveillance and other data, evidence from social sciences perspectives is also needed to support an effective and comprehensive AMR response.

About Indigenous peoples and AMR

There is very limited surveillance data and research focusing on Indigenous peoples and AMR. With respect to surveillance, in Canada the Canadian Antimicrobial Resistance Surveillance System (CARSS) is a national surveillance system that tracks antimicrobial-resistant infections and antimicrobial use in humans, farmed animals and food sources, but does not systematically track or report on AMR and AMU in Indigenous populations. The 2020 CARSS update found that “only minimal information is available on AMR and AMU in Indigenous populations and data on underlying socioeconomic factors associated with infections caused by AROs are not readily available” (Shurgold et al., 2020, p. 15).

While the disproportionate impact of antimicrobial-resistant infections on people in colonized spaces has already been documented in the case of drug-resistant TB among those living in poverty in the Global South (Farmer, 2001, 2003), there has been very little research conducted on the incidence and prevalence of antimicrobial-resistant infections among Indigenous peoples in Canada, a research gap that is due in part to the limited availability of surveillance systems and data. However, a chart review of antibiotic prescriptions in twelve First Nation communities across five provinces in Canada found that, among the population of patients seeking treatment for skin and soft tissue infections, over 40% of cases were attributable to community-acquired MRSA. The same review found that the majority of cases did not undergo diagnostic testing, and that in 25% of cases where MRSA was present, patients received inappropriate prescriptions resulting in ineffective treatment (Jeong, Nguyen, Tyndall, & Schreiber, 2020).

More generally, it is well-established that Indigenous peoples experience disproportionately poorer health outcomes relative to Canadians of settler descent, including higher prevalence and incidence rates of infectious diseases in which AMR has been observed (e.g., TB, HIV, MRSA). Indigenous peoples also experience greater barriers in accessing health care. Poorer health outcomes and barriers to accessing care are the consequence of structural determinants of health (Reading, 2018), which remain constant regardless of which specific disease or health issue we are considering. AMR, like every other health challenge that emerges in the overarching context of ongoing coloniality and other structural drivers of health and disease, is expected to have a specific and inequitable impact on Indigenous peoples.

Because of these inequities, when Indigenous peoples are discussed in health literature, it is often with a focus on their status as a “high risk population” (e.g. Amartunga, 2016). While not entirely incorrect, this threat/vulnerability approach to Indigenous health is incomplete. There is a growing literature calling for strengths-based approaches to Indigenous health, wellness and resilience, grounded in Indigenous knowledge and worldviews (Battiste & Youngblood Henderson, 2000; Gabel, Jackson, & Ryan, 2018; Simpson, 2004; Smith, 1999) and focused on sources of strength, resilience and capacity in Indigenous communities (Alfred, 1999, 2005; Simpson, 2008) rather than on gaps and deficiencies. These approaches have not yet been applied to the emerging domestic or international AMR response, and are the starting point for this project.

About the current AMR response

AMR is receiving increased attention at both the national and global level. This has led to the development of new global governance arrangements to support more coordinated, multisectoral responses within and across countries. At the global level, WHO describes AMR as a serious threat to global public health, warning that “harmonized and immediate action on a global scale” is urgently required (WHO, 2015a). In response to the call for harmonized action, WHO and other international organizations have developed a Global Action Plan on Antimicrobial Resistance, along with guidance documents to inform national action plans (WHO, 2015b; WHO, FAO, & OIE, 2016). In Canada, national-level actions to address AMR have included the development of a Federal Action Plan (Public Health Agency of Canada (PHAC), 2014, 2015), a Pan-Canadian Framework for Action (Public Health Agency of Canada (PHAC), 2017), and a Pan-Canadian Action Plan (PHAC 2023).

The global and Canadian federal AMR responses are organized into activities that reflect specific categories of scientific and biomedical expertise. The Global Action Plan objectives are: (1) improved AMR education and training; (2) strengthened surveillance and research; (3) improved sanitation, hygiene and infection prevention controls (IPC); (4) antimicrobial stewardship to regulate antibiotic use and access; and (5) increased investment in new research and development. The Pan-Canadian Action Plan similarly identifies five core components of the federal AMR response: (1) research and innovation; (2) surveillance; (3) stewardship; and (4) infection prevention and control and (5) leadership.

As we describe in the Results section, these activity areas may not fully address the larger structural and social drivers of Indigenous health that impact AMR and AMU in Indigenous populations.

About this project

This project, "*Indigenizing AMR Governance*," was funded by the Canadian Institutes of Health Research (CIHR) through a Catalyst Grant for the Global Governance of AMR and Related Infectious Disease Threats. Our goal was to learn more about the perspectives of Indigenous representational organizations on AMR; the extent to which these organizations see AMR as a health challenge; the challenges associated with AMR in Indigenous communities; the ways AMR is currently being addressed in Indigenous communities; sources of strength and resilience; and the ways Indigenous organizations have, and would like to be, involved in Canadian and international efforts to address AMR. Through this work, we wanted to support and contribute to Indigenous-led recommendations for future engagement, research and action to ensure that the AMR response is equitable and effective by meaningfully including First Nations, Métis and Inuit peoples. This report summarizes the work that we did, what we heard and learned from the research participants we spoke to, and the recommendations that emerged from these conversations.

Objectives: what we did we want to learn?

The objectives of this project were:

1. To improve our knowledge and understanding of Indigenous perspectives on AMR and its governance.
2. To identify existing knowledge about Indigenous peoples and AMR in Canada, including barriers, challenges, sources of strength, and existing sources of information/data about AMR in Indigenous communities.
3. To support the development of Indigenous-led recommendations for the equitable, effective and meaningful inclusion of Indigenous peoples in the Canadian AMR response.

To meet these objectives, the project sought to answer the following questions:

1. How do Indigenous populations, as represented by Indigenous organizations in Canada, themselves understand AMR and the emerging Canadian and international governance response? To what extent do organizations advocating for, promoting, or representing representing Indigenous peoples' interests consider AMR an important health challenge in Indigenous communities? What are the barriers/challenges in addressing AMR, and what sources of strength/capacity might be mobilized in response? How have Indigenous

representational organizations been consulted, and how would they prefer to be meaningfully included in emerging AMR governance structures?
2. What is known about Indigenous peoples and AMR in Canada at present? What can available data or information tell us about risks, vulnerabilities, gaps and opportunities?
3. On the basis of this research, what preliminary recommendations can be made to support future engagement between Indigenous organizations, Indigenous communities, and actors in the AMR response?

Scope and limitations

This project was designed as a short one-year preliminary assessment, similar to an environmental scan, to learn about Indigenous perspectives, priorities and preferences regarding AMR governance. Like most Tri-Council research projects funded between 2018-2022, the project received extensions due to COVID--related challenges. From winter 2020 onwards, the pandemic impacted the research team by affecting some members' workloads and care responsibilities. It prevented members from travelling to conduct interviews, and from holding an in-person sharing circle at the end of the project. Additionally, COVID-19 created an increased burden for Indigenous representational organizations, especially their staff holding health portfolios, as their scope of work expanded to include preventing and responding to COVID-19 in the communities they represent.

It is also likely that the larger context within which this research was conducted affected the ability and willingness of some potential interviewees to participate in this project. This context includes the multiple forms of historical and ongoing violence against Indigenous peoples that Indigenous representational organizations continue to address as part of their core mandates:

- First Nations across the country continue to grapple with the ongoing trauma and need for healing resulting from the 2021 (re)discoveries of unmarked graves at former residential school sites, discoveries that affirmed what survivors of the residential school system have been saying for years.
- Women and girls in First Nations, Métis and Inuit communities continue to experience ongoing structural and direct violence. The June 2019 release of the final report of the National Inquiry into Missing and Murdered Indigenous Women and Girls (MMIWG) found that "violence experienced by Indigenous women, girls, and 2SLGBTQQIA people amounts to genocide."
- In many regions of Canada, the climate crisis has resulted in more severe flooding, fires and other disasters that require community evacuations and displacement of many First Nation and Métis communities. These evacuations and displacements, and the resulting longer-term impacts on community members' physical and mental health, also add to the burden of work for Indigenous organizations.

The ongoing and historical violence perpetuated by the Canadian settler colonial state has a compounding impact on Indigenous peoples, and on the representational organizations that serve them. All of the people we interviewed who work in Indigenous representational organizations indicated that their staff and organizations have been overstretched, facing multiple competing priorities with too few resources. While not unique to this project, it is important to acknowledge the multiple ongoing harms caused by settler colonialism that shape research with and about Indigenous peoples, organizations and communities.

Due to the anticipated project time frame, scope, and use of qualitative methods, the project was not designed to be a comprehensive survey of all Indigenous organizations. Neither was it a community-based project working directly with Indigenous community members. The project team believed it would not be possible, within the one-year time frame of this initial scoping project, to engage in the longer-term and meaningful relationship building process required to support ethical community-based research directly with Indigenous communities. Therefore, instead we spoke with people working in Indigenous representational organizations holding a national or regional mandate to represent and advocate for their member Nations, communities and individuals. We also spoke with a small number of researchers and medical professionals who have extensive direct experience working with and/or providing health services to Indigenous communities.

Additionally, while it is increasingly recognized that the response to AMR must be grounded in a One Health approach that treats human, animal, environmental and planetary health as inter-related, this project focused exclusively on human health. Future research should consider how Indigenous peoples may be uniquely impacted by the presence of resistant organisms in farmed and wild animals, waterways, plants, and soils, as well as their unique perspectives of interconnectedness with and stewardship of the natural world. This is particularly important in light of what participants in this project told us about the importance of connection with the land, land-based ceremonies, hunting and harvesting practices as sources of strength for Indigenous communities.

Given the small scale of this project, the results and recommendations that we present must be interpreted cautiously. They are not a comprehensive assessment of the perspectives of all First Nation, Métis and Inuit organizations, nations, or communities. We hope that the results in this report will be the beginning of a longer and deeper conversation with Métis, Inuit and First Nations peoples, organizations and communities about AMR within the context of the structural determinants of Indigenous health.

Methods

This was a qualitative research project that focused on understanding the perspectives, experiences and narratives of the research participants.

The project received ethics review and approval from the University of New Brunswick and the University of Saskatchewan research ethics boards.

Potential interviewees were identified in three ways. Some were identified through the existing professional networks of our research team members. Others were identified by reviewing the websites of national and regional Métis, First Nations and Inuit representational organizations to determine the staff members holding health portfolio responsibilities in those organizations. We also invited all interviewees to suggest other people to whom we should speak.

Through this process, 26 potential participants were contacted by email with information about the project and an invitation to participate. 13 people were not interviewed, either because they did not respond to the initial email invitation or follow-up calls, or because they indicated that they or their organization, did not work on AMR or that AMR was not currently a health priority for their organization. Notably, Inuit Tapiriit Kanatami (ITK), the national representational organization for Inuit, indicated that they focus on Inuit priorities set by Inuit themselves, and AMR is not one of those priority areas. An ITK representative recommended that we contact the regional land claim organizations and the Medical Officer of Health (MOH) in each region. We conducted one interview with a medical professional who works in the North, but out of respect for the fact that at the time of this project, AMR was not an identified priority for the regional Inuit land claims organizations (and especially with the onset of COVID) we did not continue to seek out Inuit organization or Northern MOH interviewees. For future research, the Inuit Qaujisarnirmut Pilirijjutit, which supports research by and for Inuit, would be better-placed to support culturally appropriate and Inuit-led research about AMR and its impact on Inuit in Inuit Nunangat and in southern Canada.

Ultimately, 13 interviews were conducted. 8 interviews were with people holding health portfolios in Métis and First Nations organizations, with greater representation from Métis than First Nation organizations. Both national-level and regional Indigenous representational organizations are represented. We also conducted 5 interviews with medical professionals and/or researchers, all of whom have extensive (from 10 to 20+ years) experience working in and with First Nations, Inuit and/or Métis communities in northern regions (including the northern regions of provinces and the Territorial North). Due to the small number of participants, to preserve confidentiality we have not reported participants' specific geographic location, nor whether those working for Indigenous organizations are affiliated with a regional or national organization.

Interviews were conducted by two research assistants and one principal investigator (PI). A consent form was sent to participants prior to the interview, and the consent form was reviewed at the beginning of the interview. Each interview lasted approximately one hour. All participants were asked a similar set of open-ended questions, with follow-up questions for clarification or further detail.

Initially we planned to host an in-person sharing circle to share preliminary findings with participants, ensure that we had accurately interpreted what they told us, collectively identify themes and recommendations, and seek their guidance on the use, reporting and next steps that should follow from these results. Due to COVID-19, this was not possible. Instead, we sent participants a brief written summary of findings, and invited them to share feedback in writing or in a videoconference meeting with a project team member. This resulted in 3 follow up interviews in which participants shared comments and feedback on the summary of project results. All participants agreed with the summary of results, and no one stated that they thought the findings were wrong, inappropriate, or that anything needed to be corrected or removed. All participants shared additional recommendations that they thought were missing or not sufficiently emphasized. The results and recommendations presented in this report were modified based on the guidance from these interviewees.

All participants spoke to us in their capacity as individuals with extensive experience and expertise in Indigenous health. This means that interviewees working in Indigenous representational organizations were *not* speaking to us on behalf of their organization, and the views that they shared with us are *not* the official position of their organizations or of the Indigenous Nations, peoples and communities their organizations work with and represent.

All interviews were audio recorded and then transcribed. Transcripts were then ‘cleaned’ (compared against the audio files for accuracy; noting aspects of conversation that would not be evident in text, such as laughter, pauses, or tone (e.g., humour or irony); anonymized through removal of participant names and other potentially identifying information). Transcripts were analysed using NVivo, a qualitative coding and data analysis software, to identify key themes emerging across interviews, as well as points of difference or disagreement across interviews.

Analysis of the interview transcripts involved an iterative (back-and-forth) process of reading transcripts, noting initial themes and observations, discussing these with the team members involved in conducting and analysing interviews, and then revisiting and revising themes and observations as more interviews were conducted.

We conducted both manifest and latent content analysis. The first step in the content analysis was manifest analysis, which involved creating categories, or nodes, in NVivo to classify interview statements with similar meanings into categories (Hsieh & Shannon, 2005). This helped to identify patterns, variation, and common themes between and within the interviews. In manifest analysis, categories (nodes) often come from what is said directly (Hsieh & Shannon, 2005), but can also come from observations of underlying themes. For example, a statement about poor housing conditions can be coded under “poor housing conditions” or a broader category such as “poverty” or “inadequate infrastructure.” Often, a statement can be coded into more than one node. Statements were coded into as many nodes as seemed to apply. As more interviews were conducted, more nodes were added for manifest content analysis; as patterns emerged and more nodes were created, the manifest content analysis of previous interviews was reassessed as needed.

The second step in the analysis process was latent content analysis. Latent content analysis focuses less on the specific words being said, and more on interpreting the implicit meaning and significance of statements, silences, and the ways in which ideas are expressed. It takes into account both the content and contextual meaning of what is said (Hsieh & Shannon, 2005). In this project, relevant context included the historical and current political climate surrounding Indigenous health, the politics of settler colonialism, Indigenous resistance and resurgence, and the Canadian response to AMR, as well as other academic literature about AMR and Indigenous health. We drew on this knowledge to interpret what was being said, as well as what was not being said. For example, “poor housing conditions,” “poverty” and “inadequate infrastructure” can all be understood as “deficit-focused analysis”, even if participants do not use that term, because they draw attention to what is missing or lacking in communities. In the context of Indigenous peoples in Canada, and the conversations that we had with participants, these terms can also be understood as “structural determinants of health” and “consequences of settler colonialism,” and even if this is left implicit in interviews rather than being directly stated.

To develop the latent content analysis, the research assistant leading the interview analysis read all transcripts several times, and wrote memos in NVivo to describe observations and to connect statements made by interviewees to the broader context of Indigenous health, settler colonialism and the AMR response, and the academic literature about these topics. These observations were discussed and refined in meetings with the research team members involved in conducting and analysing the interviews. As more interviews were conducted, overarching themes emerged. For example, a primary overarching theme that emerged from latent content analysis of interviews was the ongoing impact of colonization and settler colonialism on Indigenous communities.

Together, the manifest and latent content analysis helped us identify key themes relating to AMR knowledge, resources, capacities, strengths, and barriers to addressing AMR. It also helped us identify the important differences and variation across regions, and across Métis, First Nations and Inuit communities and peoples. This analysis shaped the results and recommendations that we present in the following pages.

Results: what we heard, what we learned

This section presents the results of our interviews with people working in Indigenous representational organizations, and with researchers and clinicians working in/with Indigenous communities as health care providers.

It is organized into four subsections:

(1) *'The current landscape'* discusses interview participants' perspectives on the extent to which AMR, relative to other health issues, is a concern; the current level of access to information about AMR, and to antibiotics; and current engagement of Indigenous representational organizations in the federal AMR response.

(2) *'Sources of strength'* discusses participants' perspectives on the strengths of and within Indigenous communities that could support an effective AMR response.

(3) *'Barriers and challenges'* discusses participants' perspectives on the most significant barriers to, and challenges in, preventing and addressing AMR in Indigenous communities.

(4) *'Recommendations: towards a good path forward'* discusses participants' perspectives on what is required for respectful, effective federal engagement with Indigenous nations, communities and representational organizations, both within and beyond the AMR response.

The first three sections present the participants' own views and perspectives. The fourth section presents participants' views, along with some of our own observations and comments as researchers.

1. The current landscape: perspectives on AMR and Indigenous communities

Situating AMR in context of other health concerns in communities

We asked: In your view, to what extent is AMR a health concern in the communities you work with and/or represent? What infections or diseases specifically are of greatest concern? If AMR isn't a concern, what health issues are considered more pressing?

What we heard:

While recognizing that AMR is a health issue impacting Indigenous peoples, the perspective of research participants in this project was effectively summarized by one person working in an Indigenous representational organization: "it [AMR] is of concern, but it's also added to the long list of other health concerns" (I05).[2]

Everyone we spoke to – including researchers and clinicians with AMR-specific expertise – said that for the Indigenous communities they work with or represent, other health challenges are often more immediately urgent and a higher priority than AMR. Participants mentioned both specific health

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[2] Here and throughout, when quoting participants, we use the letter 'I' to indicate a participant working in an Indigenous representational organization, 'C' for clinician, and 'R' for researcher, followed by the unique interview number (01, 02, 03, etc).

issues/diseases (e.g., suicide, diabetes) and underlying drivers of poor health including food insecurity, lack of access to clean water, and inadequate housing. Where specific antimicrobial resistant infections were mentioned, MRSA and skin/soft tissue infections were identified as a particular concern.

AMR relative to other health concerns

Almost all participants (regardless of identity, geographic location or profession), when asked about the highest health priorities in their communities, named mental health, suicide, addiction and substance use as the most acute, urgent health issues facing the Indigenous communities they represented or worked with. Participants also described the interconnectedness of these specific health issues with social and structural determinants of health:

> *"We just have so many higher priorities as far as people's health and wellness… Mental health for sure, access to counselling, and access to services. People that want to detox and reduce their alcohol and drug consumption. People that require counselling and connections back to community."* (I10)
>
> *"Other things that are more front and centre are food security, diabetes, heart disease, mental health."* (I07)
>
> *"in our region we deal so much with housing crises, you know, fire, suicide, and drug use that sometimes these [AMR] issues pale in comparison because so many other priorities."…* [later in the same interview] "*If you're worried about what you're going to eat the next couple of days, or worry about overdose, or you worry about suicide then it's really hard to think about, 'oh, you know, should I finish taking an antibiotic.'"* (C03)
>
> *"It's [AMR] not as big of a concern [in the North] as lower respiratory tract infections in children like bronchitis. It's definitely got less impact on longevity and mortality than suicide and smoking and those issues like that."* (C09)

Some participants considered infectious diseases to be a higher priority than AMR:

> *"the incidence of infectious diseases are quite high: TB, HIV, Hep C, and other STIs… And now, waterborne infections are also there, because of boil-water advisories. When the water systems are not clean, or acceptable, then people do get very ill from that."* (I05)
>
> *"…that [AMR] is not the priority because we have bigger priorities that we have to tackle in many ways."*
>
> Interviewer: *And those bigger priorities would be ... ?*
>
> *"We have a lot of chronic diseases. We have infectious diseases like tuberculosis, HIV/AIDS, Hepatitis C… to talk about antimicrobial resistance… it [AMR] is something that is so isolated…" (I04)*

For this participant, AMR writ large appeared somewhat disconnected from the immediate, direct impact of specific infectious diseases, even diseases that can be resistant to antiviral and antibiotic treatment.

Many also noted very high chronic and non-communicable disease rates including cancer, heart disease, and COPD. Some participants identified diabetes as a significant concern:

> *"we know that in our province that Métis have a higher rate of below-the-knee amputations. Those with diabetes have a higher rate of below-the-knee amputations than do other [non-Indigenous people] with diabetes."* (I11)

While diabetes is a non-communicable disease that is not treated with antibiotics, and may seem unrelated to AMR, diabetes complications including foot ulcers, wounds, and below-the-knee amputations can result in skin and soft tissue infections that are a potential site for MRSA infection. This is an important reminder that the AMR response is not synonymous with infectious disease response, and that addressing non-communicable diseases (and the structural drivers of those diseases including food insecurity) may also help to reduce AMR incidence in Indigenous communities.

AMR-specific health challenges

When asked about specific resistant infections that are a particular concern for Indigenous communities, MRSA (both community- and hospital-acquired) was the most frequently identified infection, though some also noted that there is significant regional variation:

> *"*[for First Nations] *I would say MRSA is a really big concern*…[but] *I haven't heard of MRSA in Nova Scotia, but I've heard of MRSA in northern Saskatchewan or northern Manitoba."* (I06)

> *"my colleagues and I here* [northern region of a Prairie province] *have noticed serious health problems due to skin and soft tissue infection related to MRSA."* (RC01)

> *"we have communities* [in the North] *that have very high rates of community acquired MRSA."* (C09)

When discussing MRSA, most participants immediately and spontaneously (without interviewer prompting) connected MRSA to the structural and political drivers of AMR:

> *"Certain communities in our Nation have voiced concerns about high rates of MRSA. It's certainly something that's part of the vocabulary in some of the community members… and we don't even have good data to look at the incidence and prevalence of skin and soft tissue infections which I think is way above the national average. And a lot of these are due to MRSA… When we look at skin and soft issue infections, I really suspect that crowding is an issue. In health in general, whether factors like nutrition, or access to water or washing… there's a lot of things that I think drive infection rates, which in turn drive antibiotic use, which in turn drive resistance."* (C03)

> *"We have written papers… on the quantity and quality of housing and how that might relate to infections... When we do these studies, people talk about other health conditions that are affected by houses, including their mental wellbeing, cultural wellbeing, and then MRSA. Skin, soft tissue infections, they mention."* (RC01)

These are examples of the interconnectedness of AMR and the structural drivers of Indigenous health; they suggest that preventing MRSA ultimately requires improving the quality, quantity, and accessibility of housing, water and food in First Nations, Inuit and Métis communities. The relationship between poor housing quality, overcrowding, and MRSA among Indigenous peoples has also been documented in scientific and medical literature (see for example Daley et al., 2016).

The disproportionate impact of MRSA on Indigenous peoples described by participants in this research project is also corroborated by the Expert Panel on the Potential Socio-Economic Impacts of Antimicrobial Resistance in Canada, which found that "MRSA is the main resistant infection disproportionately affecting Indigenous people[s]" (Council of Canadian Academies, 2019, p. 93).

Additionally, well before this Expert Panel, there was an inquest into the preventable death in 2011 of Drianna Ross, a First Nations infant girl in God's Lake Narrows, Manitoba. Her direct cause of death was MRSA-induced sepsis, but the ultimate cause was systemic failures in health services provision. The inquest found that MRSA was both "endemic" and "normalized" in northern Manitoba First Nations communities to the extent that a nurse who testified at the inquiry indicated that "because of its prevalence, MRSA is frequently left untreated" by health care providers in these communities (Slough, 2015, p. 6).

Therefore, although there is still limited surveillance data about the *incidence and prevalence* of MRSA (and other resistant infections) among Indigenous peoples, the *impact* of MRSA on Indigenous peoples is already well-documented. In the case of First Nations, both the inequitable impact of MRSA, and the persistent surveillance data gap that would provide additional epidemiological proof of this impact, are largely a result of the ways that health services and surveillance systems are organized. We return to this point in the 'Barriers and challenges' section below.

Finally, some of the clinicians and researchers we spoke with also identified antibiotic-resistant urinary tract infections (UTIs) as a concern. While UTIs were not specifically identified by participants working in Indigenous representational organizations, the observation about resistant UTIs is corroborated by a 2018 study that found "a high prevalence of ESBL-producing *E. coli* urinary isolates from [First Nations] communities across northern Manitoba." The study recommended that nursing stations and health centres serving these First Nations communities should "be stocked with a carbapenem antibiotic for use in cases of severe infection due to suspected ESBL-producing Enterobacteriacea" (Bogaty, Kassam, Walkty, & Orr, 2018) – a recommendation that is reflected in the findings below, about current access to antibiotics in the health centres and nursing stations serving First Nations people living on-reserve.

Access to information about AMR, access to antimicrobials

We asked: (1) How would you describe access to *information* about AMR – for example: brochures; posters; guidance for medical professionals – in the communities you work with or represent? (2) How would you describe access to *antibiotics and antimicrobials* in these communities?

Access to information about AMR

When asked about access to information about AMR, all participants began not by describing information products, but by emphasizing that they did not have good data or information about the scope of AMR and resistant infections in the communities they work with or represent. For example:

> *"This is something that we know that people in the communities have expressed that they have cases [of resistant infections]... But it's very anecdotal. We don't have any kind of study that demonstrates that it's a big issue in a specific community or in a specific province."* (I04)

> *"We need to know more about AMR and the risk of transmission, those sorts of pieces."* (I10)

People working in Indigenous representational organizations said they had not seen education materials specific to AMR or specific to their Nation. Participants had different perspectives on the potential utility of educational materials, with some suggesting that materials reminding people to take antibiotics as prescribed could be useful, but others indicating that it is more important to address cost, accessibility and other systems-level factors that influence individual antibiotic use. All agreed, however, that pan-Indigenous educational materials are not appropriate, and that education or information material should include Nation-specific language, images and messages. All participants working in Indigenous representational organizations also emphasized that they had limited resources (time and money) to devote to developing such materials.

Clinicians, researchers and health providers, when asked about availability of guidance materials for medical professionals, similarly described the *absence* of these materials, and the materials and surveillance tools that in their view would be useful, but do not currently exist.

The 'Barriers and challenges' and 'Recommendations: towards a good path forward' sections describe participants' views on the surveillance, education, and other information materials that do not currently exist, and are most needed to support an effective AMR response in Indigenous communities.

Access to antimicrobials

All participants indicated that access to antimicrobials, and barriers in accessing antimicrobials, vary by region and are different for First Nations, Métis and Inuit peoples.

For First Nations peoples with 'status' under the Indian Act, and for Inuit people recognized by an Inuit land claim organization, some prescription drugs costs are covered through the federal Non-Insured Health Benefits (NIHB) program, and some of the most commonly prescribed antibiotics are routinely stocked in on-reserve nursing stations and health centres. This mitigates some barriers (prohibitively high cost, lack of locally-available prescription medications) experienced by Métis people and by First Nations peoples living off-reserve or without a Treaty number.

Most participants we spoke with indicated that, from their perspective, nursing stations providing on-reserve care to First Nations communities generally offer basic access to commonly prescribed oral antibiotics. However, the most commonly used antibiotics are also the medications least likely to be effective in treating resistant infections – and the antibiotics required to treat resistant organisms are not always covered by NIHB, or routinely stocked in nursing stations. As one clinician explained, in the First Nations communities they work in:

> *"there is reasonable access [at on-reserve nursing stations] to the most commonly prescribed antibiotics… you can get treatment for sore throat, and urinary tract infections, and minor issues…however if there's a special antibiotic that needs to be… prescribed by their physician [who is] often a phone call away, then that antibiotic needs to be flown into the community. So the prescription goes to a pharmacy, and then the prescription gets filled, and then delivered to the community. So there's a delay sometimes getting certain antibiotics to the community, because of weather and processing… Well, what happens when you have someone coming in with septic shock to the nursing station and they don't have the antibiotics there? They'll often sit there for like 10, 12, 24, 48 hours [waiting for antibiotics]… You want to have all the antibiotics available. That if someone in our community walks into the nursing station [they]*

> *would have the same access to antibiotics and care as if they would walk into Emergency in Ottawa. And that just hasn't been the case."* (C03)

Similarly, another participant described rural and remote First Nations communities' access to antimicrobials for treating resistant organisms as:

> *"Limited. Insufficient. There are an insufficient number and variety of antimicrobials available to account for the new situation of antimicrobial resistance."* (RC01)

Another clinician working in the North explained that access to antibiotics can vary depending on whether the medication is administered orally or intravenously, stating that antimicrobial access is:

> *"reasonably good with oral antibiotics. We can use Septra, doxycycline, clindamycin, orally. Not a problem. For people who need prolonged courses, let's say, of Vancomycin [which is administered intravenously], it is a problem… people who need IV Vancomycin, the majority wind up being transferred to a different community. [The issue is] mostly the capacity at the health centre. I think the staff would be competent to administer it. It's not a skills issue, but it's having one person [a health provider] in the health centre for four more hours a day on top of their regular workload becomes untenable."* (C09)

Many treatments for resistant infections require use of IV antibiotics. The limited capacity of under-staffed health care centres to administer these treatments can result in patients with resistant infections waiting longer to access appropriate antimicrobials, and having to travel out of their home communities to do so.

Participants who work with or represent members of the Métis Nation suggested that antibiotic access can be challenging for many Métis people because of their different relationship with the Crown and provincial governments. For Métis people, there is no federal, pan-regionally consistent architecture for providing health benefits akin to the NIHB program. There is therefore significant regional variation in coverage for prescription medications, and in every province "the relationship, and also the investment of the provincial budgets in the Métis Nation is different" (I04).

Where prescription drug coverage is more limited, the cost of antibiotics – particularly the medications required to treat resistant infections, which are sometimes more expensive that the more commonly-prescribed first-line treatments – can be prohibitive. This can in turn impact antibiotic use or non-use:

> *"if you can't afford your antibiotic, well you might just go to somebody else's medicine cupboard and see what they have… so making choices with that, trying to save money, that can be a challenge as well."* (I08)
>
> *"one reason people don't take their pills is because they can't afford them, or it's between choosing between groceries and medication."* (I11)

Accessing the health care providers who can prescribe antibiotics, and pharmacies that can fill prescriptions, can be challenging for both urban and rural populations, but for different reasons. For those in rural or remote areas, the geographic distance from health providers may sometimes result in antibiotic use even if it may not be required. One participant explained:

> *“some Métis in [province] live quite rurally. So driving to any primary care or pharmacy is hours and hours away. And so for example, there would be pressure from those rural communities if they had driven because they felt poorly, and went to a physician and the physician said, ‘You know what, I need to swab your throat before I can give you these antibiotics.’ They would probably say… ‘just give me the antibiotics because I'm not going to come back to the city if you get a positive swab.’ Or the doctors often will say, ‘I will give you a prescription but don't fill it or take it until you hear back from me about your swab’ [but] if somebody is feeling poorly, then they're going to go fill the prescription, they're going to start the prescription.”* (I08)

Other participants described the significant geographic challenges for Métis people living in rural or remote areas when accessing prescribers or pharmacies:

> *“[majority Métis community of approximately 400 people] is about an hour from [nearest small town] and part of that is over a gravel road, it gets flooded in the spring. It's not necessarily plowed, and if you don't drive, the taxi service just goes two or three days a week, and it's $100.”* [I07]

Métis people in this and similar communities have extremely limited geographic access to antibiotics, such that the main concern is not potential antibiotic over-use, but not being able to access required antibiotics or other medications at all. The same participant quoted above also noted that even when Métis-majority communities are directly adjacent to First Nations communities with nursing stations and health centres, Métis people are usually unable to access care at these geographically closer locations, because of the jurisdictional divisions in the ways that health services are provided to First Nations and Métis people.

For Métis and ‘non-status’ First Nations people in urban areas, there may in principle be greater availability of a wider range of antimicrobials, and closer proximity to health care providers and pharmacies. However, some participants noted that in addition to the prohibitively high cost of medications, settler colonial health care providers may not offer culturally safe and competent care:

> *“Métis people are less likely to have a good connection with their family physician for a number of reasons. Lots of them are distal determinants of health related to colonialism and that lack of trust... And so if you don't have a good relationship with your physician, you may or may not follow advice.”* (I08)

We return to this point in the ‘barriers and challenges’ section below.

Current involvement in the federal response

We asked:

To the best of your knowledge, has your organization been contacted by any federal government department or agency (e.g., Health Canada, the Public Health Agency of Canada) regarding AMR and best practices in responding to AMR that would best suits the needs of the community you work with or represent?

One of the main federal responses to AMR is a Pan-Canadian Framework for Action.[3] To the best of your knowledge, was your organization consulted in the development of this framework?

To what extent do you think it's important for the federal government to consult with your organization when developing a national response to AMR?

What we heard:
None of the people we interviewed in any national or regional First Nations or Métis representational organizations said that they had been consulted by, or involved in, the development of the federal AMR response or the core guidance documents available at the time of interviews (the 2014 *Federal Framework for Action*, the 2015 *Federal Action Plan on Antimicrobial Resistance and Use*, or the 2017 *Pan-Canadian Framework for Action*). Very few participants, whether working in Indigenous representational organizations, as researchers, or as clinicians, were familiar with the Framework for Action or other federal AMR governance documents.

It is possible that other individuals working in Indigenous representational organizations, whom we did not interview, may have had formal or informal discussions with the federal political and/or civil service staff responsible for preparing federal AMR governance documents. But, aside from a single brief reference to First Nations in the context of the federal responsibility to provide health services to "federal populations", there is no reference to Indigenous peoples generally, or to First Nations, Métis or Inuit peoples specifically, in the Pan-Canadian Framework for Action. This strongly suggests a lack of consultation and engagement with Indigenous representational organizations in developing the content of the Framework and previous governance documents.

In contrast, the Pan-Canadian Action Plan released in June 2023 includes a short section on Indigenous Peoples and AMR. It acknowledges social determinants that impact Indigenous health; that there is a gap in knowledge about Indigenous peoples and AMR; and that further research conducted in partnership with Indigenous communities would be useful. This suggests learning over time, and a growing recognition at the federal level of the need to consult with Indigenous representatives in the development of Canada's AMR response.

However, some participants working in Indigenous representational organizations expressed skepticism about the practical impact and effectiveness of the Framework and similar governance documents:

> *"I'm not a fan of frameworks. I mean, what do frameworks mean? They just, you know, they might give out some very good information, but where is the action, you know? There's no funds that are directed towards that. It doesn't increase capacity in First Nations communities. And it definitely does not increase funding or access to public health systems."* (I05)
>
> *"It's not that I think that a government strategy is not valuable. I just think a government strategy is looked at with a government lens, they tick a bunch of boxes and it's not necessarily the boxes that [the Indigenous people I represent] care about."* (I08)

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[3] The Pan-Canadian Action Plan had not been released when these interviews were conducted.

Similarly, another participant said:

> *"we can't just keep adding additional workload when we don't have resources... Even though it can be super important, if we don't have the manpower or the resources… it's really not going to go anywhere. So great attention has to be backed with capacity."* (I10)

This suggests that if the federal government were to engage with Indigenous representational organizations to develop an Indigenous-appropriate response to AMR, there would need to be funds specifically allocated to strengthening capacity, including health systems capacity, in First Nations, Métis and Inuit communities and in the representational organizations that serve these communities. We return to this point in the 'Recommendations' section below.

2. Sources of strength

We asked: In the communities that you represent and/or work with, what are the most significant sources of strength for addressing AMR?

What we heard:

It sometimes seemed more difficult for participants to answer this question than to answer questions about barriers and challenges. When asked about strengths, several participants paused, asked for the question to be repeated, or asked for clarification. Most answers to this question were also briefer than answers to the question about barriers and challenges.

This may reflect the dominance of deficit-focused approaches to Indigenous health, which emphasize what is missing or underdeveloped in Indigenous communities. There is certainly limited health care, infrastructure, housing, water, and access to services in many Indigenous communities, and these need to be addressed if Indigenous health is to be improved. But a deficit focus can, first, result in lack of recognition of the many strengths of Indigenous peoples and communities. Second, deficit-focused approaches often lend themselves to analyses that focus on the behaviour of individuals, rather than systems and structures – for example, in the assumption that individuals and families do not understand proper antibiotic use or hand hygiene, and need education and awareness-raising to remedy this lack of understanding.

Switching the perspective to focus on strengths can be a step towards changing how initiatives, action plans, and education materials are developed. Métis, Inuit and First Nations peoples are more than a vulnerable or "at risk" population, and the strengths of each community need to be incorporated into the conversation if the problem-focused narrative is going to change.

When asked about strengths that could support an AMR response for Indigenous peoples, most participants identified aspects of Indigenous cultures, community and family.

Land and culture

One participant drew a direct connection between relationships with the land, hunting rights and AMR:

> *“a lot of the traditional foods, the deer, the moose, et cetera, are hunted and used and eaten by people, and wouldn't necessarily have had any antibiotics given to them.”* (I11)

This participant observed that protecting traditional hunting and harvesting rights, and keeping contaminants out of the ecosystems within which those animals live, can ensure access to healthier food sources. It also nurtures connections with the land, which is an important aspect of cultural and community health as well as individual health and well-being. (I11)

Another participant observed that virtual and land-based community gatherings with food and music, which bring together community members of all ages, are an opportunity to share and celebrate culture, but also to share information:

> *“when we do health promotion prevention type messaging… the community is actually really engaged. And so I think that would be a strength… Our community is a huge Facebook user. So we tend to do, if there is any sort of messaging that we need to get out our community, we'll do Facebook messaging. We also are really big on gatherings… it's a really great way to just have*

> *conversations and mix what people want to talk about related to it with [health promotion] messaging."* (I08)

Although not specifically mentioned in our interviews, traditional knowledge**,** especially knowledge of traditional medicines, has been identified elsewhere as an important source of strength for Indigenous peoples. (Cybulska et al., 2011; Mushebenge, Kadima, Mashamba-Thompson, & Nlooto, 2021) While participants in our research did not discuss the role of traditional Indigenous knowledge and medicines, this likely reflects the population with whom we spoke: we did not interview Elders and other community Knowledge Holders. Traditional medicines, and Indigenous traditional knowledge more generally, are especially important in the context of preventing and addressing AMR and AMU, as these medicines may include forms of non-antibiotic treatment as well as health-promoting practices that can encourage wellness, prevent disease, and therefore reduce the need for antibiotic prescription and use.

Community closeness, trust, and strength

Participants also described the closeness and high levels of trust in many Indigenous communities, which can facilitate open, honest conversations, community-based education, and several forms of community care:

> *"The fact that our community talks amongst themselves, that's a strength. So a little bit of education in our community actually travels a long way…we call it a Métis telephone line… If you plant solid education within the community it tends to ripple outward."* (I08)

Some participants felt that relative to settler colonial communities, Indigenous communities have stronger norms and practices to support community discussions and collective problem-solving:

> *"the forums for doing that, like having the community meetings and having people have the opportunity to express their concerns or ask their questions or state what they believe, and what they know… other, non-First Nations communities just don't have that forum"* (R02)
>
> *"I've often been impressed by the communities that we work in. Their frankness in some of the discussions that they have in a communal fashion in their town halls or community centres… communities talk in a very frank, open manner about topics that, in non-Indigenous southern populations, are too fraught with emotions and sensitivity or... embarrassment or individuality, that southern [settler] populations don't want to have discussions in the open with other community members. The ability of the [First Nations] communities to come together in an open fashion to tackle, to face an issue, and to formally, collectively plan… They do have power and strength in meeting issues head on and attempting to deal with them."* (RC01)

One participant also suggested that a commitment to collective, community-led organizing and problems solving is reflected in a strong commitment to community ownership and leadership of health services:

> *"I think in terms of strength, is community's interests and desires to own their healthcare delivery and to own the data… over time, when we look towards self determination, I think that could be a key piece…."* (C03)

Participants also described community-based organizing to provide collective care in Indigenous communities. For example, one participant described supports provided by and for the community, via a regional Indigenous organization, in response to COVID:

> *"there's a lot of support for people, for our seniors and our Elders and our families that were vulnerable. There's been hamper delivery since it [COVID] started. And I believe there's been 15,000 hampers delivered. There's support for our small business owners. There's support for hunters and fishers. There's support for our artisans. There's support for our students who might have been working at jobs during school and there's support for them, financial support. iPads went out to all the families that were homeschooling their kids."* (I11)

Although this example does not relate directly to AMR, it demonstrates the high levels of care and mutual support that exist at the community level, and the capacity of Indigenous communities to come together to support their members when there are sufficient financial resources to provide material forms of care.

The existence of Indigenous organizations was also identified by some participants as a facilitator of strengths. These organizations advocate for the health and wellness of Indigenous Nations and communities, and often have a more direct connection to provincial and federal government departments. National Indigenous representational organizations can advocate at the federal level for community and nation-level needs, and can serve as a conduit between individual Indigenous Nations and communities, and federal and provincial governments:

> *"it's very important for national organizations to be involved in some way… [they can] facilitate communication… facilitate that access to the rights holders… [they] could have a coordination role, a communications role and just making sure that the information is received by the right audiences and that opportunities for engagement are done with the appropriate people."* (I06)

Participants working in Indigenous representational organizations felt that their citizens trust these organizations and would be more receptive to information coming from a national or regional Indigenous representational organization, rather than directly from settler colonial governments:

> "*any sort of important messaging that we need to pass along, if it comes from us [a regional Indigenous representational organization] within the community, it tends to be really well received.*" (I08)

We return to this point in the 'Recommendations' section.

Family

Several participants identified caring relationships among nuclear and extended family members as an important source of strength, with one participant stating that *"family is the backbone of the community"* (I11), and another describing

> *"the tremendous concern, love, that people have for their children, and the concern that they have for the health and safety for their children, which then mobilizes them to come to the health centre and ask questions like, "Why does everyone in my family have this? Why did we never see this before?"* (RC01)

Some participants suggested that love for children and family, including caring about their health and wellness, is one reason why people may share antibiotics with family members:

> *"If I'm trying to get to the bottom of why are you only half finishing your antibiotics… and somebody says, 'Well, I could only afford them, and I was worried my daughter was going to get sick, so I took half and I gave her half.' …Like, Métis folks are not First Nations, we do not have subsidized health benefits."* (I08)

While sharing of antibiotics is understood by the medical community as patient noncompliance and antibiotic misuse (a deficit-focused approach), it can also be understood as a form of care: the desire to have family members' health taken care of, in spite of limited access to affordable and culturally safe health services and medications.

Rather than approaching antibiotic sharing from a deficit-based perspective of antibiotic misuse, where the misuse is assumed to result from ignorance and a lack of knowledge about how antibiotics work, a strengths-based approach to antibiotic sharing would recognize this as a practice rooted in care and love for family and community in the face of a systems-level health failure. Obviously, this does not mean encouraging antibiotic sharing, but it means addressing antibiotic sharing by building on an existing strength. A strengths-based approach, for example, could include interventions that promote taking antibiotics as prescribed, and *not* sharing antibiotics, as a form of family and community care. In other words, it implies taking a positive, shared value and strength – care for family and community – and using this as the starting point for a discussion about how antibiotic use is connected to care.

A strengths-based approach also recognizes that the problem that results in antibiotic-sharing is not individual behaviour, but inadequate access to care and to affordable, accessible and appropriate antibiotics. A focus on care redirects attention to the *structures* required to support family and community care, such that everyone in a family and community can access and afford the medications they need to treat illness. This is important because close, caring family relationships are not, in the absence of effective medical care, sufficient to keep people healthy. The inquest report into the preventable death of Drianna Ross from MRSA, for example, emphasized the love her parents had for her and the "outstanding care" they provided: "[w]hen she got sick, Drianna's parents fought for her with all the energy and tenacity they possessed" but still "[t]he medical system failed Erna Hastings, Paul Ross [her parents] and Drianna Ross" (Slough, 2015, p. 23).

Indigenous community and family strengths are an important starting point for developing strengths-based approaches to addressing AMR, but these must be accompanied by efforts to address the serious structural and systems-level barriers and challenges that cause AMR-related illness and death in Indigenous communities.

3. Barriers & challenges in addressing AMR

We asked: In the communities that you represent and/or work with, what are the most significant barriers or challenges in addressing AMR?

What we heard:

All participants, when asked this question, immediately described many barriers and challenges to addressing AMR. Importantly, most of these barriers relate to structural determinants of health. All participants described barriers and challenges that fell into four broad thematic categories:

> (1) Health services and systems limitations. These include: inadequate access to primary care, testing and diagnostics in many communities; and limited trust in health providers due to culturally unsafe care.
>
> (2) Data, information and surveillance limitations.
>
> (3) Inadequate funding and resources at the level of Indigenous organizations and communities, which create significant capacity challenges.
>
> (4) Inadequate quality and quantity of water and housing, which drive many forms of infectious and chronic disease and facilitate the spread of resistant infections.
>
> (5) The jurisdictional complexity resulting from the ways that settler colonial governments have organized provision of health and other services for Indigenous communities.

Most of these barriers and challenges are not unique to AMR, and are well-documented impediments to Indigenous peoples' health. In this section, we have tried to focus on the specific ways that these broader barriers and challenges shape Indigenous peoples' antimicrobial access and use, and experiences with resistant infections.

Health services and systems limitations

All participants described limitations and inadequacies in health services and systems that create barriers in accessing timely, effective and culturally safe care. As discussed above in the 'Current landscape' section, participants emphasized that these barriers and limitations vary by region, and are experienced differently by First Nations, Métis and Inuit peoples. The wide range of experiences indicates the importance of distinctions-based approaches and Nation-specific rather than pan-Indigenous strategies, a point to which we return in the 'Recommendations' section.

Within the broader category of health services and systems limitations, participants described three sub-themes: inadequate access to primary care; diagnostic challenges; poor continuity of care; and culturally unsafe care that results in a lack of trust in health care providers.

Inadequate access to primary care

Although basic primary care is in principle available to First Nations living on reserve, when asked about barriers and challenges, participants in First Nations representational organizations said:

> *"we hear constantly [about] access to primary care. Basic primary triage in the community from a trusted and consistent health practitioner, you know? And also, First Nations' health systems or health services are extremely overburdened and underfunded. And that would impact every*

> *illness. Not just AMR, but getting an HIV test, getting screened for TB. Just basic primary care to get a referral to a secondary clinic."* (I06)

> *"there's not a lot of public health infrastructure in First Nations communities. For example, many people… for testing, or having to get bloodwork done, they have to leave the community. Or when it's available in their community, it takes a long time to get those results."* (I05)

Inadequate access to primary care may be a more acute challenge for Métis and 'non-status' First Nations living off-reserve, and other Indigenous people living in communities without even the basic nursing stations provided by the federal government in First Nations communities. As described above in the 'access to antimicrobials' section, people living in many rural and remote First Nations, Métis and Inuit communities may need to travel long distances to access care, and this travel can be logistically difficult and prohibitively expensive.

The most direct AMR-related consequence of limited access to primary care is that people with resistant infections may not receive timely diagnosis and treatment. As a participant noted when describing the higher rates of below-the-knee amputations among Métis people living with diabetes in one province, this is connected to limited primary care access: "it means they're not getting adequate care for their wounds, for their skin ulcers." (I11)

Wound care has become a specialized area of practice, and like other specializations, this is a medical service that is not available in all rural and remote communities. Regular wound care assessments are essential for proper healing, and can also be a first point of contact with health care professionals that can facilitate earlier referral to specialists if wounds are infected or not healing.

Limited primary care access means that skin conditions and ulcers may be more advanced by the time patients are able to access a physician, resulting in the need for below-the-knee amputations. As well as having an obvious quality of life impact, amputations can also be a site for MRSA infections, especially when specialized wound care treatment and follow-up is not available post-amputation.

Participants also noted that many remote First Nations, Métis and Inuit communities do not have physicians in residence; rather, doctors may fly in to communities for a few days each week, and be available only for phone consultations on other days. This also has consequences for diagnosis and antimicrobial prescribing, as well as continuity of care:

> *"the physicians are on the phone, they don't know the patients, so it's easy to cover your bases and you give antibiotics even though they don't necessarily need them. So I think there's some overprescribing going on because often there is not a physician present or a health care provider present to do a full evaluation. So I think that then also speaks to the resources with respects to practical care that may drive resistance."* (C03)

Some participants therefore suggested that Indigenous people who are diagnosed and prescribed by phone may receive antibiotics where these are not necessary; they may also, if they have resistant infections, be prescribed standard first-line medications that are not effective in treating resistant organisms.

In the context of COVID, some challenges associated with remote diagnosis, treatment and prescribing may be changing. We return to this point in the Recommendations section.

Diagnostic challenges

Compounding these problems with accessible and high-quality primary care, many participants noted that for rural, remote and northern Indigenous communities, health care providers (whether on-reserve nursing stations, or off-reserve health centres in small communities) do not have the ability to test blood, tissue, sputum, urine, swabs and other samples on-site:

> *"the ability to culture things is not as good as it would be in the south... If you collect a swab today in [a small fly-in community in the North] it might be two or three days before it gets flown out and it might be, realistically, sometimes it's even a week before the swabs get to the labs to get cultured, and any result at that point is questionable."* (C09)
>
> *"the diagnostic options for Indigenous remote communities are very, very poor."* (RC12)

Participants emphasized that health systems' widespread reliance on centralized lab testing, combined with the inability to test samples on-site in most rural, remote and Northern communities, results in an inability to accurately diagnose and properly treat infections. In some cases, health care providers may not take samples at all, and will prescribe medications based on visual (or, where physicians can only be reached by phone, oral) assessment of symptoms. In other cases, as the quote above indicates, samples that need to be sent to labs in large southern urban centres may not be tested in a timely fashion. In the meantime health providers are left with the choice of either treating an infection without knowing whether it is resistant or not, which may result in unnecessary or ineffective antibiotic use, or waiting to treat, which can result in infections progressing to become more severe or life-threatening.

The result is that even when Indigenous people access primary care, their medical treatment, including prescription of antimicrobials, may be determined exclusively by observation of symptoms, not actual diagnosis. In turn this may result, variously, in over-prescription, under-prescription, or use of inappropriate antibiotics.

The question of how to support equitable, sustainable access to testing and diagnostics is complex. New technologies such as rapid molecular tests, and other new tools that do not rely on laboratory-based testing, may be more feasible to implement than local on-site laboratory and samples testing facilities. Increasing the number of regionally centralized laboratory testing sites, operating directly under First Nations jurisdictional authority, may also be an option in some regions. Additionally, existing tools such as antibiograms might be more effectively used than they are at present, although some participants expressed concern about reliance on this "algorithmic system of care" (RC01). We return to this question in the Discussion section below.

Some clinicians suggested that the lack of local diagnostics capacity is exacerbated because of the limited availability of, or awareness of, clinical best practice guidelines:

> *"the other thing that's lacking is very practical advice about how to diagnose and treat infections in remote communities that don't have access to the usual kind of diagnostic equipment. We really leave nurse practitioners and community health workers and doctors without a lot of… helpful guidelines about how to use antimicrobials judiciously…. What we have is a patchwork of ideas and practices… In one part of northern Canada in Indigenous communities, they will use a rapid strep test for the throat. If it's positive, they'll give penicillin. In another area, they say, 'Well, here's a scoring system, and don't bother doing the test. Just use*

> *the scoring system.' Another part of Canada, they tell you to do a culture, wait three days or five days to get the results. We need…more help and guidance on a practical level to the caregivers."* (RC01)

Clinicians also emphasized that even when clinical guidelines exist, these are rarely validated for use in Indigenous communities, especially northern communities. Clinical guidelines developed in urban centres in southern Canada may be inappropriate for the northern, rural and remote regions in which many Indigenous communities are located, and this has direct implications for diagnosing and treating resistant infections. For example:

- A clinician working in a region where there are high rates of resistant UTIs in Indigenous populations explained that the standard first-line treatment for UTIs is oral antibiotics, but UTIs caused by ESBL organisms require a different treatment that is administered intravenously. Health care providers following clinical guidelines for UTIs, especially if they do not have on-site ability to test urine samples, will treat these UTIs inappropriately if they are prescribing the oral antibiotics routinely stocked in nursing stations. This clinician also noted that this IV treatment cannot usually be administered in nursing stations, and requires patients to travel to larger urban centres for care. (C03)
- A medical professional working North of 60 explained that the clinical guidelines for community-acquired pneumonia, which were developed in southern Canada, recommend treatment using Levofloxacin. However, use of Levofloxacin as a first-line treatment for pneumonia is problematic in the North because of the high incidence of tuberculosis: it is more difficult to diagnose TB in patients taking Levofloxacin, and Levofloxacin is also an antibiotic kept in reserve to treat drug-resistant TB. (C09)

A lack of regionally-specific clinical care guidelines validated for use in First Nations, Métis or Inuit populations impedes the ability of health care providers in these regions to provide adequate, evidence-based care. The lack of guidelines and on-site diagnostics facilities is interconnected with the lack of surveillance data, which we discuss below.

Culturally unsafe care

As discussed in the 'access to antimicrobials' section above, settler colonial health care providers may not offer culturally safe and competent care. The prevalence of culturally unsafe care, and persistent, frequent structural and direct racism experienced by Indigenous peoples when accessing care in settler colonial health systems in Canada, has been well documented (e.g. Addressing Racism Independent Review, 2020; Allan & Smylie, 2015; Kamel, 2021; Preston, 2014; Reading, 2018).

Participants explained that in addition to being a deterrent that can prevent Indigenous people from accessing care at all, culturally unsafe care has specific implications for AMR:

> *"Relationships with those that are giving the [medical] information out historically are not good… it's a colonialist system… you have a lot of Elders that still have that distrust. They went to residential schools, were part of experiments with pills. So they're not inclined to take a full dose of antibiotics because maybe they feel better after two days. So why would they take this pill from this colonialist person."* (I08)

> *"Métis people are less likely to have a good connection with their family physician for a number of reasons. Lots of them are distal determinants of health related to colonialism and that lack of trust... And so if you don't have a good relationship with your physician, you may or may not follow advice. If you're taking antibiotics you may not finish them, you may not even get the appropriate one because you might just go to your auntie's cupboard and 'Oh, she had some leftover antibiotics, I'm not feeling well.'"* (I08)

> *"There's a real lack of continuity of care. So even if you've seen a doctor, the next time you go back, that doesn't mean that they're there. And it really impacts on things like people getting, well, obviously consistent care. But if you've got a chronic disease of any kind, it impacts on the chronic disease, it impacts on your adult immunizations."* (I11)

> *"There's a real reluctance in accessing healthcare until it's very late in people's illness. Because it's not necessarily always a culturally safe place to be."* (I10)

One clinician also suggested that distrust of settler colonial health systems can also affect how health care providers make decisions about antibiotic prescribing:

> *"There's a perception that we ration care… When we try to have conversations about antibiotics and not using them in infections that are viral, it's perceived as rationing or denying care… people will assume that either we're not giving them antibiotics because we don't care or we're not giving them antibiotics because we're incompetent."* (C09)

Data, information and evidence limitations

All participants agreed that they had inadequate information, including surveillance data, about incidence and prevalence of resistant infections, and about antimicrobial access and use in the communities they work with or represent.

The lack of data about AMR and AMU, and the health systems limitations described above, are mutually reinforcing: without good testing and diagnostic capacity, it is difficult or impossible to collect accurate surveillance data about which resistant organisms are present, or the incidence and prevalence of resistant infections in First Nations, Métis and Inuit peoples. Without this statistical and biomedical data, it is difficult to mobilize the evidence required to persuade settler colonial policy makers and politicians to adequately fund testing and diagnostics facilities and the trained staff to operate them, or to stock nursing stations and health centres appropriately. Without information about AMR and AMU in the populations they advocated for an represent, it is difficult for Indigenous representational organizations to assess the relative time, attention, resources and advocacy they should devote to AMR, compared to other health challenges in their communities.

Participants noted that the limited surveillance data about AMR and AMR in Canada is not unique to Indigenous peoples:

> *"We don't know anything about antimicrobial resistance in rural, remote areas, not just Indigenous, but non-Indigenous, because we don't test for it… what data we have is based on opportunistic sampling."* (RC12)

> *"there's different CNISP [Canadian Nosocomial Infection Surveillance Program] sites across the country and most of them are large tertiary care hospitals. And they were invited to participate in*

> *this CNISP surveillance project and receive funding to have someone enter the data, but then the funding was only limited…There's obviously some data gaps because now you have certain hospitals that are participating in CNISP, but other hospitals… wouldn't have any funding to do that. So there's already a bit of a bias in terms of selection of what data you're going to get through CNISP."* (C03)

While recognizing overarching limitations in existing surveillance systems, participants also emphasized that limited data and information is more acute for Indigenous populations. Most health surveillance systems do not disaggregate data by First Nations, Métis or Inuit identity. Additionally, data collected from southern, urban hospitals likely under-represents Indigenous people, especially those from northern and rural communities. There are no surveillance systems dedicated to collecting community-level data about AMR or AMU in Indigenous populations:

> *"I definitely wouldn't say [we have] reliable access to [AMR] data because it's based on what hospitals are collecting or reporting."* (I08)
>
> *"We don't have a study that can demonstrate what is the behavioral - studies in terms of how people behave or people using antibiotics."* (I04)
>
> *"there's only a reporting system for people who had these infections while admitted in the hospital through the hospitals report, but not the community level. And that really is a big issue because we don't have data on, you know, rates of ESBL or MRSA in the community."* (C03)

Participants observed that there is no systematic surveillance of or mechanism to report resistant infections diagnosed through on-reserve health centres or nursing stations:

> *"Another big challenge would be data: how many cases do we have of MRSA? How many are recurrent cases? How many received treatment, how many completed treatment, you know? For example, TB is reportable, it's a reportable communicable disease but MRSA is not. So, how do you keep that data to determine how far and wide the problem is that you are facing?"* (I06)
>
> *"there's a lot of unknowns with antimicrobial resistance because [the North] has communities scattered over a wide area… surveillance is not as robust."* (C09)
>
> *"we don't actually know the rate of antibiotic resistance in other regions of the country among First Nations people, because there aren't surveillance studies. Any antimicrobial resistance surveillance is not, as far as I know, being done specifically in either northern communities or First Nations communities."* (RC01)

Compounding this problem, due to limited testing and diagnostic capacity, some cases of resistant infections are never clinically diagnosed at all, and therefore would not be reported even if surveillance systems existed.

Some participants also noted that in many northern communities, both on and off-reserve, patient charts and medical histories are kept on paper. This makes any systematic tracking and reporting of resistant infections far more challenging. As one clinician explained:

> *"It's just very difficult sometimes to get reliable data… there's a lot of data gaps in terms of what are the quality of the specimens, like why was it taken, what is the micro information because that's spread over three or four different health records, from the chain of the geographic*

> *location of where the patient was, where the sample was taken, and some of them are paper records only."* (C03)

In addition to being a data limitation, the use of paper records impedes continuity of care, especially for patients (often those with resistant infections) who must travel out of their home communities to access treatment (Slough, 2015).

Under-resourced Indigenous organizations & communities

All participants working in Indigenous representational organizations emphasized that their organizations, and the communities they represent, are overburdened and underfunded. A lack of resources, including financial resources, creates significant capacity constraints for Indigenous representational organizations, First Nations health systems and on-reserve nursing stations, and other community-based services in Métis, Inuit and First Nations communities:

> *"Even though I've increased my staff, we're just as busy, if not busier than ever. I feel like we have even less capacity now… Because the more you get engaged, the more people want you to engage on different things. So it just gets broader and broader until you're completely overwhelmed."* (I10)

> *"First Nations health systems are severely underfunded and that really has led to detrimental health status."* (I06)

Participants told us one reason why AMR is not a higher priority for their organizations is that they simply do not have the time or resources to take on any additional work:

> *"We haven't had the ability to or the capacity to look at that [AMR]. So there's often health concerns that we would love to get at, but it does require the staff and the ability to do that… Say I'm interested in AMR… but I don't have any funds to back it up, it's not responsible of me to say, 'Oh look, we have a problem, can't do anything about it.' And that is historically what happens from initiatives that come from all levels of government… when you talk about AMR it's great that we know it's a problem, but what is the capacity to do anything about it?"* (I08)

Participants working in national-level Indigenous representational organizations also emphasized that their direction comes from their members (for MNC: the Governing Members; for AFN: the Chiefs, Assembly and National Councils; for ITK: the four regional land claims organizations). If their members, as Nations and communities, have not identified a health issue as a priority, it is difficult for staff in representational organizations to justify devoting their limited time and resources to that issue.

Inadequate quality and quantity of water and housing

All participants identified the structural determinants of Indigenous health as the underlying drivers of resistant infections in Indigenous communities. When asked about the most significant barriers to addressing AMR and preventing antimicrobial resistant infections in Indigenous communities, participants said:

> *"The lack of ability to deal with the social determinants of health that underlie MRSA… the lack of clean water, appropriate sewage and sanitation, quality and quantity of housing. Nutrition, [which] has to do with overall health, which relates to food security… all the determinants."* (RC02)

> *"some of the water has been polluted. And there is stuff in there from mining, or whatever, that shouldn't be in there, so it's unhealthy to drink. And then the other aspect of it is there is no water to drink. A lot of communities have been on boil water advisories for years."* (I11)

> *"Overcrowding and inadequate quantity of water…most houses are on trucked water and if they run out of water, it might be very difficult to get ahold of the driver. It might be expensive because not everybody has it covered, for a call out for water. And so people are often rationing their water for what they need it for the most versus what they think they could do without. And so all those things make it very difficult to control skin infections in general."* (C09)

There is a direct link between inadequate water and housing, and antimicrobial use:

> *"Because of the heavy infectious disease morbidity, mortality, even if you used antimicrobials judiciously, you're going to use them more often in Indigenous communities than in non-Indigenous communities. Even if you were very careful, there is so much respiratory infection and diarrhea, and illness, et cetera, in Indigenous communities. You can't avoid fairly heavy use of antimicrobials."* (RC01)

In other words, inadequate clean water and overcrowded housing with mold, excessive humidity, and/or poor air circulation, in combination with other structural determinants of health, drive high infectious and chronic disease rates in Indigenous communities. This then requires heavier use of antimicrobials, which in turn contributes to AMR.

Jurisdictional complexity

Several participants noted that all the barriers and challenges described in this section are compounded by the jurisdictional complexity of health and other services delivery to Métis, First Nations and Inuit communities. The nature of and reasons for this complexity also vary. For First Nations:

> *"healthcare and health services jurisdiction has consistently been an issue for First Nations."* (I06)

> *"Even if the community wanted to know what their rates of resistance are, it's incredibly difficult because of the multiple jurisdictions involved. Because you know, the hospital's provincial-federal combined, but the community's federal, and it's a paper chart and so it doesn't get captured…if we wanted to have a clear understanding of AMR among Indigenous communities, these jurisdictional issues with respect to data need to be sorted out."* (C03)

For the Métis Nation:

> *"In each province, as you know, we have different health care systems, we have different realities. We have different challenges… we have a lot of differences between the five provinces of the Homeland of the Métis."* (I04)

Métis people have varying levels of prescription drug coverage and access to medical services depending on the level of each province's investment in Métis health, and the relationship between the regional Métis representational organization and the provincial government.

Once again, the significant variation in *how* jurisdictional barriers and complexity are experienced illustrates the importance of regionally-specific and Nation-specific strategies for Inuit, Métis and First Nations peoples, in and beyond the AMR response.

For all Indigenous peoples, some of these disparities in access to care and treatment could be at least partly addressed through a national pharmacare program and pan-Canadian formulary (prescription drug list)(CADTH Advisory Panel, 2022), and through national licensure for health professions. This would improve availability and consistency of critical resources across jurisdictions, and would do much to address health inequities, including those impacting Indigenous peoples.

4. Recommendations: towards a good path forward

We asked:

What do you think would be needed for an effective response to AMR in the communities that you represent and/or work with?

In your view, what would it mean to Indigenize the AMR response?

For the federal government and non-Indigenous groups and networks responding to AMR, what would you recommend as appropriate engagement with the Indigenous communities you work with and/or represent?

What do you see as the best role for your organization in the response to AMR?

What we heard:

Recommendations fell into seven broad themes:

- Respectful and meaningful engagement
- Strengthening First Nations, Métis and Inuit organizational and community capacity
- Strengthening the knowledge base
- Strengthening health systems and services
- Strengths-based and decolonizing education, for health services providers and for Métis, First Nations and Inuit peoples
- Improving water access (quality, quantity, affordability)
- Addressing the structural drivers of Indigenous health

All of these recommendations would build on existing strengths in Indigenous communities, and would partially address the barriers and challenges that participants identified.

Some recommendations – particularly about surveillance and education – are similar to activities already included in the existing federal AMR response documents. Yet the fit between these activities as participants described them to us, and as they are discussed in AMR guidance documents, is imperfect. For example, the Pan-Canadian Framework for Action places education and awareness-raising within the category of stewardship, and recommends patient education as one way to reduce unnecessary antibiotic use. While interviewees in this project also made recommendations about education materials, they emphasized that such materials cannot simply advise Indigenous peoples to practice good hand hygiene or avoid sharing antibiotics, without concurrent efforts to address lack of access to water and health services.

Overall, most participants were less focused on the ‘downstream’ problem of antibiotic consumption and over/mis-use, and more focused on holistic, ‘upstream’ interventions to improve the poor water, housing, and health services that simultaneously drive the infections that necessitate antibiotic use, and make it more difficult to access and use antibiotics as prescribed.

Respectful and meaningful engagement

Participants' recommendations about respectful, meaningful and ethical engagement with Indigenous peoples and representational organizations are similar to many existing frameworks: Indigenous data sovereignty, including the First Nations OCAP Principles ©; the Tri-Council statement on research involving First Nations, Inuit and Métis peoples; and the CIHR guidelines for health research with Indigenous peoples (see also Jull et al. (2020)). But these recommendations bear repeating, first, because they were emphasized by almost all participants, and second, because whether consulting about AMR or any other issue, meaningful consultation and engagement with Métis, Inuit and First Nations peoples is not optional – it is essential.

On June 6, 2021, the Government of Canada's *United Nations Declaration on the Rights of Indigenous Peoples Act* came into force. This Act commits the federal government to honouring and implementing the Indigenous human rights articulated in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). These include:

> "States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representational institutions in order to obtain their free, prior and informed consent before adopting and implementing legislative or administrative measures that may affect them." (UNDRIP Article 19)
>
> "indigenous peoples have the right to be actively involved in developing and determining health, housing and other economic and social programmes affecting them and, as far as possible, to administer such programmes through their own institutions." (UNDRIP Article 23)

All participants spoke about the good practices and principles that could help the Government of Canada honour its UNDRIP obligations, and that should be used in any consultation and engagement with Indigenous peoples, within and beyond the AMR response.

A distinctions-based approach to AMR

All participants working in Indigenous representational organizations emphasized that an effective AMR response must be Nation-specific rather than pan-Indigenous. Distinctions-based approaches that recognize the differences between (and within) First Nations, Métis and Inuit peoples, including their different relationships with the Government of Canada, are essential for respectful and effective engagement, consultation, and programs and services development and delivery.

> *"…just saying, 'here's an Indigenous strategy for AMR,' it doesn't cut it, it doesn't recognize the differences between First Nations, Metis and Inuit. It just doesn't."* (I08)
>
> *"Pan-Indigenous strategies are not effective because First Nations, Inuit and Métis have very distinct relationships with the Crown and also, the scheme in place for healthcare is very different among the three populations."* (I06)
>
> *"…recogniz[e] how important it is to say the word Métis so that Métis people feel like they actually belong to this initiative or this program or service is for them."* (I10)

Distinctions-based approaches are also needed because of jurisdictional complexity and the ways that systems are differently complex for Métis, First Nations and Inuit:

> *"you have [mainstream health provider] guidelines that are developed outside of that First Nations context. They attempt to standardize the interventions and standardize all the outcomes, but First Nations don't live in that standardized world."* (I06)

A distinctions-based approach is required for all facets of an effective AMR response, including research about access to antibiotics and incidence and prevalence of resistant infections; development of AMR response strategies and education messages; and strategies to address the structural determinants of health.

Métis, Inuit and First Nations ownership and leadership

All participants emphasised that research, consultation and engagement processes relating to AMR, as well as any resulting interventions or service delivery, must be led and owned by Indigenous peoples:

> *"It is always about the questions. It's important to understand that the communities don't want to answer questions that they are not asking. That's why it would be important to try to explore, [as] part of the process to build understanding of the issue: what kind of questions would you [Metis, First Nations and Inuit peoples] like to know, to answer, about AMR in their communities? Because probably, they have those questions, but the question has to come from them"* (I04)
>
> *"recognizing capacity and making sure that assistance is offered: 'how can I help you to get this information out to your communities in the way that you see as appropriate,' as opposed to being said, 'Hey, this is what we want you to share.' Making sure that it's a reciprocal relationship and respectful."* (I10)
>
> *"I think that it's not appropriate for the Canadian government to be engaging with our people. I think that that's something that should be done internally… It needs to be us going out into our community, asking our people and then bringing that back to the government…"* (I08)

They emphasized that ownership is not only an important ethical principle – it can also strengthen health services delivery:

> *"From our region, the communities that have had their healthcare transferred… and have taken ownership, they tend to move more quickly in terms of addressing issues."* (C03)
>
> *"it's really all about investment into community, into First Nations led, governed, implemented organizations where we see glimmers of hope."* (I06)

Several participants spoke approvingly of the British Columbia First Nations Health Authority and the Sioux Lookout First Nations Health Authority as positive examples of First Nations ownership over health services delivery, and a model for other First Nations. This is another example of the importance of distinctions-based approaches, as Inuit- or Métis- owned health services would require different implementation and delivery models.

Finally, several participants described the health frameworks and strategies that each of the national Indigenous representational organizations have developed, which define their own priorities and processes. To centre Indigenous knowledge and respect First Nations, Métis and Inuit leadership, the federal AMR response should identify ways to align with these existing First Nations, Métis and Inuit health frameworks.

Multiple levels of engagement

Participants emphasized that while engagement and consultation with national-level Indigenous representational organizations is important, there must also be engagement with regional representational organisations, individual sovereign Nations and communities.

National representational organizations emphasized that they can facilitate connections, but they are agents working on behalf of their members, who are the rights-holders. Ultimately, sovereign First Nations and their regional representational organizations (the Political Territorial Organizations), the five regional Métis organizations and the communities they represent, and the four Inuit land claims organizations and the communities they represent, are all equally important actors who must have a voice in any First Nations, Inuit and Métis AMR response.

Additionally, one participant cautioned that

> *"the AFN, MNC, and ITK do not necessarily mirror what the concerns are on the ground among the communities."* (C03)

As described above, participants told us there is significant community and regional variation in the most prevalent resistant infections, in availability of health services and antimicrobials, and in the locally-specific best practices for treatment, which may differ from clinical guidelines developed in southern urban centres for non-Indigenous populations. Therefore, an effective AMR response in Indigenous communities must understand and address perspectives and experiences at the level of local communities.

Participants emphasized that effective, respectful consultation and engagement with communities takes time:

> *"sometimes the federal government is... Their deadlines aren't the same as the deadlines of the community. They might give you something to review in August and it's going to go to their House of Commons or something in October and there's no time to actually have the input or have the consultation that there needs to be."* (I07)

Developing an Indigenous-owned AMR response will require federal actors to respect timelines and consultation processes that may differ from those of settler colonial bureaucracies.

Strengthening First Nations, Métis and Inuit organizational and community capacity

Participants emphasized that meaningful consultation and participation in Indigenous-led, Indigenous-owned processes, in addition to requiring time and genuine political commitment on the part of settler colonial government representatives, also requires supporting First Nations, Métis and Inuit organizational and community capacity-building with financial commitments and resources. This is an essential component of respectful and reciprocal relations.

As described in the 'Strengths' section above, participants see significant potential for Indigenous representational organizations to engage with their members to share information about AMR and to come together for open, frank community discussions. But as described in the 'Barriers and challenges' section, to effectively support their members, Indigenous organizations and communities require more capacity in the form of additional financial and human resources.

For several participants working in Indigenous representational organizations, this capacity strengthening must be the starting point for an effective AMR response, and is required for the other steps of strengthening the knowledge base and developing strengths-based and decolonizing education:

> *"The best first step I would say is increasing capacity in First Nations communities because people are stretched."* (I06)
>
> *"Top of the list is capacity, right? If I don't have that capacity… money to ensure that the message is delivered in a way that is meaningful… because just taking messaging from say Health Canada or [provincial health department] is not taken up by our [Métis] communities."* [in the same interview] *… I see a role for engagement: working groups, engagement, we do have the capacity to help deliver, to create and work on strategies. We have that capacity if we have the dollars to do it… engagement, community reporting, if I had the capacity I could do educational campaigns."* (I08)
>
> *"We don't even have rates of things like that [AMR]. So having funding that we could do, again, our own research that would be good and targeted research. So a targeted funding, not just open to everybody in the world." (I13)*

Participants working in Indigenous representational organizations see little value in frameworks and governance documents that do not include meaningful financial and other material support to transform high-level government strategies into effective, practical, community-based health promotion activities. Developing an Indigenous-appropriate response to AMR will require funds specifically allocated to strengthening capacity, including health systems capacity in First Nations, Métis and Inuit communities, and organizational capacity in the representational organizations that serve these communities.

Strengthening the knowledge base

As described in the Results sections, participants emphasized that there is limited knowledge, including surveillance and epidemiological data, about rates of resistant infections among Indigenous peoples. All participants described a need for AMR and AMU data and information specific to Indigenous populations.

While all participants emphasized the need for better data and information about rates of resistant infections among Indigenous peoples, we heard a range of perspectives about what information is most needed and how it should be collected.

Three themes that we heard were:

(1) centring Indigenous experiences and ways of knowing
(2) ensuring Indigenous data ownership
(3) improving surveillance with Indigenous ownership of surveillance systems and data

Centring Indigenous experiences and ways of knowing

When asked about what it might mean to 'Indigenize' the AMR response, we heard diverse perspectives and different levels of comfort with the term 'Indigenization.' Some participants expressed concern that Indigenization can result in a tokenistic adding-in of Indigenous peoples to non-Indigenous frameworks and responses. Others felt that ‘Indigenization’ can result in Métis, First Nations and Inuit peoples being treated as a single homogenous group, which is at odds with a distinctions-based approach.

Participants agreed, however, that an appropriate, effective response to AMR in First Nations, Métis and Inuit communities would require centring Indigenous ways of knowing:

> *“governments invest all this money in programming and they do it the way that is evidence-based in the way that they see it, but it doesn't privilege Indigenous ways of knowing. And that's not to say that we don't include evidence-based within our ways of knowing, but there is a way to do it that is more palatable, and it's not simply putting an infinity sign or feather on an AMR poster… if you're going to do a large Indigenous strategy, you need to prioritize Indigenous ways of knowing and collecting that data, and a lot of that is qualitative and that's hard for strategists, especially when you're working on biomedical type things like AMR.”* (I08)

For this participant, effective and appropriate research about the impact of AMR in the Indigenous community their organization represents would involve qualitative, community-based research, bringing people together with food and music and using

> *“community gatherings to understand a baseline understanding of experiences and perceptions related to AMR. We would never call it AMR, we would simply talk about how people take their antibiotics.”* (I08)

This form of knowledge is different from the quantitative, statistical data that is typically generated by surveillance systems, but is equally important for developing AMR strategies that are appropriate to specific Métis, First Nations and Inuit communities. This research strategy is also an example of how AMR-specific components could be woven into other health promotion research and activities that are already being conducted in communities, rather than developing stand-alone AMR research projects.

Similarly, participants also noted that First Nations, Inuit and Métis conceptions of health are holistic and focused on wellness in a way that is not well-aligned with many settler colonial, disease-specific frameworks:

> *“we can't isolate one specific health issue from the broader concept of what it means to be well and healthy in the community. And that we address mental health, and housing, in connection to the land, and [antimicrobial] stewardship within that.”* (C03)

Using conversations about health and wellness more generally as entry points into discussing experiences with antibiotic access and use, with skin/soft tissue infections or other resistant infections, and perceptions of the root causes of these infections, may be better-aligned with a holistic approach to health than more narrowly biomedical research strategies.

Another participant emphasized the need to centre Indigenous experiences with settler colonialism, and recognize these as a driver of AMR:

> *“to Indigenize it [the AMR response] means to acknowledge how colonization has impacted people's lives in the past and the in present. I mean, we could talk about AMR in the clinical setting, but also to ask, ‘why is AMR in First Nations communities?’ Is it because of personal behaviours or is it because of systemic issues?”* (I06)

These points relate back to the discussion about culture and traditional knowledge as a source of strength in Indigenous communities. Celebrating and protecting traditional knowledge is an important strategy of Indigenous resurgence and resistance to settler colonialism (Green, 2017; Simpson, 2004). Traditional medical knowledge may also be protective against AMR, as plant-based medicines may be an alternative to commercial antibiotics. Although beyond the scope of this project to address, an AMR response that centres Indigenous ways of knowing would entail a different way of thinking about and practicing 'research and development' beyond encouraging pharmaceutical companies to develop new antimicrobials. It would also need to be mindful of the complex politics of protecting Indigenous knowledge in the context of settler colonial patent laws (e.g., the controversial practice of patenting genes and life forms).

Data ownership

Several participants emphasized the importance of communities owning their own healthcare and surveillance data:

> *"we [health care providers] think of it as ideal to have that data but then you get into, we have to really look into data ownership and what happens with that data. And that [is] a big topic for Indigenous organizations that they really need to address. Who owns that data and what happens with that data."* (C03)

The principle of First Nations, Métis and Inuit data ownership is not unique to AMR, and 'data' of course refers not only to statistical and surveillance data, but also to other forms of information and knowledge emerging from community-based research. However, given the centrality of surveillance to AMR (it is a key component of the federal and global AMR guidance documents, and was raised by many of our participants as a key gap that needs to be addressed in order to support an effective AMR response in Indigenous communities), we reiterate the importance of data ownership in AMR surveillance.

Improving surveillance with Indigenous ownership of surveillance data and systems

In 2015, the Auditor General of Canada's report on AMR found "a lack of data available on the extent of antimicrobial resistance in remote regions and in specific vulnerable populations, including Aboriginal peoples" (Auditor General of Canada, 2015, p. 10). Our interviews suggest that this is still the case. A subsequent 2023 Auditor General report found some limited progress in using laboratory data to track resistant infections outside of hospitals, and collecting disaggregated data about some vulnerable populations affected by antibiotic-resistant gonorrhea. However, that report is silent about Indigenous peoples and AMR, with the word 'Indigenous' appearing just once in the entire document, in the context of summarizing findings from the 2015 report (Auditor General of Canada, 2023).

There are still significant gaps in AMR and AMU surveillance, particularly surveillance of and disaggregated data about Inuit, First Nations and Métis populations, resulting in a lack of data about the extent to which Métis, First Nations and Inuit peoples and communities are impacted by AMR, which resistant infections are most prevalent, how these infections are being treated, and how this compares to the Canadian population as a whole.

As described in the 'Barriers and challenges' section, participants working in Indigenous representational organizations generally agreed that they needed and wanted more data about AMR and rates of resistant infections in the communities they represent. But they emphasized that if surveillance systems are built and surveillance data collected, these systems must be Indigenous-owed and led, ensuring that data are useful, and used, at the community level:

> *"getting accurate data that communities can access and understand and also, using that evidence to get those distinct services that they require at the community level. If it's not available at the community level, where do they go and get those services? That's it, creating surveillance."* (I06)

Participants in Indigenous representational organizations also emphasized that there are many more immediate, acute health needs in the communities they represent. Some participants cautioned that allocating investments to AMR-related surveillance systems when this is not an identified community priority would not be supported by their organization or community. Others, however, noted the Sioux Lookout First Nations Health Authority in Ontario and the Northern Inter-Tribal Health Authority (NITHA) in Saskatchewan as examples of First Nations-owned health services that have had some capacity for AMR surveillance, specifically MRSA surveillance, in a community-supported way. This again points to the importance of Indigenous ownership and capacity-strengthening support for Indigenous organizations. It also points to the importance of a distinctions-based approach, as this health authority structure and resulting surveillance capacity may be not the same for Métis and Inuit organizations and communities.

As with many of our findings, it is likely that there is significant variation by region and across Métis, First Nations and Inuit communities in the level of support for and perceived need for strengthening AMR-related surveillance systems.

Effective surveillance systems also require effective, efficient and timely diagnostics systems. Diagnostics challenges were identified by all the clinicians and researchers we spoke to as one of the most significant barriers to effective treatment of resistant infections in Indigenous communities. Interventions to improve diagnostics and testing may be a more readily supported starting point for strengthening AMR-related surveillance in Indigenous communities, especially in rural, northern, and remote regions where improving local diagnostics could immediately and directly improve health outcomes for First Nations, Métis and Inuit communities by improving the ability of health care providers to rapidly diagnose and effectively treat potentially life-threatening resistant infections.

Strengthening health systems and services

The 'Barriers and challenges' section described under-resourced health systems, a lack of accessible, culturally safe care, inadequate diagnostics and samples testing, and inadequate access to antimicrobials used to treat resistant infections. The specific nature of these barriers and challenges varies by region and by First Nations, Métis and Inuit communities. Similarly, as with most of our findings and recommendations, the specific strategies to strengthen health systems will be different for First Nations, Metis and Inuit communities. We did, though, hear three overarching themes:

(1) Improving health services workforce capacity
(2) Strengthening diagnostic and treatment capacity
(3) Improving antimicrobial access

Improving health services workforce capacity

Participants identified two equally important dimensions of improving the capacity of health care providers who provide services to First Nations, Inuit and Métis communities. One dimension is the *quantity* of the workforce, especially in northern and rural communities: having enough nurses, physicians, lab technicians and other health services workers, ideally on-site, to fully staff nursing stations, health centres and other primary care facilities. Another dimension is the *quality* of that care: ensuring that medical staff are trained to provide culturally safe care that reflects the most current and locally-appropriate guidelines for diagnosis and treatment of potentially resistant infections.

> *"start by having health centres fully staffed… have educational programs and actually make sure that the people there, like nurses or doctors, have actually done the appropriate educational programs that they're supposed to do before they start work… (RC01)*
>
> *"they want to have Indigenous healthcare providers. Ideally they'd like to have Métis healthcare providers, but if that can't be, then they want to have Indigenous healthcare providers. And again, we know that having healthcare providers at all in the north and rural and remote areas is a real challenge. And there aren't very many First Nations or Métis nurses.* (I11)

In addition to supporting the training of more Indigenous health care providers, it is important to look beyond biomedical health practitioners, by recognizing the important role that Elders and other traditional knowledge-keepers can play in promoting the mental, physical and spiritual health of Indigenous peoples and communities.

Strategies to improve health services workforce capacity go well beyond AMR and are beyond the scope of this project. But with specific respect to AMR, the most important health services capacity-building needs are most likely training that would ensure culturally safe care, and training and tools to support rapid diagnosis and effective treatment of resistant infections. We discuss these below.

Strengthening diagnostic and treatment capacity

As described in the 'Barriers and challenges' section, throughout the Canadian healthcare system, there is heavy reliance on laboratory testing to diagnose illnesses, including resistant infections. Yet health care providers in many First Nations, Métis and Inuit communities in northern, rural and remote areas cannot test blood, tissue, sputum, urine, swabs and other samples on-site. This means that samples may not be taken at all, which can result in inaccurate diagnosis and prescribing. Alternately, even if samples are taken, there can be significant delays when they are sent off-site for testing, so that results may be inaccurate, and/or received too late to ensure timely care.

There is also regional variation in how and by whom testing is conducted. In some regions, physicians send samples directly to the National Microbiology Laboratory (NML); in other regions, samples are sent to provincial laboratories, where they may then be sent on to the NML. When samples testing is managed via provincial systems, results are recorded in provincial electronic records, which facilitates patient tracking and follow-up. When samples are sent directly to the NML, test results may not be entered into provincial systems, which can create greater risk of patients being lost to follow-up, or of poor continuity of care if patients are transferred out of their home community. In both cases, however, the samples testing process can take significant time.

In the case of acute infections including MRSA and UTIs, health care providers in small communities far from the NML or provincial laboratories are caught between two suboptimal choices: treat immediately, without having a lab-confirmed diagnosis that would indicate whether and which resistant organisms are present; or take a sample, send it for testing, and in the meantime either delay treatment, or begin treatment with an antibiotic that may not be effective. Both options risk suboptimal care that may allow infections to progress and cause patients to become more ill, in some cases life-threateningly so. They also create prescription and antibiotic use patterns (filling, but not completing, prescriptions) that further contribute to antimicrobial resistance.

Limited diagnostics capacity has individual and population-level consequences. At the level of individuals, it prevents many Indigenous patients from receiving accurate diagnoses and the correct treatment for resistant infections. At a population level, it impedes accurate surveillance and collection of the incidence and prevalence data to guide evidence-based policies and programs.

Unsurprisingly, participants therefore recommended:

"improving diagnostics so that we don't have the delays in culture results or even invalid results because the samples are lost or overly delayed from collection to when they arrive at the lab." (C09)

To some extent, challenges related to deterioration of samples when they are sent off-site for testing could be mitigated through greater use of dried blood spot or saliva tests, which do not require refrigeration and are therefore less likely to deteriorate during the days they may spend in transit to large labs in urban centres. This does not, however, address the significant time delays caused by reliance on off-site laboratory testing.

There are several options for addressing this challenge:

(1) Develop robust, locally-applicable antibiograms that can provide evidence-informed prescription recommendations even in the absence of a confirmed, specific diagnosis.
(2) Invest in and implement new and emergent technologies that will provide a confirmed, specific diagnosis without reliance on off-site, centralized laboratory testing.
(3) Strengthen partnerships with existing labs and to build new laboratory and samples testing sites in regional hubs in northern regions, under the direct jurisdictional authority and ownership of Indigenous nations or organizations.

Below we consider the advantages and limitations of each option. We emphasize that these are not either-or choices: the most effective response is likely a combination of all three strategies. We also emphasize that these options must be more extensively discussed by Métis, First Nations, and Inuit communities to assess the relative merits of each, and to identify region-specific needs. There would also need to be costing exercises and other assessments beyond the scope of this project.

1. Strengthen development and use of locally validated antibiograms

Antibiograms are guidelines based on aggregate data collected from laboratory-based sensitivity testing of samples (blood, tissue, sputum, urine, etc.). Samples are first tested to determine the presence of microbes that are susceptible to, or resistant to, particular antibiotics. On the basis of these results, antibiograms are developed. These tools indicate to prescribers and health care providers what microbes are likely to be present in a particular region or patient population, and recommend the antibiotics that are most likely to be effective in this context.

In most smaller, remote communities, local care providers need to focus only on their local antibiogram, but there is more variation in larger centres. When patients travel south from their home community for care, the antibiograms used in the community where they are treated and diagnosed may not be an accurate indication of the resistant infections prevalent in their home community. Physicians treating patients who have travelled for care must therefore carefully review the medical history of patients to understand which infections are prevalent in their patients' home communities, determine whether individual patients have a history of resistant infections, and see what antibiotics have previously been effective or ineffective for a given individual. This means that antibiograms are most effective in a context where health care providers have access to electronic medical records and other supports for continuity of care. This reaffirms the importance of broader health systems strengthening, especially for First Nations and Northern communities that still rely on paper charts and record-keeping.

Antibiogram advantages: Accurate, regionally-specific antibiograms may contribute to more evidence-informed prescribing, even in the absence of a laboratory-confirmed diagnosis for an individual patient. There are already validated antibiograms being used in some provinces, so there is some existing work to build upon, as well as existing systems to distribute antibiograms. These are diagnostic tools that are relatively easy to use, and many require less capacity-building and training for health care providers. They may be more cost-effective than other options such as building new laboratories or purchasing diagnostic equipment.

Antibiogram limitations: Antibiograms do not provide a confirmed diagnosis; they support a more informed assessment of the *probability* that a given antibiotic will be effective. They cannot identify new strains of resistant infections. Developing locally-validated antibiograms for use in rural, remote and Northern communities, including First Nations, would require extensive initial systematic samples-collecting and testing, because as discussed above, there currently is no systematic surveillance or reporting of resistant infections in these communities, meaning that the evidence base is very limited. Existing antibiograms have in many cases not been validated in Indigenous populations and communities. There is a risk that investing in the collection of samples and development of new, locally-validated antibiograms could misallocate resources that would be better spent on diagnostic tools that are guaranteed to provide specific, accurate diagnoses of all individual cases, rather than simply increasing the likelihood of *some* cases being more accurately treated *some* of the time. Some participants were highly critical of "algorithmic care" using antibiograms, pointing out that many under-resourced low-income countries have been able to implement on-site and rapid testing to ensure accurate, confirmed diagnoses of HIV and TB. They argued that this should be the standard of care Canada should aim for in diagnosing antimicrobial resistant infections:

> *"Canada is remarkable in a not-good way for having a very, very weak diagnostic system. And every other leading country in the world that's on the leading edge of health care, dealing with infectious disease, and we're not just talking necessarily about the developed world… has revolutionized their approach to infectious diseases by developing rapid tests that are reasonably sensitive and specific. In other words, they perform well and they get them to remote areas. And Canada does not have that… we have an algorithmic system of care. So, you have a problem,*

> *diarrhea or fever… and you get an algorithm of try this and try that based on what's most common… it's unconscionable now. It can't be supported." (RC12)*

2. **Invest and implement new technologies that will provide a confirmed, specific diagnosis without reliance on centralized laboratory testing.**

As the participant quoted above notes, there are new technologies available for rapid testing. These include PCR (Polymerase Chain Reaction) machines. PCR machines test and diagnose illnesses by examining a small amount of DNA. Therefore, they still require collecting a sample through swabbing or collecting saliva or blood. However, the sample assessment is rapid, with PCR tests producing an accurate diagnosis within a few hours. One recent systematic review and meta-analysis of in-house PCR testing for tuberculosis found that this is an accurate, cost-effective diagnostic tool, especially in resource-constrained settings (Wei at al, 2019).

Other examples of point-of-care diagnostic procedures that do not require sending samples for laboratory testing include rapid tests for HIV and tuberculosis, through assay kits that are administered and used on-site by a health care provider. These are now well-established, proven processes that can provide rapid, accurate diagnosis. Rapid point-of-care MRSA tests are also in development (Zhao et al 2022).

In making health care investment decisions, prioritizing early adoption of these newer and emergent technologies in rural, remote and northern communities, including First Nations, could be a cost-effective way to increase quality and accessibility of care. In the longer term, investing in research and development of new point-of-care diagnostic tools is also needed. There is especially a need for low-cost, easy-to-use point-of-care rapid tests that could identify common resistant infections.

PCR advantages: Purchasing PCR machines and placing them in a larger number of centres, including smaller regional hubs in rural and northern regions, would reduce reliance on samples testing in the NML and provincial laboratories. This would reduce the time from testing to diagnosis, enabling more rapid and accurate treatment. PCR machines may also, relative to sending samples off-site for laboratory testing, be a more efficient and cost-effective diagnostic strategy. Where possible, placing PCR machines in First Nations, Métis and Inuit communities may also create new employment and training opportunities, as these machines must be operated and serviced by skilled technicians. In response to COVID, the National Microbiology Laboratory has recently implement a program to place GeneXpert machines in (to date) 250 Indigenous, remote and northern Indigenous communities to enable rapid, community-based PCR testing for SARS-CoV2, Influenza and Respiratory Syncytial Virus. This roll-out includes ongoing training, supplies and other forms of community capacity-building. With these machines already in place in many communities, there is significant opportunity to expand the range of diagnostic tests to include those for MRSA, UTIs and other viral and bacterial infections in which resistance has been observed.

PCR limitations: There is regional variation in who can administer PCR tests and provide a diagnosis based on the results. Some provinces restrict this to clinicians (e.g., doctors, nurses, pharmacists). In smaller communities, clinicians may not be regularly available on-site to operate PCR machines. They may also already be over-burdened with clinical duties, and unable to unwilling to take on additional duties such as receiving training for, and conducting ongoing operation of, PCR machines. It can in principle be a delegated procedure; even then, the question of who will administer it may remain a problem in communities where human and material resources are limited.

Investing in new technologies also requires investing in the recruitment, training and retention of skilled technicians and other health care providers. It is not possible to place PCR machines and technicians in every single Métis, First Nations and Inuit community. This means that smaller communities would still need to send samples out for testing. There would still, in these communities, be delays in receiving results, and the risk of patients being lost to follow-up.

Rapid point-of-care test advantages: Relative to the cost of purchasing PCR machines and training the technicians required to use and maintain these machines, bulk purchasing of rapid point-of-care tests may be a more cost-effective alternative (though costing exercises would be needed to confirm this). They could be more easily provided to a large number of communities, including those where it is not viable to place an on-site PCR machine due to the small size of the community. Rapid tests can often be administered by a wider range of health care providers, and in some cases can be self-administered. Their ease of use, including the fact that they can be used without extensive technical training, may contribute to greater uptake. Rapid tests can be administered on-site, with results available immediately. This reduces the risk of delays in diagnosis and treatment, or of patients being lost to follow-up.

Rapid point-of-care test limitations: Currently, there are not rapid point of care tests available that can identify common resistant infections. R&D investments would be required to develop new, easy-to-use rapid tests. This is a longer-term strategy that might, over several years time, eventually result in effective new rapid tests. However, in the short term, such investments will not address immediate AMR-related needs in Indigenous communities. R&D investments for longer-term solutions would need to be balanced with investments that will have an immediate impact on Inuit, Métis and First Nations health.

For both PCR machines and rapid point-of-care tests, a further challenge may be entering the test results into provincial surveillance systems through public health reporting processes. As noted elsewhere in this report, some First Nations nursing stations use paper records and are not integrated into larger provincial or national electronic records-keeping or surveillance systems. Test results in local communities, if they are not readily available to providers elsewhere, will not be helpful if patients must be transferred out of home communities for care.

In addition to the technical barriers to uptake of PCR machines or novel rapid point-of-care tests, there may be reluctance on the part of Indigenous communities to be early adopters of new technologies that have not been thoroughly piloted and assessed for use among the non-Indigenous Canadian population. Many of our participants spoke about the lack of trust in settler colonial medical systems and health care providers. If new technologies were to be implemented in Indigenous communities, this would need to happen with Indigenous leadership and ownership.

3. Strengthen partnerships with existing laboratory systems, and build new regional centres for testing and diagnostics in northern, rural and remote communities.

It is not possible to put laboratories, or even PCR machines, in every rural, remote and northern community with a large Métis, First Nation or Inuit population. However, participants emphasized that there are many opportunities for stronger partnerships with existing laboratories, and for building or strengthening regional testing and diagnostics hubs that would enable testing that is geographically closer to the communities that must currently send samples to the NML or to laboratories in the capital cities of provinces.

One interviewee suggested, for example:

> *"partner with provincial and national laboratories… federal and provincial mandates for a partnering between Indigenous communities and provincial laboratories and universities to increase capacity for onsite diagnostics. And that would involve equipment and training, training of Indigenous health workers to do diagnostics… increased capacity, both human capacity and physical technological capacity."* (RC12)

While partnerships with existing provincial and national laboratories may be beneficial, these labs are located in large, southern urban centres. Existing labs are an importance source of expertise and training. Participants emphasized, though, that they need testing and diagnostics capacity in northern and rural Indigenous communities rather than having to send samples away to labs in larger centres:

> *"some of the delays are completely out of our control. If the airline is unable to fly for three or four days or if it requires going through multiple stages of flight, like it has to go from one community to another, all of those things add up into delays…"* (C09)

Again, participants in several provinces, both clinicians and people working in Indigenous representational organizations, identified the Sioux Lookout First Nations Health Authority and NITHA as examples of northern First Nations health services that have been able to strengthen their on-site testing and diagnostics capacities as a result of First Nations ownership and targeted investments in resources, including financial and training supports. Identifying best practices and lessons learned from these health authorities may assist in strengthening on-site testing and diagnostics in other First Nations communities.

For Métis communities who access testing and diagnostics through provincially-run clinics and labs, adequate local or regionally-centralized testing and diagnostics would also require engagement with provincial governments, and this would likely require unique negotiations between each regional Métis representational organization and their corresponding provincial health department.

Overall, it is clear that significant investments are required to develop the testing and diagnostics strategies and facilities that are essential for appropriately diagnosing and treating infectious diseases, including potentially resistant infections, in northern and rural Métis, Inuit and First Nations communities. It is also clear that mechanisms for funding and implementing testing and diagnostics strategies, facilities, and the partnerships required to support these will vary by province and by Métis, First Nations and Inuit populations.

Improving antimicrobial access

Conversations about antibiotic access and AMU in the Canadian AMR response often focus on stewardship. Stewardship, in turn, focuses on preventing "inappropriate prescribing" and ensuring "conservation" (Public Health Agency of Canada (PHAC), 2017) of antibiotics, using education campaigns to prevent over-prescription and reduce AMU through more cautious prescribing practices.

This stewardship approach in large cities and hospitals in southern Canadian urban centres, especially hospitals that serve mainly non-Indigenous populations, does not accurately reflect the realities of antibiotic access for most Indigenous peoples, especially those in northern, remote, rural, and First Nations communities.

As described in the 'Barriers and challenges' section, clinicians working in northern and rural regions of provinces and North of 60 consider antibiotic scarcity – especially, limited or no access to the antibiotics required to treat resistant infections – to be a more significant challenge for many Indigenous communities. AMU in these communities is not a problem of inadequate stewardship and over-use, but of inadequate access:

> *"My view really is that stewardship is important and we need to address antimicrobial resistance, but in the end making sure we provide the standard of care and don't jeopardize someone's chances of survival I think still trumps that."* (C03)

Stewardship activities in Indigenous communities, including First Nations health centres and nursing stations, should not focus exclusively on stewardship understood as 'preventing overuse of antibiotics' – the focus should be on *appropriate* use and *improving* equitable access.

For one participant, appropriate, equitable antimicrobial access means:

> *"Stock the health centres with appropriate resources… Fully fund public health programs like vaccination. Do all this with joint control with Indigenous communities. You'll never have good health unless people feel they have control over their wellness, their state of being."* (RC01)

As this participant notes, adequately stocking First Nations nursing stations and heath centres with a wider range of antimicrobials would require financial investments, and agreement on the part of the NIHB program to cover the cost of these prescriptions.

We acknowledge that equitable access may not mean making all antibiotics required for treating all resistant infections available in all small and remote communities. These medications are costly and still used infrequently, meaning that especially in smaller communities, stocking nursing stations with rarely used antibiotics would risk stock expiring before it could be used. However, several strategies could be considered to improve the range of antimicrobials that are locally available. These include:

- Making better use of local data (including antibiograms where relevant) to ensure clinics and nursing stations are stocked with locally effective antimicrobials and a wider relevant range of second- and third-line alternatives
- At the regional level, stock a broader range of antimicrobials that can be rapidly distributed on-demand to smaller communities. The Sioux Lookout First Nations Health Authority in Ontario and the Northern Inter-Tribal Health Authority (NITHA) in Saskatchewan are models for regional First-Nations-led systems that could act as

regional distribution hubs. This is a First-Nations specific model, but similar models may be an option for some Métis and Inuit communities, including the Métis Settlements in Alberta.
- Investing in new transportation technologies, such as drones, to rapidly distribute medications from regional hubs to more remote, rural and northern communities.

We heard repeatedly about the many demands on primary care providers working with limited resources and providing care to a very large, geographically dispersed population with complex health and medical needs. The time pressures on providers are a significant barrier to equitable access to antimicrobials, as timeliness of diagnosis and treatment is essential. While the long-term solution to pressures on care providers is to increase the number of providers in remote and rural First Nations, Inuit and Métis communities, shorter-term interventions are also needed. These could include robust toolkits and other tools that allow providers to diagnose and treat patients more quickly.

Finally, as several participants described in the 'Barriers and challenges' section, the cost of antibiotics can be prohibitive for many Métis and 'non status' First Nations peoples. Some participants mentioned the Manitoba Métis Federation (MMF) as a promising example of a program to mitigate the barrier of high prescription drug costs. The MMF's Prescription Drug Program covers the Pharmacare deductible for the prescription medication of their Métis citizens over age 55 with an annual income of $25,000 or less.[4] This is, again, an example of how Indigenous representational organizations, given sufficient investments, capacity and ownership, can effectively support their members in accessing medical care and treatment. It may be a model for other Métis representational organizations to consider.

Strengths-based and decolonial education strategies

Participants described education strategies and tools that could support capacity-building and awareness of both health care providers Indigenous peoples. For health care providers, participants recommended technical tools to guide diagnosis and treatment, and decolonial education to help providers offer culturally safe care. For Indigenous peoples, they recommended strengths-based, Nation-specific strategies developed alongside concurrent efforts to address the structural and political drivers of AMR in Indigenous communities.

For health providers

The 'Barriers and challenges' sections described the lack of guidance to assist practitioners in northern and rural communities in diagnosing and treating infections. While diagnosis and treatment requires on-site samples testing and diagnostics equipment, participants also recommended the development of clinical practice guidelines (CPGs):

> *"We need just sort of like a manual for nurses. See, so say someone comes in with a sore throat: this is what I do when someone has a sore throat… [a] CPG is really just used as a manual. Someone comes in, this is what I'm going to prescribe. So I think that for each condition, I think we have to be very careful with respect to the recommendations that are in there. But I think when these are up to date and based on evidence then that should address exactly AMR."* (C03)

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[4] See: https://www.mmf.mb.ca/prescription-drug-program

> *"there's lots of diarrhea in the Arctic. What do I actually do when someone comes to see me? Do I take a sample? Do I give them an antibiotic without a sample? Do I just not do anything unless ... Nobody knows."* (RC12)

Clinicians and care providers emphasized that clinical practice guidelines and clinical scoring systems must be validated for use in Inuit, First Nations, and Métis populations, and based on evidence from these populations. This is often very regionally specific, with one participant, for example, observing that:

> *"research people will come to Iqaluit and review records in the hospital and then put out general recommendations for the entire territory, but evidence or information that you find in Iqaluit does not apply to Kivalliq"* (C09)

The need for locally-validated clinical practice guidelines is at odds with the federal government's Pan-Canadian Framework for Action emphasis on "harmoniz[ing] antimicrobial prescribing practices across the country" through "consistent standards for prescribing" (Public Health Agency of Canada (PHAC), 2017, pp. 21-22). In First Nations, Inuit and Métis communities, such standardization is not appropriate given the regional variation in dominant types of resistant infections and regional best practices for treatment – nor is it possible given the jurisdictional complexity of Métis, First Nations and Inuit health care.

The development of evidence-based clinical guidelines for diagnosing and treating resistant infections obviously depends on evidence. Developing guidelines for health care providers, and gathering evidence upon which to base these guidelines, must occur in tandem.

Finally, participants recognized that clinical guidelines and technical intervention, including on-site diagnostic tools, are not enough if Indigenous people do not feel safe accessing care. Culturally unsafe care is a significant barrier for Indigenous people when accessing care, and this is not unique to AMR.

As previously noted, building the health workforce capacity by training Indigenous health care providers and increasing the number of Métis, Inuit and First Nations physicians and nurses is one essential strategy to ensure culturally safe and competent care.

In the meantime, given the current reality that a largely non-Indigenous health workforce is providing health and medical care to First Nations, Métis and Inuit peoples, it is essential to provide decolonial education to health care providers so that they can provide culturally safe and competent care. Although "cultural safety is an important minimum standard (and right) in taking action towards reconciliation", there are very few validated and evaluated cultural safety training modules in Canada for training health care providers who work with First Nations, Métis and Inuit peoples (Crawford, Waddell, & Lund, 2021, pp. 334, 369). This is also an area where the development of evidence-based tools could assist health care providers in delivering appropriate care.

For Indigenous peoples

Participants were clear that some education messages and strategies are not appropriate (e.g. those focused on personal hygiene) but that there is some value in other forms of health literacy strategies. Education must be strengths-based, Nation-specific, and occur in tandem with efforts to address the structural determinants of health. Education strategies should build on existing strengths: the ability of Indigenous representational organizations to effectively reach their members, the ability of communities to share information and work together to address problems, and the care people have for their families and communities.

Participants were emphatic that in the absence of action to address the structural drivers of AMR in Indigenous communities, educational materials promoting individual behaviour change to prevent the spread of resistant infections are ineffective, patronizing and inappropriate. For example:

> *"community members who were found to be positive [for MRSA]…many of them were simply told you need to wash more and use more soap and that sort of stuff. It was very much a victim blaming and the implication that they brought it because they weren't following good hygiene."* (C09)
>
> *"Skin and soft tissue infections due to MRSA are spread through… not having sheets on the mattress, and not being able to wash them, and not having enough water [for bathing]… Well, I mean, if you put that on [education materials], something about washing, and a community or people within a community have no ability to follow what you're suggesting because of the water, it's oppressive to say, suggest that someone do something when they can't.... It reverberates a bit of colonialism. Doesn't it? 'We'll tell you what to do, but we won't give you the means with which to do what we tell you to do'."* (RC01)

However, some participants suggested that basic health literacy strategies and educational materials about the importance of taking the full course of antibiotics as prescribed, and of demonstrating care by not sharing antibiotics, could potentially be useful:

> *"I think that perhaps the health literacy surrounding AMR is poor for everyone. So I wouldn't necessarily say that Métis folks are less literate when it comes to AMR, I would say that probably Canada-wide people are just starting to understand the effects of not having an antibiotic that works because we've already used it or we haven't taken it correctly."* (I08)

Participants in Indigenous representational organizations suggested education strategies could be useful if they were strengths-based and Nation-specific, and, as noted in above, if resources were available to support developing and sharing educational materials and messages.

> *"So you know, we want to make sure that [AMR-related education] is coming from a strength based [approach] and not seen as it's because of your lifestyle or your culture that you are more susceptible."* (I10)
>
> *"just as long as they are not materials that increase fear and suspicion in communities."* (105)
>
> *"From the work we've done in [our organization] we've seen, Métis people are just, they actually veer away from First Nations content… we put out the tools on the table and Métis people will take non-Indigenous material over First Nations material, because they just don't see themselves in that…If we get pan-Aboriginal stuff, we find our Métis people just aren't interested in looking at it. They just feel like they're less-than or they're a second thought."* (I10)

A distinctions-based approach to AMR education does not only mean unique materials and messages for Métis, Inuit and First Nations peoples. It also means recognizing the variation of preferences and practices within these communities.

> *“the way that I would approach it [outreach about AMR] is actually regionally [within the province]. I would reach out to each regional elected representative and just essentially develop a plan with them. So how they would like to approach it. Some regions are different, the urban centres they just come to a lecture and they like to watch a PowerPoint and then they like to have a sharing circle and there's always food involved. Whereas when you head up north, they often like to get out on the land, so it definitely needs to be tailored to regional needs.”* (I08)

> *“going in and working community by community is what's worked well and we often have sessions with the youth and Elders.”* (I07)

These quotes demonstrate that effective education and community outreach may not always require written materials such as brochures and posters; participating in in-person community gatherings, as noted in the ‘Strengths’ section above, can often be a more effective means of knowledge-sharing.

However, to reiterate, participants emphasized that education is inefficient and ineffective without simultaneous action to address the structural determinants of health:

> *“It's really hard to go into community and offer messaging around AMR when there's no solution… I think that when I'm talking about effective delivery, there has to be wrap around services that come with it. It can't just be, ‘Oh, here's all this knowledge, but guess what? You can't do anything.’ If I can say, ‘You have to take all of your antibiotics and don't worry about cost because look, it's covered.’ I mean that would be a way that you could ensure that, ‘Oh, right, okay. I don't have to worry about sharing my antibiotics because they can't afford them.’”* (I08)

As noted in the Strengths section, there may be value in a strengths-based approach to antibiotic sharing that recognizes this not as a problematic individual behaviour that must be fixed, but as a manifestation of the strong bonds and the relations of care that exist within families and communities. The problem to be addressed is the context of scarcity, high medication costs and inadequate services that is the root cause of at least some antibiotic-sharing. This context of scarcity is not something that can be addressed via education materials. However, one participant suggested that education about AMR can assist in community advocacy:

> *“I think the main usefulness of informing, increasing the knowledge of communities is not going to be their ability to change their behaviour. What information that will perhaps help them in this is lobbying or advocating for or changing the determinants [of health], and improved healthcare resources. It's basically demanding and requiring and ensuring that they receive what every other Canadian expects”* (RC01)

In sum, this does not mean that there is no need for education materials, but that (1) education materials must be strengths-based and (2) these education materials are a partial and limited solution. There should be realistic and appropriately modest expectations about what education materials and campaigns can and cannot do.

Improving water access

The inadequate access to water experienced by many First Nations, Inuit and Métis peoples in Canada has been thoroughly documented. This, along with inadequate and substandard housing, is the one aspect of AMR and/in Indigenous communities for which there is overwhelming evidence and about which no further research is required. What is required is political will, investments and action.

While this issue is not unique to AMR and has consequences for health and well-being far beyond AMR, we emphasize the need for improved water access because it was so central to the recommendations made by research participants. It was identified as a priority by every person that we spoke to. For example, one participant, when asked about the most important starting point for an effective AMR response in Indigenous communities, said:

> *"I would still go back to water and housing, the social determinants of health, making sure that those systems are in place."* (R02)

Another said:

> *"improving some of the logistical issues so that people aren't rationing water and trying to base water delivery on systems that were set up for a population half the size of what's currently in the community."* (C09)

Indigenous peoples obviously need consistent, reliable, affordable access to plentiful clean water for wound care and basic hygiene practices to prevent contracting and spreading skin and soft tissue infections, including MRSA, and to prevent the spread of waterborne illnesses. Adequate water quality, quantity and affordability is fundamental to Indigenous health and therefore cannot be treated as beyond or outside the scope of the Canadian AMR response.

While there is one brief reference to unclean water as a vector for resistant infections, strategies to improve water quality do not appear to be central to the Pan-Canadian Framework for Action. Notably, global AMR guidance documents *do* include WASH (water, sanitation and hygiene) activities as a core component of national AMR plans (WHO, 2019). These and the many other available resources and tools for developing effective WASH interventions may be useful for Canadian policy-makers.

Although we emphasize water here because it was such a dominant theme in our interviews, we reiterate that infrastructure improvements to water, sewage and sanitation systems and housing must be undertaken together; poor housing, along with inadequate water access, both contribute to the spread of, and challenges in treating, resistant infections.

Addressing the structural drivers of Indigenous health

Our research affirms that ultimately, improving the health and well-being of Métis, Inuit and First Nations peoples and communities requires addressing the structural and political drivers of Indigenous health, and their roots in settler colonialism. It is essential to address AMR not as an isolated or stand-alone issue, but in the context of broader strategies to improve Indigenous access to health and other services, and to strengthen Indigenous organizational and community capacity.

There cannot be effective prevention and treatment of AMR in Indigenous communities without addressing the water, housing and other infrastructure limitations that drive the spread of many infectious diseases and resistant infections including MRSA.

The federal AMR response cannot be expected to, by itself, transform the systems and structures of settler colonialism. But at a minimum, (1) AMR-specific interventions should not work at cross-purposes to the ultimate goal of addressing the structural drivers of health and disease and (2) this broader sociopolitical context must be recognized as an overarching constraint on the effectiveness of any efforts to improve the health and wellness of Indigenous peoples.

At the same time, the fact that settler colonialism and other structural determinants of health are the underlying drivers of poor health in Indigenous communities should not become a reason for inaction. Improving access to technology, training, and materials within the existing health care system may not, by itself, undo colonialism, but there is no reason why this more direct, immediate action to strengthen health care systems and capacity cannot be undertaken in tandem with longer-term action to address structural determinants of health. As one recent publication argues, “The social determinants are not an excuse for inadequate biomedical health programs. Interventions in the upstream determinants must be accompanied by improvements in the quality of local diagnostic, therapeutic, and rehabilitative health programs” (Orr & Larcombe, 2021, p. 125).

We cannot wait for settler colonialism to be undone, nor for the perfect evidence base and surveillance systems to be built, before taking action to ensure that all Indigenous communities have full,immediate access to rapid tests for resistant micro-organisms, antimicrobials appropriate to treat these infections, and trained, culturally competent staff with access to ongoing professional development and capacity-building.

Conclusion

We began this report by acknowledging the need for caution in interpreting the findings, given the project scope, limitations and small number of participants. While the recommendations presented here are based on a relatively small-scale project, we note that many of our own analyses and recommendations align with recommendations that have been made elsewhere – while also adding additional depth and detail that foregrounds Indigenous, especially First Nations and Métis, perspectives.

The Drianna Ross inquest report, the Canadian Auditor General’s reports, and the multiple reports detailing deficiencies in the Canadian government’s relations with and service provision to Indigenous peoples and communities, have made many recommendations, some AMR-specific and some addressing Indigenous health more broadly. Several of these recommendations, including moving from paper to electronic records in health centres and nursing stations, and developing strategies to collect information about the incidence and prevalence of resistant infections in Indigenous populations, still have not been fully implemented – or, in some cases, implemented at all.

Evidence and recommendations are not helpful if there is no political will to act on them. We conclude by emphasizing the need for political will, including investments, to implement the recommendations made in this and other reports, to address the barriers and challenges identified by our research participants, and to build on the many existing strengths in Métis, First Nations, and Inuit communities. Particularly in the context of unprecedented investments in the COVID response, and an unstable economy characterized by inflation and a potentially severe recession, there are worrying messages – including in the 2022 and 2023 federal budgets – that social spending must now be curtailed and that demands for any new investments or resources are neither feasible nor reasonable. Yet Canada has both a legal and moral requirement to honour Treaty obligations to First Nations, and the commitments made in the *United Nations Declaration on the Rights of Indigenous Peoples Act.* These include financial and resource commitments. An effective response to AMR in First Nations, Métis and Inuit communities must recognize and build on these commitments.

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