PUTTING THE PIECES TOGETHER

A National Action Plan on Antimicrobial Stewardship

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National Collaborating Centre for Infectious Diseases

Centre de collaboration nationale des maladies infectieuses

Canadian Roundtable on antimicrobial stewardship

Table Ronde Canadienne pour la gérance des antimicrobiens

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Putting the Pieces Together: A National Action Plan on Antimicrobial Stewardship

Preamble

This document provides a roadmap for improving antimicrobial stewardship (AMS) in Canada and lays out a series of 10 areas for a national Action Plan on antimicrobial stewardship. It reflects the broad consensus arising from recent interviews, documents and discussions – and particularly from the June 2016 National Action Roundtable on Antimicrobial Stewardship. This Action Plan focuses on AMS in the human health context, while recognizing the importance of action in agriculture and animal health as part of a "One Health" approach to AMS.

Introduction

The status quo is not an option as we confront the hazards of emerging antimicrobial resistance (AMR). Described recently by the Director-General of the World Health Organization as a "slow moving disaster", AMR is one of the most serious threats to human health and public safety. AMR is viewed globally as a major patient safety issue, resulting in adverse effects to both patients and populations by diminishing the effectiveness of antimicrobials intended to prevent and treat infections. The United Kingdom's Review on Antimicrobial Resistance – chaired by economist Jim O'Neill – projected that AMR will be responsible for 10 million deaths annually by 2050 if left unchallenged. The review also projected an economic global cost of 2 to 3.5% GDP, representing a productivity loss of 100 trillion USD.

One of the most urgent and cost-effective steps to be taken now is to improve the use of antimicrobials. Unnecessary consumption of antibiotics contributes directly to drug resistance. Antimicrobial stewardship – defined by the UK National Institute for Health and Care Excellence in 2015 as "an organizational or healthcare system-wide approach to promoting the judicious use of antimicrobials to preserve their future effectiveness" – is an essential step toward addressing AMR.[1]

[1] See NICE guidance on antimicrobial stewardship here: https://www.nice.org.uk/guidance/ng15

Every year, over 23 million antimicrobial prescriptions are written for human consumption in Canada[2], 30-50% of which are estimated to be unnecessary.[3] The cost of human antimicrobial prescribing in Canada exceeds $780 million, with community dispensing accounting for 87% and hospital purchases accounting for 13% of this amount.[4] A 15% reduction in prescribing in British Columbia resulted in $50M per year in cost-savings for society, $25 million of which was saved by government.[5] These numbers – compelling in their own right – pale in comparison to the incalculable human costs that come with unchecked antimicrobial prescribing, including prolonged hospital admissions, secondary costs to patients and their families (such as caregiving and out-of-pocket expenses), and the slow erosion of effective treatments for previously manageable conditions.

Canada was once regarded as a global leader in recognizing and responding to the threat of antibiotic resistance.[6] While national progress has lagged in recent years, there are pockets of excellence and leading practices to be found across the country. One of the main challenges is to find the financial means and the political will to scale up and spread these leading practices.

This Action Plan builds on and is integrated with a number of key antimicrobial stewardship initiatives taking place in Canada and internationally. For instance, antimicrobial stewardship is one of the pillars of Canada's 2015 *Federal Framework and Action Plan on Antimicrobial Resistance and Use in Canada*. *Putting the Pieces Together – A National Action Plan on Antimicrobial Stewardship* is also heavily informed by the 2016 report on antimicrobial stewardship prepared by the Communicable and Infectious Disease Steering Committee (CIDSC) Task Group on Antimicrobial Use Stewardship and approved by the Public Health Network Council. Further, reflecting increased recognition of the importance of AMR nationally, a new Antimicrobial Resistance Steering Committee was recently established as part of an integrated "One Health" approach being employed by federal, provincial and territorial (F/P/T) governments that recognizes the interconnections between human, animals and the ecosystem and the need for multisectoral collaboration on AMR, at all levels. Task groups have been

[2] See the Canadian Antimicrobial Resistance Surveillance System Report for 2016, available at: http://healthycanadians.gc.ca/publications/drugs-products-medicaments-produits/antibiotic-resistance-antibiotique/alt/pub-eng.pdf

[3] Based on estimates from the Centres for Disease Control and Prevention in the United States, where prescribing trends are considered to be similar.

[4] See the Canadian Antimicrobial Resistance Surveillance System Report for 2016, available at: http://healthycanadians.gc.ca/publications/drugs-products-medicaments-produits/antibiotic-resistance-antibiotique/alt/pub-eng.pdf

[5] Based on a recent analysis of BC's PharmaNet database currently being written up by the British Columbia Centre for Disease Control. Contact Dr. David Patrick at the UBC School of Population and Public Health for details.

[6] As early as 2004, a comprehensive National Action Plan to Combat Antimicrobial Resistance was in place for Canada, to be coordinated by the Canadian Committee for Antimicrobial Resistance (CCAR). See: http://www.cfpc.ca/uploadedFiles/Resources/Resource_Items/Health_Professionals/AntibioticResistance.pdf. In its 2009 pan-Canadian consultation report, CCAR highlighted inadequate staffing and funding as major obstacles to achieving its mandate. Funding for CCAR ended in 2009 and it was disbanded.

launched to develop a coherent approach to guide collective efforts in addressing AMR and AMU in Canada with a focus on four key components: surveillance, stewardship, infection prevention and control and research and innovation. The *Action Plan* will directly inform the deliberations of the Stewardship Task Group.

Key Documents and Discussions Leading to this Action Plan

- Federal Action Plan on Antimicrobial Resistance and Use in Canada: Building on the Federal Framework for Action
- The Communicable and Infectious Disease Steering Committee (CIDSC) Task Group on Antimicrobial Use Stewardship: Final Report to the Public Health Network Council (2016), containing 12 recommendations for core components of an AMS program or initiative
- Building Canada's Antimicrobial Stewardship Action Plan: a HealthCare*CAN* report on Issues and Insights from Interviews with AMS key informants (April 2016)
- Championing Change: Action Steps to Inform the Canadian Roundtable on Antimicrobial Stewardship (June 2016).
- World Health Organization Global Action Plan on Antimicrobial Resistance (2015)
- Canada Communicable Diseases Report: Antimicrobial Stewardship (June 18, 2015), featuring information from successful stewardship programs and Canada's Action Plan on AMR.
- Canadian Roundtable on Antimicrobial Stewardship: Meeting Report (July 2016)

Significant action is also taking place at the international level. G7 and G20 countries have stressed the threat of AMR in recent meetings, and WHO member states adopted a Global AMR Action Plan in 2015.[7] In September 2016, the United Nations General Assembly highlighted AMR at a high-level meeting of heads of state and ministers.[8] The United States and the United Kingdom, among many other countries, are contributing hundreds of millions of dollars into combating AMR through education, research, and supportive policy. Canada's recent announcement of $9M to fund the Global Action Plan shows that we are also moving in the right direction in this space.[9]

[7] The Global AMR Action Plan can be read at: http://www.wpro.who.int/entity/drug_resistance/resources/global_action_plan_eng.pdf

[8] Read about the UN High-level meeting on antimicrobial resistance at: http://www.un.org/pga/71/event-latest/high-level-meeting-on-antimicrobial-resistance/

[9] The Government of Canada's news release on this recent commitment can be read at: http://news.gc.ca/web/article-en.do?nid=1155979

Antimicrobial Stewardship Action Roundtable

It is in this context that, on June 16-17, 2016, over 50 "Champions of Change" – experts, key influencers and stakeholders in the fields of AMS and AMR – gathered in Toronto, Ontario, to begin developing a national Action Plan, spanning hospital, long-term care and community settings.[10]

The Canadian Roundtable on Antimicrobial Stewardship was guided by the following set of key assumptions:

1. Canadian efforts need to be seen as part of a global AMR effort that recognizes the four pillars of stewardship, surveillance, infection prevention and control, and innovation;
2. The primary focus of the Roundtable was on stewardship of antimicrobials used in human health, recognizing that this is only part of a broader One Health stewardship landscape that includes animal health, agriculture, and the environment; and,
3. Improved human health prescribing requires action that cuts across hospital, long-term care and community-based care settings, and is supported by dedicated human and technical resources.

This document builds on those deliberations. It describes a national multi-sectoral, concrete approach to developing antimicrobial stewardship in Canada, including key actions, partnerships, accountabilities, and resource needs. Successful implementation of this Plan holds the promise of markedly improving appropriate antimicrobial prescribing in Canada in ways that will significantly benefit both public health and the public purse.

AMS Success 2020

Roundtable participants developed a success statement for what Canada ought to be able to achieve by the year 2020:

"We have optimized the use of antimicrobials in Canada through a unified approach that connects human, animal, and environmental health, improves health outcomes, contributes to reducing antimicrobial resistance, and re-establishes Canada as a global leader in antimicrobial stewardship. We have accomplished this through:

- *Accountable and coordinated leadership across jurisdictions and professions;*
- *Heightened public, patient, and healthcare provider awareness of the importance of antimicrobial stewardship and uptake of optimal prescribing practices;*
- *A pan-Canadian approach providing for reasonably comparable or equitable programming;*

[10] See Appendix 1 for a list of participants at the Canadian Roundtable on Antimicrobial Stewardship.

- *Demonstrated improvements in AMS innovation, education, measurement, and research; and*
- *The development of efficient ways to implement or scale up leading practices across Canada."*

Participants affirmed the importance of strong leadership and clear accountabilities, while acknowledging that the responsibility for new and concerted action on antimicrobial stewardship would be shared among stakeholders. Ten Actions are described below. They specify how Canada can maximize the impact of its stewardship activities. Stewardship policy and programming need to advance in all hospital, long-term care and community-based care settings, and different settings will require different solutions. This plan addresses Actions for healthcare bodies, governments and institutions first, and moves on to describe the equally important and necessary Actions in AMS research, community AMS and AMS knowledge translation. Taken together, these Actions will nurture a culture of appropriate prescribing that prioritizes public health by preserving the effectiveness of antimicrobials for future generations.

Key Actions in the National Action Plan on Antimicrobial Stewardship

- **Action 1:** Convene and Fund a National Network to Coordinate Stewardship: "AMS Canada"
- **Action 2:** Nominate Executive Leads on AMS at the Federal/Provincial/Territorial Levels for Strategic Planning and Implementation
- **Action 3:** Enhance Accreditation for AMS
- **Action 4:** Support and Scale Up Core Operations in Hospital-Based AMS
- **Action 5:** Enhance Awareness of AMR and AMS among Prescribers and the Public
- **Action 6:** Establish an AMS Research and Development Fund
- **Action 7:** Develop and Support Core Datasets in AMU Surveillance
- **Action 8:** Incent Community Prescribers Using Audit and Feedback Mechanisms
- **Action 9:** Develop National Guidelines for Antimicrobial Prescribing and Mechanisms to Promote Adoption
- **Action 10:** Develop a Network of Centres of Excellence in Knowledge Mobilization (NCE-KM) for AMS

Action 1: Convene and Fund a National Network to Coordinate Stewardship: "AMS Canada" (Antimicrobial Stewardship Canada)

Addresses Recommendation 1 from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

Progress in AMS has been a challenge because the actions required fall under many jurisdictions, disciplines and sectors. These include: provincial and territorial governments (i.e., health care provision), the federal government (i.e., public health leadership and healthcare services to specific populations), federally funded bodies (including the Canadian Institutes for Health Research and the Canadian Institute for Health Information), other national organizations such as Accreditation Canada, HealthCare*CAN*, and NCCID, healthcare organizations (e.g. regional health authorities, hospitals and long term care facilities), healthcare providers (including doctors, nurses, pharmacists, dentists), regulatory colleges, professional associations, civil society and patient advocacy groups, and so on. There is a clear need for leadership and coordinated action to address antimicrobial resistance, and to facilitate the scale-up and spread of leading practices across the country.

This leadership and coordination will be provided by a national network of key stakeholders in antimicrobial stewardship including influencers, government agencies, service delivery organizations, and health services researchers. Hereafter, we refer to this network as "AMS Canada".

AMS Canada will not require substantial new infrastructure and can exist as a network of AMS leaders supported by their respective institutions. In advance of the AMS Action Roundtable, many of these leaders made commitments on AMS (see Appendix 2) that will be mobilized immediately by AMS Canada. A proposed membership and terms of reference for AMS Canada will be developed by the end of 2016, as well as a detailed workplan, including key initial activities for implementing this Action Plan.

This body, guided by an AMS Canada Steering Committee, will also play a key role in influencing and supporting F/P/T discussions on AMS. AMS Canada will co-ordinate and inform stewardship projects across the country, allowing activities and outputs from member organizations to be easily leveraged to support the work of others. This will allow for multi-sectoral and multi-disciplinary projects while at the same time respecting individual member mandates and responsibilities.

Action 2: Nominate Executive Leads on AMS at the Federal/Provincial/Territorial Levels for Strategic Planning and Implementation

Addresses Recommendation 1 from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

Improved coordination across federal/provincial/territorial health systems could greatly improve progress to address antimicrobial resistance and improve antimicrobial stewardship. National interventions in hospital, long-term care and community-based care settings are possible and achievable. We need only look to Canada's significant and commendable efforts promoting smoking cessation and immunization programs as examples of what Canada can accomplish with political will and targeted resources.

The formation of an F/P/T governance structure on AMR is a strong signal that Canada is taking the threat of AMR and the health and safety of Canadians seriously. To make further progress on AMS; however, Canada will need to establish a clear and efficient leadership structure to support planning and implementation of AMS policies and programs at all levels.

In September 2009, CCAR reported that the lack of an identified lead for AMR within the federal government was a major barrier to progress in achieving its mandate.[11] We therefore recommend that the federal government, as well as the provinces and territories, nominate executive leads on AMS; senior government staff knowledgeable on matters related to AMS who are empowered to work with provider groups to move quickly on AMS projects where necessary.

These executive leads would work with AMS Canada to ensure that AMS Canada's activities are coordinated with F/P/T activities in combating AMR, including stewardship, surveillance, infection prevention and control, and innovation, across all sectors and domains of practice (e.g. agriculture, veterinary care). They would also act as federal/provincial/territorial 'point persons' on the implementation of this action plan, ensuring that responsibility is taken for those aspects of the plan that fall under government remit. With these 'point persons' in place, AMS Canada will be able to effectively coordinate AMS efforts with governments where implementation hurdles present themselves, making for a smoother and more effective deployment of the action plan.

[11] See Appendix E-4 of NCCID's 'Surveillance of Antimicrobial Resistance and Antimicrobial Utilization in Canada': http://bit.ly/1XYfkdB

Action 3: Enhance Accreditation for AMS

Addresses Recommendations 2, 4, and 10 from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

Accreditation Canada is a major driver of stewardship in Canadian healthcare facilities. In 2013, Accreditation Canada began assessing a Required Organizational Practice (ROP) on AMS, establishing AMS as an accreditation requirement. The ROP currently applies to organizations providing inpatient acute care, inpatient cancer care, inpatient rehabilitation, and complex continuing care. It does not presently apply to institutions providing long-term care. Accreditation Canada's actions have provided healthcare institutions delivering acute care with a powerful incentive to invest in stewardship. As presently defined, Accreditation Canada's ROP assesses five criteria for compliance which are outlined in the box below.

Accreditation Canada's Antimicrobial Stewardship ROP

Institutions providing inpatient acute care, inpatient cancer care, inpatient rehabilitation and complex continuing care must meet a set of tests for compliance in order to satisfy the ROP. These include:

- The organization implements an antimicrobial stewardship program.
- The program includes lines of accountability for implementation.
- The program is interdisciplinary, involving pharmacists, infectious diseases physicians, infection control specialists, physicians, microbiology staff, nursing staff, hospital administrators, and information system specialists, as available and appropriate.
- The program includes interventions to optimize antimicrobial use, such as audit and feedback, a formulary of targeted antimicrobials and approved indications, education, antimicrobial order forms, guidelines and clinical pathways for antimicrobial utilization, strategies for streamlining or de-escalation of therapy, dose optimization, and parenteral to oral conversion of antimicrobials (where appropriate).
- The organization establishes mechanisms to evaluate the program on an ongoing basis and shares results with stakeholders in the organization.

The ROP provides a framework for implementing an AMS program while allowing flexibility, encouraging organizations to tailor an approach to antimicrobial stewardship that is consistent with their size, environment, and patient population. Nevertheless, many institutions have failed to meet this ROP since assessment began. In 2013, compliance was only 57%, rising to 63% and 78% in 2014 and 2015, respectively.[12] One possible reason for this low compliance is that the ROP is relatively new, and many

[12] See "Quality and Safety in Canadian Health Care Organizations: The Accreditation Canada Report on Required Organizational Practices" available at: https://accreditation.ca/sites/default/files/rop-report-2015.pdf

institution-based antimicrobial stewardship programs remain underdeveloped. Another possibility is that the perceived importance of stewardship among executives may remain low relative to the wide array of competing priorities involved in managing a facility's budget. In consequence, administrators and medical staff may lack relevant training, resources, and other supports necessary to achieve compliance with the ROP.

The United States Centres for Disease Control and Prevention publishes 'Core Elements of Antimicrobial Stewardship Programs' as part of its 'Get Smart for Healthcare', and these core elements mostly mirror the tests from Accreditation Canada's ROP[13]. These elements include:

- Leadership Commitment: Dedicating necessary human, financial and information technology resources
- Accountability: Appointing a single leader responsible for program outcomes.
- Drug Expertise: Appointing a single pharmacist leader responsible for working to improve antibiotic use.
- Action: Implementing at least one recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (i.e. "antibiotic time out" after 48 hours)
- Tracking: Monitoring antibiotic prescribing and resistance patterns
- Reporting: Regular reporting information on antibiotic use and resistance to doctors, nurses and relevant staff
- Education: Educating clinicians about resistance and optimal prescribing

CDC considers educating clinicians about resistance and optimal prescribing to be a 'core element' of antimicrobial stewardship programming in healthcare facilities. While Accreditation Canada names education in the list of interventions that can be included in an organization's AMS program, education is not specifically required as its own test for compliance. In the future, Accreditation Canada can take action by specifically assessing education of staff in healthcare facilities as part of this ROP.

A second key consideration involves long-term care facilities. As noted previously, Accreditation Canada's ROP on stewardship does not currently apply to institutions providing long-term care. Figures in Canada are limited, but as CDC notes, antibiotics are among the most frequently prescribed medications in American nursing homes, with up to 70% of residents receiving one or more courses of systemic antibiotics over a year; a significant fraction of these is thought to be inappropriate.[14] Moreover, and as CDC notes, harms from antibiotic overuse are more significant in frail and older adults who reside in long-term care facilities. These harms include risk of serious diarrheal infections from *Clostridium difficile*, increased adverse drug events and drug interactions, and colonization and/or infection with antibiotic-resistant organisms. As a leading influencer in antimicrobial stewardship, Accreditation Canada may wish to consider expanding the reach of its ROP into other care settings where AMS programming is underdeveloped, including long-term care facilities. It is also important to

[13] CDC's 'Core Elements' are discussed in detail here: http://www.cdc.gov/getsmart/healthcare/pdfs/core-elements.pdf

[14] See CDC's "Core Elements for Antibiotic Stewardship for Nursing Homes" available at: http://www.cdc.gov/longtermcare/pdfs/core-elements-antibiotic-stewardship.pdf

note that stewardship accreditation does not include community-based care and therefore there is a need for innovative approaches to ensure appropriate use of antimicrobials in this setting.

Action 4: Support and Scale Up Core Operations in Hospital-Based AMS

Addresses Recommendations 2, 4, and 10 from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

Accreditation Canada's stewardship ROP has created a powerful incentive for hospitals to invest in AMS programming. To complement the ROP, funding can be provided directly to AMS programs to help support hospitals as they develop their AMS programs. The combination of these two strategies will be particularly effective.

Similar strategies have improved prescribing in some of Canada's more successful examples of hospital-based stewardship. The Mount Sinai Hospital-University Health Network Antimicrobial Stewardship Program, for example, was funded under a grant through the Council of Academic Hospitals of Ontario (CAHO) Adopting Research to Improve Care (ARTIC) program under the Ontario Ministry of Health and Long-Term Care. Additional funding for the second phase of this program came from Public Health Ontario, expanding stewardship programs to Ontario community hospitals.[15] Successes in hospital-based AMS in Alberta have also been the result of directed investments. Alberta employs a province-wide program that includes groups of hospitals with the goal of avoiding the duplication of efforts among institutions. For example, Calgary's five hospitals fall under one stewardship program, which receives direct funding from Alberta Health Services.

Directed funds will serve as catalysts for adapting and developing optimal AMS programming. AMS Canada proposes to act as a national funder of hospital-based stewardship programs, supporting start-up efforts and maintenance costs. Hospitals will be expected to provide matching investments in their own programs, lowering costs and instilling a sense of ownership at the corporate level.

[15] For more details, see the team's article entitled "Developing and expanding hospital antimicrobial stewardship: The Ontario experience" here: http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/15vol41/dr-rm41s-4/assets/pdf/15vol41-s4-eng.pdf

Action 5: Enhance Awareness of AMR and AMS among Prescribers and the Public

Addresses Recommendations 2, 3, and 4 from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

Community-based AMS is significantly different than hospital-based AMS. Unlike in hospitals, community prescribing is undertaken by independent clinicians (e.g. physicians, dentists, nurses) whose prescribing patterns are, for the most part, not open to review. Patient attitudes vis-a-vis AMU also play a significant role in the community setting. These attitudes vary widely. Some patients demand antimicrobials for minor viral infections, while others avoid antimicrobials at all costs. AMU in the community setting – both appropriate and inappropriate – is driven by the interaction of prescriber tendencies and consumer demand. In this context, it is important to note the value that can result from one-on-one conversations about AMU between patients and their healthcare providers. Effective engagement often begins with an improvement in the public's health literacy, and actions on this front should take particular note of groups that are not easily reached. To facilitate that engagement, both community prescribers and the public must be educated about AMR and AMS for community-based AMS programming to change the culture of antimicrobial use.

Various AMR awareness campaigns have been launched and evaluated across Canada. The CIDSC Task Group on Antimicrobial Use Stewardship Report (2016) identified a range of community AMS awareness-raising exercises. Notable examples include: Alberta and BC's multi-module education program, 'Do Bugs Need Drugs', PHAC's 2014 pilot national AMR awareness campaign, Quebec's multipronged education strategy on antibiotic prescribing, and Ontario's pilot study for appropriate anti-infective community therapy. Many of these programs have been evaluated specifically for their effects on antimicrobial use, and have been associated with moderate reductions in AMU. Taken as a whole, the available literature suggests that awareness-raising can be an important component of outpatient AMS. It is important to note, however, that based on studies conducted in healthcare institutions, education alone seems to be only marginally effective in changing prescribing practices and may not produce a sustained impact in the absence of more active interventions.[16] [17] These more active interventions are discussed in Actions 8 and 9.

[16] See, for example, the IDSA/SHEA Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship: http://cid.oxfordjournals.org/content/44/2/159.full

[17] It is not at all clear how far this claim extends into outpatient antimicrobial stewardship. In healthcare institutions, AMU is driven almost exclusively by the habits of clinicians. In the outpatient setting, as noted, patient demand is a significant driver of antimicrobial prescribing and use. Patients and clinicians will require different, tailored education and knowledge translation to address their respective behaviours and needs.

Although tools for community-based AMS have been developed and evaluated, they have not been adapted or consistently adopted in Canada. The CIDSC Task Group found eight Canadian programs focused on outpatient knowledge mobilization and awareness. These programs operated in a variety of settings and timescales and under a diversity of funding arrangements (see Annex E, Table 5). This piecemeal approach does not serve Canada as a whole. Comprehensive AMS in Canada has been weak, and for the most part the campaigns have been short-lived. Moreover, there is inadequate coordination to share practice-based knowledge on how best to implement and adapt programs. As a nation, we can strive for wider and more coordinated clinician-public education on antimicrobial resistance and stewardship.

That being said, Canada's experiences with different kinds of education programs creates a 'policy lab' environment, where the strengths and weaknesses of each can be assessed. This will allow for optimal methods, messages, and target audiences to be refined. To this end, AMS Canada will oversee and support an analysis of present and past community antimicrobial stewardship programs by:

1. Engaging experts with practice-based knowledge in delivery of campaigns to public and professional audiences;
2. Conducting an inventory of leading campaigns and their tools and resources;
3. Conducting a needs analysis to identify gaps in past and existing campaigns;
4. Assessing scalability of leading practices; and,
5. Building strategic partnerships for the national dissemination of campaign materials

This analysis will provide insights about effective strategies. Based on this new information, AMS Canada will work with AMS experts to build and spread a national community AMS program to enhance awareness of AMR and AMS among clinicians and the public.

Action 6: Establish an AMS Research and Development Fund

Addresses Recommendations 8, 9, 10, and 11 from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

To deploy effective AMS programming, Canada must invest in a dedicated research agenda for AMS. Current gaps in evidence include the following:

- Canada does not have targets and benchmarks for antimicrobial use in hospital, long-term care and community-based care. This is a crucial missing step in the monitoring and evaluation of stewardship programs.
- The resources required for effective stewardship programs have not been defined and published. Cost analyses are needed to inform directed funding for stewardship.

- AMU surveillance is often limited to identifying prescribed antimicrobials and inconsistent measures of how they are being used. There is a need for information on how much antimicrobial use is *appropriate*, not simply how much is being used. This requires that indicators for appropriate antimicrobial use be developed and validated.
- The challenges associated with AMS deployment, scale and spread in different settings are under-researched and poorly understood. Further information is needed on how AMS interventions will be experienced by those who will be affected. For example, the perception of AMS programming among Indigenous prescribers and patients (both on and off reserve) has not been investigated, and should serve as a critical starting place.
- The causes and predictors of inappropriate antimicrobial prescribing and use are not completely understood. Research in this line will provide crucial background towards developing programs that work.
- Inappropriate prescribing is often a product of misdiagnosis. AMS would benefit considerably from research to inform the development of rapid and precise diagnostic tools to determine bacterial vs viral infections, drug resistance and susceptibility.

To take action on these gaps at a national level, Canada needs a *National AMS Research and Development Fund t*hat will support these and other research priorities. The Fund – ideally to be administered through AMS Canada – will also be leveraged to support the scale, spread, and evaluation of stewardship programs in hospitals, as well as community and long-term care. The precise research agenda to be financed under the National AMS Research and Development fund will be developed in a detailed workplan by AMS Canada's Steering Committee.

Several funding models exist for a granting body of this scale. The fund could be resourced through a CIHR SPOR (Strategy for Patient Oriented Research) network in a model similar to the Pan-Canadian SPOR Network in Primary and Integrated Healthcare Innovations, a network of networks building on regional and national assets to foster alliances between research, policy, and practice. As mentioned previously, Mt. Sinai-UHN's ASP was launched under CAHO's ARTIC program; a similar approach could be taken nationally, resulting in a kind of CAN-ARTIC model for the funding of stewardship research. Alternatively, the fund could be structured similarly to the Canadian Immunization Research Network, which receives funding from CIHR, PHAC, and Provincial/Territorial sources. Regardless of how it is resourced, an initial commitment of roughly $10M over 5 years would be appropriate as a starting point for this fund to act as a potent driver of new stewardship knowledge and evaluation of ongoing projects.

Action 7: Develop and Support Core Datasets in AMU Surveillance[18]

Addresses Recommendations 8, 9, and 11 from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

The Canadian Antimicrobial Resistance Surveillance System (CARSS) of the Public Health Agency of Canada provides an integrated, national picture of antimicrobial use and resistance in Canada based on available surveillance data from its nine different AMR/AMU surveillance systems.[19] Although the launch of CARSS in 2015 has helped to improve national surveillance, gaps remain. This is partly because the AMU data are not sufficiently granular. National-level data include information on pharmacy dispensing, antimicrobials purchased by hospitals, and information about community diagnosis within three regions (West, Central, and East). These data provide a useful but incomplete picture of AMU.

Standardized Metrics for AMU Surveillance

Further research is needed on an optimal standard for AMU surveillance in different contexts. Generally speaking, DOTs are the internationally preferred standard for use in facility-based stewardship programs, but this measure has drawbacks. The US Centres for Disease Control and Prevention have developed a risk-adjusted national benchmark measure for antibiotic use in healthcare facilities; as more facilities implement the measure, comparisons between facilities will become easier and more actionable. A working group based out of Alberta is currently developing a similar metric for surveillance and benchmarking that promises to be the first of its kind in Canada. Such a tool will play a valuable role in Canada's overall AMU surveillance framework, provided it can be validated. Validating a standardized metric for AMU surveillance in hospitals would be an important research goal potentially funded through the R&D fund proposed in Action 6. Similarly, it will be important to establish standard metrics for AMU surveillance in other settings, such as primary care, dentistry and long-term care facilities.

[18] In this section, we focus on surveillance of AMU, but other forms of surveillance are also relevant and important in the AMR landscape. Surveillance of resistance and sensitivity in pathogens is an important element of CARSS and should be seen as a priority area in Canada's response to AMR. Surveillance of patient outcomes is also a growing area of interest in AMR. Action on these parallel issues in AMR surveillance will inform policymakers on the impact of stewardship efforts.

[19] One of these systems is the Canadian Nosocomial Infection Surveillance Program (CNISP), which provides rates and trends of healthcare-associated infections at Canadian healthcare facilities, thus enabling comparison of rates (benchmarks), and providing data that can be used in the development of national guidelines on clinical issues related to healthcare-associated infections.

A second concern relates to the metric used to define AMU data. AMU can be described in different ways depending on the objectives of the surveillance team. Examples include Days of Therapy (DOT), Daily Defined Doses (DDD) and Number of Prescriptions, among others. All of these are viable metrics that have important advantages and disadvantages in AMU surveillance. However, because there is a diversity of metrics available and their use depends on the particular circumstances of the reporting institution, metrics are often not reported consistently. T his issue is compounded by the fact that AMU surveillance efforts are taking place at local levels (e.g., hospital-based AMU surveillance) and may not feed into CARSS. These factors make the case for the development of a more comprehensive surveillance system that incorporates data from a broader set of sources and encourages the use of standardized metrics. AMS Canada will be well positioned to help coordinate the development of core datasets in AMU surveillance with key partners including the PHAC, CIHI, Provinces and Territories, hospitals and health authorities.

A more robust surveillance system would include data on which clinicians (including physicians, nurse practitioners, pharmacists, and dentists) are prescribing which therapies for which indications or diagnoses. The Canadian federal budget recently allocated $40M toward the development of a national electronic prescription monitoring system in partnership with Canada Health Infoway. Recent comments from Canada's Health Minister have positioned it as a tool for monitoring opioid prescriptions.[20] In principle, the system should make it possible to track community antimicrobial prescribing as well. AMS Canada will consult with Canada Health Infoway to gain insight into this project's direction and its potential as an AMU surveillance tool. If it proves suitable for this purpose, CIHI will also be engaged on AMU surveillance policy in connection with the monitoring system as the national collector and distributor of health information. PHAC and other existing data system administrators and relevant research centres across Canada will also be consulted in order to gain a more in-depth appreciation of differing regional capacities and data access constraints.

[20] See Health Minister, Dr. Jane Philpott's recent remarks at the 2nd 'Charting the Future of Drug Policy in Canada' Conference. June 17th, 2016: http://news.gc.ca/web/article-en.do?nid=1086489

Action 8: Incent Community Prescribers Using Audit and Feedback Mechanisms

Addresses Recommendations 2, 3, 6, 9, 10, and 11 from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

Progress in AMS requires that there are incentives for healthcare professionals to change their prescribing behaviours. In the inpatient setting, the current evidence shows that audit and feedback measures are among the most powerful tools for changing patterns in the prescribing of antimicrobials, although these audit programs are not universally applied. Outside of hospitals, there are no consistent or comprehensive processes for assessing the prescribing patterns of individual clinicians, though some professional regulators and provinces are considering indicators of prescribing patterns that can be found in administrative and dispensing data.[21]

Under the proposed national electronic prescription monitoring system discussed in Action 7, it may soon be possible to assess the antimicrobial prescribing habits of individual clinicians. With AMU data at this level of specificity, it will be possible to build audit and feedback mechanisms for community care using incentive and regulatory programs.[22] The system will therefore operate not only as a more comprehensive surveillance tool, but also as a means of nudging prescriber behaviour toward more appropriate antimicrobial use. The initial steps in this vein can be surprisingly simple, cheap and effective. For instance, in the United Kingdom, a simple letter to high-prescribing community physicians from the Chief Medical Officer for England found a small but significant reduction in antimicrobial prescribing relative to controls.[23]

In Canada, it may eventually be possible to go even further by incorporating feedback into natural pathways of peer review and regulation. Prescribers are more likely to respond to feedback from an educator or regulator than an impersonal letter from government. With this kind of functionality in play, it may be possible to improve on the results seen thus far in the UK. System developers should keep this goal in mind when designing the prescription monitoring system.

[21] For example, the Manitoba Centre for Health Policy will be looking at the feasibility of indicators of prescribing patterns in Manitoba; the BCCDC is able to use pharmacy and laboratory datasets to describe prescribing in British Columbia

[22] In an audit and feedback process, individuals' professional practice or performance are measured and then compared to professional standards or targets. The aim of this process is to encourage prescribers to follow professional guidelines; seeing how their own practices differ from the desired standards is an incentive to change prescribing habits. See the 2012 Cochrane Review of audit and feedback measures in professional practice and healthcare outcomes: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD000259.pub3/abstract

[23] The study can be read in its entirety at: http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(16)00215-4.pdf

Action 9: Develop National Guidelines for Antimicrobial Prescribing and a Mechanism to Promote Adoption

Addresses Recommendations 2, 3 4 5, 7, and 12, from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

Canada currently does not have national-level guidelines for antimicrobial prescribing. In the absence of national guidelines, clinicians rely on a combination of clinical judgement and consideration of regional or discipline-specific guidelines and standards on antimicrobial prescribing.

AMS Canada will co-ordinate and support the development of national meta-guidelines to provide guidance on appropriate antimicrobial prescribing for common infections. These efforts will involve an expert working group, including members who developed existing guidelines, to assess the minimal, evidence-informed elements of standardized guidelines. The work will call for compiling exiting guidelines and mapping their availability to assess gaps. It is important to proceed in partnership with provincial authorities, colleges and associations of prescribers, who are well positioned to influence uptake of guidelines by prescribers under their purview. As well, the development of meta-guidelines would be coupled with a strategic dissemination strategy, prioritizing disciplines and areas of practice or jurisdictions where guidance has been unavailable, inaccessible or inconsistent. The needs of regions and facilities to adapt prescribing practice to local epidemiology will be accommodated. The development of such guidelines could be supported through the AMS Research & Development Fund proposed in Action 6.

These prescribing guidelines should be supported by a mechanism or set of mechanisms to promote compliance. Incentive programs for good prescribing practices can be enabled by an electronic prescription monitoring system as discussed in Action 8, but other options are also available. National professional organizations including the Royal College of Physicians and Surgeons of Canada or the College of Family Physicians Canada could award an accreditation or recognition of prudent use of antibiotics after a mandatory course on antimicrobial stewardship. Uptake of national prescribing guidelines should be promoted in residency training programs for family and specialist physicians. One such program, for example – called 'Décision Plus' – has been embedded as a mandatory component of family medicine residency training programs at 12 sites in eastern Quebec and is currently being evaluated for inclusion in emergency medicine training programs. Evaluations of Décision Plus have shown a favourable impact on antimicrobial prescribing and patients' perception of having been involved and engaged in health decision-making.[24] When integrated with national prescribing guidelines, these and other mechanisms (such as for dentists and other professions) have a strong chance of penetrating into prescribing behaviour and meaningfully reducing inappropriate antimicrobial use overall.

[24] One of these evaluations was published in the Canadian Medical Association Journal and can be found open-source here: http://www.cmaj.ca/content/184/13/E726.full.pdf+html?sid=42247442-bd5a-4cd3-bf75-e049e3262e0d

Action 10: Develop a Network of Centres of Excellence in Knowledge Mobilization (NCE-KM) for AMS

Addresses Recommendations 1, 2, 4, and 10 from the 2016 CIDSC Task Group Report on Antimicrobial Use Stewardship

Advancing antimicrobial stewardship in Canada requires the development and communication of strategic information to leaders and practitioners who can put this information to effective use. Knowledge producers and knowledge users need to be better connected. Currently there is no national centre for dissemination of evidence and other knowledge related to AMS in Canada. The result is that stewardship information (including what has been tried, what works and what doesn't work in various settings) is relatively siloed.

To bridge this gap, AMS Canada will develop a Network of Centres of Excellence on AMS. The Network of Centres of Excellence Initiative in Knowledge Mobilization (NCE-KM) is a partnership between Industry Canada and Health Canada that supports knowledge mobilization collaborations between academia, industry, government and not-for-profit organizations across sectors and disciplines. The program supports such collaborations for approximately $400,000 per year for four years, with the possibility of a three-year extension. Eligibility to compete for funding under this initiative requires that a Canadian university act as host.[25]

An Academic Host for the NCE

The NCE will require an academic host, and to this end the capacity of Canadian universities to host the NCE should be considered by AMS Canada. Qualifying criteria should include a demonstrated ability to broker partnerships across sectors and to bring in public health perspectives.

The NCE-KM will need representation from a broad range of well-positioned knowledge translation and mobilization experts from various areas including medicine, nursing, pharmacy, dentistry, patient safety and animal health. We anticipate that the network's membership will largely be made up of AMS Canada members, meaning that its activities can be coordinated with those of AMS Canada to ensure their maximum effect.

[25] Program details can be found in the NCE program guide, which can be retrieved from: http://www.nce-rce.gc.ca/ReportsPublications-RapportsPublications/NCE-RCE/ProgramGuide-GuideProgramme_eng.asp

The stated goal of the NCE program is to mobilize Canada's research talent in the academic, private, public, and not-for-profit sectors and apply it to improving the quality of life of Canadians. To meet that goal, this NCE would act as a national clearinghouse for materials related to AMS in healthcare institutions and community settings. These materials can include: academic publications (e.g., systematic reviews and meta-analyses on the effect of AMS programs), AMS program evaluations, staffing models for hospital-based stewardship, reviews of antimicrobial stewardship software, training materials for community clinicians, and related materials. The NCE would also have access to the skills and expertise necessary to support a national public and professional education campaign, as discussed under Action 5.

Conclusion

This document lays out a set of ten key Actions that Canada should take in the area of human health to advance antimicrobial stewardship. These ten Actions are the product of many months of consultation, debate, deliberation, and synthesis of information from diverse quarters in Canada's AMS landscape. We anticipate that these Actions will eventually form part of an integrated action plan on AMS that includes human health, agriculture, and veterinary medicine.

Delivering on the promise of this Action Plan will begin immediately. In fall 2016, HealthCare*CAN* and the NCCID, with support from the PHAC, brought together a steering (implementation) group of core stakeholders to develop draft terms of reference for AMS Canada, including a proposed membership. At that time, AMS Canada began coordinating accountabilities and responsibilities among its members. AMS Canada will also develop implementation targets, programming plans, and a proposed budget with respect to achieving the Actions that fall under its mandate.

In the medium term, national stewardship efforts are required in agriculture and veterinary medicine with the understanding that a "One Health" perspective is necessary to maximize the benefits of stewardship. Actions outside of human health are not identified in this Action Plan. However, it is essential that these be developed with experts in animal health in parallel with those presented here.

The implementation of the Actions presented in this document will achieve real progress toward extending the life cycle of antimicrobials by reducing inappropriate human antimicrobial use. Ultimately, they will prevent the erosion of tools we badly need to protect the public. These steps will only be effective if governments and health system leaders take them seriously. We have a coalition of committed and highly motivated leaders and stakeholders willing to assume leadership in AMS. With a plan and the resources to deploy it, this coalition can take concrete actions to promote the prudent use of antimicrobials.

Appendix 1: List of Participants at the Canadian Roundtable on Antimicrobial Stewardship

Participant	Organization
Ms. Alainna Jamal MD-PhD Student, Students for Antimicrobial Stewardship Society (SASS Canada) Co-Chair	University of Toronto
Dr. Allison McGeer Medical Director, Infection Control	Sinai Health System
Dr. Andrew Morris Director, Antimicrobial Stewardship Program	Mount Sinai Hospital-University Health Network
Ms. Anne MacLaurin Patient Safety Improvement Lead	Canadian Patient Safety Institute
Dr. Arjun Srinivasan Associate Director for Healthcare Associated Infection Prevention Programs	Centers for Disease Control and Prevention
Ms. Baillie Redfern Medical Student	Indigenous Physicians Association of Canada
Ms. Bersabel Ephrem Director General	Public Health Agency of Canada
Mr. Bill Tholl President & CEO	HealthCare*CAN*
Dr. Bonnie Henry BC Deputy Provincial Health Officer	BC Ministry of Health
Ms. Carole Nesbeth Policy Manager	Public Health Agency of Canada
Dr. Charles Frenette Medical Director Infection Prevention and Control	McGill University Health Center
Mr. Charles Thompson Research & Policy Analyst	HealthCare*CAN*

Participant	Organization
Ms. Cheryl Robbins Board member	Canadian Indigenous Nurses Association
Professor Colleen Flood Professor and Director	University of Ottawa Centre for Health Law Policy and Ethics
Dr. David Patrick Director	School of Population and Public Health – UBC, BCCDC
Ms. Dorothy A Strachan Partner	Strachan-Tomlinson
Dr. France Légaré Full Professor/ Canada Research Chair in Shared Decision Making and Knowledge Translation	Laval University/ CHU de Québec and Université Laval
Mr. Greg Penney Director, National Programs	Canadian Public Health Association
Dr. Gregory Taylor Chief Public Health Officer	Public Health Agency of Canada
Ms. Harpa Isfeld-Kiely Senior Project Manager	National Collaborating Centre for Infectious Diseases
Ms. Helene Sabourin Senior Director, Governance, Corporate Strategy and Quality	Accreditation Canada
Mr. Ian Culbert Executive Director	Canadian Public Health Association
Ms. Jacqueline Arthur Manager, Strategic Issues, Centre for Communicable Diseases and Infection Control	Public Health Agency of Canada
Dr. Jane Pritchard Chair, Council of Chief Veterinary Officers, CVO BC, Executive Director Plant and Animal Health Branch	BC Ministry of Agriculture

Participant	Organization
Ms. Jennifer Kitts Director, Policy and Strategy	HealthCare*CAN*
Ms. Jennifer Raven Project Lead, Major Initiatives	Canadian Institutes of Health Research
Dr. John Conly Medical Director - Infection Prevention & Control & Antimicrobial Stewardship/Professor of Medicine	Foothills Medical Centre/University of Calgary
Dr. John O'Keefe Director, Knowledge Networks	Canadian Dental Association
Ms. Josette Roussel Senior Nurse Advisor	Canadian Nurses Association
Ms. Judy Hodge Public Health Veterinarian	Katrime Integrated Health
Dr. Kanchana Amaratunga Public Health Medical Advisor	Public Health Agency of Canada
Ms. Karen Michell Executive Director	Council of Academic Hospitals of Ontario
Ms. Kira Leeb Director, Health System Performance	Canadian Institute for Health Information
Dr. Lindsay Ellen Nicolle Professor of Internal Medicine and Medical Microbiology	University of Manitoba
Dr. Manisha Mehrotra Director, Human Safety Division	Veterinary Drugs Directorate, Health Canada
Dr. Marc Ouellette Scientific Director	CIHR Institute of Infection and Immunity
Ms. Margaret Haworth-Brockman Senior Program Manager	National Collaborating Centre for Infectious Diseases

Participant	Organization
Dr. Marissa Becker co-Scientific Director	National Collaborating Centre for Infectious Diseases
Ms. Mary Carson Program Coordinator	Do Bugs Need Drugs / Alberta Health Services
Ms. Mary Elias Senior Analyst	Canadian Institute for Health Information
Dr. Michael Routledge Chief Provincial Public Health Officer	Manitoba Health, Seniors and Active Living
Dr. Nisha Thampi Assistant Professor and Pediatric Infectious Diseases Consultant	Children's Hospital of Eastern Ontario
Dr. Roy Wyman Director	The College of Family Physicians Canada
Mr. Santiago Diaz Patients for Patient Safety Champion	Canadian Patient Safety Institute
Ms. Sarah Silverberg MD Student / Students for Antimicrobial Stewardship Society (SASS) Co-Chair	University of Toronto
Ms. Shannon Pearson Project Officer	CIHR - Institute of Health Services and Policy Research
Dr. Shelita Dattani Associate Director, Professional Development	Canadian Pharmacists Association
Dr. Shelly McNeil Chief, Division of Infectious Diseases	Nova Scotia Health Authority
Mr. Shiv Brar Acting Director, Division of Anti-Infective Drugs	Bureau of Gastroenterology, Infections & Viral Diseases, Therapeutic Products Directorate
Mr. Simon Habegger Lead, Do Bugs Need Drugs	Alberta Health Services

Participant	Organization
Dr. Stephan Harbarth Professor	Hôpitaux Universitaires de Genève, Service Prévention et Contrôle de l'Infection
Dr. Susan Sutherland President	Canadian Association of Hospital Dentists
Mr. Tim Lau Pharmacy Lead & Infectious Diseases/Antimicrobial Stewardship Pharmacist	Vancouver Coastal Health
Ms. Valerie Leung Antimicrobial Stewardship Program Lead	Public Health Ontario
Dr. Yoav Keynan co-Scientific Director	National Collaborating Centre for Infectious Diseases
Ms. Yoshiko Nakamachi ASP Lead, Program Manager, Policy, Advocacy and Strategy, Antimicrobial Stewardship Program	Sinai Health System - University Health Network
Dr. Yvonne Shevchuk Associate Dean, College of Pharmacy and Nutrition	University of Saskatchewan

Appendix 2: Initial Commitments for the Canadian Roundtable on Antimicrobial Stewardship

Stakeholder	Commitment
HealthCare*CAN* Bill Tholl, President & CEO	"HealthCare*CAN* is committed to supporting the scaling up and spreading out of stewardship best practices in healthcare facilities across the country. HealthCare*CAN* commits to host a national clearinghouse on AMS guidelines, best practices and programs to be accessible by healthcare professionals, patients, and citizens. We agree to collaborate with other stakeholders in AMS to ensure that our work in AMS continues well beyond the Roundtable. Finally, HealthCare*CAN* will leverage its position as the national voice for healthcare institutions in Canada to advocate for AMS in Canada, recognizing progress made and holding governments and healthcare leaders accountable for the progress we need."
National Collaborating Centre for Infectious Diseases (NCCID) Margaret Haworth-Brockman, Senior Program Manager	"The National Collaborating Centre for Infectious Diseases (NCCID) is committed to furthering the development of antimicrobial stewardship through its role in knowledge translation and knowledge brokering. NCCID is able to work with organizations at all levels of authority and in a wide variety of public health disciplines to assist with providing evidence and information about stewardship programs, as well as assist with making connections among people and organizations for continued exchange. For example, NCCID is collaborating on new projects to scale-up Do Bugs Need Drugs and other effective efforts in a regional health community, as well as developing AMS awareness in Canada"
Public Health Agency of Canada Jacqueline Arthur, Manager, Strategic Issues; Centre for Communicable Diseases and Infection Control	"PHAC is committed to its role as a convenor of major parties in connection with the next steps and implementation of the antimicrobial stewardship action plan in Canada. PHAC further commits to bring forward the results of the Roundtable to the Federal/Provincial/Territorial AMR Governance tables to inform the development of the Canadian AMR Framework."

Stakeholder	Commitment
Sinai Health System-University Health Network Antimicrobial Stewardship Program (SHS-UHN ASP) Dr. Andrew Morris, Medical Director; Yoshiko Nakamachi, Program Manager	"The SHS-UHN ASP commits to leverage its antimicrobial stewardship leadership position and experience in establishing institution-based ASP initiatives in healthcare institutions. We will use our widely accessed website (antimicrobialstewardship.com) and its contents to support spread and adoption of best practices in antimicrobial stewardship nationally. Furthermore, we commit to work with various stakeholders interested in improving AMR and AMU data access and quality, along with data custodians, to improve collection, manipulation, interpretation, and dissemination of clinically meaningful data. The SHS-UHN ASP will use its leadership position to help establish a coordinated interprofessional national effort to improve antimicrobial prescribing and use."
Association of Medical Microbiology and Infectious Diseases (AMMI) Canada Dr. Caroline Quach, President	"AMMI Canada commits to continue in its role as the Canadian medical specialty society with membership serving as experts in the appropriate use of antimicrobials. Using our website, newsletters, and other methods of communication, we will disseminate information to the healthcare community and public relating to appropriate use of antimicrobials. AMMI's Antimicrobial Stewardship and Resistance Committee (ASRC)—which broadly represents Canadian expertise in the field— will work with other leaders in the national antimicrobial stewardship and resistance effort, to develop, implement, and disseminate best practices around appropriate use of antimicrobials. AMMI remains committed to the project of identifying knowledge users for antimicrobial stewardship resources. We further commit, through the ARSC, to work towards identifying knowledge gaps in antimicrobial stewardship and resistance and to support knowledge synthesis (e.g. systematic reviews)."

Stakeholder	Commitment
Canadian Institutes of Health Research (CIHR) Dr. Marc Ouellette, Scientific Director, Institute for Infection and Immunity	"The Canadian Institutes of Health Research (CIHR) is committed to funding, through its different research programs, various projects focused on the evaluation or the improvement of current practices in the prescription of antimicrobials. CIHR commits to supporting innovative approaches to stewardship, including funding projects developing alternative therapies or preventive strategies in order to reduce consumption of antimicrobials. We will support knowledge creation and translation of results for supported projects focused on stewardship measures. We commit to support follow-up meetings with stewardship implementers, industry and other partners to contribute to the overall reduction of antimicrobial use and the associated healthcare burden of antimicrobial-resistant infections."
Accreditation Canada	"Accreditation Canada commits to working with partners to support health care organizations to optimize antimicrobial use through the accreditation program including evidence-informed standards, education and sharing of leading practices."
Canadian Nurses Association	"The Canadian Nurses Association commits to collaborate on multisectoral AMS activities, providing a nursing voice to inform the development of a Canadian action plan. We will work toward building momentum on AMS and on raising awareness and engagement in stewardship activities through the dissemination of evidence-informed resources regarding antimicrobial stewardship to our more than 139,000 members, and to our network of 45 nursing specialties through our multiple media outlets (email, social media, webinar, feature(s) in CNA's journal Canadian Nurse). Contingent on funding, CNA further commits to lead and/or support the development of educational resources and/or an evidenced-informed tool kit for antibiotic prescribing for nurse practitioners and registered nurses in Canada."
Yvonne Shevchuk Professor of Pharmacy/ Associate Dean Academic/ Director, medSask University of Saskatchewan	"I commit to making contact with various faculties across Canada (pharmacy, medicine and nursing) to encourage review of the curriculum to include Antimicrobial Stewardship as a required component of the curriculum."

Stakeholder	Commitment
Canadian Patient Safety Institute Sandi Kossey, Senior Director; National Integrated Patient Safety Strategy	"Antimicrobial resistance is a significant patient safety burden and the Canadian Patient Safety Institute recognizes the importance of stewardship in preventing the spread of resistant pathogens that will ultimately harm patients and endanger the public. The Canadian Patient Safety Institute is committed to partnering with providers, leaders, policy makers and patients and the public to reduce harm and build knowledge, capacity and a culture of learning and improvement in support of antimicrobial stewardship programs across Canada."
Patients for Patient Safety Canada	“Patients for Patient Safety Canada (a patient-led program of the Canadian Patient Safety Institute and affiliated with the World Health Organization Patients for Patient Safety global network) is committed to ensuring that the voice, experience, and perspective of patients and families are embedded at every level of our healthcare systems. Patients for Patient Safety Canada will advocate that patient and family advisors are partners in antimicrobial stewardship programs so that patients and the public may better understand antimicrobial use and their role as active participants in stewardship efforts.”

Council of Academic Hospitals of Ontario Karen Michell – Executive Director	CAHO has supported two antimicrobial stewardship projects (ASPs) through its Adopting Research to Improve Care (ARTIC) Program. This program established a fully functional ASP in each participating hospital's ICU and be able to report antimicrobial consumption, antimicrobial costs, antimicrobial resistance, and C. difficile infections on a quarterly basis to allow comparisons across sites. As a result: • CAHO ASP in ICU Project successfully implemented and sustained ASPs in 14 participating ICUs (11 adult, 3 pediatric). • ASPs in adult ICUs showed a 23% reduction in antimicrobial consumption and a 16% reduction in antimicrobial cost. In concrete terms, the implementation of ASPs resulted in avoiding roughly 130,000 daily doses of antimicrobials. • ASPs in pediatric ICUs showed a reduction in consumption ranging from 17-34% in days of therapy, but cost differences were modest and varied. A second project was implemented [Antimicrobial Stewardship Program (ASP) ARTIC Community Hospital ICU Local Leadership (CHILL)] aimed at building capacity and knowledge through the establishment of ASPs in community hospitals across Ontario to optimize the use of antimicrobials in ICUs, increase patient safety and quality of care. CAHO is committed to sharing information about lessons learned from these two provincial implementation projects in order encourage the success of a national ASP effort.