Antimicrobial Stewardship in Food Animals in Canada: Progress on Recommendations and Stakeholder Activities

2019

NFAHW COUNCIL

This document was prepared by the National Farmed Animal Health and Welfare Council. The Council was formed in 2010 to advise governments and the animal-source food industries on all aspects of the health and welfare of farmed animals in Canada, in support of Canada's National Farmed Animal Health and Welfare Strategy. The Council is funded jointly by Canada's animal production sector, the federal government, and provincial-territorial governments. Council members are designated by their constituency because of broad expertise in farmed animal health and welfare, public health, and an interest in approaching topics and developing advice in the context of One Health.

The NFAHW Council would like to thank all our stakeholders for their input and feedback on this report. The information provided in this document was updated in January 2019. This document is expected to be evergreen, and future updates will continue to be as inclusive as possible in order to reflect the broad scope of activities supporting antimicrobial stewardship in Canada. It should be noted that although some provinces, territories and organizations are not represented in this report, this does not suggest a lack of AMU/AMR or AMS activities. The Council also thanks the National Farmed Animal Health and Welfare Council Antimicrobial Use and Resistance Committee for their time and commitment to improving Canada's farmed animal health and welfare system.

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Part One

Antimicrobial Stewardship in Food Animals in Canada - Progress on Recommendations

Antimicrobial resistance (AMR) is a global problem arising from the use of antimicrobials in both humans and animals. Antimicrobial resistance is well documented as a critical threat to modern medicine. Those involved in animal agriculture where medically important antimicrobials (Health Canada Classifications I, II, III) are used must develop strategies and programs to foster appropriate use of antimicrobials with a goal of retaining the effectiveness of antimicrobials for use in animals and humans.

Antimicrobials are essential in animal agriculture for disease management and preventing animal welfare issues. The need for the use of antimicrobials can be reduced through various infection prevention and disease control strategies at the farm level.

The NFAHW Council, livestock producer organizations, provincial and federal governments, veterinarians, the animal pharmaceutical industry and other stakeholders in animal agriculture have demonstrated leadership by being active on the topic of antimicrobial use (AMU) and antimicrobial resistance (AMU/AMR) for many years. There are many active initiatives that contribute to finding solutions, provide communication opportunities with producers and veterinarians, reduce risk of disease and foster appropriate use of antimicrobials.

The Federal government demonstrated leadership in 2015 with the development of the Federal Framework on AMR and the Federal Action Plan on AMR followed by the "Federal Action Plan on Antimicrobial Resistance and Use in Canada: Building on the Federal Framework for Action on Antimicrobial Resistance and Use in Canada" in March 2015, and in August 2017, "Tackling Antimicrobial Resistance and Antimicrobial Use: A Pan-Canadian Framework for Action" was released. This recent document's purpose was:

> *To establish a coherent approach to guide collective efforts in addressing AMR and AMU in Canada with a focus on four key components: surveillance, infection prevention and control, stewardship, and research and innovation.*[1]

The four core components of the framework were:

Surveillance – "Strong, integrated surveillance systems are needed to provide a comprehensive picture of AMR and AMU in Canada";

Infection Prevention and Control – "To contain the spread of resistant organisms and reduce AMR and AMU, standardized infection prevention and control approaches, programs and policies must be in place";

Stewardship – "Programs and policies that highlight education, awareness raising as well as professional and regulatory oversight will be required to reduce inappropriate prescribing, dispensing, and use of antimicrobials in humans and animals and to conserve the effectiveness of new and existing antimicrobials"; and

Research and Innovation – "Responses to AMR must be evidence-based and will require increased knowledge, innovative tools and collaborative approaches to better understand resistance and the development of new treatments and strategies."

By adding input from animal agriculture, human medicine and others, a pan-Canadian plan will be developed which will demonstrate how Canada will collectively act on the issue of AMR.

It is generally accepted that it will be the cumulative impact of numerous interventions or actions which will have a positive impact on AMR. Antibiotic stewardship is multidimensional and needs to include, as one facet, the changes proposed for agriculture in the development of a pan-Canadian plan. There is a role for producers, commodity organizations, veterinarians, veterinary organizations, universities and colleges, the pharmaceutical industry, regulators and others. Coordination of roles and activities and the development of consistent messaging is required.

"Antimicrobial Stewardship in Food Animals in Canada" developed in 2016 by the NFAHW Council provided description of the current situation and activities with some analysis as well as a series of recommendations to stakeholders in animal agriculture in Canada in order to identify how animal agriculture can participate as a full partner in developing a pan-Canadian plan for AMR.

This report has been developed to provide an update on the progress of stakeholders in animal agriculture with respect to the council recommendations and the Pan Canadian Framework for Action and will be shared broadly to inform government and industry stakeholders on the current status of antimicrobial stewardship in Canada.

Recommendation 1: Recognizing the critical importance of national and global action to ensure there is continued effectiveness of antimicrobials for use in humans and animals, the NFAHW Council recommends that all stakeholders in animal agriculture support the Federal Framework for Action and the Federal Action Plan for antimicrobial resistance.

STATUS: IN PROGRESS

- Antimicrobial use, resistance and stewardship is a national challenge that requires national funding. National integration between human and animal health stakeholders in the development and implementation of the Federal Action Plan will be critical to the success of Canada's initiatives to support prudent use of antimicrobials and reducing antimicrobial resistance.

Recommendation 2: Recognizing the importance of national coordination of this complex issue, the NFAHW Council recommends that all stakeholders in animal agriculture support and participate in the development of a pan-Canadian strategy to manage antimicrobial resistance.

STATUS: IN PROGRESS

- The outcome of this survey indicates that animal agriculture stakeholders have been actively engaged in various activities to support the Federal Framework for Action, and are prepared to engage in the development of the Federal Action Plan for AMR, and a pan-Canadian strategy. Continued engagement and commitment of all sectors and government partners will be critical in realizing the long-term goals of the Pan-Canadian Action Plan.

Recommendation 3: The NFAHW Council recommends that within the context of a pan-Canadian strategy for AMR, it assumes a national leadership role to bring stakeholders together to coordinate: their respective leadership roles; communication and education activities and the development of an effective partnership with those involved in human initiatives on AMR.

STATUS: IN PROGRESS

- The Council has been actively engaged in collaborating with organizations in a national leadership role to seek updates on activities and support the ongoing development of pan Canadian strategies to manage AMR. A survey was initiated with animal agriculture stakeholders in order to benchmark the antimicrobial stewardship activities that are underway in animal agriculture including communication and educational activities. The council partners with human health leaders such as the Public Health Agency of Canada, Health Canada, and the Council of Chief Medical Officers of Health to seek input on Council stewardship initiatives, to ensure the Council focuses efforts where there is a need, as well as to provide the perspective of animal agriculture on human health initiatives. Co-ordination of efforts with all animal-related sectors will be critical to successful implementation of the Federal Framework for Action, and the Federal Action Plan.

Recommendation 4: The NFAHW Council recommends that Health Canada advance proposed regulatory amendments to establish limitations and controls on the antimicrobials imported under the provisions of Own Use Importation or as Active Pharmaceutical Ingredients.

STATUS: COMPLETE

- Regulatory changes are now in force to better regulate antimicrobial imports under the provisions of Own Use Importation[41], or as Active Pharmaceutical Ingredients[42]. The restrictions on importation for personal use began when the regulations came into effect on November 13, 2017. Medically Important Antimicrobials (MIA) are no longer permitted for personal importation. Furthermore, under these new rules no person can

import a drug for use in food-producing animals or animals intended to be consumed as food (including horses) unless authorized by Health Canada. To increase oversight on Active Pharmaceutical Ingredients for veterinary use, Health Canada implemented additional regulatory requirements that APIs for veterinary use must be manufactured in accordance with Good Manufacturing Practices (GMP), and those who fabricate, import, package, label or test an API for veterinary use must hold a Drug Establishment License (DEL). Others who must hold a DEL are pharmacists, veterinarians or those compounding a drug under the supervision of a licensed veterinarian who imports for the purpose of compounding a medically important antimicrobial that is on List A. (List of Certain Antimicrobial Active Pharmaceutical Ingredients.)

Recommendation 5: The NFAHW Council recommends that the pharmacy regulators be engaged in the stewardship of antimicrobial use in animal agriculture to ensure pharmacists are aware of their legislated responsibilities regarding selling or dispensing antimicrobials for animals.

STATUS: IN PROGRESS

- The Veterinary Drugs Directorate of Health Canada has had discussions with the National Association of Pharmacy Regulatory Authorities to discuss regulatory and policy changes that are being implemented for medically important antimicrobials veterinary medicine. Additionally, the Canadian Veterinary Medical Association (CVMA) has engaged in discussions around scope of practice with the National Association of Pharmacy Regulatory Authorities (NAPRA). The provincial veterinary medical associations have engaged with the provincial pharmacy regulatory authorities respectively as they review provincial regulations, legislation, by laws and policies.

Recommendation 6: The NFAHW Council recommends that the livestock commodity organizations enhance communications with producers (for example via their sustainability or quality assurance programs) on the importance of reducing AMR through prudent and judicious use of antimicrobials.

STATUS: IN PROGRESS

- Livestock commodity associations have initiated communication regarding prudent use of antimicrobials through website and newsletter communications, and the development of tools through on farm assurance programs such as Verified Beef Production Plus, proAction®, PigCARE/PigSAFE, CHEQ™, TFC OFFSP, EFC Start Clean Stay Clean™, Chicken Farmers of Canada's (CFC) Raised *by a Canadian Farmer* On-Farm Food Safety Program and Canadian Verified Sheep Production. Other associations such as Equestrian Canada are actively seeking funding for the development and implementation of on farm assurance programs.

Recommendation 7: The NFAHW Council recommends that livestock commodity organizations lead the development of an action plan for their commodity producers to engage their veterinarians in the assessment of the use of antimicrobials, the validity of that use, the alternatives that are available and the management practices that might reduce risk.

STATUS: IN PROGRESS

- On-Farm Assurance programs requiring the engagement of veterinarians in AMU on farms were identified by various stakeholders. Some examples include the Canadian Sheep Federation's Sheep Industry Health and Welfare Strategy, pending funding approval, will include a 'Responsible antimicrobial stewardship strategy.' This strategy will support producers through legislative changes and changes in accessing veterinary drugs. Activities will include exploring, promoting and managing new veterinary drug approvals, coordinating and collaborating with additional minor use species groups; improve access to adequate veterinary care and services for sheep producers; and communication strategy and tools for stakeholders. Additionally, the CFC's Antimicrobial Use Strategy [46] was launched in 2012 and includes four key elements of surveillance, research, reduction and education.

Recommendation 8: The NFAHW Council recommends that a continuing education program for current and future producers, veterinarians, feed suppliers and other allied service providers to animal agriculture be developed at a national level and widely disseminated provincially to promote a culture of antimicrobial stewardship in Canadian agriculture and veterinary medicine.

STATUS: IN PROGRESS

- Although the survey indicated that several organizations have developed tools to inform and educate industry stakeholders such as the Canadian Animal Health Products Regulatory Advisory Committee's (CAHPRAC) informative online document on "Responsible Use of Medically Important Antimicrobials in Animals", the "Compendium of Medicating Ingredient Brochures", and the CVMA AMU Stewardship project which is developing a toolset for six production species, there is no broad continuing education program under development for use at the national level across animal agriculture and veterinary medicine. Consideration also needs to be given to education of undergraduate and graduate students through existing programs or through the development of new programs.

Recommendation 9: The NFAHW Council recommends that veterinary regulators and veterinary associations develop awareness, education and training for veterinarians on the responsibilities of veterinarians in working with clients and treating animal with regard to addressing antimicrobial resistance.

STATUS: IN PROGRESS

Updated January 2019

- The CVMA has been actively developing AMU stewardship tools for veterinarians. Provincial veterinary associations and provincial governments have developed and offered informational sessions on regulatory changes, and on species specific topics where there may be gaps in veterinary resources such as bees.

Recommendation 10: The NFAHW Council recommends that all stakeholders make efforts to build on the success of the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS), for the purpose of monitoring the effects of the new stewardship approaches and identifying and responding to emerging problems in a timely way.

STATUS: IN PROGRESS

- CIPARS in collaboration with stakeholders such as commodity groups and provinces currently reports on surveillance across species in human, farm, abattoir, retail meat and clinical animals. CIPARS is an internationally renowned program that contributes greatly to the understanding of AMU and AMR in Canada. This program has been identified as well-established with exceptional capacity to enhance and broaden activities however it will be important to ensure that CIPARS is funded to meet program delivery requirements as they evolve. Some provincial veterinary laboratories are undertaking evaluations of AMR diagnostic data, and some regional and sectoral surveillance networks are engaging in AMU/AMR data collection. Enhanced financial and human resources will be needed in order to support this recommendation and to begin to collate and analyze potential new data that is available through the various networks and stakeholders.

Recommendation 11: The NFAHW Council recommends that the federal government develop with its provincial/territorial partners, industry and other stakeholders, a robust system of collecting antimicrobial use at the national, provincial, commodity, farm and veterinarian level, for the purpose of "benchmarking" and supporting continuous improvement. The Canadian Animal Health Surveillance System is a platform that could be used to develop a plan for this surveillance. Funding for this initiative should be provided by the Government of Canada as this information is critical to measuring antimicrobial use.

STATUS: IN PROGRESS

- CIPARS collects national antimicrobial sales data and on farm sentinel broiler, turkey, and grower-finisher swine production antimicrobial use and resistance data. In addition to CIPARs, there are regional, sectoral and national surveillance networks that are working towards prioritizing AMU/AMR information needs and determining how to collect and analyze available data. Effective April 1, 2019, Health Canada has implemented a regulatory requirement for manufacturers, importers and compounders to report on the annual sales of medically important antimicrobials for veterinary use[40], which supports national antimicrobial surveillance and is complimentary to the

previously voluntary collaboration between CIPARS and the Canadian Animal Health Institute (CAHI). Currently, not all available antimicrobial use data is being collected or reporting to one national program. Enhanced resources could better facilitate the ability to research, collate and analyze data sources through a national platform. CIPARS with support from the Canadian Animal Health Surveillance System (CAHSS) could be a platform to help report this information in an aggregate way at the national level. Work needs to continue in this area.

Recommendation 12: The NFAHW Council recommends that the national commodity organizations include research priorities which address the issue of antimicrobial resistance and optimal use of antimicrobials when establishing research priorities for their sector.

STATUS: IN PROGRESS

- Many of the national commodity associations have identified priority research areas, and specific research projects in order to assist industries in adapting to changing approaches in AMU practices. Areas of focus include developing practical protocols for AMU/AMR surveillance data collection, changes to production practices and the impact on AMU, development of rapid diagnostic testing to inform AMU decisions, and exploration of vaccines and antimicrobial alternatives.

Recommendation 13: The NFAHW Council recommends a harmonized, pan-Canadian, regulatory framework for antimicrobial stewardship in agriculture and veterinary medicine that meets international standards.

STATUS: IN PROGRESS

- This is a broad recommendation that is in the process of being addressed in several ways. All medically-important antimicrobials will require a prescription effective December 2018 [43]. Veterinary oversight is an important part of antimicrobial stewardship. Veterinarians have the training to assess and diagnose animal disease and can decide if antimicrobial drugs are needed and prescribe the right treatment. Growth promotion claims were voluntarily removed from medically-important antimicrobial drug labels effective December 2018. Labelling requirements will be implemented to ensure all in-feed and in-water MIAs include responsible use statements. Significant progress has been made in building an evidence-based approach to assessing the antimicrobial resistance (AMR) risk from antimicrobials licensed for use in animals. Ongoing actions include:
    - implementing microbiological safety requirements for assessment of new veterinary antimicrobial drug submissions for use in food-producing animals
    - categorizing antimicrobials into 4 categories based on their importance in human medicine to help prioritize risk management options
    - AMR specific warnings on certain medically important antimicrobials belonging to the Categories I, II, and III

- supporting the microbiological safety evaluation of veterinary antimicrobial drugs by using CIPARS data
- encouraging prudent use of antimicrobials in animals in collaboration with:
  - provincial and territorial authorities
  - international counterparts
  - veterinarians
  - industry
  - food animal producers
  - associations
  - other animal health stakeholders
  - other federal departments and agencies

Efforts have also included updating the Compendium of Medicating Ingredients Brochure (CMIB) to ensure it is user friendly and includes all required instructions for a product. Work is underway to provide standardized templates for feed prescriptions for use by veterinarians, as well as working towards the implementation of electronic prescriptions to further enhance ease of use. The above noted efforts are in line with international standards and are assisting in establishing a Pan Canadian regulatory framework.

Recommendation 14: The NFAHW Council recommends that Health Canada develop regulatory enabling processes for low risk animal health products intended for food animals and for feed additives with physiological and health benefits.

STATUS: IN PROGRESS

- Health Canada implemented the Veterinary Health Product Notification program in November of 2017. Health Canada's Notification Program for Veterinary Health Products (VHPs) provides a user-friendly process that is proportional to the product risk to help companies meet the rules for importing and selling VHPs for companion and food- producing animals in Canada[44]. The Notification Program provides a flexible and risk appropriate regulatory framework for veterinary health products (VHPs) that have a history of safe use. The rules for VHPs require companies who manufacture, package, label, import, distribute and/or store VHPs to follow the Part 3 - Good Manufacturing Practices (GMPs) in the Natural Health Products Regulations, that all active, homeopathic and traditional medicine substances used to make a VHP are on List C: Veterinary Health. To date over 1200 products have been notified, and approval for notification will take approximately 30 days, however if an ingredient is not on an approved list then the process may take several months. It should be noted that this program is not yet open to in-feed VHPs. Health Canada is urged to open this pathway for in-feed VHPS as this is the route of administration for most of these products in animal agriculture.

- Although progress has been made on the regulatory process to approve viable antimicrobial alternatives such as probiotics and to allow greater flexibility for labelling, regulatory process gaps continue to exist. Government will need to ensure timely regulatory modernization strategies continue to be developed in order to support innovation and enable new opportunities to achieve the successful end goal of both the industry and government AMU/AMR objectives. One example would be to allow for labelling a product for pathogen reduction without labelling the product as a drug.

Recommendation 15: The NFAHW Council recommends that Health Canada advance harmonization of regulations with the United States and meet international standards.

- Health Canada's Veterinary Drugs Directorate participates in international regulatory cooperation work and shares knowledge with other jurisdictions around the world[45]. Canada collaborates with regulatory partners for both pre-market and post-market submissions, to promote harmonization of regulatory practices and standards, leverage resources, and facilitate timely access to safe and effective veterinary drugs. Although there has been progress on this recommendation, work must continue on harmonizing regulations with the United States and meeting international standards.
  Although some progress has been made with respect to international co-ordination, government regulators will need to ensure alignment with trading partners while supporting producer competitiveness and animal welfare. This would include implementing or enhancing processes for joint and parallel review with other countries, as well as enabling regulatory pathways to support new product innovation.

Of the 15 recommendations made by the NFAHW Council regarding antimicrobial stewardship in food animals in Canada, one recommendation is considered complete. All other recommendations remain in progress. The information collected to inform this document clearly demonstrates the significant commitment of animal health stakeholders in Canada to antimicrobial stewardship, while at the same time identifying the importance of ongoing engagement and collaboration in order to achieve the desired outcomes of the Pan-Canadian Framework on Antimicrobial Resistance, and the Pan-Canadian Action Plan.

Part Two

1. NFAHW Council Stakeholder Antimicrobial Stewardship Activities

The NFAHWC has recognized antimicrobial stewardship (AMS) as a component of the Pan-Canadian Framework that the Council can contribute to and address the issue of Antimicrobial Use and Antimicrobial Resistance (AMU/AMR). Antimicrobial Stewardship is an active, dynamic process of continuous improvement. It involves coordinated interventions designed to promote, improve, monitor, and evaluate the judicious use of antimicrobials to preserve their future effectiveness and promote and protect human and animal health.

Antimicrobial stewardship is multidimensional. 'Infection Prevention and Control' and 'Stewardship' are closely related in farm animal agriculture. At the same time, 'Surveillance' and 'Research and Innovation' are essential to achieving effective stewardship over time. Therefore, to report on AMS in the farmed animal section, all four components were focused on in this report.

1.1 Sources of Information

To best represent AMS in food animals in Canada, the Council's AMU/AMR Committee identified industry and professional organizations and federal-provincial-territorial governments to contact for this report between July 2018 to January 2019, including:

Canadian Animal Health Products Regulatory Advisory Committee
Canadian Animal Health Institute
Provinces/Territories via the Council of Chief Veterinary Officers
Canadian Veterinary Medical Association
Canadian Integrated Program for Antimicrobial Resistance Surveillance
Animal AMS Canada
Animal Nutrition Association of Canada
The Deans Council, Agriculture, Food and Veterinary Medicine
National Livestock Commodity Organizations, including:
- Canadian Cattlemen's Association
- Canadian Pork Council
- Dairy Farmers of Canada
- Chicken Farmers of Canada
- Turkey Farmers of Canada
- Canadian Hatching Egg Producers
- Egg Farmers of Canada
- Equestrian Canada
- Canadian Sheep Federation

Where applicable online sources were reviewed, and contacts were asked to verify the information reported. Otherwise, primary contacts were asked how their organization's activities aligned with the Pan-Canadian AMR Framework for Action components. This document is expected to be evergreen, and future updates will continue to be as inclusive

as possible in order to reflect the broad scope of activities supporting antimicrobial stewardship in Canada. It should be noted that although some provinces, territories and organizations are not represented in this report, this does not suggest a lack of AMU/AMR or AMS activities.

Additionally, the findings of this report were compared to the recommendations included in the Council paper "Antimicrobial Stewardship in Food Animals in Canada (2016)".

2. Surveillance

Groups identified by the AMU/AMR Committee were asked to describe activities that they have contributed to that have added to AMU/AMR surveillance systems within Canada. Responses below represent how industry stakeholders and national-provincial-territorial governments have collaborated in this effort.

2.1 The Deans Council - Agriculture, Food and Veterinary Medicine

The Deans Council - Agriculture, Food and Veterinary Medicine (Deans Council-AFVM) is comprised of researchers, educators and scientists in thirteen faculties located in eleven universities across Canada. The Association is a catalyst for the development and adoption of science and veterinary technology for the agricultural and food industry in Canada. Ongoing and completed research activities reported by the Association are exploring antibiotic alternatives, in addition to working with industry groups such as beef, chicken, dairy and swine to undertake surveillance activities. Some of these surveillance research activities include:

- Antimicrobial resistance of staphylococci from mastitic milk
- Evaluating the potential contribution of beef cattle to antimicrobial resistance
- Modelling Antimicrobial Resistance in generic Escherichia coli from Chicken Abattoir and Retail Meat Surveillance in Canada
- Antimicrobial resistance in foodborne bacteria, production animal pathogens, and environmental bacteria in production facilities
- PhD research - studying the nature and quantity of antimicrobial use (AMU) on Ontario swine farms during the entire production cycle, and on-farm factors associated with AMU. The study will also determine how AMU on the farm is related to antimicrobial resistance (AMR) in E. coli and Campylobacter spp. isolated from swine. In addition, the study will determine the most effectively means of communicating the results of AMU analyses to stakeholders in the swine industry.
- Prevalence of antimicrobial resistance in bovine respiratory pathogens; development of nasal probiotics to reduce the use of antimicrobials to control respiratory disease in cattle; development of new respiratory vaccine for cattle
- Production of a feasibility study for a system for continuous monitoring of the use of antibiotics in animal health in Quebec
- Surveillance study comparing the performance and results of different regression models for analysis of annual variation in susceptibility of generic Escherichia coli isolates to ceftiofur, ampicillin and nalidixic acid from retail chicken surveillance. Secondly, the impact

of using different multidrug resistance (MDR) classification metrics for analysis of annual variation in MDR was determined using generic E. coli isolates from chicken abattoir surveillance. Antimicrobial susceptibility data were obtained from the Canadian Integrated Program for Antimicrobial Resistance Surveillance.

- Surveillance and communication of antimicrobial use in nursing piglets and nursery pigs on Ontario swine farms

2.2 Canadian Animal Health Institute

The Canadian Animal Health Institute (CAHI) is a national trade association that represents Canadian developers, manufacturers, and distributors of animal pharmaceuticals, biologics, feed additives, and animal pesticides. For over a decade, CAHI voluntarily provided the PHAC with the kg of antimicrobial actives distributed by its members annually. As CAHI's members represent 95% of animal health products sales in Canada[2], the data has been valuable to meeting the World Health Organization (WHO) recommendation for countries to know the volume of antimicrobials used in veterinary medicine. The data has evolved so that it now reflects the kg of antimicrobial actives distributed by the family of antimicrobial, province, production and companion animal, and route of administration.

2.3 Canadian Integrated Program for Antimicrobial Resistance Surveillance

The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS), is a national program committed to the collection, analysis, integration and communication of trends in AMU/AMR in humans, animals, and food across Canada. CIPARS reports AMR information across species (human, chicken, pigs, beef cattle, and turkey), and surveillance components (animal feed, sick animals, farm, abattoir, retail, and humans). CIPARS currently reports on antimicrobials intended for use in production and companion animals in addition to farm-level use data for broiler chickens, turkeys, grower finisher pigs, and marine finfish. CIPARS also reports on antimicrobials sold for use as pesticides on crops. Currently, framework development is underway for the collection of AMU/AMR information from the feedlot beef and dairy sectors. CIPARS integrates information across time, across regions, across host species, and between AMU and AMR.

The information collected, analyzed and reported by CIPARS involves joint collaboration with several federal government departments, provincial ministries of agriculture and health, the pharmaceutical industry, local veterinarians, food-animal producers and their respective organizations, and academia. The information collected by CIPARS supports the creation of evidence-based policies for AMU and the identification of appropriate measures to contain the emergence and spread of AMR.

2.4 Provinces/Territories

In 2016, the AMU Surveillance Working Group of the CCVO published "Non-Human Antimicrobial Use Surveillance in Canada: Surveillance Objectives and Options"[4]. This report reviewed current Canadian non-human AMU surveillance programs and compared those programs to those in other counties. The working group's report then formulated

recommendations and options for non-human AMU surveillance in Canada. The report recommended that AMU surveillance in Canada must have a flexible framework to address future initiatives. Additionally, the report stressed the importance of the detailed data that needs to be annually incorporated into Canada's AMU surveillance program.

2.4.1 British Columbia

The British Columbia (BC) Ministry of Agriculture produces publicly available information on provincial AMU/AMR surveillance. This information includes peer - reviewed publication of the distribution of over-the-counter antimicrobials and the distribution of antimicrobials in over-the-counter retail outlets, livestock and poultry feed mills, aquaculture feed mills, livestock and poultry veterinarians, and companion animal veterinarians. Using AMR results generated by the Ministry's veterinary diagnostic laboratory, AMR reports on bacteria significant to animal health and public health have been produced and are publicly available. The Ministry is also working with the University of British Columbia and the BC Centre for Disease Control (BCCDC) on examining AMR trends particularly in the poultry sector.

2.4.2 Alberta

Alberta (AB) has supported CIPARS activities through sample collection, shipping, and testing, and continues to do so. Alberta has also engaged with private practitioners to include antimicrobial sensitivity testing in various research projects.

2.4.3 Saskatchewan

Saskatchewan's Prairie Diagnostic Services (PDS) created a disease surveillance veterinarian position, funded by the government of Saskatchewan under Growing Forward 2, to develop animal health surveillance using laboratory data and the position evolved to have a primary focus on AMR topics and initiatives; funding for this position is continued under the Canadian Agricultural Partnership. PDS publishes annual antibiograms on their website. Saskatchewan also provided GF2 funding to PDS for targeted surveillance of AMR in respiratory pathogens in feedlot cattle and funding to increase AMR surveillance capacity (state of the art diagnostic equipment plus funding for a full-time microbiologist and technician).

Saskatchewan supports CIPARS activities, providing funding to increase the number of swine farms enrolled in the surveillance program plus funding to conduct AMR on Saskatchewan broiler farms. This was funded under GF2, and continues under CAP. New under CAP, Saskatchewan is providing CIPARS support for the development of an AMR/AMU surveillance program for feedlot cattle.

2.4.4 Manitoba

Manitoba (MB) Agriculture is analyzing provincial veterinary lab diagnostic data concerning AMR through Veterinary Diagnostic Services. Efforts are on-going to attempt

to compare AMR data between the veterinary diagnostic lab and public health diagnostic labs in Manitoba. Manitoba Agriculture is also working with the Manitoba Veterinary Medical Association (MVMA) to conduct a survey to determine AMU patterns among practitioners and practice types.

2.4.5 Quebec

Since 1993, Québec's Department of Agriculture, Fisheries and Food (MAPAQ) has carried out passive monitoring of resistance to antimicrobial agents, important in veterinary medicine and public health, of certain pathogenic bacteria with a poultry, beef and pork origin, isolated to generally sick animals that could have been treated with antibiotics through Québec's veterinary antibiotic monitoring programme[48].

As part of the government's prevention policy for health[50] (Orientation 4, goal 2), MAPAQ, together with the Department of Health and Social Services, has committed to the integrated management of antibiotics, in order to ensure their judicious utilisation. One evaluation is under way, involving the implementation of a system to monitor the use antibiotics in animal production, in cooperation with the Centre of Expertise in Animal Health affiliated with the University of Montreal's Faculty of Veterinary Medicine.

2.4.6 New Brunswick

The Government of New Brunswick (NB), the Animal Health Services Branch of the NB Department of Agriculture, Aquaculture and Fisheries has been active in AMU/AMR activities. The province of NB is one of two provinces in Canada that has a Provincial Veterinary Laboratory that supports Provincial Veterinary Service by working collaboratively to provide a comprehensive service to large animal, food animal, and small ruminant clients. At this time, the field service in-house computer program tracks antibiotics sold by veterinarians and supplies all 20 provincial veterinarians with medical information. In the future, the program will be able to track antibiotics sold to individual clients.

The New Brunswick Provincial Veterinary Laboratory contributes to AMR surveillance by performing susceptibility testing on bacterial pathogens isolated from specimens submitted for microbial culture. *Salmonella* isolates are all sent for serotyping to the PHAC's laboratory in Guelph, and susceptibility testing is completed for the CIPARS database. Isolates of *Staphylococcus* sp. with high levels of AMR are sent to researchers at the Atlantic Veterinary College and the Ontario Veterinary College for further study.

2.5 National Livestock Commodity Organizations

National livestock commodity organizations were asked to submit their contributions to Canada's AMU/AMR surveillance systems. Many of the organizations support the CIPARS activities and encourage their producers, usually through quality assurance programs, to

appropriately document all medications, including antimicrobials that are administered to their animals.

2.5.1 Canadian Cattlemen's Association

Through the Beef Value Chain Roundtable, the Canadian Cattlemen's Association (CCA) works to support the CIPARS efforts to expand beef-related surveillance activities to a broader range of bacteria in abattoir and retail meat samples. Additionally, the Beef Cattle Research Council (BCRC) has conducted a series of research projects in collaboration with the CIPARS to develop a practical framework and protocols for AMU/AMR surveillance data collection in feedlot environments. The BCRC also funded the development of a Western Canadian (now nation-wide) cow-calf surveillance network that has enabled the collection of on-farm AMU/AMR data.

2.5.2 Canadian Pork Council

The Canadian Pork Council (CPC) represents producers in several surveillance initiatives, such as the one coordinated through the Canadian Animal Health Surveillance System (CAHSS) which is trying to establish an AMU minimum data that can be compared across commodities. Additionally, pork producers participate in CIPARS questionnaires, administered by their herd veterinarian.

2.5.3 Dairy Farmers of Canada

The Dairy Farmers of Canada (DFC) proAction® program requires that farmers complete a pharmaceutical record to record all medications used, with a treatment record including the initials of the individual treating the animal, drug expiry date, dosage, route of administration, animal identification, prescription if required. DFC participates in the CAHSS Dairy Network, which focuses on dairy cattle health surveillance.

2.5.4 Chicken Farmers of Canada

Chicken Farmers of Canada (CFC) has worked together with CIPARS to develop and implement an on-farm surveillance program to monitor AMU/AMR. This surveillance has helped to define the CFC AMU reduction strategy and to analyze the impacts of the strategy.

2.5.5 Turkey Farmers of Canada

Turkey Farmers of Canada (TFC) works with CIPARS to implement on-farm surveillance of AMU/AMR and provides on-going support through communication to producers. TFC also provides feedback through working groups and technical committees. (e.g. CAHSS AMU Network, and the PSVCRT AMR/AMU Working Group).

2.5.6 Canadian Hatching Egg Producers

Canadian Hatching Egg Producers (CHEP) supports surveillance as a part of Canada's supply chain approach to AMU and developed an internal industry survey to measure

the use of antibiotics on broiler hatching egg farms. The most recent version of the survey was distributed to producers and member provincial boards in August 2018 and covers the life of the flock. Producers are also required to complete the Spent Broiler Breeder Flock Sheet, which includes AMU for the last 120 days of the cycle and reflects the *Safe Food for Canadians Regulations* requirements for shipping birds to Canadian federally registered processing facilities.

Canadian Hatching Egg Producers is a member of the CAHSS AMU working group which was formed to look at minimum requirements for AMU data collection and reporting. Finally, CHEP is a member of the Poultry Sustainability Value Chain Roundtable AMR/AMU Working Group, which has surveillance as one of its priorities.

2.5.7 Egg Farmers of Canada

As part of Egg Farmers of Canada's (EFC) Start Clean-Stay Clean™ program, farmers complete a pharmaceutical record to record all medications used, the method of administration, drug identification number, veterinary prescriptions, and withdrawal times.

Egg Farmers of Canada participates in the CAHSS Poultry Network, the CAHSS AMU Network, the Joint Government-Industry working group for the Control of *Salmonella* and *Campylobacter* in Poultry, and the Poultry Sustainability Value Chain Roundtable AMR/AMU working group, all of which address surveillance.

Lastly, EFC recently provided funding to CIPARS to collect AMU, AMR, and pathogen surveillance information on egg farms.

2.5.8 Equestrian Canada

Currently, Equestrian Canada (EC) does not have surveillance measures in place. However, EC is working on the development of an on-farm Animal Care/Quality Assurance program, as well as an equine identification database, both of which will begin to collect animal health records that will monitor AMU usage.

2.5.9 Canadian Sheep Federation

The Canadian Sheep Federation's (CSF) Canadian Verified Sheep Program has a farm-level veterinary drug (including antimicrobial) use surveillance as part of the recordkeeping requirements.

3. Infection Prevention and Control

Groups were asked to identify what activities they perform to contain the spread of resistant organisms and reduce AMU/AMR, standardize infection prevention and control approaches, and, if any, what program and policies they have in place.

3.1 The Deans Council – Agriculture, Food and Veterinary Medicine

In addition to ensuring agriculture and veterinary students are well educated on infection prevention and control activities, the Deans Council AFVM has been actively involved in research activities that evaluate opportunities, strategies and programs to prevent and control infectious diseases such as exploring antibiotic alternatives, working with industry groups such as beef, dairy, hatching and layer as well as exploring antimicrobial impacts on municipal and well water. Some specific activities include:

- Network meta-analysis to determine the relative efficacy of antibiotics for the treatment of mastitis
- Identifying the best strategies for treating toe tip necrosis and digital dermatitis in feedlot cattle
- Lighting during incubation in combination with sanitation of hatching eggs with antimicrobial proteins
- Understanding and preventing E. coli resistance at the abattoirs

3.2 Canadian Animal Health Institute

In March 2014, CAHI's members voluntarily agreed to support the removal of growth promotion claims from MIAs. When communicated to the VDD, this information began a process which resulted in the removal of growth promotion claims from MIA, and it contributed to the change of over the counter MIAs to prescription only by December 1, 2018[5]. The removal of growth promotion claims from MIA and the movement to prescription status impacts over 340 products. This action helps to facilitate the responsible AMU by ensuring that veterinarians will have oversight of MIAs used.

The CAHI advocated for many years for greater oversight of Own Use Importation (OUI) veterinary drugs and use of Active Pharmaceutical Ingredients (API) in animal production and veterinary medicine. In May 2017, a new regulation was introduced to have greater regulatory controls over non-Canadian licensed products[6]. This new regulation helps to ensure use of Canadian licensed veterinary drugs and to ensure these products meet the same measures to protect humans, animals, and plants from diseases, pests, or contaminants as those of our trading partners. CAHI continue to advocate for science and risk-based regulatory pathways to allow the registration of innovative animal health products and tools to support infection prevention and control.

3.3 Provinces/Territories

3.3.1 British Columbia

Via the federal-provincial-territorial policy framework for Canada's agriculture and agri-food sector, such as Growing Forward and the Canadian Agricultural Partnership, the BC Ministry of Agriculture has supported and hosted biosecurity training for various agricultural livestock industries. This training includes awareness and implementation of CFIA recognized national industry biosecurity plans.

3.3.2 Alberta

Alberta has a Biosecurity Champions program which has run for approximately ten years. Biosecurity Champions is a group of producers, farm representatives, and academic and veterinary organizations that share information on biosecurity initiatives, the development and implementation of biosecurity promotion plans, and the distribution of biosecurity promotional materials. Alberta also administers a disease investigation program which provides veterinary consultation on biosecurity and disease prevention strategies with producers and their veterinarians.

3.3.3 Saskatchewan

Under Growing Forward 2, Saskatchewan hosted two biosecurity sessions for private veterinarians and Registered Veterinary Technologists in February 2018. These training sessions were offered to assist veterinarians and technicians in developing competency in preparing, implementing and evaluating farm-level biosecurity plans and implementing routine personal and vehicle biosecurity when attending farm premises.

Under the Canadian Agricultural Partnership, biosecurity funding is available for livestock producers. This includes funding for biosecurity assessments completed by a veterinarian and equipment upgrades for their farm. Eligible livestock sectors include beef cattle, bees, bison, cervids, dairy cattle, goats, poultry, sheep and swine.

3.3.4 Manitoba

Manitoba has on-going communication activities around effective biosecurity practices to contain the spread of resistant organisms and reduce AMU.

3.3.5 Quebec

Québec's Department of Agriculture, Fisheries and Food (MAPAQ), with its industry partners and veterinary associations, is currently developing an awareness and prevention campaign, within its new Québec's integrated animal health programme (PISAQ). The goal of this programme is to support producers in the adoption of recommended prevention and disease-control practises, and the judicious use of medicines

3.3.6 New Brunswick

In the fall of 2018, the New Brunswick Provincial Veterinary Service in-house computer program will have further capabilities to track antimicrobial refills and will limit antimicrobials sold to prevent overuse at the farm level. The field veterinary service is also updating their internal policies to restrict the sale of antimicrobials to only those clients who have had a veterinary interaction or visit within the last 365 days.

3.3.7 Prince Edward Island

Prince Edward Island (PEI) developed in-house go kits for enhanced biosecurity practices for PEI Dept of Ag/Fisheries staff visiting farms.

Under Canadian Agricultural Partnership assurance stream PEI developed on-farm biosecurity kits that were given to all participating farms for PEI's "Open Farm Day" and "Breakfast on the Farm". These kits included biosecurity signage, disinfectant mats, disposal gloves, disposable booties, hand sanitizer, disinfectant refill and biosecurity pamphlets.

During PEI Provincial Exhibition Old Home Week created biosecurity signage and display for children to learn about how to enter and exit a barn in a biosecure manner and about the importance of zoonotic disease.

3.4 Animal Nutrition Association of Canada

The Animal Nutrition Association of Canada (ANAC), a national trade association of the livestock and poultry feed industry, is working with Health Canada, the CFIA, and other industry groups on standard prescription templates for in-feed drug prescriptions. This will assist in the upcoming policy changes, as it impacts in-feed medications.

ANAC participates in the joint Government-Industry Working Group on the Control of *Salmonella* and *Campylobacter* in Poultry.

3.5 National Commodity Organizations

Each national commodity organization emphasizes the importance of biosecurity to their producers, often through their on-farm food safety program, and highlights the importance of containing the spread of disease.

3.5.1 Canadian Cattlemen's Organization

Verified Beef Production Plus (VBP+), is an on-farm food safety program for Canadian beef producers. The VBP+ program works closely with the Canadian Roundtable for Sustainable Beef (CRSB), to enhance sustainability in the Canadian beef industry. Biosecurity is emphasized in this program to reduce the risk of introducing disease and to control the spread of disease within and between operations.

3.5.2 Canadian Pork Council

The Canadian Pork Excellence platform was launched in 2018. This platform includes PigSAFE[6]. The updated food safety program has considered Health Canada's 2017 regulatory and policy changes. The program also includes a biosecurity module that stresses the importance of protecting the herd from the introduction of disease and preventing the spreading of disease outside the operation.

3.5.3 Dairy Farmers of Canada

proAction®, formerly Canadian Quality Milk, is an on-farm quality assurance program where farmers offer proof to customers that they work to ensure milk quality and safety, and to continually improve animal health and welfare as well as environmental

stewardship. proAction®'s biosecurity module emphasizes that preventative programs for dairy herds can have two components 1) a vaccination plan and 2) a biosecurity plan. The program highlights that a preventative program reduces the risk of disease entering and leaving the herd.

3.5.4 Chicken Farmers of Canada

The *Raised by a Canadian Farmer* On-Farm Food Safety Program (OFFSP) focuses on animal health, cleanliness and safety, and includes biosecurity protocols (CFIA National Avian On-Farm Biosecurity Standard) to protect flock health and prevent disease transmission[8]. The program is mandatory for all chicken producers in Canada, audited annually and includes enforcement mechanisms through the provincial boards. In 2013 CFC received full federal, provincial, and territorial government recognition for the effective implementation of the program and this recognition is maintained through regular program reviews and audits.

3.5.5 Turkey Farmers of Canada

Turkey Farmers of Canada's (TFC) On-Farm Food Safety Program© (OFFSP) is a national mandatory food safety program with the objective to provide turkey producers with measures to control on-farm pathogens; minimize the risk of disease transmission; ensure that marketed turkeys are free of medications or other chemical residues; and, ensure that farm personnel are appropriately trained[9]. TFC incorporated applicable provisions from the CFIA National Avian On-Farm Biosecurity Standard. Ultimately, OFFSP biosecurity protocols are in place to decrease the risk of disease on farm and to decrease the spread of disease between operations. TFC has received full government recognition for the TFC OFFSP under the Food Safety Recognition Program (FSRP).

3.5.6 Canadian Hatching Egg Producers

Canadian Hatching Egg Quality (CHEQ™) is CHEP's provincially mandatory on-farm food safety program, based on HACCP principles and is regulated by the CFIA as part of the Food Safety Recognition Program[10]. The program is audited annually, enforced with penalties for non-compliance, and reviewed to ensure it reflects current science, regulations, and industry practices. The CHEQ™ program includes biosecurity, bird health, egg handling and storage, pest control, and cleaning and disinfection. The CHEQ™ program was updated in 2018 to reflect continuous improvements to egg quality.

CHEP collaborated with the CFIA Avian Biosecurity Advisory Council (ABAC) to update the National Avian On-Farm Biosecurity Standard. CHEP is a member of the ABAC, which developed and revised the standard.

CHEP is a member of the Joint Government-Industry Working Group on the Control of *Salmonella* and *Campylobacter* in Poultry, which is focused on the reduction of these pathogens in live poultry and poultry food products. CHEP is working with the CFIA on

the revisions to the *Hatchery Regulations*, which include requirements for testing for all breeder flocks across Canada. The regulations will complement existing provincial breeder flock programs, which currently include testing and vaccination schedules.

3.5.7 Egg Farmers of Canada

EFC's Start Clean-Stay Clean™ HACCP-based on-farm food safety program provides critical control elements and measures to prevent, reduce, or eliminate all identified biological, chemical, and physical hazards. Biosecurity is a significant focus of the program to prevent and control the spread of pathogens[11].

Furthermore, EFC's national microbiological sampling protocol requires testing of pullet and laying hen facilities for *Salmonella* Enteritidis (SE). This protocol also outlines corrective actions and management procedures that must be followed in the event that SE is identified.

3.5.8 Equestrian Canada

Equestrian Canada's National Farm and Facility Level Biosecurity Standard for the Equine Sector is a national biosecurity standard containing voluntary guidelines and recommendations to benefit both owners and custodians in protecting horses from disease[12].

3.5.9 Canadian Sheep Federation

The CSF incorporated the National Sheep On-Farm Biosecurity Standard into the Canadian Verified Sheep Program, including training on program implementation and helpful record-keeping concerning biosecurity[13]. Development of comprehensive flock health plan within the Canadian Verified Sheep Program helps monitor and manage illness and disease. This helps inform management practices and plan prevention activities.

4. Stewardship

Groups were asked to report on their AMS activities that contribute to AMU/AMR education and awareness.

4.1 The Dean Council – Agriculture, Food and Veterinary Medicine

The Deans Council AFVM plays a key role in educating veterinarians and agriculture students so that upon graduation they are prepared to support their clients and stakeholders in appropriate antimicrobial stewardship. The Deans Council AFVM has also reported extensive research and study activities to support veterinarians, industry and producers in enhancing antimicrobial stewardship in farmed animal production:

- Antimicrobial stewardship and its impact on antimicrobial use, antimicrobial resistance, and animal health on dairy farms
- Evidence synthesis in support of prudent antimicrobial use
- Factsheets for Ontario Livestock Producer Organizations & Veterinarians
- Questions about AMU in National Dairy Study 2015

- Evaluating the potential contribution of beef cattle to antimicrobial resistance
- Scoping review of alternative to antibiotics in beef cattle
- Scoping study of alternatives to antibiotics in swine production

4.2 Canadian Animal Health Products Regulatory Advisory Committee

The Canadian Animal Health Products Regulatory Advisory Committee (CAHPRAC) provides the Health Products and Food Branch of Health Canada with stakeholder input into the Canadian regulatory system for animal health products and animal feed. The committee provides strategic policy advice from the perspective of regulated parties and stakeholders. As part of CAHPRAC's guidance, the committee published an informative online piece on "Responsible use of Medically Important Antimicrobials in Animals[14]." The section highlights the changes that will take place as of December 1, 2018, when all MIAs for veterinary use will be sold by prescription only and provides essential information for stakeholders to prepare for this change.

CAPRAC also facilitated dialogue with industry leaders on the communications provided stakeholders involving veterinary oversight of MIA, inclusive of the switch of over 340 products from over the counter to prescription status. This activity helped to ensure a common message on the changes was being delivered to producers.

Additionally, the CAHPAC provided input to the updating of the "Compendium of Medicating Ingredient Brochures". It serves as a regulatory guide in the formulation and labelling of medicated feeds for their efficacious and safe use[15]. The compendium list includes medical ingredients permitted by Canadian regulations to be added to livestock feed, drug products that may only be used under a veterinarian prescription as well as over the counter products that may be used in the manufacturing of livestock feed. Also, it sets out the labelling requirements to ensure compliance with prescribed labelling standards.

4.3 Canadian Animal Health Institute

The CAHI, along with its members, developed a voluntary responsible use logo for MIA products[16]. The logo is intended to be a reminder to MIA users that the products need to be used responsibly to best manage AMR in humans and animals.

4.4 Provinces/Territories

In 2012, the CCVO created the Antimicrobial Use in Animal Agriculture Committee, including representatives from all of the provincial and territorial Agriculture or related Departments and key federal government departments. The goal of the Committee was to share information and policy recommendations to the CCVO to assist in forming policy to preserve the efficacy of antimicrobials for human and animal health. In 2015, the committee published "An Evaluation of a Prescription Use Only Policy for Veterinary Antimicrobials" to evaluate the rationale for and definition of a prescription use only policy for veterinary antimicrobials and its effect on AMU in livestock and AMR in food animals, related food products, and humans[17].

Prescription use only policy refers to antimicrobials that would require a prescription within a jurisdiction. The categories and volumes of antimicrobials that fall under the jurisdiction may differ with the policy. Prescription use only policy is often recommended with the hypothesis that such a policy would result in decreased AMU/AMR, as producers would require veterinary supervision[17]. However, the committee did hypothesize that producers that did not have veterinary oversight before such a policy may have increased antimicrobial access with veterinary oversight[17]. In conclusion of the report, the committee reviewed policies and the results of analysis of available data, and there was no indication that application of a prescription use only policy would solely reduce AMR or AMU in food production animals in Canada[17]. The limitation of the committee's review of other countries is that other countries incorporated AMS activities with their prescription use only policy. Therefore, the impact of the policy of its own could not be solely assessed[17]. A prescription use only policy is just one tool, as AMS is needed to support prudent AMU.

4.4.1 British Columbia

The British Columbia (BC) Ministry of Agriculture licenses over-the-counter retailers to sell non-prescription veterinary pharmaceutical products. Licensing includes oversight of the licensees' pharmaceutical purchases. The Ministry has generated articles on the federal policy and regulatory changes to address AMR for the Ministry's stakeholders including veterinarians, the beef industry and the Society of BC Veterinarians.

4.4.2 Alberta

Alberta Agriculture and Forestry has been engaging in multiple speaking engagements to producer groups through regional or annual general meetings, forage association meetings, and other opportunities arranged by counties or Agricultural Service Boards. There have also been meetings and educational sessions set up for and veterinarians regarding the federal changes around oversight. Alberta is also developing a provincial One Health Strategy which has produced some stewardship opportunities through the stakeholder engagement processes completed thus far and partnered with the Alberta Veterinary Medical Association to host a One Health Antimicrobial Workshop which brought together leaders across the human-animal-environmental health spectrum. Alberta has also played a key role in the CVMA development of a National Veterinary Oversight System.

4.4.3 Saskatchewan

The Saskatchewan Ministry of Agriculture has hosted a series of stewardship activities to encourage prudent AMU, to discuss AMR issues, and on upcoming federal changes. These AMS activities include:

- Antimicrobial Prudent Use Education and Awareness for Livestock and Poultry Producers – 2013/2014 – A series of presentations to SK producers to raise awareness;

- Antimicrobial Prudent Use Education and Awareness for Livestock and Poultry Producers – 2015/2016 – A series of roundtables with SK producer groups to stimulate discussion and identify needs;
- Honeybee health and management sessions for veterinarians – February 2018; and
- Saskatchewan AMR roundtable - 2015, 2016, and 2017 – To bring together multidisciplinary groups of stakeholders to discuss current issues in AMR as pertains to SK animal health
- Saskatchewan Ministries of Agriculture and Health have partnered to introduce the first Western One Health Conference on AMS (to be held in Regina on January 23/24, 2019)
- Saskatchewan Veterinary Medical Association requires a minimum of one hour continuing education on AMR annually for its members
- Presentations at industry events and producer meetings to discuss the upcoming federal changes and to answer questions on AMR/AMS

4.4.4 Manitoba

A Manitoba working group participates with the Manitoba Veterinary Medical Association to discuss AMR/AMU issues and activities and, as requested, joins in meetings with industry associations to discuss AMR/AMU regulatory changes and to discuss concern and issues around AMU/AMR. Additionally, MB Agriculture supports ongoing on-farm food safety programs.

4.4.5 Ontario

The Farmed Animal Antimicrobial Stewardship Initiative (FAAST), a Canadian Agricultural Partnership Program is a collaboration between the Ontario Veterinary Medical Association, ACER Consulting, government, academic, and industry partners[18]. The FAAST provides information and tools to veterinarians and farm animal owners on AMU/AMR issues and policy and regulatory changes.

To align with federal changes, the Ontario Ministry of Agriculture, Food and Rural Affairs implemented amendments to its Livestock Medicines Act to eliminate medically important antimicrobials from the list of products sold at Livestock Medicines Outlets in Ontario. In recent years, the ministry has engaged key partners including farmer, industry, retailer, veterinary and public health organizations, delivering more than 60 presentations and consultations to raise awareness of the importance of antimicrobial stewardship, and to complement federal and provincial regulatory changes.

4.4.6 Quebec

In September 2015, SQSBEA, Quebec's Animal Health and Welfare Strategy[49] adopted a 2015-2020 intervention framework, including a recommendation on antimicrobial resistance and the judicious use of antibiotics. Québec's Department of Agriculture, Fisheries and Food (MAPAQ) is currently working on an action plan based on SQSBEAS's goals.

A mandatory prescription for category 1 to 4 antibiotics, as defined by Health Canada, has been in place in Québec since 1984. The Pharmacy Act (RLRQ, chapter P-10) governs the activities of health professionals who prescribe, sell and use medicines intended for animals. The Veterinary Surgeons Act (RLRQ, chapter M-8) sets out the list of mandatory-prescription drugs for animals.

In 1986, a permit system for pre-mixes and medicated feed was implemented for the manufacture, distribution and sale of medicated pre-mixes and food, by virtue of the Animal Health Protection Act (RSQ, c, P-42).

On August 29, 2018, the Québec government published in the Québec Official Gazette the Regulations Amending the Regulations on the administration of certain medicines, which aim to prohibit the use as a preventive measure and to limit the use as a curative measure, antibiotics that are of high human health importance. The change comes into effect on February 25, 2019.

4.4.7 New Brunswick

All 20 provincial New Brunswick veterinarians are actively increasing client awareness of prudent AMU and trying to address prevention. Having the large animal, food animal, and small ruminant client serviced mostly by New Brunswick's Provincial Veterinary Service enables more provincial-wide awareness of antimicrobials and fosters a more unified approach.

4.4.8 Prince Edward Island

Prince Edward Island (PEI) has developed an "Antimicrobial Resistance in Agriculture" educational website to address AMR and upcoming federal changes[19]. Additionally, the PEI Department of Agriculture and Fisheries are speaking to the antimicrobial changes at every opportunity and held a course for veterinarians in Atlantic Canada on honeybee health and their antimicrobial requirements.

4.5 Canadian Veterinary Medical Association

The CVMA is involved in regular communication activities on AMU/AMR and is highlighting current regulatory and policy changes that are affecting the prescription of antimicrobials and veterinary oversight responsibilities.

Over the past several years, the CVMA has held three workshops focusing on AMU surveillance, AMS, and veterinary oversight of AMU. In February 2017, CVMA held a workshop on "National Antimicrobial Use (AMU) Surveillance for Veterinary Practitioners". The purpose of the workshop was to review the current setting and activities for veterinary AMU surveillance and to identify the requirements for future prescription-based AMU data and information collection. After reviewing the current surveillance landscape of Canada, the workshop focused on specific challenges associated with veterinary prescription-based AMU surveillance. Workshop participants were asked to consider potential gaps to

prescription-based AMU surveillance and possible solutions and approaches to surveillance data collection.

In May 2017, CVMA held an "Antimicrobial Stewardship Workshop". The purpose was to consult with veterinary stakeholders to assess and provide advice on the information gathering, oversight, and decision support-needs of veterinarians and veterinary practices to support veterinary AMS. The first part of the workshop focused on a review of current veterinary AMS activities and participants were asked to identify what and where AMS was succeeding in Canada, where are the challenges, and what could act as opportunities to renew stewardship. Activities that were highlighted included:

- Canadian Veterinary Medical Association Antimicrobial Prudent Use Guidelines 2008 for beef cattle, dairy cattle, poultry, swine;
- Guidelines for the Legitimate Use of Compounded Drugs in Veterinary Practice;
- Therapeutic Decision Cascade for Animal and Public Safety;
- Ontario Stewardship Survey;
- Alberta One Health Antimicrobial Workshop; and
- Veterinary Oversight of Antimicrobial Use – A Pan-Canadian Framework of Professional Standards for Veterinarians.

In the second part of the workshop, the AMU Stewardship project was addressed. The objective of this project is the development of a toolset to provide information, oversight, and decision-making support related to prudent AMU for six species groups: swine, poultry, beef cattle, dairy cattle, small ruminants, and companion animals. The project launched January 1, 2017, with a target end date of March 31, 2018. Workshop participants were asked to contribute to the projects planning by brainstorming information needed for the project, key stakeholders to collaborate with, how to best work with those stakeholders, and provide recommendations for the project's success.

Finally, in February 2018, the CVMA held a "Veterinary Oversight of Antimicrobial Use Workshop Series". The first phase of the workshop series was dedicated to AMU Stewardship. During this phase, the participants reviewed and provided feedback on the Prudent Use Guidelines and other veterinary decision-support tools, including on the progress of the AMU Stewardship project. The second phase of the workshop series focused on AMU surveillance. During this phase, the AMU Surveillance project was discussed, and participants were engaged for input on the project. Participants were asked to provide input into the implementation of functional veterinary-based AMU surveillance. At the time of the workshop, the project had completed a situational analysis of current Canadian AMU and veterinary AMU surveillance and designing a pilot prototype to initiate AMU surveillance. The project will support AMU surveillance nationally and worldwide and assist in targeting AMS activities.

The CVMA has developed in collaboration with other stakeholders such as CAHI, Health Canada, CFIA and ANAC, web resources to support communication with veterinarians regarding ongoing policy and regulatory changes around the use of antimicrobials in animals[51].

In late 2018, the CVMA released its new online platform: “CVMA Guidelines for Veterinary Antimicrobial Use”. The new application builds off the previous 2008 Prudent Use Guidelines for Antimicrobial Use (PUGS). The original scope of four species groups (beef, dairy, poultry swine) has been expanded in the 2018 guidelines to include small ruminants and companion animals. Additional fields were added including brand trade names, labeled vs. extra-label use and Health Canada Category. The shift to electronic format allows for more frequent information updates and addition of new resources, accessibility via a variety of devices (e.g. laptop, tablet, smartphone), and a searchable interface and filtering for quicker access to information.

The Guidelines are integrated within the existing CVMA website allowing for layered access to veterinarians for some material via members and non-member veterinarian accounts, while still allowing public to access initial screens (but not the database). This integration creates a common and feel, eliminates the need to create brand new accounts for all veterinarians in Canada, ensures that material will continue to be addressed from a national veterinary perspective. Piloting was undertaken with subject-matter experts and their teams and updating, and further development will continue on an evergreen basis.

Building on the above, the CVMA has proposed the development of a National Veterinary Oversight System for AMU over 5 years aiming to enhance and integrate surveillance, stewardship and communication activities across a wide range of stakeholder groups

4.6 Animal AMS Canada

In October 2017, the Ad-Hoc Committee on Antimicrobial Stewardship in Canadian Agriculture and Veterinary Medicine, in collaboration with the Public Health Agency of Canada, held a workshop to discuss leadership in AMS[20]. The objectives of the workshop were to identify gaps in current AMS in Canadian initiatives and identify future AMS proposals, define a plan for immediate and long-term AMS initiatives, communication plans, and policy changes, and to formalize a leadership group to integrate stakeholders to collaborate in future activities. Participants came to a consensus that there is a need for a leadership group for AMS in Canada that incorporates human and animal stakeholders. To create this group, the participants agreed to develop a proposal to form "Animal AMS Canada," with the support of the Animal Nutrition Association of Canada (ANAC), the CVMA, the CAHI, and under the auspices of the NFAHWC. The proposal for the NFAHWC support is under consideration by the Council.

4.7 Animal Nutrition Association of Canada

The ANAC is a national trade association of the livestock and poultry feed industry. They represent feed and ingredient manufacturers, distributors, and suppliers in Canada's agriculture industry and provides its members with information based on developments in the agri-food sector and government policies and regulations. Many of ANAC stewardship activities focus on the policy changes coming into effect December 1, 2018, which they communicate using fact sheets via an AMS page on their website[21]. As well, ANAC fields phone calls daily from the feed industry as well as veterinarians and producers looking for more information on the December 1 policy change and how this will impact their business.

ANAC participates on the industry-government feed vs. drug working group to address regulatory gaps to allowing feed additives approved in the Canadian marketplace. Many feed additives approved in other jurisdictions, but not available in Canada, are helpful tools to help reduce the need for antimicrobial use in livestock production.

ANAC participates on the poultry industry's National AMU Steering committee as well as the Poultry Sustainability Value Chain Roundtable's AMR-AMU working group.

4.8 National Commodity Organizations

The national commodity organizations communicate the importance of AMU/AMR to their producers through numerous means, and some have formalized that communication in the form of an industry policy or strategy.

4.8.1 Canadian Cattlemen's Association

The CCA communicates the importance of prudent AMU and the significance of the upcoming policy changes through their Action News on the CCA website[22] and through promoting the relevant requirements for AMR stewardship in the Code of Practice for the Care and Handling of Beef Cattle[23]. The majority of the national beef sector's stewardship activities are communicated through the BCRC. The BCRC website displays an educational section on AMR, including the function of antimicrobials, categories, concerns, surveillance, and highlights the beef industry's AMU/AMR research focus[24]. Finally, Verified Beef Production Plus (VBP+), the beef industry's HACCP based program, expects and highlights the importance of a valid vet/client/patient relationship (VCPR) for the prudent AMU[25].

4.8.2 Canadian Pork Council

The CPC website communicates the importance of AMU/AMR on their AMR/AMU webpage[26]. The webpage raises awareness on AMR and global and Canadian responses, including the upcoming policy and regulatory changes. PigCARE highlights the development of AMR and its risks to human and animal health and stresses the importance of responsible AMU, implementing good biosecurity, and having a vaccination program[6]. The program's first line of action is good management and

husbandry practices. Additionally, the Vaccine and Drug Use Policy of the PigSAFE/PigCARE programs provide producers with the tools to ensure proper AMU on their animals[6].

4.8.3 Dairy Farmers of Canada

In 2017, DFC developed a policy statement that committed to the collaboration with government and to remaining committed to initiatives to safeguard the use of antimicrobials[27]. Additionally, proAction® highlights the importance of treatment decisions being made with a veterinarian to ensure prudent use of antimicrobials to avoid AMR[7].

4.8.4 Chicken Farmers of Canada

Chicken Farmers of Canada has developed various web pages dedicated to antimicrobial education to stakeholders[28] and consumers[29]. Two issues of an AMU magazine have been distributed to producers to speak about the AMU Strategy and provide education on best practices for reducing antimicrobial use on-farm [39]. They have also produced videos and brochures which have been used in presentations with all value-chain members.

Chicken Farmers of Canada developed an AMU Strategy in conjunction with the ANAC, the Canadian Hatchery Federation, the Canadian Hatching Egg Producers, the Canadian Poultry and Egg Processors Council, Turkey Farmers of Canada, and the Canadian Association of Poultry Veterinarians. The AMU strategy was built on the foundations of reduction, surveillance, stewardship, and research and innovation. Key elements of the AMU Strategy include defining AMU, analyzing AMU/AMR trends, reviewing best management practices, ensuring effective controls of AMU, educating stakeholders on the issues of AMU/AMR, and researching and determining the availability of antimicrobial alternatives.

As part of CFC's AMU Strategy, Canada's chicken industry announced that the preventative use of Category I antibiotics was no longer permitted as of May 15, 2014. Following on that success, the preventative use of Category II antibiotics was eliminated at the end of 2018, with a goal of eliminating the preventative use of Category III antibiotics by the end of 2020. A re-assessment of the 2020 target will be performed in 2019. The AMU Strategy has been incorporated into the *Raised by a Canadian Farmer* On-Farm Food Safety Program to specify the restrictions on Category I and II antibiotics

4.8.5 Turkey Farmers of Canada

The importance of appropriate and responsible use of antibiotics in the turkey industry is stressed on the antibiotics information page of the TFC corporate website[30]. TFC also has a farmer-only portal that houses the electronic versions of the TFC On-Farm Programs, an online library of Research Notes, Turkey Farming Info Sheets, and related information on important farm and industry issues including AMU[31] and regulatory or

policy developments affecting veterinary drug usage (e.g. December 1, 2018 implementation date of the change to prescription-only requirements for MIAs).

The turkey industry has implemented an Antimicrobial Use Strategy to address concerns surrounding the development of AMR. The Strategy outlines the reduction of the preventive use of MIAs by setting timelines to eliminate the preventive use of Category II antimicrobials by the end of 2018 and the preventive use of Category III antimicrobials by the end of 2019. The strategy is an expansion of the current Category I initiative under which, in May of 2014, the Canadian poultry industry withdrew the preventive use of Category I antimicrobials.

The AMU Strategy is enforced in Canada's turkey industry via audited certification of the TFC OFFSP by provincial auditors[9]. The OFFSP also requires appropriate use of all medications and farmers are encouraged to discuss AMR with their veterinarian and inquire about alternative treatments before initiating antimicrobial therapy.
The Canadian turkey industry communicates frequently with industry stakeholders across the supply chain on the AMU Strategy and responsible use of antibiotics. The *Guidelines for Antimicrobial Use in Turkey Production* were developed in consultation with a range of poultry veterinarians and provide background on AMU and the development and spread of AMR, the AMU Strategy, and roles within the Strategy.

4.8.6 Canadian Hatching Egg Producers

In addition to the mandatory implementation of CHEQ™, implementation of surveillance, and AMU-related communication to producers, CHEP has developed responsible AMU guidelines for broiler hatching egg producers, which encourages increased veterinary oversight and recommends producers consult with their veterinarians, and continuously improve on-farm management and egg handling practices. CHEP supports CgFARAD to cover requests for extra label use in broiler breeders under veterinary supervision. Preventative use of Category I antibiotics was no longer permitted in broiler breeders starting May 14, 2015.
Communication to producers on regulatory changes coming December 1, 2018, is being highlighted by CHEP, so producers have as many tools as possible to maintain bird health and welfare while being able to treat flocks as required. Communication activities are also related to domestic and international developments related to AMR.

4.8.7 Egg Farmers of Canada

EFC shares information with egg boards and farmers regarding antimicrobial initiatives to maintain a common awareness of issues and initiatives across the sector. This information sharing has touched on EFC banning the preventative use of Category 1 antimicrobials on-farm and for incoming chicks in 2014, and Health Canada policy changes regarding antimicrobial oversight. New results and outcomes will also be shared across the industry once completed as well as enhancements to our national SC-SC™ Farmers Guidelines.

4.8.8 Equestrian Canada

Equestrian Canada supplies education to both producers and veterinarians on their national website[32]. The website stresses the concern of the increase in AMR, the importance of appropriate AMU and biosecurity, and provides resources concerning the upcoming policy changes.

4.8.9 Canadian Sheep Federation

The CSF has participated in various consultation processes concerning AMU/AMR, including the CVMA's *Veterinary Oversight of Antimicrobial Use (AMU) Workshop* and disseminates vital AMU/AMR information through communication networks and social media.

The CSF's Sheep Industry Health and Welfare Strategy, pending funding approval, will include a 'Responsible antimicrobial stewardship strategy.' This strategy will support producers through legislative changes and changes in accessing veterinary drugs. Activities will include exploring, promoting and managing new veterinary drug approvals, coordinating and collaborating with additional minor use species groups; improve access to adequate veterinary care and services for sheep producers; and communication strategy and tools for stakeholders.

5. Research and Innovation

Groups were asked to report on activities that they participate in research and innovation that may contribute to increased AMR knowledge, the creation of tools, and the development of new treatments or strategies.

5.1 The Deans Council - Agriculture, Food, and Veterinary Medicine

The Deans Council AFVM has reported extensive activity and study in the field of research and innovation that address antimicrobial resistance and use, alternative to antibiotics, and demonstrates broad support across industry sectors to address gaps in available science and enhance innovation. Some of these activities include:

- Advancing Canadian Waste Water Assets
- Advancing Canadian Wastewater Assets Microbial Research Laboratory
- Antimicrobial and immune modulatory biological functions of host defense peptides in infectious diseases of production animals
- Bacteriophages as innovative strategies to minimize food safety risk
- Characterizing the microbiome of beef cattle to identify risk factors that affect respiratory health
- Egg Production for a complete cycle feeding dietary seaweed
- Evaluation of the human burden of disease from third generation cephalosporin resistant *Escherichia coli* and *Salmonella* infections and the contribution from antimicrobial use in food producing animals
- Investigation of irrigation water safety in British Columbia; Development of bacteriophages for reducing foodborne pathogen contamination

- Molecular Ecology of Waterborne Microbes
- Natural Sciences and Engineering Research Council Industrial Research Chair in Infectious Diseases of Dairy Cattle
- Ontario Ministry of Agriculture Food and Rural Affairs (OMAFRA) funded research - Evaluation of the Canadian Quality Milk program on Ontario dairy farms
- Prevalence of antimicrobial resistance in bovine respiratory pathogens; development of nasal probiotics to reduce the use of antimicrobials to control respiratory disease in cattle; development of new respiratory vaccine for cattle
- Research on molecular epidemiology of antimicrobial resistance in bacteria from animals
- Sustainable production of animal protein in the absence of antibiotics
- Use of a One Health approach integrating genotypic, phenotypic, social, and qualitative information to improve understanding and communication of antimicrobial resistance
- Use of nasal probiotics to prevent bovine respiratory disease in feedlot cattle
- The Genomics Research and Development Initiative (GRDI) is performing genomics work on AMR in Canada.

5.2 Canadian Animal Health Products Regulatory Advisory Committee

CAPRAC has been a sounding board to ensure enabling regulation for safe and effective animal health products in the Canadian market. Consultation is in progress on the technical requirements and claims for the gut modifier category of products. These products will be important to the health of production animals and competitiveness of our farmers. CFIA will be the lead agency for pre-market assessment of these products. Enabling regulation in support of product licensure will stimulate innovation in the area of gut modifiers.

5.3 Canadian Animal Health Institute

CAHI members invest millions of dollars on an ongoing basis to bring new animal health management tools to the market. A history of some of the innovation that have helped to manage animal and human health and the environment can be found on CAHI's History of Innovation[52] webpage.

5.4 Canadian Integrated Program for Antimicrobial Resistance Surveillance

CIPARS supports several surveillance-based research projects, which aim to either explore other food animals/commodities, other bacterial species, better integration of the data (e.g., through risk assessment and epidemiological modelling), new laboratory techniques (e.g., whole genome sequencing), and through novel communication approaches (e.g., how to best convey antimicrobial use information to different stakeholders).

5.5 Provinces/Territories

5.5.1 British Columbia

British Columbia has published literature on adjusting the Population Correction Unit (PCU) measure of animal biomass to incorporate animal length of life. BC is initiating research on AMU and AMR in the finfish aquaculture industry. The province is also supporting research at the University of British Columbia on developing alternative

treatments on livestock including the use of bacteriophages in reducing pathogens on farm and in animal-derived food products.

5.5.2 Alberta

Alberta staff have been working on various research projects (some independently and some in collaborations with the Agriculture and Agri-Food Canada, Public Health Agency of Canada, and academia) related to AMR. In particular, there has been extensive work done with bovine respiratory disease pathogens and comparisons between conventional feeding and "raised without antibiotics" feeding in feedlot cattle. There has also been some work on genetic characterizations of AMR in broilers. Also, AB has participated in project work focusing on lamb feedlot mortality which looked at the causes of death and included a culture and sensitivity aspect to it.

5.5.3 Saskatchewan

Saskatchewan has provided funding (WCVM/PDS collaboration) to investigate AMR in feedlot cattle in Saskatchewan. PDS is investing in advanced diagnostic methodology to improve ability to detect and investigate AMR in laboratory submissions and in research

5.5.4 Quebec

The goal of the Agri-Food Innov'Action Programme is to develop new knowledge by supporting research and innovation activities, particularly in order to grow the productivity of the food production sectors, with a view to sustainable development.

5.6 Animal Nutrition Association of Canada

Many ANAC member companies are involved in private research around in-feed tools that can aid in gut health, thus reducing the need to use antimicrobials in some instances. These products are part of a larger tool kit to help producers in their antimicrobial reduction strategy. ANAC is working to ensure the regulatory environment changes to help ensure these types of products can be approved for use in Canada in the near future.

5.7 National Commodity Organizations

Canada's national commodity organizations dedicate vast amounts of resources to AMU/AMR research, both solely and in collaboration with academic, and industry stakeholders, and government.

5.7.1 Beef Cattle Research Council

In 2016, the BCRC and the National Beef Value Chain Roundtable (BVCRT) completed an analysis of AMR in the beef industry, consulted with industry stakeholders, and collaborated with funders to create the National Beef Antimicrobial Research Strategy[33]. The strategy identified priority areas of research for the beef industry, including:

- AMR,
- AMU, and
- Antimicrobial alternatives

The BCRC also actively participates in the Research and Innovation Task Group established as part of the Pan Canadian Action Plan on AMR.

Canada's Beef Science Cluster, a partnership between Agriculture and Agri-Food Canada (AAFC) and BCRC, focuses its resources on three core areas of research. Of which, one is to "improve public confidence in Canadian beef, outcomes are to improve food safety, strengthen the surveillance of AMU/AMR, develop effective antimicrobial alternatives, ensure animal care, demonstrate the safety and efficacy of new production technologies, improve environmental sustainability and measure the beef industry's environmental benefits[34]."

The third Beef Science Cluster has allocated 24% of the funding to animal health, welfare, and AMR[35]. Projects in progress under the third Cluster include:

- Understanding and preventing *E. coli* resistance at the abattoirs,
- Identifying the best strategies for treating toe tip necrosis and digital dermatitis in feedlot cattle,
- Understanding *Mycoplasma bovis* pneumonia in beef cattle,
- Investigating antimicrobial resistance (AMR) and virulence factors of *Mycoplasma bovis,*
- Characterizing the microbiome of beef cattle to identify risk factors that affect respiratory health,
- The Canadian Cow-Calf Surveillance Network,
- Determining the minimum fiber requirement for feedlot cattle,
- Strategies to enhance the use of wheat grain in feedlot diets, and
- Evidence-based prebiotic and probiotic solutions for improving gut health and feed efficiency in cattle.

5.7.2 Canadian Pork Council

Swine Innovation Porc (SIP) facilitates research and development in the Canadian swine industry. Responsible AMU is one of SIP research priorities and demonstrates the industry's commitment to decrease AMU/AMR. Examples of research being conducted by SIP include[36]:

- New tools to enable effective genomic selection for disease resilience, and
- Bio-exclusion and bio-containment strategies to control epidemics resulting from airborne viral and bacterial transmission

5.7.3 Dairy Farmers of Canada

The Dairy Research Cluster aims to promote the efficiency and sustainability of Canadian dairy farms, grow markets, and improve food safety and quality. A research priority in the cluster is animal issues, of which, AMR is a focus. The Dairy Research Cluster is completing their second Cluster of projects in 2018, of which there are 27 projects[37].

5.7.4 Chicken Farmers of Canada

Chicken Farmers of Canada contributes to research through the Canadian Poultry Research Council (CPRC) and has established an industry research Chair at Dalhousie University for Sustainable Antibiotic Reduction. Nearly half of CPRC's research funding is dedicated to bird health and antibiotic alternative research (e.g. feed alternatives, vaccines, etc.). Also, CPRC's "Avian Gut Microbiology" research program examines the impact of gut microflora on the nutrition, feed conversion, pathogen carriage, and health of poultry in the context of AMR[38].

5.7.5 Turkey Farmers of Canada

Collectively, the Canadian poultry industry and stakeholders, including Turkey Farmers of Canada (TFC), have invested over $2.2 million in antibiotic alternatives and AMR research, which has been leveraged to over $10.8 million with additional funding from the government. Research projects focus on poultry gut health, vaccine development, understanding the impact of pathogens, and antibiotic alternatives.

5.7.6 Canadian Hatching Egg Producers

To support research and innovation locally, provincially, and nationally, Canadian Hatching Egg Producers (CHEP) is a founding member of the Canadian Poultry Research Council (CPRC). The CHEP Research Committee reviews CHEP's national research priorities annually, based on feedback from farmers and provincial boards, and taking into consideration existing research. These priorities are communicated to the CPRC in its calls for projects. Current research priorities include alternatives to antimicrobials, breeder welfare, poultry health and disease, environmental research, control of foodborne pathogens, and production-based research.

To support CIPARS, CHEP funds a research project which looks at AMU in the last 120 days, and foodborne pathogens in broiler breeders sent to federally registered processing plants. The source of the on-farm AMU information is the flock sheet for the broiler hatching egg industry or the *Spent Broiler Breeder Flock Sheet*. In addition to CIPARS, the project team includes CFIA, University of Montreal, and industry veterinarians, with additional funding from the Public Health Agency of Canada (PHAC).

5.7.7 Egg Farmers of Canada

Egg Farmers of Canada (EFC) has a formal research grant program with an annual call for proposals that offers financial support to individual research projects at Canadian universities and research institutions. EFC's research grant program is currently funding a number of projects on bird health and nutrition and food safety with an AMU/AMR aspect. Most recently, EFC funded a CIPARS laying hen AMU/AMR and pathogen surveillance study. EFC is also a member of the Canadian Poultry Research Council (CPRC), which prioritizes and funds many research projects on AMR and antibiotic alternatives.

5.7.8 Equestrian Canada

Although Equestrian Canada (EC) is not currently participating in AMU/AMR research, EC is planning to develop an animal care/quality assurance program and Equine Identification and Traceability database.

5.7.9 Canadian Sheep Federation

The Sheep Value Chain Roundtable brings together sheep industry stakeholders and government members to discuss the industry's challenges and opportunities for development. Collectively the Roundtable members contribute to AMU/AMR research projects, including:

- *Characterization of drug use in sheep flocks and presence of antimicrobial resistance* - Paula Menzies, Olaf Berke, Richard Reid-Smith, Scott McEwen, Catherine Moon, Lisa Scott
- *Creation of tools for veterinary practitioners, grouping relevant, up-to-date information on extra-label drug use (ELDU), which is a routine practice in the treatment or prevention of sheep diseases.* - Gaston Rioux, Catherine Element-Boulianne, Pascal Dubreuil, Richard Bourassa
- *Evaluating the health of Saskatchewan sheep* – Saskatchewan Sheep Development Board and University of Saskatchewan
- *Determination of infectious agents affecting the dairy potential of meat ewes and their antibiotic resistance to establish an action and intervention plan aimed at reducing risk factors and controlling impacts on the productivity of Quebec sheep productions.* – Center of Expertise in Sheep Production in Québec (CEPOQ)
- *Development of a Multivalent Recombinant Orf Virus Vaccine to Protect Against Maedi Visna Virus Infection* – Sarah Wootton
- *Development of a vaccine to protect against Toxoplasma gondii infection in sheep* – Sarah Wootton
- *Development of a Sheep Respiratory Vaccine* - Andrew Potter

6. Antimicrobial Stewardship in Food Animals in Canada (2016) Recommendations

The NFAHWC published 15 recommendations in the report “Antimicrobial Stewardship in Food Animals in Canada” in April 2016 for stakeholders in animal agriculture to identify how to participate as a full partner in developing a pan-Canadian plan for AMR (listed in Appendix A). Based on the findings of this report, the NFAHWC AMU/AMR Working Group reviewed the progress of those recommendations (Table 1).

Table 1. Review of Antimicrobial Stewardship in Food Animals in Canada (2016) Recommendations

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
1	All stakeholders in animal agriculture support the Federal Framework for Action and the Federal Action Plan for antimicrobial resistance. **Status: In Progress**	All stakeholders contacted provided input on activities underway to support the Federal Framework for Action, and there is significant interest in providing input and engaging in the Federal Action plan			
2	All stakeholders in animal agriculture support and participate in the development of a pan-Canadian strategy to manage antimicrobial resistance. **Status: In Progress**	All stakeholders contacted provided input on activities underway to support the Federal Framework for Action, and there is significant interest in providing input and engaging in the Federal Action plan. Provincial and Federal Governments and industry associations have developed national standards, and regional and sectoral training tools and materials to enhance biosecurity practices, raise awareness of biosecurity, to maintain the health of the herd or flock and reduce the risk of disease introduction.		The CCVO published a paper "An Evaluation of a Prescription Use Only Policy for Veterinary Antimicrobials" which recommended that implementing prescription use for MIA would not alone resolve or reduce AMR/AMU in food production animals	
3	That within the context of a pan- Canadian strategy for AMR that the Council assume a national leadership role to bring stakeholders together to coordinate: • their respective leadership roles • communication and education activities	Council has been actively engaged with CAHSS and the potential transition of CAHSS to the Council		• Council has engaged with CFIA, Health Canada and PHAC to provide input on Pan Canadian Framework and has engaged with leaders on the Pan Canadian Action plan to seek updates and provide input where possible. • Council has been working with all stakeholders to collect and report on existing stewardship	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
	• development of an effective partnership with those involved in human initiatives on antimicrobial resistance. **Status: In Progress**			activities as well activities that support the Framework • Council has also been engaged in discussions with AMS Canada and participated in CVMA and PHAC/AMS Canada consultations which discussed how organizations can work collaboratively and minimize duplication of efforts.	
4	That Health Canada advance proposed regulatory amendments to establish limitations and controls on the antimicrobials imported under the provisions of Own Use Importation or as Active Pharmaceutical Ingredients. **Status: COMPLETE**			Complete November 2017	
5	That the pharmacy regulators be engaged in the stewardship of antimicrobial use in animal agriculture to ensure pharmacists are aware of their legislated responsibilities regarding selling or dispensing antimicrobials for animals.			Discussions between provinces, veterinary regulators, Heath Canada and pharmacy regulators have been ongoing	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
	Status: In Progress				
6	That the livestock commodity organizations enhance communications with producers (for example via their sustainability or quality assurance programs) on the importance of reducing antimicrobial resistance through prudent and judicious use of antimicrobials. **Status: In Progress**		On farm assurance programs being delivered or under development - Dairy, Beef, Poultry, including Hatching Eggs, Eggs (layers), Sheep, Equine, Pork National Biosecurity standards developed for poultry, beef cattle, dairy cattle, swine, equine, sheep, goat, mink Industry communication and materials developed to support the implementation of strong biosecurity practices	• Newsletter communications on prudent use and upcoming policy and regulatory changes • Relevant requirements for stewardship in codes of practice and On-Farm Programs • Educational website material • Position statements in support of AMU/AMR policy changes	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
7	That livestock commodity organizations lead the development of an action plan for their commodity producers to engage their veterinarians in the assessment of the use of antimicrobials, the validity of that use, the alternatives that are available and the management practices that might reduce risk. **Status: In Progress**	some provincial work on AMU at veterinary level;		• On Farm Assurance programs – Beef Cattle Verified Beef Production Plus, PigCARE/PigSAFE, Dairy Farmers of Canada proAction®, Turkey Farmers of Canada OFFSP, Chicken Farmers of Canada's Raised by a Canadian Farmer OFFSP, Canadian Hatching Egg Quality (CHEQ™), Egg Farmers of Canada Start Clean-Stay Clean™, Canadian Verified Sheep Program. • CAP applications to enhance, develop or implement stewardship strategies • Development and implementation of stewardship strategies that include trend analysis • Best practices, effective controls, education, and research in addition to elimination of category I, II, III preventative use by 2019 for turkey and 2020 for chicken.	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
8	That a continuing education program for current and future producers, veterinarians, feed suppliers and other allied service providers to animal agriculture be developed at a national level and widely disseminated provincially to promote a culture of antimicrobial stewardship in Canadian agriculture and veterinary medicine. **Status: In Progress**		• Deans Council AFVMducates agriculture and veterinary students in order to ensure they are able to provide support to clients and industry in the area of infection prevention and control • PEI Provincial Exhibition Old Home Week created biosecurity signage and display for children to learn about how to enter and exit a barn in a biosecure manner and about the importance of zoonotic disease, development of biosecurity kits for producers • SK delivered biosecurity training for veterinarians and veterinary technologists, as well as established a CAP program for on farm biosecurity assessments	• CAHPRAC developed an informative online document on "Responsible use of Medically Important Antimicrobials in Animals" and consulted with CFIA on “Compendium of Medicating Ingredient Brochures" • CAHI developed a voluntary responsible use logo for MIA products to remind users of the importance of responsible use • Provinces have undertaken various outreach and education activities to inform and seek input from veterinarians and livestock producers • FAAST in Ontario is a government, veterinary, consulting, academia, and industry initiative to provide information and tools to veterinarians and farm animal owners on AMR/AMU issues, policy and reg changes • PEI has established an Antimicrobial Resistance in Agriculture website • Quebec’s integrated animal health program with industry	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
				partners and veterinary associations to support producers in the adoption of recommended prevention and disease control practices and prudent use.	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
9	That veterinary regulators and veterinary associations develop awareness, education and training for veterinarians on the responsibilities of veterinarians in working with clients and treating animal with regard to addressing antimicrobial resistance. **Status: In Progress**	CVMA held a workshop on National Antimicrobial Use Surveillance for Veterinary Practitioners		• Provinces have undertaken various outreach and education activities for veterinarians and producers to inform and seek input from veterinarians and livestock producers • FAAST in Ontario is a government, veterinary, consulting, academia, and industry initiative to provide information and tools to veterinarians and farm animal owners on AMR/AMU issues, policy and reg changes • PEI has established an Antimicrobial Resistance in Agriculture website • CVMA has undertaken regular communications highlighting regulatory and policy changes, held 3 workshops on surveillance, stewardship, and veterinary oversight of AMU • CFAVM trains agriculture and veterinary students in prudent antimicrobial use and stewardship • Quebec introduced regulations to prohibit preventative use and limit treatment with	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
				medically important antimicrobials.	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
10	That all stakeholders make efforts to build on the success of the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS), for the purpose of monitoring the effects of the new stewardship approaches and identifying and responding to emerging problems in a timely way. **Status: In Progress**	• CAHI reporting on the KG of antimicrobial actives distributed by developers, manufacturers, and distributors of active pharmaceuticals • CIPARS in collaboration with stakeholders such as commodity groups and provinces report on surveillance across species in human, farm, abattoir, retail meat and clinical animals • Quebec passive monitoring of antimicrobial resistance. Developing programs for monitoring the use of antibiotics in animal production • CAHSS has established an AMU AMR Network • Provinces are reporting or working towards reporting on laboratory AMR data, and some are reporting on provincial distribution • Cow-calf surveillance network enabling the collection of on farm AMU/AMR data • Industry established or developing on farm assurance programs recording on farm			

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
		medication use, route, DIN, prescriptions, and withdrawal Deans Council AFVM reports research in the areas of: • Antimicrobial resistance of staphylococci from mastitic milk • Evaluating the potential contribution of beef cattle to antimicrobial resistance • Modelling Antimicrobial Resistance in generic Escherichia coli from Chicken Abattoir and Retail Meat Surveillance in Canada • Antimicrobial resistance in foodborne bacteria, production animal pathogens, and environmental bacteria in production facilities			

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
11	That the federal government develop with its provincial/territorial partners, and industry and other stakeholders, a robust system of collecting antimicrobial use at the national, provincial, commodity, farm and veterinarian level, for the purpose of "benchmarking" and supporting continuous improvement. **Status: In Progress**	• CAHI reporting on the KG of antimicrobial actives distributed by developers, manufacturers and distributors of active pharmaceuticals • CIPARS in collaboration with stakeholders such as commodity groups and provinces report on surveillance across species in human, farm, abattoir, retail meat and clinical animals • Extensive participation in CAHSS which has established an AMU AMR Network • Provinces are reporting or working towards reporting on laboratory AMR data, and some are reporting on provincial distribution • MAPAQ's monitoring project carried out by CESA – Quebec's centre of expertise in animal health • Cow-calf surveillance network enabling the collection of on farm AMU/AMR data • Industry established or under development of on farm assurance programs recording on farm medication use, route,			

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
		DIN, prescriptions, and withdrawal			

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
12	That the national commodity organizations include research priorities which address the issue of antimicrobial resistance and optimal use of antimicrobials when establishing research priorities for their sector. **Status: In Progress**	• Research projects to develop a practical framework and protocols for AMU/AMR surveillance data in feedlot environments • Beef Science Cluster has identified strengthening surveillance of AMU/AMR • Cow Calf Surveillance network • Dairy Research Cluster AMR focus	CFAVM reports research supporting infection prevention and control such as: • Network meta-analysis to determine the relative efficacy of antibiotics for the treatment of mastitis • Identifying the best strategies for treating toe tip necrosis and digital dermatitis in feedlot cattle • Lighting during incubation in combination with sanitation of hatching eggs with antimicrobial proteins • Understanding and preventing E. coli resistance at the abattoirs	Dean's Council AFVM reports research activities such as: • Antimicrobial stewardship and its impact on antimicrobial use, antimicrobial resistance, and animal health on dairy farms • Evidence synthesis in support of prudent antimicrobial use • Factsheets for Ontario Livestock Producer Organizations & Veterinarians • Questions about AMU in National Dairy Study 2015 • Evaluating the potential contribution of beef cattle to antimicrobial resistance • Scoping review of alternative to antibiotics in beef cattle • Scoping study of alternatives to antibiotics in swine production	• Nearly half of CPRC's research funding has been directed towards bird health and antibiotic alternative research • Research projects to develop a practical framework and protocols for AMU/AMR surveillance data in feedlot environments • Research on measure of animal biomass to incorporate animal length of life • Research on veterinary pathogens of importance for veterinary and public health • Finfish AMU/AMR • Research on bovine respiratory disease pathogens and comparisons between conventional feeding and raised without antibiotics feeding in feedlot cattle • Genetic characterizations of AMR in broilers • Lamb feedlot mortality which included antimicrobial culture and sensitivity testing • BCRC has identified AMU, AMR, and ATB alternatives as a priority • E-Coli Resistance in Abattoirs • Treatment of toe tip necrosis and digital dermatitis in feedlot cattle

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
					• Mycoplasma bovis AMR and virulence • Microbiome and risk factors to animal health • Minimum fibre requirements for feedlot cattle • Enhance use of wheat grain in feedlot diets • Evidence based prebiotic and probiotic solutions to improve gut health and feed efficiency • CFC research chair "Sustainable Antibiotic Reduction" • CPRC research on alternatives, vaccines, biosecurity, gut microflora • EFC research grant program which funds projects on vaccines, alternatives, bird health and food safety with an AMU/AMR aspect[47]. • Characterization of drug use in sheep flocks and resistance • Tools for veterinarians on up to date information on ELDU • Evaluation of the health of SK sheep • Infectious agents affecting the dairy potential of meat ewes and antibiotic resistance • Development of Orf Virus vaccine to protect against Maedi Visna

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
					• Development of a vaccine to protect against toxoplasma gondii • Development of a sheep respiratory vaccine. Dean's Council AFVM reports research in the areas of: • Advancing Canadian Waste Water Assets • ACWA Microbial Research Laboratory • Antimicrobial and immune modulatory biological functions of host defense peptides in infectious diseases of production animals • Bacteriophages as innovative strategies to minimize food safety risk • Characterizing the microbiome of beef cattle to identify risk factors that affect respiratory health • Egg Production for a complete cycle feeding dietary seaweed • Evaluation of the human burden of disease from third generation cephalosporin resistant Escherichia coli and Salmonella infections and the contribution from antimicrobial use in food producing animals • Investigation of irrigation water safety in British Columbia; Development of bacteriophages

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
					for reducing foodborne pathogen contamination • Molecular Ecology of Waterborne Microbes • NSERC Industrial Research Chair in Infectious Diseases of Dairy Cattle • OMAFRA funded research - Evaluation of the Canadian Quality Milk program on Ontario dairy farms • Prevalence of antimicrobial resistance in bovine respiratory pathogens; development of nasal probiotics to reduce the use of antimicrobials to control respiratory disease in cattle; development of new respiratory vaccine for cattle • Research on molecular epidemiology of antimicrobial resistance in bacteria from animals • Sustainable production of animal protein in the absence of antibiotics • Use of a One Health approach integrating genotypic, phenotypic, social, and qualitative information to improve understanding and communication of antimicrobial resistance

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
					• Use of nasal probiotics to prevent bovine respiratory disease in feedlot cattle

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
13	A harmonized, pan-Canadian, regulatory framework for antimicrobial stewardship in agriculture and veterinary medicine that meets international standards. **Status: In Progress**			• All medically important antimicrobials will require a prescription effective December 2018. • Growth promotion claims are being removed from medically important antimicrobial drug labels effective December 2018. Ongoing actions include: o implementing microbiological safety requirements for assessment of new veterinary antimicrobial drug submissions for use in food-producing animals o categorizing antimicrobials into 4 categories based on their importance in human medicine to help prioritize risk management options o AMR specific warnings on	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
				certain medically important antimicrobials belonging to the Categories I, II, and III ○ supporting the microbiological safety evaluation of veterinary antimicrobial drugs by using CIPARS data ○ encouraging prudent use of antimicrobials in animals • Efforts have also included updating the Compendium of Medicated Ingredients Brochure • Work is underway to provide standardized templates for feed prescriptions for use by veterinarians • Piloting electronic feed prescriptions • AMS Canada and PHAC conducted a workshop to	

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
				identify gaps in current AMS initiatives in Canada, identify future proposals, define a plan for immediate and long term AMS initiatives, comms plans, policy changes and leadership to integrate stakeholders to collaborate in future activities. Implementation work is ongoing	
14	That Health Canada develop regulatory enabling processes for low-risk animal health products intended for food animals and for feed additives with physiological and health benefits. **Status: In Progress**			• CAHPRAC provides stakeholder input and strategic policy advice to Health Canada and CFIA on regulatory system for animal health products and animal feed. • Health Canada has established the Veterinary Health Products Program which is designed to expedite notification of ingredients on the approved list however this is not currently available for feed	• BCRC, Beef Science Cluster, and Feather industries have identified antimicrobial alternatives as a priority • Prebiotic and probiotic solutions for improving gut health and feed efficiency of cattle • CAPRAC has been a sounding board to ensure enabling regulation for safe and effective animal health products in the Canadian market

Council Recommendations		Surveillance	Infection Prevention and Control	Stewardship	Research and Innovation
15	That Health Canada advance harmonization of regulations with the United States and meet international standards. **Status: In progress**			• Canada collaborates with regulatory partners for both pre-market and post-market submissions, to promote harmonization of regulatory practices and standards, leverage resources, and facilitate timely access to safe and effective veterinary drugs.	

Appendix A – Summary of Activities by Organization

A.1 The Deans Council – Agriculture, Food and Veterinary Medicine

The Deans Council – Agriculture, Food and Veterinary Medicine is comprised of researchers, educators and scientists in thirteen faculties located in eleven universities across Canada. The Association is a catalyst for the development and adoption of science and veterinary technology for the agricultural and food industry in Canada. Ongoing and completed research activities reported by the Association are exploring antibiotic alternatives, in addition to working with industry groups such as beef, chicken, dairy and swine to undertake surveillance activities.

In addition to ensuring agriculture and veterinary students are well educated on infection prevention and control activities, the Deans Council AFVM has been actively involved in research activities that evaluate opportunities, strategies and programs to prevent and control infectious diseases such as exploring antibiotic alternatives, working with industry groups such as beef, dairy, hatching and layer egg.

The Deans Council AFVM plays a key role in educating veterinary and agriculture students so that upon graduation they are prepared to support their clients and stakeholders in appropriate antimicrobial stewardship. The Deans Council AFVM has also reported extensive research and study activities to support veterinarians, industry and producers in enhancing antimicrobial stewardship in farmed animal production.

The Deans Council AFVM has reported extensive activity and study in the field of research and innovation that address antimicrobial resistance and use, alternative to antibiotics, and demonstrates broad support across industry sectors to address gaps in available science and enhance innovation.

A.2. Canadian Animal Health Institute

The CAHI is a national trade association that represents Canadian developers, manufacturers, and distributors of animal pharmaceuticals, biologics, feed additives, and animal pesticides. The CAHI provides the PHAC with the kg of antimicrobial actives distributed by its members.

In March 2014, CAHI's members voluntarily agreed to remove growth promotion claims from the labels of MIAs. This began a process which resulted in the change of over the counter MIAs to prescription only by December 1, 2018[5]. The CAHI also advocated for greater oversight of Own Use Importation and use of Active Pharmaceutical Ingredients. In May 2017, a new regulation was introduced to have greater regulatory controls over non-Canadian licensed products[6].

CAHI, along with its members, developed a voluntary responsible use logo for MIA products[16]. The logo serves as a reminder to MIA users that the products need to be used responsibly to best manage AMR in humans and animals.

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Finally, CAHI members invest millions of dollars every year in research and development of animal health management tools important to animal, human and environmental health.

A.3 Canadian Animal Health Products Regulatory Advisory Committee

The CAHPRAC provides the Health Products and Food Branch of Health Canada and Canadian Food Inspection Agency with stakeholder input into the Canadian regulatory system for animal health products used in production and companion animals. As part of CAHPRAC's guidance, the committee published an informative online piece on the upcoming regulatory changes, "Responsible use of Medically Important Antimicrobials in Animals[14]." It consulted the CFIA on updating the Canadian Medicating Ingredients Brochure and aided in having enabling regulation for licensure of gut modifiers in the Canadian market.

A.4 Canadian Integrated Program for Antimicrobial Resistance Surveillance

The CIPARS is a national program committed to the collection, analysis, integration and communication of trends in AMU/AMR in humans, animals, and animal-sourced food across Canada. The CIPARS reports across species, surveillance components, AMR and AMU, or a combination of these[3]. The information collected supports the creation of policies for AMU and the identification of appropriate measures against AMR.

A.5 Provinces/Territories

In 2016, the AMU Surveillance Working Group of the CCVO published "Non-Human Antimicrobial Use Surveillance in Canada: Surveillance Objectives and Options"[4]. This report reviewed current Canadian non-human AMU surveillance programs and compared those programs to those in other counties. The working group's report formulated recommendations and options for non-human AMU surveillance in Canada.

In 2012, the CCVO created the Antimicrobial Use in Animal Agriculture Committee, including representatives from all of the provincial and territorial Agriculture or related Departments and key federal government departments. In 2015, the committee published "An Evaluation of a Prescription Use Only Policy for Veterinary Antimicrobials" to evaluate the rationale for and definition of a prescription use only policy for veterinary antimicrobials and its effect on AMU in livestock and AMR in food animals, related food products, and humans[17].

A.5.1 British Columbia

British Columbia publishes information on provincial AMU/AMR surveillance, including the distribution of antimicrobials and the AMR of bacteria significant to animal health and human health

Through GF2 and CAP the Ministry supports and hosts biosecurity training for various agricultural livestock industries.

Stewardship activities include the Ministry of Agriculture's oversight of veterinary pharmaceutical purchases by licensed over-the-counter retailers and generation of articles for veterinarians and livestock producers on the federal changes to combat AMR.

The Ministry has published research on incorporating animal length of life into the PCU measure of animal biomass. It is commencing research on AMU and AMR in the finfish aquaculture industry.

A.5.2 Alberta

Alberta has supported Canada's AMU/AMR surveillance through its contribution to CIPARS. Alberta staff have been working on various AMR related research projects. In particular, there has been extensive work completed on bovine respiratory disease in feedlot cattle.

Alberta's Biosecurity Champions program shares information on biosecurity initiatives, the development and implementation of biosecurity promotion plans, and the distribution of biosecurity promotional materials. Alberta also administers a disease investigation program which provides veterinary consultation on biosecurity and disease prevention strategies.

Alberta has been engaging in multiple speaking engagements with stakeholders regarding the upcoming regulatory changes. Alberta is also developing a provincial strategy which has produced some stewardship opportunities through the engagement processes.

A.5.3 Saskatchewan

Saskatchewan's Prairie Diagnostic Services (PDS) initially developed a disease surveillance veterinarian position, funded by the government of Saskatchewan under Growing Forward 2, to develop animal health surveillance using laboratory data. The position evolved to have a primary focus on AMR topics and initiatives; funding for this position is continued under the Canadian Agricultural Partnership. PDS publishes annual antibiograms on their website. Saskatchewan also provided GF2 funding to PDS for targeted surveillance of AMR in respiratory pathogens in feedlot cattle and funding to increase AMR surveillance capacity (state of the art diagnostic equipment plus funding for a full-time microbiologist and technician).

Saskatchewan supports CIPARS activities, providing funding to increase the number of swine farms enrolled in the surveillance program plus funding to conduct AMR on Saskatchewan broiler farms. This was funded under GF2, and continues under CAP. New under CAP, Saskatchewan is providing CIPARS support for the development of an AMR/AMU surveillance program for feedlot cattle.

Under Growing Forward 2, Saskatchewan hosted two biosecurity sessions for private veterinarians and Registered Veterinary Technologists in February 2018. These training sessions were offered to assist veterinarians and technicians in developing competency in

preparing, implementing and evaluating farm-level biosecurity plans and implementing routine personal and vehicle biosecurity when attending farm premises.

Under the Canadian Agricultural Partnership, biosecurity funding is available for livestock producers. This includes funding for biosecurity assessments completed by a veterinarian and equipment upgrades for their farm. Eligible livestock sectors include beef cattle, bees, bison, cervids, dairy cattle, goats, poultry, sheep and swine.

Saskatchewan has hosted a series of stewardship activities to encourage prudent AMU, to discuss AMR issues, and on upcoming federal changes. These AMS activities include:

- Antimicrobial Prudent Use Education and Awareness for Livestock and Poultry Producers – 2013/2014 – A series of presentations to SK producers to raise awareness;
- Antimicrobial Prudent Use Education and Awareness for Livestock and Poultry Producers – 2015/2016 – A series of roundtables with SK producer groups to stimulate discussion and identify needs;
- Honeybee health and management sessions for veterinarians – February 2018; and
- Saskatchewan AMR roundtable - 2015, 2016, and 2017 – To bring together multidisciplinary groups of stakeholders to discuss current issues in AMR as pertains to SK animal health. Saskatchewan Ministries of Agriculture and Health have partnered to introduce the first Western One Health Conference on AMS (to be held in Regina on January 23/24, 2019)
- Presentations at industry events and producer meetings to discuss the upcoming federal changes and to answer questions on AMR/AMS.

A.5.4 Manitoba

Manitoba Agriculture has been working to analyze provincial veterinary lab diagnostic data concerning AMR through Veterinary Diagnostic Services. Efforts are made on-going to compare AMR data between the veterinary diagnostic lab and public health diagnostic labs in MB. Manitoba Agriculture is also working with the MVMA to conduct a survey to determine AMU patterns and participates in an MVMA AMR/AMU working group.

Manitoba has on-going communication activities around effective biosecurity practices to contain the spread of resistant organisms and reduce AMU/AMR. A MB working group participates with the MVMA to discuss AMR/AMU issues and activities and join in meetings with industry associations to discuss AMU/AMR concerns and regulatory changes. Manitoba Agriculture supports ongoing on-farm food safety programs.

A.5.5 Ontario

The Farmed Animal Antimicrobial Stewardship Initiative (FAAST), a Canadian Agricultural Partnership Program, is a collaboration between the Ontario Veterinary Medical Association, Acer Consulting, government, academic, and industry partners[18]. The FAAST

provides information and tools to veterinarians and farm animal owners on AMU/AMR issues and policy and regulatory changes.

To align with federal changes, the Ontario Ministry of Agriculture, Food and Rural Affairs implemented amendments to its Livestock Medicines Act to eliminate medically important antimicrobials from the list of products sold at Livestock Medicines Outlets in Ontario. In recent years, the ministry has engaged key partners including farmer, industry, retailer, veterinary and public health organizations, delivering more than 60 presentations and consultations to raise awareness of the importance of antimicrobial stewardship, and to complement federal and provincial regulatory changes.

A.5.6 Quebec

In September 2015, SQSBEA, Quebec's Animal Health and Welfare Strategy [49] adopted a 2015-2020 intervention framework, including a recommendation on antimicrobial resistance and the judicious use of antibiotics. Québec's Department of Agriculture, Fisheries and Food (MAPAQ)is currently working on an action plan based on SQSBEAS's goals.

Since 1993, MAPAQ has carried out passive monitoring of resistance to antimicrobial agents, important in veterinary medicine and public health, of certain pathogenic bacteria with a poultry, beef and pork origin, isolated to generally sick animals that could have been treated with antibiotics through Québec's veterinary antibiotic monitoring programme[48].

As part of the government's prevention policy for health[50] (Orientation 4, goal 2), MAPAQ, together with the Department of Health and Social Services, has committed to the integrated management of antibiotics, in order to ensure their judicious utilisation. One evaluation is under way, involving the implementation of a system to monitor the use antibiotics in animal production, in cooperation with the Centre of Expertise in Animal Health affiliated with the University of Montreal's Faculty of Veterinary Medicine.

MAPAQ, with its industry partners and veterinary associations, is currently developing an awareness and prevention campaign, within its new Québec's integrated animal health programme (PISAQ). The goal of this programme is to support producers in the adoption of recommended prevention and disease-control practises, and the judicious use of medicines.

A mandatory prescription for category 1 to 4 antibiotics, as defined by Health Canada, has been in place in Québec since 1984. The Pharmacy Act (RLRQ, chapter P-10) governs the activities of health professionals who prescribe, sell and use medicines intended for animals. The Veterinary Surgeons Act (RLRQ, chapter M-8) sets out the list of mandatory-prescription drugs for animals.

In 1986, a permit system for pre-mixes and medicated feed was implemented for the manufacture, distribution and sale of medicated pre-mixes and food, by virtue of the Animal Health Protection Act (RSQ, c, P-42).

On August 29, 2018, the Québec government published in the Québec Official Gazette the Regulations Amending the Regulations on the administration of certain medicines, which aim to prohibit the use as a preventive measure and to limit the use as a curative measure, antibiotics that are of high human health importance. The change comes into effect on February 25, 2019.

The goal of the Agri-Food Innov'Action Programme is to develop new knowledge by supporting research and innovation activities, particularly in order to grow the productivity of the food production sectors, with a view to sustainable development.

A.5.7 New Brunswick

New Brunswick (NB) has a Provincial Veterinary Laboratory that supports Provincial Veterinary Service. The NB Provincial Veterinary Laboratory contributes to AMR surveillance by performing susceptibility testing on bacterial pathogens isolated from submitted specimens. The field service in-house computer program tracks antibiotics sold by veterinarians. In the future, the program will be able to track antibiotics sold to individual clients. All 20 NB veterinarians are actively increasing client awareness of prudent AMU.

In the fall of 2018, the NB Provincial Veterinary Service in-house program will have further capabilities to track antimicrobial refills and will limit antimicrobials sold to prevent overuse. The field veterinary service is updating their policies to restrict the sale of antimicrobials to clients that have had a veterinary interaction within the last 365 days.

A.5.8 Prince Edward Island

Prince Edward Island (PEI) has developed an "Antimicrobial Resistance in Agriculture" educational website to address AMR and upcoming federal changes[19]. Additionally, the PEI Department of Agriculture and Fisheries are speaking to the antimicrobial changes at every opportunity and held a course for veterinarians on honeybee health.

PEI delivered several initiatives to enhance infection prevention and control. PEI developed tools such as in-house go kits for enhanced biosecurity practices for PEI Dept of Ag/Fisheries staff visiting farms, and a CAP Assurance program to develop on-farm biosecurity kits that were given to all participating farms for PEI's "Open Farm Day" and "Breakfast on the Farm". These kits included biosecurity signage, disinfectant mats, disposal gloves, disposable booties, hand sanitizer, disinfectant refill and biosecurity pamphlets. Additionally, during PEI Provincial Exhibition Old Home Week biosecurity signage and displays were developed for children to learn about how to enter and exit a barn in a biosecure manner and about the importance of zoonotic disease.

A.6 Canadian Veterinary Medical Association

The CVMA is involved in regular communication activities on AMU/AMR and is highlighting current regulatory and policy changes that are affecting the prescription of antimicrobials and veterinary oversight responsibilities.

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Over the past several years the CVMA held three workshops focusing on AMU surveillance, AMS, and veterinary oversight of AMU. In February 2017, CVMA held a workshop on "National Antimicrobial Use (AMU) Surveillance for Veterinary Practitioners". The purpose of the workshop was to review the current setting and activities for veterinary AMU surveillance and to identify the requirements for future AMU data and information collection. After reviewing the current surveillance landscape of Canada, the workshop focused on specific challenges associated with veterinary prescription-based AMU surveillance. Workshop participants were asked to consider potential gaps to prescription-based AMU surveillance and possible solutions and approaches to surveillance data collection.

In May 2017, CVMA held an "Antimicrobial Stewardship Workshop" The purpose was to consult with veterinary stakeholders to assess and provide advice on the information gathering, oversight, and decision support-needs of veterinarians and veterinary practices to support veterinary AMS. The first part of the workshop focused on a review of current veterinary AMS activities and participants were asked to identify what and where AMS was succeeding in Canada, where are the challenges, and what could act as opportunities to renew stewardship. Activities that were highlighted included:

- Canadian Veterinary Medical Association Antimicrobial Prudent Use Guidelines 2008 for beef cattle, dairy cattle, poultry, swine;
- Guidelines for the Legitimate Use of Compounded Drugs in Veterinary Practice;
- Therapeutic Decision Cascade for Animal and Public Safety;
- Ontario Stewardship Survey;
- Alberta One Health Antimicrobial Workshop; and
- Veterinary Oversight of Antimicrobial Use – A Pan-Canadian Framework of Professional Standards for Veterinarians.

In the second part of the workshop, the AMU Stewardship project was addressed. The objective of this project is the development of a toolset to provide information, oversight, and decision-making support related to prudent AMU for six species groups: swine, poultry, beef cattle, dairy cattle, small ruminants, and companion animals. The project launched January 1, 2017, with a target end date of March 31, 2018. Workshop participants were asked to contribute to the projects planning by brainstorming information needed for the project, key stakeholders to collaborate with, how to best work with those stakeholders, and provide recommendations for the project's success.

Finally, in February 2018, the CVMA held a "Veterinary Oversight of Antimicrobial Use Workshop Series" The first phase of the workshop series was dedicated to AMU Stewardship. During this phase, the participants reviewed and provided feedback on the Prudent Use Guidelines and other veterinary decision-support tools, including on the progress of the AMU Stewardship project. The second phase of the workshop series focused on AMU surveillance. During this phase, the AMU Surveillance project was discussed, and participants were engaged for input on the project. Participants were asked to provide input into the implementation of

functional veterinary-based AMU surveillance. At the time of the workshop, the project had completed a situational analysis of current Canadian AMU and veterinary AMU surveillance and designing a pilot prototype to initiate AMU surveillance. The project will support AMU surveillance nationally and worldwide and assist in targeting AMS activities.

The CVMA has developed in collaboration with other stakeholders such as CAHI, Health Canada, CFIA and ANAC, web resources to support communication with veterinarians regarding ongoing policy and regulatory changes around the use of antimicrobials in animals[51].

In late 2018, the CVMA released its new online platform: “CVMA Guidelines for Veterinary Antimicrobial Use”. The new application builds off of the previous 2008 Prudent Use Guidelines for Antimicrobial Use (PUGS). The original scope of four species groups (beef, dairy, poultry swine) has been expanded in the 2018 guidelines to include small ruminants and companion animals. Additional fields were added including brand trade names, labeled vs. extra-label use and Health Canada Category. The shift to electronic format allows for more frequent information updates and addition of new resources, accessibility via a variety of devices (e.g. laptop, tablet, smartphone), and a searchable interface and filtering for quicker access to information.

The Guidelines are integrated within the existing CVMA website allowing for layered access to veterinarians for some material via members and non-member veterinarian accounts, while still allowing public to access initial screens (but not the database). This integration creates a common and feel, eliminates the need to create brand new accounts for all veterinarians in Canada, ensures that material will continue to be addressed from a national veterinary perspective. Piloting was undertaken with subject-matter experts and their teams and updating, and further development will continue on an evergreen basis.

Building on the above, the CVMA has proposed the development of a National Veterinary Oversight System for AMU over 5 years aiming to enhance and integrate surveillance, stewardship and communication activities across a wide range of stakeholder groups

A.7 Animal AMS Canada

In October 2017, the Ad Hoc Committee on Antimicrobial Stewardship in Canadian Agriculture and Veterinary Medicine, in collaboration with the Public Health Agency of Canada, held a workshop to discuss leadership in AMS[20]. Participants came to a consensus that there is a need for a leadership group for AMS in Canada. To create this group, the participants agreed to develop a proposal to form "Animal AMS Canada," with the support of the Animal Nutrition Association of Canada (ANAC), the CVMA, the CAHI, and under the auspices of the NFAHWC.

A.8 Animal Nutrition Association of Canada

The ANAC is a national trade association of the livestock and poultry feed industry that represents feed and ingredient manufacturers, distributors, and suppliers in Canada’s agriculture industry. Many of ANAC AMS activities focus on the upcoming policy changes, which

they communicate using fact sheets via an AMS page on their website[21]. As well, ANAC fields phone calls daily from the feed industry as well as veterinarians and producers looking for more information on the December 1 policy change and how this will impact their business.

ANAC participates on many industry and industry/government working groups related to the responsibility use of antimicrobials to ensure the feed industry is part of the solution when dealing with the global threat of antimicrobial resistance.

A.9 National Livestock Commodity Organizations

A.9.1 Canadian Cattlemen's Association

Through the BVCRT, the CCA works to support the CIPARS efforts to expand beef-related surveillance. The BCRC has conducted a series of research projects in collaboration with the CIPARS to develop a practical framework and protocols for AMU/AMR surveillance data collection in feedlots. The BCRC also funded the development of a Western Canadian cow-calf surveillance network that has enabled the collection of on-farm AMU/AMR data.

Verified Beef Production Plus, an on-farm food safety program for Canadian beef producers, works closely with the CRSB, to enhance sustainability in the Canadian beef industry. Biosecurity is emphasized in this program to reduce the risk of disease introduction and control the spread of disease within and between operations. The CCA communicates the importance of prudent AMU and the significance of the upcoming policy changes through their CCA Action News[22]. The BCRC website also displays an educational segment on AMR[24].

In 2016, the BCRC and the National BVCRT completed an analysis of AMR in the beef industry, consulted with industry stakeholders, and collaborated with funders to create the National Beef Antimicrobial Research Strategy[33]. The BCRC also actively participates in the Research and Innovation Task Group established as part of the Pan Canadian Action Plan on AMR. Canada's Beef Science Cluster, a partnership between AAFC and BCRC, focuses its resources on three core areas of research. The third Beef Science Cluster has allocated 24% of the funding to animal health, welfare, and AMR[35].

A9.2 Canadian Pork Council

The CPC represents producers in several surveillance initiatives, such as the one coordinated through the CAHSS which is trying to establish an AMU minimum data that can be compared across commodities. Additionally, pork producers participate in CIPARS questionnaires, administered by their herd veterinarian. The CPC website communicates the importance of AMU/AMR on their website[26].

The Canadian Pork Excellence platform was launched in 2018. This platform includes PigSAFE and PigCARE. PigSAFE, the food safety program component of the platform, has incorporated Health Canada's 2017 regulatory and policy changes[6]. PigCARE, the animal care assessment program of the platform, highlights the development of AMR and its risks

to human and animal health and stresses the importance of responsible AMU, implementing good biosecurity, and having a vaccination program[6].

Swine Innovation Porc facilitates research and development in the Canadian swine industry. Responsible AMU is one of SIP research priorities and demonstrates the industry's commitment to decrease AMU/AMR[36].

A.9.3 Dairy Farmers of Canada

In 2017, DFC developed a policy statement that committed to the collaboration with government and to remaining committed to initiatives to safeguard the use of antimicrobials[27]. proAction®, an on-farm quality assurance program to assist dairy farmers, emphasizes that a preventative program reduces the risk of disease entering and leaving the herd[7]. Additionally, proAction® emphasizes the importance of treatment decisions being made with a veterinarian to ensure prudent AMU to avoid AMR[7].

proAction® requires on farm data collection with respect to antimicrobial usage. DFC is actively involved in the CAHSS Dairy Surveillance network which focuses on dairy cattle health in Canada.

The Dairy Research Cluster aims to promote the efficiency and sustainability of Canadian dairy farms, grow markets, and improve food safety and quality. A research priority in the cluster is animal issues, of which, AMR is a focus.

A.9.4 Chicken Farmers of Canada

In collaboration with Canada's poultry stakeholders, CFC developed a national AMU Strategy. The AMU strategy was built on the foundations of reduction, surveillance, stewardship, and research and innovation. Chicken Farmers of Canada has worked with CIPARS to develop and implement an on-farm AMU/AMR surveillance program. This program assisted in defining the AMU reduction strategy and analyzing its impact.

As part of the CFC's AMU Strategy, Canada's chicken industry announced that the preventative use of Category I antibiotics was no longer permitted as of May 15, 2014. Following that success, the preventative use of Category II antibiotics was eliminated at the end of 2018 with a goal of eliminating the preventative use of Category III antibiotics by the end of 2020.

The AMU Strategy has been incorporated into the *Raised by a Canadian Farmer* On-Farm Food Safety Program. Additionally, the On-Farm Food Safety Program includes biosecurity protocols to protect flock health.

Chicken Farmers of Canada has developed various web pages, videos, and brochures dedicated to antimicrobial education to producers [39], stakeholders[28] and consumers[29].

Chicken Farmers of Canada contributes to research through the CPRC and has established an industry research Chair at Dalhousie University for Sustainable Antibiotic Reduction.

A.9.5 Turkey Farmers of Canada

Turkey Farmers of Canada's OFFSP is a national food safety program for turkey producers with biosecurity protocols to decrease the risk of disease on farm and between operations[9]. The turkey industry has implemented an Antimicrobial Use Strategy that outlines the reduction of the preventive use of MIAs and aims to address concerns surrounding the development of AMR by eliminating the preventative use of Category II antibiotics by the end of 2018 and Category III antibiotics by the end of 2019. The AMU Strategy is enforced in Canada's turkey industry via audited certification of the TFC OFFSP[9]. The OFFSP requires appropriate use of all medications and farmers are encouraged to discuss AMR and alternatives with their veterinarian.

Turkey Farmers of Canada supports CIPARS activities through communication to producers and providing feedback through working groups and technical committees. The importance of responsible use of antibiotics in the turkey industry is also stressed on TFC's website[30]. The TFC On-Farm Programs farmer-only portal houses the electronic versions of the TFC On-Farm Programs, an online library of Research Notes, Turkey Farming Info Sheets, and other AMU related information[31].

Collectively, the Canadian poultry industry and stakeholders, including TFC, have invested over $2.2 million in AMR research and antibiotic alternatives. Research projects focus on poultry gut health, vaccine development, the impact of pathogens, and alternatives.

A.9.6 Canadian Hatching Egg Producers

To support AMU surveillance, CHEP developed an internal industry survey to measure AMU on broiler hatching egg farms. Producers are also required to complete the Spent Broiler Breeder Flock Sheet which includes AMU over the last 120 days of the cycle. Canadian Hatching Egg Producers is a member of the CAHSS AMU working group which was formed to examine minimum requirements for AMU data collection and reporting. Additionally, CHEP is a member of the Poultry Sustainability Value Chain Roundtable AMR/AMU Working Group and the Avian Biosecurity Advisory Council.

Canadian Hatching Egg Producers is a member of the Joint Government-Industry Working Group on the Control of *Salmonella* and *Campylobacter* in Poultry. Canadian Hatching Egg Producers is working with the CFIA on the revisions to the *Hatchery Regulations*, which include requirements for testing for all breeder flocks across Canada.

Canadian Hatching Egg Quality (CHEQ^{TM}), which prioritizes food safety, is CHEP's mandatory on-farm food safety program and is regulated by the CFIA as part of the Food Safety Recognition Program[10]. The program was updated in 2018 to reflect continuous improvement in egg quality. In addition to the mandatory implementation of CHEQ^{TM} at the

provincial level, CHEP is highlighting communication to producers on regulatory changes and has developed responsible AMU guidelines, which encourages increased veterinary oversight and recommends producers consult with their veterinarians, and continuously improve on-farm management. CHEP supports CgFARAD to cover requests for extra label use in broiler breeders under veterinary supervision. Preventative use of Category I antibiotics were no longer permitted in broiler breeders starting May 14, 2015.

To support research and innovation, CHEP is a founding member of the CPRC. The CHEP Research Committee reviews CHEP's national research priorities annually, based on feedback from farmers and provincial boards, and taking into consideration existing research. Current research priorities include alternatives to antimicrobials and control of foodborne pathogens. To support CIPARS, CHEP funds a research project which looks at AMU in the last 120 days, and foodborne pathogens in broiler breeders sent to federal processing plants.

A.9.7 Egg Farmers of Canada

Egg Farmers of Canada's on-farm food safety program, Start Clean-Stay Clean™, contains biosecurity requirements to prevent and control the spread of pathogens[11]. It also requires farmers complete a pharmaceutical record to record all medications used in detail. In 2014, EFC banned the preventative use of Category 1 antibiotics for use on-farm and for incoming chicks. EFC shares information with egg boards and farmers regarding antimicrobial initiatives to maintain a common awareness of issues and initiatives across the sector.

EFC participates in the CAHSS Poultry Network and AMU Surveillance working group, the Joint Government-Industry working group for the Control of Salmonella and Campylobacter in Poultry, and the Poultry Sustainability Value Chain Roundtable AMR/AMR working group, all of which address surveillance. In addition to contributing to these surveillance working groups, EFC's own national microbiological sampling protocol requires surveillance testing of pullet and laying hen facilities for *Salmonella* Enteritidis (SE).

There is a strong commitment to research at EFC. Since 2015, EFC has had a formal research grant program with an annual call for proposal which supports a variety of research projects on bird health and nutrition, and food safety with an AMU/AMR aspect. Most recently, EFC funded a CIPARS laying hen AMU/AMR and pathogen surveillance study. EFC is a founding member of the Canadian Poultry Research Council (CPRC), which prioritizes and funds many research projects on AMR and antibiotic alternatives.

A.9.8 Equestrian Canada

Currently, EC does not have surveillance measures in place. However, EC is working on the development of an on-farm Animal Care/Quality Assurance program and an equine identification database, both of which will be used to collect animal health records that will monitor AMU.

Equestrian Canada supplies education to both producers and veterinarians on their national website[32]. The website stresses the concern of the increase in AMR, the importance of appropriate AMU and biosecurity, and provides resources concerning the upcoming policy changes. Included in these communications is EC's National Farm and Facility Level Biosecurity Standard for the Equine Sector. This standard contains voluntary guidelines and recommendations to benefit both owners and custodians in protecting horses[12].

A.9.9 Canadian Sheep Federation

The CSF incorporated the National Sheep On-Farm Biosecurity Standard into the Canadian Verified Sheep Program, including training on program implementation and helpful record-keeping concerning biosecurity[13].

The CSF has participated in various consultation processes concerning AMU/AMR, including the CVMA's *Veterinary Oversight of Antimicrobial Use (AMU) Workshop*. The CSF disseminates AMU/AMR information through communication networks and social media.

The CSF's Sheep Industry Health and Welfare Strategy, pending funding approval, will include a 'Responsible antimicrobial stewardship strategy.' This strategy will support producers through legislative changes and changes in accessing veterinary drugs.

The Sheep Value Chain Roundtable brings together sheep industry stakeholders and government members to discuss the industry's challenges and opportunities for development. Collectively the Roundtable members contribute to numerous AMU/AMR research projects.

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