

The Pan-Canadian Stakeholder Consultations on Antimicrobial Resistance

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*Submitted by
The Canadian
Committee on
Antibiotic
Resistance*

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EXECUTIVE SUMMARY

Antimicrobial resistance is "a crisis which threatens to rob the world of opportunities to treat or cure many infectious diseases." (World Health Organization [WHO], 2000, <http://www.who.int/infectious-disease-report/2000/index.html>).

Whenever we expose a microbe to a drug, we're selecting those microbes that can survive in the presence of that drug. To that extent, resistance is an inevitable side effect of using antibiotics and antivirals. However, the way in which humankind is currently using, under-using, over-using, mis-using and abusing these drugs is increasing the speed at which resistance is developing. After methicillin was no longer effective in the treatment of *Staphylococcus aureus*, vancomycin became the drug of choice. It took close to forty years for resistance to vancomycin to emerge, but resistance to new anti-methicillin resistant *Staphylococcus aureus* antibiotics, such as daptomycin and linezolid, have developed within 10 years of these antibiotics becoming available on the market.

When interviewed in 2008, Dr. Howard Zucker, the former WHO assistant director for health technology and pharmaceuticals, stated "Half the medicines in the world are inappropriately sold or prescribed" (Burnett, D., <http://www.readersdigest.co.za/content/superbugs-attack/>). In a number of African, Asian and some European countries, antibiotics are sold over the counter. Regardless whether sold over the counter or prescribed by a physician, the consumer often demands antibiotics even if they are ill with a viral infection. It is also well known that the consumer often stops the medication the minute they start to feel better, rather than completing the full course.

However, it's not just improper use of antibiotics in humans, but the improper use in animals which has led us to this crisis point. Pigs, chicken, fish and cattle around the world are given antibiotics to fight disease and promote growth resulting in the strong possibility that one could contract a drug resistant illness from exposure or consumption of one of these animals.

We are just now learning how antimicrobial resistance is impacting our environment and in turn how such environmental contamination can have an impact on humans.

In 1998, the Government of Canada created the Canadian Committee on Antibiotic Resistance (CCAR) to coordinate and advocate the control of the development and spread of

antimicrobial resistance (AMR) in Canada. The CCAR provided a unique and fruitful intersection within and between the human health and agrifood sectors. Working together on activities identified in the [National Action Plan to Address Antibiotic Resistance](#), the CCAR provided outreach to the health care and agricultural communities through a variety of activities, including professional seminars, reports, information documents for specific target audiences and through its comprehensive website. The CCAR also worked with various levels of government to develop policy and develop solutions for managing antimicrobial resistance.

However, a number of specific challenges were faced by the CCAR as it sought to meet its mandate:

- There was not an adequately staffed infrastructure (i.e. secretariat) to coordinate and/or integrate AMR activities nationally and there was a lack of fulltime employees to assist with implementation. Historically, when actions were identified they were implemented on a voluntary basis by the CCAR Board and the community of practice at large;
- There was no identified lead for AMR within the federal government. The current link between the CCAR and the federal government was not at an appropriate level to move policy items ahead and ensure AMR issues were being heard by senior officials within government; and
- The funding provided to the CCAR was not sufficient given the breadth of responsibilities falling under its mandate. There was little additional funding directed towards the National Action Plan, let alone new and emerging priorities.

In 2008, it was agreed that – given the ever expanding nature of antimicrobial resistance - it was time to develop a more comprehensive approach to addressing AMR issues in Canada. The CCAR worked with the Public Health Agency of Canada on a series of consultations with key stakeholders across Canada to identify priority actions and possible governance models for the years ahead. This report summarizes the feedback received during the consultations.

The methodology used for these consultations was iterative and thematic. The data was qualitative in nature and was collected through an on-line survey, video/teleconference sessions, a face to face meeting with key organizations, and mini conference sessions. All feedback was analyzed and the summaries presented back to participants for validation. The following highlights the findings:

SURVEILLANCE: There is a need to appoint a lead to oversee AMR surveillance activities across Canada. The lead organization should develop an AMR Surveillance Working Group and oversee the development and implementation of a Pan-Canadian AMR Surveillance Plan that integrates surveillance activities across the multiple sectors (i.e. animal, human, environmental) and is standardized, timely, easily accessible and responsive to its multiple users (e.g. local, rural, laboratories, pharmacies, governments, etc) and the Canadian public at large.

ANTIMICROBIAL STEWARDSHIP: It was determined that Canada needs to establish a lead for antimicrobial stewardship who – in partnership with key stakeholders - will oversee the development and implementation of a comprehensive Pan-Canadian Antimicrobial Stewardship Plan. Stakeholders require, among other things, easy access to antimicrobial usage guidelines and surveillance data on antimicrobial utilization and antimicrobial resistant organisms. As well, enforcement of appropriate antimicrobial use in both the human and animal sectors needs to be coordinated.

EDUCATION and TRAINING: Canada must build on existing AMR education/ training campaigns, combine education/ training with other strategies such as regulation, and support increased collaboration between schools and institutions. There was strong support for a rollout of the Do Bugs Need Drugs? (DBND) campaign and the Bugs & Drugs antimicrobial reference guide on a national scale.

GOVERNANCE: The participants encouraged the Public Health Agency of Canada to take the lead in moving AMR forward within the federal government of

Canada. Several common themes were identified that should be incorporated into the new governance model for AMR. The themes include:

1. Secure funding from multiple agencies/government departments;
2. Develop a secretariat/coordinating body responsible for overall coordination & integration;
3. Link to a high level governmental decision making body; and
4. Build the governance model around existing successful AMR activities and existing action plans.

Antimicrobial resistance is one of the most significant public health issues facing humankind today. It is a complex problem, with complex causes, requiring multiple incremental solutions. As with climate change, there are no simple solutions, but leadership at the national level is required if Canada hopes to make any advances in this area. It is the CCAR's sincere wish that the thoughtful discussions that lead to the conclusions highlighted in this report will be accepted by the Government of Canada and result in a renewed investment of resources and talent directed towards antimicrobial resistance.

BACKGROUND

“The future of humanity and microbes will likely evolve as ...episodes of our wits versus their genes.”

*Dr. Joshua Lederberg, geneticist,
Nobel Prize Winner 1959*



In the January 29, 2009 edition of The New England Journal of Medicine, Arias et al wrote: “We have come almost full circle and arrived at a point as frightening as the pre-antibiotic era: for patients infected with multi-drug-resistant bacteria, there is no magic bullet” [1]. Antimicrobial resistance affects all aspects of Canadian life from one’s personal health to the food one eats and the physical environment. What follows are three summaries from Canadian experts on the current status of antimicrobial resistance in the three interconnected sectors of human health, animal health, and the environment.

HUMAN HEALTH

*Dr. John Conly MD FRCPC FACP
Professor of Medicine, Pathology & Laboratory Medicine
and Microbiology & Infectious Diseases
Head, Department of Medicine, University of Calgary
Clinical Head, Department of Medicine, Calgary Health Region
Director, Centre for Antimicrobial Resistance
University of Calgary and CHR*

Antibiotic resistance has increased dramatically and rapidly during the last decade, and it is widely acknowledged to be one of the most serious threats to the treatment of infectious diseases [2–7] on a global basis. The unforgiving and surging rise of antimicrobial resistance prompted a stark warning by the World Health Organization (8) in its recent report, “Overcoming Antimicrobial Resistance,” that humanity is faced with a crisis which threatens to rob the world of opportunities to treat or cure many infectious diseases. It is sobering to recall that a scant 100 years ago the three major causes of death in our country were pneumonia, tuberculosis and gastrointestinal infections. In addition to significant increases in costs and greater toxicity of newer drugs, antimicrobial resistant organisms (AROs) are continuously eroding the therapeutic armamentarium leaving fewer or no available alternative agents. It has been noted that countries and hospitals [9, 10] with the fewest antibiotic prescribing controls demonstrate the greatest frequency of resistant organisms, providing suggestive epidemiologic evidence for a causal relationship.

There are many examples of microorganisms which have exhibited increasing rates of resistance to commonly used antimicrobials, including methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), multiply antibiotic resistant *Shigella* and *Salmonella* species, extended spectrum beta-lactam (ESBL) resistant enteric gram-negative bacilli (*Klebsiella*, *Enterobacter species*) and penicillin-resistant *Streptococcus pneumoniae* (PRSP). Some of these organisms, such as PRSP and multiply resistant *Shigella* and *Salmonella* species, are more common in the community setting, while MRSA, VRE, and ESBL are most often associated with patients in health care facilities. A recent article in the *Canadian Medical Association Journal* has demonstrated the unrelenting evolution of MRSA in Canadian hospitals, increasing from a mean of 1% to 6% in the last 5 years [11], providing a glimpse of the future in Canada with respect to this pathogen for which only limited options are available.

With respect to the economic burden of antimicrobial resistance on the healthcare system in Canada, very little published data is available. The few studies published suggest that there is a substantial economic burden of AROs, the most significant being hospital related costs. A recent report [12] summarized the Canadian studies and indicates that some data for the economic burden of MRSA, VRE, MDR-TB and MDR-*Neisseria gonorrhoeae* is available but that data for many other pathogens is lacking. The costs for isolation and management of colonized and infected MRSA patients has been estimated at \$1,363 and \$14,360/annum, respectively, with estimated annual costs to Canadian hospitals of \$42-59 million.[13] Similarly, the incremental costs for managing VRE colonized patients was estimated at \$6,732 /patient with an estimated cost to Canadian hospitals of \$5-16 million/annum [14]. It is estimated that the current overall medical costs of antimicrobial resistance to the Canadian healthcare system, predominantly affecting the institutional sector, may be as much as \$200 million per year [15]. These figures are likely conservative given the dearth of published literature for many of the non institutional based organisms. By comparison, the US Office of Technology Assessment has estimated that the costs of managing antibiotic resistance in the United States range from US \$0.1-10 billion per year [16].

ANIMAL HEALTH ¹

Scott McEwen DVM, DVSc, Diplomate ACVP,
Professor, Department of Population Medicine,
Ontario Veterinary College,
University of Guelph

John Prescott VetMB PhD FCAHS,
Professor, Department of Pathobiology,
Ontario Veterinary College,
University of Guelph

Large quantities of antimicrobial agents are used in food-animal production and veterinary medicine. In some countries, larger quantities by weight are actually used in animals than in humans [17]. Unfortunately, antimicrobial consumption data for animals in Canada are lacking, making a comparison with use in this country difficult. While a few antimicrobials are used exclusively in animals, most are the same drugs, or members of the same class, as those used in humans. The World Health Organization (WHO) has recently classified antimicrobials with respect to their importance to human health [18]; several of the drugs listed in the critically important category are also used in animals. In fact, some of these critically important antimicrobials for humans (e.g. fluoroquinolones, third-generation cephalosporins) are also listed as critically important for animals by the World Organization for Animal Health (OIE) [19].

Unfortunately, no consensus yet exists among public health and animal health experts on how to balance the health needs of animals and humans with respect to antimicrobial use [20]. A major barrier is the lack of agreement on the magnitude of adverse public health effects from antimicrobial use in animals; however recent advances in surveillance are greatly improving our understanding of these effects.

Antimicrobials are used in animals for treatment, disease prophylaxis and growth promotion. The latter category, which is concerned with production efficiency rather than animal welfare, is the most controversial, particularly when it selects for resistance in antimicrobials of human

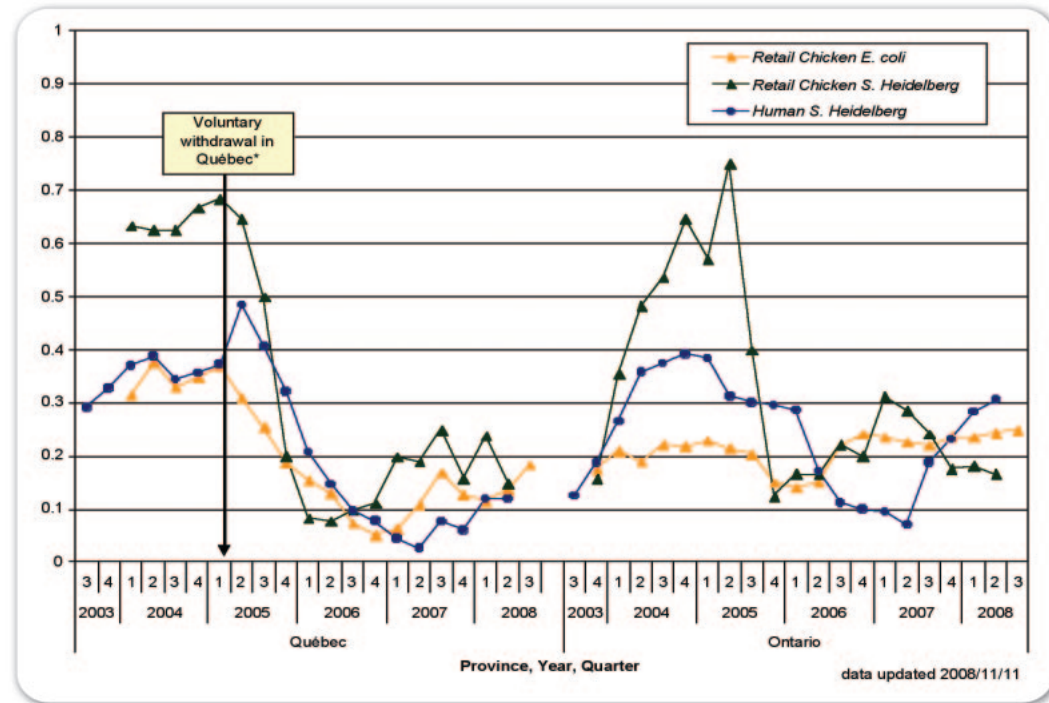
health importance. This has occurred in the case of resistance to penicillins, tetracyclines, sulfonamides, glycopeptides and others. In Europe the use of antimicrobials for growth promotion is banned, but in Canada and most other countries, they are widely available for use without a veterinary prescription. A notable exception is the province of Quebec where all antimicrobial use in animals must be conducted under a veterinary prescription.

Prophylactic use of antimicrobials is also of particular human health concern when such use is widespread in an animal industry, involves mass medication of entire groups of animals and involves the use of antimicrobials of especially high importance to human health. One such example has recently been thoroughly documented by the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) [21]. CIPARS detected a marked increase in resistance among *Salmonella heidelberg* to the third-generation cephalosporin, ceftiofur. Related drugs are critically important for the treatment of a variety of infections of humans, including *Salmonella* infections in children [18]. The increase in resistance was observed in *Salmonella* from commercially available chicken meat, and from humans (Figure 1). Although CIPARS does not yet conduct comprehensive monitoring of antimicrobial use in animals, there is evidence that hatcheries in at least some parts of Canada were routinely injecting hatching eggs with ceftiofur for the prevention of bacterial infection. For a period of time, the hatcheries voluntarily stopped using ceftiofur for this purpose and CIPARS subsequently detected a marked drop in the prevalence in resistance in *Salmonella heidelberg* in chicken, chicken meat, and humans. Although ceftiofur is not approved for this use in hatching eggs in Canada, veterinarians may legally prescribe it off-label (i.e. in a manner not formally approved by regulatory authorities). Unfortunately, under current legislation, federal authorities can do little to stop such practices, even when they may have adverse human health consequences.

¹ Our thanks to Rebecca Irwin and Rita Finley, at the Public Health Agency of Canada, for providing technical feedback on this section

Figure 1:

Proportion (moving average of previous three quarters) of isolates resistant to ceftiofur among retail chicken *E. coli*, and retail chicken and human clinical *S. heidelberg* isolates in Québec and Ontario. CIPARS 2003 – 2008 (Preliminary) (Source (14))



* The yearly averages of the quarterly values presented in Figure 1 do not necessarily match annual proportions presented in Table 1, because in Figure 1 each of these data points represents the average of the previous three quarters.

Food animals, particularly poultry, are also important reservoirs of *Campylobacter* infections in humans. In Europe and the US, there was evidence that the incidence of fluoroquinolone-resistant human *Campylobacter* infections increased after these drugs were licensed for use in food animals [22]. This led to a restriction of fluoroquinolone approvals in Canada and a requirement for CIPARS to monitor the impact of these decisions.

In addition to monitoring resistance to major classes of antimicrobials in *Salmonella* and *Campylobacter* in most major food animal species and animals, CIPARS also

measures resistance to generic *E. coli* isolates collected from caecal samples in healthy chicken, beef and swine in abattoirs across Canada. These data are important because they provide an indication of the antimicrobial selection pressure in various food animal species, and the type and quantity of resistance genes to which Canadians are routinely exposed in their food supply. The results indicate that there is a large pool of resistant *E. coli* in the major food producing animals, particularly chicken and swine. *E. coli* is also a common pathogen of animals and resistance is of concern in food animal medicine.

There is evidence that some multi-resistant, including cef-tiofur-resistant, *E. coli* carrying important cephalosporin and other resistance genes isolated from retail chicken and generally regarded as “generic” or commensal bacteria may in fact be identical to, and potentially sources of, human urinary pathogenic *E. coli* [23]. Such resistant bacteria, even if not human pathogens, are an important potential source of resistance genes for a major class of antibiotics, the beta-lactams, as well as other resistance genes for human and animal bacteria.

More recently, methicillin-resistant *Staphylococcus aureus* (MRSA) are emerging rapidly in companion and in food animals (notably swine), having been acquired initially from humans, adapted to different animal species, and now becoming a source of infection for people [24]. While most public health attention has focused on antimicrobial use in food animals, particularly growth promoters, there is increasing attention on companion animals. These animals often share living space with humans, and come into close contact with susceptible people, allowing an opportunity to spread zoonotic infection (infection transmissible from animals to humans). Sick pets are also in many cases treated with human drugs, therefore there is potential for resistance selection pressure in zoonotic bacteria. This is an area that warrants more research.

The burden of illness associated with infections due to antimicrobial resistant pathogens from animals and food has not been described in a comprehensive manner due to existing gaps in the current information. However, there are a few studies that have investigated this issue at a pathogen level, providing an insight into the impact of antimicrobial resistance to public health. In Canada, *Salmonella* and *Campylobacter* are the most common causes of enteric infections, with an estimated annual total of 214,000 and 600,000 cases, respectively [25]. Although salmonellosis has been estimated to cost \$846.2 million annually [26], total costs are much higher because people with infections due to antimicrobial resistant strains are four (4) times more likely to be hospitalized than people infected with susceptible strains [27]. Added to these high costs is the need to treat patients with more expensive antimicrobials, as initial therapy may be ineffective.

Hospital-acquired infections, MRSA in particular, have recently attracted much interest due to the recent increases of these diseases in Canada. Costs associated with these infections are not dependent only on treatment costs, but are compounded by costs due to screening, isolation of patients and their contacts, and infection control measures. An economic impact analysis of MRSA conducted in Canadian hospitals determined that the cost associated with MRSA infections ranges between \$42 million and \$59 million annually [13]. Probably only a small proportion of these MRSA are in any way related to animals, but this remains to be determined by surveillance and research. Overall, whether the infections are caused by *Salmonella*, *Campylobacter*, or MRSA, infections that are drug resistant add at least \$14.2 million to \$25.5 million to the annual cost of health care in Canada [12], plus an additional \$10.3 million for screening patients and \$15.9 million more for isolation of carriers to prevent spread of resistance to other patients.

ENVIRONMENTAL HEALTH

Tom Edge, Ph.D.
National Water Research Institute
Environment Canada

In addition to being a human and animal health problem, antimicrobial resistance is also an ecological problem. Hospitals, clinical settings, and farms are not closed systems. People and domestic animals interact with diverse terrestrial and aquatic ecosystems. The microorganisms in these ecosystems have been the source of many antibiotics, and the evolutionary origin of many antibiotic resistance genes [36]. Microorganisms in natural ecosystems evolved the ability to resist the antibiotic compounds they may produce themselves, as well as those produced by competing microorganisms. In fact, many bacteria in the environment are capable of subsisting on antibiotics of natural and synthetic origin as their only carbon source [31]. The diverse pool of antibiotic resistance genes in soil microbial communities (the soil resistome) was recently proposed to be an underappreciated environmental reservoir of antibiotic resistance with potential implications for emergence of resistance in clinically important pathogens [32].



A. The Past and the Future

“In March 1942, a 33-year old woman lay dying of streptococcal sepsis in a New Haven, Connecticut, hospital, and despite the best efforts of contemporary medical science, her doctors could not eradicate her bloodstream infection. Then they managed to obtain a small amount of a newly discovered substance called penicillin, which they cautiously injected into her. After repeated doses, her bloodstream was cleared of streptococci, she made a full recovery, and she went on to live to the age of 90.

Sixty-six years after her startling recovery, a report described the 70 year old man in San Francisco with endocarditis caused by vancomycin-resistant Enterococcus Faecium (VRE). Despite the administration, for many days, of the best antibiotics available for combating VRE, physicians were unable to sterilize the patient’s blood, and he died still bacteremic. We have come almost full circle and arrived at a point as frightening as the pre-antibiotic era: for patients infected with multidrug-resistant bacteria, there is no magic bullet.”ⁱ

ⁱ Arias CA, Murray BE. Antibiotic-Resistant Bugs in the 21st Century – A Clinical Super-Challenge. The New England Journal of Medicine 2009;360(5): 439-43.

“Humanity is faced with a crisis which threatens to rob the world of opportunities to treat or cure many infectious diseases.” (Conley, J, see Chapter 2)

“There are patients today in hospitals for whom there are no effective therapies”ⁱⁱ

July 2009: A 60-year old Quebec man is one of five people around the world found to have a strain of H1N1 flu resistant to the anti-viral drug Tamiflu® (oseltamivir).ⁱⁱⁱ

Prior to the introduction of antibiotics the three major causes of death were pneumonia, tuberculosis and gastrointestinal infections (see Chapter 2). Are we headed back in time as more and more organisms become resistant to antimicrobials?



CCAR
CCRA

ii Manning Anita. *USA TODAY*, date? quote by Gary Doern, director of clinical microbiology at the University of Iowa.

iii CBC News, July 2009. *Tamiflu-resistant strain rare – health officials*. www.cbc.ca/health/story/2009/07/22/swine-flu-tamiflu-resistance.html

The potential linkages between antimicrobial resistance in ecosystems and in clinical settings are complex, and the potential for transfer of antimicrobial resistance is not just one way. Pharmaceuticals and personal care products like antibiotics already occur widely in Canadian municipal wastewater effluents, and source waters used for drinking and recreation. To date, concentrations of antibiotics measured in these settings have generally been very low, and often orders of magnitude below levels believed to be associated with selecting for resistant bacteria [40, 34]. However, the potential for sub-inhibitory concentrations of antibiotics to have effects on microbial communities in ecosystems is not well understood [35].

Large numbers of antibiotic resistant bacteria can be released into the environment from sources like municipal wastewater effluents and agricultural wastes. Antibiotic resistant bacteria like *E. coli* occur in Canadian municipal wastewater effluents, and source waters used for drinking and recreation [33, 30]. Municipal wastewater treatment plants perform important roles in reducing the quantities of fecal microorganisms released into the environment. To date, studies that have assessed whether municipal wastewater treatment plants can selectively increase the release of antibiotic resistant bacteria into the environment have provided contradictory results. A recent study found that while a municipal wastewater treatment plant reduced overall concentrations of *Acinetobacter* spp. and fecal bacteria like *E. coli* in its final effluent, the proportional frequency of multi-drug resistant *Acinetobacter* spp. increased through the wastewater treatment process [41]. It is uncertain how widespread or significant this type of phenomenon might be across hundreds of municipal wastewater treatment plants operating in Canada.

In addition to questions about the implications of environmental releases of antibiotic resistant bacteria, are questions about the antibiotic resistance genes they carry. These genes may be transferred to other microorganisms, and persist or spread long after the original host bacteria have died off. Municipal wastewater treatment plants provide locations for mixing high concentrations of bacteria, nutrients, and opportunities for exchange of genes – “bac-

terial bordellos” as described by one prominent Canadian microbiologist. Szczepanowski et al. [39] found that a plasmid from activated sludge bacteria of a sewage treatment plant carried antibiotic resistance determinants/genes for nine different antibiotics (ampicillin, penicillin G, chloramphenicol, erythromycin, kanamycin, neomycin, streptomycin, sulfonamides, tetracycline, and trimethoprim). It has recently been proposed that antibiotic resistance genes be considered as emerging contaminants for which mitigation strategies are needed to prevent their widespread dissemination [38].

Patrick and Hutchinson [37] indicate that a short clinical encounter with a sick patient is not the best time to stand back and contemplate the long evolutionary history and ecological dimensions of antimicrobial resistance. However, they draw a parallel between global warming and carbon emissions, and protecting public health and reducing our antimicrobial resistance “footprint”. A better understanding is needed of the ecology of antimicrobial resistance in order to reduce our antimicrobial resistance footprint, and provide for a comprehensive approach to antimicrobial stewardship.

Antimicrobial resistance (AMR) is a complex issue requiring increasingly complex interventions. In 1998, the Government of Canada created the Canadian Committee on Antibiotic Resistance (CCAR), a coordinating and advocacy group to control the development and spread of antimicrobial resistance. The CCAR achieved a great deal during its eleven years of operation, but these achievements did not come easily. Often the work was done by volunteers or hard choices had to be made due to budgetary restraints. All the while, the number of AMR resistance cases continued to grow in Canada. Consequently, in 2008, the Canadian Committee on Antibiotic Resistance and its' funding body, the Public Health Agency of Canada, agreed that it was time to review what was working and areas needing improvement with the hopes of developing a more comprehensive approach to addressing AMR issues.

The CCAR believed that the best way to perform this review was to hold a series of consultations with key stakeholders across Canada to ask for their opinions. This document summarizes the findings from those consultations. However, before delving into the stakeholder's feedback, this chapter highlights some successes and challenges faced by the CCAR over the past decade.

SUCCESSSES

Since 1998, the CCAR has provided a unique and fruitful intersection within and between the human health and agrifood sectors. Working together on activities identified in the National Action Plan to Address Antibiotic Resistance (<http://www.ccar-ccra.com/english/pdfs/Action%20Plan.Sept2004.pdf>) the CCAR provided outreach to the health care and agricultural communities through a variety of activities, including professional seminars, reports, information documents for specific target audiences, and through its comprehensive website. The CCAR also worked with various levels of government to develop policy and develop solutions for managing antimicrobial resistance.

The following are examples of some of the work performed by the CCAR and/or CCAR's members over the past 11 years:

1. National AMR Action Plan

- a. In 2004, the CCAR hosted a National Policy Conference in Alymer Quebec. The resulting document [The 2004: National Action Plan to Address Antibiotic Resistance](#) remains relevant to this day <http://www.ccar-ccra.com/english/overview-national-e.shtml>.

2. Surveillance

- a. The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) – With the endorsement of the CCAR, CIPARS was developed and now monitors trends in antimicrobial use and antimicrobial resistance in selected bacterial organisms from human, animal and food sources across Canada. The CCAR has always been an advocate for close working relationships between the human and animal health sectors and CIPARS has not only shown that it can be done, but has made Canada an international leader in this area. <http://www.phac-aspc.gc.ca/cipars-picra>
- b. Canadian Nosocomial Infections Surveillance Program (CNISP) – CNISP involves the surveillance of health care associated organisms, including antimicrobial resistant organisms (AROs) (i.e. MRSA, VRE, CDI), in 52 hospitals across Canada. This surveillance infrastructure is one of the most established in Canada. Created in 1994, CNISP is a collaborative effort of the Canadian Hospital Epidemiology Committee (CHEC), a subcommittee of AMMI Canada and the Public Health Agency of Canada. CNISP provides rates and trends on nosocomial infections at Canadian health care facilities thus enabling comparison of rates, and provides evidence-based data that can be used in the development of national guidelines on clinical issues related to nosocomial infections. <http://www.phac-aspc.gc.ca/nois-sinp/survprog-eng.php>

INTRODUCTION

*CCAR Mission:
CCAR advocates for, facilitates
and promotes programs related to
surveillance, optimal antimicrobial
use and infection prevention and
control to limit antimicrobial resistance.*

3. Stewardship

- a. AMR Veterinary Curriculum – Sponsored by the CCAR, the AMR curriculum was developed for veterinarian students across Canada.
- b. Antimicrobial Stewardship Modular Curriculum for Infectious Diseases and Pharmacy Residents. A CCAR/AMMI Canada initiative to develop a modular, case based curriculum at the learning level of Infectious Diseases and Pharmacy trainees, which can be used by multiple groups within existing training curricula or by individual learners.
- c. Susceptibility Testing Guidelines. CCAR Board Member, Dr. Edith Blondel-Hill, and colleagues developed this invaluable guide for laboratories which is currently being updated for a second edition.

4. Education and Training

- a. Do Bugs Need Drugs Program – The CCAR has collaborated with this internationally acclaimed AMR educational program that targets the general public and practitioners. Currently it is operational in Alberta and British Columbia. <http://www.dobugsneeddrugs.org/>
- b. Bugs & Drugs Antimicrobial Handbook –CCAR Board Members, Dr. Edith Blondel-Hill and Susan Fryters, developed this comprehensive, evidence-based reference with local recommendations for the appropriate use of antibiotics and the optimal treatment and prevention of infectious diseases.
- c. CCAR Website – The CCAR website receives on average 192 hits per day and is seen as an excellent source of information on AMR activities across Canada and around the world.
- d. Guidelines for the Prevention and Management of Community-associated Methicillin-Resistant *Staphylococcus aureus* (CA-MRSA): A Perspective for Canadian Health Care Practitioners. Canada was a

world leader with the publishing of this document in advance of most countries including the United States and the United Kingdom. These guidelines provide information about the epidemiology and microbiology of CA-MRSA in Canada and recommendations on its treatment, prevention and control.

http://www.ccar-ccra.com/english/pdfs/R06-716_barton_9745.pdf

- e. Infection Prevention And Control Best Practices for Long Term Care, Home and Community Care including Health Care Offices and Ambulatory Clinics Sponsored by the CCAR, this document, developed by leading infection prevention & control (IPC) specialists from across Canada, provides much needed guidance to non-hospital health care offices and agencies for preventing the transmission of infection. <http://www.ccar-ccra.com/english/pdfs/IPC-BestPractices-June2007.pdf>
- f. Infection Prevention and Control Best Practices for Small Animal Veterinary Clinics. Sponsored by the CCAR, this document, developed by leading veterinary specialists from across Canada, provides much needed guidance to small animal veterinary clinics for preventing the transmission of infection. <http://www.ccar-ccra.com/english/pdfs/GuidelinesFINALDec2008.pdf>
- g. Coaching Association of Canada Awareness and Professional Development Campaign. A unique partnership between the CCAR and the Coaching Association of Canada (CAC) to highlight the need for greater awareness and education when it comes to dealing with Staph/MRSA skin infections. http://www.coach.ca/eng/story_details.cfm?ID=239



CHALLENGES

A number of specific challenges were faced by the Canadian Committee on Antibiotic Resistance (CCAR) as it sought to meet its mandate. The following highlights the CCAR's area of concern:

- 1. AMR Governance (Leadership / Coordination / Integration):** The breadth of the subject area requires extensive work to effectively engage all the necessary players. There is not an adequately staffed infrastructure (i.e. secretariat) to coordinate and/or integrate AMR activities nationally. As well, there is no identified Lead for AMR within the Federal Government and the current link between outside professional bodies (like CCAR) and the Federal Government is not at an appropriate level to move policy items ahead and ensure AMR issues are being heard by senior officials within government.
- 2. Funding Structure:** The CCAR's mandate was to advocate for, facilitate and promote programs related to surveillance, optimal antimicrobial use and infection prevention and control to limit antimicrobial resistance. The funding provided to the CCAR (approximately \$300,000 annually) was not sufficient given the breadth of responsibilities falling under its mandate. In addition, there was little additional funding directed towards the National Action Plan (<http://www.ccar-ccra.com/english/overview-national-e.shtml>), let alone new/emerging priorities.
- 3. Dedicated workers:** There is a lack of fulltime employees to direct, coordinate, integrate, and engage the various players in identifying relevant actions and implementing those actions. Historically, when actions were identified they were implemented on a voluntary basis by the CCAR Board and the community of practice.

BEYOND 2009

In 2008, it was agreed that - given the ever expanding nature of antimicrobial resistance - it was time to develop a more comprehensive approach to addressing AMR issues in Canada. Consequently in January 2009, the CCAR and the Public Health Agency of Canada initiated a series of consultations with key stakeholders across Canada to identify priority actions and possible governance models for the years ahead.

This chapter has highlighted areas that worked well for the CCAR during the past decade and challenges that were faced by the organization. It is the CCAR's sincere wish that the Government of Canada will draw on these lessons learned in addition to the feedback from the stakeholder consultations contained in the subsequent chapters, to develop a comprehensive infrastructure to support antimicrobial resistance activities across Canada in the years to come.

METHODOLOGY

Goal of Pan-Canadian AMR Stakeholder Consultations: To inform current and future discussions on antimicrobial resistance (AMR) on behalf of the Public Health Agency of Canada by soliciting input on governance and relevant technical / scientific issues from key stakeholders with the intent of effectively managing and preventing AMR in Canada.

Information contained in this report has been synthesized based on the information gathered through a variety of methods and from a range of sources from November 2008 to June 2009. The process used was iterative in nature. Information gathered in the early stages of the consultation was reflected back to participants in the next phase for the purpose of validation, identification of gaps in the data and to probe deeper into key issues identified. This final report is based on information gathered through a survey, one-on-one interviews, video/tele-conferencing, mini sessions held at relevant conferences, and a national face to face meeting (see Appendix B for list of participants).

SURVEY & INTERVIEWS

In October 2008, the CCAR established the Consensus Conference Planning Committee (see Appendix C) to assist with the design of a National Scientific Meeting on Antimicrobial Resistance planned for January 2009. The goal of the meeting was to provide a forum for human/animal/environmental health specialists to understand key antimicrobial resistance trends across the various disciplines and identify collaborative opportunities to prevent and reduce AMR in Canada.

In November 2008, an online survey was posted on the CCAR, the Association of Medical Microbiologists and Infectious Disease Canada (AMMI Canada) and the Community and Hospital Infection Control Association (CHICA) websites to provide an opportunity for potential participants and those involved in antimicrobial resistance activities across Canada to provide input prior to the proposed conference. Planning Committee members also emailed the survey to relevant stakeholders and identified specific experts in the AMR field to be interviewed.

The survey was divided into four areas (the survey questionnaire is in Appendix D).

- a) Collection of demographic information in order to determine the composition of the respondents in terms of locale, organization, profession and specialty.

- b) Respondent's perceptions regarding the current status of AMR activities in their areas in terms of both activities underway as well as gaps in the current system. Participants were asked to specify points related to Education/Training, Best Practices and Guidelines, Surveillance, Stewardship and Research.
- c) Respondent's recommended priority actions in each of the areas identified in the preceding section and a question regarding an overarching priority. In addition, participants were asked to identify any successful actions/outcomes that they were aware of and to name that jurisdiction (whether Canadian or international).
- d) The final section was focused on integration and asked participants to identify actions required to improve coordination and integration of AMR issues in Canada.

The interviews were held over the phone and the interviewer asked open ended questions in order to ensure the respondent had an opportunity to identify all issues related to AMR that they felt were pertinent (the interview questionnaire is found in Appendix E).

In December 2009, interest surrounding the National Scientific Meeting on Antimicrobial Resistance had reenergized national discussions on the topic to the point where the Public Health Agency of Canada (PHAC) asked the CCAR to expand the consultation process and initiate a series of cross-country consultations in lieu of holding one scientific meeting. The planning committee for the conference was reconvened to assist with the planning for this new format.

The desired outcome for the consultations was: *"Identify opportunities for coordinating and integrating antimicrobial resistance activities across Canada."* The planning committee used the survey results to inform the design of the consultations and in reviewing the demographics of the respondents it aimed to increase input from both the environmental and animal sectors whose AMR work intersects with human health. As a result, a targeted emailing campaign was initiated in March 2009 where the survey was sent directly to numerous experts in all three sectors. The response from both the human and animal sectors was excellent, but there were limited responses from those working in the environmental area.

In total, there were 59 respondents to the survey. The demographic component of the survey captures their home province, their profession and their type of organization(s).

Table A

PROVINCE			
BRITISH COLUMBIA	5	QUEBEC	3
ALBERTA	16	NOVA SCOTIA	2
SASKATCHEWAN	2	NEW BRUNSWICK	0
MANITOBA	5	NEWFOUNDLAND/LABRADOR	1
ONTARIO	23	PRINCE EDWARD ISLAND	2
YUKON/NORTHWEST TERRITORIES/NUNAVUT	0		

Table B

PROFESSION & ORGANIZATION

	Federal government	Provincial government	Local Health Authority	Private Practice	University/College	Private Industry	NGO	Other	Response Count*
physician	0	2	5	1	10	0	0	1	11
veterinarian	3	4	0	4	3	0	0	0	11
scientist	2	1	0	0	5	0	0	0	6
nurse	1	4	9	0	0	0	0	2	12
epidemiologist	5	2	2	0	3	0	0	0	8
laboratory technologist	0	1	0	0	0	0	0	0	0
pharmacist	0	1	7	0	1	0	1	1	10
Inspector	0	0	0	0	0	0	0	0	0
Other	0	0	1	0	0	0	0	2	3
Response	7	11	23	5	17	0	1	6	

*Several respondents identified with more than one category and more than one organization.

B. Hospital Acquired AMR Organisms in Healthy Patients

"I am pretty healthy for a man in his sixties. I was out working on my roof one day, slipped and fell to the ground. Fortunately I was quickly taken to the hospital for surgery. My surgery was successful in terms of damage to my spine and punctured lung, however I contracted both an enterococcal and staphylococcal infection following surgery. Others in surgery in the same hospital that day were also infected with the same bacteria. They gave me vancomycin, however it was a very high dose – they had to make it high enough to kill the bugs but not enough to damage my kidney and liver. I was in and out of hospital during that time. During one of my trips into the hospital I acquired two more antimicrobial resistant bacteria. There was another round of attempts to treat those with antibiotics. In total I was on a high dose of antibiotics for over nine months before we finally beat it." (Interview)

The incidence of MRSA in Canadian hospitals has increased from 1% to 6% in the last five years (see Chapter 2).

The incidence of VRE in Canadian hospitals has increased from 3% to 7% from 2001 to 2006. ^{iv}

^{iv} Public Health Agency of Canada, The Canadian Nosocomial Infection Surveillance Program, Surveillance for Vancomycin Resistant Enterococci (VRE) in Patients Hospitalized in Canadian Acute-Care Hospitals Participating in CNISP 2006 Results, www.phac-aspc.gc.ca/nois-sinp/reports-rapport/vre-erv06_result-eng.php.

Based on the categories contained within the survey and interview questions, a thematic analysis was used to identify key themes arising from the survey and interview responses. The survey was targeted to those working in the AMR field and the responses were qualitative in nature and analysed as such. The analysis was divided into Education/Training, Best Practices & Guidelines, Surveillance, Stewardship, Research and Integration/Coordination. In the analysis, consideration was given to province of origin and comments that reflected coordination & integration were noted in both the specific topic area as well as the integration and coordination discussion.

The final synthesis of those results is contained in Appendix F.

CONSULTATIONS

The planning committee decided to group the consultations into three topic areas: AMR Surveillance, AMR Stewardship and AMR Education/Training. An expert subcommittee was created for each of the three topic areas to provide advice on the planning for that specific area (see Appendix B) and the following objectives for the consultations were agreed upon:

- To identify technical/scientific challenges/gaps in the management of AMR across Canada and identify opportunities for addressing these challenges/ gaps;
- To identify key AMR stakeholders across Canada and foster positive working relationships which will extend beyond the consultation process; and
- To identify the advantages and disadvantages of potential governance models for AMR at a national level in Canada.

Within each topic area it was agreed that the following cross cutting themes would be considered:

- Prevention and control of AMR
- Best practices
- Health delivery across the continuum of care (e.g. vulnerable populations, acute, LTC, community, primary care)
- Families
- Educators/Students
- Animal and Environmental Health as it pertains to Human Health
- Governance specific to the topic area under discussion

Invitations to participate in the consultations were sent out via the planning committee and the subcommittee experts to their professional networks and were also posted on the CCAR, AMMI Canada and CHICA-Canada websites.



VIDEO/TELE-CONFERENCE CONSULTATIONS

There were three 2-day video/teleconference sessions held between late March and mid June 2009. A total of 97 individuals registered for the three sessions. Many participants attended more than one session. The participants were from the following provinces and organizations:

Table C

Org	BC	Alta	Sask	Man	Ont	Que	N.S.	P.E.I.	Nfld	Total
Hosp					11	1		1		13
Health Authority	4	10	1		2		1			18
Govt	1	2		1	12	3	1	1	1	22
Private	1		2		3					6
Univ		3	2	2	6	1		1	1	16
NGO	1			2	5	2				10
Research	4		1	4	3					12
Other										
	11	15	6	9	42	7	2	3	2	97

Each session started with an introduction by PHAC and/or a CCAR representative and then a presentation related to current status and knowledge in the topic area was presented by an expert recommended by the subcommittee.


Draft challenge statements, developed from the survey results and in consultation with the subcommittee members, were presented to participants in each of the sessions as a starting point for discussion. Participants were asked if the challenge statements reflected the current issues in that topic area, and if not, to identify additions and changes. They were also asked to reflect on what specific points should be emphasized within those challenges. The points raised from participant's

comments were then summarized into approximately four or five key themes. This summary was presented to the participants for their changes and/or validation (see relevant chapters on each topic).

Participants then identified one or two next steps that they felt were crucial in order to achieve change within the next two years. Comments were taken verbatim and then analyzed for themes.

Following the session, a draft summary of the discussion was shared with all participants and any errors and omissions were incorporated accordingly.

C. Community Acquired Resistant Organisms



"I developed MRSA after I scratched what I thought was a pimple on my right buttock. Two days later, I got this huge lump at the area where the pimple was. The following day, I went to our Immediate Medical Center and was started on Bactrim. I was told to hot-pack the lesion. After I hot-packed the lesion, the infection spread like wild fire. The following day, I was unable to walk because my entire buttock was purple, full of pus, and extremely painful. My primary care doctor sent me right to the hospital where my surgeon performed emergency surgery on me. I now have an 8-inch surgical incision that has been laid open so it can heal from the inside out. The wound is now about 3/4 inch deep and 2 inches wide since it has healed somewhat thanks to the "Wound Pump" I will be wearing for at least another three weeks. I was hospitalized and given massive doses of antibiotics and will be on antibiotics for another three to four weeks, or more if necessary." ^v

^v patient story published on medicinenet.com

CONFERENCE MINI-SESSIONS

There were three national conferences held by key organizations involved in AMR activities during the consultation time period. A mini-session was held at each of these conferences where the participants were asked to review and respond to the same challenge statements used during the video/teleconference sessions. When possible, the feedback from the video/teleconference consultations were also shared. The number of participants in each of the mini-sessions was as follows:

Community and Hospital Infection Control Association of Canada (CHICA-Canada)	25
Association of Medical Microbiologists and Infectious Disease Canada (AMMI Canada)	4
Canadian Public Health Association Conference (CPHA)	9

Similar to the video/teleconference sessions, the participants at the mini-sessions were also asked to reflect on what specific points should be emphasized within the challenge statements and then were asked to identify one or two next steps that they felt were crucial in order to achieve change within the next two years. Again, comments were taken verbatim and then analyzed for themes, ensuring that the themes represented by all of the statements were incorporated into a summary document that was shared with participants for review.

Following verification with the participants that all the summary documents accurately reflected their discussions, the information from the mini-sessions, video/teleconference sessions and the survey was assimilated into the following chapters within this report: Surveillance, Stewardship and Education/Training.

NATIONAL COORDINATION & INTEGRATION MEETING

On May 26, 2009, the Antimicrobial Resistance National Coordination and Integration Meeting was held. There were 24 national organizations invited to the meeting, all responsible or with members responsible for actions related to antimicrobial resistance. Twenty organizations were represented at the meeting, in addition to three areas within the federal government.

The primary purpose for this meeting was to address the third objective of the consultations which was: “To identify the advantages and disadvantages of potential governance models for AMR at a national level in Canada.”

The comments made by the participants at the meeting were documented and then analyzed for themes. The draft report from the meeting was sent to all of the participants for their review and validation. All comments received were incorporated into the report under the chapter “Governance”.

SUMMARY

The methodology used for these consultations was iterative and thematic. The data was qualitative in nature and was collected through an on-line survey (59 participants), video/teleconference sessions (97 participants), a face to face meeting with key organizations (28 participants), and mini conference sessions (38 participants). An analysis was carried out to reflect the responses from each of these sources and presented back to participants for validation.

A 55 year old woman was cystoscoped for urinary problems and placed on long term antibiotics. A year later she was admitted to hospital and found to be colonized with MRSA in her urine. Initially an attempt was made to treat the MRSA in her urine although it's not recommended and this led to a vaginal yeast infection due to antibiotic use. The antibiotics were stopped and the woman discharged home after 10 days. During each admission she was placed in precautions although no further attempts were made to treat her MRSA in the urine.

CA-MRSA: “A recent study involving the Centers for Disease Control and Prevention found that approximately one in five infections was being acquired in the community, with no apparent links to healthcare settings. Nearly one in four cases was serious enough to require hospitalization.”^{vi}

The risk of acquiring community-acquired MRSA increases with the number of antimicrobial drug prescriptions a person takes.^{vii}

vi UCLA Pediatric Update; “Antibiotic Infections on the Rise in Community” Summer 2005, Volume 12, No 2.

vii Schneider-Lindner V, Delaney JA, Dial S, Dascal A, Suissa S, *Antimicrobial Drugs and Community-acquired Methicillin-Resistant Staphylococcus aureus, United Kingdom*, Centres for Disease Control and Prevention 2007; 13(7).

CURRENT STATUS & CHALLENGES

There are numerous antimicrobial resistance surveillance activities currently being carried out across Canada. Two national initiatives were repeatedly referenced as excellent examples of Pan-Canadian surveillance programs; the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) and the Canadian Nosocomial Infection Surveillance Program (CNISP).

However many challenges were also noted.

Antimicrobial resistance (AMR) surveillance is an area that involves many disciplines and jurisdictions. AMR surveillance crosses the three sectors of animal, human, and environmental health and consequently involves various departments within provincial, territorial and federal governments, but also national organizations, regional authorities, and frontline personnel. The following six challenge statements reflect the complexity of the subject area. Below each of the challenges are some of the key themes which arose from the discussions.

1. Detect and report on drug-resistant organisms, in a standardized, consistent and reliable manner, across Canada.

The factors compounding this challenge include a lack of standard definitions and a wide range of, and sometimes inconsistent, reporting requirements from various stakeholders and government authorities. The participants agreed that there is a lack of leadership for surveillance in Canada ranging from the initial identification and agreement on what is to be reported through to the identification, development and dissemination of standardized definitions and measures (i.e. data sets).

2. Improve timely communication and access to AMR surveillance information

There was frustration on the part of many participants at not knowing the various surveillance initiatives currently underway or planned and not having an easy way to access that information. As well, there was strong agreement on the need for timely and relevant access to information with reference to current published surveillance information being at least 1-2 years behind. The point was raised many times that the front-line practitioners needed real-time information to make informed decisions and finding or accessing that information was extremely difficult (e.g. need to develop a timely, meaningful feedback loop from the analysis and interpretation of antimicrobial usage data to those prescribing the medications and/or attempting to manage AMR organisms in the field). Along the same lines it was stressed that the community of practice needs to better communicate emerging trends to the lay person and decision makers.

3. Improve coordination and information data sharing mechanisms.

The participants commented that the Canadian Committee on Antibiotic Resistance (CCAR) did a great job coordinating across various sectors (e.g. animal human & environment), but the need for continued and expanded coordination and collaboration between academia, organizations, provinces and federal departments, etc, was mentioned numerous times. As well, the need for data-sharing agreements to enable more effective sharing and reporting of surveillance data was emphasized.

ANTIMICROBIAL RESISTANCE SURVEILLANCE

Antimicrobial Resistance Surveillance Definition: “The systemic and systematic tracking and forecasting of antimicrobial resistant organisms and antimicrobial use through the continuous collection of high-quality data, the integration, analysis and interpretation of those data into surveillance products, and the dissemination of those surveillance outputs to those who need to know in order to undertake necessary actions or responses”

Adapted from the National Advisory Committee on SARS and Public Health. Learning from SARS: Renewal of Public Health in Canada. October 2003

² Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) tracks temporal and regional trends in antimicrobial use and antimicrobial resistance in selected species of enteric bacteria obtained at different points along the food chain and from human cases

³ Canadian Nosocomial Infection Surveillance Program (CNISP) monitors healthcare-associated infections at healthcare facilities across Canada.

The emphasis needs to be on antimicrobial drug use in order to be able to identify interventions – Overuse and misuse needs to be tracked so that we can address the issues.”

*Participant,
Surveillance session*

“The difference between monitoring and surveillance is that surveillance implies identifying thresholds and those thresholds require the commitment to intervene when met or exceeded”

*Participant,
Surveillance session*

4. Monitor patterns of antimicrobial drug use in a consistent and comprehensive manner, across Canada

Participants agreed on the need to monitor antimicrobial use within both the human and animal populations. The majority of participants identified that ‘for the most part the information is already collected...it just needs to be extracted and analysed’ so what was required was the dedication of time and resources to ensure this takes place. The participants discussed the necessity of ensuring a feedback loop to prescribers and practitioners as being a crucial component of any antimicrobial drug surveillance system.

5. Determine and monitor the public health risks associated with antimicrobial resistance across disciplines including agriculture, veterinary medicine, and the environment.

The need to determine the relationship between antimicrobial use and antimicrobial resistant organisms in the animal sector and how they impact on human health, as well as the relationship between resistant organisms and antimicrobials found in the environment and how they impact on human health needs, were two common themes. It was felt that existing surveillance systems such as CIPARS were doing an excellent job, but many participants recommended the expansion of existing surveillance systems to include other organisms in order to better understand the pressures from non-human sources. The need for cross-sector research was also noted.

6. Ensure that AMR surveillance systems are responsive to emerging trends.

Many participants commented that committing to perform health surveillance implies a system which is built to provide timely data and is responsive to change and that the current AMR surveillance infrastructure is not robust enough to support this. Current information systems do not allow for easy extraction or sharing of data and there is a lack of adequate human resources to analyse, interpret and communicate the findings in a timely manner. Also,

the participants stated that Canada needs to develop a more systematic review of international trends to ensure that AMR surveillance in Canada is in line with emerging international issues.

SOLUTIONS

In responding to the challenge statements, the consultation participants discussed potential solutions. Their statements were summarized into the following theme areas.

LEADERSHIP

There was overwhelming agreement amongst participants that the number one priority was identifying the lead(s) for AMR surveillance in Canada.

The participants felt that the lead could be either one federal department or an effective joint partnership between two federal departments or an external organization. This lead organization would then have the following three main responsibilities:

NATIONAL AMR SURVEILLANCE WORKING GROUP

There was strong agreement that one of the first activities of this lead organization was to establish an AMR Surveillance Working Group. This working group should be multi-disciplinary and multi-sector and have representatives from:

- Federal departments & agencies (e.g. Public Health Agency of Canada, Canadian Food Inspection Agency, Agriculture Canada, Health Canada, Environment Canada, etc)
- Non-Government Organizations involved in AMR surveillance including AMMI Canada, CHICA-Canada, Accreditation Canada, & the Canadian Patient Safety Institute
- Provinces/Territories
- Industry
- Academia

The responsibilities of the AMR Surveillance Working Group would be to develop and oversee the implementation of a Pan-Canadian AMR Surveillance Plan which would:

- i. Establish goals, short and long term objectives, targets and interventions, roles and responsibilities for AMR surveillance activities across Canada;
- ii. Develop consistent case definitions, data sets, and lab standards which are in line with the international community; and
- iii. Identify the scope of AMR surveillance activities and explore:
 - What antimicrobial resistant organisms are to be under surveillance?
 - How best to measure antimicrobial usage?
 - How best to evaluate implications of food exposure, environmental exposure, animal exposure (i.e. wild, companion & abattoirs) on human health?

1) Existing AMR Surveillance Systems

In addition, the participants supported the enhancement of two of Canada's current AMR surveillance programs: CIPARS and CNISP. The participants believed that both programs had solid infrastructures that provide valuable information and should be expanded to provide more comprehensive AMR surveillance in the areas of animal/human health and healthcare associated infections respectively (see Appendix A for cost estimates provided by the programs).

2) Technology

The participants believe that the lead organization should implement the following information system activities:

- i. Explore mechanisms to extract AMR data from existing databases – “collect data once and use often”;
- ii. Establish an interactive website where information describing current surveillance and research projects from across multiple sectors can be posted and reviewed in real-time;

- iii. Develop AMR susceptibility surveillance systems that enable prescribers and users of antimicrobials to apply to their practices accordingly; and
- iv. Support the development of data sharing agreements between epidemiology/laboratory; human/animal/environment; and Federal/Provincial/Territorial governments, etc..

3) Communications

Finally, the participants agreed that communication needed to be improved between government departments, non-governmental organizations, prescribers, users, experts, policy makers and the general public regarding what surveillance activities are underway and the key surveillance findings. The participants proposed that the leading body:

- i. Develop and implement a communication strategy which will include ensuring the timely and appropriately worded communication of emerging trends to those performing AMR surveillance across the various sectors; frontline practitioners; lay people; decision makers; and all applicable government departments.

SURVEILLANCE SUMMARY

The core message from the AMR surveillance consultations was that those who are in decision making positions need to appoint a lead now to oversee AMR surveillance activities across Canada. The lead organization must develop an AMR Surveillance Working Group and oversee the development and implementation of a Pan-Canadian AMR Surveillance Plan that integrates surveillance activities across the multiple sectors (i.e. animal, human, environmental) and is standardized, timely, easily accessible and responsive to its multiple users (e.g. local, rural, laboratories, pharmacies, governments, etc) and the Canadian public at large.

ANTIMICROBIAL STEWARDSHIP

Antimicrobial Stewardship Definition: “Antimicrobial Stewardship includes not only limiting inappropriate use but also optimizing antimicrobial selection, dosing, route, and duration of therapy to maximize clinical cure or prevention of infection while limiting the unintended consequences, such as the emergence of resistance, adverse drug events, and cost.”

Clinical Infectious Diseases 2007; 44: 159–177

“The improper use of antibiotics and the consequential development of antimicrobial resistance is like watching a train wreck in slow motion...the complexity and seriousness of this issue is comparable to climate change”

Participant, Antimicrobial Stewardship session

CURRENT STATUS & CHALLENGES

There have been some improvements in antimicrobial stewardship activities across Canada during the past 10 years. Some hospitals have implemented antimicrobial stewardship programs; educational programs have been developed to promote the effective use of antimicrobials in both the human and animal sectors; and surveillance initiatives which monitor antimicrobial use and resistance across the human/animal sectors (e.g. CIPARS) are now in existence. However, according to the stakeholders consulted during this process, Canada has a long way to go in order to address antimicrobial stewardship in a consistent and comprehensive manner.

The following six challenge statements were drawn from the gaps identified in the survey and by experts in the field of antimicrobial stewardship. These were presented during the consultations to participants for their consideration and input. Below each of the challenges are some of the key themes which arose from the discussions.

1. **Develop a universally agreed to definition and understanding of antimicrobial stewardship across the continuum of care**

The challenges in developing an agreed upon definition and understanding are related to the complexity of the topic area. All participants agreed that a Pan-Canadian definition needed to be developed which is understood by a broad audience (public & politicians included), and will encompass human health across the continuum of care, as well as animal health and agriculture.

2. **Develop a coordinated integrated inter-disciplinary Pan-Canadian approach to antimicrobial stewardship**

Many of the respondents felt that this was the biggest challenge - the complexity of the issue and lack of a conceptual framework being at the heart of the matter. The Canadian Committee on Antibiotic Resistance (CCAR) provided a forum for human and animal health experts to meet and share information,

but was always limited in its capacity to address the broad antimicrobial stewardship issues due to the lack of a Pan-Canadian antimicrobial stewardship plan that involved all stakeholders. An effective antimicrobial stewardship program requires leadership from Federal/ Provincial and Territorial (FPT) politicians and multiple government departments who will set achievable goals and secure the necessary resources (e.g. fiscal, human, material) to solicit and secure buy-in from the human and animal health sectors, agriculture, industry, academia, and the public at large.

3. **Develop and promote public and professional awareness of antimicrobial stewardship responsibilities and concerns**

A main challenge in this area is the breadth of those involved including medical practitioners, pharmacists, veterinarians, agricultural industry, consumers and politicians. Specifically, those working on the front-line were identified as being the most challenging to reach. There was recognition of a successful model such as the [Do Bugs Need Drugs?](#) program and the [Bugs & Drugs](#) antimicrobial handbook and the question was raised as to why these or similar resources were not available nationally. Participants also recommended linking with existing national campaigns (e.g. the Canadian Patient Safety Institute’s “*Safer Healthcare Now!*”, the Canadian Medical Association’s “Optimal Prescribing” and CHICA-Canada’s “Power of One” initiatives). The need for business cases was also discussed. Many participants argued that we needed to develop business cases in order to achieve buy-in to develop antimicrobial stewardship programs while others argued that the evidence already existed and we just needed to better communicate it. Finally, the point was raised that education alone will likely not work and that enforcement (e.g. legislation, accreditation) is needed to support these initiatives.

4. Ensure that antimicrobial use is based on best available evidence

One key challenge for practitioners is the lack of peer dialogue and not having easy access to applicable surveillance or research data further isolates them in their practice. In other words, Canada needs to establish feedback loops where drug usage and resistance patterns are constantly measured and shared with prescribers. Similar to the comments provided during the surveillance session, the participants stated that a lot of valuable data is already being captured, but mechanisms need to be developed to extract and communicate the information in a timely and efficient manner. As well, practitioners should be able to compare their findings against that from other areas. The use of enforcement tools based on best available evidence was raised; however, one of the challenges identified in using this approach was that unless prescribers were convinced it was the best option for their patients they will likely find a way around the regulations. Finally, many participants commented on the limited cross sector surveillance & research. CIPARS is doing a great job bringing human and animal health surveillance data together but is currently limited in its scope. Similarly, CCAR brought human and animal health scientists together to share information but there needs to be an ongoing mechanism for human, animal and agricultural scientists to work together to identify and address previously unexplored areas of research.

5. Develop a comprehensive way of measuring antimicrobial use that is consistent across Canada, across the continuum of care, and across sectors

The key component of this challenge is how to develop a consistent way of measuring antimicrobial use across the multiple sectors (e.g. hospitals, community, veterinary and agriculture) in order to have meaningful Pan-Canada antimicrobial utilization data that can also be related to international findings. The point was raised that there is currently little incentive for the pharmaceutical industry to participate in such monitoring given that current patent laws mean that

patents expire prior to resistance developing. Finally, some participants suggested that use of antimicrobials should be more controlled under legislation.

SOLUTIONS

In responding to the challenges the participants discussed potential solutions. Their statements were summarized into the following priority actions which were later validated by all the participants.

LEADERSHIP

There was strong agreement that the complexity of antimicrobial stewardship - multiple layers of accountability, multiple sectors – requires a structure that promotes collaboration and coordination of efforts. The need to establish a truly Pan-Canadian antimicrobial stewardship program that involves practitioners, the public, government, academia, industry and politicians was emphasized. When the participants were asked how best to proceed, they suggested the first activity should be to confirm a leader for antimicrobial stewardship in Canada. The leader must be “action oriented” and play a “knitting role” bringing all the elements of antimicrobial stewardship together across the country.

1) National AMR Stewardship Working Group

The participants all supported the creation of a national working group on antimicrobial stewardship. This working group can build on lessons learned from local/regional antimicrobial stewardship programs across Canada and abroad. Representatives on the working group should include:

- Federal departments & agencies (e.g. Public Health Agency of Canada, Canadian Food Inspection Agency, Agriculture Canada, Health Canada, Environment Canada, etc)
- Non-Government Organizations involved in AMR (e.g. Canadian Patient Safety Institute, AMMI Canada, CHICA-Canada, National Collaborating Centre for Infectious Diseases etc)

“50% of antimicrobial use in Canada is said to be in the area of animal health and the majority of that use is for growth stimulation and disease prevention”

Dr. J. Prescott, University of Guelph, 2009

- Provinces/Territories (e.g. the heads of provincial formularies, etc)
- Industry (e.g. insurance companies)
- Academia

One of the first responsibilities of the Antimicrobial Stewardship Working Group would be to develop a coordinated integrated inter-disciplinary Pan-Canadian Antimicrobial Stewardship Plan. Within this plan the working group would:

- Develop a universally agreed to definition for antimicrobial stewardship⁴ which is broad in scope and encompasses human health across the continuum of care, veterinary health and agriculture;
- Establish goals, short and long term objectives, targets and interventions that are data based rather than text based, roles and responsibilities for antimicrobial stewardship activities across Canada; and
- Explore various mechanisms to formalize the Pan-Canadian Antimicrobial Stewardship Plan (e.g. through legislation, policies and practice guidelines).

2) **Communication, Education and Enforcement**

This ‘carrot and stick’ approach combines behavior change through communication and education with behavior change through administrative controls. While most preferred the carrot approach, there was recognition that research shows that administrative controls are often more effective. The lead organization would be responsible for overseeing the implementation of a combination of the two strategies. Within the first strategy, the following actions have been highlighted:

- Develop a national coordination and information on-line sharing network which will provide a clearinghouse of antimicrobial stewardship information available across the country (e.g. tools, strategies, surveillance information, ongoing research, research findings, business case templates, etc.);
- Establish forums for ongoing dialogue between sectors (i.e. animal/agriculture and human; community/primary healthcare/long term care and hospitals; industry and government, etc) to share ideas, research, issues and usage patterns – “collective intelligence”; and
- Develop and promote education programs for public, relevant professionals & politicians
 - Provide the Bugs & Drugs antimicrobial handbook on-line (see Appendix A for estimated costs)
 - Support the national implementation of the Do Bugs Need Drugs? educational program (see Appendix A for estimated costs)
 - Train antimicrobial stewardship specialists to work with practitioners in the same way that pharmaceutical representatives do – only with antimicrobial use and resistance information; and
- Partner with other complementary initiatives as appropriate. Join forces with:
 - The “Power of One” initiative from CHICA-Canada
 - The Canadian Medical Association’s ‘Optimal Prescribing’ initiative
 - The Canadian Patient Safety Institute’s “*Safer Healthcare Now!*” campaign.



⁴ Antimicrobial stewardship includes not only limiting inappropriate use but also optimizing antimicrobial selection, dosing, route, and duration of therapy to maximize clinical cure or prevention of infection while limiting the unintended consequences, such as the emergence of resistance, adverse drug events, and cost. *Clinical Infectious Diseases* 2007;44:159–177

Good Antimicrobial Stewardship is a practice that ensures the optimal selection, dose and duration of an antimicrobial therapy that leads to the best clinical outcome for prevention or treatment of an infection while producing the fewest toxic effects and the lowest risk for subsequent resistance. Dr. Lynora Saxinger, 2009

Within the enforcement strategy, the following mechanisms were suggested:

- i. Add antimicrobial stewardship as a standing accreditation item for facilities;
- ii. Require livestock producers to go through a certification process before they are allowed to use the medications they currently access over the counter;
- iii. Change legislation - identify antimicrobials in our legislation as distinct and needing specific attention;
- iv. Modify patent legislation to entice pharmaceutical industry to join the antimicrobial stewardship campaign;
- v. Make the drug companies responsible for the ecological impacts of their own drugs - shift the responsibility to them; and
- vi. Tighten regulations regarding antimicrobial usage in the agricultural industry (i.e. Do not allow antibiotics to be used as growth stimulators).

3) Surveillance & Research

The participants all agreed that we need to develop a comprehensive way of measuring antimicrobial use that is consistent across Canada and across sectors. To begin the stakeholders wanted the lead to:

- i. Explore antimicrobial usage tracking systems currently in place in other countries such as the USA and develop a drug feedback loop(s) in Canada (i.e. real time utilization data for practitioners); and
- ii. Promote cross-sector research to further establish link between human health and animal/environmental exposure.

STEWARDSHIP SUMMARY

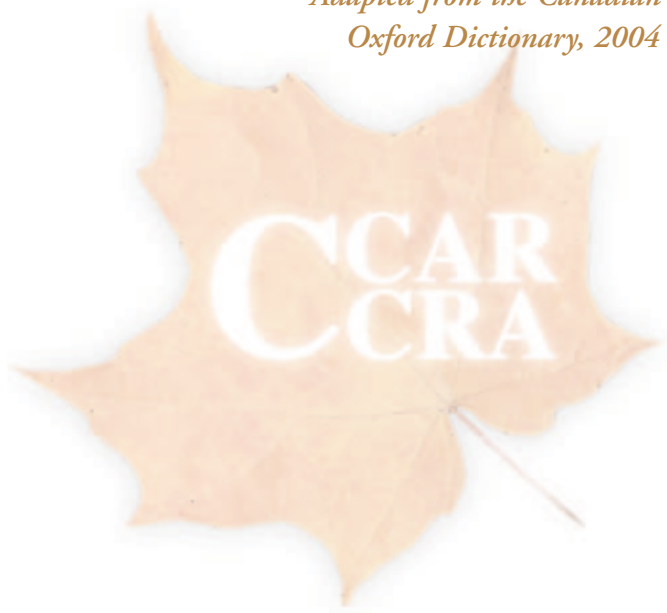
Currently the antimicrobial stewardship programs that exist in Canada are local and/or regional in nature. Canada needs to establish a lead for antimicrobial stewardship who – in partnership with key stakeholders - will oversee the development and implementation of a comprehensive [Pan-Canadian Antimicrobial Stewardship Plan](#). Stakeholders require, among other things, easy access to antimicrobial usage guidelines and surveillance data on antimicrobial utilization and antimicrobial resistant organisms. As well, it is quite likely that enforcement will be required to control the use of antimicrobials in both the human and animal sectors and the lead will need to coordinate this multi-disciplinary, multi-sector and multi-faceted campaign.

ANTIMICROBIAL RESISTANCE EDUCATION & TRAINING

Education Definition: “The act or process of giving intellectual, moral, and/or social instruction to a person”

Training definition: “the act or process of teaching or learning a new skill”

Adapted from the Canadian Oxford Dictionary, 2004



CURRENT STATUS & CHALLENGES

The participants agreed that Canada is fortunate to have some excellent programs in the antimicrobial resistance (AMR) education and training area; however there is a lack of consistency across the country. Alberta’s [Do Bugs Need Drugs?](#) program is acknowledged internationally as a successful AMR campaign though it has only been implemented in two provinces in Canada.

The following six challenge statements were drawn from the gaps identified in the initial AMR survey performed by the Canadian Committee on Antibiotic Resistance (CCAR) and experts in the field of AMR education / training. The challenges were presented to the consultation participants for their review and input and the following reflects their comments.

1. Increase public awareness and knowledge about AMR and promote appropriate antibiotic use in Canadian cities, rural and remote communities, and First Nations communities.

The participants endorsed this challenge statement, but agreed that AMR education and training programs worldwide need more effective evaluation built into their campaigns. The participants also discussed the issue of effectively reaching vulnerable populations such as First Nations communities and how to encourage Public Health to become more engaged in AMR public education programs.

2. Improve training for prescribers, users and providers of antimicrobials on antimicrobial resistance, appropriate use of antibiotics and infection-prevention and control procedures.

The key issue in this area was identified as determining why prescribers, users, and providers of antimicrobials are not modifying their behaviour despite the growing evidence of its importance.

3. Coordinate access to existing AMR educational material through web-based and other distribution options.
Participants felt that a great deal of public education and training material already existed in Canada, but it was often difficult to identify what exactly was available and where to access it.

4. Communicate regularly updated national antimicrobial prescribing guidelines to relevant professionals
Prescribing behaviours vary dramatically province to province with no real explanation as to why. Prescribing guidelines exist, but are not widely used and are not national in scope.

5. Promote an interest in and recognition of AMR research and policy issues in Canadian colleges and universities, and encourage the inclusion of AMR topics in Canadian college and university curricula.
A number of university programs had AMR curricula in place, but the current university climate is ‘competitive’ rather than ‘cooperative’ and the participants questioned how this paradigm could be shifted so that every academic organization in the country could benefit from lessons learned and best practices in this area.

6. Facilitate inter-disciplinary (human, animal, environmental) information sharing on AMR, including special forums, conferences, etc., for both students and practitioners.
The lack of inter-disciplinary information sharing, with specific mention of the animal/human interface was raised by the participants. Specifically, the participants were concerned about the need for ‘consistent messaging’ and preventing the unnecessary duplication of efforts.

SOLUTIONS

Following the participant's review of the challenges the following key themes rose out of the discussions that followed.

LEADERSHIP

To begin, the participants identified the need to identify a lead which would bring together a working group for AMR education/training.

1) National AMR Education/Training Working Group

The working group members should include:

- Provincial, Territorial, and Federal Governmental departments/agencies, including the Public Health Agency of Canada; Canadian Food Inspection Agency; Federal and Provincial Drug Plans; Ministries of Health, Education, Environment, and Agriculture, etc ; and
- National professional licensing and other organizations (i.e. Canadian Medical Association, Canadian Nursing Association; Canadian Veterinary Medical Association; Canadian Pharmacists' Association; Canadian Society of Hospital Pharmacists; Canadian Agency for Drugs and Technologies in Health; AMMI Canada; CHICA – Canada; the National Collaborating Centre for Infectious Diseases; Canadian Pediatric Society; Canadian Public Health Association; Canadian Patient Safety Institute; Ontario Veterinary College; etc)

This AMR Education/Training Working Group would:

- i. Develop and oversee the implementation of a Pan-Canadian AMR education/training campaign keeping the following factors in mind:
 - Any AMR educational/training campaign needs to have a multifaceted and multi-year approach

- An AMR campaign needs to form part of a larger strategy that includes surveillance, stewardship, and regulatory changes
- A national AMR campaign needs a national coordinator(s), but should be regional/locally implemented to ensure the campaign responds to local issues and cultures

The AMR education/training campaign would be divided into two components: Public Awareness and Professional Development and would consider the following:

2) Public Awareness Campaign

The participants felt strongly that Canada should not “re-invent the wheel”, but rather build on a successful AMR education/training campaign already operational in Canada and implement the [Do Bugs Need Drugs?](#) (DBND) campaign nationally

The advantages being:

- It is already in place in two provinces & is recognized internationally
- The materials are developed – it would cost relatively little to make available to all of Canada (see Appendix A for cost estimate)
- It has consistent and simple messages
- It targets specific groups (i.e. children and youth), yet has a broader public component
- Materials could be made available from a centralized point, but still facilitate local implementation (i.e. adapt to fit a vulnerable population such as a First Nations community)
- A national DBND campaign would facilitate consistent terminology (i.e. consistent messaging) when educating/training
- A national DBND campaign would facilitate effective evaluation

The participants also emphasized the need to build the following into a Pan-Canadian AMR education/training campaign:

- i. Ensure a solid research and evaluation component is built into the campaign from the outset;
- ii. Combine an AMR education/training campaign with appropriate enforcement of regulations like those seen with the seatbelt or bicycle helmet campaigns; and
- iii. Require all organizations which are asking for AMR surveillance data to also support the AMR education/training campaigns (i.e. Public Health).



3) Professional Development

On the professional front, the participants identified the following priorities:

- i. Develop/enhance AMR curriculum for students in veterinary, medical, nursing and pharmacy programs
 - Share best practices amongst universities by promoting collaboration between universities and colleges
 - Promote research in determining most effective ways to change behavior in prescribers, users and providers of antimicrobials;
- ii. When targeting prescribers, users and providers of antimicrobials, partner with professional organizations/associations. For example, join forces with:
 - The upcoming “Power of One” initiative from CHICA-Canada
 - The Northern Antibiotic Resistance Partnership (NARP)
 - The Canadian Medical Association’s ‘Optimal Prescribing’ initiative
 - The Canadian Patient Safety Institute’s “Safer Healthcare Now!” campaign;
- iii. Combine an AMR educational/training campaign for professionals with appropriate enforcement regulations
 - The hand hygiene campaign is a good example of a campaign that works and is supported by accreditation

- iv. Provide the Bugs & Drugs Antimicrobial Handbook nationally (see Appendix A for cost estimates)
 - Get federal & provincial bodies which purchase antibiotics to fund distribution of this reference to prescribers, users, and providers; and
- v. Establish forums for information sharing between practicing professionals and students.

EDUCATION/TRAINING SUMMARY

The participants of the AMR education/training sessions emphasized the need to build on existing AMR education/training campaigns, combine education/ training with other strategies such as regulation, and support increased collaboration between schools and institutions. There was strong support for a rollout of the [Do Bugs Need Drugs?](#) (DBND) campaign and the Bugs & Drugs antimicrobial reference on a national scale. The participants supported the appointment of a national lead and the development of a Pan-Canadian AMR Education / Training Working Group supported by regional networks across Canada.



CURRENT STATUS AND CONSIDERATIONS

Key stakeholder organizations were invited to a face to face meeting to discuss structures and strategies to improve the coordination and integration of antimicrobial resistance (AMR) activities across Canada in the years ahead. Participants reviewed AMR governance models from other countries; governance models addressing health issues in Canada; lessons learned from the Canadian Committee on Antibiotic Resistance (CCAR); and the results from the Pan-Canadian AMR consultations on Surveillance, Stewardship, and Education / Training. Within this context, participants were asked to discuss potential governance models for antimicrobial resistance activities in Canada and were asked how their organization might participate in these activities in the years ahead.

CRITERIA

The participants identified criteria for determining the most effective governance model. Their recommended criteria include:

1. **Resources** – What are the financial implications – financial and human – for the model? Is there potential for funding of this model?
2. **Build on successes** – Does the model build on the successful work that has been done and the work currently underway?
3. **Information exchange** - Does the model support opportunities for communication, and collaboration between all of the players; is the potential for regular forums of discussion a component of the model?
4. **Comprehensive** - Does the model encompass Surveillance, Education/Training and Stewardship while keeping in mind cross cutting themes such as best practices and research?
5. **Positioning** – Is the model structured to ensure that there are linkages with the senior level in the federal and provincial governments?

6. **Stakeholder buy-in** – Does the model provide a way of engaging all relevant stakeholders in taking action to address AMR?
7. **Geographic Scope** – Does the model promote involvement across Canada?
8. **Innovation** – Does the model support innovation across the country and sharing of those innovations with those in other parts of Canada?
9. **Complexity** – Does the model respond to the complexity of issues and players (i.e. involve experts from the human/animal/environmental sectors)?
10. **Outcomes** – Will the model facilitate the achievement of actions and priorities identified through the 2009 consultations?
11. **Leadership** – Does the model clearly identify the leader(s)?

GOVERNANCE OPTIONS

Participants were divided into three groups and asked to discuss and develop governance options for antimicrobial resistance.

Two options focused on the components of a comprehensive AMR campaign. One group described it as a house and presented the following model:

Figure 1:



ANTIMICROBIAL RESISTANCE COORDINATION & INTEGRATION

Governance Definition: “The need for governance exists anytime a group of people come together to accomplish an end. Most agree that the central component of governance is decision-making. It is the process through which this group of people make decisions that direct their collective efforts”

http://www.iog.ca/boardgovernance/html/gov_wha.html

Their second option was described as the “bottom up” approach and suggested the components of a national AMR campaign should focus on enhancing existing initiatives (e.g. ISMP, Do Bugs Need Drugs?, Canadian Patient Safety Institute – *Safer Healthcare Now!* campaign, CIPARS, CNISP, etc) and let the provinces develop their own practice documents. The group members proposed that the national AMR campaign could develop a scorecard to report on how the country was doing in this area on an annual basis. As well, the national group could perform economic analyses and provide networking opportunities between different government departments and different non-government organizations by sponsoring an annual meeting/forum for information sharing and accountability. There was no discussion as to who would fund the national component of this program, but the group members did suggest that the Public Health Agency of Canada provide the coordinating function.

Four other options were created which primarily focused on two main elements: 1) the proposed funding body(s), and 2) the location of the coordinating secretariat. The first option was entitled the “Nested Institute” and proposed that the secretariat could reside inside the Canadian Agency for Drugs and Technologies in Health (CADTH) or the Canadian Patient Safety Institute (CPSI) and that it would be funded jointly by the Therapeutic Products Division/Veterinary Drugs Directorate, the Canadian Food Inspection Agency (CFIA), the Public Health Agency of Canada (PHAC) and Environment Canada.

The second option within this category proposed the creation of regionalized networks for AMR with a centralized secretariat. The networks would report to the Public Health Agency of Canada (PHAC) and would be funded by the PHAC. A key component of this model would be enabling provinces/territories or organizations to lead national initiatives where they had developed expertise.

Figure 2:



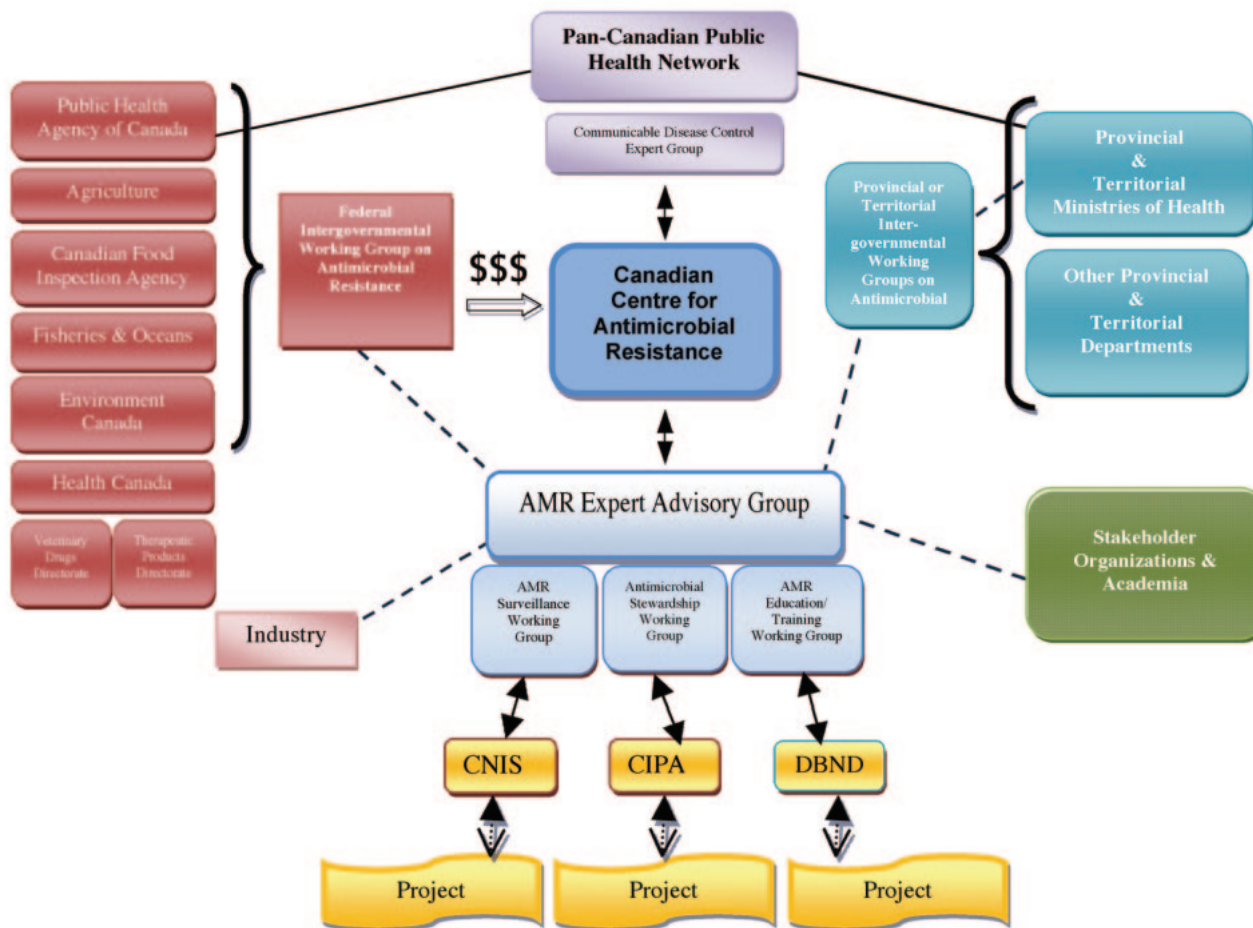
The third option recommended integrating with the pharmaceutical industry. The model for operations could follow one of the two described above with the exception being that the animal & human pharmaceutical companies would provide funding thereby promoting a corporate/social responsibility. The third option led to a discussion on the advantages and disadvantages of soliciting funding from industry. The main advantage would be the potentially large amount of funding that could be made available for such things as health care professional education. The disadvantage is that it introduces the “fox in the henhouse” and perhaps a conflict between aims. The group agreed that the funding would have to be unrestricted and there was some doubt that industry would be willing to do this. In the end, the group agreed that industry should be involved, but relying on industry alone to principally fund Canada’s AMR campaign was not ideal.



Finally, an option was put forward to create a Canadian Centre for Antimicrobial Resistance. The specific activities of this centre would focus on AMR Surveillance, Stewardship and Education/Training and would build on existing success stories such as the Canadian Nosocomial Infection Surveillance Program (CNISP), the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS), and the Do Bugs Need Drugs? Program (DBND). A noted benefit of this model was leveraging existing stakeholder groups through their respective programs.

The Canadian Centre for Antimicrobial Resistance would be located within the federal government. Funding would come from federal government departments that have a vested interest in AMR (as noted in the following diagram). The Canadian Centre for Antimicrobial Resistance would be informed by an advisory group and would also be represented at the Communicable Disease Control Expert Group (CDCEG) of the Pan-Canadian Public Health Network.

Figure 2:



D. Use of Antimicrobials in Animals and Link to Human Health

A report in the *New England Journal of Medicine* described the following case: A 12-year-old boy picked up resistant salmonella through exposure on his family's farm to an infected cow. His father had used the cephalosporin antibiotic, ceftiofur, to clear up a bout of diarrhea among the herd.^{viii} The offending organism was resistant to ceftiofur's chemical cousin, ceftriaxone, the drug of choice for treating salmonellosis in children. The organism, found in the cow and the boy, was resistant to 13 antibiotics in total. He was extremely sick but did eventually recover.



viii Johnston, N, *Deadly Bug Alert Farming Antibiotic Threat*, *Globe and Mail*, September 2000



In Canada we are once again seeing increasing numbers of cephalosporin-resistant Salmonella in poultry. In 2005 the number of cephalosporin-resistant bacteria found in chicken samples purchased in grocery stores in Quebec and Ontario as well as in samples taken from humans had reached alarming numbers and a voluntary ban on ceftiofur use for chickens was put into place. The numbers of resistant bacteria then decreased (See Chapter 2). The voluntary ban was lifted two years later; however the most recent CIPARS update indicates that antibiotic resistance in retail chicken bacteria increased in Quebec, Ontario, British Columbia and Saskatchewan from 2007 to 2008.^{ix}



ix Webster P, *The Perils of Poultry*. Canadian Medical Association Journal 2009;181: 21-4.

The participants spent a great deal of time discussing this last option. They agreed that it satisfied the majority of the criteria described in the previous section. This model reflects the complexity of the relationships required when addressing AMR issues. It is built on existing successful collaborations such as CIPARS and CNISB, incorporates federal/provincial and territorial (FPT) governments, encourages inter-governmental working groups on AMR, and provides a communication pathway to the FPT Deputy Ministers of Health through the Communicable Disease Control Expert Group of the Pan Canadian Public Health Network. It designates a coordinating secretariat body in the Canadian Centre for

Antimicrobial Resistance which would establish and monitor the necessary goals and objectives in the agreed upon priority areas such as Surveillance, Stewardship and Education / Training. The fact that the Centre would be funded by contributions from multiple sources - thereby reducing the overall burden on one department/branch of government - was also seen as a huge advantage.

Another key element was leaving the option open for provinces/territories and stakeholder organizations to contribute to the process either as a participant or by taking the lead. The following table highlights those areas where the participating organizations identified their willingness to engage.

Table 1:

Organization	Education/ Knowledge Translation	Surveillance/ Research	Intellectual Capital	Stewardship	Advocacy	Will help get issue on gov't agenda
Canadian Pediatric Society (CPS)	•	•			•	
Antimicrobial Resistance and Nosocomial Infections(ARNI)						•
Canadian Hospital Epidemiology Committee (CHEC)		•				•
Association of Medical Microbiologists and Infectious Disease Canada (AMMI Canada)	•		•	•		
Canadian Medical Association (CMA)	•				•	
Centre for Antimicrobial Resistance, UofC			•			
Canadian Veterinary Medical Association (CVMA)	•		•	•	•	•
Canadian Agency for Drugs and Technologies in Health (CADTH)	•					•
Canadian Society of Hospital Pharmacists (CSHP)			•	•		
College of Family Physicians of Canada (CFPC)			•			
Community and Hospital Infection Control Association (CHICA)	•		•	•		
Canadian Association of Clinical Microbiology and Infectious Diseases (CACMID)		•		•		
Canadian Public Health Association (CPHA)	•				•	•
Ontario Veterinary College, University of Guelph	•	•	•		•	
Canadian Foundation for Infectious Diseases (CFID)					•	
National Collaborating Centre for Infectious Diseases (NCCID)	•					
Canadian Animal Health Institute (CAHI)				•		
Canadian Patient Safety Institute (CPSI)	•					•
Canadian Bacterial Diseases Network & Centre for Global Health Research		•				
Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)		•				•

Finally, this model provides a venue (i.e. The Canadian Centre for Antimicrobial Resistance) for information exchange between FPT government officials, stakeholder organizations, academia, industry and other experts in the field. A role previously provided by the CCAR and one the participants did not want to see lost.

A few additional comments were voiced related to this model and moving the AMR agenda ahead in general. Specifically relating to the above model, participants expressed concern over how working within a government structure can increase the length of time it takes to move initiatives forward and that AMR issues 'needed to be dealt with now'. The participants also voiced concern over the relationship between the AMR Expert Advisory Group and the Pan Canadian Public Health Network and stated they did not want the two groups to be at odds over policy and implementation issues. Participants did not know how exactly to address this issue, but indicated that it was a lesson learned from other health areas (i.e. immunization).

A couple of participants urged the Public Health Agency of Canada to clearly define the scope of AMR issues under this initiative, as soon as possible. For example, will this initiative include all resistant organisms or just health care associated resistant organisms?

Finally, the participants expressed concern over not knowing who would champion the development of the Canadian Centre for Antimicrobial Resistance. Participants stated that cynicism exists within the stakeholder organizations due to the lack of federal leadership in this area to date and that they want to see a governmental organization (i.e. PHAC) actually carry forward the AMR agenda and establish a new governance model once and for all.

SUMMARY

On May 26, 2009, twenty-eight participants representing 20 organizations and the Public Health Agency of Canada participated in a face to face Pan-Canadian Antimicrobial Resistance (AMR) National Coordination & Integration meeting.

Participants reviewed antimicrobial resistance governance models from other countries; governance models addressing health issues in Canada; lessons learned from the Canadian Committee on Antibiotic Resistance (CCAR); and the results from the Pan-Canadian AMR consultations on Stewardship, Education/Training and Surveillance and then identified several common themes that they believed were important to incorporate into a new governance model for AMR. The themes include:

1. Securing funding from multiple agencies/government departments;
2. Developing a secretariat/coordinating body responsible for overall coordination & integration;
3. Linking to a high level governmental decision making body; and
4. Building the governance model around existing successful AMR activities and existing action plans.

Participants discussed various governance models and what roles their organizations could play with relation to AMR activities in Canada. The meeting ended with the participants encouraging the Public Health Agency of Canada to take the lead in moving forward within the Federal Government of Canada the solutions identified during the AMR Surveillance, Stewardship, and Education/Training sessions and the options developed during this Pan-Canadian AMR Coordination and Integration meeting.

CONCLUSIONS

“There are risks and costs to action. But they are far less than the long range risks of comfortable inaction”.

John F Kennedy

In the 20th century, the French writer and physician Louis Ferdinand Celine (1894-1961) wrote that “...antibiotics have taken half the tragedy out of medicine”. Fast forward a short period to 2009 and we now have organisms that are resistant to essentially all available antibiotics and the emergence of antiviral resistance. The remarkable speed with which these microbes can be and are spread globally, the additional cost burdens associated with their management, the associated increase in morbidity and mortality, and the decline in the amount of antimicrobial research and development, has set the stage for a public health tragedy.

In 2008, the Public Health Agency of Canada (PHAC) decided that - given the ever expanding nature of antimicrobial resistance (AMR) - it was time to develop a more comprehensive approach to addressing AMR issues in Canada. It notified the Canadian Committee on Antibiotic Resistance (CCAR) that as of June 30, 2009, CCAR's contract with the federal government would end. Prior to CCAR closing its doors, the PHAC asked the CCAR to hold a series of consultations with key stakeholders across Canada to identify priority actions and governance models for the years ahead. It is through these discussions that the members of CCAR have prepared this report for the Public Health Agency of Canada.

The consultations were divided into four topic areas: 1) AMR Surveillance, 2) AMR Stewardship, 3) AMR Education / Training, and 4) Coordination and Integration (i.e. governance).

The core message from all four consultation areas was that the Government of Canada needed to immediately take action. In the areas of AMR surveillance, stewardship, and education/training, the stakeholders wanted leads assigned. The lead(s) needed to build on the work of the CCAR and bring together the necessary team of multi-disciplinary experts (i.e. animal, human and environmental health) to develop a comprehensive and coordinated plan for that specific topic area that would be adopted by all involved sectors.

The stakeholders supported building on existing antimicrobial resistance plans such as the CCAR's [National Action Plan to Address Antibiotic Resistance \(2004\)](#) and programs such as the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS), the Canadian Nosocomial Infection

Surveillance Program (CNISP), and the [Do Bugs Need Drugs?](#) program (DBND), but emphasized the need for adequate resources (human and fiscal) to support their enhancement and/or implementation nationally.

With relation to coordination and integration, the stakeholders reviewed various governance models and identified several common themes that they believed were important to incorporate into a new governance model for antimicrobial resistance in Canada. The themes included:

1. Securing funding from multiple agencies/government departments;
2. Developing a secretariat/coordinating body responsible for overall coordination & integration;
3. Linking to a high level governmental decision making body; and
4. Building the governance model around existing successful AMR activities and existing action plans.

The majority of stakeholders who attended the Pan-Canadian AMR Coordination and Integration meeting in Ottawa, supported the development of a Canadian Centre for Antimicrobial Resistance. The Canadian Centre for Antimicrobial Resistance would be located within the federal government and funded by a consortium of federal departments/agencies that have a vested interest in antimicrobial resistance. The centre would be informed by an advisory group and would be represented at the Communicable Disease Control Expert Group (CDCEG) of the Pan-Canadian Public Health Network.

Over a six month period, over 200 stakeholders from across Canada participated in the Pan-Canadian AMR Stakeholder consultations, a number that does not reflect the additional number of experts who volunteered their time to participate in multiple sessions. The members of the CCAR have done their utmost to accurately reflect the discussions held during the consultations. The CCAR now submits this final report to the Public Health Agency of Canada with the sincere wish that the Public Health Agency of Canada will take immediate action to garner the necessary renewed investment of resources and talent required to address one of the most significant public health issues facing Canada and the world today.

Program Name	Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)	The Canadian Nosocomial Infection Surveillance Program (CNISP)
Program Description	Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) tracks temporal and regional trends in antimicrobial use and antimicrobial resistance in selected species of enteric bacteria obtained at different points along the food chain and from human cases	Canadian Nosocomial Infection Surveillance Program (CNISP) monitors healthcare-associated infections in selected healthcare facilities across Canada
Budget	Requesting an estimated additional \$1.9 million per year to enhance the current CIPARS infrastructure.	Requesting an estimated additional \$1-1.5 million per year, over and above the current budget.
Budget Details	<p>This proposal focuses on enhancing the 'human' module, specifically:</p> <ul style="list-style-type: none"> • Enhancing data integration and analysis including integration with outbreaks; • Human - integration with CNISP; and • Human - integration of other pathogens (community Enterobacteriaceae (Klebsiella, etc). <p>It also involves developing strategies and partnership to integrate data and isolates from hospital and community. Total estimated operating budget = \$800k</p> <p>Required staffing is: 5 FTE (epi) and 5 FTE (lab and other support), and an operating budget similar to our APF initiative. Total estimated salaries = 1060K.</p>	<p>This budget is to:</p> <ul style="list-style-type: none"> • recruit more epidemiologists and statisticians at PHAC; • recruit more IT personnel at PHAC to create and regularly update a CNISP website; • recruit a communications expert at PHAC; • provide more financial support to CNISP hospital sites for data and isolate collection; • provide more support of lab characterization of surveillance isolates; and • expand the number and types of facilities participating in surveillance to provide a more representative sample of healthcare facilities.

APPENDIX A

Program Cost Estimates



Program Name	Do Bugs Need Drugs? Community Education Program	Bugs & Drugs Antimicrobial Prescribing Reference
<p>Program Description</p>	<p>Background: Do Bugs Need Drugs? (DBND) is a community education program about the wise use of antibiotics. Starting as a six month pilot in Grande Prairie, Alberta in 1998, the program expanded to all of Alberta and British Columbia in 2005. Program components are used by First Nations and Inuit Health (FNIH), other provincial health ministries, Italy, the United Arab Emirates, and some locales in the United States. A DBND Executive Committee governs DBND activities.</p> <p>Scope: DBND programs include accredited continuing education for healthcare professionals, academic instruction for post-secondary students, and programs for the community. Educational activities are supported by nine print items, translated materials, television ads, and a bilingual website.</p> <p>Key messages: DBND focuses on three key messages: 1. Handwashing is the best way to stop the spread of infections; 2. Not all bugs are created equal. Bacteria and viruses are different and antibiotics don't work against viruses; 3. Use antibiotics wisely to prevent bacteria from becoming resistant to antibiotics.</p> <p>Effectiveness: Surveys from the Grande Prairie pilot clearly demonstrated the effectiveness of educating parents by providing programs for children in school. In addition, the Grande Prairie pilot demonstrated a 25% reduction in antibiotic prescribing and improved antibiotic selection during the six-month intervention. Pre and post surveys of physicians and pharmacists attending continuing education sessions have shown increased knowledge and awareness of key messages, and pharmacists have consistently noted increased confidence in contacting physicians to discuss antibiotic therapy options.</p>	<p>Bugs & Drugs is an antimicrobial prescribing reference developed in Alberta by Dr. Edith Blondel-Hill and Susan Fryters. Originally published in 1997, four editions have been released, the latest in 2006. Alberta Health Services holds the copyright to the book. A pdf version of the 2006 edition is available on line at www.bugsanddrugs.ca.</p> <p>Bugs & Drugs is a primary prescribing reference for physicians, pharmacists and nurse practitioners in Alberta, British Columbia and elsewhere in Canada. Internationally, it has recently been recommended in a review of web based programs for antimicrobial stewardship.¹ The Bugs & Drugs book is the official reference of the Do Bugs Need Drugs? program, which is funded by Alberta Health and Wellness and the British Columbia Ministry of Health. The book is used for educational programs for healthcare professionals and students and for baseline monitoring of appropriate antibiotic prescribing. Over 47,000 copies of the 2006 edition have been distributed.</p> <p>Cost of inappropriate antibiotic use. Appropriate use of antibiotics is critical to limiting the emergence of antimicrobial resistant organisms and the associated costs of managing patients with resistant infections. In the former Capital Health region alone (population 1.1 million), antimicrobials constituted about 22% (\$11M) of the total in-patient drug budget of \$48M in 2008-09. In 2008 in British Columbia total outpatient costs for antimicrobials and those covered by BC PharmaCare were \$71M and \$16M respectively.</p>

PROPOSED ACTIVITIES

Bugs & Drugs: The Bugs & Drugs antimicrobial prescribing guide is the official reference of the DBND program for healthcare professionals. It is currently available in hard copy and on-line with the expectation that it will be developed in PDA format. The PDA version would be offered as a one-time promotional offering to family physicians, pediatricians, pharmacists, nurse practitioners, infectious disease experts, academics, and other leaders in the field in Canada.

First Nations and Inuit Health: DBND has supplied grade two and daycare teaching kits and supporting print materials to all FNIH community health centres in Alberta and British Columbia, and to some FNIH health centres in Saskatchewan (in partnership with the Northern Antimicrobial Resistance Partnership), Manitoba, and Ontario. DBND material has been adapted by the health service in Nunavut. DBND resources and training would be provided to all FNIH jurisdictions in Canada.

Advertising: The budget includes funding for two advertising campaigns: a television ad and magazine inserts. Both have been used effectively in Alberta and British Columbia. Surveys in Alberta have shown that the television ad significantly improves recall of key messages. In British Columbia, insertion of the DBND Parent Guide into a parenting magazine was a cost effective way of familiarizing Canadians in that province? with the DBND program. A national advertising campaign ensures delivery of consistent health messages across Canada and costs less than individual provincial campaigns. Endorsement by federal health agencies lends weight and credibility to key messages, draws attention to local initiatives, and elevates the importance of appropriate use of antibiotics in the minds of Canadians.

Conservative estimates suggest that at least 50% of antimicrobials used in North American communities and hospitals are inappropriate. ^{2 3} Further, physician surveys in Alberta and British Columbia have demonstrated a lack of knowledge of appropriate antibiotic use among family practitioners. These findings indicate an ongoing need for prescribing recommendations and guidance.

In the latest published analysis (2001) the cost per patient with MRSA in a Canadian hospital was over \$14,000. ⁴ In another Canadian study from the same year, the incremental costs associated with treating a patient with a resistant infection was estimated to be \$6,700. Incremental costs included longer hospitalizations, need for intensive care, more expensive antibiotics, increased laboratory tests, and increased isolation and infection prevention and control measures. ⁵ These costs are in addition to the burden to patients and families in terms of increased morbidity and mortality.

Need for update

Current prescribing guidelines, such as those provided in Bugs & Drugs, are an essential prerequisite to appropriate antibiotic use. More than 2000 articles dealing with guidelines and recommendations for antimicrobial use have been published since the 2006 edition of Bugs & Drugs. An update is required so that this reference remains a credible and effective tool for appropriate antimicrobial prescribing by healthcare professionals.

Demand for PDA and hard copy. Surveys of physicians, pharmacists and nurses attending continuing education events and of students enrolled in healthcare fields strongly indicate a need for prescribing information in PDA format as well as continued availability in hard copy and on-line.

E. AMR and the Environment

Every day millions of Canadians pour a glass of water from the tap and drink it. Some of that water comes from sources like wells that may not have water treatment. Could that tap water contain antimicrobial resistant bacteria?

Every year many Canadians go swimming in our lakes, rivers, and oceans. At many locations, beaches and recreational areas can be contaminated by fecal pollution from sources like municipal sewage or agricultural wastes. Are swimmers impacted by antimicrobial resistant bacteria in that recreational water?

“Pharmaceuticals and personal care products like antibiotics already occur widely in Canadian municipal wastewater effluents, and source waters used for drinking and recreation.” (See Chapter 2)





“A recent study found that while a municipal wastewater treatment plant reduced overall concentrations of Acinetobacter spp. and fecal bacteria like E. coli in its final effluent, the proportional frequency of multi-drug resistant Acinetobacter spp. increased through the wastewater treatment process” (see Chapter 2)

“Finnish research points out this disturbing possibility: VRE in the fertilizer-used sewage sludge may pass on their resistance genes to other bacteria, creating a host of new super bugs.”^x



^x Sahlstrom L, Reh binder V, Albi hn A, Aspan A, Bengtsson B. Vancomycin resistant enterococci (VRE) in Swedish sewage sludge. Acta Veterinaria Scandinavica 2009;51:24.

Coordination and support for provincial initiatives. Many of the DBND educational programs and resources are designed for delivery at the community level. As such, they are the responsibility of provincial and territorial governments. DBND will continue to make educational resources available at the provincial and local level on a cost recovery basis. Many materials can be accessed at no cost from the website.

However, to expand access to DBND across Canada, coordination at the national level is needed. The budget includes salaries for a national coordinator and administrative support, two face-to-face meetings of provincial coordinators (first year only), and support for a small panel of expert educators.

The panel of experts would be responsible for educating FNIH and provincial trainers, who in turn would provide education at the regional and community level. This approach, which has successfully provided manpower for DBND in Alberta and British Columbia, multiplies the target population through successive teaching opportunities. It is anticipated that the panel of experts would be needed only until FNIH, provincial and local infrastructure became established.

DBND maintains a series of accredited training sessions for healthcare professionals, which would be available to the expert educators and FNIH and provincial trainers. In addition, DBND has considerable experience with grassroots programming and can facilitate communication with community groups and institutions that are able to disseminate the programs locally.

Community teaching resources: DBND print resources include the Parent Guide (English, French, Arabic, Chinese simplified, Chinese traditional, Korean, Persian, Punjabi, Somali, Spanish, Vietnamese), handwashing signs and stickers for children and adults, pamphlet, poster, children's sticker, and activity placemat. Additionally DBND has developed a teaching resource for Grade 2 students and an activity box for child care centres. The budget includes provision of an initial sample of these items for community use.

Website: DBND maintains a website in English and French (www.dobugsneeddrugs.org and www.francais.dobugsneeddrugs.org), which posts information for the public and healthcare professionals. It includes the teaching resources for public presentations, grade two students, daycares, and seniors as well as translations of the Parent Guide.

Linking national and provincial initiatives: As detailed in the CCAR consultations, experience from other jurisdictions has shown that high-level, nationally administered programs that do not directly engage community members are not particularly effective in improving antimicrobial utilization. As such it is imperative that national initiatives, such as an advertising campaign, be linked to provincial and local educational programs for healthcare professionals and the public. Assistance from existing federal health agencies and committees will be needed to establish links and develop incentives for provincial participation.

F. Canary in a Coal Mine

C. difficile is not an antimicrobial-resistant organism (ARO) but rather is an indicator of the likelihood of AROs in health care settings as it represents the extent to which other organisms are being eliminated through prevention methods in the institution.

An elderly woman came back from a hospital stay in Phoenix Arizona and entered an Ontario hospital with C. difficile. She spent the next two years in and out of hospital with recurrent diarrhea and C. difficile relapses despite many regimens of antibiotic therapy including pulsed vancomycin. However, the C. difficile was resistant to the treatment. Her last years of life were uncomfortable and her social life was miserable due to the diarrhea. She eventually died from complications related to the diarrhea.

An elderly gentleman who was having difficulty managing at home was admitted to a medical ward. He happened to be there when there was transmission of VRE. He was placed in precautions during his stay which meant staff had to gown and glove to provide care. He had no family close by and spent his hospital stay without any personal contact from his caregivers who always wore gloves and gowns to come in contact with him. Research has shown that people in precautions receive less care from both physicians and the care team and are at higher risk for falls and medication errors. They also have a longer length of stay.

A study in Quebec showed that a stronger strain of the bacteria may be present in hospitals in the province. The study found that C. difficile was indirectly responsible for 108 deaths during a six-month period.^{xi}



xi Health Canada, *It's Your Health: C. difficile*. www.hc-sc.gc.ca, July 2009.

Budget

Item #	Description	Cost (\$)
1	Bugs and Drugs distribution	200,000
2	FNIH	500,000
3	Advertising	2,000,000
4	National coordination	200,000
5	Expert educator panel	200,000
6	Print material and teaching resources	300,000
7	Website maintenance and translation services	100,000
Total		\$3,500,000

Budget Details

1. Bugs & Drugs distribution includes administrative costs and royalties for dissemination of the PDA version of Bugs & Drugs to family practitioners, infectious disease specialists, pharmacists, nurse practitioners, post secondary students, medical residents. The budget for updating and conversion of the book to PDA and for translation into French is included in a separate budget.
2. FNIH costs include training at the provincial level and provision of print materials for the community and teaching kits for pre-school and grade school children
3. Seasonal national television advertising and one time insert in a national parenting magazine.
4. National coordination includes salary for national coordinator and administrative support, and two in-person meetings of national and provincial coordinators (two meetings in year one and annually thereafter).

Item #	Item	Personnel	Cost (\$)
1	Literature search and synthesis	Health Technology Assessment group • Literature search and assessment	50,000
2	Update B&D content Pre-production proofing	Authors • Draft new content • Incorporate revisions after expert review • Proofreading prior to production	150,000
3	Expert review	Panel of medical experts	In kind
4	Administrative support	Secretarial assistant	20,000
5	Translation of text only to French	French medical translation service	100,000
6	Graphic art	Graphic artist	2,000
7	Conversion to PDA	IT group	200,000
Total			\$522,000

Costs include a literature search and synthesis, writing updates based on evidence from the literature, expert review and consensus gathering for guidelines and recommendations, conversion to PDA, formatting for printing, activities associated with producing a French translation, graphic art, and administrative support.

Sustainability. We recommend that a business plan be developed so that costs of production, storage, distribution, royalty fees, and scheduled updating are recovered from sales. Previous purchasers have included individuals, provincial health ministries, and healthcare professional organizations. As such the budget items included with this request are onetime costs with future expenditures recovered from product sales.

	<p>5. Expert educator panel includes costs of identifying members, training for panel members, and education sessions delivered by expert education panel members at the provincial level and to FNIH. The aim is to build capacity to support and deliver programs in FNIH and the provinces.</p> <p>6. Print materials and teaching resources includes initial supply of each of the DBND print items (Parent Guide available in English and French and nine other languages, pamphlet, poster, hand washing signs and stickers in English and French, children's sticker and activity placemat) and access to the DBND grade two teaching kit and DBND daycare activity box.</p> <p>7. Website and translation services covers routine costs associated with maintaining a current website and translation to ensure bilingual access.</p>	
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APPENDIX B

AMR Consultation Participants & Affiliation



Name	Affiliation
Alfred Gin	Canadian Society of Hospital Pharmacists (CSHP)
Allan Ronald	NCCID
Allison Marcil	Regina General Hospital
Andre Corriveau	MOH, Alberta Health
Andrew Morris	Mount Sinai
Angela Bakos	Public Health Nurse
Angela Dipietro	
Anisha Lakhani	UBC
Anne Bialachowski	Community and Hospital Infection Control (CHICA)
Annie-Marie Bourgault	Public Health Laboratory
Barbara Catt	Sunnybrook
Benedikt Huttner	University of Geneva
Bernice Heinrichs	Nurse
Betty Ann Henderson	Alberta Health Services
Bill Lesley	Canadian Agency for Drugs and Technologies in Health (CADTH)
Bob Bannatyne	Thunder Bay District Unit Health
Brenda Coleman	Mt. Sinai Hospital
Bruce Dalton	Alberta Health Services, Calgary
Bruce Gamage	BC Centre for Disease Control - PHSA PICNet BC
Carol Amirault	Cumberland Health Authority
Carol Loveridge	WPG Occupational Health Care
Carolyn Pim	Senior Medical Advisor, CCDIC, Public Health Agency of Canada
Catherine Baker	Nurse, Brampton
Cathy Munford	CHICA Canada
Chantal Backman	Canadian Patient Safety Institute
Cheryl Main	McMaster
Cindy Woodson	Communicable Disease Coordinator
Clare Barry	Infection Prevention and Control
Claudia Crusell-Balogh	Grand River Hospital
Connie Falcicchio	
Daniel Thirion	Member, CSHP ID-PSN (involved in ASP)
Darren Korber	U of Sask
David Patrick	BC Centre for Disease Control

Deana Sabuda	Past Chair, CSHP ID-PSN, Alberta Health Services
Deborah Norton	Nurse, Saskatchewan
Debra Doe	Nurse
Denise Gravel	Canadian Hospital Epidemiology Committee (CHEC)
Diana Ludwick	WPG Occupational Health Care
Diane Hunley	Nurse, Thunder Bay
Diane Wallace	Grand River Hospital
Donald Sutherland	PHAC
Donna Lowe	University Health Network, Toronto
Donna Wiens	
Dylan Pillai	Canadian Bacterial Diseases Network & Centre for Global Health Research
Edith Blondel-Hill	Interior Health Authority
Elizabeth Hydesmith	NCCID
Ethan Rubinstein	Infectious Disease
Gabriel Piette	Agriculture Canada
Gayla Dionne	
George Zhanel	
Gerald Evans	AMMI Canada
Gerry Hansen	CHICA Canada
Glenda Schuh	Schuh and Associates
Greg Horsman	Saskatchewan Public Health Laboratory
Heather Onyette	Canadian Paediatric Society (CPS)
Howard Njoo	Director General, Centre for Communicable Diseases and Infection Control, PHAC
Jackie Wrightsell	CCDIC, Public Health Agency of Canada
Jason Walker	Health Point Consulting Inc.
Jay McClure	Atlantic Veterinary College, University of PEI
Jeff Chan	Thunder Bay Regional Health Sciences Centre
Jim Hutchinson	Canadian Committee on Antibiotic Resistance
Joanne Archer	PHSA - PICNet BC
John Conly	Centre for Antimicrobial Resistance, Calgary, Centre for Antimicrobial Resistance, U of C
John Maxted	College of Family Physicians of Canada (CFPC)
John Lawrence	Environment Canada
John Prescott	Canadian Veterinary Medical Association (CVMA)
John Stewart	Port Perry Medical Associates
Jun Chen Collett	BC Children and Women's Hospital
Karen Jessett	Canadian Food Inspection Agency

Karen Riley	Pharmacy, QA
Keith Campbell	Animal Biosecurity, Canadian Food Inspection Agency
Lateef Adewoye	Health Canada
Laura Thompson	NCCID
Lei Ang	Queen Elizabeth Hospital
Leigh Rosengren	Rosengren Consulting
Leslie Forrester	Powell River
Linda Dresser	University of Toronto
Linda Kingsbury	Nurse
Linda Sulz	Regina Health
Liz Van Horne	
Louise Holmes	Vancouver Coastal Health-Communicable Disease Control
Lynn Nadeau	Clinical Pharmacist - Hotel Dieu Hospital
Manisha Mehrotra	Health Canada, Vet, Ottawa
Marc Desjardins	Canadian Association of Clinical Microbiology and Infectious Diseases (CACMID)
Marc Dionne	Public Health Physician
Margaret Fast	National Collaborating Centre for Infectious Diseases (NCCID)
Margaret Gray	Alberta Health Services, Edmonton
Margaret Litt	Executive Director, Canadian Committee on Antibiotic Resistance (CCAR)
Marie Nadeau	Quebec Ministry of Agriculture and Fisheries
Marika Dussault	Pfizer Animal Health
Marion Yetman	Community and Hospital Infection Control Association (CHICA)
Marit Main	Vernon Alliance Church
Mark Scott	Alberta Health Services
Marra Fawziah	UBC
Marta Haley	Canadian Animal Health Institute (CAHI)
Mary Carson	Do Bugs Need Drugs (DBND)
Mary leBlanc	Nurse, PEI, would listen by phone
Megan Clammer	Public Health Nurse
Melissa Coleman	Canadian Foundation for Infectious Diseases
Merv Wetzstein	BCMAL
Mike Mulvey	Antimicrobial Resistance and Nosocomial Infections (ARNI)
Millicent Toombs	Canadian Medical Association (CMA)
Monique Pitre	University Health Network
Nicole Le Saux	Children's Hospital of Eastern Ontario
Nora Boyd	Erie St. Clair Infection Control Network



Otto Vanderkooi	Pediatric Infectious Diseases Residency Training Program
Patrick Boerlin	Ontario Veterinary College, University of Guelph
Patsy Rawding	IPCP
Paul Hasselback	Canadian Public Health Association (CPHA)
Paul Sockett	FNIHIB Rep
Philippe Lagacé-Wiens	Medical Microbiologist, Winnipeg
Ray Saginur	Canadian Foundation for Infectious Diseases
Rebecca Irwin	Public Health Agency of Canada
Richard Johnson	
Risa Cashmore	Infection Control
Rita Finley	PHAC
Rodica Gilca	
Rosemary Zvonar	Ottawa Hospital
Ruth Stanley	PHAC
Sandra Walker	U of Toronto, Sunnybrook
Scott McEwen	Ontario Veterinary College, University of Guelph
Scott Weese	Ontario Veterinary College, University of Guelph
Shirley MacDonald	
Shiva Ghimire	Health Canada
Sophie Hebert	PHAC
Sue Lafferty	Alberta Health Services, Edmonton
Susan Fryters	Alberta Health Services, Edmonton
Tania Fernandes	Trillium Hospital
Thomas Chin	St. Michael's Hospital
Tim Lau	Vancouver Coastal Health
Tom Edge	Environment Canada
Trisha Dowling	Western College Of Vet Med
Uma Chandran	Alberta Health Services
Victoria Williams	Sunnybrook
Warren Skippon	Canadian Veterinary Medical Association
Xian-Zhi Li	Health Canada

APPENDIX C

Planning Committee Members

AMR Conference Planning Committee

Elizabeth Henderson	Calgary Health Region
Clare Barry	Infection Prevention and Control Consultant
Cathy Munford	CHICA –Canada
Elizabeth Bryce	Vancouver Coastal Health, CNISP representative
Nora Boyd	CCAR Board member, Erie St Clair IC Network
Susan Fryters	CCAR Board member, Alberta Health Services Edmonton
Margaret Fast	National Collaborating Centre for Infectious Diseases
Richard McCoy	AMMI Canada
Marlies van Dijk	Western Node Leader, Safer Healthcare Now!
John Prescott	CCAR Board Member, University of Guelph
Laura Thompson	National Collaborating Centre for Infectious Diseases
Margaret Litt	Exec. Director, CCAR
Sara Brocklehurst	Admin/Finances, CCAR
Fay Weller	Consultant

Additions for AMR Consultation Planning Committee

Carolyn Pim	CIDIC, Public Health Agency of Canada
Moheene Soondrum	CIDIC, Public Health Agency of Canada
Robert Mayne	Consultant

Surveillance Planning Sub Group

- Elizabeth (Betty-Ann) Henderson, Alberta Health Services Calgary & University of Calgary
- Dr. Elizabeth Bryce, Vancouver Coastal Health
- Laura Thompson, National Collaborating Centre for Infectious Diseases
- Clare Barry, Infection Prevention and Control Consultant
- Margaret Fast, National Collaborating Centre for Infectious Diseases

Stewardship Planning Sub Group

- Lynora Saxinger, University of Alberta Hospital
- Richard McCoy, AMMI Canada
- Susan Fryters, CCAR Board member, Alberta Health Services Edmonton

Education/Training Sub Group

- Mary Carson, Do Bugs Need Drugs?
- Nora Boyd, CCAR board member, Erie St Clair Infection Control Network
- Susan Fryters, CCAR Board member, Alberta Health Services Edmonton
- Cathy Munford, CHICA-Canada
- Elizabeth (Betty-Ann) Henderson, Alberta Health Services Calgary & University of Calgary
- Clare Barry, Infection Prevention and Control Consultant



The Canadian Committee on Antibiotic Resistance will use the information collected via this survey to assist in the development of a report for the Public Health Agency of Canada on Antimicrobial Resistance in Canada.

Note: results will be treated confidentially and anonymously. No personal identifying information will be collected or reported and only aggregate responses will be published.

1. What province or territory do you live in?

- British Columbia
- Alberta
- Saskatchewan
- Manitoba
- Ontario
- Quebec
- New Brunswick
- Nova Scotia
- Prince Edward Island
- Newfoundland
- Yukon, Nunavut, Northwest Territories

APPENDIX D

AMR On-Line Survey

2. What is your area of expertise? (You may choose more than one)

	Federal government	Provincial government	Local Health Authority	Private Practice	University/ College	Private Industry	NGO	Other
Physician	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Veterinarian	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scientist	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nurse	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Epidemiologist	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Laboratory Technician	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pharmacist	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspector	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Area(s) of specialization/title

3. Within the area you work and/or are responsible for describe initiatives related to antimicrobial resistance currently underway relating to the following areas:

(up to 3 brief point form answers)

- a) Education/Training
- b) Best Practices/Standards/Guidelines
- c) Antibiotic Stewardship (includes regulatory initiatives)
- d) Research
- e) Surveillance
- f) Other

4. What are some gaps in the area that you work and/or are responsible for related to antimicrobial resistance?

(up to 3 brief point form answers)

- a) Education/Training
- b) Best Practices/Standards/Guidelines
- c) Antibiotic Stewardship (includes regulatory initiatives)
- d) Research
- e) Surveillance
- f) Other

5. Within the area that you work and/or are responsible for describe one priority initiative related to antimicrobial resistance that you

would like to see developed within the following areas and why:

(up to 3 brief point form answers)

- a) Education/Training
- b) Best Practices/Standards/Guidelines
- c) Antibiotic Stewardship (includes regulatory initiatives)
- d) Research
- e) Surveillance
- f) Other

6. Describe one priority initiative related to antimicrobial resistance in general that you would like to see developed and why:

(up to 3 brief point form answers)

7. If you are aware of a success story, in which an issue was addressed in such a way that positive outcomes occurred (i.e. reduced infection, change in societal attitude and behaviour, etc.) please respond in point form to the following:

(This could have occurred in Canada or elsewhere and could be an issue outside of anti-microbial resistance issues).

- a) What was the issue being addressed?
- b) What was the outcome achieved?
- c) In what province or country did this occur?

8. In order to achieve your organization's goals related to AMR with whom do you connect and for what purpose?

	to jointly achieve goals	to acquire information	for leadership in taking action	to change policy or legislation	to engage others across Canada in achieving goals
Federal government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provincial government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health Authority	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Local or provincial NGOs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National NGO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Area(s) of specialization/title

9. Please provide any suggestions regarding how to improve the interface between human, animal and environment in order to achieve the priorities you've identified?



1. Describe what you feel are the most exciting initiatives occurring in Canada in the area of antimicrobial resistance – either animal or human.
2. Describe what you feel are the gaps.
3. What do you believe are the priority actions that need to be taken in this field?
4. What suggestions do you have about achieving improved coordination, consistency and integration across Canada?

APPENDIX E

Questions for Telephone Interview

APPENDIX F

AMR Survey Results

OVERVIEW

In order to provide a base for the development of a comprehensive and integrated Pan-Canadian antimicrobial resistance response a survey was sent to practitioners and professionals working in the antimicrobial resistance field in November 2008 and to additional practitioners in March 2009; in addition interviews were held with key experts in the field. The survey was divided into three sections. The first captured the

demographics of the respondents; the second the current status, including gaps, and; the third requested proposed actions for an effective response.

RESPONDENTS

There were 59 respondents to the survey. The demographic component of the survey captures their home province, their profession and their type of organization(s).

PROVINCE

BRITISH COLUMBIA	8.5%	QUEBEC	5.1%
ALBERTA	27.1%	NOVA SCOTIA	3.4%
SASKATCHEWAN	3.4%	NEW BRUNSWICK	0
MANITOBA	8.5%	NEWFOUNDLAND/LABRADOR	1.7%
ONTARIO	39.0%	PRINCE EDWARD ISLAND	3.4%
YUKON/NORTHWEST TERRITORIES/NUNAVUT	0		

PROFESSION & ORGANIZATION

	Federal government	Provincial government	Local Health Authority	Private Practice	University/College	Private Industry	NGO	Other	Response Count*
physician	0	2	5	1	10	0	0	1	11
veterinarian	3	4	0	4	3	0	0	0	11
scientist	2	1	0	0	5	0	0	0	6
nurse	1	4	9	0	0	0	0	2	12
epidemiologist	5	2	2	0	3	0	0	0	8
laboratory technologist	0	1	0	0	0	0	0	0	0
pharmacist	0	1	7	0	1	0	1	1	10
Inspector	0	0	0	0	0	0	0	0	0
Other	0	0	1	0	0	0	0	2	3
Response	7	11	23	5	17	0	1	6	

*Several respondents identified with more than one category and more than one organization.

SPECIALTIES

of references: category

10: Infectious diseases	1: Antimicrobial resistance risk assessment
9: Infection Control	1: CIPARS – retail coordinator
9: Infection Prevention and Control	1: microbiologist
2: Drug utilization/improved prescribing and use	1: Molecular Epidemiology of AMR
2: Education Services	1: Program Director Do Bugs Need Drugs?
2: Antimicrobial Stewardship	1: Critical Care
2: Veterinary – food animals	1: Long Term Care

SURVEILLANCE

Participants were asked to identify Activities Underway, Gaps and Priority Actions for Surveillance activities related to Antimicrobial Resistance. As the analysis indicates there are numerous positive activities occurring across the country. The gaps and priority actions identified include the need for more effective coordination, integration, and sharing across disciplines.

Initiatives Underway

In addition Information regarding reporting status across the country can be found in the document: RESULTS Questionnaire on reporting status for: Methicillin resistant Staphylococcus aureus (MRSA), Vancomycin resistant enterococcus (VRE) and Clostridium difficile infection (CDI); (Public Health Agency of Canada, 2008).

References to specific provinces beside a comment refer to the province that the respondent came from – this does not mean that this action is province wide or implemented by the provincial government.

NATIONAL SURVEILLANCE INITIATIVES

- Canadian antimicrobial benchmarking initiative
- Canadian Nosocomial Infections Surveillance Program (CNISP)
- Identifying causative organisms for BSI, VAP, SSI (Alberta)
- Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) includes retail meat surveillance, enteric bacteria and AMR within said bacteria

PROVINCIAL SURVEILLANCE INITIATIVES

- Developing Province wide surveillance system (BC)
- Extensive surveillance of resistance in bacteria isolated from food animal (ON)
- PEI provincial survey for zoonotic and AMR pathogen (PEI)

ANTIMICROBIAL USE DATA

- Community antimicrobial consumption survey (AB)
- Quality indicators in place to determine the use of antibiotics in an effort to gain information (MB)
- Regular monitoring & reporting of Antibiotic usage (Hosp. based) (ON)
- Hospital antibiogram produced every 1-2 years (ON)
- Antibiograms published (site and ICU) annually (ON)

ANTIMICROBIAL ORGANISMS SURVEILLANCE

- PICNet CDAD surveillance (BC)
- Local AMR organism tracking system (BC)
- AROs Surgical site infections of C-sections and hernias (BC)
- ARO management, reporting & surveillance (AB)
- track UTI, pneumonia, SSI c-sections, blood stream infections, gastroenteritis, MRSA, C. difficile (AB)
- MRSA, CDI, VRE, MBL Pseudomonas aeruginosa (Univ. AB)
- collecting data on trends with ESBLs (Sask)
- Local HA – ongoing surveillance and reporting of AROs (MB)
- 5 days/week – monitor lab results, maintain database of ARO & patients (MB)
- Development of surveillance and reporting of individuals at risk for AROs (MB)
- Implemented electronic database specific to Infection control – nurses provide reports (MB)
- Laboratory based reports (MB)
- Development of a surveillance database for Acute Care (ON)
- Physicians/Residents receive Quarterly reports of # of resistant orgs in ICU include c. diff, ESBL, MRSA, VRE, Pseudomonas (breakdown MDR, Acinetobacter & Stenotrophomonas) (ON)
- On-farm surveillance (ON)
- Monitor program on antimicrobial resistance for bacteria of animal and food origin (data from MAPAQ and vet college)

PATIENT SCREENING, TESTING AND RESULTS

- Screening for AROs for all inpatient & OR patients (BC)
- Screening all patients that have been in a healthcare facility in the last year for MRSA and VRE (AB)
- MRSA admission screening (AB)
- Semi-annual screening of high risk patients (AB)
- Point prevalence monitoring of isolation (AB)
- Swab all patients admitted to Family Medicine (MB)
- All patients screened for ARO's based on risk (PIDAC) (ON)
- MRSA & VRE only
- Screening for MRSA and VRE Surveillance for CDAD (hospital based) (NS)
- MRSA Surveillance (Nfld)

Challenges

The following challenges were derived from the gaps identified by respondents as well as the recommended priority actions.

1. Ensure that AMR surveillance systems are responsive to emerging trends.
2. Detect and report on drug-resistant organisms, in a standardized, consistent and reliable manner, across Canada
3. Monitor patterns of antimicrobial drug use in human medicine, in a consistent and comprehensive manner, across Canada
4. Determine and monitor the public health risks associated with antimicrobial resistance across disciplines including agriculture, veterinary medicine, and the environment.
5. Improve timely communication and access to AMR surveillance information
6. Improve coordination and data-sharing mechanisms.

Priority Actions

The following actions were identified by respondents as approaches they felt could address the current issues and challenges of antimicrobial resistance surveillance.

ACCESS TO UTILIZATION DATA

Enhancement of technology to facilitate extracting & reporting of Abx use data in quick and easy to use manner

- Data sharing mechanisms

- Need laboratory support provincially to get better AMR information to veterinarians.

MEANINGFUL & TIMELY ANTIMICROBIAL USE AND RESISTANCE DATA:

- Development of an annual sharing and publishing of AMR data from the diagnostic laboratories
- Yearly antibiograms developed
- Need to include target animal pathogens into overall AMR surveillance program
- CNISP and others doing pretty well for MRSA, VRE and we don't need to duplicate that effort. Look at other pathogens or other hosts (e.g. animal and environmental antimicrobial resistance rates).
- CA-MRSA rates antimicrobial prescribing rates (specific agents) in the outpatient setting
- Better data on ESBLs
- exposure assessment method development
- Obtain quality use data from the agricultural/vet sectors (poultry, cattle, pigs)
- Surveillance of antimicrobial used and antimicrobial resistance data of veterinary pathogen bacteria in Canada

LOCAL/COMMUNITY SURVEILLANCE

- Community surveillance for antimicrobial resistance
 - finding benchmarks for small rural facilities-standard formulas
 - surveillance tools/databases for smaller settings, acute care and longterm care
- Dissemination of local resistance patterns to prescribers
 - private practice responsibility with compensation - we are the front line that should know the situation
 - more CFIA vets and programs

PATIENT TESTING AND RESULTS

- Dedicated staff specific to AMR to increase timely results (currently 48 hours for results too long)
 - generation of susceptibility reports for all hospital clients
 - screening done for CMRSA or ESBLs which contribute to resistance
 - the ability to communicate with other sites;
- A system that would allow the different sites to have the same info so that when one site finds a new positive person, we are all informed.



CONSISTENT SURVEILLANCE AND REPORTING DEFINITIONS

- Nationally standardized case definitions for HAI
- Standardized national definitions for healthcare associated AMR
- Standard definitions such that all of Canada describes & tracks AMR's the same way

ANTIMICROBIAL STEWARDSHIP

Participants were asked to identify activities underway, gaps and priority actions for antimicrobial stewardship activities related to antimicrobial resistance. As the analysis indicates, there are numerous positive activities occurring across the country. The gaps and priority actions identified include the need for more effective coordination, integration, and sharing across disciplines.

Initiatives Underway

FORMULARY

- Formulary restrictions (AB)
- Limited formulary manipulation (AB)
- Restricted use - formulary and required consults (MB)
- Restricted antimicrobial order forms, restricted formulary monitoring antimicrobial use (NS)
- Med Policies involvement Dose Optimization
- Day 3 bundle

HOSPITAL BASED

- Hospital reserves some drugs for certain specialties
- Policies for restricting hospital antibiotic use (QU)
- Pharmacist accompanies the IPC on rounds each day and reviews all patients with diarrhea for multiple factors including appropriate antibiotic use
- A stewardship program is about to begin shortly with a dedicated ID physician, a Pharmacy Lead and a Program Manager

HEALTH AUTHORITIES/REGIONALY BASED

- Antimicrobial utilization committee - standing regional committee, antimicrobial restriction (AB)
- Starting regional antimicrobial stewardship program pilot (prospective, dedicated teams, interventions suggested) (AB)

- Social marketing/advertising campaign targeting hospital practitioners, antibiotic formulary management (AB)
- UTI identification in LTC within region (BC)
- Have started the process of funding an antimicrobial stewardship program (ON)
- Antibiotic Utilization Committee (Sask)
- Antimicrobial restriction ecologic effects of antibiotics committee
- Monthly audit of LTC areas for antibiotics prescribed for infections/colonizations
- computerized decision support

PROVINCIAL & NATIONAL

- Provincial - monthly review of DDD/100 pt day antibiotic data -tabulate pharmacist recommendations for antibiotic streamlining -monitor acceptance to antibiotic restriction guidelines (ON)
- Provincial team looking at antimicrobial stewardship in hospitals
- National AMMI committee cochair-developing stewardship modules for all Canadian Fellows

Gaps / Issues

- No (or limited) stewardship program in place (mentioned for local, provincial and national)
- Limited involvement of physicians in antibiotic stewardship
- Unclear authority regarding restriction of antibiotic use
- Lack of (timely) knowledge and dedicated resources
- Too hospital focused
- Veterinary profession and food animal industry has not embraced antimicrobial stewardship
- Gap in provincial agriculture addressing AMR as an issue
- No formal process or organization that enhances stewardship as a prime responsibility
- Definition not clear – antibiotic or antimicrobial stewardship
- Feed millers selling drugs and/or medicated feeds to producers
- We need to move to Policies and recommendations ...beyond science and data collection... to application

Challenges

The following challenges were derived from the gaps identified by respondents as well as the recommended priority actions.

- Develop universally agreed to definition and understanding of antimicrobial stewardship across continuum of care
- Develop a coordinated integrated inter-disciplinary pan-Canadian approach to antimicrobial stewardship
- Develop and promote public awareness of antimicrobial stewardship responsibilities and concerns
- Ensure that antimicrobial use is based on best available evidence
- Develop a comprehensive way of measuring antimicrobial use that is consistent across Canada, across the continuum of care, and across sectors

Priority Actions

IMPLEMENT ANTIMICROBIAL STEWARDSHIP PROGRAM(S)

- National Antimicrobial Stewardship program – structured, dedicated funds
- AMR stewardship program for all restricted antimicrobials in health regions
- Antibiotic stewardship guidelines for antibiotic prescribed and enforcement of those guidelines
- development of antibiotic stewardship programs within acute care
- population-based initiatives and province wide initiatives;
- Expansion of the concept of antibiotic stewardship so that it can be adopted at all levels, from physicians and pharmacists to patients and from hospitals to the home and our environment.

INFORMATION RE: ANTIMICROBIAL STEWARDSHIP STRATEGIES

- compendium of antimicrobial stewardship strategies with evidence for their utility
- Physician education to use the 1st line meds if possible. This would give us some leeway if the patient's organism becomes resistant.
- Guide to inform facilities how to set up an antibiotic stewardship program

- Need easy to use guide for family physicians
- Better understanding of why prescribers do what they do and how they make decisions

IMPLEMENT PREVIOUS REPORTS:

- 1999 Health Canada Report on Food-Animal use of Antimicrobials
- Get rid of growth promotion claims
 - Implement veterinary prescription only for antibiotics
 - Get rid of the “own use” disaster
 - Oversight of VDD approval process
 - 2002 Health Canada Advisory Committee (APIs and OUIs)

REDUCE ANTIMICROBIAL USE

- Tighter control on use of antibiotics
- Eco smart antibiotic prescribing in hospitals
- More effective work with FPs to improve antimicrobial utilization
- Formulary restrictions and physician education must go hand in hand
- Minimizing broad spectrum use by community practitioners

GUIDELINES & ENFORCEMENT FOR ANTIMICROBIAL USE

- Stringent guidelines plus ongoing proof of compliance
- Mandatory peer review of prescribing practices
- Regulatory framework for limiting antibiotic use, and reducing fear of being held negligent for not using broad spectrum Rx
- Provincial authorities to monitor and where appropriate restrict antimicrobial use in animals.
- Restrict use of certain drugs to some specialists in all hospitals
- Limit antibiotic use in livestock (Canada can afford higher prices for meat)
- Consistent formulary access based on best practices in listing antibiotics



EDUCATION/TRAINING

Participants were asked to identify activities underway, gaps and priority actions for education/training activities related to antimicrobial resistance. As the analysis indicates there are numerous positive activities occurring across the country. The gaps and priority actions identified include the need for more effective coordination, integration, and sharing across disciplines.

Initiatives Underway

PHARMACISTS

- Training of all new pharmacists on how best to use antimicrobial handbook to optimize use of antibiotics in health region hospitals (AB)
- Pharmacist training, ID fellows training (AB)
- Creating an antibiotic handbook for pharmacists and staff (ON)
- Orientation of new pharmacists (ON)
- Lunch hour rounds for pharmacists (teaching about ID topics) (Sask)

PHYSICIANS

- Antimicrobial resistance lectures for medical students and residents (NS) (AB) (ON) (QU)
- Antimicrobial therapy taught to undergraduate, post-graduate students and residents, with an emphasis on measures to reduce antibiotic resistance (ON)
- ID doc providing in-services to hospitalists on prescribing restriction of certain antibiotics (carbapenems) (ON)
- Orientation of new physicians (ON)
- AMR lectures for physician CME (NS) (QU)

VETERINARIANS

- Development of a national veterinary curriculum around AMR
- Veterinary curriculum on AMR (ON) (Sask) (PEI)
- Veterinary CE on prudent use of antimicrobials (PEI)
- Swine medicines course for producers
- OFFS -cattle medicine responsible use course developed with cattle commodity groups

HEALTH CARE WORKERS

- Continuing medical education sessions (about AROs) for pharmacists, physicians, nurses (AB)
- Staff inservices – written and verbal, includes Abx resistance, Abx use, Abx stewardship (AB) (MB) (ON)
- Training for post-secondary students in healthcare fields (AB)
- Staff education and training regarding the Alberta Health and Wellness Infection Prevention and Control guidelines and MRSA guidelines (AB)
- Routine Practices and Additional Precautions inservices (AB)
- New employee orientation identification of infections control measures to prevent spread of AMR (BC) (AB)
- A resource for HCW in acute and LTC in our health service delivering area (BC)
- Staff education of latest policies (MB)
- Updated the IC manual to reflect the Manitoba Health Guidelines for AROs-January 2007 document. Facilitated mandatory education sessions were provided to policy users at all sites in the RHA on the changes and current guidelines.(MB)
- Workshops on AROS for various health sectors, toolkit development (ON)

NURSES

- NHAP and UTI protocol for RNs (AB)
- Education in core competencies in infection prevention and control (ON)

COMMUNITY

- Education of patients (AB) (MB)
- Extensive social marketing program for hand hygiene, appropriate use of isolation, appropriate use of antimicrobials (AB)
- Education for preschool and school age children, their parents and teachers (AB)
- Education Fairs (AB)
- Patient and family public education (MB)

OTHER

- Teaching & training grad students in molecular epidemiology of AMR (epidemiologist, ON)
- Orientation – judicious use of antibiotics, appropriate specimens, signs and symptom prior to treatment, control of spread of AROs (Laboratory technologist, ON)
- Distribution of the Bugs & Drugs antimicrobial handbook to medical, pharmacy and nurse practitioner students (AB)

Gaps/Issues

Practicing health care workers – no time for continuing education sessions

- Lack of AMR education in curriculum for health care professionals and veterinarians
- Lack of AMR continuing education opportunities for health care workers
- Lack of intra-regional medical resources and expertise for areas outside of large urban centres
- Academics (vet) not taking AMR seriously and this gets transmitted to students
- Physicians not taking AMR seriously re: hand hygiene & donning PPE
- Many healthcare professionals do not take antimicrobial resistance seriously

Challenges

The following challenges were derived from the gaps identified by respondents as well as the recommended priority actions.

1. *Increase public awareness and knowledge about AMR and promote appropriate antibiotic use in Canadian cities, rural and remote communities and on First Nations reserves*
2. *Improve training for clinical practitioners on antimicrobial resistance, appropriate use of antibiotics and infection-prevention and control procedures*
3. *Coordinate access to existing AMR educational material through web-based and other distribution options.*

4. *Communicate regularly updated national antimicrobial prescribing guidelines to relevant professionals*
5. *Promote an interest in and recognition of AMR research and policy issues in Canadian colleges and universities, and encourage the inclusion of AMR topics in Canadian college and university curricula.*
6. *Facilitate inter-disciplinary (human, animal, environmental) information sharing on AMR, including special forums, conferences, etc., for both students and practitioners*

Priority Actions

INCREASE IN AMR CONTENT IN STUDENT CURRICULUM FOR:

- Physicians
- Nurses
- Pharmacists
- Veterinarians

MANDATORY EDUCATION PROGRAM FOR PRACTICING PHYSICIANS, NURSES, VETERINARIANS AND PHARMACISTS ON AMR TO INCLUDE:

- its control and impact
- their responsibility
- narrow spectrum agents
- microbiology training
- systems education
- pharmacodynamics
- effective hand hygiene and barrier precaution

POTENTIAL MODELS FOR TRAINING FOR PRACTICING PHYSICIANS, NURSES, PHARMACISTS:

- Do Bugs Need Drugs training for doctors, nurses, residents
- Self study modules
- National web-based curriculum on AMR issues
- Mandatory on-line certification on a yearly basis
- Distance learning graduate course whose focus is on AMR



CONSISTENT EDUCATION

- Across disciplines
- Across health authorities/regions

COLLABORATION & SHARING OF EXPERTISE

- Finding ways to encourage collaboration and sharing of expertise on antimicrobials among physicians, pharmacists and nurses.
- Conferences specifically on antibiotic resistance methods, trends in Canada- no data for us

COMMUNITY EDUCATION / TRAINING

- We need to involve the public. Once they are aware they will do their part.
- I think that the public would respond very positively to the concept of antimicrobial "stewardship". It

implies personal ownership of the problem and a willingness to act responsibly and cooperatively.

- Increase awareness of ARO's and the prevention of ARO's in the community
- Do Bugs Need Drugs training for families
- Provision of education to First Nations communities
- Education on personal hygiene (daily bathing, hand hygiene)
- Identifying effective strategies to reach rural and remote populations with educational initiatives.

Success in other Jurisdictions

Respondents were asked to document success stories; including the issue being addressed, the outcome achieved and where this was occurring:

What was the issue being addressed?	What was the outcome achieved?	Province or country?
Antibiotic use in the community for RTIs	Decreased use of antibiotics and increased use of first line antibiotics for RTIs; Do Bugs Need Drugs? Program	Alberta, BC -
Outpatient clinic: wanted doctors to prescribe antimicrobials of choice rather than give samples of newest antimicrobials (FQs);	Removed samples. Stocked with supplies of older first-line agents	Alberta
National, broad based antimicrobial strategies and specific resistance- erythromycin	Reduced resistance	Finland
Knowledge and awareness of importance of handwashing and appropriate use of antibiotics among the general public	Parents of grade two children who received instruction in school were more knowledgeable than members of the general public, despite parents not being directly targeted	Alberta
Hand hygiene	Increased compliance	Calgary
Stopping metallobeta lactamase Pseudomonas, originating/amplified by physical plant	Find it, fix it/seal it, screen for it, kill it	Alberta
Strict implementation of transmission precautions	Decreased AROs	Scandinavia



What was the issue being addressed?	What was the outcome achieved?	Province or country?
Enhanced hand washing to reduce MRSA rates	A significant reduction in health-care associated infection rates for MRSA	Holland (Netherlands)
Group A strep macrolide resistance	Reduced group A strep macrolide resistance with removal of erythromycin from formulary;	Finland
Surveillance data demonstrating cephalosporin resistance in human <i>Salmonella heidelberg</i> related to use of 3rd generation cephalosporin in chicken production	Reduced use of drug by chicken producers with subsequent decrease in prevalence of resistance among human <i>S. heidelberg</i>	Ontario & Quebec
Reporting all patients with diarrhea to IPC and pharmacy can review use of antibiotics and isolation etc and ID physician to follow up on any patients with relapse or treatment failure	Increased awareness of how antibiotic use contributes to CDAD (<i>C. diff</i>) - physician changing prescribing	Ontario
MRSA in the hospital and starting universal surveillance of all admissions	Reduced MRSA infection rate within 1 year	Illinois, USA
Improved handwashing	Investment in surveillance and actively rewarding compliance	USA
Development of a simple surveillance tool - many ICPs in smaller settings have no back up and do not have a tool for surveillance. This may result in them producing inaccurate information.	Hand hygiene	Ontario
<i>Salmonella enteritidis</i> eradication program	<i>Salmonella enteritidis</i> eradication	Netherlands
Ceftiofur resistance in <i>Salmonella heidelberg</i> (from humans and chickens) and poultry generic <i>E. coli</i> ; likely related to the off-label use of ceftiofur in the poultry industry. One province voluntarily withdrew this use.	Reduction in the prevalence of ceftiofur-resistant <i>Salmonella heidelberg</i> in humans.	Quebec
Use of antibiotics as feed additives/growth promoters	Increased awareness of AMR issues within feed industry, and anecdotal reports of decreased usage of antibiotics in feeds	Canada
Neonatal scores - limited use of antibiotics short term with good management health practices	The success rate was significant once buy-in and in time good diligent management was instituted	Canada
Antibiotic residue in BBQ pigs	The CQA program identified and stopped it	Canada

Achieving Results

Respondents were asked

“In order to achieve your organization's goals related to AMR with whom do you connect and for what purpose?”

The responses were as follows:

	To Jointly achieve goals	To acquire information	For leadership in taking action	To change policy or legislation	To engage others across Canada in achieving goals	Response Count
Federal Government	15	6	12	15	10	31
Provincial Government	18	20	14	21	8	33
Health Authority	19	13	15	9	4	27
Local or provincial NGO	8	7	7	3	8	13
National NGO	9	8	9	3	14	17

INTEGRATION/COORDINATION

Respondents were asked to provide any suggestions regarding how to improve the interface between human, animal and environment in order to achieve the priorities identified. In addition there were comments made in response to some of the other questions that spoke to the need for increased integration and coordination across the country as well as across disciplines.

Gaps/Issues

- Commitment re: AMR from PHAC and provincial governments
- Human and animal initiatives working in isolation
- We know the basics for inducing resistance; we fail badly in translating what we know into outcomes.
- Lack of consistency and coordination
- Lack of integration between animal, human and environment

Priority Actions

GOVERNMENT COMMITMENT TO ADDRESSING AMR

- True commitment by fed/prov governments to AMR as a key public health issue
- Canadian AMR strategy developed and endorsed by FPT with accountability framework
- AMR surveillance and research recognized as a core PHAC/HC/CFIA/AAFC/prov activity with concomitant funding and horizontal integration
- Clear national strategy with governance model
- Federal and provincial gov't to act together in identifying the issues, then jointly approach the industry to encourage cooperation.
- Adequately support folks and initiatives trying to do this, with government support, but not restricted by bureaucratic and political whims

CROSS CANADA HORIZONTAL INTEGRATION

- Research and national initiatives for a consistent AMR approach
- Antibiotic Stewardship standardized across the country
- Horizontal integration of AMR surveillance and AMR stewardship activities
- Stronger and renewed CCAR
- Development of a formal organization with sole aim of promoting stewardship.

INTEGRATION BETWEEN HUMAN AND ANIMAL INITIATIVES

- Integration of human and animal initiatives related to AROs -our activities need to be aligned for greatest success.
- Start with Info sharing/collaboration initiative – all interested parties form user group, website and newsletter to share CHEC data, local antimicrobial utilization initiatives, projects to assess vet abx use impact on human health
- More links between human and veterinary medicine in molecular epidemiology of AMR
- Initiatives that demonstrably change the way that vets/doctors practice.
- increased discussions between the medical and veterinary communities

NATIONAL STRATEGIES

- Goals of national strategy: stop MRSA growth, reduce vire, reduce c.difficile
- more multi-discipline based research and programs to cross this interface
- Mandatory reporting of ARO rates which include colonizations and infections across the country.
- Cross Canada, interactive, meaningful, biofeedback loops, integrated with driver practices being changed.
- All practitioners/prescribers need to take this on – own this
- Move from organism-specific to general concepts of infection control for managing antimicrobial resistant organisms
- Government is slow and linear -need a way to do it fast - perhaps move outside government for implementation
- Need national targets – aggressive targets

INTERNATIONAL

- Make this a global issue – bring it to the attention of politicians and households
- Control of agricultural use of antibiotics public health infrastructure and promotion in developing countries
- Improve sanitation, access to clean water, nutrition, vaccines in developing countries
- It is a global issue- the food chain use of antibiotics impacts the human susceptibilities and exposures

Integration Between Animal, Human And Environment At All Levels

- Ongoing contact between the various parties at all levels and not just at Committee levels
- Meetings that involve participants (including speakers) from the other areas.
- Collaboration on producing guidelines.
- Annual national meeting/workshops
- The new Agency for Health Protection and Promotion in Ontario is working on a model that will, we hope, improve this. In addition, the Agency should have the capacity to conduct research and support the field.
- Mix-up disciplines - What are significant worries in medical and vet sectors re what pathogens and genes identified for the environmental sector to study.
- Better integration of food, human, and animal data for better understanding
- Increased consumer understanding of how lax and non-regulated livestock drug use in Canada is.



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APPENDIX G

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