Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

Dave Léger, Sheryl Gow, Anne Deckert, Brent Avery, Lucie Dutil,
Danielle Daignault, Richard Reid-Smith, Rebecca Irwin
Antimicrobial Resistance Program, Laboratory for Foodborne Zoonoses,
Public Health Agency of Canada

Minimizing antimicrobial resistance has become a priority on an international scale to protect human and animal health. A properly designed national surveillance system should provide relevant, high quality data to assess trends in antimicrobial resistance. Surveillance is also essential for the development and evaluation of prudent use practices in human and veterinary medicine, the development of risk management strategies and to support the development of international food safety standards. Countries that already have well established national surveillance programs for antimicrobial resistance include the United States and Denmark.

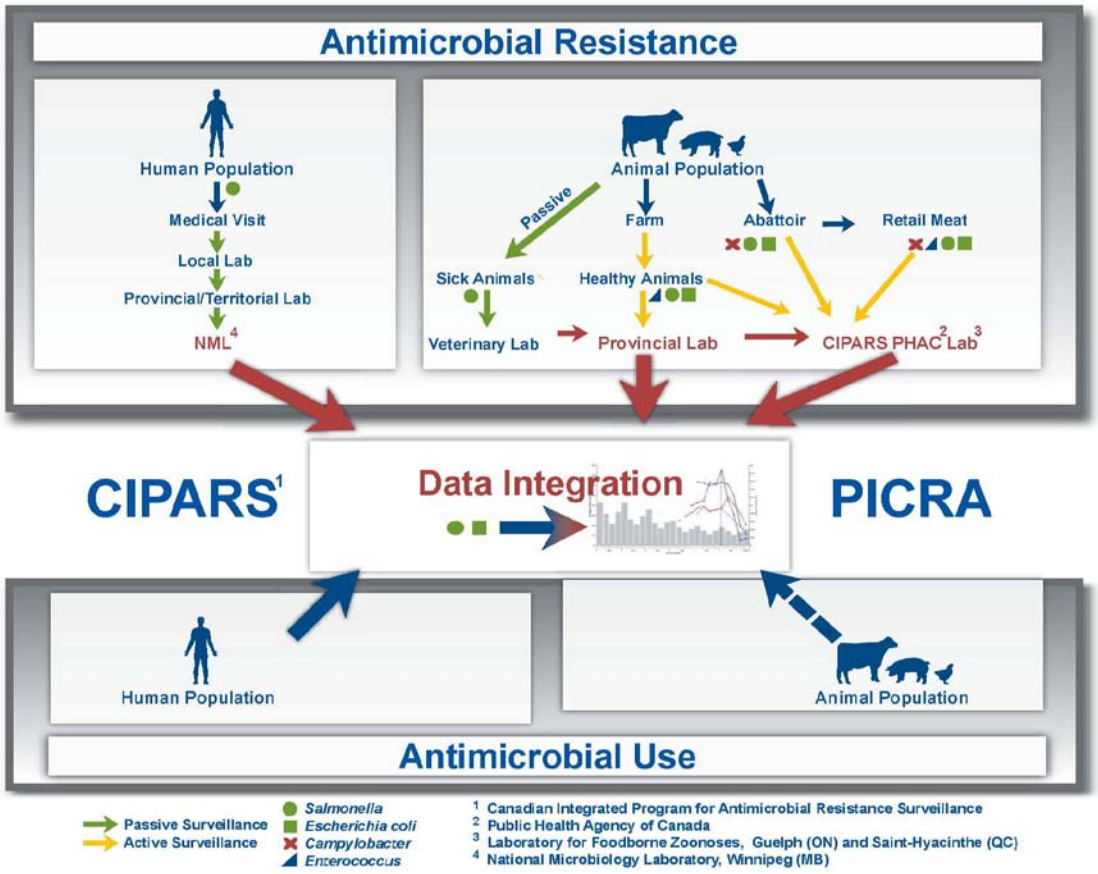
The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) is a representative and unified surveillance system for antimicrobial resistance and antimicrobial use in humans and animals. It was developed in response to the recommendations of the 2002 Health Canada Advisory Committee on Animal Uses of Antimicrobials: Impact on Resistance and Human Health. CIPARS was designed to harmonize with similar surveillance programs in other countries such as NARMS (USA) and DANMAP (Denmark).

CIPARS conducts surveillance in multiple sectors. Surveillance at federally registered abattoirs and at retail food outlets includes the three major commodities, beef, poultry and pork. These active agri-food surveillance activities provide a measure of potential human exposure to antimicrobial resistant organisms arising from the consumption of animal products**.** Passive surveillance data is being collected from human and animal cases of *Salmonella*. Human antimicrobial use data (Intercontinental Medical Statistics [IMS] Health - prescriptions through Canadian retail pharmacies), is reported and attempts are currently being made to generate accurate estimates of antimicrobial use in the agri-food sector. Antimicrobial use and resistance data are analyzed, integrated and published in Annual Reports, which are accessible on the CIPARS web site.

The Farm Program was the third active surveillance component of CIPARS to be implemented with sample and data collection beginning in the winter of 2006. The primary objectives of the farm program are; to establish an infrastructure to support a national surveillance program to provide farm data regarding antimicrobial use and resistance among enteric bacteria; to investigate potential associations between antimicrobial use and resistance in the agri-food sector and finally, to provide quality data for future human health risk assessments. This component of CIPARS was first developed in grower-finisher swine as a “proof of concept”. Sentinel herd demographic and antimicrobial use data are collected through questionnaires administered by herd veterinarians. This swine farm surveillance initiative was funded primarily by the Agricultural Policy Framework (APF), Agriculture and Agri-Food Canada. The Ministries of Agriculture in Alberta and Saskatchewan provided laboratory and financial support for additional sentinel sites in those provinces. Funding from PHAC has allowed this program to continue through 2009-2010. Sustainable funding is being sought for this active surveillance component of CIPARS.

The bacteria of interest vary among CIPARS components and agri-food commodities (Figure 1). Isolates of generic *E. coli* and *Enterococcus* serve as indicators of resistance in commensal gut flora. *Camylobacter* and *Enterococcus* isolates are speciated, *Salmonella* are sero-typed with a sub-set undergoing phage-typing and pulse field gel electrophoresis (PFGE) testing prior to assessing antimicrobial susceptibility. Antimicrobial susceptibility testing is performed using the Sensititre® Microbiology System and the National Antimicrobial Resistance Monitoring System Veterinary Public Health Plate configurations (Trek Diagnostics, Cleveland, Ohio, USA). Targeted molecular studies have investigated the occurrence of genes that confer resistance to antimicrobials commonly used in food animals and antimicrobials designated very highly important to human medicine. Sampling, laboratory and analytic methods are described on the CIPARS website and in Appendix A of the 2006 Annual Report.

Figure 1. Schematic diagram of CIPARS component programs



Antimicrobial use and resistance findings are reported by CIPARS using a categorization of antimicrobials developed by the Veterinary Drugs Directorate, Health Canada (Categorization of antimicrobial drugs based on importance to human medicine), which places antimicrobial drugs in one of four categories: Cat. I - Very high importance; Cat. II - High importance; Cat. III - Medium importance; Cat. IV - Low importance.

The 2007 CIPARS Annual Report presents agri-food data in a standardized format broken down by commodity (e.g., beef, poultry, pork), with subsections for each of the bacteria of interest (e.g., *Salmonella, E. coli*, *Campylobaacter*, *Enterococcus*) and the specimen source - surveillance program (e.g., abattoir, retail, farm, animal clinical). Data on isolate recovery rates, and typing/speciation are provided with highlights and summaries of notable/emerging resistance patterns. Temporal and spatial trends in retail data are presented to compare changes in resistance for each bacterial species.

The figures below are provided as examples of how this type of analysis is presented (2007 Preliminary Report). Trend data from retail beef indicated the percentage of generic *E. coli* isolates in Ontario with streptomycin resistance was lower in 2007 than in 2003; in other provinces, there were no significant temporal variations in the percentages of generic *E. coli* isolates from beef resistant to the antimicrobials tested (Figure 2). In retail chicken, the percentage of generic *E. coli* isolates with ampicillin resistance was significantly lower in 2007 compared to 2003; the percentage of isolates with ceftiofur resistance from Québec was significantly lower in 2007 than in 2004, whereas the percentage of isolates with ceftiofur resistance from Saskatchewan was higher in 2007 than in 2004-2005. No significant temporal variations were identified in Ontario (Figure 3). In retail pork samples, there were no significant temporal variation in percentages of *E. coli* isolates resistant (Figure 4). It should be noted that the retail program has been operational in Québec and Ontario since its implementation in 2003, Saskatchewan was added in 2004, and in recent years the program has expanded to include British Columbia and the Maritime provinces.

The 2006 Annual Report contained estimates of *kilograms of antimicrobials in dosage form distributed in Canada for use in animals* as provided by the Canadian Animal Health Institute, a trade association representing pharmaceutical manufacturers and distributors. These data included all licensed antimicrobials for use in food, sporting and companion animals and fish, and were aggregated at the class level.

New to the CIPARS Annual Report in 2007 will be the publication of antimicrobial use data from the Farm-Swine surveillance program. Antimicrobial use data are collected through producer questionnaires applied by the herd veterinarian. These data are reported by route of administration, weight (age) of grower-finisher pig, and reason for use. Demographic, management and animal health data are also summarized. Antimicrobial resistance findings from pig faecal isolates of generic *E. coli*, *Salmonella* and *Enterococcus* are presented as they were in the 2006 report using standard CIPARS formats. The 2007 Annual Report will be posted/published by Winter 2010.

CIPARS has provided support for several farm-based antimicrobial use and resistance research projects, including on-going surveillance research in feedlot beef and dairy. The potential to expand farm surveillance to these sectors, and broiler chicken, are being explored.

In an effort to provide surveillance information in a timely fashion, preliminary results are posted on the CIPARS website in advance of the full Annual Report. Beyond the Annual Reports, CIPARS information is disseminated through oral and poster presentations at scientific conferences, veterinary and producer meetings, and peer reviewed publications.

In summary, CIPARS is a national program dedicated to the collection, integration, analysis, and communication of trends in antimicrobial use and resistance in selected bacteria from humans, animals, and animal-derived food sources across Canada. This information supports the creation of evidence-based policies for antimicrobial use in hospitals, communities, and animal production with the aim of prolonging the effectiveness of these drugs, and the identification of appropriate measures to contain the emergence and spread of resistant bacteria among animals, food, and people.

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Address all correspondence to Dave Léger; email: david_leger@phac-aspc.gc.ca

Figure 2. Temporal variation of resistance to selected antimicrobials in ***E. coli*** isolates from **beef** samples; ***Retail meat*** *surveillance 2002-07*

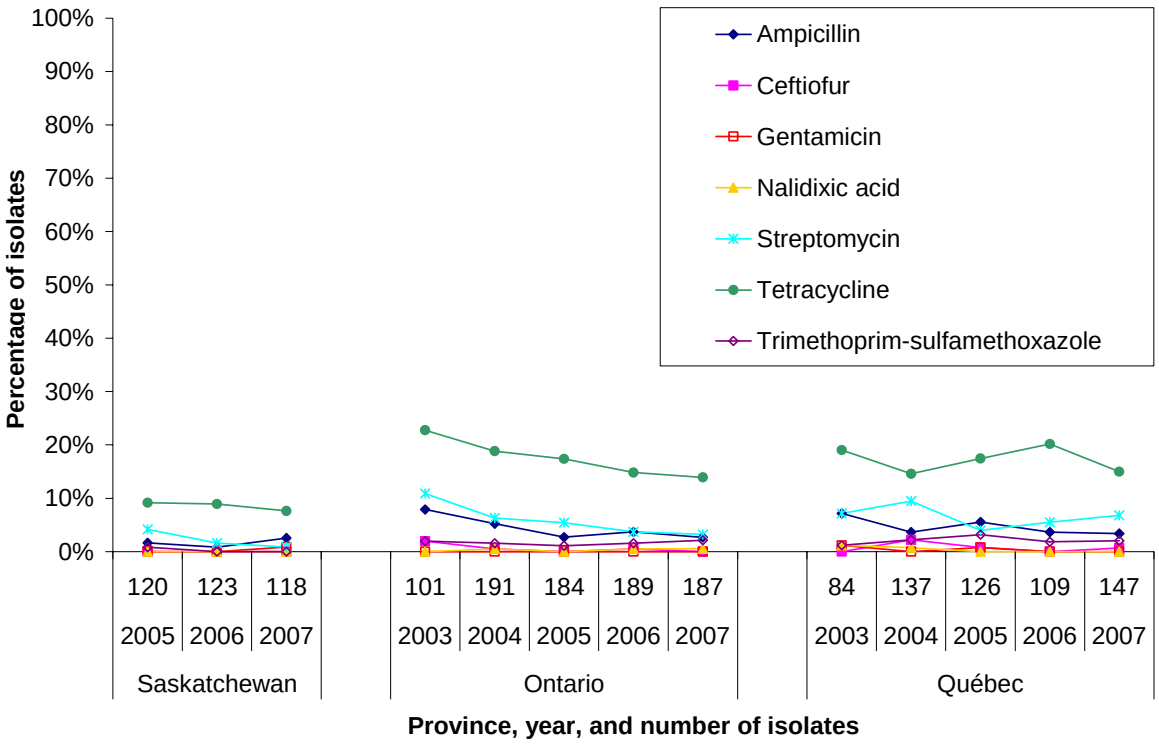

Figure 3. Temporal variation of resistance to selected antimicrobials in ***E. coli*** isolates from **chicken** samples; ***Retail meat*** *surveillance 2002-07*

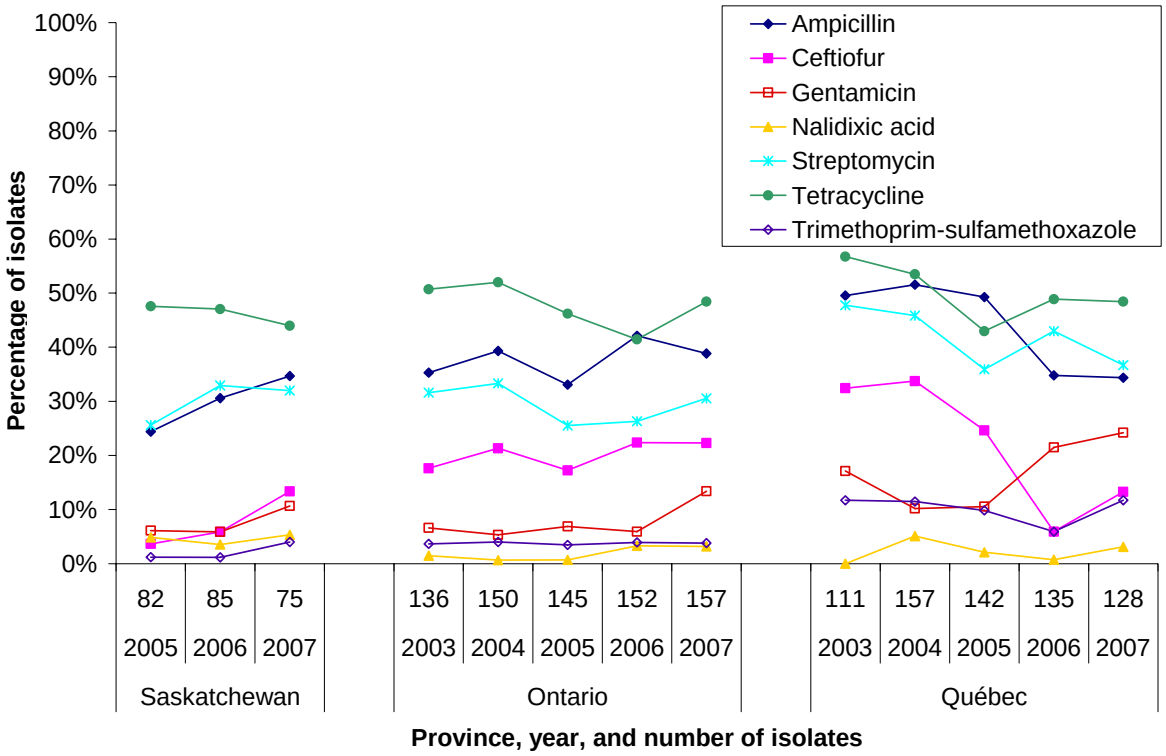

Figure 4. Temporal variation of resistance to selected antimicrobials in ***E. coli*** isolates from **pork** samples; ***Retail meat*** *surveillance 2002-07*