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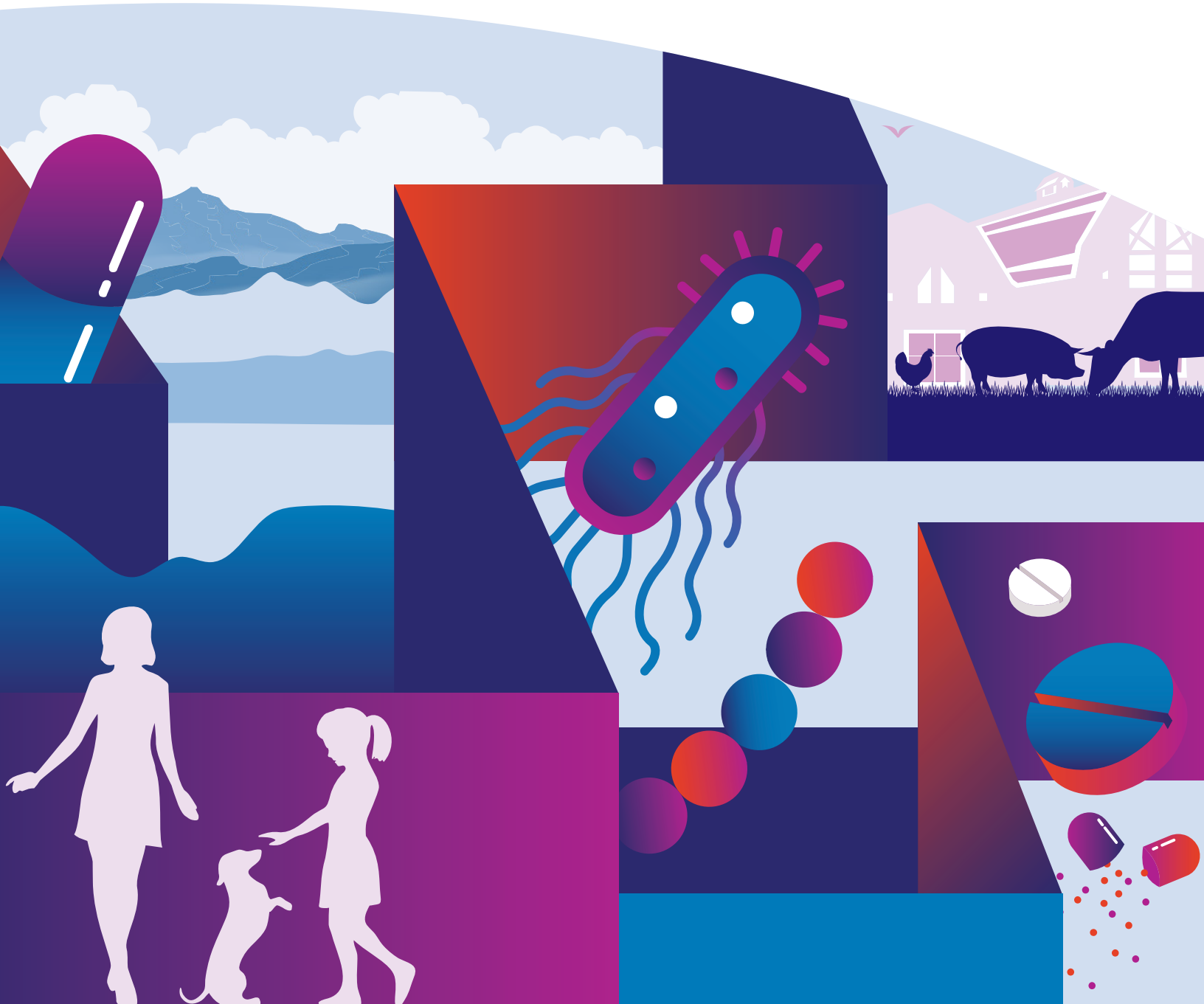
Canada

Canadian Antimicrobial Resistance Surveillance System (CARSS):

2024 Key Findings



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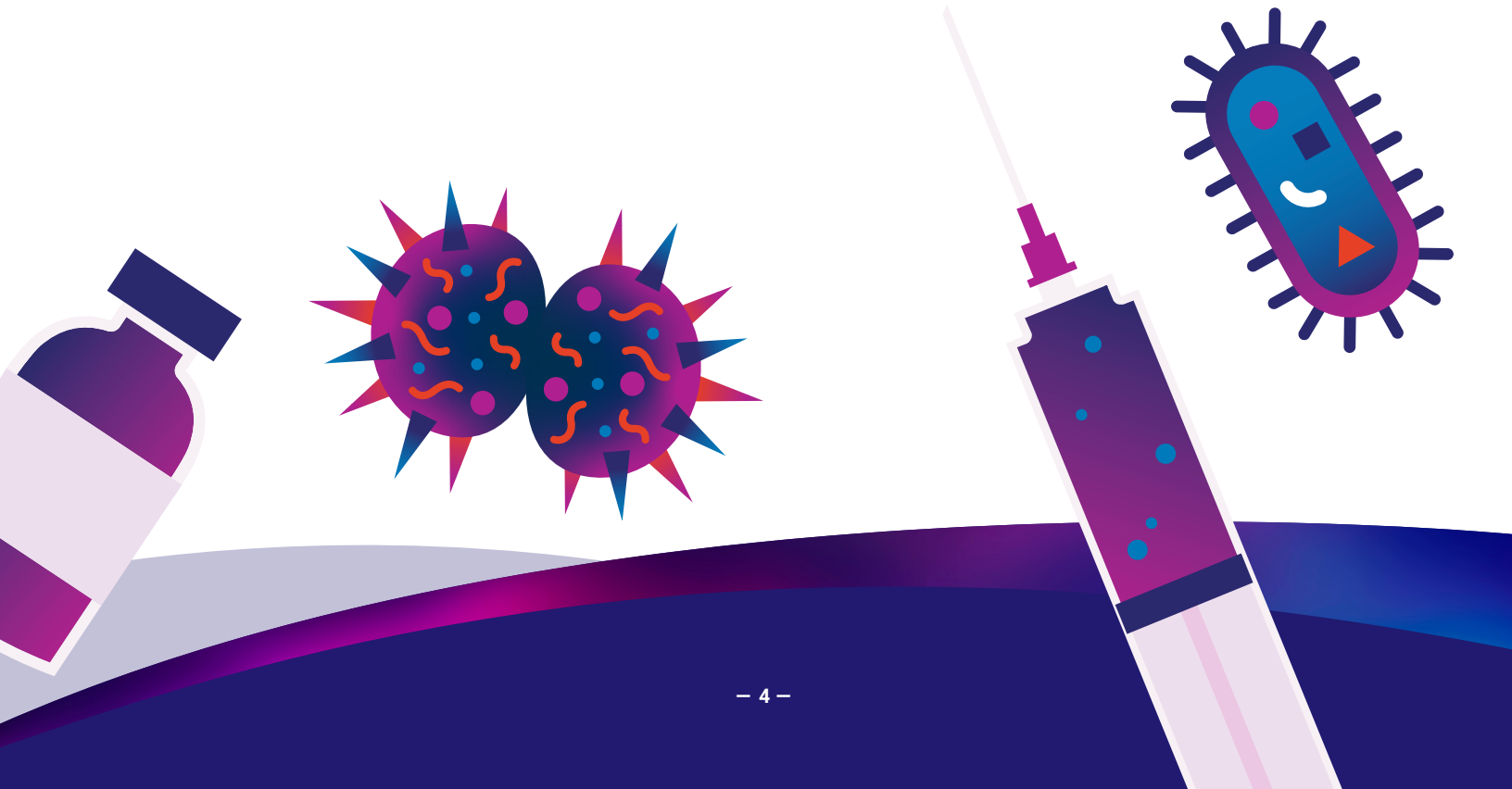
Introduction to antimicrobial resistance

Antimicrobials are a cornerstone of contemporary medicine, frequently employed to treat, prevent, and manage infections. Antimicrobial resistance (AMR) arises when bacteria, viruses, fungi, and parasites adapt to survive the effects of these drugs designed to eliminate or inhibit them[1]. Consequently, infections resistant to antimicrobials become harder to treat and are often linked to more severe outcomes, medical complications, and sometimes death. Although AMR can occur in nature over time, the misuse and overuse of antimicrobials in humans, animals, plants and crops can accelerate the process. This is why the prudent and responsible use of antimicrobials is crucial. AMR can spread between people and animals, either through direct contact or through the food chain and the environment; it is a complex problem, requiring a One Health solution[2].



The impact of AMR in Canada

Antimicrobial resistant infections significantly affect human health, and, in some cases, the incidence of these infections is on the rise. The Council of Canadian Academies projected that if the proportion of human infections resistant to first-line antimicrobials increased from 26% in 2018 to 40% by 2050, the number of deaths in Canada attributable to AMR would rise to 13,700 per year[3].

Of the AMR infections monitored in Canadian hospitals, the Public Health Agency of Canada (PHAC) estimates that 1 resistant infection is detected for every 220 patients admitted to sentinel acute-care hospitals. A number of priority infections are under surveillance and include methicillin-resistant *Staphylococcus aureus* (MRSA) bloodstream infections (BSIs), vancomycin-resistant *Enterococcus* (VRE) BSIs, *Clostridioides difficile* infections (CDI), *Candida auris* and carbapenemase-producing Enterobacterales (CPE).

If AMR is not addressed, global economic losses could exceed $100 trillion by 2050, with Canada potentially experiencing a reduction in GDP of more than $20 billion[3]. Healthcare costs play a significant role in these figures; for instance, evidence from Canada indicates that an antimicrobial-resistant MRSA infection incurs over $8,000 more in healthcare costs compared to a susceptible infection. This estimate excludes mortality and additional economic consequences[3]. Furthermore, if AMR decreases productivity in animal farming and exports of animal products by 10%, the Canadian industry could face losses around $190 billion over the next 30 years[3].

The increasing occurrence of resistant infections highlights the necessity for rigorous AMR surveillance and an evidence-based use of antimicrobials to reduce the risk posed by this complex One Health issue.

Key surveillance findings (2018 to 2022)

Public health surveillance underpins Canada's efforts to counter AMR. Established in 2015, CARSS brings together data and findings from 10 different surveillance programs based at PHAC, covering both human and animal health, in collaboration with Health Canada's Veterinary Drugs Directorate, the Department of Fisheries and Oceans and the Canadian Food Inspection Agency.

CARSS serves as a national focal point for AMR surveillance activities, highlighting evidence and trends from PHAC and partners, and providing relevant, timely, accurate, and comprehensive information to stakeholders, to support research, policies and actions against AMR and inappropriate AMU, a key driver of AMR.

Key trends	2018 to 2022 trend summary
Vancomycin resistant *Enterococcus* bloodstream infections	Trending up
Carbapenemase-producing Enterobacterales infections	Trending up
Methicillin-resistant *Staphylococcus aureus* bloodstream infections (Healthcare-associated)	Stable
Methicillin-resistant *Staphylococcus aureus* bloodstream infections (Community-associated)	Trending up
Clostridioides difficile infections	Stable
Drug-resistant *Mycobacterium tuberculosis* infections	Stable
Drug-resistant *Neisseria gonorrhoeae* infections	Trending up
Multidrug-resistant vaccine-preventable invasive *Streptococcus pneumoniae* infections	Trending up
Drug-resistant invasive Group A Streptococcal infections	Trending up
Resistant Typhoidal and non-typhoidal *Salmonella enterica* infections (*2019 to 2023)	Trending up
Candida auris	Not available

As highlighted in prior CARSS reports, several 5-year AMR indicators in humans continue to worsen between 2018 and 2022.

- The incidence of VRE BSIs increased by 5.9% (from 0.34 to 0.36 infections per 10,000 patient days); the 30-day all-cause mortality was 34% among hospitalized patients with a VRE BSI.
- CPE rates (both infection and colonization) rose from 0.06 to 0.14 per 10,000 patient-days.
- Healthcare-associated (HA) MRSA BSI rates among hospital patients remained stable over this 5-year period (ranged from 0.42 to 0.50 per 10,000 patient days) while community-associated (CA) MRSA BSI rates increased between 2018 and 2022 (from 0.50 to 0.56 per 10,000 patient days). Over this 5-year period, all-cause mortality rates ranged from 16.3 to 19.8 per 100 MRSA BSI cases for overall MRSA BSI, 19.4 to 25.7 for HA-MRSA BSI and 12.3 to 17.6 for CA-MRSA BSI.
- The incidence of HA-CDI decreased from 3.95 to 3.66 infections per 10,000 patient-days. CA-CDI rates remained stable, ranging from 1.19 to 1.41 infections per 1,000 patient admissions over the five-year period. Overall, CDI attributable mortality within 30 days of diagnosis remained low and fluctuated between 1.2 and 2.7 deaths per 100 cases.
- *Mycobacterium tuberculosis* (TB) resistance remained stable with only two cases of extensively drug-resistant TB reported during this time frame. Resistance to any TB drug ranged between 8.2% and 10.5% and reported multidrug-resistant cases counted for 0.6% and 1.4%.
- The 2022 national gonorrhea rate (similar to the rate from 2018 and 2019) is three times higher than it was three decades ago. There are reports of extremely drug-resistant (XDR) gonorrhea in Canada and, on average, 8.2% (range 6.1% to 11.7%) of *Neisseria gonorrhoeae* isolates collected during this period demonstrated resistance to azithromycin (a nationally recommended gonorrhea treatment prescribed as a part of dual therapy).

- Multidrug-resistant invasive pneumococcal (IPD) infections increased by 93.2% between 2018 and 2022.
- Since 2019, *Salmonella* isolates from human infections have shown increased resistance to some key antimicrobials.
- From 2012-2022, Canada experienced 43 cases of *Candida auris* infection or colonizations, an emerging pathogen in Canada. 34.9% of these cases were multidrug-resistant (resistant to 2 classes of antifungals).

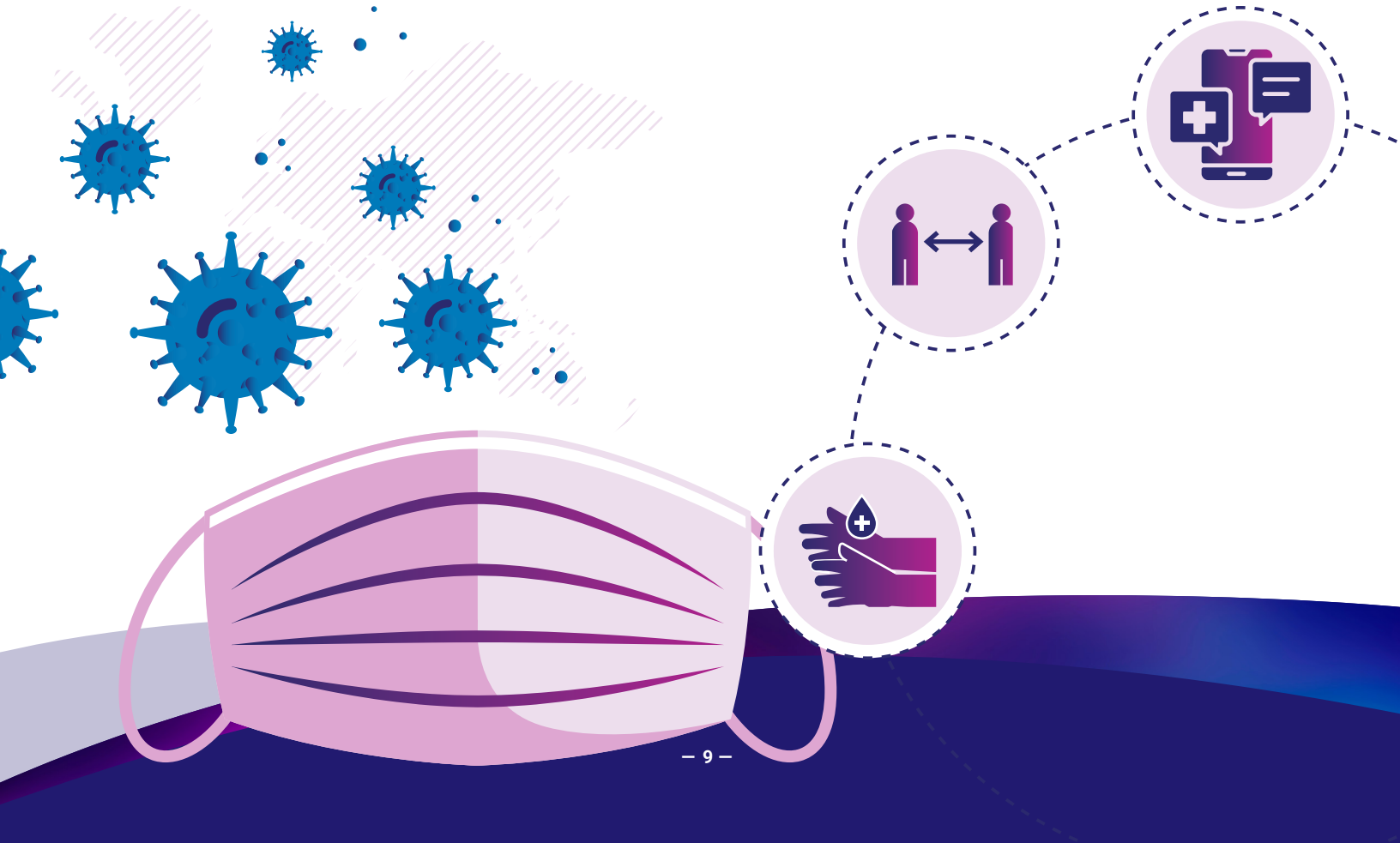
More detailed findings can be found on the AMR Dashboard, which organizes findings by pathogen.

- Overall, human antimicrobial use (AMU) continues to decrease, however, nearly one-fifth (18.4%) of prescriptions were deemed inappropriate or suboptimal in participating Canadian healthcare facilities. Annual antimicrobial prescriptions in the community sector declined by 6.6% between 2019 and 2023.
- The amount of antimicrobials sold for use in animals has plateaued since 2019. The reported AMU on volunteer sentinel farms increased for broiler chickens, turkeys, and feedlot cattle between 2022 and 2023, while there were decreases for grower-finisher pigs.
- Antimicrobial use in aquaculture also increased between 2021 and 2022[4].

More detailed findings on human and animal AMU can be found on the AMU Dashboard, which organizes findings by settings.

The impact of the COVID-19 pandemic on antimicrobial prescribing

When COVID-19 began in March 2020, there was an immediate decrease in the average monthly number of antimicrobial prescriptions in Canada. In the early pandemic period (April 2020 to June 2021) before COVID-19 vaccines were widely available, there was a decrease in antimicrobial prescribing by 33% compared to pre-pandemic levels. This was likely due to several factors including reduced healthcare access, a shift to virtual care, and reluctance to seek non-urgent medical attention. Social distancing and decrease in contact with others, which reduced other viral infections, also played a role. Rates were lowest during 2020-2021, but started rebounding by mid-2021, rising by 25.6%. By the end of 2023, prescribing rates returned to pre-pandemic levels. Although the pandemic temporarily reduced AMU, it did not lead to lasting change.



Strengthening national surveillance of AMR — Update on progress on the Pan-Canadian Action Plan on AMR

In June 2023, the federal, provincial and territorial Ministers of Health and Agriculture released the Pan-Canadian Action Plan on Antimicrobial Resistance (PCAP)[5,6], a 5-year (2023 to 2027) blueprint to coordinate an accelerated pan-Canadian response to address AMR. PHAC has identified ways to enhance surveillance efforts under the PCAP through existing and strengthened partnerships among federal, provincial, and territorial (FPT) authorities, as well as industry sectors. A key action is to expand the sources, coverage, and integration of AMR and AMU surveillance data. This includes leveraging modern laboratory technologies and standardized reporting to monitor AMR and AMU across One Health sectors. Specific attention will be given to improving data from environmental sources, transmission pathways between sectors, and populations disproportionately affected by AMR and inappropriate AMU.

One year after its release, the Pan-Canadian Action Plan on Antimicrobial Resistance: Year 1 Progress Report (June 2023 to May 2024)[7] was published to highlight FPT activities and advancements during the first year of implementation. Some key surveillance milestones include:

- **AMRNet**, a national laboratory-based surveillance system that integrates human and animal AMR data to support a One Health response to AMR, expanded to seven provinces/territories.
    - » AMRNet submitted data on more than 300,000 isolates to World Health Organization Global Antimicrobial Resistance and Use Surveillance System.

    - » AMRNet-Vet is the veterinary component of AMRNet. This pilot project expanded to four veterinary laboratories and has reported on AMR trends among felines, canines and bovines.

- The **Gonococcal Antimicrobial Surveillance Program (GASP – Canada)** has expanded AMR prediction testing of *Neisseria gonorrhoeae* clinical specimens to 10 provinces/territories, with a focus on northern and remote regions.

- The **Enhanced Surveillance of Antimicrobial-Resistant Gonorrhea (ESAG)** program expanded participation from 4 to 6 jurisdictions, which will provide further detail on key populations affected by AMR-gonorrhea to target approaches in gonorrhea prevention and treatment.

- PHAC partnered with the **Canadian Primary Care Sentinel Surveillance Network (CPCSSN)** to obtain access to de-identified primary healthcare electronic medical records. This new data source is being used to help monitor how antibiotics are being used in primary care. CPCSSN data are being explored, as a data source for how primary care physicians diagnose infections, including AMR infections.

- The **Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)** is a national program that collects, analyzes and communicates trends in AMU and AMR for select bacteria from humans, animals and retail meat in collaboration with federal, provincial, academia and private industry partners. CIPARS has expanded to include whole genome sequencing phenotypic prediction of AMR for *Salmonella* isolates from humans and diagnostic clinical animal samples from 2018-2023, information on gram positive organisms from poultry, chicken layer surveillance data, and AMR data on bovine respiratory pathogens. CIPARS has also expanded to include on-farm feedlot cattle and dairy cattle surveillance components.

- For the first time, CARSS is including data on dairy and feedlot cattle:
    - » Collection of AMU data in feedlot cattle started in 2019 as a pilot project. An expert panel, consisting of feedlot cattle industry representatives, the major veterinary practitioners involved in feedlot medicine across Canada and AMU and AMR experts, was convened to work with CIPARS to draft a framework for the collection of AMU data and samples for the detection of AMR from the feedlot sector. Strong industry support for this initiative resulted in this team receiving external funding to support the initiation and continuation of this project. Following the conclusion of the pilot phase in 2022, the core of the program transitioned into a CIPARS component.
    - » Dairy cattle surveillance, under the Canadian Dairy Network for Antimicrobial Stewardship and Resistance (CaDNetASR), started in 2019 as a pilot in collaboration with 4 veterinary colleges in Canada and CIPARS. This program was also supported by industry, including support from the Dairy Research Cluster 3 grant. Initially, the program aimed to enroll 30 herds across five selected regions: British Columbia, Alberta, Ontario, Quebec, and the Maritimes (specifically Nova Scotia). Following the conclusion of the pilot phase in 2022, the program transitioned to a core CIPARS component covering sampling in three regions: British Columbia, Ontario, and Quebec.
- PHAC is continuing activities to strengthen the environmental component of Canada's One Health AMR response by enhancing FoodNet Canada's collection of surface water for AMR and antimicrobial testing, as well as leveraging wastewater surveillance to investigate population-level AMR and AMU trends and continue to work to determine its value-add and overall impact in the realm of AMR.

AMR continues to be a global priority. A Political Declaration on AMR was adopted at the UN General Assembly High-Level Meeting on AMR on September 26, 2024. Priorities identified in the UN Political Declaration align well to the commitments in Canada's Action Plan, including enhancing integrated One Health AMR and AMU surveillance.

AMR and AMU amongst equity deserving populations

Equity is a key component of Canada's strategy to combat AMR, as it affects certain socio-demographic groups more than others. Initiatives are currently in progress to enhance surveillance by integrating socio-demographic and genomic data to better understand the unequal impacts of AMR in Canada.

Some key priority populations with increased risks for AMR infections and adverse health outcomes from AMU include:

- **Residents of long-term care facilities** (LTCF) are at a higher risk for antimicrobial-resistant infections and negative outcomes from avoidable antibiotic use, with urinary tract infections (UTIs) being a common reason for unnecessary antibiotic use[8,9,10]. LTCFs typically have less developed antimicrobial stewardship programs when compared to other healthcare facilities, like hospitals. The AMRTF is collaborating with PHAC's Behavioural Science Office on research to ensure best practices for testing and treating UTIs, aiming to reduce unnecessary urine cultures and antibiotic prescriptions.

- The **gay, bisexual and other men who have sex with men (gbMSM)** community in Canada is disproportionately affected by several sexually transmitted AMR pathogens concurrently circulating in Canada: multidrug-resistant (MDR) *Mycoplasma genitalium (M.genitalium)*, XDR shigellosis and MDR gonorrhea[11-15]. Doxycycline is being used or considered as a preventative measure against syphilis, gonorrhea and chlamydia among gbMSM in some jurisdictions. While there is no routine national surveillance of the AMR component of shigellosis, monitoring XDR shigellosis and MDR *M. genitalium* signals within the gbMSM community is important, as the widespread use of doxycycline for prevention of other STIs could facilitate spread of resistant strains[16-17].

- **People who inject drugs (PWID)** face a high risk of severe AMR infections, including invasive Group A Streptococcal (iGAS) infections and MRSA BSI[18-21]. CNISP and the Enhanced iGAS Surveillance System (a joint initiative between PHAC's Centre for Emerging Respiratory Infections and Pandemic Preparedness, the National Microbiology Laboratory and provincial/territorial health) are currently collecting data on the incidence of these infections among PWID, with findings forthcoming.

- **People born outside of Canada** are disproportionately affected by both TB and drug-resistant TB[22]. The Canadian Tuberculosis Reporting System (CTBRS) and Canadian Tuberculosis Laboratory Surveillance System (CTBLSS) continue to monitor TB among people born outside of Canada and AMR TB, respectively.

- **Indigenous people** have higher rates of certain infections linked to AMR, such as IPD and iGAS[23,24]. In some Northern communities, antibiotic-resistant gonorrhea presents a significant challenge[25]. The expansion of AMR prediction testing for gonorrhea clinical specimens, especially targeting northern and remote regions, offers crucial data to help address this issue.

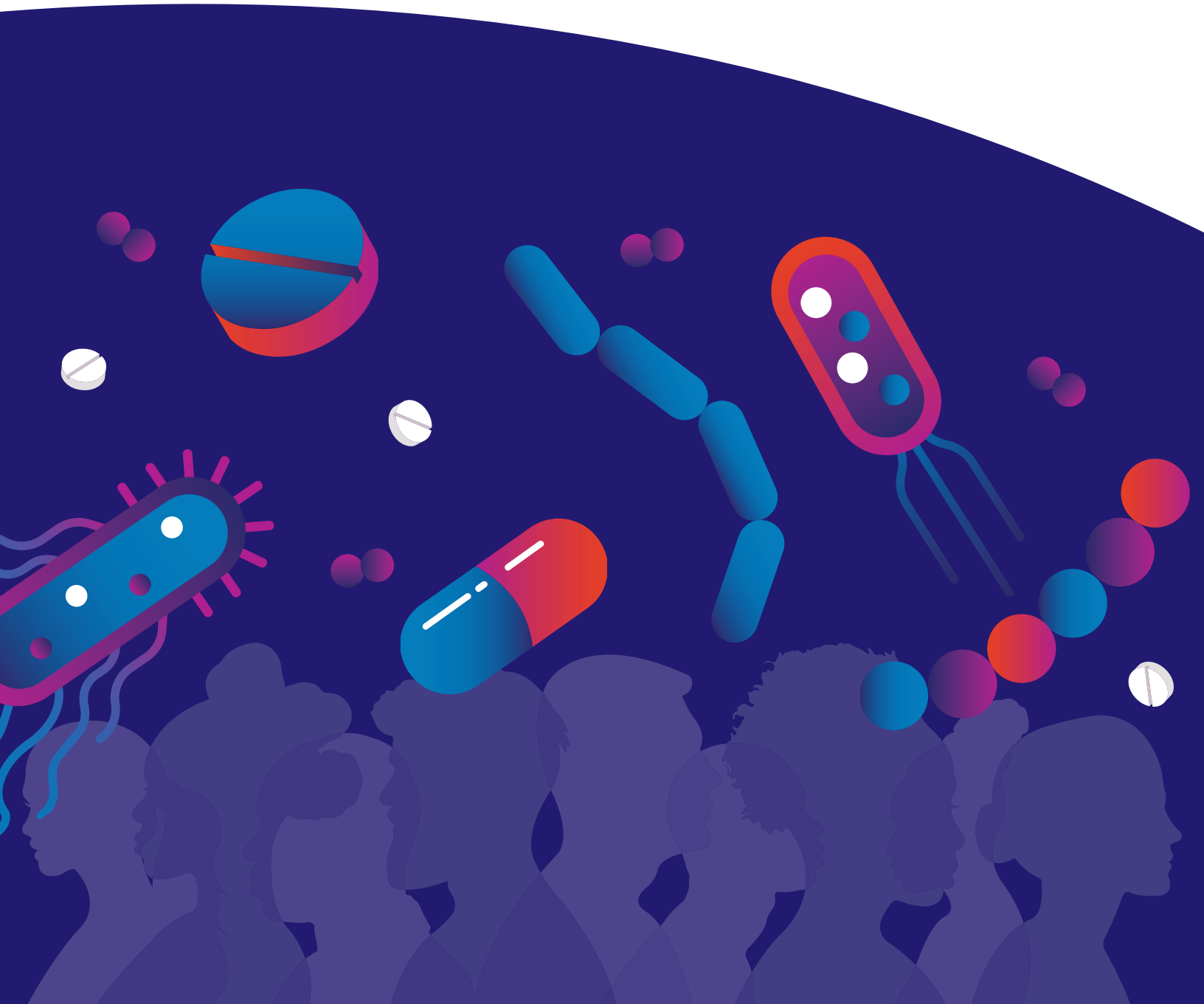
- Other equity deserving groups include **sex workers**, who can experience higher levels of AMR-gonorrhea[15], and **unhoused populations**, among whom there has been an outbreak of iGAS that included macrolide-resistant infections[18].

- Taking oral antibiotics without consulting a medical professional is one type of misuse of antibiotics. An AMRTF analysis of data from a public opinion survey found that **self-medicating with oral antibiotics** was more likely among the following groups:

    - individuals aged 35 years and younger
    - males
    - members of the LGBTQ+ community
    - employed individuals
    - Indigenous people
    - rural residents
    - individuals with lower household income
    - individuals who have children

Having drug insurance coverage was found to protect against self-medication with oral antibiotics, suggesting that drug coverage could be one measure to reduce this AMR risk behavior in the community[26].

PHAC is enhancing efforts to understand and address health disparities related to AMR and AMU in critical populations and settings. This information can guide culturally appropriate and collaborative community-prevention strategies to prevent AMR infections and develop targeted antimicrobial stewardship interventions for key populations.



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*** The Veterinary Antimicrobial Sales Reporting (VASR) system is jointly operated by both PHAC and HC. VASR is one surveillance component of CIPARS.**

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