

TECHNICAL NOTES

Antimicrobial Resistance and Stewardship Data Tool

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Introduction

The Antimicrobial Resistance and Stewardship (AMR-AMS) Data Tool provides comprehensive data on antimicrobial resistance (province-wide antibiogram, antimicrobial resistant organism (ARO) trends), antimicrobial use (AMU) in the community and hospitals, and hospital antimicrobial stewardship program (ASP) structural and strategic elements. These data are updated annually to track trends in resistance, support optimal empiric prescribing, and advance antimicrobial stewardship efforts. This document summarizes how information included in the tool was prepared, including data sources, population definitions, analytic considerations, and limitations.

Ontario Antibiogram

Antibiograms are a summary of the cumulative susceptibility of bacterial isolates to specific antibiotics in a given population. Antibiograms are an antimicrobial stewardship strategy used to guide choice of empiric therapy and track resistance patterns.

Data Source

The Ontario Laboratories Information System (OLIS) provides inpatient, LTC (long-term care), and outpatient microbiology results for >95% of Ontario laboratories. OLIS is housed within ICES. ICES is an independent, non-profit research institute funded by an annual grant from the Ontario Ministry of Health (MOH) and the Ministry of Long-Term Care (MLTC). As a prescribed entity under Ontario's privacy legislation, ICES is authorized to collect and use health care data for the purposes of health system analysis, evaluation and decision support. Secure access to these data is governed by policies and procedures that are approved by the Information and Privacy Commissioner of Ontario.

Patient Population

Using unique encoded identifiers, OLIS data were linked at the individual patient level to other provincial administrative datasets housed at ICES, including the Registered Persons Database (RPDB), Canadian Institute of Health Information Discharge Abstract Database (CIHI-DAD), and Continuing Care Reporting System- Long-term Care (CCRS-LTC). Data were analyzed at ICES. Patient setting was derived from the above databases. Patients not in hospital or LTC at the time of sample collection were considered community-based.

Specimen Source

Data were stratified into mutually exclusive categories:

- Respiratory
- Blood
- Urine
- Other

Isolate Counts

To avoid bias associated with repeated testing, only the first culture result per patient per organism per year was included. Susceptibility was calculated only for organisms with ≥ 30 isolates.

Organisms

Different phenotypes of bacterial species were combined (e.g., Extended-spectrum beta-lactamase (ESBL) and non-ESBL *E. coli*). Less common species are grouped by genus.

Susceptibility Display

Susceptibility is calculated as the percentage of susceptible isolates among all tested isolates. Susceptibility ranges from 0–100% and is colour-coded:

- **Red:** 0–59%
- **Yellow:** 60–79%
- **Green:** $\geq 80\%$
- **Grey:** Intrinsic resistance
- **White:** No data or tested isolates fewer than 30

Limitations

Individual patient characteristics, history, type of infection, and antibiotic pharmacokinetic and pharmacodynamic attributes should be taken into account when using antibiogram to guide empiric antibiotic use.

Susceptibility results are limited to what laboratories report and does not include suppressed results. Where susceptibility was missing, two-step imputation was used:

1. **Rule-based imputation** using intrinsic resistance and expected cross-resistance (e.g., if resistant to amoxicillin-clavulanate, isolate will also be resistant to amoxicillin)
2. **Model based imputation:** logistic regression models using age, sex, setting, region, organism, and available susceptibility data

Heterogeneity in OLIS reporting and laboratory formatting can result in variation. All information is provided “as-is.”

ARO Trends

The Antimicrobial Resistant Organism (ARO) Trends component of the tool summarizes the epidemiology of selected high-priority antimicrobial-resistant organisms in Ontario using laboratory susceptibility data from the Ontario Laboratories Information System (OLIS). These analyses describe temporal trends, geographic variation, and population-level characteristics of individuals with AROs. This component supports surveillance by identifying emerging patterns in resistance and informing public health and stewardship priorities at regional and provincial levels.

Data Source

Antimicrobial resistant organism data were extracted from OLIS based on reported susceptibility data.

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Definitions

Carbapenem resistant Enterobacterales (CRE)

CRE were defined as Enterobacterales (*Escherichia*, *Klebsiella*, *Enterobacter*, *Citrobacter*, *Morganella*, *Providencia*, *Proteus*, *Serratia* species) that were resistant to at least one carbapenem (ertapenem, imipenem, meropenem). Due to decreased intrinsic susceptibility of *Proteus* species to imipenem, resistance in this situation was not counted as CRE. Only the first isolate per patient per organism per year was reported. Only diagnostic specimens with antimicrobial susceptibility data were included (no surveillance screening specimens included).

Patient Population

Using unique encoded identifiers, OLIS data were linked at the individual patient level to other provincial administrative datasets housed at ICES, including the Registered Persons Database (RPDB), Canadian Institute of Health Information Discharge Abstract Database (CIHI-DAD), and Continuing Care Reporting System- Long-term Care (CCRS-LTC). Data were analyzed at ICES. Patient characteristics and setting were derived from the above databases. Patients not in hospital or LTC at the time of sample collection were considered community-based.

Specimen Source

Data were stratified into mutually exclusive categories: respiratory, blood, urine, and other.

Geographic Location

ARO incidence/proportion was assigned to a Public Health Unit (PHU) using the patient's Forward Sortation Area (FSA) of residence.

Marginalization

The Ontario Marginalization Index (ON-Marg) was used to stratify by dimensions such as material resources, racialized and newcomer populations, age and labour force, and households and dwellings.¹ The FSA of residence determined quintile assignment.

Census Data

Census population counts from Statistics Canada or Ministry of Finance were used as denominators.²

Limitations

Susceptibility results are limited to what laboratories report. Where susceptibility was missing, rule-based imputation using intrinsic resistance and expected cross-resistance was used. Heterogeneity in OLIS reporting and laboratory formatting can result in variation. All information is provided “as-is.”

Community AMU

The Community Antimicrobial Use component of the tool describes outpatient oral antibiotic dispensing across Ontario using population-based data from IQVIA. These data provide annual estimates of antimicrobial prescribing in the community, stratified by key demographic and prescribing characteristics to support monitoring of trends and stewardship priorities.

Data Source

Community AMU data are provided by IQVIA’s Geographic Prescription Monitor (GPM) database and include dispensing data, insurance claims, and sales data. A geo-spatial algorithm is used to estimate prescriptions from pharmacies not captured in the database to project to full Ontario population coverage.

Metric

Community AMU is measured as prescriptions per 1,000 population per year. Ontario population denominators are provided by the Ontario Ministry of Finance or Statistics Canada.

Stratification

Community antimicrobial use is stratified by:

- Provider Specialty (i.e., General Practitioner/Family Medicine (GP/FM), Dentist, Other, All)
- Patient Sex
- Age Group (i.e., <18 years, 18–64 years, 65+ years, All)
- Antibiotic Category
 - Penicillins without beta-lactamase inhibitor (amoxicillin, cloxacillin, penicillin)
 - Penicillins with beta-lactamase inhibitor (amoxicillin-clavulanate)
 - Cephalosporins, first generation (cephalexin, cefadroxil)
 - Cephalosporins, second generation (cefuroxime, cefixime)
 - Fluoroquinolones, second generation (ciprofloxacin, norfloxacin)

- Fluoroquinolones, third generation (moxifloxacin, levofloxacin)
- Macrolides (azithromycin, clarithromycin, erythromycin)
- Nitrofurantoin
- Metronidazole,
- Tetracyclines (tetracycline, doxycycline)
- Lincosamides (clindamycin)
- Trimethoprim and/or sulfonamides (co-trimoxazole, trimethoprim)
- Linezolid
- Fosfomycin

Hospital AMU

To understand the landscape of antimicrobial stewardship programs and collect antimicrobial use (AMU) data, Public Health Ontario (PHO) periodically conducts surveys of hospitals in Ontario. As part of each survey, hospital corporations are able to authorize the sharing of their AMU data on the PHO website for the purpose of benchmarking use to identify opportunities for improved antimicrobial stewardship.

Data Source

Hospital antimicrobial use is provided by hospitals via the PHO Ontario ASP Landscape Survey. This voluntary online survey is conducted every 1 or 2 years. The survey is distributed to all hospital corporations in Ontario, except for those that primarily deliver mental health or ambulatory services. Distribution is targeted to reach the individual most responsible for antimicrobial stewardship in each hospital/corporation, usually an ASP pharmacist or physician. The intent is to obtain one response per hospital and collect hospital facility-specific antibiotic use data. Participating hospitals submit antibiotic use data aggregated at the hospital level, covering all antibacterial agents in WHO ATC J01 classification.³

Metrics

Two main standardized measures:

- **Defined Daily Doses (DDD):** the assumed average maintenance dose per day for a drug used in adults, standardized per 1,000 patient days.
- **Days of Therapy (DOT):** a count of days a patient receives an antimicrobial (any dose), standardized per 1,000 patient days.

Limitations

All data (except hospital type and region) are self-reported. Hospitals may join or withdraw from participation at any time. All information is provided on an “as-is” basis. PHO cannot and does not warrant or represent that the information is accurate, complete, reliable or current.

Hospital ASP

Antimicrobial stewardship is a Required Safety Practice (RSP) for organizations that pursue accreditation through Accreditation Canada.⁴

To understand the changing landscape of ASPs, PHO periodically conducts surveys of hospitals in Ontario. As part of each survey, hospital corporations are able to authorize the sharing of their information on the PHO website for the purpose of providing corporations a means to share information regarding their antimicrobial stewardship activities and insights into how ASPs are advancing in peer hospitals.

Data Source

Hospital ASP activities are provided by hospitals via the PHO Ontario ASP Landscape Survey.

Metrics

The following components are included at the individual hospital level:

- ASP structure: ASP contact information and resourcing
- ASP strategies:
 - Actions to optimize antibiotic use including antibiograms
 - Clinical decision support
 - Antibiotic allergy assessment
 - Formulary restrictions
 - Intravenous to oral policies
 - Prescribing guidelines
 - Prospective audit and feedback

Limitations

All data (except hospital type and region) are self-reported. Hospitals may join or withdraw from participation at any time. Presence of an ASP may not directly align with Accreditation Canada RSP criteria. Data are generally reported at a hospital corporation level unless site-specific responses were provided. All information is provided on an “as-is” basis. PHO cannot and does not warrant or represent that the information is accurate, complete, reliable or current.

References

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Contact

For questions about this tool, contact asp@oahpp.ca.

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