Advancing surveillance of antimicrobial resistance: Summary of the 2015 CIDSC Report

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Abstract

Background: Antimicrobials are essential for the treatment and control of infectious diseases and therefore, the development and spread of antimicrobial resistance (AMR) is a global health concern. It is recognized that robust AMR surveillance is necessary; however, current gaps in national surveillance programs need to be addressed to enable better evidence-informed program and policy decisions.

Objective: To describe how an AMR Surveillance Task Group prioritized national AMR surveillance data requirements for high priority AMR organisms for human health in Canada and made recommendations on addressing the current data gaps.

Methods: The 2015 AMR Surveillance Task Group examined the data requirements for previously identified first priority organisms and assessed whether the current system met, partially met or did not meet these requirements. Information was summarized into synopsis tables and a ranking process was used to prioritize the data requirements and develop specific recommendations to address the gaps.

Results: First priority organisms identified for AMR surveillance are: *Clostridium difficile*, Extended-spectrum β-lactamase-producing organisms, Carbapenem-resistant organisms (*Acinetobacter* + Enterobacteriaceae species), *Enterococcus* species, *Neisseria gonorrhoeae*, *Streptococcus pyogenes* and *S. pneumonaea*, *Salmonella* species, *Staphylococcus aureus*, *Mycobacterium tuberculosis* and *Campylobacter* species. For these organisms, there were 19 high priority data requirements identified: 10 of these requirements were met by the current surveillance systems, seven were partially met and two were unmet. For the two high priority data metrics in the community setting, the Task Group recommended conducting a point-prevalence community-based study (i.e., every five years) to follow infection rates of *C. difficile* infection, and community level antibiogram data on an annual basis for susceptibility data for Enterobacteriaceae species (*E. coli* and *Klebsiella*) causing genito-urinary infections. There were eight medium priority data requirements identified: one requirement was met by the current surveillance system, five were partially met and two were unmet. The medium priority unmet data requirements included susceptibility of infection isolates for *C. difficile* (diarrheal disease) and infection rates for Enterobacteriaceae species causing genito-urinary tract infections in community settings. It was noted that the feasibility of obtaining this medium priority data in the community setting was low. The Task Group identified bloodstream infections as the top priority site of infection for AMR surveillance in the health care setting given the high morbidity and mortality associated with bloodstream infections. The importance of collecting susceptibility data on *N. gonorrhoeae* in the community was underscored given the rise in resistance and that the current surveillance system only partially collects this data. The Task Group recommended that a review of the national AMR surveillance data requirement priorities should occur on an ongoing basis and when new issues emerge.

Conclusion: While current national surveillance programs either capture or partially capture many of the identified data requirements for first priority organisms, several gaps still remain, especially in community settings. A national review of the recommendations of the Task Group is underway.

Introduction

Resistant strains of bacteria have emerged since antibiotics were first introduced. The development of antimicrobial resistance (AMR) presents increasingly serious and complex challenges to clinical practice and public health in the prevention, control and treatment of infectious diseases in both humans and animals.

Surveillance is fundamental to understanding the current state and progression of AMR. For several years, the Public Health Agency of Canada (PHAC) has worked with provinces and territories on a number of surveillance programs to monitor AMR and ongoing antimicrobial use (AMU) in hospitals and community-based settings, as well as veterinary and agricultural settings (1-4). A key commitment of the Federal Action Plan on AMU and AMR in Canada is to merge the different surveillance systems into a common focal point through the Canadian Antimicrobial Resistance Surveillance System (CARSS), launched in 2014 (5). CARSS provides an integrated picture of AMU/ AMR in Canada based on surveillance data from PHAC's nine surveillance systems and laboratory reference services and is now published yearly (6). In addition to addressing AMR in specific high-risk populations such as Indigenous peoples, analyzing surveillance data with a sex and gender-based focus have been noted for future considerations.

The Communicable and Infectious Disease Steering Committee (CIDSC) of the Pan-Canadian Public Health Network Council (which represents federal, provincial and territorial partners) has identified AMR as a priority along with the need for robust surveillance systems to inform effective AMR prevention and control programs and policies. In 2014, CIDSC established an expert-based Task Group to develop recommendations to address common health care acquired infections and operational issues related to surveillance of AMR. The Task Group identified key elements of a pan-Canadian AMU-AMR approach to the human health aspects of surveillance and established a list of organisms for AMR surveillance ranked by first, second and third priority of importance (**Table 1**).

Table 1: Priority organisms considered for AMR surveillance[1]

First priority	Second priority	Third priority
Clostridium difficile	*Aspergillus* species	*Aeromonas* species
ESBL-producing organisms[2]	*Bacteroides* species	*Chlamydia pneumoniae*
Carbapenem-resistant organisms (*Acinetobacter* + Enterobacteriaceae species)[3]	*Candida albicans*	*Cryptococcus neoformans*
Enterococcus species	*Chlamydia trachomatis*	*Haemophilus influenza*
Neisseria gonorrhoeae	*Helicobacter pylori*	Non-tuberculosis mycobacteria (pulmonary)
Streptococcus pyogenes *Streptococcus pneumoniae*	*Pseudomonas aeruginosa*	
Salmonella species	Group B *Streptococcus*	
Staphylococcus aureus	*Shigella* species	
Mycobacterium tuberculosis		
Campylobacter species		

[1] As developed and accepted by the CIDSC AMR Surveillance Task Group, December 2014 (unpublished report)
[2] Extended-spectrum β-lactamase (ESBL)-producing organisms: Enterobacteriaceae species (*Klebsiella, E. coli*), *Pseudomonas*. Others to consider: *Providencia stuartii, Citrobacter, Serratia, Proteus, Enterobacter*
[3] Carbapenem-resistant organisms (CROs): Enterobacteriaceae species (*Klebsiella, E. coli*), *Pseudomonas, Acinetobacter*

In 2015, a new CIDSC expert-based task group, the CIDSC AMR Surveillance Task Group was formed to develop advice and recommendations on the priority data requirements (data metrics) needed to support a robust AMR surveillance system for each of the first priority organisms identified in human health. This article summarizes the CIDSC AMR Surveillance Task Group's findings in the Report to CIDSC: the Antimicrobial Resistance Surveillance Data Requirements for Priority Organisms (7).

Methods

The Task Group members included Canadian infectious diseases clinicians, infection prevention and control practitioners, medical microbiologists, public health practitioners and AMR experts. The Task Group first reviewed and summarized the surveillance data requirements for the first priority organisms. A ranking process was then conducted to prioritize the data requirements and specific recommendations to address these gaps in the surveillance data were developed.

Phase 1: Review of surveillance data requirements

The CIDSC AMR Surveillance Task Group reviewed the following surveillance data requirements for each of the first priority organisms:

- Site of infection (refers to the syndrome or type of specimen to collect [e.g., bloodstream infection, genito-urinary tract infection, etc.]).
- Data source (refers to the surveillance system that provides data).
- Data variable of interest (as measured by infection rate, colonization rate or susceptibility of organism).
- Priority and relevance (refers to the importance of this measure for each organism and whether this is the most suitable measure).
- Feasibility (refers to whether it is possible to collect the data required).
- Rationale for measure (as required).
- Antibiotics to consider for testing (as required).
- Other considerations (as required).

For each organism reviewed, the CIDSC AMR Surveillance Task Group selected the site of infection(s) deemed to be of national importance and/or which aligned with the World Health Organization (WHO) global AMR surveillance requirements (8).

Phase 2: Development of synopsis tables

A discussion summary was prepared for each organism including a description of the existing surveillance system(s) and respective system limitations. This summary also included a subjective ranking of the priority of the data requirement(s) and a recommendation according to the expert opinion of the Task Group members. A synopsis table was created from this information for each first priority organism that featured:

- The setting (health care [i.e., acute care hospitals] or community [i.e., setting where primary health care is provided, including long term care facilities]).
- The required data metric:

- Infection rate (incidence and/or prevalence),
- Colonization rate (incidence and/or prevalence),
- The organism's antibiotic susceptibility information.
- A rating of the priority of the data requirement (high, medium, low).
- An assessment of whether the current surveillance system meets the identified need (meets needs, partially meets needs, does not meet needs or a brief description if the data metric is considered low priority).
- Action required to fill identified gaps, if any.
- The feasibility to implement the proposed new action to fill the identified gap.

For the infecting and colonizing isolates, the type of antibiotic susceptibility chosen was based on available laboratory information, clinical relevance and WHO reporting (9). The susceptibility data of interest was provided as susceptible/intermediate/resistant (SIR) data rather than minimum inhibitory concentrations (MIC).

Table 2 shows a sample synopsis table for one priority organism, *C. difficile*, with grey bars showing the health care and community settings with types of data required underneath.

Table 2: Sample synopsis table for *Clostridium difficile* (Diarrheal illness)

Setting and Required Data Metric	Priority of Data Metric	Current Surveillance System	Feasibility
Healthcare setting			
Infection Rate	High	Meets needs	High
Susceptibility of infection isolate	Medium	Meets needs	High
Colonization Rate & Susceptibility of colonization isolate	Low	Current surveillance system does not collect and/or report	Not assessed
Community setting			
Infection Rate	High	Does not meet	Medium
Susceptibility of infection isolate	Medium	Does not meet	Low
Colonization Rate and Susceptibility of colonization isolate	Low	Current surveillance system does not collect and/or report	Not assessed

Phase 3: Identification of priority data requirements and recommendations

A three-step process was undertaken to examine the most important data requirements and the feasible next steps:

Step 1: The list of data requirements was stratified by priority (high, medium, low). Priority in this instance referred to an assessment of the overall importance of the data requirement for national AMR surveillance, as deemed by a consensus of Task Group members.

Step 2: The list of data requirements from Step 1 was further stratified by status of current surveillance system. The Task Group assessed the status of the corresponding surveillance system in place and whether it currently collected and/or reported on the priority data metric identified. For each data requirement, the corresponding national surveillance system currently in place was categorized into: meets needs, partially meets needs or does not meet needs.

Step 3: The list of data requirements from Step 2 was further stratified by a feasibility measure as categorized as: high, medium or low feasibility, or not assessed. Feasibility was determined by the amount of person-time effort and financial resources that will be needed to accomplish the proposed action to fill the required data gap.

Recommendations were developed through examination of the three-step process, discussion and consensus-building.

Results

High priority data requirements

For the first priority organisms, the CIDSC AMR Surveillance Task Group identified 19 high priority data metrics required for a robust national AMR surveillance system. Of these, 10 were met, seven were partially met and two were not met by the current surveillance system.

Meets needs

The Task Group examined the 10 of 19 high priority metrics for which the existing national surveillance systems met the required needs. When assessed for feasibility, eight had high feasibility for collecting the data and no new action was required (as no gaps were identified) and two had medium feasibility to continue to collect the required data, subject to ongoing availability of resources.

Partially meets the needs

The Task Group then examined the seven of 19 high priority metrics for which the existing national surveillance systems partially met the required needs (**Table 3**). Of these, four were bloodstream infections in health care settings (susceptibility of infection isolates for *Enterococcus*; infection rates and susceptibility of infection isolates for Enterobacteriaceae species *E. coli* and *Klebsiella;* infection rates of *S. aureus*; and susceptibility of infection isolates for *S. aureus*); two were in community setting (susceptibility of infection isolates for *S. aureus;* susceptibility of infection isolates for *Neisseria gonorrhoeae*); and one was in both the community and healthcare setting (susceptibility of infection isolates for *Streptococcus pneumoniae* [invasive disease]). In assessing what was needed to meet requirements, six could be met with high or medium feasibility and one with low feasibility. The high priority data metric with low feasibility was identified for susceptibility of infection isolate of *N. gonorrhoeae* in the community.

Table 3: High priority data metrics where current surveillance systems partially meet the needs

Organism	Setting	Priority data metric	Current surveillance system	Feasibility
Enterococcus: (Bloodstream infections) - VRE identified as most important)	Health care	Susceptibility of infection isolate	Partially meets needs	High
Enterobacteriaceae species: *Escherichiae coli* and *Klebsiella* (Bloodstream infections)	Health care	Infection rate and susceptibility of infection isolate	Partially meets needs	Medium
Staphylococcus aureus (Bloodstream infections)	Health care	Infection rate	Partially meets needs	Medium
S. aureus (Bloodstream infections) (MRSA identified as most important)	Health care	Susceptibility of infection isolate	Partially meets needs	Medium
S. aureus (Other infection sites including bloodstream infections and colonization sites) (MRSA identified as most important)	Community	Susceptibility of infection isolate	Partially meets needs	Medium
Streptococcus pneumoniae (Invasive disease)	Health care and community	Susceptibility of infection isolate	Partially meets needs	Medium
Neisseria gonorrhoeae	Community	Susceptibility of infection isolate	Partially meets needs	Low

Abbreviations: VRE, Vancomycin-resistant Enterococci; MRSA, methicillin resistant *Staphylococcus aureus*

Does not meet the needs

The Task Group then examined the two of 19 high priority metrics for which the existing national surveillance did not meet the required needs (**Table 4**). These two metrics were for infection rates of community-based surveillance of *C. difficile* and susceptibility of infection isolates for Enterobacteriaceae species. In both cases, the feasibility to address the actions required to fill the data gap was identified as medium.

Table 4: High priority data metrics where current surveillance systems do not meet needs

Organism	Setting	Priority data metric	Current surveillance system	Feasibility
Clostridium difficile (Diarrheal disease)	Community	Infection rate	Does not meet needs	Medium
Enterobacteriaceae species *Escherichiae coli* and *Klebsiella* (Genito-urinary tract infections)	Community	Susceptibility of infection isolate	Does not meet needs	Medium

Medium priority data requirements

Among the first priority organisms, the Task Group identified eight medium priority data metrics; four in a health care setting, three in community settings and one in both health care and community settings (**Table 5**). Among these, there was one data metric for which the existing surveillance systems fully met the needs and five data metrics (four in hospital settings), for which the current surveillance systems partially met the needs. One of the data metrics in the community setting that partially met the need was infection rates for *S. aureus*; and the feasibility to meet this data need was deemed low. There were two data metrics, both in community settings, for which the current surveillance system did not meet the needs. These were for susceptibility of infection isolate for *C. difficile* and infection rates for Enterobacteriaceae species, specifically, *E. coli* and *Klebsiella* genito-urinary tract infections in the community.

Table 5: Medium priority data metrics

Organism	Setting	Priority data metric	Current surveillance system	Feasibility
Clostridium difficile (Diarrheal disease)	Health care	Susceptibility of infection isolate	Meets needs	High
Enterobacteriaceae species *Escherichiae coli* and *Klebsiella* (colonization sites)	Health care	Susceptibility of colonization isolate	Partially meets needs	Medium
Pseudomonas species and *Acinetobacter* species (Bloodstream infections)	Health care	Susceptibility of infection isolate	Partially meets needs	Medium
Pseudomonas species and *Acinetobacter* species (colonization sites)	Health care	Susceptibility of colonization isolate	Partially meets needs	Medium
Campylobacter species	Health care and community	Susceptibility of infection isolate	Partially meets needs	Medium
Staphylococcus aureus (Other infection sites [including Bloodstream infections] and colonization sites)	Community	Infection rate	Partially meets needs	Low
C. difficile (Diarrheal disease)	Community	Susceptibility of infection isolate	Does not meet needs	Low
Enterobacteriaceae species *E. coli* and *Klebsiella* (Genito-urinary tract infections)	Community	Infection rate	Does not meet needs	Low

Low priority data requirements

Among the first priority organisms, the Task Group identified 14 low priority data metrics (data not shown). Some surveillance systems currently collect or partially collect these low priority

data metrics and it was acknowledged that their ongoing priority may need to be reviewed.

Recommendations

The Task Group recommended that efforts be focused on high and medium priority data metrics where the current surveillance systems partially met or did not meet the data requirements and where there was a medium to high feasibility to address the data gaps identified.

There was consensus among the Task Group members that given their high morbidity and mortality in the health care setting, top priority should be given to AMR surveillance of bloodstream infections from *Enterococcus* species, Enterobacteriaceae species (*E. coli* and *Klebsiella)* and *Staphylococcus aureus*. This recommendation is in keeping with WHO recommendations for AMR surveillance (9). While the current national surveillance system partially collects data on organisms with a specific resistance pattern deemed currently most important (e.g., methicillin resistant *Staphylococcus aureus* or MRSA) it was noted that ideally, the rate of <u>all</u> bloodstream infections caused by these organisms in the health care setting should be collected (with medium feasibility) and in order to monitor for emerging resistance, all available susceptibility patterns should also be identified.

For the two high priority data metrics in the community setting, the Task Group recommended conducting a point-prevalence community-based study (i.e., every 5 years) to follow infection rates of *C. difficile* infection, and community level antibiogram data on an annual basis for susceptibility data for Enterobacteriaceae species (*E. coli* and *Klebsiella*) causing genito-urinary infections. In addition, it was recommended that collecting community-based susceptibility data on *N. gonorrhoeae* was a high priority given its rise in resistance and the fact that the current surveillance system only partially collects this data. However, the feasibility to collect this data more fully was deemed low given logistical and clinical limitations.

Overall, the Task Group also recommended that a review of the national AMR surveillance data requirement priorities occurs on an ongoing basis and as new issues emerge. Further recommendations regarding medium and low priority data requirements can be found in the full report.

Discussion

The CIDSC AMR Surveillance Task Group conducted a thorough assessment and prioritization process to identify national priority AMR surveillance data requirements and data gaps in first priority AMR organisms. It found that, for just over half of the high priority data metrics (10/19) identified, the existing surveillance systems met the required needs.

When comparing surveillance data for first priority AMR organisms in different settings, community level AMR data was identified as a major gap for national surveillance. Currently this lack of surveillance data results in knowledge gaps in understanding the burden of AMR infection in the community setting. Bloodstream infections were identified as the top priority

site of infection for AMR surveillance for several organisms in the health care setting. In light of the fact that AMR and AMU is ever-changing, the Task Group recommended that a review of the national AMR surveillance data requirement priorities should occur on an ongoing basis and as new issues emerge.

The Task Group report has been submitted to the Pan-Canadian Public Health Network Council and is currently under examination. Through the mandate of the Pan-Canadian Public Health Network Council, next steps will include establishing federal, provincial and territorial roles and responsibilities to address these gaps.

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Conflict of interest

None. Dr. Kanchana Amaratunga is one of the Guest Editors for this issue and recused herself from taking editorial decisions on this manuscript. Editorial decisions were made by the Editor-in-Chief, Dr. Patricia Huston and the other Guest Editor, Jacqueline Arthur.

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