

# One Health surveillance and antimicrobial resistance: How does integration of animal and human components impact the effectiveness and economic efficiency of surveillance systems?

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## Abstract

Antimicrobial resistance (AMR) is recognised as a major global threat to human and animal health. Highly performant integrated surveillance systems are needed, but little is known about modifying the level of integration of surveillance systems will impact their effectiveness and economic efficiency. We propose to evaluate different innovations in integrated surveillance systems for AMR using a new evaluation framework that will enable to compare their performances and economic value according to their level of integration.

**Keywords:** *One Health surveillance, integration, antimicrobial resistance, surveillance systems evaluation*

## Introduction

Antimicrobial resistance (AMR) is recognised as a major global threat to human and animal health and can have important economic impacts (1, 2). Antibiotics are needed to treat infectious diseases in humans and animals, but are also used in animal production to treat and prevent infections and as growth promoters. These types of use have benefits for the industry, but can also contribute to produce and disseminate resistant microorganisms that can infect humans (3).

To rapidly detect the emergence of new resistant microorganisms and to implement interventions to stop or slow their dissemination, it is crucial to develop and maintain highly effective and efficient surveillance systems. A critical component of such systems is the integration of resistance surveillance in microorganisms circulating in humans and animals (4). Such integrated surveillance systems (ISS), consistent with a “One Health” approach to surveillance, are broadly encouraged nationally, regionally and internationally (2). A few systems have been developed worldwide with this goal, such as the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) that has been in function in Canada since 2002.

At a global scale, recent efforts have been made to develop the minimal requirements of AMR integrated surveillance at the human-animal interface (2). However, few studies have formally evaluated the effectiveness and economic efficiency of these systems and documented the added value of different integration methods.

Generic frameworks for surveillance system evaluation exist, but are not designed to capture the added value of integration (5,6). Also, evaluating ISS presents specific challenges. There is a lack of standardisation on criteria and methods to use for such systems and on how to measure the level of integration between human and animal surveillance activities<sup>4</sup>. This lack of standardisation also makes it difficult to compare ISS across different countries or regions, and to identify the most performant integration strategies.

We propose to evaluate and compare the effectiveness and economic efficiency of ISSs for AMR using a new evaluation framework. The ultimate goal is to document the added value of integration between the human and animal sectors, using ISS for AMR as business cases. More specifically, the project has three phases. PHASE 1 will lead to the development of a specific framework for AMR–ISS evaluation on effectiveness and economic efficiency. During PHASE 2, Canada’s AMR–ISS (CIPARS) will be evaluated using this framework, and in PHASE 3, other innovative AMR–ISS will be evaluated and compared with the Canadian system.

## Materials and methods

This project is currently in its first phase and we present an overview of the project approach. The development of a framework for evaluating the effectiveness and economic efficiency of AMR–ISS (PHASE 1) is being done using qualitative methods and a participatory approach with five categories of stakeholders: CIPARS team members, CIPARS end users in human health, CIPARS end users in animal health, international experts on AMR surveillance and international experts on One Health evaluation. The main method for data collection during PHASE 1 is group interviews. Two types of group interviews, consensus panels and focus group discussions (FG) are being used to complete the specific objectives of PHASE 1:

1. to develop a common definition of ISS at the human-animal interface;
2. to develop a list of essential objectives and outcomes that an ISS for AMR should target;
3. to develop a methodology to measure the level of integration of AMR-ISS;

4. to identify emerging themes representing issues related to ISS evaluation for AMR;
5. to develop, adapt and validate a logic model for a generic AMR-ISS;
6. to develop, adapt and validate an evaluation framework for AMR-ISS evaluation.

A thematic analysis is being conducted on the FG transcripts. Emerging themes will be used to answer to PHASE 1's objectives 1 to 4. Results from this analysis will be used to develop a definition of ISS and a list of objectives and outcomes. Building on these items (definition, objectives and outcomes), on previous surveillance systems evaluation frameworks, and on NEOH One Health evaluation framework (7), a preliminary logic model and a preliminary evaluation framework for AMR-ISS evaluation is being developed. The preliminary logic model and evaluation framework for AMR-ISS evaluation will be presented to the participants with the objective to adapt and validate them through a consensus panel approach.

In PHASE 2, the CIPARS will be evaluated using the evaluation framework developed in PHASE 1. The methods that will be used to evaluate the systems will depend on the criteria and measurement scales identified during PHASE 1, and will include both quantitative and qualitative methods.

In PHASE 3, a census of innovative AMR integrated surveillance systems will be conducted using the scientific and gray literature, and a preliminary list of systems will be selected and validated by the stakeholders, with the objective of identifying at least three other ISSs to evaluate using the framework. Ultimately, evaluations of surveillance systems conducted under objectives 2 and 3 will be analysed comparatively to appreciate the association between different levels of integration and the performance's evaluations of these systems using a multi-criteria analysis approach. This part will help to identify innovative strategies that can improve the effectiveness and efficiency of integrated surveillance and to evaluate the Canadian system in light of innovative systems worldwide.

## Results

The project received ethical approval in October 2016, and the first phase is currently being completed. Seven out of 10 CIPARS team members and 10/17 invited CIPARS end-users accepted to participate to group discussions (four are associated to human health and six to animal health).

Preliminary analysis of focus groups showed important emerging dimensions that are essential to consider for the development of an evaluation framework for AMR-ISS. First, it was clear for participants that the term 'integration' in integrated surveillance systems for AMR goes beyond the integration of animal and human surveillance components, and refers to the integration of surveillance components all along the food chain (on farms, abattoir, retail, humans).

Second, there was a strong consensus in the perception that the integrated surveillance design of CIPARS was one of the main drivers of its effectiveness, because it is crucial to detect trends in AMR from multiple animal species, at different collection points along the food chain and in humans.

In addition to the data, the presence of multiple animal health experts within CIPARS team was also perceived as an important contributor to the effectiveness of ISS. This added-value can be seen at different levels: (i) it allows the analysis and interpretation of the surveillance results in context; (ii) it facilitates the dissemination of surveillance information to a broad and multidisciplinary network of end-users and (iii) it strengthens the credibility of results in front of key stakeholders from the animal sector.

Issues regarding the evaluation of the added value of AMR-ISS have also emerged from the discussion. A major aspect regards the difficulty to attribute the ultimate impacts of integration on policy and behaviors changes. For example, both CIPARS team members and end-users expressed the strong belief that CIPARS activities had a direct influence on behavior changes regarding the use of antimicrobial in food production, but they perceived that although these are important outcomes, they can hardly be quantified.

Measuring the economic efficiency of AMR-ISS was also perceived as a challenge. Two evaluation approaches were discussed. A first approach would be to compare the actual costs of different national AMR-ISS. For example, the annual costs of operating the systems could be calculated and compared to the scope and capacity of detection of the systems. This approach would allow a qualitative comparison of the costs of systems with different levels and methods of integration. A challenge associated with this approach is that only a few ISS exist actually, and that these systems have been developed in different contexts that will make cost comparisons difficult.

Another approach would be to evaluate the cost of systems over a longer time period and to contrast these costs to a number of events that would have been detected by each system. In case the events have led to an intervention, the cost of the intervention could be added and compared to an estimation of the cost of 'no-intervention'. This cost-benefit approach would have the advantage to assess the economic efficiency of ISS in a long-term perspective and to formally compare the system's efficiency. However, the difficulty to define 'an event' in the complexity of AMR epidemiology was considered a major barrier.

## Discussion

This project will have an immediate impact on animal and public health internationally. First, it will produce a specific tool to evaluate the performance of AMR-ISS, a concrete outcome that will be useful for decision-makers around the world. Second, evaluations of the surveillance systems will offer an opportunity for changes that may increase the effectiveness and efficiency of AMR-ISS by allowing the identification of innovative and highly performant strategies.

Finally, from a more global perspective, by comparing different surveillance systems according to their level of integration, the project will be one of the first to document the added value of integrated One Health surveillance. This project is linked to the COST Action TD1404 – Network for the Evaluation of One Health (NEOH), which aim is to enable evaluations of One Health activities<sup>7</sup>. It is not a case study of this initiative per se, given that this project has started two years later. However, two members of the research team (including Aenishaenslin, principal researcher) are NEOH members and some components of the general evaluation framework developed by NEOH will be adapted and included in the specific framework in development for One health surveillance.

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