

1. Editorial

One Health, collaboration and systems thinking help shift AMR surveillance to action

One Health surveillance for antimicrobial resistance (AMR) has been promoted by national and international organisations for more than a decade and is a central recommendation of the World Health Organization's *Global action plan on antimicrobial resistance*. Surveillance systems that integrate information about resistant microorganisms circulating in humans, animals and ecosystems with information on drivers of resistance (e.g. antimicrobial use) are needed to enhance our understanding of the complex epidemiology of AMR and, more importantly, to inform targeted actions. In recent years, we have been reflecting on the structure, operation and impacts of integrated surveillance systems for AMR based on our experience in Canada with the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS), and in the context of our research with the CoEval AMR consortium to develop guidance for the evaluation of integrated surveillance systems[1][2]. Our reflections coalesced into two major themes that, we believe, are relevant for people working with or using the information produced by DANMAP.

First, the added value of a One Health approach in surveillance goes beyond the integration and joint analysis of data from different sectors. One Health should be reflected in the way individuals, teams and organisations collaborate and work together across and beyond disciplines. Strong networks that include government, industry, and non-governmental organisation perspectives are essential to mobilise knowledge produced and to generate evidence of impact for actions informed by this knowledge. Indeed, the implementation and maintenance of integrated surveillance programs such as DANMAP in Denmark, and CIPARS in Canada, has created and solidified networks of people and organisations from different disciplines and sectors that are key to using and enhancing integrated surveillance data to change practices and policies. For example, in Canada, integrating and analysing AMR data from chicken meat and humans created evidence that antimicrobial use in poultry meat production may lead to resistant bacteria in chicken meat, which can potentially be transferred to humans. Working with the Canadian poultry industry, in 2013 CIPARS was able to develop and implement on-farm AMR surveillance in the poultry sector that was critical for assessing the effectiveness of industry led changes in antimicrobial use policies and practices and their positive impact on AMR. Unfortunately, this important aspect of One Health surveillance is less often recognised or valued but should be repeatedly highlighted: without investment of time, resources and ongoing commitment from partners to build and maintain these networks, the effectiveness of integrated surveillance cannot be optimised or sustained.

Second, strong collaboration and engagement across sectors create space for inclusion of new and different perspectives in the analysis and interpretation of surveillance data. This helps provide a clearer view of the complex system from which AMR emerges and spreads, which again can lead to enhanced knowledge generation and suggestions for action that would be impossible when working in silos. For example, many systems, including CIPARS and DANMAP have long integrated the collection and analysis of data on antimicrobial use in different sectors, and some programs include further information on reasons for use and management practices. While the data may be collected, routinely integrating this information and the perspectives of those, who provided it, in the interpretation of results happens less often and chances for actions based on these crucial insights are missed. But incorporation of different perspectives and the enhanced knowledge created could position integrated AMR surveillance systems to support rethinking how our food production and health systems could be less dependent on antimicrobials, more sustainable and better able to cope with increasing threats from social and environmental crises.

We recognize that implementing transdisciplinary collaboration and systems thinking to address complex problems such as AMR requires special skills. We believe that teams and organisations working within programs such as DANMAP are pioneers of these approaches and are important models for other teams, organisations, or countries wishing to strengthen the integration of a One Health approach in their AMR surveillance strategy.

One Health surveillance is essential to face the increasing challenge of AMR and has the potential to generate outcomes that go beyond the knowledge produced from integration of data from different sources and sectors. People, teams and networks involved in AMR surveillance systems are as important as the data, as they translate data into action, and enable us to better understand the systemic changes that are required to achieve better health for all, without sacrificing one sector for the short or long-term benefit of another.

Cécile Aenishaenslin (Associate Professor, University of Montreal; CoEvalAMR network lead) and Jane Parmley (Associate Professor, University of Guelph)

- [1] Rüegg SR, Antoine-Moussiaux N, Aenishaenslin C, Alban L, Bordier M, Bennani H, et al. Guidance for evaluating integrated surveillance of antimicrobial use and resistance. CABI One Health. 2022;2022:ohcs20220007.
- [2] CoEval-AMR. Convergence in evaluation frameworks for integrated surveillance of antimicrobial resistance and antimicrobial use: the CoEval-AMR Network. <https://coevalamr.fp7-risksur.eu/network>. Accessed 25 Jun 2020.

Acknowledgements

DANMAP is based on a strong collaboration between several institutions and on the contributions from highly skilled staff from many specialties and professions. Without their knowledge and engagement, there would be no DANMAP surveillance.

The DTU National Food Institute would like to thank the following:

- The meat inspection staff and company personnel at the participating slaughterhouses for collecting samples from animals at slaughter
- The staff of local Veterinary and Food inspections units for collecting food and animal samples
- The staff of the Danish Veterinary and Food Administration's Laboratory, Ringsted for analysing animal and food samples and discussing the interpretation of the results
- The Danish Veterinary and Food Administration, for collecting and transmitting data on antimicrobial resistance in food and animal samples. Furthermore, we would like to thank the staff of the Food and Feed Safety Division for discussing the interpretation of the data
- The Danish Veterinary and Food Administration, for collecting and transmitting data on veterinary consumption of antimicrobial agents from VetStat, financing data collection and providing data for interpretation. Furthermore, we would like to thank the staff of the Animal Welfare and Veterinary Medicine Division for introducing the New Vetstat database and discussing interpretation of the data
- The Danish Agriculture and Food Council for collaboration regarding the estimation of live biomass of production animals
- Statistics Denmark for providing data necessary for the estimation of live biomass of poultry
- The Danish Aquaculture Producer Organisation for providing data necessary for the estimation of live biomass of fish
- Colleagues at the National Food Institute, DTU, for valuable discussions on many topics related to the report

Statens Serum Institut would like to thank the following:

- The Departments of Clinical Microbiology and the DANRES group - Danish Study Group for Antimicrobial Resistance Surveillance - for providing data on resistance in bacteria from human clinical samples and discussing many of the topics included in the report
- The staff of the Neisseria and Streptococcus Typing Unit at SSI for providing data on samples and resistance in beta-haemolytic streptococci, *H. influenzae* and *Neisseria gonorrhoeae*
- The staff of the Foodborne Pathogens Unit at SSI for providing data on resistance in *Campylobacter* and *Salmonella* from human clinical isolates
- The staff of the Staphylococcus Laboratory at SSI for providing data on invasive staphylococcal infections as well as all MRSA
- The staff of the Antimicrobial Resistance Reference Laboratory and Surveillance Unit at SSI for providing data on resistance in the referred *E. coli*, *K. pneumoniae*, *A. baumannii*, *P. aeruginosa* and vancomycin and linezolid-resistant enterococci
- The staff at the Unit of Mycology at SSI for providing resistance data for human *Candida* and *Aspergillus*
- Colleagues at the Infectious Disease Epidemiology & Prevention Unit at SSI
- Colleagues at the Data Integration and Analysis Secretariat at SSI
- The Danish Health Data Authority and the Register of Medicinal Products Statistics for providing data on antimicrobial consumption on healthcare activity
- All Danish hospital pharmacies for providing data on antimicrobials consumed at hospitals through special deliverances