Antimicrobial Resistance Surveillance Technology: Keys to Success

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The World Health Organisation's *Global Action Plan on Antimicrobial Resistance* calls upon countries to strengthen antimicrobial resistance (AMR) surveillance.

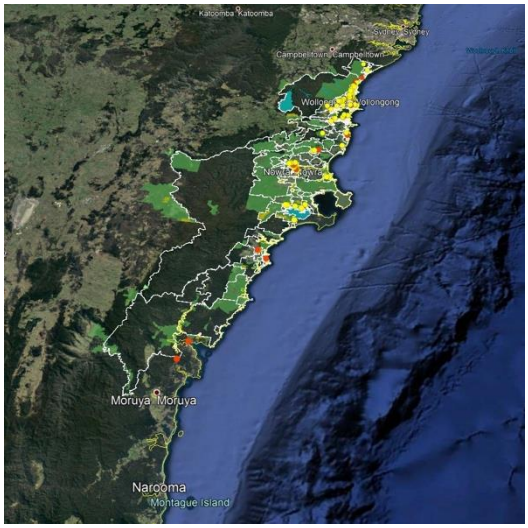
Australian governments have responded with a plan to implement a nationally coordinated surveillance program that takes a One Health approach – recognising that human, animal, and environmental health systems are closely interconnected, so monitoring AMR and the use of antibiotics must take place across all systems.

This surveillance program will expand existing capabilities that focus on human health data by introducing animal and environmental data as well as geographic and Artificial Intelligence technologies.

This technologically enhanced One Health approach to monitoring AMR and antibiotic use provides significant promise for AMR management. However, there is uncertainty about the best way to manage the risks associated with this approach.

Our engagement with global experts in health ethics, law, policy, the social sciences, and health and social care services showed that:

- Any high-technology surveillance system needs to build and maintain social licence to operate, with the general public and specialist stakeholders all empowered to provide input into the best approach.
- Privacy is a central focus for ensuring ongoing understanding and support of such a system.
- The quality of the system needs to be tangible and transparent – from end-user capabilities to data security and rigour of analysis.



Above: Google Earth image of the Illawarra region with overlay of SA2 geography and major hospitals

If it is to be successful, a high-tech, One Health AMR surveillance system must gain and maintain social license to operate

Policy Implications

- Active and sustained engagement with the public and with professional stakeholder groups is essential for the success of any AMR surveillance activity.
- Gaining and maintaining social licence to operate relies on earning the trust of experts and communities. It also relies on the quality and efficacy of the surveillance system, including quality of outputs and end-user capabilities to receive, interpret and apply its findings.
- Strong governance of privacy, data quality and safety is an essential foundation for enduring success.

Background

Antimicrobial resistance (AMR) occurs when bacteria and other microbes become resistant to the antibiotics, antifungals and other medicines that had earlier been effective treatments. This resistance allows these bacteria and other microbes to spread and cause life-threatening infections that are difficult to treat.

If left unchecked, AMR is forecast to cause 10 million deaths annually by 2050 and add US$100 trillion burden to health systems worldwide.

The first step in tackling this problem is to understand what causes AMR. To date, the focus of research and biomedical investment has primarily been on the development and spread of AMR in hospitals and human health systems. However, with mounting evidence that resistance developed in animal or environmental systems can lead to resistance in human systems, it is now time to expand this focus to antimicrobial use across human, animal, and environmental systems to give a true picture of the threat of AMR.

This kind of One Health monitoring presents significant challenges. It requires bringing together the necessary data streams across diverse areas of human, animal, and environmental systems. It requires new ways of processing and analysing these data. Finally, it requires new ways of working across these systems to effectively track, trace and tackle antibiotic resistance.

The result will be a system that helps to predict and prevent AMR outbreaks before they occur; identify with high precision the origin of outbreaks that do occur; and simulate (and cost) the outcomes of potential AMR interventions and other decisions that might impact AMR evolution, propagation, and population exposure.

The Challenge

In addition to the many practical and technical challenges involved in developing a next-generation, technologically enhanced One Health monitoring system, there will also be a series of important ethical, legal, and social implications to address as this new capability pushes the boundaries of current practice.

As Australian public health bioethicists and researchers Chris Degeling, Jane Johnson and Gwendolyn Gilbert have argued regarding technologically enhanced approaches to surveillance generally: ‘the benefits of earlier outbreak detection are significant, but implementation could be opposed in the absence of social licence or if ethical and legal concerns are not addressed.’

We wanted to understand the key ethical, legal, and social implications for a system like this. To that end, we convened a global panel of 41 Australian and international experts in ethics, law, health, and social policy using a modified Delphi method to form a view regarding this important question.

The Evidence

Through successive rounds, experts were asked to identify and then rank key themes and issues within a One Health AMR monitoring system, or the information generated by such a system, including a rating of the difficulty of solving each issue.

Final Ranking of Issues in Descending Order of Importance:

1. **Consent/social licence**: issues surrounding public consultation and empowerment of the community to influence their own health care.
2. **Privacy**: issues surrounding the collection, storage and sharing of health data, including the threshold of anonymity for individuals and communities.
3. **End-user capability**: issues surrounding the importance of training people to properly interpret data generated by a technologically enhanced AMR monitoring system, including guidelines for response to and use of information at a systems level as well as community education.
4. **Data security**: issues surrounding the importance of informed consent, even for aggregate data.
5. **Causal inference**: issues surrounding the potential for inaccurate attributions of AMR causation arising from use of this technology – such as reputational damage – and therein the importance of understanding it as a tool for generating hypotheses rather than conclusions.

While all fields of experts identified most of these issues, there were variations in how often key themes were raised by experts in different fields: ethical experts were more likely to identify the issue of privacy; legal and regulatory experts were more likely to note issues with causal inference and privacy; social services and social science experts were more likely to identify issues surrounding end-user capability and matters of consent/social licence; and policy, government and implementation experts were more likely to note issues of causality and consent/social licence.

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Appendix: Method

We used a modified Delphi method to elicit expert opinion regarding the key ethical, legal, and social implications and risks of a One Health technologically advanced AMR monitoring and surveillance system. Whilst Delphi methods often force consensus to emerge, in this modified approach we did not force consensus.

Forty-one experts were identified across AMR-relevant ethical, legal, social, and public health policy fields (between nine and 11 experts per field), both resident in Australia and overseas. Experts were presented with information about AMR and the role of surveillance in detecting, monitoring and responding to AMR. They were then presented with a vignette demonstrating the role of a One Health AMR surveillance system in detecting, monitoring, and responding to an AMR outbreak in Australia.

Response rates varied across rounds, with Round One yielding a response rate of almost 40 per cent, and Round Two a response rate of just over 25 per cent (that is, five fewer responses than were received for Round One). At the commencement of each round, all experts were asked to self-identify their area of expertise: ‘ethical’, ‘legal and regulatory’, ‘social’, or ‘policy, government, and implementation’.

In Round One, experts were asked (using free-text responses) to list the top three issues they identified with an AMR surveillance system itself, or with the information generated by such a system. Participants were asked to elaborate on why they identified each of these issues, and to hypothesise about how difficult each of the issues they identified would be to resolve (using a defined scale of ‘extremely easy’ to ‘extremely difficult’.

Round Two of the Delphi was distributed to the same group of experts as Round One (except where participants had ‘opted out’ from receiving further communications). Round Two presented participants with the top five issues identified in Round One (see above). Experts were asked to rank these five issues in order of importance and to estimate how difficult they each of these issues would be to resolve (using a defined scale of ‘extremely easy’ to ‘extremely difficult’). Participants were also asked (using free-text responses) to suggest means of resolving the issue they considered to be most important.

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