Takeaways from workshop 4: Environment

Guests attending workshop:

- Brent Gilpin, ESR
- Louise Weaver, ESR
- Sara Burgess, Massey

In this work we are taking a very broad definition of the 'environment': The environment is a dynamic concept where things connect and where there's an ability to transmit microbes or genes. The environment changes constantly and is often a vector for transmission rather than a source itself. It's more about something happening (e.g. transmission occurring) than a specific place (e.g. soil in Auckland).

The environment is the least studied aspect in an integrated view of infectious diseases and AMR in Aotearoa New Zealand

Currently:

- Environmental aspects aren't a significant focus of the approach to infectious diseases and AMR.
- We don't know enough about environmental exposures to drugs, microbes and AMR genes; quantities of these in the environment; the impact of these interacting with other chemicals; and pathways of spread.
- There's little data sharing and many researchers don't know what other researchers are working on.
- There are small ad hoc studies underway throughout Aotearoa New Zealand to fill in knowledge gaps, e.g.:
    - Sara Burgess is working on a study of the Manawatu river to understand whether antibiotic resistance genes are going into the local river and persisting, and what the risk is for human exposure.
    - Louise Weaver is doing a small, one-site study on wastewater looking for antimicrobials, AMR genes, and AMR organisms. They're looking at what's coming in and also in oxidation ponds. Early results suggest there's a huge range of AMR genes (~120-150) at low levels.
    - Brent Gilpin is working on a small one-off project with MfE to track faecal contamination by isolating pathogens and performing whole genome sequencing (WGS) from 30 rivers.
- There is a knowledge base of potential problems in the country but it's not connected. E.g. a survey on NZ farms found relatively high prevalence STEC but this hasn't been actioned.

What would be ideal in the future?

- Environmental aspects included in an integrated approach to infectious diseases and AMR
- An integrated and long-term approach to research and environmental monitoring
- There's a clear understanding of the roles of different organisations in NZ (e.g. ESR)
- Researchers working together better within NZ
- NZ well connected to international efforts
- Research priorities for NZ determined and then leverage other knowledge from overseas work

Data sources are fragmented and there are significant data gaps

Currently:

- Ownership of data creates barriers to sharing, e.g.:
    - Council must give permission for wastewater data
    - ESR cannot combine MOH and MPI data without prior permission which is a barrier to combined analysis of human and animal isolates
    - Not all food safety sectors happy for e.g. listeria isolates to go onto food safety centre database
- Data isn't collated into one database
    - LAWA have some relevant data e.g. some *E. coli* data

    - FDA will test products imported from NZ e.g. STEC testing for export meat to US
- Some data that should be collected isn't
    - E.g. ESR don't capture ESBLs on a regular basis, don't regularly get isolates that would be appropriate for comparison with environmental and animal isolates. More of what ESR does is on leading edge of resistance – organisms coming into country.
- Data that's collected is mostly not shared unless the researcher voluntarily choses to
    - E.g. researchers will publish results and maybe some associated data but the data does go to a national database

What would be ideal in the future?

- An Integrated database
- Drawing on new ways to capture relevant data, e.g.:
    - Shellfish testing done by Cawthron
    - NZRM Culture Collection

Improving monitoring and surveillance is key

Currently:

- Regional councils monitor high use recreational areas (water)
- There is wastewater testing for COVID-19, which may provide a platform to broaden surveillance but viral surveillance is different to bacterial

What would be ideal in the future?

- First, a comprehensive and well-designed baseline study to inform future work
- Any subsequent environmental monitoring to be designed around action-initiating surveillance, and be regular and ongoing to track change over time
- Broad surveillance unlikely to be practical or financially feasible, but priority settings could be targeted e.g. airports, specific rivers
- Identify sentinels – these could be physical sites, bugs, resistance genes
- Study, define and think creatively about potential indicators
    - Use evidence to inform indicators e.g. *E. coli* not a good measure of viruses, no correlation between levels of *E. coli* and AMR.
    - Study new applications in NZ e.g. shellfish, flies, rats
- Design to specific application e.g. wastewater good for studying population level changes, less likely to be useful at the individual person, organism, or gene level

Insights need to drive action

Currently:

- The system is reactive and it costs a lot
- If there's an outbreak, MPI has mandate to go into suspected source and test. Many outbreaks are covert.
- Cost analyses tell us that prevention would save $$ e.g. in US $70 return for every $1 spent, in NZ *Campylobacter* reduction est. to save NZ $50mill per year
- The process isn't clear and as a result prevention and interventions can be missed e.g. the Havelock North outbreak of Campy missed intervention points
- Studying outbreaks informs new practices e.g. understanding the source of a 2012 Listeria outbreak enabled people to communicate heightened risk of eating certain foods to specific populations (e.g. immunocompromised people in hospital)

What would be ideal in the future?

- Proactive and preventative system
- Information shared widely
- Using ongoing surveillance and monitoring data and science to make predictions and inform actions e.g. bug X increases in area Y in month X due to specific weather patterns and alert to higher risk
- New activities are established with a specific outcome in mind, e.g.: establish genomic epidemiology in outbreak management, combining WGS and rapid screening survey when patients provide faecal sample
- Recognition of cost saving drives preventative approaches

Suggestions for further input

- The importance of considering the role of climate change in our project was highlighted and Alex Macmillan and Rhys Jones were suggested as experts to speak to.