



Office of the Prime Minister's Chief Science Advisor
Kaitohutohu Mātanga Pūtaiao Matua ki te Pirimia

Project scope

Kotahitanga: Uniting Aotearoa against infectious diseases and antimicrobial resistance

As agreed by the panel at our first meeting on 19 April 2021

Summary of workstreams

- 1. Context:** This workstream will analyse the global and local context and explain the approach taken for the report.
- 2. Prevention and risk mitigation of infectious diseases.** Prevention is better than cure. This workstream will focus on general solutions to reducing the incidence of infections in Aotearoa, and policy levers to pull, including discussion of challenges and barriers to each approach.
- 3. Infectious diseases in Aotearoa New Zealand:** This workstream will take an Aotearoa New Zealand-specific focus, summarising the evidence for infectious diseases (human, animal, plant) and highlight the diseases of particular concern and knowledge gaps for Aotearoa New Zealand. We will then have three 'spotlight' workstreams to highlight general issues and solutions for specific infections of concern.
 - 4. Spotlight on drug-resistant infections in Aotearoa New Zealand:** This workstream will focus on the threat of drug-resistant infections (antimicrobial resistance, AMR) as the big slow-burning pandemic for infectious diseases, summarising Aotearoa New Zealand-specific evidence (human, animal, plant and presence in the environment), knowledge gaps, and local solutions. It will not be a comprehensive review of all drug-resistant infections but will discuss some infections in Aotearoa that illustrate the emerging threat of AMR, e.g. methicillin-resistant *Staphylococcus aureus* (MRSA), urinary tract infections and gonorrhoea.
 - 5. Spotlight on group A *Streptococcus* and rheumatic fever in Aotearoa New Zealand:** This workstream will focus on a specific infection and its major complication that highlights the issues with health inequities, issues with access to antimicrobials, and limited accessibility of antibiotics. It will examine holistic solutions to infection prevention and control.
 - 6. Spotlight on *Campylobacter* infections in Aotearoa New Zealand:** This workstream will focus on a food- and water-borne infection that has high and growing incidence rates in Aotearoa New Zealand and emerging risk of drug-resistant strains, and will examine specific solutions to reduce these rates.

1. Context

- **Motivation for this report**
 - Increasing rates of antimicrobial resistance (AMR) and infectious diseases in humans, animals and plants
 - Potentially dire intergenerational impacts of running out of effective treatments for infectious diseases
 - Current resistance to changing the status quo which could lead to poor outcomes
 - Risk to public health and economy
 - Need for Aotearoa New Zealand-specific analysis due to our unique disease profile at the human-animal-environmental interface
 - The current social licence to act due to COVID-19

- **History, current and future context of infectious disease and treatment**
 - Brief history of infectious diseases and development of antibiotics and other antimicrobials
 - Unique Aotearoa New Zealand context
 - Relatively high incidence rates of infectious disease and high vulnerability in specific subsets of the population
 - Proximity of people to agriculture, animals and the environment leading to increased risk of zoonotic diseases
 - Economic reliance on agriculture, with intensification in certain sectors e.g. poultry, pigs
 - Relatively recent introduction of humans and animals
 - Free from some diseases common elsewhere
 - Opportunities to eradicate some infections
 - Less diversity of pathogens
 - High levels of international travel by New Zealanders
 - Connection with the Pacific
 - Need to work with our regional neighbours in tackling infectious diseases for many reasons – political, scientific and for social accountability
 - Regional connection has led to spread of infectious diseases to our Pacific neighbours and vice versa
 - Other practices that need to be considered – e.g. sharing antimicrobials (and are they expired ones?) and the role of Aotearoa New Zealand researchers and healthcare workers in Pacific countries
 - Inequitable burden of disease
 - Impact Māori and Pacific more than other ethnicities
 - Burden of negative health outcomes for untreated infection
 - Wider impacts of burden of illness (e.g. time stress, financial stress, missing school)
 - Emergence of AMR
 - What is it?
 - Not just bacteria and viruses, also includes parasites, fungi
 - WHO has ranked this high on their priority list and identified urgent/serious/concerning threats (global level)
 - Where is it found and how common?
 - Global rates
 - Where infections are occurring (e.g. hospitals, communities, farms, wildlife, environment)
 - How it might enter and spread in Aotearoa New Zealand
 - What causes it?
 - The system is the driver – consider how the socioeconomic and legal model of drug use and development drive perverse outcomes
 - Consequences magnified for certain demographics as a result of historical inequities and systematic racism
 - Factors that perpetuate AMR
 - Inappropriate use of antimicrobials
 - Transmission of resistant organisms in community and healthcare settings
 - Leakage of drugs into the environment which drive AMR
 - Resistant strains developing overseas which are imported to Aotearoa New Zealand
 - Environmental and genetic factors that increase viability of multidrug-resistant bacteria
 - Failure of market – thinking new drugs would keep being developed but they haven't
 - COVID-19 impacts on infectious disease and drug-resistant infections
 - Changes in rates of infectious diseases and antimicrobial use
 - Look at Aotearoa New Zealand and overseas data

- Changes in use of antimicrobials due to telephone consultations (some missed out on care that was needed, others avoided unnecessary drugs)
 - Changes in use of antimicrobials to prevent secondary microbial infections
 - Inappropriate use of antimicrobials to treat COVID-19
 - Changes in rates of infections (e.g. decreased flu and *Campylobacter* but increased skin infections)
 - Disinfectant-resistant bacteria resulting from pandemic
 - Reuse of PPE and potential spread of bacteria
 - Changes to standard procedures
 - Diverting research effort from bacterial to viral diseases
 - Normalisation of antimicrobials in lots of household products
 - Silver lining: social and cultural licence to take infectious disease more seriously; behaviour change; use of non-antimicrobial treatments; the public have a better understanding of IPC – we have an opportunity to embed this knowledge for future generations
 - Climate change impacts on infectious diseases and drug-resistant infections
 - Increased temperature
 - Disasters and associated flooding and crowding
 - Decreasing wilderness and biodiversity
 - Expanding vector habitats
 - Future context
 - Ageing population
 - Ethnic demography will shift
 - Changing physical and social environments
 - Regional connectedness
 - What does this mean for Aotearoa New Zealand? How do we future proof?
- **Policies and work underway**
 - Aotearoa New Zealand
 - Where do the responsibilities and leadership lie for these issues in Aotearoa New Zealand? What different roles do different organisations have?
 - What can we learn from experience with COVID-19? Important roles of iwi and researchers; need agility but within a unified governance and integrated response; need to build capability in generic areas; need for a more joined up network of expertise.
 - Policies/regulations
 - Antimicrobial Resistance Action Planning Group (MOH, MPI)
 - Notification of specified diseases
 - Therapeutic Products and Medicines Bill (at second reading)
 - Commitments made via international agreements
 - HQSC workstreams
 - ACC workstream
 - PHARMAC workstreams
 - NZ Veterinary Association guidelines
 - Collaborative efforts
 - One Health Aotearoa
 - Large research projects
 - SYMBIOTIC: Syndemic Management of the Biology and Treatment of Infections and Chronic conditions
 - Work we are building on
 - Royal Society Te Apārangi 2017 report
 - ACC scoping of developing national antibiotic guidance
 - International
 - Global efforts
 - WHO Global Action Plan
 - Pew Trust Antibiotic Resistance Project
 - Partnership to Fight Infectious Disease

- Global Drug Facility
 - AMR Action Fund (\$1 billion)
 - Ineos Oxford Institute for AMR Research
 - AMR Industry Alliance
 - CARB-X
 - Global Antibiotic Research and Development Partnership (GARDP)
 - New Drugs for Bad Bugs (ND4BB)
 - Joint Programming Initiative on AMR
 - Community for Open Antimicrobial Drug Discovery (CO-ADD)
 - Shared Platform for Antibiotic Research and Knowledge (SPARK) by Pew Trust
 - Global Research Collaboration for Infectious Disease Preparedness (GLOPID-R)
 - International Centre for Antimicrobial Resistance Solutions (ICARS)
 - ReAct
 - Vaccine Impact Modelling Consortium
 - WHO library of country-specific national plans/policies
- **Holistic approach needed**
 - Kotahitanga – a united approach
 - Drawing on some of the principles of ‘One Health’ (i.e. the need to take a transdisciplinary approach and think about human-animal-environment interface) but recognising that a “one” size fits all approach doesn’t work to reach equitable outcomes in our society
 - Drawing on Te ao Māori, especially the interconnection between humans and our environment, and kaitiakitanga to consider impacts of our actions on future generations
 - Scientific, economic and ethical dimensions
 - Collaborative international action

2. Prevention and risk mitigation of infectious diseases

- **Prevention is better than a cure**
 - Eliminating all AMR pathogens isn’t possible, but the goal is to diminish prevalence and negative consequences
 - Vaccines, IPC, and improving health outcomes and healthcare access are key to prevention
 - **Vaccines**
 - COVID-19 has shown how quick vaccines can be developed; new technology off-patent can accelerate development (e.g. mRNA); we are at a major turning point that may refocus efforts to develop vaccine against infections that have been hard to prevent.
 - What can we use vaccines for? What can’t we use vaccines for? Human and non-human use?
 - What are the priorities for vaccines for Aotearoa New Zealand? What is holding up development? Is it economic or development limitations?
 - Lack of economic incentives may limit vaccine use for zoonotic infections that only pose risk to humans not the animals harbouring the infection E.g. Leptospirosis
 - What are the barriers to a strep A vaccine?
 - What could we develop or manufacture in Aotearoa New Zealand vs what would we need to rely on from overseas?
 - Vaccine uptake
 - **Infection prevention and control (IPC)**
 - Hospital programmes
 - Clean water and sanitation
 - Food safety
 - How to prevent importing resistant strains?
 - How do we access hard-to-reach groups?

- **Eliminating inequities in access and outcomes**
 - Access to healthcare and medicine
 - Reducing environmental risk factors (e.g. improving housing)
- **Responsible treatment of infectious diseases**
 - **Optimising the use of antimicrobials**
 - Antimicrobial stewardship
 - Common definition – optimising use (selection, dosage, and duration) to minimise poor outcomes, both on an individual level (best clinical outcome, minimal toxicity) and societal level (minimal impact on subsequent resistance)
 - Broadening this for our project – to have intergenerational guardianship (kaitiakitanga), protecting an ecosystem that doesn't have resistance, protecting antibiotics from other kinds of chemical exposures that can undermine them.
 - What can we learn from countries that have lower rates of AMR e.g. Scandinavian countries?
 - How do we balance the need for leadership and everyone needing to be stewards?
 - We need to make sure the policy is connected to the expertise
 - Build the community and make sure they are empowered
 - Would a formal research consortium on infectious disease help?
 - Is guidance on use enough? Are there other ways to approach?
 - Human health – no national guidelines (some scoping work led by ACC)
 - Vet – has ~10 guidelines for ~10 different species (led by NZVA)
 - Need for national guidelines but responsiveness to context specific needs
 - Can we restrict use of some antimicrobials?
 - Targets – use over COVID-19 could help with setting these
 - **Education/communication/training**
 - Improving societal awareness; different groups to consider (e.g. sector-specific, public, officials/legislators)
 - What's the baseline level of awareness and understanding? i.e. AMR and AMS are commonly mixed up
 - How do we make sure this is designed for all New Zealanders?
 - Lessons from COVID-19 – the role of localised communications, grass roots organisations and trusted figures in local communities
 - **Development of new antimicrobials**
 - What are the incentives for making new drugs internationally? What policy settings might stimulate drug discovery? How does Aotearoa New Zealand fit into this?
 - How do we use the new antimicrobials?
 - Strategic introduction of antimicrobials – intergenerational impacts of what drugs we introduce now or save for future (are we using less toxic now and leaving more toxic for future generations? Already happening e.g. for cystitis)
 - Economic challenges + possible solutions e.g. CARB-X, DISARM and PASTEUR Acts, 'subscription-style' payment model for antibiotics in UK - what is Aotearoa New Zealand's role in this?
 - Repurposing antibiotics
 - Prodrugs
 - Antimicrobial peptides

- **Alternative approaches to avoid overuse/misuse of antimicrobials**
 - Rapid diagnostics and smarter utilisation of diagnostics
 - Genome sequencing of infectious disease
 - New therapies
 - Monoclonal antibodies
 - Bacteriophage therapies
 - Microbiome-affecting therapies

- **Enhanced surveillance**
 - Enhanced surveillance for antimicrobial usage --> predictions for emerging drug-resistant pathogens
 - More community-based approaches – not exclusively expert-driven surveillance mechanisms
 - What would best practice be? Integrated, systematic and nationally coordinated?
 - AI/data e.g. OUTBREAK
 - CDDEP resistance map
 - Serological libraries (e.g. proposed Global Immunological Observatory)
 - eDNA
 - UK open prescribing database

- **Research to strengthen knowledge base**
 - What are the priority research areas?
 - What knowledge gaps need to be filled?
 - What is Aotearoa New Zealand's contribution to a global research challenge?
 - What local research is critical?

- **Strengthening connections between human, environmental and animal health practitioners, researchers and policymakers, and indigenous partnership**
 - Guidance from te ao Māori
 - Embracing the transdisciplinary nature of the global one health approach and making it work in Aotearoa New Zealand
 - Strengthening the science-policy interface
 - Need a strong link to health professionals
 - Embrace the strengths of academia e.g. adaptable and responsive
 - Need to be better at coordinating different streams of advice and expertise, and data
 - Integrate response and have the right expertise at the table
 - Keep networks from COVID-19

3. Infectious diseases in Aotearoa New Zealand

- **Why we are concerned about infectious diseases in Aotearoa New Zealand**
 - High rates or poor outcomes make some infections a priority to tackle here (and for these we may be able to play an important role globally from a treatment or prevention perspective)
 - Infectious diseases place a significant and inequitable health burden on our more vulnerable communities
 - Some infections are not being adequately treated leading to serious health consequences
 - Over-treatment is contributing to a slow-burning pandemic of drug-resistant infections
 - Drug-resistant infections are increasing which means that our traditional ways of treating these diseases will become ineffective
 - Possible economic implications of infectious diseases in our agricultural or horticultural industries, or a new disease emerging from Aotearoa New Zealand

- **Current status in Aotearoa New Zealand**
 - Rates/trends
 - Stocktake of infectious diseases and microbes (e.g. *S. aureus*, *Mycobacterium tuberculosis*, *Mycoplasma bovis*, *Salmonella*, *Cryptosporidium*, *Pseudomonas syringae pv. actinidiae* (Psa))
 - Specific infections to highlight
 - Drug-resistant infections [see workstream 4]
 - Group A strep/rheumatic fever/rheumatic heart disease [see workstream 5]
 - *Campylobacter* infections [see workstream 6]
 - How do rates differ by ethnicity?
 - Monitoring/reporting – coverage and limitations
 - What system level changes are needed?
 - Human infection monitoring relies on labs referring samples to ESR, then published on EpiServ
 - What's notifiable and why?
 - AMR genes themselves currently do not make microbes notifiable – should they?
 - Animal infection monitoring less coordinated and done through the Animal Health Laboratory (MPI) and private labs exist
 - For poultry, data limited on whether those animals are susceptible to what they are being treated for
 - Diagnostics
 - Private vs public labs may have different drivers for diagnostic testing
 - How coordinated is the national diagnostic laboratory system?
 - What is the connection between human and animal diagnostic labs in Aotearoa New Zealand?
 - Don't see consistent smart use of diagnostics across Aotearoa New Zealand, e.g. legionnaires disease test
 - What are the limitations of current diagnostics? Can we improve how we use the tests we have?
 - What are the impacts of using cheaper tests (e.g. genotype tests) over culture-based diagnostics?
 - Who does the inequitable burden of infectious disease sit with?
 - Ethnicity, age, location
 - Some sectors – e.g. farming, aged care
- **Evidence of spread**
 - Person-to-person
 - Zoonoses
 - Consider companion vs production animals vs wildlife differently
 - Environmental
 - Contaminated water e.g. Havelock North
 - Food – e.g. mahinga kai (watercress)
 - Plants
 - Soil e.g. Legionnaires' disease caused by *Legionella longbeachae*.
- **Exacerbating factors**
 - Crowding, tight-fit housing, movement (informal sheltering)
 - Travel and migration
 - Pets
 - Agricultural intensification

- **Projections**
 - Are rates of particular diseases expected to increase or decrease?
- **Knowledge gaps**
 - Can we diagnose and treat unknown microbes?
 - What's the range of household hygiene practices in Aotearoa New Zealand? Why are skin infections more common in deprived households – what are the practices at different homes?
- **Implications for Aotearoa New Zealand**

4. Spotlight on drug-resistant infections in Aotearoa New Zealand

Reason for focus: AMR is the big slow-burning pandemic for infectious disease that may render our current treatments ineffective

- **Antimicrobial use in Aotearoa New Zealand**
 - Scale/distribution/trends
 - Understanding quantity *and* quality important
 - Humans
 - How does use/access differ by ethnicity in Aotearoa New Zealand?
 - Animals
 - Phasing out of some drugs in livestock industry?
 - Plants
 - Environment
- **Antimicrobial resistance in Aotearoa New Zealand**
 - Scale/distribution/trends
 - Humans
 - Specific drug-resistant infections to highlight (not exhaustive)
 - Gonorrhoea
 - MRSA
 - ESBLs (specific concerns with UTIs)
 - VREs
 - CPEs
 - TB
 - How do these rates differ by ethnicity?
 - Animals
 - Plants
 - Environment
- **Potency**
 - How is the toxicity of the antibiotics to the microbe changing?
- **Monitoring/surveillance**
 - What's the current system? Should it be extended? Does it reach everyone? Is data reported back to prescribers? Is it readily available in a timely manner?
 - Routine testing that happens for human health doesn't happen for animal
 - Benefits of capturing equivalent data in human and animal sectors
 - Want to monitor + model for predictive power e.g. whether we would expect outbreaks to move (as well as knowing what's currently happening)
- **Challenges**
 - Animal and human health sectors face same issues and could have shared solutions
 - Public/sector-specific awareness and understanding of issue (have surveys been done?)
 - Impacts on marketing agriculture and horticulture – rapidly growing consumer interest re antimicrobial residues and contamination with antibiotics

- **Projections**
- **Knowledge gaps**
 - To what extent is animal use driving resistance in humans?
 - How do AMR genes enter Aotearoa New Zealand and how are they transmitted?
- **Implications for Aotearoa New Zealand**

5. Spotlight on group A *Streptococcus* and rheumatic fever in Aotearoa New Zealand

Reason for focus: highlights the issues with health inequities, complexity of multifaceted causes and solutions, issues with access to antimicrobials, limited accessibility of antibiotics

- **Direct biological causes**
 - Infection with strep A to rheumatic heart disease
- **Indirect causes/risk factors**
 - Privilege and institutional racism
 - Socioeconomic deprivation
 - Crowded, tight fit or transient housing
 - Age
 - Sex
 - Genetic risk factors
- **Rates of strep A throat and skin infection, acute rheumatic fever and rheumatic heart disease**
 - Global
 - Aotearoa New Zealand – how do these differ by ethnicity?
- **Monitoring and surveillance**
 - National registry (proposed but not yet established)
 - Screening for sore throats
 - Acute rheumatic fever notifiable
 - Screening for rheumatic heart disease
- **Impacts**
 - Economic implications (much higher downstream costs to treat RF/RHD than a sore throat)
 - Future burden
- **Diagnosis and treatment**
 - Strep throat – relies on antibiotics (benzathine penicillin G) and accurate diagnosis
 - Barriers
 - Use of serology
 - Rheumatic fever diagnosis
 - Secondary prevention – prophylactic antibiotics
 - Barriers/incentives
 - Rheumatic heart disease
- **Emergence of AMR**
 - *S. pyogenes* may not be a huge AMR threat though there is evidence of strains here and overseas
- **Prevention and risk mitigation**
 - What interventions have we tried? Did we measure effectiveness? What were the limitations? Can we audit this?
 - MOH rheumatic fever prevention programme (2012-2017)
 - School-based interventions (urgency meant studying effectiveness ahead of implementation not done). Next step?
 - Future interventions – ensure monitoring when establishing new systems to monitor progress
 - Need for context-specific interventions
 - Reduce group A *Streptococcus* infection

- Look for studies on repeat infection with group A strep
 - Housing
 - Communication and education strategies
 - Early detection and treatment of strep A infection
 - Improved rapid diagnostics
 - Should screening include skin?
 - Aus data
 - Use of antibiotics
 - Health profession awareness
 - Access to medicines
 - Development of a vaccine
 - Culturally relevant and accessible care
- **Further research needed**
 - New funding for research: HRC and Cure Kids
 - Carriage rates for RF not well understood and need better diagnostics to improve this

6. Spotlight on *Campylobacter* infections in Aotearoa New Zealand

Reason for focus: a food- and water-borne illness, has high and growing incidence rates of infection, risk of emergence of drug-resistant strains

- **Sources of infection**
 - Food sources
 - Agricultural practices, e.g. dairy intensification
 - Management of waterways
- **Rates**
 - Increasing rates in Aotearoa New Zealand
 - Different strains and specific Aotearoa New Zealand strains
- **Drug-resistance**
 - Evidence of emergence of AMR
- **Monitoring and surveillance**
 - How is this achieved? Are there gaps?
- **Impacts/costs**
 - Any studies on the economic impacts?
- **Health impacts**
 - What are the impacts on animals?
 - What are the impacts on human health?
- **Prevention and risk mitigation**
 - Challenges with vaccines for zoonotic infections

Communications

For Twitter: #ResistResistanceNZ #StopTheSpread