# Antimicrobial stewardship in human healthcare in Aotearoa New Zealand: urgent call for national leadership and co-ordinated efforts to preserve antimicrobial effectiveness

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Antimicrobial resistance (AMR) is an immense threat to human health. Within 30 years, the global number of deaths from AMR-associated infections is predicted to increase from ~700,000 to ~10 million people annually, if we do not act now.[1] The Aotearoa New Zealand (NZ) response to the current COVID-19 pandemic has been lauded internationally—founded in science, responsive to expert advice, implemented with clear leadership and communication, and subject to ongoing critical evaluation and improvement. We must now apply this successful approach to the catastrophic, slower burning pandemic of AMR.

Antimicrobial-resistant microorganisms such as methicillin-resistant *Staphylococcus aureus* (MRSA) and ciprofloxacin-resistant *Neisseria gonorrhoeae* already challenge clinical care in NZ. However, it is the steadily increasing incidence of infections caused by antimicrobial-resistant Enterobacterales, such as *Escherichia coli* and *Klebsiella pneumoniae,* in hospitalised and community patients that is of greatest concern.[2–4] Extended spectrum β-lactamase-producing Enterobacterales (ESBL-E) are resistant to most penicillins and cephalosporins, and often also to other unrelated agents like trimethoprim and ciprofloxacin. Carbapen-

emase producing Enterobacterales (CPE) are resistant to almost all antimicrobial agents, including "ultra-broad-spectrum" carbapenems, and have a 30–50% mortality when they cause invasive infections.[5]

The health, social and economic consequences of increases in AMR for NZ are difficult to quantify but are potentially enormous. AMR-associated infections increase morbidity and mortality through use of "second-line" agents that are often less effective and more toxic.[2,5] An immediate concern is the exhaustion of funded oral treatments for "simple" infections, such as cystitis due to ESBL-E, in the community. This often necessitates use of intravenous agents in hospital settings at increased cost, resource utilisation and patient inconvenience. AMR will also compromise interventions such as joint replacement and cancer treatment that rely on effective antimicrobial therapy to prevent and treat life-threatening infections. AMR-associated infections and related care (eg, time off work or school to travel to hospital for treatment) will disproportionately impact the most socioeconomically disadvantaged among us, those living in rural or remote settings, and Māori and Pacific populations who shoulder a greater infection and AMR burden and have increased reliance on antimicrobial therapy.[6,7]

One of the biggest drivers for AMR is antimicrobial use, which is high in human health in NZ compared with many developed countries.[8,9] Most of our antimicrobial use (95%) is in the community[9] and up to 50% may be inappropriate.[2] The NZ community antibacterial consumption rate increased 49% between 2006 and 2014; in 2013, it exceeded that of 22 out of 29 European countries.[8] A subsequent modest 14% decrease occurred across 2015 to 2018, mainly due to reductions in under 5 year olds,[10] which is pleasing as antimicrobial use in childhood may create reservoirs of resistant pathogens impacting communities cross-generationally. The recent reduction in antibacterial use may reflect changing attitudes due to sustained clinician-led efforts to discourage inappropriate antimicrobial use (Table 1). In contrast to the community setting, public hospital inpatient antibacterial use in our larger cities was low in 2012–2013 compared with Australian and English hospitals, but still greater than countries like Sweden and France.[11] Although in keeping with overseas, it is somewhat ironic that most of our limited resource to support appropriate antimicrobial use focuses on public hospitals rather than on the community.

The NZ AMR Action Plan[12] sets out, in a One Health approach (acknowledging the complex and intimate relationships between human health, animal health, agriculture, and the environment), a five-pronged strategy to slow AMR development:

1. Awareness and understanding
2. Surveillance and research
3. Infection prevention and control
4. Antimicrobial stewardship
5. Governance, collaboration and investment

The two disciplines that share responsibility for slowing the development of AMR are antimicrobial stewardship (AMS) and infection prevention and control (IPC). The AMS component recognises that antimicrobial use produces selection pressure on the microbial environment and promotes proliferation of resistant strains with the potential to cause harm. The IPC component acknowledges the ability of microorganisms to spread between people and within the wider environment.

We are nearing the end of the five-year AMR Action Plan (2017–2022)[12] and progress has been poor.[13] AMS has not been prioritised in our health system. In 2013, the Health Quality and Safety Commission (HQSC) published a scoping report that offered insight into what was needed to progress AMS in NZ.[14] Key recommendations were to establish:

- National leadership and coordination of AMS activities
- National antimicrobial prescribing guidelines
- Quality improvement tools and measures

In the near decade that has followed this report, none of these recommendations have been achieved.

We have fallen far behind Australia, which has well-established national leadership, antimicrobial guidelines, auditing

**Table 1:** Summary of key AMS activities in NZ 2011–2021.[a,b]

| Year | Initiative | Key papers | Leadership organisations |
|---|---|---|---|
| 2011 | National community antimicrobial prescribing guidance published | | bpac[nz] |
| 2012 | Healthcare Associated Infections Governance Group (HAIGG) established | | MOH |
| | Surgical Site Infection Improvement Programme initiated | | HQSC |
| 2013 | Five DHBs (Auckland, Canterbury, Capital and Coast, Counties-Manukau, Waitemātā) employed AMS pharmacists | | DHB |
| | Antimicrobial restrictions introduced into DHB hospitals | | PHARMAC |
| | | Scoping report on AMS published[14] | HQSC |
| 2014 | | Call to reduce antimicrobial use in NZ[2] | University |
| 2015 | | Benchmarking comparison paper on the quantity of DHB inpatient antibiotic use (five DHBs)[11] | DHB |
| 2016 | | Benchmarking paper on the quantity of community antibiotic use[8] | ESR |
| | | Example of professional organisation position statement on AMR[c 22] | RACP |
| 2017 | NZ government committed to deliver on AMR through the NZ AMR Action Plan[12] | | MOH, MPI |
| | Health AMR Coordination (HARC) Group established[d] | | MOH |
| | NZ AMR Governance Group established[e] | | MOH, MPI |
| | | Benchmarking paper on AMS practice in DHB hospitals[19] | DHB, MOH |

**Table 1:** Summary of key AMS activities in NZ 2011–2021[a,b] (continued).

| Year | Initiative | Key papers | Leadership organisations |
|---|---|---|---|
| 2018 | | Benchmarking paper of AMS practices in rural hospitals[23] | DHB, university |
| | | Benchmarking paper on the impact of ethnicity on community antibiotic use[24] | DHB/bpac[nz] |
| | | Paper showing 95% of human antibacterial dispensing is in the community[9] | DHB, university, PHARMAC |
| | | First paper describing successful AMS initiative to promote oral rather than intravenous antimicrobial administration in DHB hospitals [f 25] | DHB |
| | NZ AMR Action Plan progress report (year 1) published | | MOH, MPI |
| 2019 | | Paper describing a pharmacist-led penicillin allergy de-labelling service in a DHB hospital[26] | DHB |
| | | Paper showing the impact of smartphone app on prescriber adherence to antibiotic guidelines[27] | DHB |
| 2020 | ACC scoping project for delivery of national antimicrobial guidance completed | | ACC |
| | National initiative for World Antimicrobial Awareness Week to improve indication documentation on antimicrobial prescriptions | | DHB, NZ AMS/Infection Pharmacist Expert Group |
| | Draft National Sepsis Action Plan released for consultation[g] | | ACC, NZ Sepsis Trust |
| | | First published point prevalence survey of antimicrobial use in DHB inpatients[f 28] | DHB |
| | | Paper exploring the feasibility of using an e-prescribing system to inform AMS ward rounds[29] | DHB, University |
| | | Paper exploring NZ nursing attitudes to antimicrobial prescribing[30] | University |

**Table 1:** Summary of key AMS activities in NZ 2011–2021[a,b] (continued).

| Year | Initiative | Key papers | Leadership organisations |
|---|---|---|---|
| 2021 | Office of Prime Minister's Chief Science Advisor major project on Antimicrobial Resistance and Infectious Disease initiated | | Office of the Prime Minister's Chief Science Advisor |
| | NZ AMS/Infection Pharmacist Expert Group officially formed | | DHB, PSNZ, NZHPA |
| | AMS incorporated into new Health and Disability Services Standards[16] | | MOH, Standards NZ |

a. Community HealthPathways was initiated in Canterbury in 2008 and is now nationwide. It offers a unique platform to convey AMS information to community prescribers across NZ. Hospital HealthPathways was initiated in Canterbury in 2015 and is soon to be implemented in other sites in NZ.

b. Hyperlinks accurate as of 12 August 2021.

c. Other national organisations, such as New Zealand College of Public Health Medicine and Royal Society Te Apārangi, also have position statements on AMR/AMS

d. "to provide a forum in which government agencies and representative health professional bodies, agencies and organisations with a stake in AMR can share information and expertise, and coordinate activities."

e. "to oversee and provide advice on implementation of the Action Plan, as well as alignment between the Ministry of Health and the Ministry for Primary Industries."

f. Other DHB AMS groups had already undertaken this type of work without the visibility of formal publication.

g. This follows NZ's obligations, as a member state of the World Health Assembly, to follow the recommendations within Resolution 70.7 relating to sepsis (includes AMS).

ACC – Accident Compensation Corporation; DHB – District health board; HQSC – Health Quality and Safety Commission; MPI – Ministry for Primary Industries; MOH – Ministry of Health; NZCPHM – NZ College of Public Health Medicine; NZHPA – NZ Hospital Pharmacists' Association; PSNZ – Pharmaceutical Society of NZ; RACP – Royal Australasian College of Physicians.

tools and standards. In comparison, NZ has undertaken some AMS activities (Table 1), but efforts remain fragmented, poorly coordinated and inadequate. In this viewpoint we, as clinicians with expertise and/or concerns about AMS, offer our recommendations (Table 2) on steps urgently needed to progress AMS in NZ. We have focused on human health but acknowledge that a broader One Health approach is needed to slow AMR. Our recommendations are not in any order, but we believe that early establishment of an overarching national expert group and independent centre for AMS (with adequate resourcing) is essential to lead and co-ordinate the other activities proposed. Our viewpoint was drafted (SG and ED) and reviewed (MT and SC) by a small group before seeking feedback from a wider collection of clinicians using targeted and snowball methods.

*1. Establish a National AMS Expert Group (NAMSEG) to provide leadership and governance and set strategy for AMS.* This should be established at the Ministry of Health (MOH) and accountable to the Director-General of Health in parallel with the new National IPC Expert Group formed in response to the COVID-19 pandemic. Separate but overlapping membership between the AMS and IPC expert groups would recognise that these distinct disciplines share responsibility for slowing AMR. NAMSEG must focus specifically on AMS rather than AMR, and involve the right mix of expertise. We seek a real commitment from the MOH to adequately support NAMSEG—related groups such as the Healthcare Associated Infections Governance Group (established in 2012) and Health AMR Coordination Group (established in 2017) have been disestablished and/or failed to function effectively through inadequate governmental leadership and support.

*2. Establish a National Centre for AMS (NCAMS) to coordinate a national quality programme for antimicrobial use.* The NCAMS should provide access to (and support use of) quality improvement tools (eg, auditing systems for between facility benchmarking), develop initiatives to improve antimicrobial use (including those involving consumers), monitor performance against quality markers, and establish clinical care standards with the oversight of NAMSEG. Establishment of a NCAMS is the most cost-effective way to coordinate and cohesively progress AMS operationally across the range of providers (eg, hospitals, aged care, general practice and independent prescribers) who will require varying support to implement effective AMS. The AMS scoping report[14] suggested the MOH

**Table 2:** Summary of key recommendations to progress human AMS in NZ.

1. Establish a National AMS Expert Group (NAMSEG) to provide leadership, governance and set strategy for AMS.
2. Establish a National Centre for AMS (NCAMS) to coordinate a national quality programme for antimicrobial use.
3. Develop national standards for AMS for all NZ healthcare settings.
4. Develop, publish and maintain national antimicrobial prescribing guidelines that span the human healthcare continuum.
5. Review and improve the funding model for antimicrobial agents in NZ.
6. Increase AMS leadership and workforce to adequately cover all settings.
7. Standardise surveillance and reporting of antimicrobial usage data.
8. Facilitate a consistent approach to systems support for AMS.
9. Promote research to inform AMS relevant to the NZ healthcare system.
10. Ensure current and future healthcare workers are adequately educated about AMS, and strengthen consumer resources.

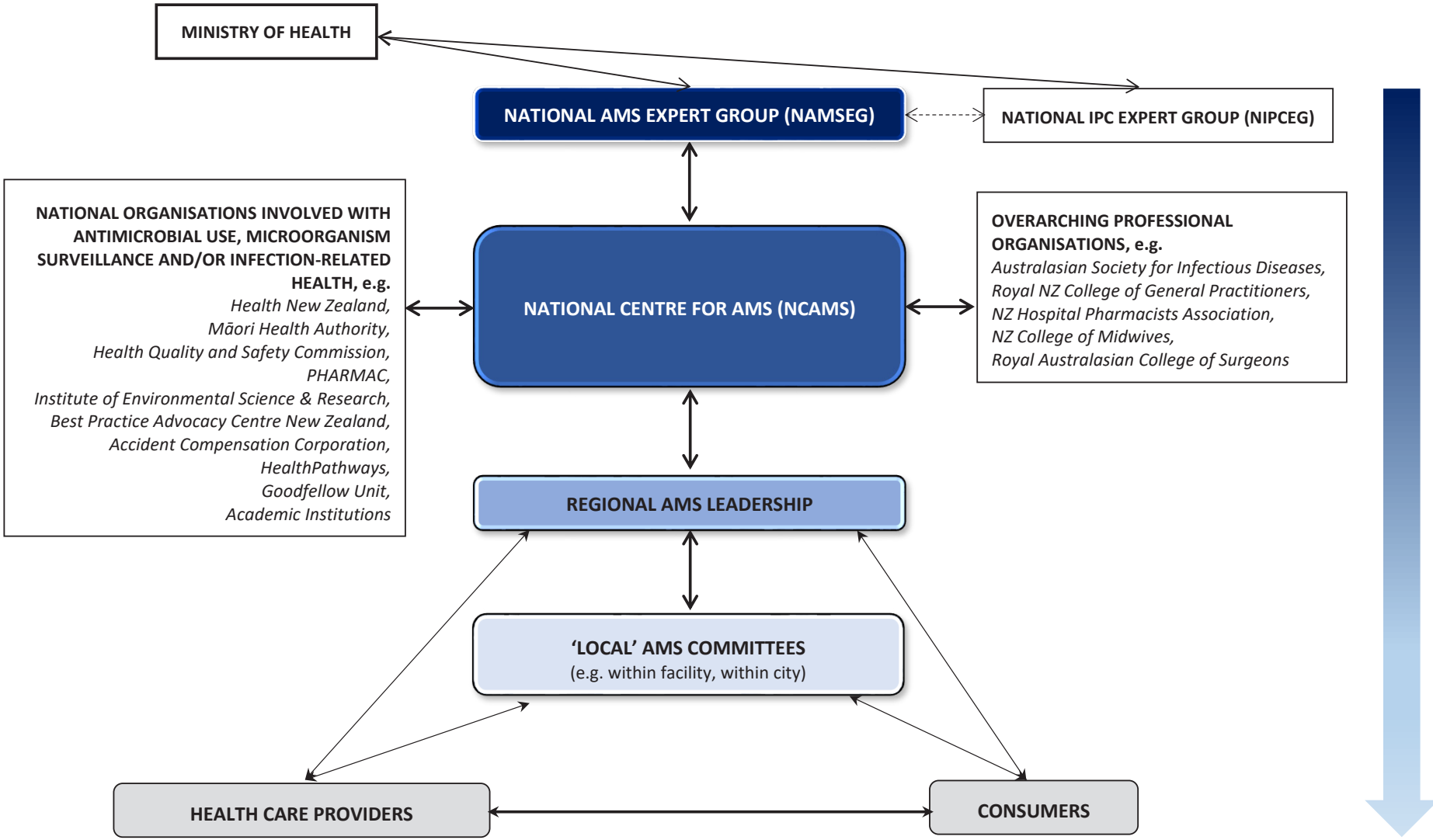
and/or HQSC as the logical leadership choice for AMS nationally. We agree that the leadership should sit with the MOH (via NAMSEG) but think that the NCAMS should be established as a new separate entity with independent ongoing funding. The presence of such an entity may have avoided years of unsuccessful negotiations between the MOH and the Australian National Centre for Antimicrobial Stewardship, which led to the regrettable decision to suspend access to the National Antimicrobial Prescribing Survey[15] for NZ users. In our view, the NCAMS should work in partnership with relevant national organisations (eg HQSC, PHARMAC) and professional bodies (eg, Royal NZ College of General Practitioners, NZ Australasian Society for Infectious Diseases) to inform and facilitate national activities. Engagement with existing provider AMS committees (such as those currently in some of our public hospitals) is critical—one model that could be dovetailed into our health reforms is to establish four regional AMS groups that work with the NCAMS, and facilitate regional cross-sector uptake. Engagement with Māori communities and iwi providers (including the Māori Health Authority when established) is essential to ensure equitable management of infection and antimicrobial use in line with our Te Tiriti o Waitangi responsibilities. Consumer engagement is needed and, as community antimicrobial use must be a focus, strong involvement of community clinicians within the NCAMS and NAMSEG is required. Figure 1 depicts our proposed approach and the interplay between organisations.

*3. Develop national standards for AMS for all NZ healthcare settings.* The new Health and Disability Services Standard[16] sets out the minimum AMS requirements that some service providers such as hospitals and aged residential care facilities must meet to be certified under the Health and Disability Services (Safety) Act 2001. This had the potential to be the single most important document to influence antimicrobial use in NZ. It is disappointing that no experts in AMS were formally involved in its development (despite both the NZ AMS/Infection Pharmacist Expert Group and NZ Australasian Society for Infectious Diseases advocating for this). As this standard does not cover the full spectrum of health provision in NZ (eg, it does not directly impact general practitioners, dentists, independent midwives or community pharmacists) and is limited in detail about what is required, we recommend that specific clinical care standards for AMS are created. These specifications for AMS should then also inform requirements of other certification processes, such as that for general practice.

*4. Develop, publish and maintain national antimicrobial prescribing guidelines that span the human healthcare continuum.* NZ has a range of guidelines for antimicrobial use presented on different platforms (eg, mobile health apps, HealthPathways website) and originating from various sources, including district health boards (DHBs), bpac$^{nz}$ and individual organisations (eg, National Heart Foundation).[17] These often contain conflicting advice and invariably involve duplication of efforts in an already stretched health system. Development of national guidance under a collaborative model and with appropriate expertise would support equitable and responsible antimicrobial use. Comparison and benchmarking of guideline adherence would be facilitated, as seen in Australia via their National Antimicrobial Prescribing Survey.[15] The Accident Compensation Corporation (ACC) has already undertaken scoping work to identify what is needed to deliver national antimicrobial guidance. We support progressing this initiative collaboratively with key stakeholders and, on completion, transfer of guideline governance and maintenance to the NCAMS.

*5. Review and improve the funding model for antimicrobial agents in NZ.* PHARMAC is in a unique position to influence antimicrobial use via provision of a restrictive antimicrobial formulary, funding of agents that support AMS, and collaborative leadership. We think PHARMAC should be empowered to act more assertively to support AMS beyond the soft wording in the AMR Action Plan[12] that they should "continue to *consider* antimicrobial stewardship under PHARMAC's Factors for Considerations in antimicrobial funding decisions." We think PHARMAC should be able to openly and explicitly prioritise AMS and actively seek out ways to support it. Strengthening community antimicrobial

**Figure 1:** Proposal for a national and regionally led structure for AMS in NZ. A model involving strong partnerships and engagement (healthcare provider and consumer) is essential. National organisations and professional bodies undertake AMS activities in line with both the National Centre for AMS (consistent messaging) and their individual functions, including direct engagement with healthcare providers and consumers across NZ (blue arrow). Regional and local AMS leadership is also necessary to facilitate activities across the breadth of healthcare system.



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restrictions would be a good start. In DHB hospitals, agents like ciprofloxacin and clindamycin require Infectious Diseases or Clinical Microbiology approval unless prescribed in accordance with a DHB guideline. In the community, access is unimpeded. This lack of alignment makes little sense. We favour funding of agents like ciprofloxacin and clindamycin only if certain patient, infection and/or organism criteria are met. This method has reduced quinolone use in Australia, with measurable effects on AMR.[18] We are not clear why this could not be implemented in our community via an electronic approval system akin to our existing "Special Authority" approach. Due to the low antimicrobial purchase costs in NZ, alternative prohibitive barriers should be explored to prevent a workaround with non-subsidised prescriptions.

We think PHARMAC should commit to timely funding of "new" (often already well-established in clinical practice internationally) antimicrobial agents to support AMS. Funding of new agents in NZ is a lengthy process that relates poorly to the urgent demands seen with evolving AMR. For example, a 2018 clinician submission for restricted hospital access to ceftazidime-avibactam, a critical medicine for treatment of CPE infections, has still not been approved despite a positive review from PHARMAC's clinical advisors (Pharmacology and Therapeutics Advisory Committee Anti-Infective sub-committee). Community funding of a modified-release nitrofurantoin preparation, a positive step for AMS, took over five years to be realised. Oral fosfomycin is inequitably funded for community patients by some DHBs to avoid hospital admissions due to cystitis caused by ESBL-E. Failure to fund oral fosfomycin will likely increase the use of agents that are broader spectrum or more toxic, and inflate healthcare costs and harms. The traditional PHARMAC model of assessment and tender has provided NZ with a robust and cost-effective platform to access medicines. However, we propose that their process for assessment of antimicrobial agents is reviewed to ensure it matches pace with AMR.

Novel approaches are needed. It could be that all antimicrobial-related funding decisions, including restrictions and prioritisations, are made by NAMSEG with PHARMAC moving more into an effector rather than a decision-making role. Establishment of an independent national list of antimicrobial restrictions could leave PHARMAC responsible for implementation in the public sector while the private sector could be addressed by including the requirement to comply with these restrictions in a clinical care standard.

*6. Increase AMS leadership and workforce to adequately cover all settings.* Current funded resource for AMS fails to meet Australian recommendations for AMS pharmacist and medical resource in all but one DHB.[19] Of particular concern is the virtual absence of AMS resource in primary care and in remote and rural settings, especially for those serving large Māori populations, who disproportionately suffer infection, AMR and subsequent challenges for AMS. NAMSEG must set a minimum requirement for AMS resourcing in order to deliver the quality improvements required. This should take into account all healthcare settings and be appropriate for the regional and local governance arrangements developed through the incoming Crown entity Health NZ. We have described a national leadership model via NAMSEG and NCAMS, but local engagement and leadership is also necessary with a multidisciplinary approach encompassing and supporting the available workforce (eg, primary care pharmacists, nurses, community laboratory microbiologists, and scientists). A starting point might be to define an AMS role for pharmacists in general practice. Standards, training and support for this could be developed via the NCAMS, with peer support via the NZ AMS/Infection Pharmacist Expert Group.

*7. Standardise surveillance and reporting of antimicrobial usage data.* The quality and quantity of antimicrobial use in all sectors should be reviewed and reported regularly. A standardised approach across NZ would help with assessing antimicrobial usage for ongoing evaluation and feedback to services and prescribers, as well as benchmarking. We propose that this is a task for the NCAMS to coordinate and recommend that all AMS programmes are required to participate. The NCAMS should provide the tools and mechanisms for data collection and analysis, and

the findings should be made freely available to the public. Standardisation of infectious diseases and antimicrobial susceptibility surveillance, together with appropriate reporting to AMS groups, is also needed to inform AMS efforts.

*8. Facilitate a consistent approach to systems support for AMS.* The NCAMS should be involved in discussions around national information-technology solutions to ensure standardisation of access and that systems that can help promote AMS are prioritised. AMS functionality should be incorporated into electronic prescribing and administration software, including strategies to promote guideline adherence and appropriate pathogen directed de-escalation. Vendors can be encouraged to promote AMS through introduction of additional legislative or funding requirements such as a need to document the indication and a review or stop date for antimicrobial use within the prescription. These measures would streamline efforts to review the appropriateness of antimicrobial use.

*9. Promote research to inform AMS relevant to the NZ healthcare system.* Key research includes understanding consumers' perspectives and behaviours related to antimicrobial use, evaluating equity issues, and understanding the pathways to facilitate judicious antimicrobial use among all professions, including medical doctors, nurses, pharmacists, dentists, midwives and optometrists. We propose the creation of specific AMS funding streams from the Health Research Council and encourage other research funders such as PHARMAC to also prioritise funding of AMS research. We further suggest that larger (eg, national, regional or public hospital) AMS programmes should include research as a key component.

*10. Ensure current and future healthcare workers are adequately educated about AMS and strengthen consumer resources*. There should be consistent, up-to-date, expert-led AMS (along with AMR and IPC) teaching in all undergraduate healthcare programmes throughout NZ. Additionally, all healthcare workers involved with antimicrobial use should be required to learn regularly about AMS as a core continuing education requirement. Educational institutions and professional organisations should be supported in providing suitable AMS teaching materials. Consistent educational messaging from national organisations (eg, HQSC, PHARMAC) is important and could be facilitated through partnership with the NCAMS and relevant professional bodies.

We have outlined a starting point for progressing AMS in human health in NZ. It undoubtedly needs a centralised coordinated response with adequate funding and commitment from the government. The health reforms, with establishment of Health NZ and the Māori Health Authority, provide an opportunity to incorporate our recommendations with strong focuses on community antimicrobial use and weaving our Te Tiriti o Waitangi responsibilities throughout. Improved efficiency through reduced fragmentation and duplication of AMS activities should offset at least some of the initial costs of the suggested changes and reduce the devastating health and economic consequences of AMR. We should evaluate overseas AMS models (such as that of the highly successful national Swedish programme[20]) for applicability in NZ, but must be clear to tailor these, using additional research if necessary, to the broader interconnected issues of our own infectious diseases challenges and health inequities. NZ has high levels of some infections, disparities in access and utilisation of healthcare, and high morbidity and mortality from common antimicrobial-susceptible infections and sequelae such as *S. aureus* sepsis and rheumatic fever. It is promising that the Office of the Prime Minister's Chief Science Advisor is undertaking a major project on AMR and infectious disease in 2021.[21] Without a commitment to action from the government and its ministries, the threat to life in NZ from AMR will relentlessly increase. AMS *must* be prioritised and developed in order to lessen the impact on our people.

# Definitions

*Antimicrobial resistance (AMR)* refers to developed resistance of a microorganism (bacterium, virus, fungus or parasite) to an antimicrobial agent that it was originally susceptible to. AMR occurs naturally, but is facilitated by antimicrobial use, and inadequate infection prevention and control.

*Antimicrobial stewardship (AMS)* aims to optimise the use of antimicrobial agents in the prevention and treatment of infections, and minimise the potential harms that may result from their use including antimicrobial resistance, adverse drug reactions and excessive healthcare costs. An AMS programme includes governance, surveillance of the quantity and quality of antimicrobial use, education and training, and implementation of quality improvement initiatives.

*Infection prevention and control (IPC)* aims to actively monitor, identify and prevent spread of infections to reduce harm to patients and health workers. An IPC programme includes governance, education and training, policies and procedures, surveillance of infection, and management of the environment.


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**Competing interests:**
Dr Murdoch reports he is a member of the panel for the Office of the Prime Minister's Chief Science Advisor's project on Antimicrobial Resistance and Infectious Diseases.
Mr McRae reports he is a member of the New Zealand Antimicrobial Stewardship/Infection Pharmacist Expert Group, and a member of the Infection Prevention Advisory Group for ACC.
Ms Mccall reports she is a member of the Canterbury District Health Board Hospital Antimicrobial Stewardship Committee.
Dr Maze reports he is a member of the Canterbury District Health Board Hospital Antimicrobial Stewardship Committee.
Ms Lim reports that she is a member of the New Zealand Antimicrobial Stewardship/Infection Pharmacist Expert Group and Southern District Health Board Antimicrobial Stewardship Committee.
Miss Li reports that she is a member of the New Zealand Antimicrobial Stewardship/Infection Pharmacist Expert Group and a member of the Capital and Coast District Health Board Antimicrobial Stewardship Committee.
Dr Kelly reports he is Chair of the National Infection Prevention and Control Expert Group, Ministry of Health.
Mr Issa reports he is a member of the New Zealand Antimicrobial Stewardship/Infection Pharmacist Expert Group; a member of the Waikato District Health Board, Antimicrobial Steering Group; coordinator on the New Zealand Hospital Pharmacists' Association – Infectious Disease/Antimicrobial Stewardship Special Interest Network; a member of the New Zealand Hospital Pharmacists' Association; and a member of Pharmaceutical Society of New Zealand.
Dr Howard reports involvement in writing antimicrobial guidelines at Waikato District Health Board.
Mrs Hardie reports she is a member of the New Zealand Antimicrobial Stewardship/Infection Pharmacist Expert Group and member of the Waitematā District Health Board Antimicrobial Stewardship Committee.
Dr Gardiner reports that she is co-lead for the New Zealand Antimicrobial Stewardship/Infection Pharmacist Expert Group; a member of the panel for the Office of the Prime Minister's Chief Science Advisor's project on Antimicrobial Resistance and Infectious Diseases; a member of the Steering Group for the ACC scoping report on developing national antimicrobial guidance for NZ; and Secretary of the Canterbury Antimicrobial Stewardship Strategic Group and Secretary of the CDHB Hospital Antimicrobial Stewardship Committee.
Mr Duffy reports that he is co-lead for the New Zealand Antimicrobial Stewardship/Infection Pharmacist Expert Group; a member of the Ministry of Health AMR Co-ordination (HARC) Group; a member of the Steering Group for the ACC scoping report on developing national antimicrobial guidance for NZ; a member of the PTAC Anti-infective sub-committee (PHARMAC); and a member of Auckland DHB Antimicrobial Stewardship Committee.
Ms du Plessis reports that she is Lead for the Counties-Manukau Hospital Antimicrobial Stewardship Program and Chair for the Counties-Manukau Hospital Antimicrobial Stewardship Committee.
Dr Chambers reports being Deputy Chair of Canterbury District Health Board Hospital Antimicrobial Stewardship Committee; a member of the reference group for the Prime Minister's Chief Science Advisor's project on Antimicrobial Resistance and Infectious Diseases; and a member of PTAC Anti-infective sub-committee (PHARMAC).
Dr Campbell reports that she is the Pharmaceutical Society of NZ representative on the NZ Antimicrobial Stewardship/Infection Pharmacist Expert Group; a member of the Ministry of Health Antimicrobial Resistance Coordination Group representing the Pharmaceutical Society of New Zealand; and a member of the Reference Group for the Office of the Prime Minister's Chief Science Advisor's project on Antimicrobial Resistance and Infectious Diseases.
Dr Bupha-Intr reports that she is a member of the Capital and Coast DHB Antimicrobial Stewardship Committee.
Dr Briggs reports that he is a member of the PTAC Anti-Infective Subcommittee (PHARMAC).
Dr Birch reports being on the Canterbury District Health Board Hospital Antimicrobial Stewardship Committee.

Dr Betty reports having provided advice to the panel for the Office of the Prime Minister's Chief Science Advisor's project on Antimicrobial Resistance and Infectious Diseases, and being Medical Director of the Royal NZ College of General Practice.
Dr Batlle-Perales reports being a member of the Antimicrobial Steering Group at Waikato Hospital.
Brendan Arnold is the clinical lead for Antimicrobial Stewardship at Southern District Health Board.

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