Curbing antimicrobial resistance

A technology-powered, human-driven approach to combating the ‘silent pandemic’.

Australia has the potential to be a strong global contributor in the development of technologies to combat antimicrobial resistance (AMR). The challenge is ensuring creative and practical solutions make it through the commercialisation process to the places they are needed.

AMR is a looming global health crisis, recently designated one of the top 10 public health threats facing humanity by the World Health Organisation (WHO).

AMR is the process whereby microorganisms, such as bacteria, become resistant to the effects of antibiotics and other drugs used to treat infections.

Loss of effective antimicrobial treatments would be catastrophic for human and animal health.

AMR can lead to the emergence of “superbugs” that are resistant to all available treatments and can cause life-threatening infections. Without preventative action it is estimated that, by 2050, AMR could cause more than 10 million deaths per year and cost the global economy US$100 trillion.

However, rather than focus on the discovery of new antibiotics, this report has honed in on new and emerging technology-based solutions that could prevent the evolution and spread of resistance. These technologies would help Australia and the rest of the world maintain and extend the effectiveness of antibiotics for longer. We focused on preventative technologies that can make an impact on human, animal, and environmental health, now and into the future.

Through research and consultation with over 100 multidisciplinary stakeholders spanning government, academia, and industry, this report has identified actions that Australia can take to control, mitigate, and manage AMR that will complement global efforts to develop new antimicrobials.

Potential solutions

Key technology-based solutions to adopt, adapt or further develop to address AMR

Sensing and surveillance
Integrated sensor technologies and surveillance systems to monitor AMR across human, animal and environmental sectors.

Point-of-care diagnostics
Simple, affordable and action-oriented point-of-care diagnostics to enable timely diagnosis and treatment of infections.

Vaccination technologies
A data-driven, risk-based approach to vaccine production, leveraging new and emerging vaccination technologies.

Prevention through design: High-risk settings
Designing our farms, hospitals, and other high-risk settings to prevent the spread and growth of AMR organisms by deployment of antimicrobial surfaces, air sterilisation technologies, and engineering solutions.

Consultations explored the barriers to implementation of the technology-based solutions, as well as key enablers to ensure they are able to make significant gains against AMR.

The message from stakeholders was clear – there is a lack of coordination in our efforts to stop the rise of AMR, significant data siloes across states and sectors, and a need to increase community understanding about the significance of the issues and impacts of AMR.

Streamlining and simplifying pathways to market was called out as a key requirement to enable technology-based AMR solutions to get to the places they are needed the most – both within healthcare settings, and beyond.

The criticality for rapid solution development and deployment is exacerbated by the acceleration of AMR from the impacts of climate change, and need to better monitor and manage the current and emerging issues associated with increased AMR prevalence.

These challenges must be overcome if we are to halt the rising rates of AMR and the looming threat to global human health.

Project framework

Project framework highlighting potential solutions and enabling technologies to mitigate and manage AMR

Challenges	Enablers	Potential solutions	Outcomes
Lack of trusted and complete multi-sectoral data	Data	Integrated surveillance and sensing systems	Comprehensive data and action-oriented insights
Climate change accelerating AMR	Standardisation	Point-of-care diagnostics	Reduced incidence of AMR in environment, plants, humans, animals
Lack of new technologies and treatments coming to market	Commercialisation	Vaccination technologies	More solutions in the market
Limited awareness, understanding, accountability, and responsibility to improve AMR outcomes	Implementation	Prevention through design	Educated, empowered, enabled and aligned citizens and sectors
	Education		

Recommendation 1

Establish centralised coordination and leadership for AMR management across human health, animal health and environmental health sectors

To support a unified approach, we recommend the establishment of centralised coordination and leadership for AMR management to align domestic and international activities across human health, animal health and environmental health sectors.

Without this coordination it will be difficult to address the lack of awareness, understanding, accountability, and responsibility to improve AMR outcomes, and to tackle the impacts of climate change that can accelerate the emergence and spread of AMR across sectors. This leadership should:

- Provide national, multi-sectoral representation and coordination.
- Drive the development of an enabling policy, regulatory, financial, and commercial landscape.
- Ensure long-term AMR strategy is accompanied by robust implementation plans, reporting and review.
- Integrate AMR management into urban and environmental planning practices.
- Guide clear and concise AMR messaging, awareness, and education.

Recommendation 2

Streamline and optimise the commercialisation process to support Australian AMR solutions entering the market

This coordinated leadership of recommendation 1 should be accompanied by streamlining and optimising the commercialisation process to support Australian AMR solutions entering the market.

This could be achieved by the Australian and State Governments, in collaboration with the private sector and industry associations, providing pathways to market and support for new AMR prevention and mitigation technologies.

Currently, there are policy, regulatory and financial barriers that severely hinder this process, limiting our options to manage and combat AMR.

By streamlining processes both domestically and internationally for new AMR technologies to enter the global market, we could manufacture and distribute the best new AMR technologies to where they are needed, as rapidly as possible.

It is crucial that this process:

- Establishes central AMR oversight to track and manage AMR funding and solutions.
- Creates a streamlined process for expediting AMR solutions.
- Advocates for international alignment, collaboration, and harmonisation.
- Supports regulator capacity and capability to bring AMR solutions to market.
- Leverages strategic partnering approaches across sectors as a practicable delivery solution.

The high-level recommendations outlined are key to efficient and effective management of AMR, and to supporting a viable marketplace for Australian innovations and economic prosperity.

They are supported by the following policy priorities, which emerged through research and consultation as being critical to achieve sustainable, systemic, and equitable impact against AMR.

- Establish robust One Health data policies and standards.
- Establish fit-for-purpose, sustainable funding models and financial incentives.
- Treat priority AMR solutions as a public good.

Australia has a strong research sector, with significant expertise, experience, and capacity to investigate and develop best practice solutions to Australia's biggest challenges.

The following research priorities were identified during consultations as important for successful mitigation and management of AMR.

- Fundamental AMR research.
- Point-of-care diagnostics.
- Vaccines.

Stakeholders were also asked to assess Australia's readiness to adopt, adapt, or further develop the prioritised potential solutions identified.

These findings highlight where Australia is ready to realise the benefits of these solutions, and the areas where more work is needed.

Along with the challenges presented by the COVID-19 pandemic, there's a silver lining. An increased awareness of the impact of communicable diseases, increases in vaccination infrastructure and point-of-care diagnostic capability, and an increased understanding of the importance of public health surveillance has resulted.

This leaves Australia well-positioned to leverage these lessons and to apply them in the domain of AMR.

It is essential to take a One Health perspective when it comes to tackling AMR. This means acknowledging the connection between humans, animals, and the environment and understanding that our actions in one sector can have positive or negative consequences in another. To effectively manage, mitigate, and control AMR, it is important that sectors impacted by and contributing to it work together, both within Australia and beyond.

Australia can become a leader in AMR management by taking the steps necessary to commercialise the creative and practical solutions that are being developed nationally, and by supporting sectors to coordinate activities to tackle this multi-faceted issue.

If the right steps are taken now, Australia has the potential to be an influential global player in developing new and innovative technologies to combat AMR.

Readiness indicator scale and readiness assessment

Potential solutions	Infrastructure readiness	Skills availability	Social and ethical readiness	Economic and commercial readiness	Policy and regulatory readiness
Integrated sensing and surveillance systems	◔	◑	◑	◔	◔
Point-of-care diagnostics	◑	◕	◕	◑	◑
Vaccination technologies	◑	◑	◕	◑	◕
Preventative design: High-risk settings	◔	◕	◑	◔	◔

Key	Not ready		More work required		Ready
	○	◔	◑	◕	●

The Australian Academy of Technological Sciences and Engineering (ATSE) is a Learned Academy of independent experts that helps Australians understand and use technology to solve complex problems. ATSE brings together Australia's leaders in applied science, technology and engineering to provide impartial, practical and evidence-based advice on how to achieve sustainable solutions and advance prosperity.

As Australia's national science agency and innovation catalyst, CSIRO solves the greatest challenges through innovative science and technology. CSIRO works with organisations to deliver world-leading research and development solutions to help their business innovate, improve and grow.

The full report will be available to download from 28 February 2023.

Contact us
csiro.au/amr
amrmission@csiro.au