Australian Government

CTPCO
CRITICAL TECHNOLOGIES POLICY COORDINATION OFFICE

Novel antibiotics and antivirals

Systems for identifying or designing new types of antibiotic and antiviral drugs that can treat bacterial and viral infections in humans and animals safely and effectively. New antibiotic and antiviral drugs must be continually developed and tested to ensure there are drugs available to treat both new infectious diseases and existing bacterial and viral diseases that become resistant to existing drugs. Examples include drugs to treat Methicillin-resistant Staphylococcus aureus (MRSA) and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

Key Sectors

- Health
- Agriculture
- Education & Research
- Energy & Environment

Estimated impact on national interest	Low	Med	High
Economic Prosperity			X
National Security		X	

Key Australian Government Actions

Initiatives

- Resistance joint initiative – Australia's National Antimicrobial Resistance Strategy
- National Microbial Genomics Framework 2019-2022
- Medical Research Future Fund (MRFF) Priority Mission
- National Manufacturing Strategy – Priority area of Medical Products
- National Research Infrastructure (NRI) and 2021 NRI Roadmap
- Agricultural Innovation Policy Statement
- Various Rural RDC priority initiatives

Regulations

- Therapeutic Goods Act 1989
- Therapeutic Goods Regulations 1990
- Defence and Strategic Goods List 2021

Example Outcomes

- Pandemic preparedness and response
- Improved individual health
- Prevention of disease in livestock and companion animals
- Improved public health outcomes
- Reduced mortality and morbidity from infectious and communicable diseases
- Reduce workforce absenteeism due to infectious and communicable diseases

Underpinning Science

ANZ Standard Research Classification Category

- Agricultural biotechnology
- Applied computing
- Applied ethics
- Artificial intelligence
- Biochemistry and cell biology
- Bioinformatics and computational biology
- Clinical sciences
- Data management and data science
- Fisheries sciences
- Genetics
- Immunology
- Industrial biotechnology
- Machine learning
- Medical biotechnology
- Sociology
- Plant biology
- Software engineering
- Statistics
- Veterinary sciences

Example Applications

Readiness Level – Now

- Bacteriophage therapy for bacterial infection
- Antibacterial drugs to deal with new bacterial infections or drug resistant bacteria
- Antiviral drugs to deal with new viruses or drug resistant viruses
- New vaccines against emerging viruses
- Dose regimen optimisation to treat critically ill patients
- Needle-free mechanisms of delivery for vaccines against viral and/or bacterial infections

Readiness Level – 2–5 years

- Improved speed and accuracy for identification and characterisation of bacteria and viruses
- Rapid antibacterial and antiviral drug development in response to new or evolving threats

Readiness Level – Beyond 5 years

- New antibiotics and antivirals that act on different cellular structures, proteins or functions
- Personalised antibacterial and antiviral treatments
- Repurposing of existing pharmaceutical compounds for antimicrobial or antiviral use
- Therapeutic application of naturally occurring compounds for antimicrobial or antiviral use
- Broad-spectrum antibacterial and antiviral drug development to treat novel or unforeseen pathogens

Australia's place in the world

The United States has the highest research impact for novel antibiotics and antivirals, with China second, and Australia 8th. China has the highest number of patents in this area, almost double that of the US, with Australia ranking 15th. Venture capital (VC) investment has been increasing steadily at around 8% p.a. The US has a clear lead in VC investment this area, over China and the United Kingdom. Of note, VC investment in Ireland and Israel ranks 4th and 5th respectively. Australia ranks 10th for VC investment.

The top 10 international institutions comprises a number of different countries, with Harvard University (US) and the Institut national de la santé et de la recherche médicale (France) ranked closely in 1st and 2nd. The University of Melbourne (Australia) is ranked 10th. The diversity of countries represented in the top 10 institutions reflects the global significance of antimicrobial resistance and the urgent need for new antibiotics and antivirals.

Antibiotic and antiviral development is an area where Australia performs strongly in research, with five institutes in the international top 50. This capability is supported by our expertise in genomics and genetic engineering, as well as government commitment to international anti-microbial resistance initiatives.

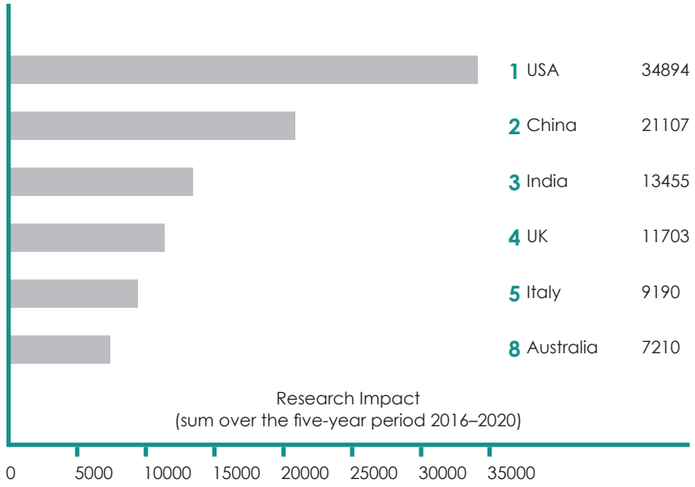
Opportunities and Risks

Maintaining Australia's high standard of living and longevity requires a steady flow of novel antibiotic and antiviral drugs. Every time a person, plant or animal is treated with an antibiotic or antiviral drug there is some risk that the bacteria or virus will develop resistance to that drug. Given enough time the antibiotic and antiviral drugs currently relied on will become less effective or stop working entirely, and infectious diseases that are currently treatable could once again become deadly.As well as protecting Australians from death and disease, novel antibiotics and antivirals have the potential to increase Australia's economic prosperity. Drugs can be exported from Australia or licenced for sale overseas. More effective antibiotics and antivirals can reduce treatment times and shorten or eliminate costly hospital stays. Antibiotics and antivirals with fewer side effects can get people back to work sooner and attract premium pricing in developed economies. Having a 'war chest' of antibiotics and antivirals with different mechanisms of action increases the chances that an effective treatment can be quickly identified and dispensed when a new bacteria or virus emerges to threaten Australian society.

The risks from novel antibiotics and antivirals stem from lacking them when they are needed, and the large amount of time and money that is currently required to discover and develop novel antibiotics and antivirals that are effective and safe to use. Further risks arise from public acceptance. When a safe and effective novel antibiotic or antiviral is approved for use, it likely won't be widely prescribed right away, limiting and delaying the return on investment for developing the drug and also limiting public access. While this may anger investors and potential patients, it limits the opportunities for drug resistance to arise and ensures the drug is available for when it is truly needed.

Research Impact (RI)

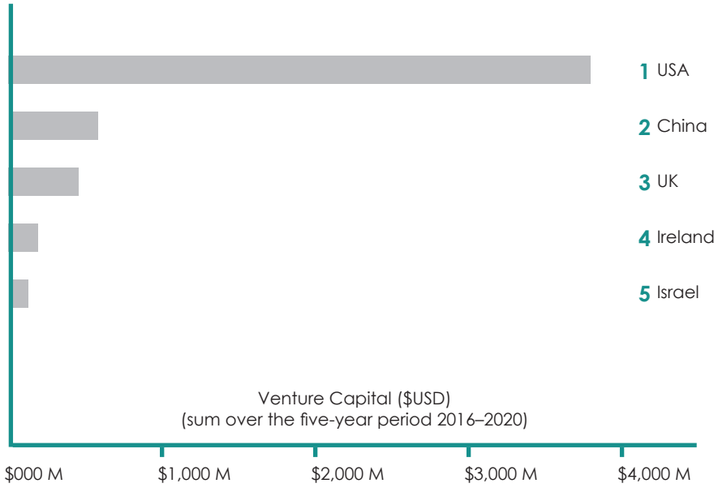
The United States has the highest research impact, with Australia ranked 8th. Total volume of published research has increased at around 8% p.a. over the 5 year period 2016–2020, with 23% of research involving international collaboration.



The research impact provides an indication of the productivity of a country or institution. Here, productivity was assumed to be represented by the volume of publications (i.e. scholarly output) as an indicator of the resources & facilities, and the level of interest in the publications as an indicator of quality.

VC Investment

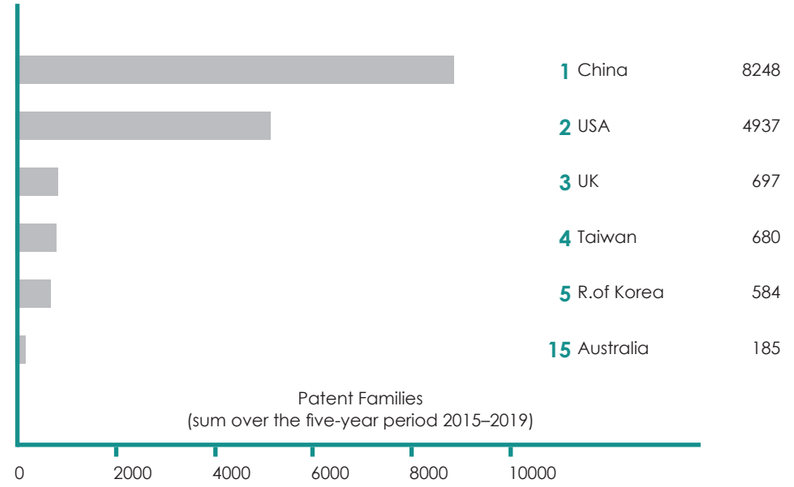
The United States has significantly higher venture capital (VC) investment for novel antibiotics and antivirals, compared to China and the United Kingdom. Australia ranks 10th. Investment in this area has been growing at around 8% p.a. since 2016.



Data from Crunchbase. The Crunchbase database provides a partial view of the global VC landscape. However the quantity, quality and richness of the data are considered to be statistically significant, and indicative of global trends.

Patents – International

The number of patents filed for this field has increased by 27% annually from 2015 to 2019. Most patents for this technology were filed by Chinese applicants or inventors ahead of the United States, with Australia ranked 15th.



Research Institutions – International

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Rank	Top International Institution	Research Impact
1	Harvard University | United States	2960
2	Institut national de la santé et de la recherche médicale | France	2958
3	French National Centre for Scientific Research (CNRS) | France	2804
4	Chinese Academy of Sciences | China	2421
5	Imperial College London | United Kingdom	2200
6	University of Oxford | United Kingdom	2071
7	Spanish National Research Council (CSIC) | Spain	1820
8	National University of Singapore | Singapore	1670
9	National Institutes of Health | United States	1650
10	University of Melbourne | Australia	1565

Research Institutions – Australia

Australia has 5 universities in the top 50 international institutions. The University of Melbourne, the highest ranked Australian institute, ranks 10th internationally. The University of Queensland ranks 13th, University of Sydney 25th, University of New South Wales 32nd and Monash University 42nd.

Rank	Top Australian Institution	Research Impact
1	University of Melbourne	1565
2	University of Queensland	1283
3	University of Sydney	1133
4	University of New South Wales	1011
5	Monash University	871
6	Royal Brisbane and Women's Hospital	372
7	University of Adelaide	312
8	Murdoch University	304
9	University of Western Australia	250
10	CSIRO	230

Patents – Australia

Top 5 Australian Patent Applicants	Patent Families
The University of Melbourne	10
Monash University	9
University of Queensland	9
Griffith University	9
University of Sydney	7

Patents filed by Australian businesses, 2015–2019.