Serpentarium established at UPNG

Australian antivenom saving lives: Case Study

Snakebite causes suffering, disability and premature death around the world. Globally, almost 7,400 people are bitten by snakes every day, leading to about 2.7 million cases of envenoming (venom poisoning) and 81,000–138,000 deaths each year. Australia and its neighbours are home to a majority of the world’s most venomous snake species and our region hosts many other venomous creatures. Consequently, Australian clinicians and scientists have been able to conduct world-leading research in the areas of envenoming first aid, antivenom production and international collaborations. This case study focuses on the work of the NHMRC-funded Australian Venom Research Unit (AVRU) and the impacts of its work.

Origin

Due to its variety of venomous animals, Australia is an ideal place for research on toxins and has a long established research capability in this area. The Commonwealth Scientific and Industrial Research Organisation (now CSIRO, a private company) became involved in antivenom research in the 1920s and, in 1928, the first medical research grant provided by the Australian Government was used for the development of tiger snake antivenom, manufactured at CSIRO.

Australia has a variety of venomous animals, including snakes, spiders, scorpions, jellyfish, and box jellyfish, which pose a significant threat to public health. The Australian Venom Research Unit (AVRU) is a world leader in venom research and has a long history of collaboration with both domestic and international organisations. The Unit's work is focused on developing and improving antivenoms, educating healthcare professionals, and investigating the cardiovascular actions of venom components.

Grants and Investment

AVRU was established with seed funding from CSL and The University of Melbourne. The unit was also supported by grants from the Victorian Government and from contract consultancy work. Department of Health / NHMRC funding from 2001 to 2011. AVRU received annual funding from the Australian Government Department of Health. Since 2011, NHMRC has administered this funding. AVRU has also supported AVRU staff through the following grants:

- Dr Ken Winker: funded grant 2012
- Dr David Williams: Peter Doherty Biomedical Fellowship, 2017

Other government funding:

- Department of Foreign Affairs and Trade (DFAT), 2018
- Department of Health and Ageing (DoHA), 2002
- Victorian Government, 2002

Associate Professor Bryan Fry: Australian Research Council (ARC), 2004

Other funding:

- CASS Foundation: 2006
- Nestlé Australia: 2006
- Wyeth Australia: 2002
- Australian Venom Research Unit

Regional

AVRU has collaborated with both domestic and international organisations. Collaborations include work with:

- Victorian State Government and from contract consultancy work.
- In 2017-2019 AVRU collaborated with Ophirex Inc. to preclinically assess the efficacy of the snake antivenom, manufactured by CSL. This preclinical study established that delayed oral doses of varespladib were effective in treating severe envenoming caused by taipan venom.

National

AVRU has also supported AVRU staff through the following grants:

- NHMRC Case Studies in Research Impact
- NHMRC Project Grants: 2012
- Australian Research Council (ARC): 2004
- Dr Winkel’s work on the development of both a snakebite envenoming roadmap and antivenom guidelines.

International

- Bio-Rhein Snake Farm (Germany), Conselho Superior de Investigaciones Científicas (CSIC), Spain, and University of Oxford, United Kingdom, to audit venom quality and antivenom efficacy.
- Evolutionary Virology Laboratory, Indian Institute of Science: to investigate venom evolution and its consequences for antivenom manufacture.

Collaborations

Antivenom research and envenomation treatment is an ideal place for research on toxins and has a long history of collaboration with both domestic and international organisations. Collaborations include work with:

- The Australian Institute of Health and Welfare, the Australian Bureau of Statistics and the National Coronial Information System to enable the analysis of venomous injuries and deaths across Australia through data linkage.
- Sequin: a part of CSL, to co-develop Australian antivenoms and the Australian antivenom app.

Regional

- The PNG, Snakebite Partnership, which includes PNG National Department of Health, the Australian Government, the University of PNG, Sequin to distribute life-saving Australian antivenoms across PNG, and Instituto Clodomiro Picado (ICP), University of Costa Rica, UPNG and Port Moresby General Hospital to develop a novel taipan antivenom.

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Trials and Results

New antivenom to treat taipan bite in PNG AVRU, in collaboration with ICP, developed the first new antivenom for human use in over 40 years and distribution of the venom in PNG. The novel taipan antivenom was developed as a fraction of the cost of the existing antivenom. In 2012-2014, an NHMRC-funded Phase II clinical trial in PNG found that the new antivenom safety and effectively neutralised the toxic effects of taipan venom in snakebite patients.

Adjust therapy for taipan bites

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Assessing the efficacy of Australian antivenoms

Polyvalent antivenoms contain antibodies raised against multiple snake species. Overlap in venom profiles across species may result in polyvalent antivenoms offering protection against bites from snakes whose venoms were not used in the original immunising mixture. Work by Dr Williams and Associate Professor Christine Wright discovered that Sequin’s Polyvalent Snake Antivenom neutralised the venom lethality of PNG’s small-eyed snake (2014) and the Papan black snake (2017).

Venus evolution

Associate Professor Bryan Fry’s work has identified the evolution of a range of venoms delivery systems (Nature, 2006). Dr Timothy Jackson’s work has highlighted the influence of ecology on venom composition and activity (2019).

Health Outcomes

The AVRU team has leveraged its knowledge of Australia’s venomous creatures to benefit snakebite victims around the world.

Saving lives in Papua New Guinea

Many venomous snakes in PNG are caused by factors also found in Australia. The work conducted in PNG helps to inform snake management in Australia.

- Establishment of the Charles Campbell Toxinology Centre (CCTC) Snakebite Clinic at Port Moresby General Hospital. The clinic treated 300-350 snakebite cases per year and introduced treatment protocols that lowered fatality rates from 14% to just 2.2%.
- Development of a Parasitology Management course (2004-present) to upskill health workers in snakebite patient management. A guideline, Venomous bites and stings (PNG), was published to guide patient management.
- The PNG, Snakebite Partnership. More than 800 visits of HEAving antivenom (donated by Sequin) have been distributed to 54 health centres across PNG since 2018. This project is led by Dr Watt and has saved more than 300 lives using Australian antivenoms.

Putting snakebites on the world stage

In 2017, Dr Williams chaired the WHG Snakebite Envenoming working group. The AVRU team were instrumental in advocating for snakebite to become a top category Neglected Tropical Disease (2017). For snakebite to be addressed globally (2018) and in 2019, Dr Williams led the development of the WHO’s Strategic Roadmap for the prevention and control of snakebite envenoming.

For more than 100 years, the primary treatment for venomous bites and stings in PNG published in 2000 was heparin, risking the venom from a Papuan taipan to local knowledge with venom first aid. In 2008, Dr Ronelle Welton led work revealing that contact with venomous creatures between life and death, and the importance of early treatment in reducing fatalities. For more than 100 years, the primary treatment for venomous bites and stings in PNG was heparin, risking the venom from a Papuan taipan.

Investigating Australia’s venomous creatures

Australia has a variety of venomous animals, including snakes, spiders, scorpions, jellyfish, and box jellyfish, which pose a significant threat to public health. The Australian Venom Research Unit (AVRU) is a world leader in venom research and has a long history of collaboration with both domestic and international organisations. Collaborations include work with:

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Prof Struan Sutherland AO (1905-1989) was a clinician researcher and founding Director of AVRU (1994–1999), a position held by Dr Andrew Watt (1999–2019) and now held by Dr Bryan Fry (2020–present). Dr Sutherland’s work on antivenom manufacture and its clinical testing was critical in the development of effective antivenoms for venomous bites and stings in PNG.

Dr Elizabeth Williams is a Professor of Pharmacology at the University of Melbourne. She is the CEO of the Global Snakebite Initiative and a consultant for the WHO on venomics and venom first aid.

Dr Ken Winker is an NHMRC Doherty Research Fellow and former Director of AVRU (1999-2015). He is a Senior Research Fellow at The University of Melbourne.

Dr William Jackson is a Senior Research Fellow at the University of Queensland and was deputy Director of AVRU during the early years of its establishment.

Dr Andrew Watt is a medical researcher with a background in neuroscience. He has led the PNG Snakebite Partnership since 2011. Since 2019, he has been co-head of AVRU.

Dr Timothy Jackson is an NHMRC Doherty Research Fellow and was deputy Director of AVRU during the early years of its establishment.

Dr Bryan Fry is the CEO of the Global Snakebite Initiative and a consultant for the WHO on venom first aid.

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