

Assessment of health and biomedical science in Queensland

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This assessment of science and research activities, and Queensland Government investment, in health and biomedical research institutes has been undertaken as part of the Queensland Government's examination of its science capability and investment, following the State government election in March 2012.

This is the **seventh** in a series of audits of the Queensland Government's scientific capability and investment, overseen by the Office of the Queensland Chief Scientist.

The findings of this report are principally based on interviews conducted with representatives from Queensland's health and biomedical sector – including anecdotal evidence collected during interviews. The findings are also informed by:

- Data from the Queensland Government R&D Expenditure Report 2012-13, Health of Queensland Science (OQCS, 2013), Queensland Life Sciences Report (OQCS, 2013).
- The Audit of Science Investment and Funding Programs (Innovation & Science Development), DSITIA (May 2013).
- Data collected from the institutes and organisations reviewed in this report.

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Acknowledgements

Dr Debra Venables, Office of the Queensland Chief Scientist

Professor Peter Andrews AO co-Lead Author

Peter Andrews is an eminent scientist and bio-entrepreneur. He was appointed as Queensland's first Chief Scientist in 2003, retiring in December 2010.

Professor Andrews completed his PhD in the pharmacological applications of quantum chemistry at the University of Melbourne in 1969. He has since led multidisciplinary scientific teams at several Australian universities, and has been at the forefront of the development of the Australian biotechnology industry as a founder or board member of more than 10 scientific companies.

Professor John Shine AO FAA co-Lead Author

John Shine is a world-renowned Australian scientist. He was Executive Director of the Garvan Institute of Medical Research in Sydney from 1990-2011.

In the late 1980's, he was instrumental in the development and growth of California Biotechnology (CalBio). Professor Shine continues to fulfil a number of significant roles in the Australian health and medical sector, including that of Chairman of the Board of Australian biopharmaceutical company, CSL Limited. In 2010, Professor Shine received the Prime Minister's Prize for Science.

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*With a **growing and ageing population**, where chronic disease is prevalent, costs of care are escalating and consumer expectations are rising, there is no choice but to change the way we do things in health. Public funds must be prioritised to achieve the best possible health outcomes per dollar spent.* Blueprint for better healthcare in Queensland. Queensland Health. February 2013

Executive Summary

Health and medical research is the essential R&D of the health care system and as such should be an integral and highly valued activity in all health care delivery institutions.

All of the leading international and national health systems place a high priority on research as a driver for excellence and cost effectiveness of health care.

To date, although substantial, funding of health and biomedical research has been somewhat *ad hoc* in Queensland. While this has resulted in an impressive development of both physical and human capital, such that Queensland health and medical research has a strong international reputation, future momentum in the sector will require a more co-ordinated focus on ‘translational’ research activities, better linking basic research discoveries from Queensland and worldwide, with clinical application.

This will maximally leverage the impressive research capabilities built up in Queensland hospitals, universities and research institutes to deliver real cost reductions in health care and commercial value to research discoveries.

The end result should be for Queensland to maintain its current position with respect to research excellence, while taking a leadership role in the next stage: effectively and efficiently converting that research into useful clinical and commercial outcomes.

As health and medical research is the R&D of the health system, primary responsibility for its future direction and ongoing support should lie with the Health Department, with specific initiatives, e.g.

around commercialisation, carried out in close collaboration with other government agencies responsible for innovation.

Key findings

The Queensland Government’s considerable investment in health and biomedical research over the past decade, and the consequent development of world class health and biomedical infrastructure, has been a powerful mechanism for attracting world class scientists to Queensland and has enabled that talent pool to be very successful as, for example, indicated by publication and citation records, and leveraging funding from other sources.

Against this enviable background, the exponential advances currently occurring in worldwide medical research present enormous opportunity for the State to integrate its research and clinical strengths in focussed projects to both reduce health care costs and develop value-added innovative new therapeutics, vaccines, diagnostics and clinical practice.

However to take full advantage of these opportunities, focussed support for translational research - where it is of benefit to Queensland - is needed, both financially and culturally.

Better translation of health and biomedical research into tangible health and economic outcomes for Queenslanders would be facilitated by future investment in preventative health, health services delivery and health economics research, and clinical genomics; areas that are currently under-resourced in the State.

Executive Summary: Key findings

Government's investment

- Between 1998 and 2011, the Queensland Government invested \$4.9 billion into science, research and development, innovation and education through the Smart State policy.^{1,2}
- Since 2001, the Government has invested \$376 million towards infrastructure, operational funding, projects, collaborations and skills through the Smart State programs, **to support the health and biomedical research institutes included in this review.**
- In 2012–13, the Queensland Government directly spent \$203 million and leveraged a further \$320 million on R&D activities (including funds leveraged by QIMR Berghofer of \$91.5 million) across all sectors: **Total Queensland Government R&D Expenditure of \$523 million.**³
- **Health** is the largest area of research performed across a number of departments and government bodies (including QIMR Berghofer) with 50% (\$263 million) of Government spend going towards this area of research.
- There are clearly two main facets to the funding of health and biomedical research organisations by the State:
 - Infrastructure related funding, including support for capital projects and for operational support, and
 - Support for programs, projects and initiatives.

Operational Funding

- The Queensland Government has provided ongoing operational funding to several of Queensland's prestigious health and medical

research institutes but in a manner that has been generally inconsistent and non-transparent.

Areas of Strength

- Health and medical research in Queensland is strong by national and international benchmarks with particular strengths in areas including:
 - Cancer
 - Genomics
 - Imaging
 - Tropical / infectious medicine
 - Neurodegenerative disorders (mental health)
 - Vaccine development and delivery.
- Basic research in molecular and cellular biology, drug design and discovery, immunology and pharmacology is also highly regarded.
- Queensland has strong supporting infrastructure in the areas of:
 - Advanced imaging
 - Early phase clinical trials
 - Genetic/genomic services.

1. Queensland Government research and development expenditure report 2010-2011. The State of Queensland (Office of the Queensland Chief Scientist), 2012
2. DSITIA Science Delivery Division Audit. Office of the Queensland Chief Scientist, Department of Science, Information Technology, Innovation and the Arts. Queensland 2012.
3. Queensland Government research and development expenditure report 2012-2013. The State of Queensland (Office of the Queensland Chief Scientist). 2014.

Executive Summary: Key findings

Gaps and Weaknesses

Need to grow capacity

- Preventative health, health services delivery and health economics research are under-resourced or under-supported in the State.
- Queensland is very active in the area of determining genome wide associations with disease; however there are capacity gaps:
 - clinicians with knowledge of how to exploit this expertise to inform patient diagnosis and care
 - a need for growth in Genetic Counselling to match the exploitation gap.
- Growing the State's capacity in these areas will provide for more effective and targeted translation of research outcomes into clinical products, processes and services.

Translation

- Despite a record of excellence in research, many of Queensland's health and biomedical research institutes do not have a strong record of translation of research into commercial or clinical outcomes.

Clinical Research

- The research culture within Queensland's hospital network is not as robust and productive, across the board, compared with other states.
- Despite obvious pockets of excellence, research and teaching excellence could be better integrated into healthcare services delivery provision in Queensland's public hospitals.
- There are no robust KPIs for research and teaching excellence for the State's Health and Hospital Services.
- There is insufficient support for early and mid-career clinicians with

an interest in research, through fellowships (bottom up support) or mentoring and leadership (top down support).

- Tracking of direct Government funding for health and medical research is challenging and not managed through a central agency or business unit.
- Funding support for health and medical research (including the Department of Health's clinical fellowships programs) has not always been clearly targeted towards identified priorities for Queensland or capacity gaps.

Overlaps

- The State has a wealth of capacity in gene sequencing, bioinformatics and medical imaging, including substantial infrastructure support for these areas of expertise.

International collaboration

- Queensland's health and biomedical researchers appear to have a high level of international connectedness.¹
- Queensland's research collaboration with China is strong and a number of Queensland's health and biomedical research institutes have long-term collaborative relationships with Chinese partners.

Local collaboration

- Genuine collaboration and cooperation between Queensland's medical research institutes could be improved.
- Overall, engagement between Queensland's hospitals and universities is not strong. However there are several examples of emerging alliances between key research and clinical care organisations, such as the Herston Imaging Research Facility, the Head and Neck Cancer Centre, the Queensland Mental Health Alliance, the University of Queensland Centre for Clinical Research, and the Brisbane Diamantina Health Partners.

Executive Summary - Strengths

Disciplines

IMMUNOLOGY

GENOMICS

BIOCHEMISTRY & MOLECULAR BIOLOGY

Health Services Delivery – need to grow capacity

Diseases

Tropical

Infectious
Diseases

Antibiotic
Resistance

Skin

Breast

Cancer

Prostate

Cardiovascular
& Respiratory
Diseases

Heart

Lung

Schizophrenia

Neuroscience
and
Behavioural
Sciences

Alzheimers /
Dementia

Depression

Transplantation

Renal
Medicine

Chronic Kidney
Disease

Platform Technologies
& Capabilities

SEQUENCING

MEDICAL IMAGING

EARLY PHASE CLINICAL TRIAL CAPABILITY & CAPACITY

Executive Summary: Recommendations

KEY THEMES:

- Better translation of health and biomedical research into clinical outcomes
- Better translation of health and biomedical research into commercial outcomes
- Operational Support for major Independent Medical Research Institutes
- Addressing Emerging Gaps: Health Services Delivery; Health Economics; Preventative Health; Clinical Genomics.

Supporting these **KEY THEMES** are a number of general **RECOMMENDATIONS** for Government to consider:

FUNDING MECHANISMS

- To reinforce the culture of an excellent research and evidence-based health care system, **support for health and medical research** should be the **responsibility of the Department of Health** – supported by DSITIA – and funded through mechanisms quarantined from overall Hospital and Health Services budgets.
- A detailed audit of all funding for health and medical research (including the clinical fellowships program) by the Department of Health should be considered, including:
 - how to best manage such funding going forward, from an administrative point of view
 - where funding should be targeted, both in terms of policy, programs and initiatives (fellowships, operational funding, building research capacity) and in terms of health and medical research priorities for the State.
- **Operational** funding for universities is a responsibility for the Federal Government and is not the role of the State Government.

ACCOUNTABILITY

- The CEOs of Queensland's **Hospital and Health Services** should have **explicit KPIs** that demonstrate **commitment to research**.)

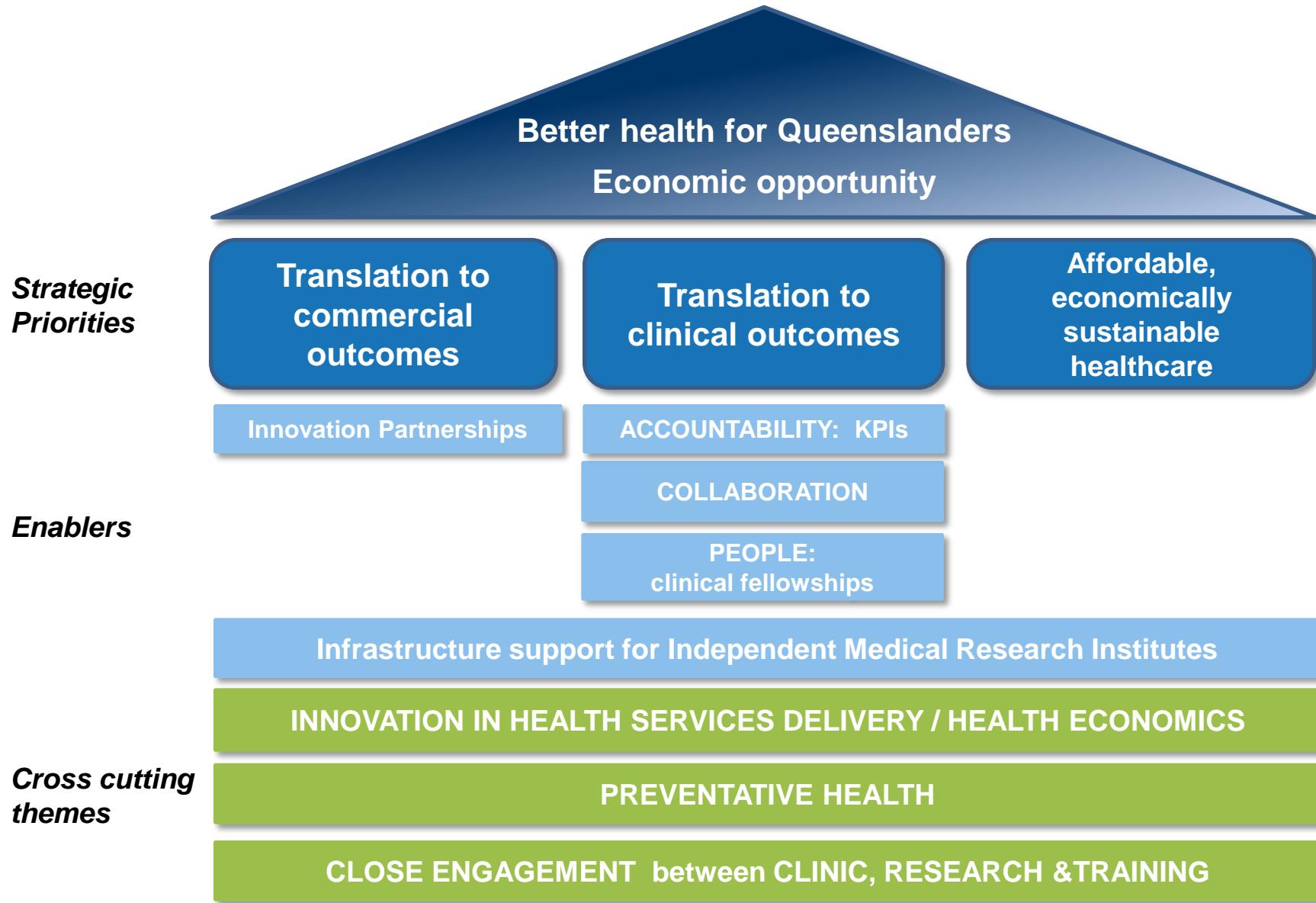
PROGRAMS AND INITIATIVES

- Government support for health and medical research **programs and initiatives** could comprise a four pronged approach that underpins a focus on translational research to enhance cost effectiveness of health care and valued added commercialisation of research outcomes.

These should include:

1. Addressing gaps in support for health services delivery, health economics and preventative health.
2. Clinical (health and medical) Fellowships
3. Innovation Partnerships
4. Infrastructure support for major Independent Medical Research Institutes

Executive Summary: Recommendations



Terms of Reference

The following terms of reference were agreed in consultation with the Queensland Chief Health Officer, Preventive Health Unit (Department of Health), and Science Division (DSITIA).

Background

The Queensland Government is committed to using science and innovation for economic success by ensuring it has access to the best possible scientific advice - directed toward meeting the future policy challenges of Queensland industries and contributing to sound decision-making about environmental, economic, industry and social issues.

It is now proposed to undertake an assessment and strategic analysis of the science and research activities, and the Queensland Government's investment, in health and biomedical research institutes in the State to provide the Government with an evidence-based decision framework to support any future investment.

This assessment reviews the scope, outcomes, collaborative profile, commercial potential, impact and capacity gaps of the State's health and biomedical research institutes.

How can the Queensland Government best support health and biomedical science in the State:

- in a transparent manner
- such that it provides the Government with the best return on its investment, by delivering optimal benefits to Queenslanders
- so as to maintain momentum of previous investments and add value to, and support, the Government's objectives.

In proposing recommendations for future Queensland Government policy in relation to the above, this assessment will consider:

1. *What is the scope of the Government's investment in health and biomedical science in Queensland?*
2. *What are the areas of expertise/strength in health and biomedical research in Queensland, and what are the gaps and overlaps?*
3. *What are the collaborative profiles of the relevant health and biomedical research institutes?*
4. *How can the joint capability and activities of the State's health and biomedical research institutes best be harnessed – to drive better translation of health and biomedical research and to deliver optimum health and economic benefits to Queenslanders?*
5. *Are there any alternative mechanisms available to government to encourage and stimulate the development and maintenance of health and biomedical research capability and expertise in the State?*

Key points

This assessment process has involved information gathering in relation to Queensland's publicly funded health and biomedical research institutes.

It included consultation with senior management of the major publicly funded institutes, industry and key Queensland Government representatives, and a process of internal and external review.

The Queensland Chief Scientist has provided process and governance oversight, objective evaluation of the assessment process and outputs, and final recommendations in consultation with the Chief Health Officer (who has been recused from deliberations concerning the QIMR Berghofer due to her role as a Board member).

Audit process steps

1. Terms of Reference – preparation and submission
2. Background documentation aggregation
3. Development of consultation list
4. External consultations and analysis
5. Consolidation of themes and findings
6. Interim Report – preliminary recommendations
7. Presentation to Minister for Health for feedback
8. Follow-up on feedback and final consultation
9. Final Report to Minister for Health and Minister for Science, Information Technology, Innovation and the Arts.

Process: Consultation list

Primary Contacts

University of Queensland	Griffith University	Queensland University of Technology	Queensland Health / Department of Health	Other
Prof. Peter Høj Vice-Chancellor	Eskitis Institute Prof. Ron Quinn Director	Faculty of Health Prof. Ross Young Executive Dean	Dr Jeannette Young Chief Health Officer	Australian Institute for Tropical Health and Medicine Prof. Ian Wronski Prof. Louis Schofield
Prof. Max Lu, Provost	Griffith Health Institute Prof. David Shum Acting Director	Institute for Health and Biomedical Innovation Prof. Lyn Griffiths Executive Director	Dr Kaye Pulsford Senior Director – Preventive Health	Life Sciences Queensland Mr Mario Pennisi
Prof. Anton Middelberg Acting DVC Research	Glycomics Institute Prof. Mark von Itzstein, Director	Australian Centre for Health Services Innovation (AusHSI) Prof. Nicholas Graves	Dr Sue Hooper Director – Health and Medical Research	QIMR Berghofer Prof. Frank Gannon, Director
Australian Institute for Bioengineering and Nanotechnology Prof. Peter Gray, Director			Metro North HHS* Mr Malcolm Stamp Chief Executive	Queensland Children's Medical Research Institute Prof. Keith Grimwood, Director
Department of Medicine and Biomedical Sciences Prof. Nicholas Fisk, Executive Dean			Metro South HHS* Dr Richard Ashby Chief Executive	Wesley Research Institute Prof. Christian Gericke, CEO
Department of Health and Behavioural Sciences Prof. Bruce Abernethy, Executive Dean				Translation Research Institute Prof. Ian Frazer
Diamantina Institute Prof. Matt Brown, Director				Mater Research Institute Prof. John Prins, Director
Institute for Molecular Biosciences Prof. Brandon Wainwright, Director				
Queensland Brain Institute Prof. Perry Bartlett, Director				
University of Queensland Centre for Clinical Research Prof. Murray Mitchell, Director		Key point Consultation with clients was conducted through face-to-face interviews by the audit team		
Tetra Q Prof. Maree Smith, Director			*Hospital and Health Service	

Why do Governments invest in Science?¹



Introduction

This assessment and strategic analysis of the science and research activities, and the Queensland Government's investment, in health and biomedical research institutes in the State is intended to provide the Government with an evidence-based decision framework to support current and future investment.

The end result should be for Queensland to maintain its current position – and indeed grow this - with respect to research excellence, while taking a leadership role in the next stage: converting that research into useful clinical and commercial outcomes.

Role of the Queensland Government

- The State has a role in **linking health and medical research into the needs of the State**. In achieving this, disciplines such as health economics play a key role.
- It is not the recommendation of this report that the Queensland Government, in a fiscally restrained environment, direct more State funding towards basic research, which is the domain of the Australian Government. Rather, the report makes recommendations that carefully employ State funds to **drive integration** of research outcomes into the health care system and into commercial outcomes, i.e. translation.
- However, it is worth noting that the State government can play a role in funding basic research, when:
 - there is a lack of alignment between the science and research priorities of the State and those of the Australian Government
 - when there is a strategic opportunity to address a Queensland specific challenge, leverage private sector investment in the State, or drive a Queensland specific opportunity.

- Queensland also has clearly defined **science and research priorities** –

"To ensure any future investments provide value for money and are well aligned with any Queensland Government objectives, the Queensland Chief Scientist has reviewed Queensland's science and research priorities to ensure they are focussed on well defined areas, and reflect identified needs and activities considered important by the Government. These priorities ... also align with the 30 year Queensland Plan vision and the ... Strategic Research Priorities for Australia." 1

- Priorities of direct relevance to this report include:
 - Remain internationally competitive by attracting and retaining science and research talent.
 - Early detection, treatment (and ultimately) prevention of age-related and Queensland dominant diseases (e.g. skin, tropical).
 - Improving health data management and services delivery (including telemedicine).

Introduction

Role of the Queensland Government

The Queensland Plan: Queenslanders' 30-year vision

Our brightest minds will take on the world and we will work collaboratively to achieve the best results for Queensland.

Our bright minds are fostered to lead the research and innovation that drives economic success.

In July 2014, the Queensland Government released The Queensland Plan: Queenslanders' 30-year vision. The following targets and goals are of direct relevance to this report:



TARGET	GOALS	SUCCESS FACTORS
FOUNDATION: ECONOMY <i>Economic prosperity creates opportunity</i>		
Bright ideas: Our brightest ideas have real social and economic benefits.	G13 - We are focused on industry development and diversification G15 - Our centres of excellence drive innovation	<ul style="list-style-type: none">• We maximise opportunities in Asia.• Our businesses work together to innovate and embrace new opportunities.• We are a global leader in innovative industry practices.<ul style="list-style-type: none">- Local and international specialists develop ground-breaking processes and products.- Innovation is embedded into our education and training, providing workers with the skills to identify and the support to act on opportunities.- Innovative businesses and emerging industries are encouraged and supported. We have the highest proportion of start-ups and entrepreneurs in Australia.• All regions have a centre of excellence for training, innovation and employment.• Our education is technologically advanced - attracting foreign students.• Our knowledge economy is strong, specifically in science, professional services, and research and development.• We invest and convert research into innovation.*

Introduction

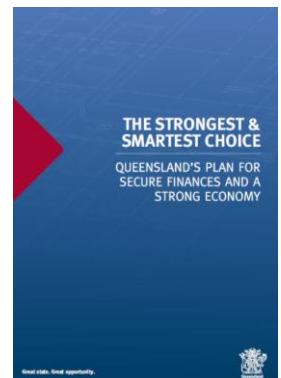
Role of the Queensland Government

The Queensland Plan: Queenslanders' 30-year vision

TARGET	GOALS	SUCCESS FACTORS
FOUNDATION: HEALTH AND WELLBEING <i>Active, healthy lifestyles drive our success.</i>		
<i>Life expectancy:</i> Regional and Aboriginal and Torres Strait Islander Queenslanders have the same life expectancy as other Queenslanders.	G16 - We are physically and mentally healthy.	<ul style="list-style-type: none">• We have a balance between prevention and treatment.<ul style="list-style-type: none">- Our healthcare system is sustainable.• Lifestyle diseases are in decline.• Life expectancy has increased for Indigenous Queenslanders.• We have improved affordability of healthy options.• Mental health has improved.
FOUNDATION: PEOPLE <i>Creating opportunities for everyone</i>		
<i>Liveability:</i> Queensland is the best place to live in Australia.	G27 - We attract bright minds to Queensland.	<ul style="list-style-type: none">• Regions are attractive to bright minds and trained professionals.*<ul style="list-style-type: none">- We attract bright minds to Queensland through our reputation and the global ranking of our universities.• Queensland has a reputation for innovative excellence.<ul style="list-style-type: none">- We are future-focused, with significant investment in research and development, and innovation.- We offer an attractive lifestyle where bright minds and innovative thinking are encouraged, and diversity is fostered.

The Strongest and Smartest Choice: Queensland's Plan for Secure Finances and a Strong Economy

The Strong Choices Investment Package will establish a series of funds to provide ongoing support for a broad range of public infrastructure projects over the next six years, including the proposed \$500 million *Entrepreneurial and Innovation Fund*.



Key Findings: Historical Government Investment

Historical Funding Commitments (prior to 2013-2014)¹

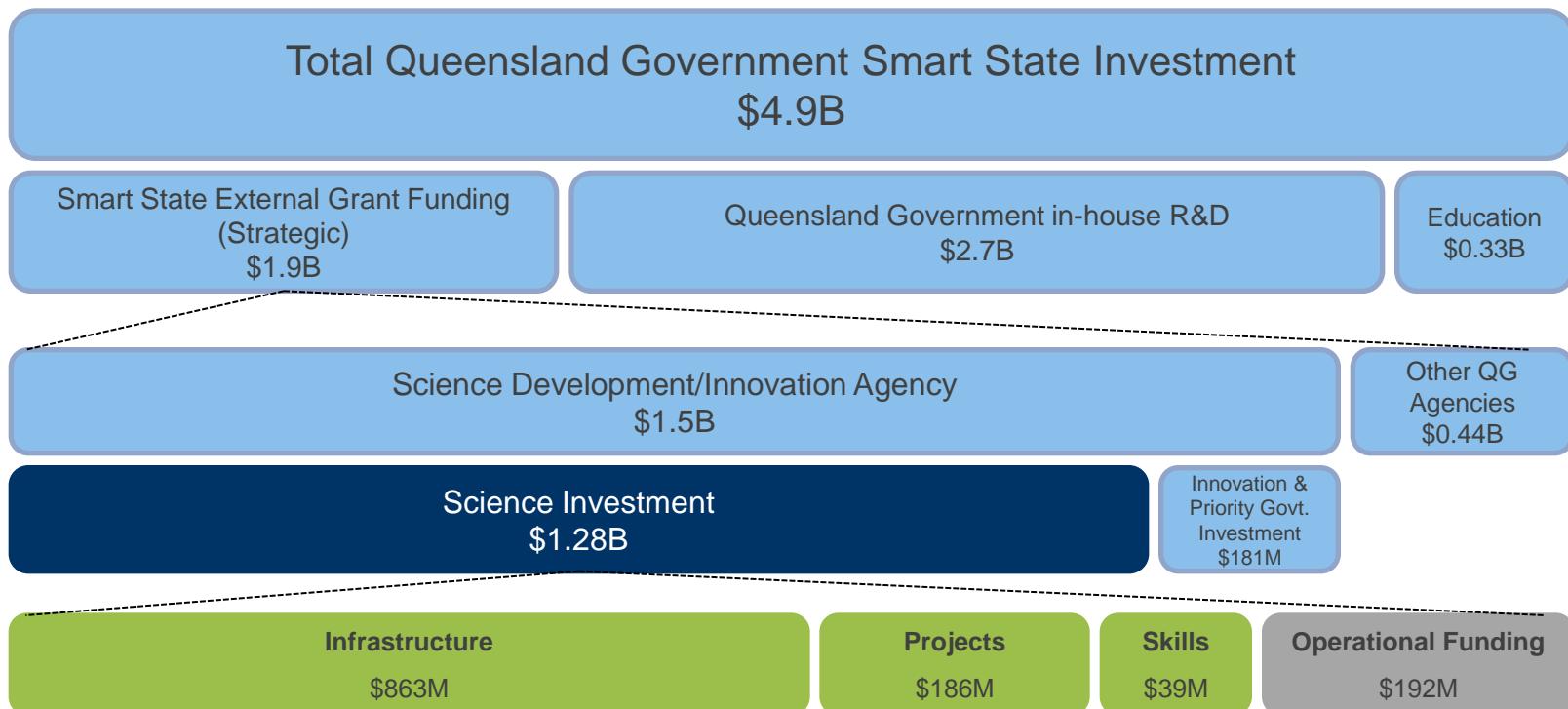
Queensland Government

The Queensland Government's strategic investments in health and biomedical science capability over the last decade have left an enduring legacy – having a significant impact upon Queensland's competitiveness in terms of its global reputation for science excellence and its research capability.

- Between 1998 and 2011, the Queensland Government invested \$4.9 billion into science, research and development, innovation

and education through the Smart State policy.

- Of this \$4.9 billion, DSITIA and its predecessors invested \$1.28 billion towards science infrastructure (\$863 million), operational funding (\$192 million), projects and collaborations (\$186 million) and skills (\$39 million).¹



Key Findings: Historical Government Investment

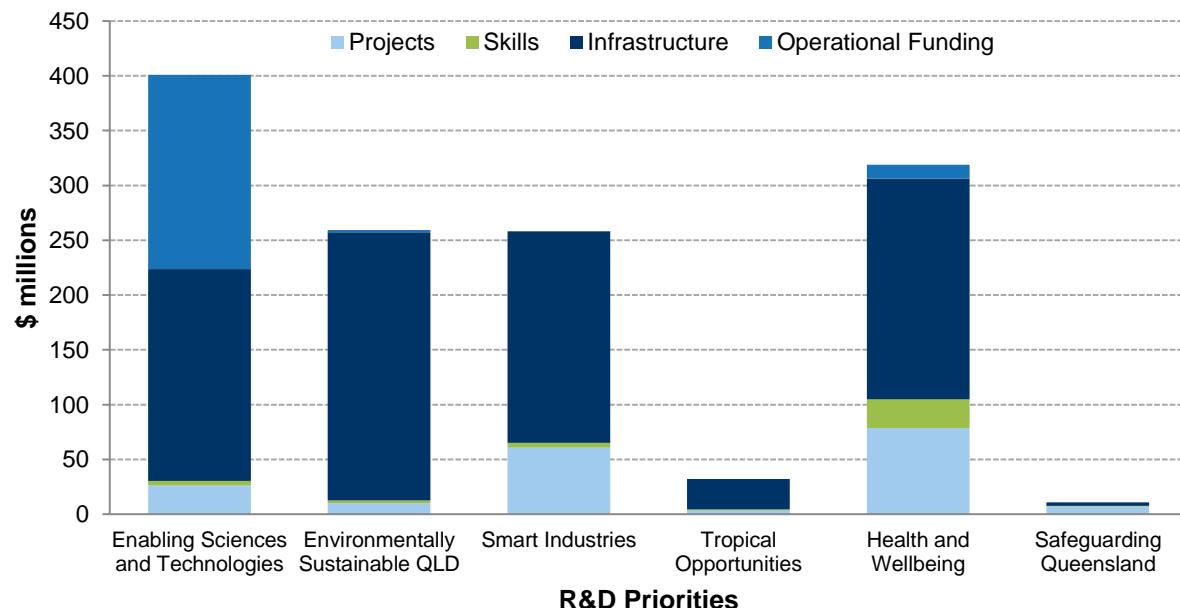
Historical Funding Commitments (prior to 2013-2014)¹

DSITIA and its predecessors

- The \$1.28 billion science investment by DSITIA and its predecessors included the following areas of relevance to this report:
 - Projects: \$69.3 million in health, \$6.1 million in community wellbeing, \$26.5 million in enabling science and technology
 - Skills: \$21.8 million in health, \$2.4 million in community wellbeing, \$4 million in enabling science and technology
 - Operational: \$12.1 million in health, \$0.4 million in community wellbeing, \$177 million in enabling science and technology
- This investment has leveraged approximately \$2.7 billion from external sources.

"As per the figure below, overall, the largest quantum of research investment in external agencies has been in the R&D priority of the Enabling Sciences and Technologies (33% of total investment) with, as previously noted, a strong (65%) focus on biological sciences. This is followed by Health and wellbeing (22%), an Environmentally sustainable Queensland (21%) and Smart Industries (21%). The remaining 3% investment was within the R&D priorities of tropical opportunities and safeguarding Queensland."¹ #

Science Investment by R&D Priorities (Total \$1.28 billion)¹



Note, these R&D priorities are historical - predating the 2014 Queensland Government Science and Innovation Action Plan and associated Queensland Science and Research Priorities. However, they reflect the Queensland Government R&D priorities at the time of the Smart State funding commitment.

Key Findings: Historical Government Investment

Historical Funding Commitments (prior to 2013-2014)¹

Queensland Government - Funding for Infrastructure (Capital and Operational)

- The Queensland Government has made significant investments in new health and biomedical infrastructure in the State.
- Of the \$1.28 billion science investment made by DSITIA and its predecessors from 1998 to 2012,² \$1.055 billion was committed to provide infrastructure and operational support support:¹
 - \$370.4 million for enabling science and technology
 - \$213.3 million for health related capital and operational support
 - \$27.7 million for tropical opportunities (infrastructure)
 - \$0.4 million for community well being (operational).
- Between 1999 and 2012, the Queensland Government (DSITIA and Department of Health) committed \$528 million in infrastructure (capital and operational) support for the institutions covered in this review. Some of these funds will be expended in out years.
- DSITIA and the Department of Health have supported the construction of major health and biomedical research facilities in the State, such as:
 - The Translational Research Institute - \$46.7 million
 - BioPharmaceuticals Australia - \$7.09 million
 - The Institute for Molecular Biosciences - \$15 million
 - QIMR Berghofer Central - \$35 million.
- This investment has leveraged substantial funding from other sources, including philanthropy, the university sector, the Australian Government and industry.
- In 2012, the Queensland Government committed a total of \$42.12 million over three years (expenditure beginning in 2013-2014) towards the Australian Institute of Tropical Health and Medicine at James Cook University.
 - This includes \$34.32 million for construction of facilities in Cairns, Townsville and the Torres Strait, and is supported by a \$42 million contribution from the Australian Government.
- There has also been considerable support from the Government, through DSITIA and its predecessors, and through the Department of Health, for operational funding for key health and medical research organisations, including the following **commitments** (some of the committed expenditure is for out years):
 - university institutes
 - Institute for Molecular Biosciences: \$127.5 million (\$10 million expended in 2013-2014)
 - Queensland Brain Institute: \$25 million
 - Australian Institute of Tropical Health and Medicine: \$7.8 million over 3 years, beginning in 2013-2014.
 - independent medical research institutes
 - QIMR Berghofer: \$66.9 million since 2009
 - Mater Research Institute: \$4.87 million (2007 to 2013)
 - Wesley Research Institute: \$1.2 million (2007 to 2013)
- See table on following page for details

Key Findings: Historical Government Investment

Historical Funding Commitments (prior to 2013-2014)

Queensland Government (DSITIA and Queensland Health)[#] infrastructure funding commitments: capital and operational - awarded to the institutes under this review (1999 to 2012)¹

INSTITUTE (considered in this review)	Capital Projects	Operational support	NOTE
Australian Centre for Health Services Innovation (AusHSI)		2.08	\$1.21M in 2013-2014 ²
Australian Institute for Bioengineering and Nanotechnology	20.00		
Australian Institute of Tropical Health and Medicine (AITHM)	34.32	7.80	Expended over 3 years from 2013-2014
BioPharmaceuticals Australia	7.09		
Centre for Integrated Preclinical Drug Development incorporating TetraQ	8.10		
Eskitis Institute (including \$3.5M for Queensland Compound Library)	15.50		
Institute for Glycomics	19.00		
Institute of Health and Biomedical Innovation (IHBI), QUT	22.50		
Institute for Molecular Bioscience	15.00	127.50	\$10M in 2013-2014 ²
Mater Research Institute	13.00	4.87 #	From 2007.
QIMR Berghofer Institute for Medical Research	35.00	66.94 #	From 2007. \$18.86M in 2013-2014
Queensland Brain Institute	20.00	25.00	
Queensland Brain Institute - Clem Jones Centre for Ageing Dementia Research (CJCADR)		9.00	Expended over 5 years from 2013-2014
Queensland Children's Medical Research Institute			
St Andrews Medical Institute			
Translational Research Institute (TRI) (\$46.7M + \$2.52M equity)	49.22		
University of Queensland Centre for Clinical Research (UQCCR)	20.00		
Wesley Research Institute (WRI)	12.22	0.95 #	From 2007. \$0.25M in 2013-2014 ²
Sub Total: \$283.86M		SubTotal: \$244.14M #	TOTAL: \$528M #

Others of relevance

e-Health research centre		5.00	
Facility for Medical Diagnostic Technologies in Queensland (MedTeQ)	1.83		
Medical Engineering Research Facility	5.00		
Queensland Nuclear Magnetic Resonance Network	5.04		
Queensland Tropical Health Alliance	19.50		

Key Findings: Historical Government Investment

Historical Funding Commitments (prior to 2013-2014)

Queensland Government - Funding for Programs, Projects and Initiatives

- The Government's investment in health and biomedical infrastructure has attracted world class science and scientists to the State. This has been facilitated by Government funding for skills and project support.
- Of the \$1.28 billion science investment made by DSITIA and its predecessors from 1998 to 2012, \$225 million was committed to provide people and project support.¹
 - \$91.1 million for health related projects and skills support
 - \$26.9 million for enabling science and technology
 - \$8.5 million for community well being.
- As per the table below, between 2008 and 2012 (under Smart State 3 and 3a) the Queensland Government, through DSITIA and its predecessors, committed \$18.67 million in competitive funding to support projects and fellowships in the institutes considered in this review.
- Additional fellowship support for health and biomedical research has been provided through \$39.5 million committed by the Department of Health for **health and medical research fellowships** between 2010 and 2012.

Queensland Government competitive funding (DSITIA): projects and fellowships - awarded to the institutes under this review (2008 to 2012)

INSTITUTE ²	Project funding (\$ millions)	Fellowship funding (\$ millions)
Australian Institute for Bioengineering and Nanotechnology	2.24	2.87
Eskitis Institute	2.08	
Institute for Glycomics	0.71	
Institute of Health and Biomedical Innovation (IHBI)	2.88	1.43
Mater Research Institute		0.81
QIMR Berghofer Institute for Medical Research	1.8	0.66
Queensland Brain Institute	1.5	0.45
Translational Research Institute		1.25
TOTAL	\$11.2 million	\$7.47 million

Key Findings: Historic Government Investment

Historical Funding Commitments (prior to 2013-2014)

Department of Health

Health and Medical Research Fellowships

Senior Clinical Research Fellowships

Funding of up to \$850,000 per annum for five years available to attract and retain researchers to Queensland who are international leaders in their field.

Health Research Fellowships

The Health and Medical Research Fellowships provide funding of up to \$150,000 per annum for three years as salary support which will allow Hospitals and Health Services to back-fill the clinical time of practicing clinicians or other health professionals to undertake clinical or health service research.

Clinical Academic Fellowships

The Clinical Academic Fellowships provide funding of up to \$75,000 per annum for five years towards the salary of a new clinical academic position.

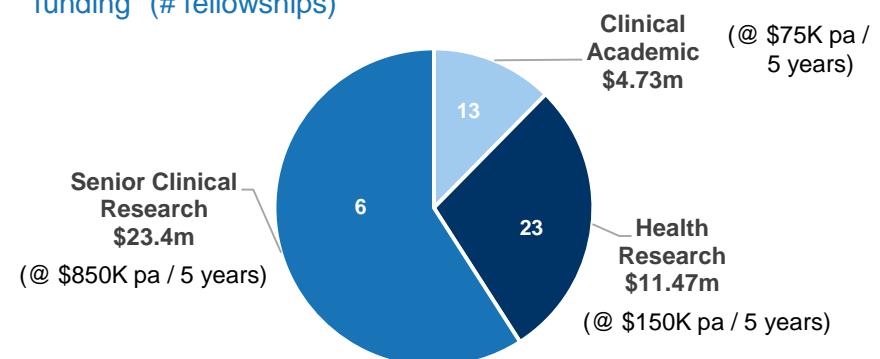
The fellowships are designed to increase collaboration between Queensland Government health care facilities and Queensland universities by jointly creating a new position for a clinical academic.

Other fellowships

In 2012, Queensland Health also announced the first round of the Nursing & Midwifery and Physiotherapy fellowships from the Trusts available for these (total of \$362K awarded for 8 fellowships).

- The Department of Health has committed \$39.5 million since 2010 towards the Health and Medical Research Fellowships.
- Fellowships awarded from 2013 applications have not yet been announced. A full list of the awarded fellowships is at Appendix 1.
- Over half of the funding has supported six Senior Clinical Research Fellowships throughout Queensland, in the following areas:
 - respiratory diseases
 - infectious diseases
 - transplantation immunology
 - cardiovascular medicine and haematology
 - Aboriginal and Torres Strait Islander health
 - cancer cell biology.
- Metro North and Metro South Health and Hospital Service both reported providing in house clinical fellowship support.

Department of Health - health and medical research fellowships funding* (# fellowships)



Key Findings: Current Government Investment

Current Funding for Research Institutes

Health and Medical Research in Australia is funded from a variety of sources¹⁻³

1. Australian competitive research grant schemes, funding the direct costs of research, principally:

- National Health and Medical Research Council (NHMRC) grants - Australia's peak body for supporting health and medical research. NHMRC funding in 2013 was \$858 million.
- Australian Research Council (ARC) grants – the ARC explicitly does not support research in clinical medicine, however it does support research into human health topics as well as basic biological sciences with potential applications in health.²

2. Australian Government operational support, to provide for the indirect costs associated with research in Australia:

- For Universities (Higher Education Providers): Higher Education Provider Research Block Grants - Secondary gains provided to universities to cover the indirect cost associated with university research in Australia

- Participating universities receive an annual grant amount (block) and are responsible for administering this block funding within broad guidelines – exactly how each university distributes these funds back to the university's researchers and research organisations varies between universities, and is not entirely transparent
- Estimates vary, but **on average universities receive around 40-50 cents per dollar of competitively awarded research grants** from the various funding schemes (ARC and NHMRC)¹
- In 2014, the Australian Government is expected to provide \$1.72 billion to Australian universities as block grants to support research and research training.³

3. For Independent Medical Research Institutes

- Funding is provided annually for overhead infrastructure costs specifically for NHMRC accredited independent medical research institutes based on a proportion of competitive research funding awarded to the institute by the NHMRC through the Independent Research Institutes Infrastructure Support Scheme (IRIIS)

- Where sufficient funds are available, **recipients are paid 20 cents per dollar of competitively NHMRC awarded research grants**.

4. International research grant schemes, principally the U.S. National Institutes of Health (NIH)

5. Private Funding, including

- Philanthropy
- Business & Industry support.

1. Shaping Up: Trends and Statistics in Funding Health and Medical Research. Research Australia, 2011.

2. Submission to National Commission of Audit. Australian Association of MRIs. 26 November 2013.

3. <http://docs.education.gov.au/node/34765>

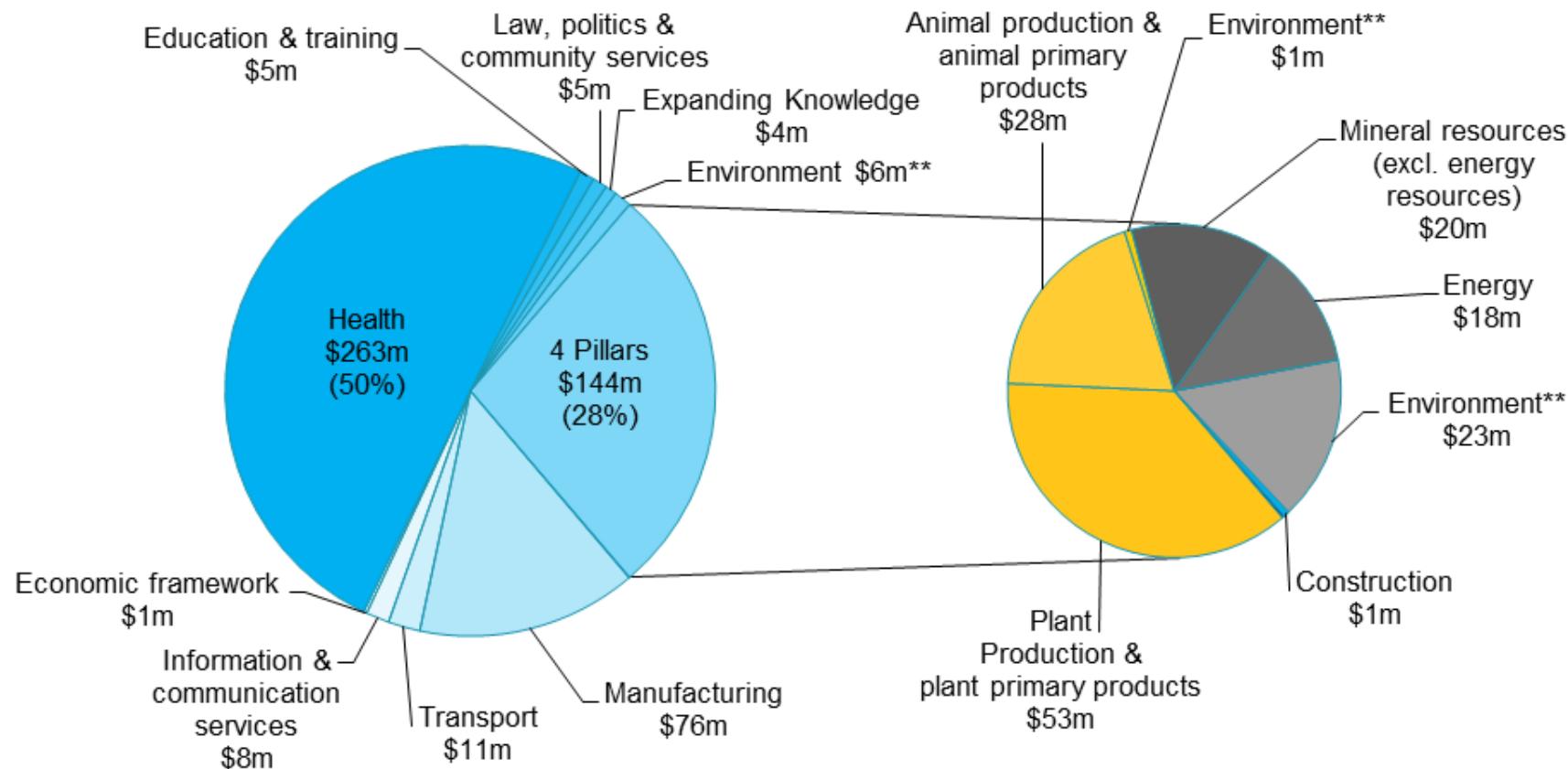
Key Findings: Current Government Investment

Current Queensland Government R&D Expenditure¹

- In 2012–13, **Queensland Government spend** on R&D was \$431 million (including leveraged funds).
- **Total Queensland Government expenditure**, including funds leveraged by QIMR Berghofer of \$91.5 million, gives a ‘real’ total of \$523 million for 2012-13.
- Of this, \$203m was **direct Queensland government funding**, of which \$80 million was spent in-house and \$123 million spent externally.
- A further \$320 million was **leveraged** from the Australian Government, universities, businesses and other external sources (including \$91.5 million in leveraged funds from QIMR Berghofer).
- **Health** is the largest area of research performed across a number of departments and government bodies (including QIMR Berghofer) with 50% (\$263 million of \$523 million) of funding going towards this area of research. Of this \$263 million :
 - \$97 million is DSITIA competitive grant funding and other funding e.g. including Centre of Advanced Imaging, Institute of Molecular Bioscience and the Queensland Tropical Health Alliance
 - \$155 million is expended by Queensland Health, the HHSs and QIMR
 - \$12 million is expended by various other departments and government bodies.
- The **Department of Science, Information Technology, Innovation and the Arts** (DISITIA) is the largest funder of R&D within the Queensland Government and invested 36% (\$72 million) of Queensland Government funding in performing research across a variety of disciplines and funding research externally, as well as substantial infrastructure commitments (e.g. The Centre for Advanced Materials Processing and Manufacturing and the Queensland Tropical Health Alliance). Department of Agriculture, Fisheries and Forestry (DAFF) is the second largest at 28% (\$57 million).
- The **Department of Health** spent 14% (\$28 million of \$203 million) of Queensland Government funds, with an additional 5% (\$10 million) spent by nine of the 17 Hospital and Health Services (board-run hospitals that provide public health services in Queensland, reporting to the Department of Health and set up in 2012). This also includes the \$13.97 million provided to QIMR Berghofer as operational funding upon which QIMR Berghofer leverages substantially to develop a significant R&D portfolio.

Key Findings: Current Government Investment

Total Queensland Government R&D Expenditure (\$523m*) for 2012-13 and the four pillar areas of research** 1



Total Queensland Government R&D expenditure includes both Queensland Government funding (\$203m) and leveraged funds (\$320m) for 2012-13, including \$91.5 million in leveraged funds from QIMR Berghofer.

The research areas are Socio-economic objectives as defined by the Australia Bureau of Statistics. The four economic pillars are: **Agriculture (yellow): animal production and animal primary products, plant production and plant primary products, and projects aligned to agriculture and environment.

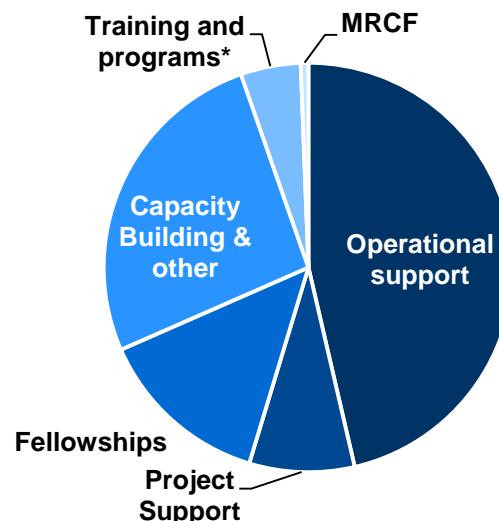
Construction (blue): construction. **Resources (grey)**: mineral resources; energy; and **Tourism** of which there was no expenditure.

Key Findings: Current Government Investment

The Department of Health

- In information provided by the Funding and Contract Management Unit and the Allied Health Professions Office of Queensland, the Department of Health (not including Health and Hospital Services) expended \$49.28 million in contractual commitments to universities and research institutions for research and research support in FY 2013-2014:
 - \$22.9 million in operational support
 - \$10.9 million in direct research support, including project support and fellowships
 - \$13 million for capacity building
 - \$2.3 million to support training and programs*
 - \$300,000 for the Department's annual commitment toward the Medical Research Commercialisation Fund (MRCF).
- The commitment of \$22.9 million in operational support includes:
 - over \$20 million to support institutions specifically addressed in this review
 - Australian Centre for Health Services Innovation (AusHSI) (\$1.21 million)
 - QIMR Berghofer Medical Research Institute (\$18.86 million, including \$5 million for depreciation of capital assets)
 - Wesley Research Institute (\$0.25 million).
- operational funding to the following health and biomedical related centres /programs /institutes:
 - Queensland Emergency Medical Foundation - \$2 million
 - Queensland Centre for Gynaecological Cancer - \$225,000
 - Cancer Prevention Research Centre (University of Queensland) - \$137,892
 - Centre for Palliative Care Research and Education (CPCRE) - \$370,388
 - The Skin Cancer Research Group (James Cook University) - \$16,304.

Department of Health contractual commitments for research and research support in FY 2013-2014



Key Findings: Current Government Investment

Department of Science, Information Technology, Innovation and the Arts

Accelerate Queensland Science and Innovation Program

In October 2013, the Queensland Government launched the Science and Innovation Action Plan. As part of the 'Action Plan' the Government committed to investing \$8.75 million as part of the new *Accelerate Queensland Science and Innovation Program*, which includes:

- \$3 million *Accelerate Fellowships* program that focuses on the development of early to mid-career fellowships.

The program supports early- and mid-career scientists with up to \$300,000 to undertake research that can have a positive impact on Queensland

- \$4.25 million *Accelerate Partnerships* program that focuses on collaborative science and research projects with an emphasis on translating research into outcomes for Queensland.

The program offers grants of up to \$500,000 to support projects which involve collaborations, and improve linkages between research and the frontline where it can be applied and have impact.

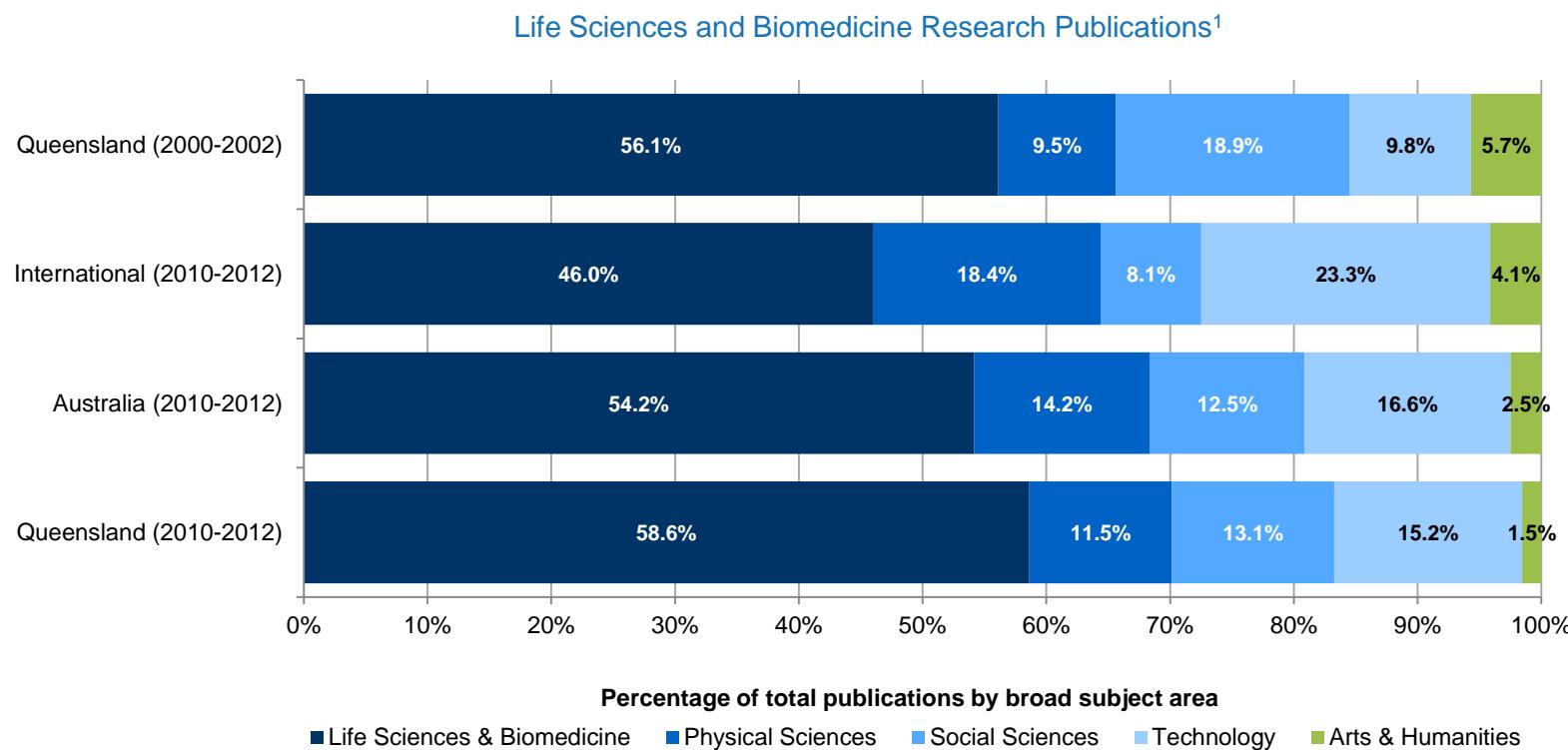
- Up to \$1.5 million in *Accelerate Ideas* to assist collaborations between researchers and industry to demonstrate the commercial viability of new ideas.
- Round 1 of the *Accelerate Fellowships* and *Accelerate Partnerships* programs have now been awarded.
- **The following recipients are of relevance to this review.**

Recipient	Project name	Funding amount	Project description
Central Queensland University	Building resilience in regional schools	\$203,273	To develop a mental health resilience program for early secondary school children in regional Queensland.
Queensland University of Technology	CHERISH: Better, cheaper hospital care	\$498,228	To speed the recovery of older patients after serious illness, by translating the 'Eat Walk Engage' program developed at the Royal Brisbane and Women's Hospital to other hospitals.
Recipient	Fellowship title	Funding amount	Project description
Assoc. Prof. Scott Wearing, Queensland University of Technology	Innovative technologies to aid early detection of diabetic foot ulcers	\$300,000	This project will investigate innovation technologies to aid early detection of diabetic foot ulcers.
Dr David Muller, The University of Queensland	Novel tetravalent dengue virus subunit vaccines delivered by Nanopatch	\$180,000	This project will develop a low-cost and effective dengue vaccine based on Queensland-developed Nanopatch - a needle-free way of delivering vaccines.
Dr Gabriella Constantinescu, Hear and Say	Telemedicine helping deaf children in rural Australia learn spoken language	\$180,000	This project will investigate the effectiveness of delivering specialised listening and spoken language early intervention for children with hearing loss in regional areas via telemedicine.

Key Findings: Areas of Strength

Life Sciences and Biomedicine Research

- Queensland has a history of excellence in research and productivity in the health and biomedical sciences.
- The life sciences (including health) and biomedicine make up a large majority area of active research in Queensland as measured by scientific publication.¹
- It comprises a larger share of Queensland's scientific publication activity than seen in Australia and the rest of the world and has grown in importance over the past decade.

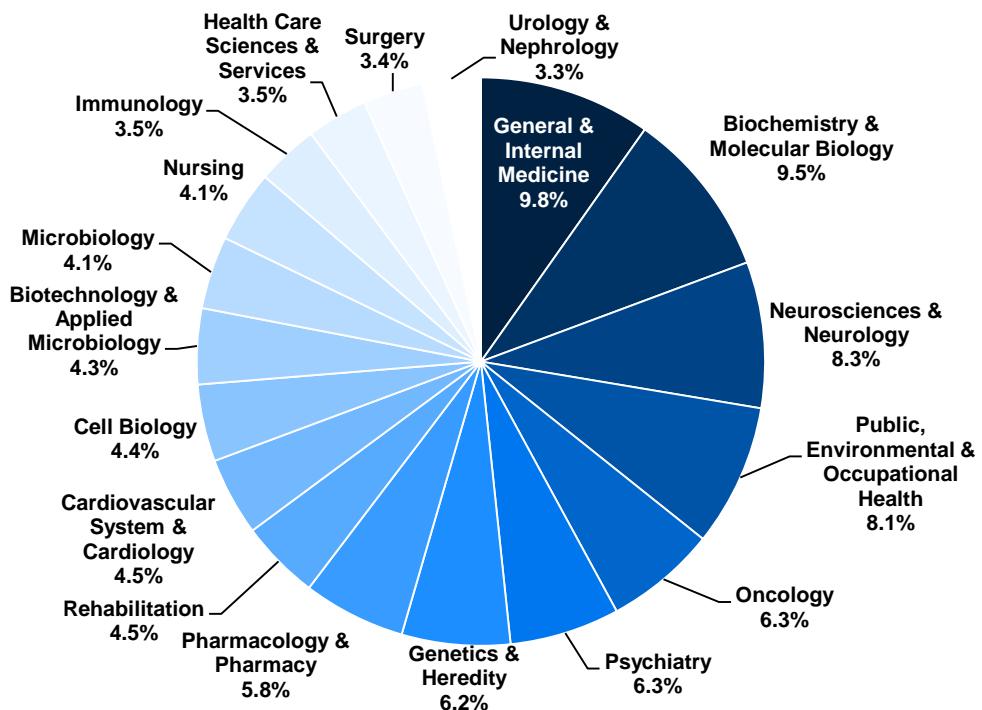


Key Findings: Areas of Strength

Queensland's Health and Biomedical Research

- This following was clearly reflected in our interviews with health and biomedical stakeholders, and confirmed in a general bibliometric analysis and a review of the publication record of key institutes.
- Key basic research strengths in the State include:
 - Genomics / Genetics / Bioinformatics
 - Immunology and pharmacology
 - Cellular and molecular biology
 - Drug design and discovery.
- This strength is also reflected in the findings of the Excellence in Research for Australia (ERA) 2012 National Report. The ERA report also showed particular strengths in medical microbiology and nursing.² ERA data is outlined on page 30.
- Queensland also has capacity and strong capability in the following platform technologies / capabilities
 - Gene sequencing
 - Advanced medical imaging
 - Early phase clinical trials.

Queensland Health and Biomedical Research Publications
(Research areas with 500 or more publications 2010-2012)¹



Key Findings: Areas of Strength

Queensland's Health and Biomedical Research – ERA Results 2012

The Excellence in Research for Australia report provides an assessment of research strength in Australia's universities (does not include independent medical research institutes) which is based on a detailed review of publication data, research outputs, researchers, external income and institutes).

Ranking	Definition
1	Well below world standard
2	Below world standard
3	At world standard
4	Above world standard
5	Well above world standard

Queensland Health and Biomedical related ERA results 2012 (N/A = not assessed)

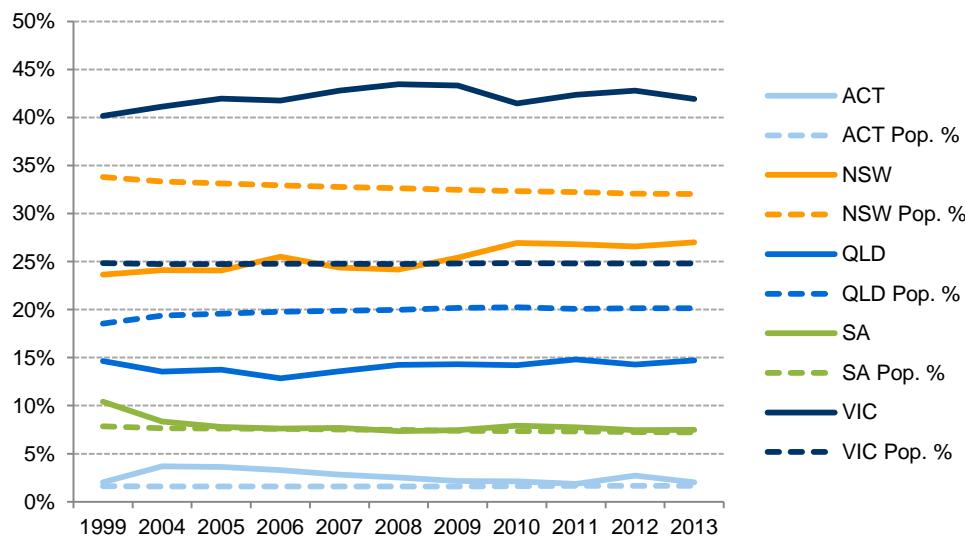
Field of Research	Griffith University	James Cook University	Queensland University of Technology	University of Queensland	Central Queensland University	University of Southern Queensland	University of the Sunshine Coast
Medicinal and Biomolecular Chemistry	3	N/A	N/A	4	N/A	N/A	
Biochemistry and Cell Biology	2	3	N/A	4	N/A	N/A	
Genetics	3	3	N/A	4	N/A	N/A	
Microbiology	3	3	3	4	N/A	N/A	
Medical and Health Sciences	3	2	3	5	3	2	1
Medical Biochemistry and Metabolomics	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cardiovascular Medicine and Haematology	N/A	3	N/A	5	N/A	N/A	N/A
Clinical Sciences	3	1	N/A	5	N/A	N/A	N/A
Complementary and Alternative Medicine	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dentistry	3	N/A	N/A	4	N/A	N/A	N/A
Human Movement and Sports Science	2	1	4	5	N/A	N/A	N/A
Immunology	3	4	N/A	5	N/A	N/A	N/A
Medical Microbiology	4	5	N/A	5	N/A	N/A	N/A
Neurosciences	3	4	N/A	5	N/A	N/A	N/A
Nursing	4	3	4	5	3	N/A	N/A
Nutrition and Dietetics	N/A	N/A	4	N/A	N/A	N/A	N/A
Oncology and Carcinogenesis	3	N/A	3	5	N/A	N/A	N/A
Ophthalmology and Optometry	N/A	N/A	3	N/A	N/A	N/A	N/A
Paediatrics and Reproductive Medicine	N/A	2	N/A	4	N/A	N/A	N/A
Pharmacology and Pharmaceutical Sciences	2	2	N/A	4	N/A	N/A	N/A
Medical Physiology	2	N/A	N/A	N/A	N/A	N/A	N/A
Public Health and Health Services	1	1	3	4	2	1	N/A
Other Medical and Health Sciences	N/A	N/A	N/A	N/A	5	N/A	N/A

Key Findings

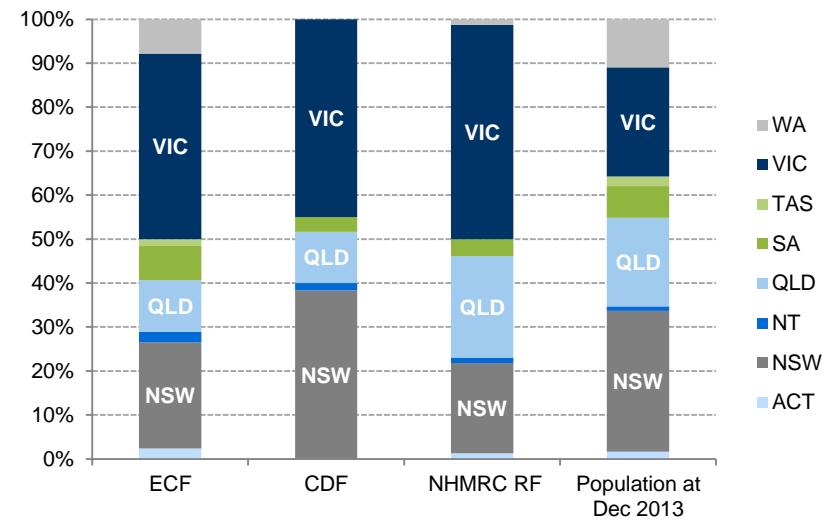
Health and Medical Research Funding for Queensland

- However, despite this record of publication excellence, we are concerned that Queensland's performance in overall NHMRC Funding (project, people and other support) has remained relatively constant since 1998, when the Smart State Investments commenced.
- During this time, Queensland's proportion of overall NHMRC funding has remained well below what might be expected in proportion to the State's population and contribution to the national GDP (both approximately 20%).
- This is also true when evaluating the NHMRC funded fellowships for health and medical researchers, including the Early Career Fellowships (ECF – to foster career development at the postdoctoral level), Career Development Fellowships (CDF – to enable early- to mid-career researchers to establish themselves as independent, self-directed researchers) and NHMRC Research Fellows (RF – to enable high-calibre researchers to undertake full-time research). (also see page 37).
- These findings are in no way a definitive measure of the clinical research activity in the State. However, when viewed alongside health and medical publication data (p 33), they cannot be ignored - particularly when seen in comparison to the performance of Victoria.

Percentage of NHMRC funding received, by state.^{1,2}



NHMRC people support – percentage of fellowships (# fellowships not \$ funded) received, by state (1990-2013).^{1,2}

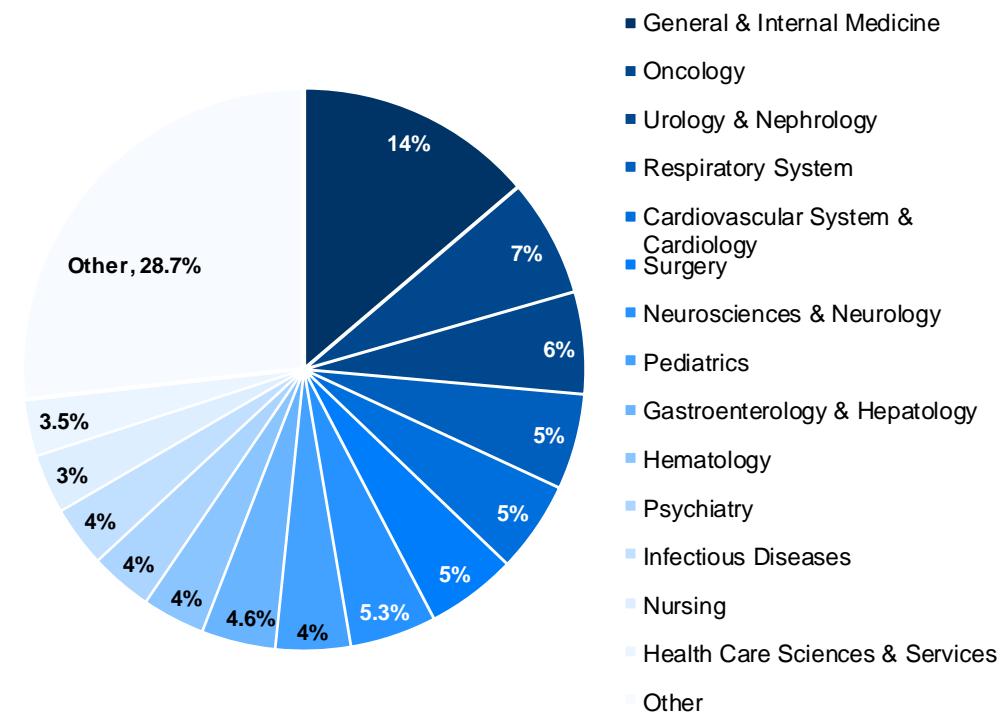


Key Findings: Areas of Strength

Disease Focus

- Queensland has particular research strengths in the following disease areas:
 - Tropical and infectious diseases
 - Kidney disease
 - Neurodegenerative and behavioural disorders
 - Cancer, with particular expertise in skin / prostate
 - Cardiovascular and respiratory diseases.
- This finding was supported by information gathered during the consultation process, and informed by a bibliometric analysis (p27) and an analysis of the Top 15 Research Areas within Queensland Health (based on Queensland Health Authored Publications).
- Queensland also has expertise in:
 - Vaccine development and delivery, including:
 - development of the world-first cervical cancer vaccine Gardasil
 - research towards development of a needle-free vaccine delivery solution, with strong industry support
 - Early phase clinical trials of a new approach to a malaria vaccine.
 - 'Tele'- medicine/health/rehabilitation.

Queensland Health Authored Publications by Research Area 2010-2012. Top 15.¹



Key Findings: Areas of Strength

Queensland Health's program of health and medical research fellowships

The health and medical fellowships programs within Queensland Health have added significant value to building and supporting clinical research excellence in the State.

- During the stakeholder interviews, there was a general consensus, from researchers, clinicians and administrators, that the clinical research fellowships administered by Queensland Health (*Senior Clinical Research Fellowships*, *Clinical Academic Fellowships*, and *Health Research Fellowships*) add significant value to building and supporting clinical research excellence in the State.
- Details of funding provided for the fellowship program are outlined on page 22.
- The salary support provided by the *Health Research Fellowships* (\$150,000 per annum for three years) to back-fill the clinical time of practicing clinicians or other health professionals undertaking research goes a long way towards supporting the research activities of early and mid-career clinicians.
- Both Metro North and Metro South HHS also reported providing competitive, in-house support for clinicians wishing to undertake research. However, not to the \$ value of the *Health Research Fellowships*.
- The *Senior Clinical Research Fellowships* (\$850,000 per annum for five years) have by all accounts played a valuable role in bringing change agents into the Queensland Health network – senior clinicians with established and well-regarded research programs, who can motivate and mentor young clinician researchers.
- However, during the stakeholder interviews, many of those consulted agreed that a gap was emerging (see pages 39-40) and some of the funds previously expended on *Senior Clinical Research Fellowships* should be redirected towards mid-career fellowships.

Key Findings: Collaboration and Engagement

Queensland Connectedness

International collaboration:

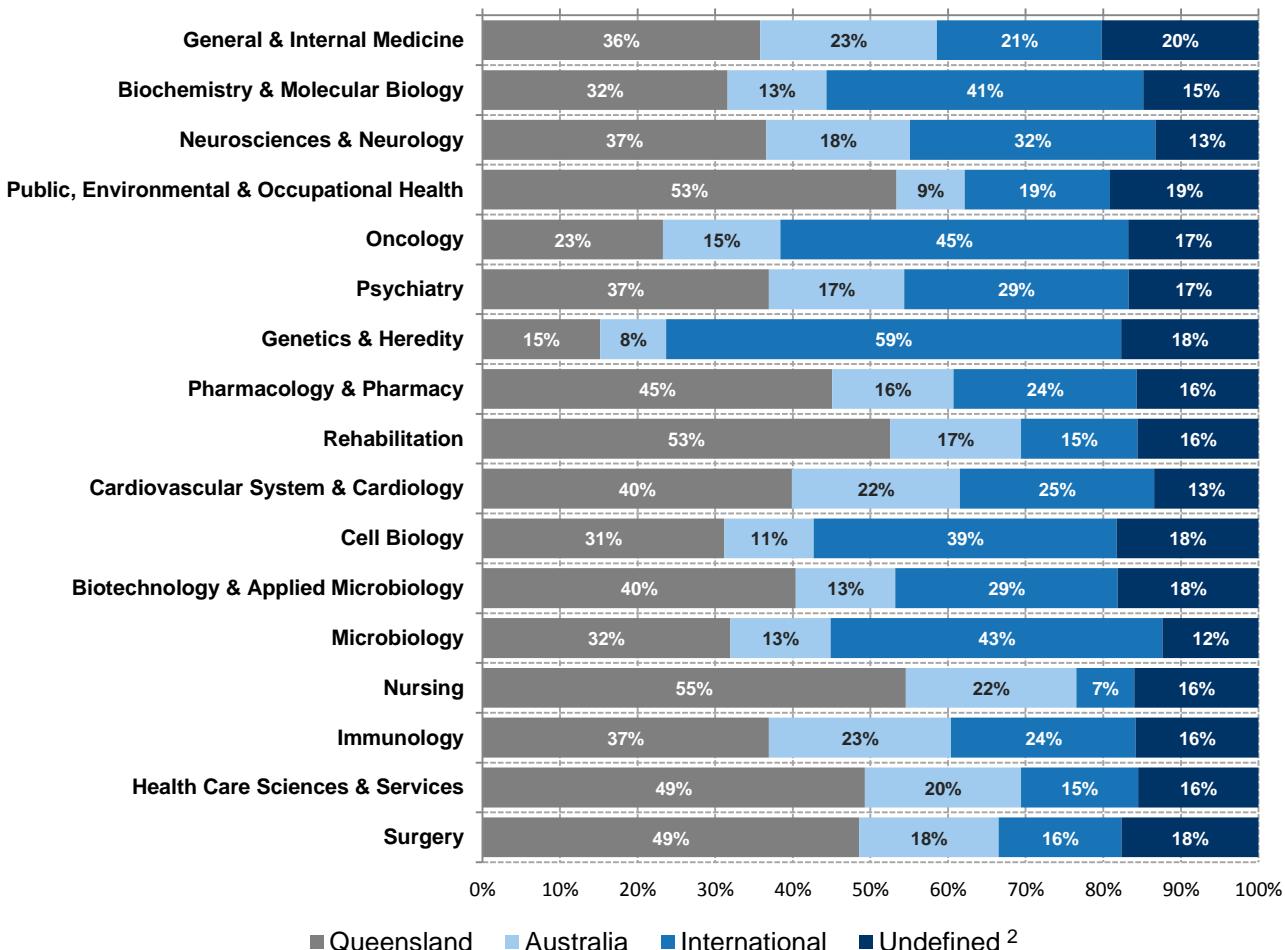
- Queensland's health and biomedical researchers appear to have a high level of international connectedness.¹
- This is particularly evident in the area of Genetics / Heredity and Oncology.

Local collaboration:

- Genuine collaboration and cooperation between Queensland's medical research institutes could be improved.
- However, there are several examples of emerging alliances between key research and clinical care organisations, such as the Herston Imaging Research Facility, the Head and Neck Cancer Centre, and the Queensland Mental Health Research Alliance.

Connectedness of Top Health & Biomedicine Research Areas¹

Percentage of publication affiliations from inside and outside Queensland 2010 - 2012



Key Findings: Collaboration and Engagement

International Collaboration

- Queensland's health and biomedical researchers appear to have a high level of international connectedness.¹
- Queensland's research collaboration with China is strong and a number of Queensland's health and biomedical research institutes have long-term collaborative relationships with Chinese partners.

Queensland-Chinese Academy of Sciences (CAS) Program²

- Queensland is the only sub-national government in the world to have a jointly funded collaborative research program with the CAS. Investment by the Queensland Government of nearly \$1.3 million has leveraged over three times the original investment by Queensland home and Chinese host institutions resulting in a total value of nearly \$4 million for the program.
- Health and biomedical projects supported under the program have delivered significant progress, including the establishment of the first joint Australia-China neuroscience laboratory and discoveries that will assist the development of new therapeutics for the treatment of neurological diseases such as dementia.
- CAS is now the single largest international science research collaborator with Queensland based on joint publications.

Queensland-China Science Partnerships

Queensland's health and biomedical research institutes have established a number of highly productive and valuable partnerships with colleagues in China, including:

- The Joint Sino-Australian Neurogenetics Research Laboratory between the Queensland Brain Institute, Diamantina Institute, and the Shanghai Changzheng Hospital and Second Military Medical University.
- The Joint Laboratory of Neuroscience and Cognition between the Queensland Brain Institute and the Institute of Biophysics of the Chinese Academy of Sciences.
- A collaboration between the Eskitis Institute and the Shanghai Institute for Materia Medica (SIMM) of the Chinese Academy of Sciences to investigate the development of pharmaceuticals from Traditional Chinese Medicines.
- A partnership agreement between the Institute for Glycomics and Institut Pasteur Shanghai for collaborative drug research and development.
- An MOU between Griffith University and the School of Public Health, Fudan University to encourage development of educational programs in public health.

Key Findings: Translation and Commercialisation

Commercialisation of research outcomes

Progressing the outcomes of research from public research institutions towards a commercial application is a tangible way to increase the socio-economic impact of publicly funded research.

However, the quantitative measures typically used to measure technology transfer activities are only able to capture a subset of the commercialisation activity from universities and research institutes.¹

Commonly used commercialisation indicators include patents issued, PCT patent applications,[#] licensing activity and revenue, formation of, investment in and the growth/development of start-up companies, and industrial funding of R&D.²

There are a number of mechanisms available to governments – and universities and research institutes – to facilitate the progress of research outcomes entering into and progressing through the commercialisation pipeline.

The Queensland Government and a number of Queensland's health and biomedical research institutes have invested in The Medical Research Commercialisation Fund.

The Medical Research Commercialisation Fund

The Queensland Government, through the Department of Health and DSITIA, have committed approximately \$2.5 million to support **The Medical Research Commercialisation Fund (MRCF)** since January 2009. MRCF is an investment collaboration that supports the development and commercialisation of early-stage medical discoveries from Australian medical research institutes and allied

research hospitals.

The MRCF is the only remaining seed/start-up fund dedicated to supporting very early-stage opportunities emerging from Australia's medical research institutes and research hospitals.

Queensland is a financial contributor to MRCF. There are also nine Queensland members of MRCF, including the following institutions considered under this review:

- Australian Institute for Bioengineering and Nanotechnology
- Australian Institute of Tropical Health and Medicine
- Diamantina Institute
- Institute for Health and Biomedical Innovation
- Institute for Molecular Bioscience
- QIMR Berghofer Medical Research Institute
- University of Queensland Centre for Clinical Research
- UQ - Mater Research Institute.

MRCF has successfully leveraged significant funding for Queensland early stage medical research companies. This includes the recent announcement of a successful US\$44.5 million fundraising round by Spinifex Pharmaceuticals (UQ - Diamantina). This is one of the single biggest fundraising events for any Australian biotechnology company and will support Phase 2 clinical trials of new treatments for neuropathic and inflammatory pain.

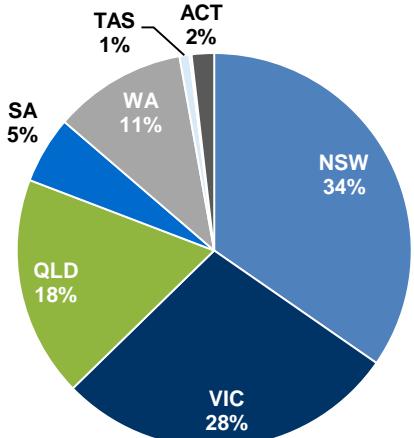
[#] The PCT is an international treaty that makes it possible to seek patent protection for an invention simultaneously in a large number of countries. The granting of patents remains under the control of the national or regional patent Offices.²

Key Findings: Translation and Commercialisation

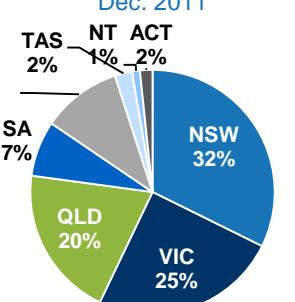
Queensland's share of health and biomedical related patents

Patent applications filed under the Patent Cooperation Treaty (PCT)^{1,2}

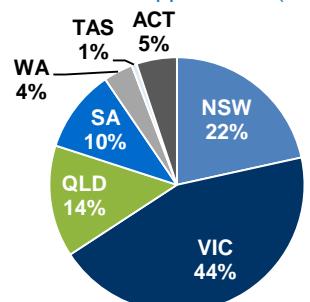
Share of Australian PCT Patents (2011)



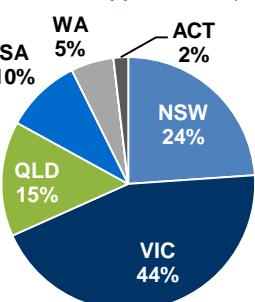
Proportion of Australian Population Dec. 2011



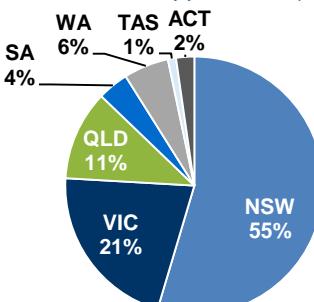
Biotechnology related PCT applications (2011)



Pharmaceuticals related PCT applications (2011)



Medical Technology related PCT applications (2011)



While it is generally acknowledged that patent applications are not an accurate measure of commercialisation activity, they can be an indicator of:

- the translation of research into the development of technologies
- an intent to utilise the invention, typically for commercial purposes.³

Queensland's share of the Australian total number of PCT applications filed is relatively comparable to the State's proportion of Australia's population (and to GSP – both around 20%). However, when examining PCT applications by technology, the State's performance in health and biomedical related technologies is underwhelming.

Not surprising, Victoria outperforms all States in biotechnology and pharmaceutical related PCT applications (44% - compare with NHMRC funding page 31), whilst Queensland produces only 14-15% of the Australian total in these fields.

Given NSW's dominant cluster of medical technology (including medical devices) companies, that State's performance in medical technology related PCT applications is at 55% of the Australian total, while Queensland is responsible for only 11%.

Key Findings: Addressing Gaps

Support for Clinician Researchers

More support is needed for early and mid-career clinicians with an interest in research.

- During the interviews for this review there was broad and overwhelming agreement that more support is needed for early and mid-career clinicians with an interest in research.
- The Queensland Government awarded 23 *Health Research Fellowships* between 2010 and 2012. No fellowships were awarded in 2013.
- The NHMRC also provides support for clinical research, through fellowship support. The NHMRC's Early Career Fellowships and Career Development Fellowships provide funding early to mid-career health and medical researchers to undertake advanced training and establish themselves as independent, self-directed researchers. The NHMRC also provides for Postgraduate Scholarships, to support health and medical graduates early in their career to train as researchers and develop their capacity for original independent research.
- While Queensland generally has a success rate for the NHMRC's early to mid-career fellowship programs comparative to other states, our proportion of the total number of funded fellowships is well below what might be expected based on the State's population, particularly in comparison to NSW and Victoria. This suggests there is still some way to go in building health and medical – and in particular, clinical – research capacity in the State, and a role for the State Government to play in supporting those capabilities in our clinical workforce.

Funding of NHMRC Postgraduate Fellowships, by State, 2008-2012



Funding of NHMRC Early Career and Career Development Fellowships, by State, 2008-2012



Key Findings: Addressing Gaps

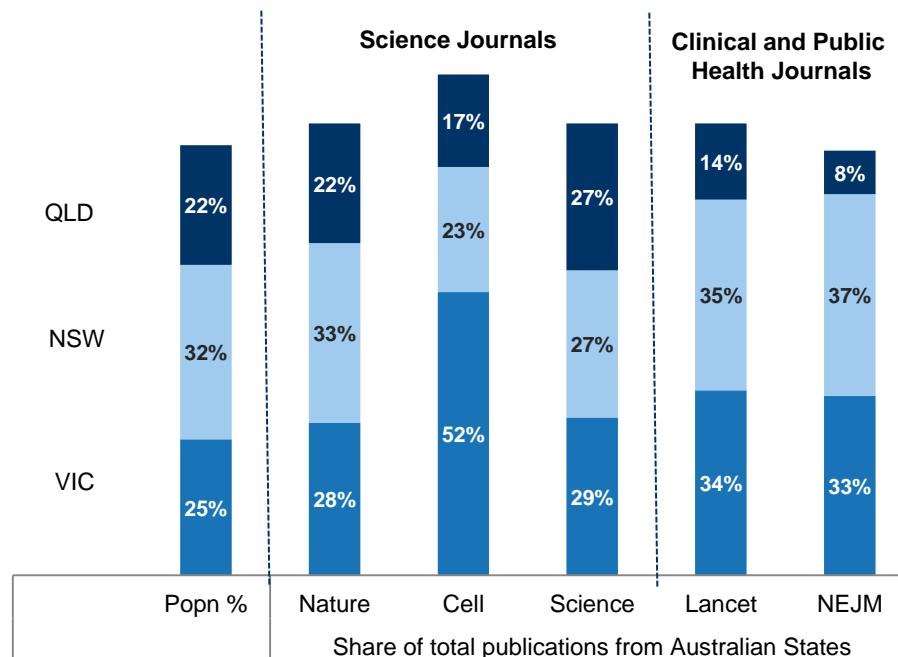
Clinician Research

- Queensland has a history of excellence in research and productivity in the health and biomedical sciences. This is particularly true in the State's health and biomedical research institutes, where a record of research excellence is evident.
- However, there is evidence (both anecdotal – collected during the interviews for this assessment – and quantitative) suggesting that despite pockets of excellence, and strong support for clinical research in our hospitals from senior administrators and the Minister for Health, the research culture within Queensland's hospital and health services network is not as robust and productive, across the board, compared with other states.
- Between 2001 and 2011, in a selection of premier international journals publishing health and biomedical research:
 - Queensland performs at or above levels in proportion to the State's population in key international science journals.
 - Queensland performs well below levels in proportion to the State's population (and GDP), and below the relative performance of other Australian states, in two of the world's premier clinical and public health journals (*Lancet* and the *New England Journal of Medicine*), where publications are typically authored or co-authored by clinician researchers.
- This however, does not reflect upon the impact of the

publications referenced here. It does not measure any level of international recognition, citation, or the ability of the publications to impact upon practice or policy.

Visibility in key journals 2001-2011

(# of publications presented as share of total publications from Australian states)¹



Key Findings: Addressing Gaps

Clinician Research

There is a gap in the engagement between clinician researchers and academic researchers.

- This review has indicated that the senior leadership of Queensland's major medical research organisations believe there is a gap in the engagement – in both directions – between clinician researchers and academic researchers.
- While there are many examples of where such engagement is active and productive, in general the interviewees indicated that this was not occurring as widely as needed to ensure:
 - real and active translation of research into clinical practice and better health outcomes
 - academic excellence and robustness embedded in all clinical research programs.
- There are a number of mechanisms available to government to help support stronger partnerships between medical and health professionals and academics and to facilitate faster translation of research outcomes into evidence based practice in real healthcare settings. Some of these mechanisms are explored in the recommendations that follow.

Exploiting genetics and genomics capability

Equip the state with the capability to exploit our world class genetics and genomics skills and infrastructure.

- Queensland is very active in the area of determining genome wide associations with disease, facilitated by the state's extensive genomics infrastructure and skills base – including sophisticated gene sequencing technology.
- However, there is a need to ensure that the State is equipped with clinicians capable of exploiting this expertise:
 - to inform patient diagnosis and
 - to ensure that these world class capabilities accelerate the translation of this knowledge into improved patient care.
- These efforts must be matched by a growth in Genetic Counselling skills and expertise in Queensland, to work with health care teams providing support to patients and families addressing the implications of genetic contributions to disease.¹

Key Findings: Addressing Gaps

Health Services Delivery and Preventative Health – The Facts

Despite the significant gains in life expectancy and many areas of health risk, in Australia and internationally, the growing burden of chronic (predominantly preventable) disease has become a critical issue for health systems and governments.¹

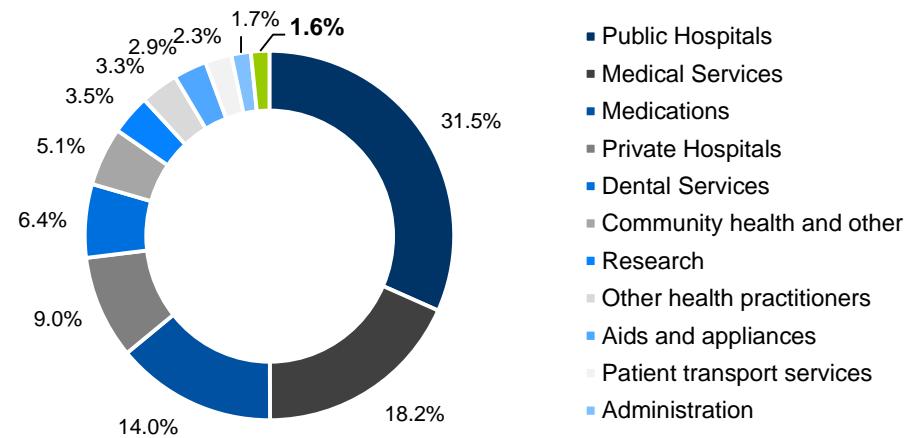
The Facts

- Queensland's population is projected to both grow and age significantly – the percentage of the population over 65 will rise from 15% (2011) to 30% by 2051. This will place new and greater demands on our healthcare system.

Expenditure and Cost

- 10% of Australian GDP is spent on health; the total expenditure on health services by Queensland Health was nearly \$10 billion in 2012-13.
- In 2013 (latest breakdown data), the NHMRC spent 45% of its grant funding on biomedical research (\$369.9 million), followed by clinical medicine (35%), public health (15%) - but only 5% on health services.
- It is estimated that the Australian Government spends approximately 1.6% of overall annual health expenditure in the year on public health (which includes preventative health activities). This does not include relevant expenditure in other non-health sectors (e.g. local governments and schools).^{1,2}
- "Chronic diseases have been estimated to cost Queenslanders \$5 billion per year in direct health care costs, and an additional \$22 billion in lost productivity, and other costs such as lost earnings and the cost to carers."³

Australian Government Annual Health Expenditure³



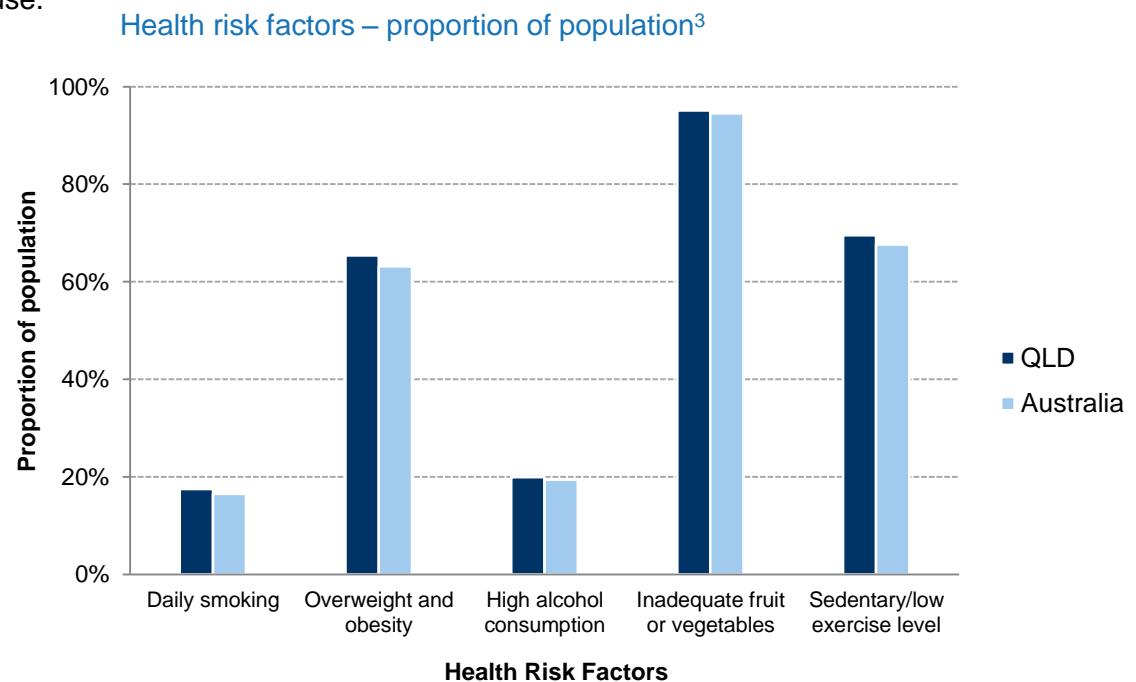
1. National Preventative Health Taskforce. Australia – the healthiest country by 2020. Commonwealth of Australia, 2009.
2. Australian Institute of Health and Welfare. Australia's Health 2012. Australia's health series no.13. Canberra: AIHW, 2012.
3. Queenslanders tackling chronic disease: becoming Australia's healthiest State. Smart State Council Report. The State of Queensland, 2008.

Key Findings: Addressing Gaps

Health Services Delivery and Preventative Health – The Facts

Chronic Disease and Prevention

- Chronic disease is the leading cause of death and disability in wealthy nations including Australia and the United States, and as such, has become a significant economic and social burden for Governments, communities, and individuals.¹
- The top three causes of death and illness in Australia in 2010 were ischemic heart disease, stroke and lung cancer.
- Most chronic diseases are preventable. The major modifiable risk factors for chronic disease include poor nutrition, physical inactivity, overweight and obesity, smoking and harmful alcohol use.²
- In Queensland:³
 - Slightly more than one in six adults smoke on a daily basis
 - More than six out of every 10 adults are overweight or obese
 - Approximately seven in every 10 Queensland men and women lead a sedentary lifestyle or have a low level of exercise
 - Most Queensland adults do not eat the recommended serves of either fruit and / or vegetables
 - One in five men and women is a heavy drinker.



1. State of Preventive Health 2013. Australian National Preventive Health Agency. Commonwealth of Australia, 2013.

2. Preventative Health Strategic Directions 2010-2013. Division of the Chief Health Officer. The State of Queensland (Queensland Health), 2010.

3. Australian Bureau of Statistics (ABS). Australian Health Survey: First Results, 2011–12. Canberra: ABS, 2013 (released June 2013).

Key Findings: Addressing Gaps

Support for capacity gaps – health services, health economics and preventative health

There is a need to address the capacity – and funding – gap in health services delivery, health economics and preventative health research in Queensland.

Health Services Delivery and Health Economics

- With a growing and ageing population, where chronic disease is prevalent - costs of care are escalating and consumer expectations are rising. Public funds must be prioritised to achieve the best possible health outcomes per dollar spent.
- Health Services research has traditionally faced challenges competing for national competitive grant funding, due to the often small scale nature of the research (pilot studies) and the lack of research pedigree (but certainly not research capability) of some of the healthcare professionals involved (nurses, allied health, community health).

Preventative Health

- Queensland has existing pockets of excellence in research addressing the increasing prevalence of preventable chronic diseases in the wider population, lifestyle-related health issues in our children and youth, and the health impact of our increasingly ageing population.
- However, growing our state wide capability and capacity in preventative health research, and supporting a broad, cross disciplinary approach across the health, education, business and community sectors, has the ability to have significant impact upon the health of Queenslanders and upon the cost of health care to individuals and to the State.

Addressing the gap

- This research should be better integrated into all facets of health and biomedical research in the State and should be a key element of any integrated health science strategy for the State.
- It has the potential to improve the clinical effectiveness and cost-effectiveness of healthcare provision, as well as informing and improving decision making by researchers, policy makers and funding agencies (including government).
 - There is likely to be an important role for health economics, when used appropriately, in assisting Government in prioritising any future financial support for health and biomedical research and its translation into clinical care and commercial outcomes.
- Hence, there is a need for local support to solve problems of relevance to the healthcare sector in the state.

Recommendations

Summary of Recommendations

There are eight Recommendations arising from this assessment, which have been summarised below.

Funding Mechanisms

- To reinforce the culture of an excellent research and evidence-based health care system, **support for health and medical research** should be the **responsibility of the Department of Health** – supported by DSITIA – and funded through mechanisms quarantined from overall Hospital and Health Services budgets. (see Recommendation....)
- A **detailed audit** of all funding for health and medical research (including the clinical fellowships program) by the Department of Health should be considered, including:
 - how to best manage such funding going forward, from an administrative point of view
 - where funding should be targeted, both in terms of policy, programs and initiatives (fellowships, operational funding, building research capacity) and in terms of health and medical research priorities for the state.
- **Operational** funding for universities is a responsibility for the Federal Government and is not the role of the State Government.

Accountability

- The CEOs of Queensland's **Hospital and Health Services** should have **explicit KPIs** that demonstrate **commitment to research**.

Programs and initiatives

- The basis of government support for health and medical research **programs and initiatives** should comprise a four pronged approach that underpins a focus on translational research to enhance cost effectiveness of health care and valued added commercialisation of research outcomes and addressing gaps in capability and capacity.

These should include:

1. Addressing gaps in support for health services delivery, health economics and preventative health.
2. Clinical (health and medical) Fellowships
3. Innovation Partnerships
4. Transparency in operational support for major Independent Medical Research Institutes

Recommendations: Health Services, Health Economics and Preventative Health

Health Services Delivery and Health Economics – building capacity and directing capability

- Growing capacity and capability in **health economics and health services research** has the potential to:
 - address questions about the relative value of competing investments / strategies in health care sector
 - improve the health services patients receive by finding innovative solutions that enhance the ways in we organise, manage, finance, and deliver high quality care; that reduce medical errors; and that improve patient safety
 - build stronger partnerships between medical and health professionals and academics providing for more effective and targeted translation of research outcomes into clinical products, and evidence-based processes and services.

Investing in Prevention

- Strategies to prevent premature death and illness caused by chronic disease can:¹
 - Reduce the social burden on the individual and the community
 - Allow better use of health resources and generate substantial economic benefits over time
 - Produce a healthier workforce and hence boost economic performance and productivity.

Recommendation 1. Support for health services delivery, health economics and preventative health

Addressing a gap in support from the Australian Government, and in an endeavour to improve the effectiveness and impact of health and biomedical research, the State Government should consider how best to support the existing **health services delivery, health economics** and **preventative health** capabilities in the state, how to grow capacity in these areas, and how to direct that capacity and capability towards better translation of health and biomedical research to clinical and commercial outcomes.

Recommendations include:

- 1.1. Prioritising a portion of funds for health and medical research (clinical) fellowships to support health services and health economics, and preventative health research. (See pages 46 and 48)
- 1.2. Noting the possibilities for a continuing (and even possibly expanded) DSITIA-led Accelerate Program, including the Accelerate Partnerships program, over the next three years, with health services and prevention featuring as priorities for support: encourage connections between state wide research practitioners, technology services, industry partners and communities in these areas to submit coordinated proposals.
- 1.3. Ensure all applications for Queensland Government funding to support health and biomedical research projects are accompanied by a health economics analysis, to assist the Government in optimising the economic value from any investment in the sector.

Recommendations: Translate to the clinic

Better translation of health and biomedical research into clinical outcomes / health benefit

Research embedded in clinical care and delivery

- The ability to translate the findings of health and biomedical research into clinical products, practices and services that deliver better health outcomes for Queenslanders - and better economic outcomes (cost efficiencies) for the Government and the community - is best achieved when research is embedded and valued in the health system.

Recommendation 2. Clinical Research KPIs

- 2.1. The CEOs of Queensland's Hospital and Health Services should have strong and measurable key performance indicators (**KPIs**) for teaching and research outcomes.

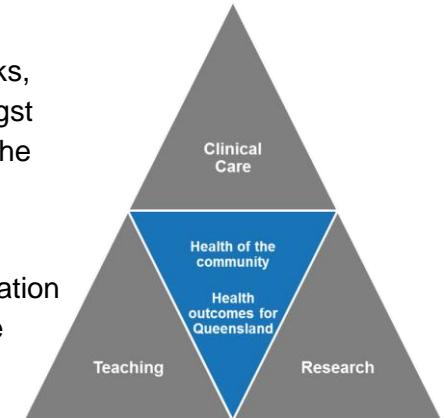
Recommendation 3. Focussed, transparent and accountable support for health and medical research

- 3.1. Support for health and medical research should be the responsibility of the Department of Health – supported by the Department of Science, Information Technology, Innovation and the Arts – and funded through mechanisms quarantined from – or at least clearly visible within - overall Hospital and Health Services budgets.
- 3.2. A detailed **audit** of all funding from the Department of Health **for health and medical research** (including the clinical fellowships program) should be considered, including:
 - how to best manage such funding going forward, from an administrative point of view
 - where funding should be targeted, both in terms of policy, programs and initiatives (e.g. fellowships, operational funding, building research capacity) and in terms of health and medical research **priorities** for the state (e.g. health services delivery, health economics and preventative health. See page 45)

Recommendations: Translate to the clinic

Integrating Health Research, Training and Clinical Care

- ‘Advanced Health Research Centre’ is one of the many terms (academic health science centre / network, integrated health research centre / network) to describe the bringing together (integration) of hospital networks, universities, and medical research institutes to integrate – and increase collaboration and cooperation amongst those in - research, teaching and training, and clinical care. In doing so, they aim to facilitate and speed up the effective translation of health and medical research into improved healthcare practices and delivery.
- Models of Advanced Health Research Centres have been operating successfully in the United States and Canada, the United Kingdom, Sweden and Singapore for some time. The concept has been under consideration in Australia in recent years, and a number of key partnerships already exist (e.g. Monash Partners, Brisbane Diamantina Health Partners and the South Australian Health and Medical Research Institute).
- In 2010, the NHMRC released a public discussion paper, *Developing Advanced Health Research Centres in Australia*, exploring the integration of leadership in research and research translation to improve patient care and health professional education.¹ Subsequently, the McKeon Review recommended the establishment of Integrated Health Research Centres “to integrate research excellence with healthcare service delivery and facilitate best-practice translation of research directly into healthcare delivery.”²
- In July 2014, the NHMRC formally called for submissions from partnerships across research, translation, health care and training in Australia, for recognition as Advanced Health Research and Translation Centres (AHR&TC).



Recommendation 4. Integrating Health Research

- 4.1. Support the concept of an **integrated health science strategy for Queensland** that aims to deliver real improvements and efficiencies in health care and commercial value to research discoveries for the State.

This would build upon the proposed single Advanced Health Research and Translation Centre for Brisbane, but as part of a larger Queensland wide network.

The tropical expertise of James Cook University, and the growing health and medical precincts at the Gold Coast and Sunshine Coast (new major hospital / university precincts emerging) must be leveraged and included in any **integrated health science strategy for Queensland**. This expertise should be noted in, and in some appropriate way potentially linked to, the Brisbane AHR&TC proposal.

Recommendations: Translate to the clinic

Support for early- and mid-career clinical researchers

Key Drivers of the timely translation of world class research into clinical outcomes, and the adoption of new treatments and practices include:

- strong clinician engagement in robust clinical research
- a culture (and budget) that supports research and excellence, throughout all levels of the healthcare system
- strong links between the academic research and healthcare delivery to drive end user focused research in our universities and MRIs.

Principal challenges for early to mid-career clinicians entering into a research program include:

- The ability to 'buy out' clinical time. In particular, being able to secure sufficient and substantial amounts of time to ensure that the research can be conducted in a robust, effective and strategic manner.
- Training in research practice and excellence – including the financial and career challenges involved in taking time out to undertake a PhD.

Recommendation 5: Clinical Fellowships

- 5.1. As part of a broader detailed audit of funding for health and medical research, the Department of Health should consider undertaking a thorough evaluation and review of the outcomes of the Clinical Fellowships program.
- 5.2. Subject to a review of the Clinical Fellowships programs, and in the context of relative benefit to cost, we recommend considering:
 - Reducing or removing financial support for the **Senior Clinical Research Fellowships**, this will facilitate
 - Increasing support for **Health Research Fellowships** with a focus on early to mid-career clinicians and health practitioners - we recommend up to **30 per annum @ up to \$150K per annum for three years** (i.e. no change in the level of support per fellowship).
 - **Linking** the award of all the Clinical Fellowships to a requirement that the clinician establish a formal partnership with an academic(s) from a Queensland University or research institute
 - **Focusing** the Clinical Fellowships on areas of identified need and relevance to Queensland (see pages 45 and 46).

Recommendations: Direct Funding for Research Institutes

Direct Funding for Research Institutes

- Historically, the Queensland Government has provided recurrent (operational) funding to several of Queensland's prestigious health and medical research institutes (university based and independent), but not others.
- By and large, these payments have been inconsistent and non-transparent.
- The findings of this report are consistent with those of the Government's **Audit of Science Investment and Funding Programs** which found: *Operational funding arrangements with universities and independent research organisations were however found to be temporary, piecemeal and expose the government to continuing ad-hoc requests for recurrent funding.¹*

Recommendation 6. Operational Funding for Universities

6.1. Operational funding for universities, and university based research institutes, is a responsibility of the Federal Government through the Block Funding model, and is not the role of the State Government - other than in those circumstances where the Government's strategic objectives can be best advanced by supplementing such funding.

Recommendations: Direct Funding for Research Institutes

Direct Funding for Research Institutes

- Queensland has three independent medical research institutes that qualify for funding under the Independent Research Institutes Infrastructure Support Scheme (IRIIS): QIMR Berghofer Medical Research Institute (QIMR-B), Mater Research Institute and the Wesley Research Institute.
- Historically, all three independent medical research institutes have also received varying degrees of operational funding support from the Queensland Government. The Wesley and Mater Research Institutes no longer receive operational funding support from the State, while in 2013-2014 QIMR-B received \$18.86 million, including \$5 million for depreciation of capital assets. (See page 26)
- The State does have a role in continuing to provide operational funding support for the State's independent MRIs which receive their operational funding exclusively via the Independent Research Institutes Infrastructure Support Scheme (IRIIS), **where there is value in doing so**.
- Independent MRIs that are receiving flow on benefits from Research Block Grants (via Universities), should be considered for operational support on any residual difference.
- The State must be cognisant of NHMRC Funding Policy in relation to the IRIIS: *Independent medical research institutes in each jurisdiction will not be eligible for IRIIS payments if their State Government decreases the overall level of infrastructure support that it provides.*²

Recommendation 7. Operational Funding for Independent Medical Research Institutes

- 7.1. The State has a role in continuing to provide operational funding support for independent (Governance) medical research institutes of a sustainable and substantial size - institutes bringing in a minimum of \$2 million/annum in Tier 1 Competitive grants (e.g. NHMRC, ARC, NIH).
- 7.2. However, unlike the State's previous such investments, going forward operational funding support for independent medical research institutes of a **sustainable size** should be provided:
 - in a transparent manner, based on measurable translation of research into clinical or commercial outcomes
 - giving consideration to other sources of infrastructure funding and the gap in funding between Research Block Grants received by universities (~40-50 cents per dollar of competitively awarded research grants) and funds the Independent MRI receives from the Independent Research Institutes Infrastructure Support Scheme (20 cents per dollar of competitively awarded NHMRC research grants).

The impact (if any) of this on the existing quantum of operational funding that the State provides to QIMR-B remains to be determined.

Recommendations: Translate to Commercial Outcomes

Innovation Partnerships

- How do you make Queensland's health and biomedical research sector more attractive to investment and more competitive?
 - To drive the future direction of the health and biomedical research in the State in a direction which supports the strategic direction of the Department of Health and to enhance collaboration across the translational pathway (clinical and commercial) this review proposes a scheme of Innovation Partnerships.
- The Innovation Partnerships would be designed to bring together researchers, clinicians, technology services (e.g. TetraQ, Nature Bank, Patheon Biologics contract manufacturing facility), industry partners (local, national and international), and communities.
- The partnerships present the next logical step to successful clinical collaboration, and are a natural precursor to larger collaborative projects, such as major collaborations with national or international industry partners. They provide a stepping stone towards development of products, practices or services with real world application and marketability.
- Support for the Innovation Partnerships would focus on projects with clear potential to reduce costs, increase health benefits in priority areas for Queensland (e.g. health economics, e-health, diabetes/obesity, tropical health, indigenous health) and facilitate commercial outcomes – all of which is consistent with the Queensland Government's Science and Innovation Action Plan.¹
- There is likely to be a role for any future Academic Health Science Networks in the State in facilitating the collaborative partnerships, and their effective translation, outlined here.

Recommendation 8. Innovation Partnerships

- 8.1. Funding support from the Department of Health support to establish and drive collaborative partnerships, and their effective translation, between clinical, research and industry partners that engage with end-users in the community, to address problems of specific need to Queensland / Queensland Health.
- 8.2. Propose at least **two** such Innovation Partnerships per annum with each partnership to receive **\$1 million per year – matched by industry partners – for three years** (potentially renewable).

Noting that these Department of Health Innovation Partnerships would complement the DSITIA Accelerate Partnerships scheme and would be aligned with the expectations of the Queensland Government's \$500 million *Entrepreneurial and Innovation Fund* (part of the Strong Choices Investment Program).²

Appendix 1: Department of Health - Health and Medical Fellowships

Senior Research Fellowships

Clinician	Host Facility	Brief description
ROUND 1 - 2010		
Professor David Paterson	Consultant, Infectious Diseases Unit, Royal Brisbane and Women's Hospital Professor of Medicine, The University of Queensland Centre for Clinical Research	Professor Paterson aims to study the molecular and clinical epidemiology of infections with antibiotic resistant organisms. This study will have a particular focus on the translation of knowledge into prevention and treatment of these infections.
Professor Peter Sly	Research Project Director, Queensland Children's Medical Research Institute Senior Clinical Research Fellow Royal Children's Hospital Professor, University of Queensland, Centre for Clinical Research	Professor Sly's research aims to understand the mechanisms underlying chronic childhood lung diseases in order to improve clinical management and to delay or prevent the onset of such conditions with consequent reductions in adult lung diseases.
ROUND 2 - 2011		
Professor Jonathan Golledge	Director of Vascular Surgery, Townsville Hospital Professor of Vascular Surgery, James Cook University	Professor Golledge aims to set up a centre of clinical research excellence in Peripheral Artery Disease in North Queensland with the ultimate aim to better treat and manage this disease.
Professor Geoff Hill	Division Head, Department of Immunology, Queensland Institute for Medical Research	Professor Hill aims to set up a national reference centre for cellular therapy with the ultimate aim to reduce fatalities and side effects associated with stem cell transplants for leukaemia sufferers.
ROUND 3 - 2012		
Professor Ken O'Byrne	Senior Medical Officer and Professor in Medical Oncology, Princess Alexandra Hospital	Professor O'Byrne aims to develop a comprehensive cancer translational research program including establishing a tissue biobank and conducting clinical trials.
Professor Robyn McDermott	Director of the Centre for Chronic Disease Prevention, James Cook University	Professor McDermott aims to establish a Centre for Chronic Disease Prevention and Care in Cairns which will serve the rural and remote communities of far north Queensland, especially Aboriginal and Torres Strait Islander communities.

Appendix 1: Department of Health - Health and Medical Fellowships

Health Research Fellowships

Researcher	Queensland Health Facility	Brief description
ROUND 1 - 2010		
Associate Professor Michael Breakspear	Royal Brisbane and Women's Hospital, Mental Health Services	Combining brain imaging and computer modelling to develop a diagnostic test for psychotic disorders.
Dr Katrina Campbell	Princess Alexandra Hospital, Nutrition and Dietetics	Obesity influencing blood vessel function and degree of kidney disease.
Mr Satyan Chari	Royal Brisbane and Women's Hospital, Safety and Quality	Investigating the role of the environment in the causation and prevention of falls and injuries from falls among hospitalised patients.
Ms Shoni Colquist	Princess Alexandra Hospital, District Planning, Metro North HHS	Discovery interviews to better understand patient and clinician experience of the health system.
Dr Pamela Dodrill	Royal Children's Hospital, Speech Pathology	The evaluation of three different interventions for children with a restricted range of dietary intake.
Dr Robyn Grote	Royal Children's Hospital, Queensland Motion Analysis Centre	Using sophisticated motion capture technology to capture and quantify movement in adults with movement disorders.
Professor David Johnson	Princess Alexandra Hospital, Nephrology & Transplant Services	Undertaking clinical trials in kidney disease designed by leading Australasian experts.
Professor James McCarthy	Royal Brisbane and Women's Hospital, Infectious Diseases	Improving the care of patients with infectious diseases
Ms Kathryn Plonka	Metro South Health Service District, Oral Health	Investigating childhood dental interventions including education, home visits, dental products and early detection from antenatal to age 24 months.
Associate Professor Elizabeth Powell	Princess Alexandra Hospital, Gastroenterology and Hepatology	Improving the outcome of treatment in overweight patients with liver disease.
Dr Maria Scarcia	Townsville Hospital, Psychology	Tracking the mental health outcomes of individuals following a traumatic brain injury.
Dr Lata Vadlamudi	Royal Brisbane and Women's Hospital, Neurology	Understanding the genetic cause of epilepsy through twin studies.
Professor Claire Wainwright	Royal Children's Hospital, Queensland Children's Respiratory Centre	Focus on cystic fibrosis, bronchiolitis and asthma in children.

Appendix 1: Department of Health - Health and Medical Fellowships

Health Research Fellowships (cont.)

ROUND 2 - 2011		
Dr Daniel Chambers	Consultant Thoracic and Transplant Physician, The Prince Charles Hospital	To develop a diagnostic tool to identify patients at-risk for lung transplant rejection at an early stage where intervention will have a meaningful impact on long-term survival.
Associate Professor Scott Bell	Director of Thoracic Medicine and Senior Staff Specialist, The Prince Charles Hospital	To examine the causes, clinical impact and risks of infection in adults with cystic fibrosis.
Dr David Reid	Staff Physician, Department of Thoracic Medicine, The Prince Charles Hospital	To develop new anti-bacterial strategies for adult patients with cystic fibrosis.
Ms Tania Withington	A/Director of Social Work Child and Youth Mental Health, Royal Children's Hospital	To explore the relationships between placement stability and disruption for children in out-of-home care.
Professor Amanda Henderson	Nursing Director of Education, Princess Alexandra Hospital	To identify those practices that foster learning inquiry within the nursing team.
Ms Annette Bird	Clinical Nurse Consultant, Acute Pain Service, Gold Coast Health Service District	To improve pain assessment and management of acute post-operative pain, ultimately leading to an improvement in patient's experiences and outcomes.
ROUND 3 - 2012		
Professor John Fraser	Eminent Staff Specialist in Intensive Care, Adult Intensive Care Services, The Prince Charles Hospital	To continue research into combating and treating end stage cardiovascular and respiratory diseases. This research will facilitate the integration of emerging cardiovascular devices and technology into clinical practice.
Dr Bena Cartmill	Advanced Speech Pathologist, Oncology, Princess Alexandra Hospital	To examine the treatment-related and service delivery factors impacting on patient and carer outcomes. This research will focus on patients with head and neck cancer who are receiving intensified non-surgical oncological treatment.
Ms Angela Ratsch	Nursing Director of Critical Care and Workforce Services, Fraser Coast Health Service in the Wide Bay Health Service District	To examine the effects of orally self-administered wild tobacco (pituri) on maternal and neonatal outcomes in the Australian Aboriginal and Torres Strait Islander populations.
Associate Professor Maher Gandhi	Senior Staff Specialist, Haematology, Princess Alexandra Hospital	The award of the 'CCQ/OMHR John McCaffrey Clinical Research Fellowship' will allow Associate Professor Gandhi to continue his research in the immunobiology of lymphoma and addressing problems of direct clinical relevance. This fellowship is co-funded by Cancer Council Queensland (CCQ).

Appendix 1: Department of Health - Health and Medical Fellowships

Clinical Academic Fellowships

Position	Health Service District	University	Brief description
ROUND 1 - 2010			
Clinical Academic Fellow in Social Work	Children's Health Service District	Queensland University of Technology	Lead a program of research and clinical practice that aims to significantly reduce levels of depression, suicide and self harm in children and young people.
Professor of Midwifery	Gold Coast Hospital	Griffith University	Provide evidence to policy makers and clinicians to ensure that childbearing women receive the highest quality of maternity care, and that such care is cost-effective.
Dietician (Advanced) Clinical Academic Fellow	Princess Alexandra Hospital	University of Queensland	Promote excellence in dietetics through clinical practice, education/training, and research (with a specific research focus on the management of malnutrition).
Senior Specialist in Geriatric Medicine	Princess Alexandra Hospital	University of Queensland	Provide "Telegeriatrics" with the objective of further advancing the research and development capacity already established in the Princess Alexandra Hospital Health precinct.
Senior Clinical Academic Fellow in Neurology	Royal Brisbane and Women's Hospital	University of Queensland	Improve the clinical neurological care for Queenslanders with epilepsy as part of the Comprehensive Epilepsy Program being developed on the Herston Campus and underpin the development of cutting-edge clinical research to improve outcomes in patients with epilepsy.
Senior Clinical Academic Fellow in Oncology	Royal Brisbane and Women's Hospital	University of Queensland	Harness modern biological discovery in the oncology arena to improve regional and tertiary care in Queensland within an integrated comprehensive cancer care centre / service framework.

Appendix 1: Department of Health - Health and Medical Fellowships

Clinical Academic Fellowships (cont.)

Position	Health Service District	University	Brief description
ROUND 2 - 2011			
Professor in Physiotherapy – Aged Care Rehabilitation	The Prince Charles Hospital	Australian Catholic University	Undertake research and provide leadership and education for clinicians and researchers to explore best practice in improving patient flows, falls prevention, recovery and quality of life for the elderly population and for patients following neurological events such as stroke and head injury.
Senior Clinical Academic Fellow in Obesity Research and Prevention	Mater Public Hospital	University of Queensland	Support the Mater Children's Hospital program for medical monitoring and intervention for overweight children, where an emphasis on education, diet, exercise and lifestyle choices aims to protect the ongoing health of these children. The outcomes of this program aim to improve the health and lifestyles of children and their families and to develop new therapies for the early prevention and treatment of diabetes.
Nurse Researcher Clinical Academic Fellowship (Mental Health)	Royal Brisbane and Women's Hospital	Queensland University of Technology	Promote and facilitate a research culture fostering capacity building and research skills acquisition within a multi-disciplinary team environment. In line with nationally identified Mental Health benchmarks, undertake research that contributes to evidence based practice to improve Clinical Outcomes for Mental Health consumers and improved clinical practice for Mental Health Clinicians.

Appendix 1: Department of Health - Health and Medical Fellowships

Clinical Academic Fellowships (cont.)

Position	Health Service District	University	Brief description
ROUND 3 - 2012			
Principal Fellow, Medical Radiation Science and Sonography	Mackay Base Hospital	University of Central Queensland	Focus on ensuring that patients are receiving radiation treatments safely, and not unnecessarily, resulting in better patient outcomes and cost savings. It will be based in a relatively new area of research and will also focus on developing a research culture within Mackay and regional Queensland. The position will also develop a research postgraduate program at the University of Central Queensland.
Academic Thoracic Physician for Lung Cancer	The Prince Charles Hospital	University of Queensland	Provide long and short term clinical care to lung cancer patients at The Prince Charles Hospital and assist in developing a state-wide respiratory network, and state of the art research into lung cancer diagnosis and management. The position will also provide training and mentorship to junior research, clinical, nursing and allied health colleagues.
Midwifery Clinical Academic Fellow	Royal Brisbane and Women's Hospital	University of Queensland	Mentor nurses and midwives who are undertaking research higher degrees. It will also undertake research into pre-conception and early pregnancy care and establish an evidence based framework for pre-conception care in Queensland.
Office of Queensland/OHMR – Nursing and Midwifery Clinical Academic Fellowship	Nambour General Hospital	University of the Sunshine Coast	This position is a co-funded position between Queensland Health and the Nursing and Midwifery Office of Queensland. It will establish a Maternal Child Health Research Reference Group which will increase nursing research capacity in the Sunshine Coast. This will link in with the new Sunshine Coast University Hospital.

Appendix 1: Department of Health - Health and Medical Fellowships

Nursing and Midwifery and Physiotherapy Fellowships

Researcher	Title	Value
ROUND 1 - 2012		
Physiotherapy		
Sandra Brauer	The Stroke IMPACT trial: Improving physical activity via treadmill training.	\$248,083
Nursing and Midwifery		
Wendy Chaboyer	Randomised controlled trial of negative pressure wound therapy versus standard care to prevent surgical site infections in obese women undergoing caesarean section.	\$29,710
Brigid Gillepsie	Using negative pressure to aid wound healing in surgical wounds: a vacuum of evidence?	\$14,612
Jennifer Rowe	Learning about Mothering and Baby: Implementing a perinatal parenting program for first time mothers.	\$14,196
Brenda Happell	To investigate whether poor health behaviours and inadequate primary health care are major contributors to the risk of chronic disease and early death in persons with serious mental illness.	\$25,322
Judy Munday	The Clinical Effectiveness of Interventions to assist perioperative temperature management for women undergoing caesarian section: a systematic review	\$4,992
Nicole Marsh	Securing Venous Peripheral Devices Effectively in Hospitals: The SAVE trial	\$9,675
Raymond Chan	A double blind randomized controlled trial of a natural oil-based emulsion containing allantoin versus aqueous cream for managing radiation induced skin reactions in patients with cancer.	\$15,000

Appendix 2

Connectedness' of Top Health & Biomedicine Research Areas

Note on data: Categorisation of Institutional Affiliations

A total of 13,010 author institutions were recorded on the 36,157 papers that featured a Queensland based author in the period 2010-2012. Institutions with more than 50 mentions were manually categorised as either:

1. *Queensland*

Further sub-divided into 13 categories consisting of each of the 8 Queensland based universities, Queensland Institute of Medical Research (QIMR), Queensland Health' (including all public hospitals), Other Queensland Government Departments, Other Queensland and finally CSIRO. All CSIRO affiliations on publication with a Queensland author were considered to be Queensland based. However, an unknown proportion will in reality be attributed to CSIRO research centres outside of Queensland.

2. *Australia*

3. *International*

The remaining 11,500 institutions with <50 publications each in that period (and which collectively account for about 17% of all institutional mentions) were not categorised and labelled 'Other/Undefined'. However, most of these are likely to be International institutions. Purpose written software was used to automatically analyse each research area and produce a distribution of publications by location using the above categorisation.

It is important to note that this method does not distinguish between the number of authors for each institution on an individual publication. For example, a paper with 7 authors from the University of Queensland, one from the University of Sydney and one from Harvard University will be recorded as one publication for each for the UQ, other Australia and international categories.