Australian Government

National Health and Medical Research Council

National Health and Medical Research Council Submission to the Productivity Commission's research study on public support for science and innovation in Australia

August 2006

CONTENTS

INTRODUCTION

Knowledge is a key factor in determining the strength and prosperity of a nation. Australian health and medical research is internationally recognised for its quality, ingenuity and innovation. To ensure ongoing success and prosperity, it is essential that as a nation, Australia continues to invest well in creating knowledge through research activities. Numerous studies have documented the effectiveness of Australian health and medical research, and the considerable benefits to the Australian community arising from health and medical research,

This submission focuses on the NHMRC's commitment to improving the health of Australians through funding innovative health and medical research and developing high quality, evidence-based health advice. The submission therefore draws on the NHMRC's experience over recent years, and provides some insights into its future directions.

This is an exciting period for the NHMRC. As outlined below, it has recently changed its governance arrangements and has a new Chief Executive Officer, new Council and new Principal Committees. It is currently developing it new strategic directions.

BACKGROUND

The NHMRC is Australia's peak body for supporting health and medical research and developing health advice.

The NHMRC became an independent statutory agency within the Health and Ageing Portfolio on 1 July 2006. This change was made by Government in response to three major reviews:

- *Sustaining the Virtuous Cycle for a Healthy, Competitive Australia: Investment Review of Health and Medical Research* — Final Report, Australian Government, December 2004[1];
- *Governance of the National Health and Medical Research Council; Audit Report No. 29 2003-04*, Australian National Audit Office, February 2004[2]; and
- Review of Corporate Governance of Statutory Authorities and Office Holders, June 2003[3].

The Australian Government also made a significant new investment in health and medical research as part of its response to the Investment Review. In developing its new strategic plan, the NHMRC will be considering other recommendations in the Investment Review. It is apparent that for further improvements to the organisation and its effectiveness to be achieved, the organisation's structure and operations will need to undergo some changes. To achieve this outcome within the current level of resources will require considerable attention

[1] http://www.health.gov.au/internet/wcms/publishing.nsf/Content/health-hsid-investreview
[2] http://www.anao.gov.au/WebSite.nsf/Publications/43951F0CEE2A6186CA256E3F0013CD33
[3] http://www.finance.gov.au/governancestructures/docs/The_Uhrig_Report_July_2003.pdf

and diligence in the setting of priorities for action and the distribution of those resources. Further information on the functions of the NHMRC is provided at Attachment 1.

ROLE OF PUBLIC SUPPORT

Australia continues to face major challenges with the emergence of new diseases and the impact of a wide range of medical conditions that result in disability and death. With rapid improvements in knowledge, there are opportunities to better understand the basis for these conditions and to explore new ways of prevention or treatment. To ensure Australia continues to be well placed in delivering high-level health services, the Australian Government's investment in health and medical research, through the NHMRC, is producing world-class health and medical research and the production of authoritative health guidelines which will ensure continuing advances in individual health, improved patient care, the development of new therapies and the sustainability of the Australian healthcare system.

There are numerous examples of public support for health and medical research leading to tangible health benefits for the Australian community, including Professor Ian Frazer's development of a cervical cancer vaccine and the research of Australia's Nobel Prize Winners including Professor Barry Marshall and Dr Robin Warren's discovery of *Helicobacter pylori* as the cause of gastric ulcers, and Professor Peter Doherty's discovery on how the immune system recognises virus-infected cells. Further examples of Australia's and the NHMRC's contribution to advancements in health and medical research is provided at Attachment 2 and Attachment 3.

While the methodology used has been questioned, the current best available recognised model to understand the economic impact of health and medical research is the 2003 Access Economics report *Exceptional Returns the Value of Investing in Health R&D in Australia*[4] .

Exceptional Returns estimated that every dollar invested in health and medical research will be recouped many times over. It highlights, for example, that economic returns for research and development on cardiovascular delivers an 8-fold return, respiratory research and development a 6-fold return and digestive system research and development a 5-fold return.

The Australian government has recognised that the community's investment in research generates significant returns in the form of improved health and wellbeing. The *Investment Review of Health and Medical Research* estimates that, over the past 40 years, the benefits in longevity and quality of life of Australians resulting from investment in health and medical research is worth over $5,000 billion.

The most fundamental role of public support for science and innovation is, therefore, to build knowledge to improve people's lives, without discrimination, e.g. regardless of socio-economic status, age, geography etc.

[4] http://www.asmr.org.au/general/Except.pdf

CURRENT LEVELS AND NATURE OF SUPPORT

Decision making principles and program design

The NHMRC's allocation of funding has historically been based on selecting the highest quality ideas and researchers. The legacy of this approach is that it has yielded a performance result that has, in a range of areas, Australian health and medical research significantly outperforming comparable traditional international benchmarks.

The corresponding and considerably more complex issue, however, lies around the decision on the level of funding appropriate to meet Australia's health and medical research needs. Addressing this intuitively simple question about the 'demand' for health and medical research requires a detailed understanding of how health and medical research contributes functionally to Australia and Australians.

This gives rise to the challenge of understanding and prioritising those needs, even before we can attempt to articulate the benefit of health and medical research at a micro level. In turn, it is only after this is more clearly understood that we can evaluate the appropriateness of decision-making principles and program design elements that guide the allocation of funding within the different components of Australia's innovations system.

There is an enormous potential to gain from strengthening over time NHMRC's capacity for more business-intelligent allocation of health and medical research funding. Given that Australian health and medical research is already in a strong position, it is incumbent on any decisions to improve the current system to implement changes in a measured, although not unnecessarily slow, manner.

Total levels of support

Private sector investment in health and medical research in Australia is low in comparison to that in other countries. The NHMRC recognises the importance of private sector investment in, and access to, research and research outcomes and appreciates that it has a role in facilitating increased private sector involvement in health and medical research.

There are two critical issues for private sector bodies wishing to invest in health and medical research, being:

- access to research and research outcomes; and
- the environment in which they operate.

The first of these issues is of considerable importance. For commercial wealth to be generated from Australian Government funded health and medical research, there need to be appropriate mechanisms and systems in place for the private sector to gain access to research and research outcomes. The fact that there are venture capital funds within Australia specialising in health and medical research that are under-committed highlights this problem.

The Australian Government can play an active role to address these issues by:

- developing a research/private sector collaboration strategy;
- promoting current research to the private sector;
- promoting knowledge transfer out of institutions where the knowledge is generated;
- promoting the use and exploitation of research outcomes by institutions; and

- promoting education in intellectual property, commercialisation, and the broader healthcare system within institutions.

The second issue of critical importance to the private sector is the environment in which they operate. The private sector will only invest in heath and medical research if it is confident of the regulatory regime in which they operate, and if the regulatory regime is internationally competitive. While Australia has a reputation for excellence in health and medical research, Australia is competing internationally, and specifically with South-east Asia to attract private sector investment.

The regulatory environment is set by the Australian Government, and the State and Territory governments. From an NHMRC perspective, if Australia is to have an internationally competitive regulatory regime, there needs to be close collaboration and coordination of health and medical industry policy and downstream regulatory policy. Further, as Australia is competing internationally for investment, regulatory differences between jurisdictions can undermine confidence in the stability of the regulatory environment. There needs to be a collaborative approach between the Australian Government and the State and Territory governments to industry regulation.

Australia's experience in benefiting strongly from a vibrant and effective health and medical research sector makes the issue of the appropriate level of funding for the sector less about the total level of public funding, but more about the total net public benefit of health and medical research and the overall level of investment, i.e. public and private and national and international.

What areas receive public support?

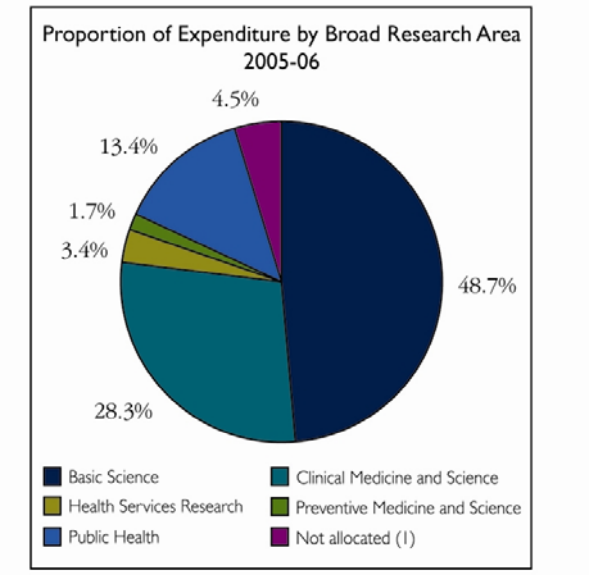
The NHMRC is committed to develop Australia's health and medical infrastructure, through its continuing commitment to excellence in health and medical research, backed by substantial improvements through innovative health and medical research outcomes. This commitment is supported by measures which coordinate an integrated national strategy to research investment, and lead to more cost-effective and cost-efficient investment overall.

In supporting the development of health and medical research in Australia, the NHMRC provides leadership and support in the following areas:

- basic research;
- applied research;
- health advice;
- ethics; and
- translational research.

Figure 1 provides a n overview of the allocation of NHMRC funding toward broad research areas in 2005-06.

Figure 1: Comparison between triennia: Expenditure pattern by broad research area[5]



The NHMRC is also committed to supporting the Australian Government National Research Priorities (NRPs) and National Health Priority Areas (NHPAs). This is reflected in the NHMRC's commitment to develop its business intelligence capabilities and therefore, its ability to facilitate the outcome-effectiveness of fundamental and targeted health and medical research. Further information on NRPs and NHPAs is provided at Attachment 4.

How much do we spend?

Health and medical research is an area of growing demand and rapid innovation that is attracting investment by governments, industry, philanthropists and financial investors around the world.

During 2005, the NHMRC allocated:

- $292 million to fund more than 600 investigator initiated health and medical research projects in 52 Australian Universities, hospitals and medical research institutes;
- $80 million for leading medical research into leukaemia, kidney disease, HIV/AIDS, cancer, maternal health, arthritis and melanoma
- $9 million for new equipment
- $10 million to support existing clinical trials
- $2.5 million to support researchers to commercialise their research outcomes
- $13.4 million to 20 independent medical research institutes to upgrade infrastructure, improve technology and build on existing resources
- $6.5 million for Indigenous health research
- $7.5 million to support urgent research relating to possible avian-induced pandemic influenza

The investment during 2005 of $420 million represents a doubling of government investment in health and medical research in Australia since 1999. In May 2006, the government announced further support for improvements in Australia's health through the allocation of an

[5] Source: NHMRC Research Management Information System (RMIS)/PMF Dataset as at 6 May 2006. Note – Infrastructure and transitional grants are not allocated to a broad research area

additional $905 million for Australian health and medical research. This represents continued commitment by the Government to investment in the future health of Australians with:

- $500 million over four years for research into new medical knowledge and technologies;
- $170 million over nine years for a new Australian Health and Medical Research Fellowship Scheme;
- $235 million to support research institutions such as the Walter and Eliza Hall Institute of Medical Research and the National Stem Cell Research Centre.

Figure 2 provides an overview of the increasing investment in the NHMRC by the Australian government.

Figure 2: NHMRC Research Funding (1999-2000 to 2008-09)

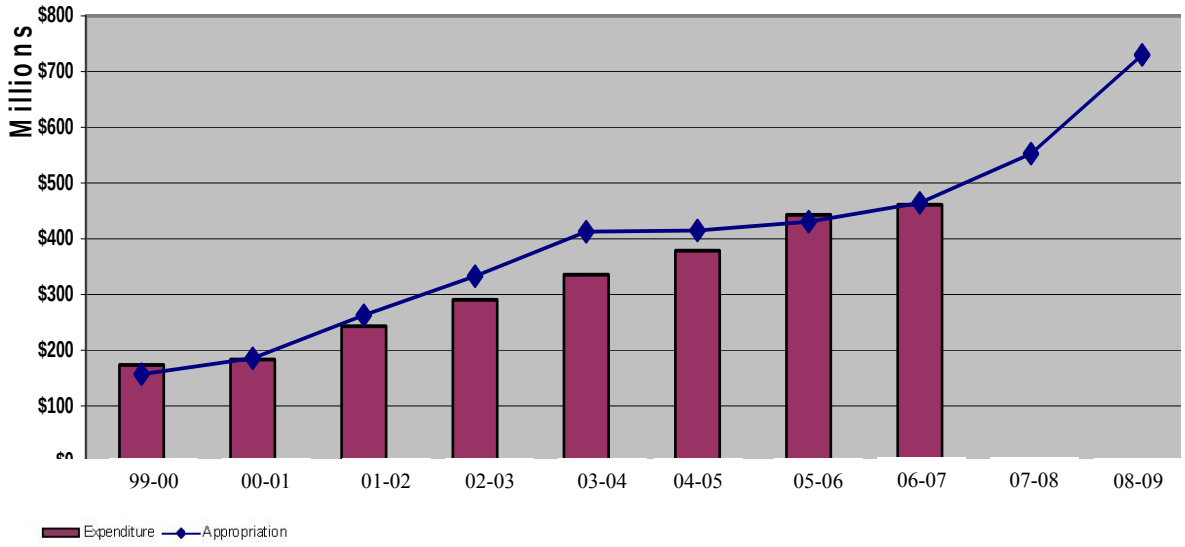
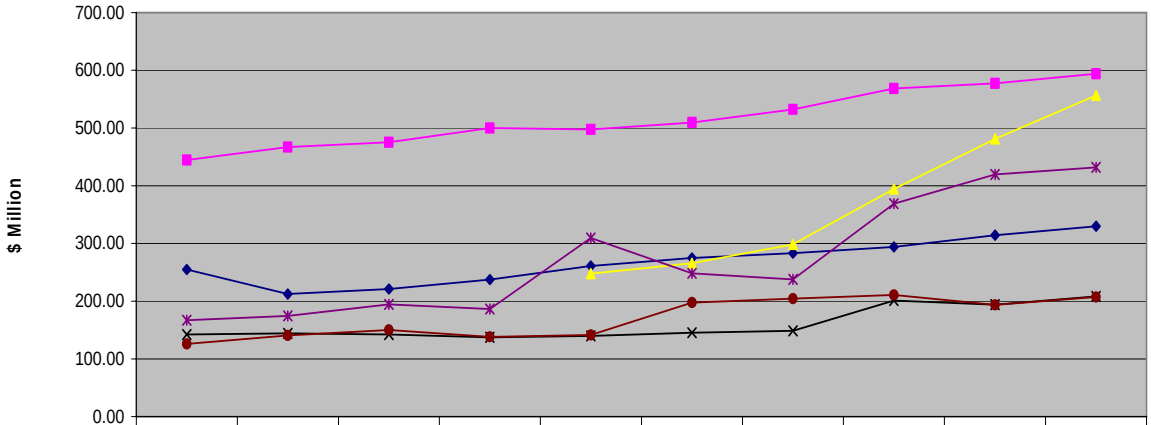


Figure 3 outlines the support provided by the Australian Government for selected research agencies and programs. NHMRC expenditure as a proportion of the health budget and a proportion of GDP is shown in Figure 4.

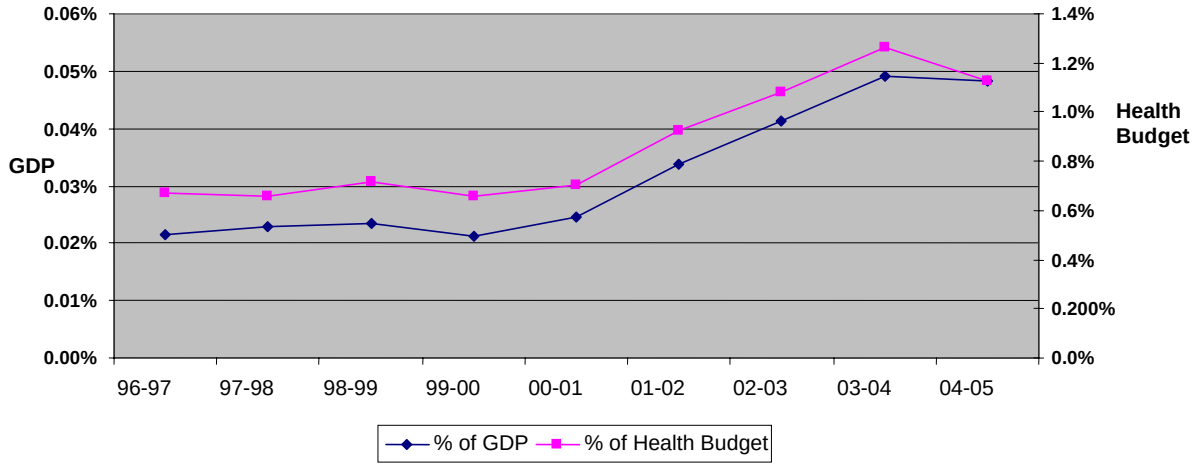
Figure 3: Overview of the Australian Government's Support for Science and Innovations (1996-97 to 2005-06)[6]



	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06 (budget est)
DSTO	254.90	212.20	221.30	237.60	261.00	275.00	283.40	293.90	314.40	329.70
CSIRO	444.50	466.80	475.40	500.00	497.70	509.60	532.10	568.60	577.10	593.90
ARC					247.80	265.80	298.30	394.40	481.40	556.50
CRC	142.30	144.30	142.30	137.50	139.70	145.30	148.60	201.10	194.00	208.20
NHMRC	167.00	174.50	194.60	186.50	309.70	248.30	237.70	369.00	419.50	431.90
Rural	126.00	140.50	150.20	138.20	141.30	197.50	204.30	210.70	193.70	207.20

Year

Chart 4: NHMRC Funding as a proportion of GDP and the Australian Health Budget



The funding shown in Table 1 reflects NHMRC's increasing investment in the NRPs and that NHMRC-funded researchers are applying the thematic priorities to their own research. Table 2 provides a breakdown of NHMRC's funding allocation to the goal for Promoting and Maintaining Good Health.

Table 1: Funding by National Research Priority[7]

National Research Priority	2004-05 ($ million)	2005-06 ($ million)
1. An Environmentally Sustainable Australia	0.5	1.6
2. Promoting and Maintaining Good Health	244.9	261.2
3. Frontier Technologies for Building and Transforming Australian Industries	6.3	20.8
4. Safeguarding Australia	1.1	5.0

[6] Australian Science and Technology at a Glance (2005) Department of Science, Education and Training
[7] Source: PMF dataset as at 6 May 2006

Table 2: Funding for the goals of the Promoting and Maintaining Good Health NRP[8]

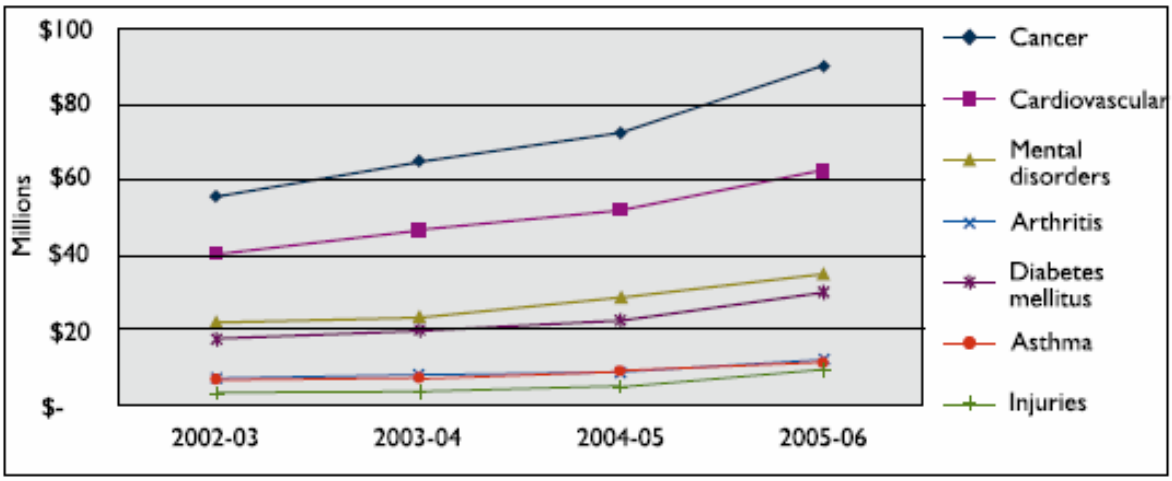
Goal	2004-05 ($ million)	2005-06 ($ million)
1. Ageing well, Ageing Productively	107.7	109.2
2. A healthy start to life	55.9	59.3
3. Preventive healthcare	70.1	82.1
4. Strengthening Australia's social and economic fabric	11.3	10.5

The NHMRC commitment to addressing Australia's major burdens of diseases and has contributed substantially to research funding to the NHPAs. Expenditure against the NRPs in 2005 was:

Asthma	$11.2 million
Arthritis	$40 million
Cancer	$95 million
Cardiovascular disease	$75.5 million
Diabetes mellitus	$26.6 million
Injury prevention	$9.1 million
Mental health	$44.2 million

Figure 5 outlines the NHMRC's increasing commitment to funding research which address NHPAs

Figure 5: Expenditure by National Health Priority Area 2002-03 to 2005-06[9]



ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS

Excellence in research is an important priority for the community and is seen by the NHMRC as a cornerstone for improvement of the health standards of all Australians. The Australian Government funding for health and medical research is critical for the health and welfare of the Australian population. Australia's investment in health and medical research generates

[8] Source: PMF dataset as at 6 May 2006
[9] Source: PMF dataset as at 6 May 2006

significant returns for Australia both in terms of improved health outcomes and direct (and indirect) wealth generation. These returns are broadly from:

- increased health of the Australian community, thereby reducing the burden on the healthcare sector;
- increased quality of life, thereby increasing social cohesion, decreasing the burden on the healthcare sector, absenteeism, and indirect impacts of chronic conditions (eg. impact of lost productivity through absenteeism of family members to care for an ill relative);
- increased longevity, thereby increasing productivity through increasing the number of available labour market participants; and
- increasing and improving available treatment options, thereby reducing the cost of health care through effective treatments, decreased burden on PBS and MBS, better use of existing and new technologies and decreased duration of individual hospital stays.

What are the impacts of the science and innovation system?

Australia is internationally renowned for its research excellence. There is a steady flow of new discoveries and knowledge from NHMRC-funded research that may provide the basis for new treatments, therapies and products. A snapshot of NHMRC achievements in 2003-2006 is provided at Attachment 2. A summary of NHMRC funded research projects being undertaken in universities, hospitals and medical research institutes across the country is presented in Attachment 3. A case-study showcasing NHMRC's international impact through the development of health advice is provided at Attachment 5.

The NHMRC has produced a number of publications which highlight the outstanding achievements of the Australian health and medical research sector:

- Investing in Australia's Health (2002)[10]
- 10 of the best (2005)[11]

10 of the best (2006) is currently in production and will be available to the Productivity Commission when it becomes available later in 2006.

Other countries' experiences may provide lessons

The review of international data reveals divergence in the way agencies are collecting and reporting data. While there are some common measurement methodologies, these are generally limited to basic information such as general research expenditure and publication outputs. There is little comparable information reported against recognised fields of science.

One reason for this is that each funding institution is structured differently, with nationally relevant objectives, different national economic circumstances and different government reporting systems. While most countries provide information on research funding by type of grant and priority area, these reflect domestic concerns and are not usefully comparable across either agency or countries. International comparisons in many cases provide little more than reflections of the nature of different domestic priorities and circumstances.

[10] http://www.nhmrc.gov.au/publications/_files/nh42.pdf
[11] http://www.nhmrc.gov.au/publications/synopses/thebest.htm

However, in the context of increasing pressures for research funding agencies worldwide to provide a higher level of analysis of research outputs and outcomes, some common approaches to data collection and presentation are emerging. The current NHMRC performance indicators reflect international good practice in this regards.

In 2003, the NHMRC commissioned a report to assess the international performance of Australian health and medical research which drew on international data collections from OECD and US NSF. The report indicated that:

- Australia, by international standard, is 'mid-range' in terms of total national public and private health expenditures. However in terms of health and medical research expenditure, Australia ranks around 'mid to low' range. This applies to research expenditure per head of population as well as research as a share of total health expenditure.
- Australia's total budget expenditure for health and medical research and development as a percentage of GDP is around mid-range when compared with benchmark countries.

In terms of outputs, Australia's researchers perform well internationally. While scientific output recorded in publication matches international benchmarks, in terms of application of research outcomes (indicated by patents registered and granted) Australia's effort lags.

Difficulties in evaluating impacts

The NHMRC's experience in the measurement of the performance of health and medical research is that there is an increasing international appreciation that there is a need to improve the understanding of the economic, social and environmental benefits arising from health and medical research. This includes the ability to more specifically identify the benefits flowing from public investment into national health and medical research.

One of the key emerging priorities for the NHMRC over the 2006-09 Triennium is to advance its capability in this area, with the intention to better articulate our understanding of how health and medical research translates into the improved health and well-being of Australians. It will then, in turn, be able to better understand how this ripples through to all aspects of Australian society, ranging from longer and healthier working lives to amelioration of pain and suffering of people.

While the NHMRC is still developing its methodology, it has made considerable efforts to demonstrate practically the benefits of health and medical research. The NHMRC has directed significant resources towards developing and implementing its Performance Measurement Framework and developing protocols to evaluate the impact and the benefits of the Australian Government's investment in health and medical research.

A particular emphasis has been placed on primary data collection and analysis in order to meet the NHMRC's statutory and strategic reporting requirements, provide enhanced responses to *ad hoc* requests for information, and as an aid in demonstrating and promoting the outcomes of health and medical research. Many of the indicators and targets are benchmark activities and many remain difficult to achieve, due in part to limitations in the NHMRC's information systems.

Key initiatives to inform the NHMRC's performance measurement reporting include the establishment of the Evaluation and Outcomes Working Committee (EOWC) to steer the peer review of final project reports and to evaluate and disseminate the outcomes arising from NHMRC funded research.

The NHMRC also has implemented strategies (e.g. Record of Research Achievement (RORA)[12] and Measure of Research Impact and Achievement (MORIA)) to better measure comparatively the inputs (not outputs or outcomes) into the NHMRC's funding schemes. This has enabled the NHMRC to measure the impact of research, on the research sector, or as a measure of the quality of research, which is an element of impact as defined above and obviously not the whole picture. The MORIA is still under development.

Measurement and methods can matter

At present, the best available recognised model to understand the economic impact of health and medical research is the 2003 Access Economics report *Exceptional Returns the Value of Investing in Health R&D in Australia*[13].

The report demonstrates that the direct benefits to the companies or industries responsible for producing health and medical technology, and the indirect outcomes which produce social benefits for all Australians, are significant. It concludes that the outcomes for Australians of continued excellence in health and medical research, namely better health and quality of life and lower costs, will be positive in all regards.

Whilst providing a valuable benchmark on our current understanding of the economic contribution of health and medical research, there were methodological difficulties noted in arriving at an accurate assessment of economic and social impacts.

There is a need for a more accurate methodology to quantify the total economic and social contribution of health and medical research to the Australian community. This model will need to map in detail the various pathways of the translation of health and medical research into improved health outcomes and wealth generation. This exercise will not only deliver a more accurate methodology to measure the contribution of health and medical research to the Australian community, but will also identify specific impediments within the healthcare sector in the various pathways.

While detailed evaluation of health and medical research outcomes is difficult, and measurement in empirical terms even more so, it is important to note that the financial nature of the four year budget cycle does not provide a full indication to the Australian Government of the real fiscal impact of research. For example, the Government's 2006-07 increase to health and research funding reflects a direct cost to the Government over the Budget and Forward Estimates. It does not reflect the benefits that will be returned to government and the community in the coming years (on average taking about 10 years).

This investment benefit can be generalised as improved health and wellbeing outcomes that drive commensurate reductions in consumption of health care services and can extend, for example, the productive working lives of mature age people. The financial costing nature of

[12] http://www.nhmrc.gov.au/publications/_files/qualgrid.pdf
[13] http://www.asmr.org.au/general/Except.pdf

the current budget system therefore does not provide an intrinsic incentive for health and medical research to invest effort into understanding these cost/benefit relationships. Such an understanding is necessary to enable the NHMRC to begin to predict, at least broadly, the impact of health and medical research on Australia's health and welfare, and ultimately to develop a more 'business intelligent' understanding of planned and actual outcomes.

The NHMRC considers that benchmarking NHMRC funding against domestic and international Gross Domestic Product (GDP) figures, which can be characterised as an input measure, remains useful in the immediate term. However, the NHMRC considers input measures have a limited usefulness in that they do not attempt to correlate with outcome benefit measures. While this may seem to be somewhat ambitious in the health and medical research context, this science has been in existence for a long time and the NHMRC's moves in this direction will be realistic and measured.

International Benchmarks

As part of its Backing Australia's Ability initiative, in 2003 the Department of Education, Science and Training completed a mapping exercise of Australia's science and innovation activities across the public and private sectors. The significant study mapped Australia's science and innovation system against international benchmarks. The report *Mapping Australian Science and Innovation – Main Report* (2003)[14] examines the strengths of Australian research and development.

The study reported that while Australia continues to deliver advances in science and innovation (including health and medical research), we will need to leverage our science and innovation system to capture the benefits of inward knowledge flows and technology transfer from larger and more technologically advanced countries. Securing such benefits for Australia will require strong links with international research, technology and business, and have the knowledge and skill base to effectively integrate, adapt and adopt.

Current impediments to Australia's innovation system

While the Australian Government has sought to reduce impediments to Australia's innovation system, specifically through the Backing Australia's Ability initiative[15], significant impediments remain. The majority of impediments surround the uptake of research outcomes into products and/or services. These impediments, while normally associated with commercialisation, can also have a major impact on the non-commercialisation pathways from health and medical research to improved health outcomes.

To ensure that the best possible outcomes are realised from the Australian Government's investment in health and medical research, NHMRC seeks to foster an environment in which research outcomes are translated into policy and practice aimed at achieving health benefits, with returns accruing to the Australian economy as appropriate. While commercialisation is an important mechanism for research outcomes, particularly in the pharmaceutical and devices sectors, NHMRC's key responsibility is to facilitate better health.

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14 http://www.dest.gov.au/sectors/research_sector/publications_resources/mapping_australias_science_innovation_system/mapping_australias_science_and_innovation_system.htm

15 http://backingaus.innovation.gov.au/default2001.htm

In addition to a range of issues outlined in a submission to the House of Representatives Standing Committee on Science and Innovation inquiry[16], the NHMRC considers the following to be important factors of concern in relation to the innovation system:

1. *Gaps in the availability of comparable information on how the various elements of the innovation system perform relative to the levels of investment*

There are some limitations on the effectiveness of traditional government program-driven investments in bridging gaps between the relative fields of focus. This is the case within and across all levels and jurisdictions of government and the limitations on integration and coordination of effort means, in essence, that the opportunity for take-up and implementation of health and medical research knowledge and products is not as systematic as it could be.

2. *Privacy laws and impact on health and medical research*

The privacy regulation framework is a complex, patchwork of Commonwealth and State/Territory legislation, administrative decisions, and codes of conducts which can hamper health and medical research as it has the potential to act as a barrier to the exchange of information.

3. *Health and Gender issues in the research sector:*

Researchers who require time for child-rearing or ill-health can be disadvantaged and losses from the research career path often occur when careers are interrupted for health or family reasons.

4. *The size and strength of the Australian market*

Australia's market size limits what can be produced within Australia. Researchers considering potential innovations must, from the outset, aim to meet the requirements of an international market, which may be over and above those of the local market. Researchers must be encouraged to target a global approach from the outset when considering a venture.

5. *The fall off in student numbers in the fields of Science, Technology, Engineering and Mathematics.*

Australia needs an adequate workforce of highly trained and skilled researchers in order to maintain Australia's health and medical research at international standards and to ensure that such research leads to improved health outcomes. The essential role performed by universities and research institutes in training and developing skilled researchers is not adequately fostered, valued and publicly recognised.

6. *Public opinion impeding the introduction of emerging technologies and their products*

The public opposition to new technologies and their products (e.g. genetically modified products and nanotechnology) can place significant constraints on their uptake and use.

7. *Lack of knowledge and expertise in translating innovation into a commercial product*

Business models and expertise for commercialisation that are appropriate for large institutes may not be useful for smaller organisations.

[16] NHMRC submission to the House of Representatives Standing Committee on Science and Innovation inquiry, *Pathways to technological innovation*, May 2005 http://www.aph.gov.au/house/committee/scin/index.htm

8. *The lack of strong interchange and interaction between individuals in the research and academic community, the corporate sector and government*

The Australian Government and State and Territory governments need to ensure that Australia has appropriate and internationally competitive industry policy and regulatory regimes to enable industry to thrive. A prosperous health and medical industry will deliver greater direct and indirect returns to government and the Australian community.

9. Impediments within the medical research community

- A lack of time to dedicate to clinical research rather than clinical practice;
- The need for basic infrastructure including support staff;
- Insufficient mentors and role models for young clinical researchers and hence insufficient critical mass of those with research interests and clinical awareness;
- The income from research does not compare with what is earned in clinical practice; and
- Insufficient strong collaborations between universities and health settings.

10. Funding in the initial stages of research and development

- Promotion of basic discoveries to the point where they are of interest to the commercial world is under funded;
- Sources of additional funding for patent protection and defence are scarce;
- Sources of additional funding for academic business development offices are scarce; and
- Lack of, or difficulty in obtaining, pre-seed and seed funding.

11. Lack of funding in later stages of research commercialisation

- The lack of a major pool of venture capital money, accessible locally, and run by people who tolerate the realities of risk taking in this area;
- Downstream, the lack of a meaningful capital market and unsophisticated valuation of technology has led, on the one hand to companies inappropriately using Initial Public Offerings (IPOs) as their initial vehicle for raising capital and secondly, to companies that should be at the IPO stage raising small amounts of capital compared to what US companies of a similar ilk can raise from their special high technology share market (NASDAQ);
- Difficulty in attracting venture capital, business angels or philanthropic investment;
- There is a negative perception of commercialisation and research application generally among many Australian scientists working at the basic end of the spectrum;
- There is a perception that unrealistic expectations and insufficient value is placed on commercialisation activities by government funding bodies; and
- There is a lack of:
  - investment through private sector;
  - appreciation of research being undertaken in institutions;
  - collaboration between institutions and private sector; and
  - private sector engagement in educational resource allocation and development;

12. Taxation relating to health and medical research

To ensure ongoing success and prosperity, it is essential that as a nation, Australia makes a considerable investment in creating knowledge through research activities. Given that a number of studies have documented the effectiveness of Australian health and medical

research, and the considerable benefits to the Australian community arising from health and medical research, greater investment in this area would almost inevitably lead to increased benefits to the nation as a whole.

- Current tax incentives should be reviewed to explore how they might greater encourage investment in health and medical research.
- Current taxation measures should be also be reviewed to ensure that any tax laws that seek to stimulate intellectual property development and commercialisation are fully effective, and provide direct tax assistance to encourage all phases of commercialisation activity, including offsetting expenses associated with activities such as patenting.

CONCLUSION

Australia is well placed to benefit economically, socially and environmentally from continued investment in health and medical research.

Public investment in health and medical research is essential to ensure Australia is able to continue to deliver tangible health benefits to the community. In the coming years, Australia will need to address new challenges to our health system, including an ageing population, health impacts from our changing life-styles and threats from new emerging diseases and bioterrorism.

In that context, the NHMRC does not consider a diversified approach to public support for science and innovation to be problematic provided there is a capacity for coordination and facilitation of the broader, whole of life cycle, planning and implementation of government and other investment. This includes a coordinated approach to measuring science and innovation impacts.

This approach preserves the ongoing importance of pure research, which is fundamental to developing Australia's ongoing scientific capacity, while optimising translation of outputs arising from health and medical research investment. Combined with Australia's ongoing commitment to excellence in research and translation of research, this will strengthen our international comparative advantage by attracting a greater proportion of international funding and investment and further developing Australia as a health and medical research powerhouse.

Attachment 1

The Functions of the NHMRC

The functions of the NHMRC come from the statutory obligations conferred by the *National Health and Medical Research Council Act* 1992 (the Act)[17]. This legislation was amended by the Government in June 2006 in order to strengthen the NHMRC's governance arrangements.

The Act provides for the NHMRC to pursue activities designed to:

- raise the standard of individual and public health throughout Australia ;
- foster the development of consistent health standards between the various States and Territories;
- foster medical research and training and public health research and training throughout Australia ; and
- foster consideration of ethical issues relating to health.

The NHMRC also has statutory obligations under the *Research Involving Human Embryos Act* 2002[18] and the *Prohibition of Human Cloning Act* 2002[19].

While the NHMRC's transition to new governance arrangements has not changed the NHMRC's fundamental objectives, it will inevitably change how the NHMRC operates. The NHMRC is therefore undergoing a transformation that will enable it to contribute to Australia's intellectual capital by strengthening the scientific and technical capacity of the health and medical research sector, through provision of excellence in research, development of ethical frameworks, and delivery of high quality and valued public health and clinical health advice.

In addition to the NHMRC's traditional role for supporting best practice health and medical research, ethics and advice, the NHMRC recognises the opportunity to improve upon Australia's world-class research by enhancing its focus on translation of research and knowledge into practice, in all its relevant forms.

Under the new governance arrangements, the Chief Executive Officer is responsible for all operational and financial operations of the organisation, while the role of the Council of the NHMRC is to assist the CEO in implementing the NHMRC's strategic plan and provide authoritative, independent advice on scientific and technical issues. The direct consequence of these changes is that the NHMRC is reviewing closely both its strategic directions and its operational arrangements.

The NHMRC provides funding to support Australia's health and medical research sector in two broad categories, *research support* and *researcher support*.

Research Support includes:

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[17] http://www.comlaw.gov.au/comlaw/Legislation/ActCompilation1.nsf/0/4AFACF8FAAF9ED97CA25719C0081EF9F?OpenDocument

[18] http://www.nhmrc.gov.au/publications/_files/embryact.pdf

[19] http://www.nhmrc.gov.au/publications/_files/prohibit.pdf

- *Project Grants* enable individual researchers or a group of researchers to undertake a scientific investigation in the biomedical, clinical, public health or health services field;
- *Program Grants* support teams of researchers to pursue broadly based collaborative research activities;
- *Strategic awards* provide a mechanism by which the NHMRC can respond to opportunities for pursuing innovative projects and national and international collaborations at the frontiers of health and medical research;
- *Enabling Grants* assist Australian researchers to continue high quality, world-class research by providing support for specific facilities and/or activities to enhance the national health and medical research effort; and
- *Equipment Grants* and *Infrastructure Grants* provide funding for specific equipment and overhead infrastructure.

Researcher support includes

- *Training Fellowships* provide opportunities for Australian researchers to undertake research that is both of major importance in its field and of benefit to Australian health.
- *Career Awards* provide support for experienced Australian researchers to undertake research that is both of major importance in its field and of benefit to Australian health.
- *Career Development Awards* build Australia 's health research skills, increase knowledge ;and encourage the growth of knowledge-based industries in Australia.
- *Scholarships* scheme supports outstanding Australian health and medical graduates early in their career.

The NHMRC has a number of other award schemes for specific health issues, including

- Palliative care
- Potential avian influenza-induced pandemic
- Preventive healthcare and strengthening social and economic fabric
- Type I diabetes

Attachment 2

Achievements of the NHMRC

The achievements of the NHMRC are the result of the wealth of expertise on the Council, the Principal Committees and various working parties and also from the dedicated contributions by several thousand of Australia's most respected practitioners, researchers and members of the community, who share their common goal of improving the health of the national. It is through their efforts that Australians enjoy a high standard of health.

The NHMRC maintains extensive information on its ongoing activities which may be useful to the Productivity Commission in developing this report on science and innovation, includes

- Annual Reports[20],
- Strategic Plans[21]
- Performance Measurement Report – a report on the performance of the NHMRC[22]
- NHMRC-supported research: the impact of journal publication output [23]

In 2006 the NHMRC completed a review of the implementation of the NHMRC Strategic Plan 2003-2006 which was based on its Performance Measurement Framework (PMF). This report is currently under embargo, however can be made available to the Productivity Commission for the purposes of this study.

NHMRC Achievement Highlights 2003-2006

- The NHMRC has achieved above world average citation rates – The world average is 6.5 citations per publication (cpp). The national average is 6.6 cpp compared to the average cpp of 9.4 for NHMRC funded research. This is up from 7.6 in 2003.

- In 1999, it was estimated that Australia produced approx 2% of the OECD research output. Relative to GDP, Australia has outperformed other OECD countries, producing approx 3% of the OECD health and medical research (HMR) output at almost twice the OECD average. (Grant 2004).

- NHMRC-funded research produces a steady flow of new discoveries and knowledge that provides the basis for new treatments, therapies and products. A selection of research outcomes has been published (NHMRC's 10 of the Best, August 2005).

- Commercialisation - shows the level of funding for grants that may lead to commercial activity in 2005-06. The PMF target for this activity was 2.5% of expenditure through the MREA. It was met by an allocation of more than $11.5 million (2.6%), a significant increase on the $6.5 million allocated in 2002−03.

[20] http://www.nhmrc.gov.au/publications/synopses/nh34syn.htm
[21] http://www.nhmrc.gov.au/publications/_files/nh46.pdf
[22] http://www.nhmrc.gov.au/publications/synopses/pmf2006.htm
[23] http://www.nhmrc.gov.au/publications/_files/nh75.pdf

- Basis for Industry development – Around one third of a sample of 100 Australian biotechnology companies recently surveyed by Research Australia were based on NHMRC funded research.

- IP developed - Seventy-nine per cent of researchers who responded to the NHMRC Stakeholder Survey 2005 indicated awareness of the responsibilities for protecting IP. Additionally, of the 400 final reports analysed from grants ending in 2004, 23% (91/400) indicated that their research had resulted in the development of IP.

- Significant rates of national and international collaboration - 53% (213/400) of grants involved national collaboration and leveraged $43.2 million nationally while 46% (185/400) of grants involved international collaboration, leveraging $49.5 million internationally

- External funding from partnerships – For the last triennium, more than 6% of new funding awarded per annum was matched by external funding.

Attachment 3

NHMRC funded research in Australia

Cardiovascular disease

- The establishment of a major start-up company to market new drugs for ischaemia, based on discoveries from NHMRC-funded research
- Development of new technology involving the use of microwave energy for ablation therapy for cardiac arrhythmias — the removal of extra electrical pathways within the heart that cause fast or irregular heart rhythms)
- New findings about the way in which blood pressure is elevated in overweight people and the importance of mental stress and psychiatric illness (including depression) as risk factors in heart disease, potentially leading to better preventive care
- Identification for the first time of a gene that appears to control the size of the human heart. This is important, because people with large hearts are at increased risk of developing fatal heart disease later in life

Respiratory disease

- The demonstration in an animal model that a molecule which affects the immune system, contributes to the slow build-up of fluid in the lungs and hence to asthma and pulmonary oedema. This finding has implications for therapies that will benefit sufferers of asthma and pulmonary oedema and for the possibility of commercial development
- A project involving the use of a laboratory model of asthma to study abnormal responses of smooth muscle in the airways. The study of cells from asthmatic patients showed that one reason people with asthma have a thicker layer of smooth muscle around their airways is that they lack a protein called C/EBP alpha, which acts to regulate the growth of smooth muscle cells
- A study of the dose-response effects of known carcinogens in dust-related diseases in Western Australia showing relationships between exposure and development of disease. This information will inform the production of occupational health and safety exposure standards and compensation policy in Australia
- A study that characterised the changes in the immune system of allergic patients during successful treatment with allergy shots for seasonal hay fever and mild asthma caused by allergy to couch grass pollen. The study provided important information of relevance to the development of vaccines against grass pollen hay fever and asthma

Mental health

- A study to clarify to what extent common health risk behaviours of teenagers pose a threat to later health and wellbeing has shown that the use of cannabis in young people increases their risk of developing mental disorders
- A study that followed up on an education program for parents of shy, withdrawn and inhibited preschoolers has established for the first time that prevention of anxiety in young children may have implications for mental health later in life
- The discovery of a familial form of dementia associated with Lewy bodies (deposits found in damaged nerve cells in the brain) has provided an important step toward finding genetic determinants of this disease

- The localisation for the first time of a cadherin gene that confers susceptibility to bipolar disorder. Testing in mice identified a molecular pathway involved in the pathogenesis of bipolar disorder that may yield potential targets for novel therapeutic treatments for this condition

Cancer

- New knowledge from the study of graft versus host disease that increased the understanding of stem cell mobilisation and transplant tolerance
- The development of living tissue models with the potential to replace artificial implants, such as silicone implants for breast reconstruction. The technology involves the use of a patient's own tissue or cells and has been the subject of a number of patent applications
- The development of a form of cancer therapy based on the use of radioactive atoms that produce a very intense focus of radiation (Auger emitters) attached to a tumour-targeting protein. Imaging by positron emission tomography showed that the damage to DNA caused by a DNA-binding drug was sufficient to kill tumour cells. These findings open the possibility of a strategy in which tumour targeting can be verified before administration of therapeutic doses of radioactivity
- The discovery that genetic differences between patients influence the efficacy of the drug tamoxifen (used for treatment of breast cancer worldwide) and therefore the success of tamoxifen treatment. Knowledge of the genetic make-up of an individual patient may allow the selection of better treatment regimens and may also influence the efficacy of treatment for opioid dependence

Nervous system disorders

- The finding that the metabolic activity of the enzyme lactate dehydrogenase increases just before the onset of degeneration of retinal photoreceptors, which could provide a greater understanding of why retinitis pigmentosa causes blindness
- Identification of the brain mechanisms responsible for visual loss after parietal stroke, which suggested a possible remedial therapy using somatosensory attention cues
- The description of a novel mechanism that allows additional force to be produced by human muscle, probably via plateau potentials. The finding has implications for the use of functional electrical stimulation to enhance muscle performance after spinal cord injuries
- The development of new, validated technology for screening babies for ysosomal storage disorder, which affects one baby per 5,000 births in Australia. The greater understanding arising from this research has resulted in the completion of successful clinical trials and approval from the US Food and Drug Administration for clinical use of a new treatment known as enzyme replacement therapy

Diabetes

- A study of appropriate diets for achieving the combined goals of losing weight, improving cardiovascular health and preventing diabetes
- The finding that a kinase enzyme may provide a target for new treatments for the prevention and control of diabetes
- Identification of new strategies to reduce the diabetic complication, renal disease. Various combinations of drugs that influence multiple hormone systems in the kidney were more effective than conventional treatments that block only one pathway

- A study that provided substantial evidence that macrophages promote the progression of diabetic renal disease. These findings have pointed to potential mechanisms by which macrophages may contribute to the development of the renal fibrosis that accompanies diabetic renal disease

Arthritis and musculoskeletal disorders

- The finding that stretching exercises for contractures after ankle fracture were ineffective is likely to influence future clinical practice
- A large, randomised trial of anti-inflammatory treatment with ibuprofen for hip replacement surgery showed that ibuprofen reduced the rate of bone formation in the wrong areas, but, paradoxically, failed to improve symptoms
- The first demonstrations that bone loss could be reduced in rheumatoid arthritis by targeting the bone resorption process. This finding offers a possible mechanism by which the debilitating reduction in joint movement associated with rheumatoid arthritis may be prevented
- Successful clinical trials of supplementing milk with calcium and vitamin D3 to improve the musculoskeletal health of older adults, particularly men. The trials provided evidence for the development of physical activity and nutrition guidelines—and public health policy—to promote improved musculoskeletal health

Infectious disease

- A study of the diagnosis of brain abscesses by magnetic resonance methods has led to the development of new technology based on Magnetic Resonance Spectroscopy for the identification of disease-causing organisms, such as bacteria and viruses, in humans and has resulted in a provisional US patent pending
- A discovery concerning the facilitation of secondary antibody responses, which has implications for the treatment of infections and boosting the immune processes activated by vaccination
- Computer modelling studies showed how climate and other environmental variables influence both the range and abundance of the mosquitoes that transmit malaria in Australia and Papua New Guinea. This new knowledge should improve the effectiveness of efforts to control the mosquitoes that transmit malaria in Australia and Papua New Guinea
- The finding that the bacterium, Group A streptococcus (GAS), causes a substantial and underestimated disease burden in Victoria, which may lead to the development of Australian guidelines for the management of GAS and models for the use of GAS vaccines

Maternal conditions and foetal development

- New information about influences on the intrauterine environment that affect foetal lung development, which has implications for improved perinatal management
- The evidence from a study of 15,000 patients that epidural and spinal anaesthesia reduce pelvic operative mortality and morbidity
- Research in Western Australia has influenced State and national policies including those relating to Indigenous research, the establishment of an Australian Research Alliance for Children and Youth, folic acid supplementation and food fortification, mental health promotion and foetal alcohol syndrome
- A study to gain crucial information on the role of the interstitium in kidney disease and repair, which may help in the search for renal stem cells that may one day offer

therapy for end-stage renal disease. Interest in the renal interstitium is growing as its importance in paediatric development and disease is becoming apparent

Attachment 4

National Research Priorities and National Health Priority Areas

National Research Priorities

The Australian Government has nominated a number of NRPs to concentrate the national research effort. Research areas falling under the NRPs are the targets for building critical mass and promoting collaboration among research organisations and with industry. The four NRPs are:

1. *An Environmentally Sustainable Australia* – Transforming the way we utilise our land, water, mineral and energy resources through a better understanding of human and environmental systems and the use of new technologies;
2. *Promoting and Maintaining Good Health* – Promoting good health and well being for all Australians;
3. *Frontier Technologies for Building and Transforming Australian Industries* – Stimulating the growth of world-class Australian industries using innovative technologies developed from cutting-edge research; and
4. *Safeguarding Australia* – Safeguarding Australia from terrorism, crime, invasive diseases and pests, strengthening our understanding of Australia's place in the region and the world, and securing our infrastructure, particularly with respect to our digital systems.

As lead agency for implementing the *Promoting and Maintaining Good Health* NRP, the NHMRC funded research addressing the four priority goals of:

- *A healthy start to life* – Counteracting the impact of genetic, social and environmental factors which predispose infants and children to ill health and reduce their wellbeing and life potential;
- *Ageing well, ageing productively* – Developing better social, medical and population health strategies to improve the mental and physical capacities of ageing people;
- *Preventative health care* – New ethical, evidence-based strategies to promote health and prevent disease through the adoption of healthier lifestyles and diet, and the development of health-promoting products; and
- *Strengthening Australia's social and economic fabric* – Understanding and strengthening key elements of Australia's social and economic fabric to help families and individuals live healthy, productive, and fulfilling lives.

National Health Priority Areas

The National Health Priority Areas (NHPA) initiative is Australia's response to the World Health Organization's global strategy *Health for All by the year 2000* and its subsequent revision.

The NHPA initiative, overseen by the National Health Priority Action Council, is a collaborative effort involving the Australian, State and Territory governments and is focused on those areas that:

- contribute significantly to the burden of illness and injury; and
- have potential for health gains and reduction in the burden of disease.

A hallmark of the NHPA initiative has been to identify new priority areas on a regular basis. The initial set of NHPAs included cardiovascular health, cancer control, injury prevention and control and mental health. Then, in 1996, a mechanism was developed to identify new NHPAs. By targeting specific areas that impose high social and financial costs on Australian society, collaborative action can achieve significant and cost-effective advances in improving the health of Australians. Currently, seven different health areas have been identified for priority attention as NHPAs:

- arthritis and musculoskeletal conditions;
- asthma;
- cancer control;
- cardiovascular health;
- diabetes mellitus;
- injury prevention and control; and
- mental health.

In addition, the initiative focuses on common health risk factors and health inequalities as reflected by NHPA diseases and conditions. Taken together, the seven NHPAs account for almost 80% of the total burden of disease and injury in Australia.

Attachment 5

Case Study: Translation of Australian and International Research into International Health Policy - *Australian Drinking Water Guidelines*

The *Australian Drinking Water Guidelines* is Australia's premier resource for ensuring drinking water quality. Since 1972, the Guidelines have been developed by the National Health and Medical Research Council (NHMRC), with the Natural Resource sector collaborating with the NHMRC on the Guidelines since 1987.

Until 1996, the *Australian Drinking Water Guidelines*[24] focused primarily on providing guideline values for contaminants in drinking water which would be used by State/Territory regulatory agencies in establishing individual State or Territory standards or license conditions for drinking water. Following a number of significant water quality incidents in the 1990s resulting from failures within the water supply system, (Milwaulkee, USA 1993; Sydney 1998), it became apparent that relying on monitoring water after it left the treatment plant did not offer the level of protection appropriate for the community. This concern was further highlighted by a serious contamination incident in Walkerton, Canada (2000) where seven people died.

In addressing this concern, in 1998 the NHMRC, in collaboration with Monash University and the CRC for Water Quality and Treatment, initiated work on the development of a preventive risk management framework which would focus on managing and monitoring critical points within the water supply system to ensure the supply system was able to achieve drinking water quality that would meet the guideline values established by NHMRC. The approach would guide water supply managers through a catchment-to-tap examination of their water supply, and provide guidance on the management, monitoring and improvements

The Framework for Management of Drinking Water Quality was developed using leading Australian and international research, and was recognised by the World Health Organization and other international organisations and governments as the leading approach to preventive management of drinking water quality. Principles outlined in the NHMRC's Framework were incorporated in the WHO *Guidelines for Drinking Water Quality* (2004)[25].

In 2004, the Guidelines were further expanded to include an interactive decision support tool The Community Water Planner[26]: A tool for small communities to develop drinking water management plans. This innovative tool provides guidance to local drinking water supply managers on developing drinking water quality management plans, based on the Framework, that are tailored for their individual and specific water supplies. The Planner is now widely used through-out Australia's rural and remote communities, and also in the South Pacific, North America, Asia, Europe and Africa, and provides a model which is robust and flexible enough to be useful in climates as diverse as Morocco and Iceland.

[24] http://www.nhmrc.gov.au/publications/synopses/eh19syn.htm
[25] http://www.who.int/water_sanitation_health/dwq/guidelines/en/index.html
[26] http://www.nhmrc.gov.au/publications/synopses/eh39.htm

The development of the *Australian Drinking Water Guidelines*, the Framework for Management of Drinking Water Quality, and the decision tool has highlighted the expertise and international reputation of Australian water quality scientists, and the NHMRC's ability to produce both nationally and internationally relevant health advice.