1-1-2004

Science for life: an evaluation of New Zealand's health research investment system based on international benchmarks

Samuel Garrett-Jones
University of Wollongong, sgarrett@uow.edu.au

Tim Turpin
University Of Western Sydney

Brian Wixted

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Abstract

During the past decade there have been major developments in the way that research investments have been monitored and evaluated. While there are differences in the ways governments fund research around the world, and a diversity of approaches to evaluation, there are a number of common themes that can be observed in national experiences. As the importance of evaluation increases, the gap between current practice and best practice becomes more significant, and the need for comparative study and methods development grows. Current international 'better-practice' approaches to research evaluation and performance indicators reflect two important considerations. First, they make a clear distinction between input, output and outcome indicators and assessments of impact. Only limited refinements have occurred in recent years in input and output performance indicators. However, quite considerable developments have occurred in relation to the development of indicators and approaches for assessing the outcomes and impact of research.1 Second, evaluation and reporting mechanisms vary considerably according to the intended audience for the reporting. In particular, as nations move toward strategically targeting limited government research resources reporting demands at the programme level, and for specific stakeholder groups becomes all the more pressing.

Keywords

system, investment, benchmarks, science, health, evaluation, international, research, zealand, life

Disciplines

Business | Social and Behavioral Sciences

Publication Details

Garrett-Jones, SE, Turpin, T and Wixted, B, Science for life: an evaluation of New Zealand's health research investment system based on international benchmarks, Wellington, New Zealand: The Ministry of Research Science and Technology, 2004.

AUSTRALIAN EXPERT GROUP IN INDUSTRY STUDIES

University of Western Sydney

Science for Life

An Evaluation of New Zealand's Health Research Investment System based on International Benchmarks

Final Report

Sam Garrett-Jones
Tim Turpin
Brian Wixted

The Australian Expert Group in Industry Studies (AEGIS)

AEGIS research focuses on elucidating the dynamics of industrial growth and development, mapping product systems so as to analyse and reveal the drivers of innovation in different industries. AEGIS focuses on exploration and analyses of innovative capacity in industry, including both technological bases and organisational arrangements, and the relationships between such capacity and economic growth.

The aim is to provide a more effective basis for public policy development so as to assist with Australia's shift to the knowledge-intensive economy the nation needs in the twenty-first century.

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- Industry Innovation
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- Research into Knowledge Intensive Businesses
- Econometric Modelling and Forecasting of E-Commerce Diffusion'

The authors of this report are Associate Professor Sam Garrett-Jones, Professor Tim Turpin and Brian Wixted.

AEGIS can be contacted at:

Level 8, 263 Clarence St
Sydney NSW 2000

PO Box Q1287
QVB PO NSW 1230

Phone: (02) 8255 6200 Fax: (02) 8255 6222

Email: aegis@uws.edu.au
Web: http://www.aegis.uws.edu.au

ACKNOWLEDGEMENTS

We are grateful to Mark Dingle and Cameron Wood of the New Zealand Ministry of Research, Science and Technology for their assistance in helping us with the details of the New Zealand research system, providing us with data and for their comments and suggestions in preparing this report.

Staff of the Health Research Council of New Zealand were very helpful in putting us in touch with contacts in health research councils internationally, and with organising a list of high profile medical researchers within the New Zealand system. The presentations by staff on the activities and processes of the HRC and in answering all our queries were also very helpful. In particular we would like to thank Dr Bruce Scoggins and Dr Patricia Anderson for their valuable assistance.

We were fortunate to benefit from the experience of a significant number of people from different parts of the research system in New Zealand and to discuss their opinions of the various aspects of the evaluation's terms of reference. These conversations included staff of the Ministry of Health, the Auckland Hospital, purchase agents and researchers in the universities.

Representatives of agencies in Australia, Canada, Ireland, the Netherlands, Sweden, the United Kingdom, and the USA were particularly cooperative in providing published and unpublished data.

Susan Cozzens from the School of Public Policy at Georgia Tech pointed us toward the complex array of US data and their limitations and provided helpful comments in interpreting the medical research status of indigenous peoples in Canada and the USA.

Finally, we would like to acknowledge the assistance of Celine de Bellis in producing the final report.

We are most grateful to all those who have contributed to the development of this report, however, the opinions expressed here are those of the authors and the usual disclaimers apply.

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Executive Summary

The New Zealand Ministry of Research, Science and Technology (MoRST) is committed to the evaluation of the effectiveness and efficiency of its contributions to the New Zealand research system. As part of this commitment MoRST has commissioned an evaluation of the *Health Research Output Class,* which is invested by the Health Research Council of New Zealand (HRC). The evaluation, reported here, relates to the *appropriateness* of the New Zealand Government's strategic investment in and management of health research generally (in all its aspects). The Australian Expert Group in Industry Studies (AEGIS) at the University of Western Sydney was commissioned to carry out a study covering six of the nine terms of reference for the evaluation (see Box 1.1 on page 14). Appendix 6 provides examples from the HRC's evaluations and ongoing work in the area of research uptake, and ensuring accessibility, as well as identifying current research capabilities and the existence of areas of international strength within the New Zealand health research system

The body of this report presents the findings of the AEGIS study. The objective of the evaluation was to contribute to a better understanding of the management of Health Research Output Class investments, and health research investment more broadly, in order to better inform future policy interventions. Analysis of the New Zealand system and international comparisons are used to identify areas in the current system where improvement can be usefully pursued. A benchmark of 'appropriateness' (both for level of investment and management models) is taken as 'comparable OECD countries'. The main countries selected for international benchmarks are Australia, Canada, Ireland, the Netherlands, Sweden and the United States.

The report is organised in three parts:

- *Current status of and environment for health research investment in New Zealand*: Chapters 1 and 2 provide an overview of the international environment for health research and the New Zealand health research policy and investment framework;
- *International benchmarks:* Chapters 3 and 4 review the health research systems in six other OECD countries and analyse international levels of health research investment, while Chapter 6 discusses New Zealand's specific commitment to developing Māori health research capability by comparison with health research programmes for aboriginal populations elsewhere; and
- *The future vision for health research investment:* Chapters 5, 7 and 8 discuss a number of issues that flow from the local and international experience in planning and managing health research investments and present recommendations for consideration and action. The report concludes with an estimate of the cost implications arising from the recommendations and a possible implementation timeline.

Overview of findings

In terms of strategy and delivery of programs the New Zealand health research system stands up well against international experiences. The HRC has a world-class research assessment process and the management of the Health Research Output Class is widely accepted across the system as operating at a high standard.

However, the evaluation identified growing tensions within the system associated with a contradiction between the ability to develop, assess and carry out high quality health research and the ability to deliver adequate funding to support such research.
Three main **observations** are made on the level of health research funding in New Zealand by comparison with the benchmark countries.

- New Zealand's current level of public investment in health research appears **substantially lower** than almost all the benchmark countries. Of these countries, only Ireland spends less, proportionally, on health research and development.

- Most of the benchmark countries are **increasing their investment** in health research – some by as much as 20 per cent per annum. By contrast, there is no evidence of sustained increase in health research investment in real terms in New Zealand in recent years. Indeed, national data on health research in the universities provide clear evidence of a **decline** in New Zealand's expenditure on health research, as a proportion of GDP.

- The **cost structures** of many of the comparator health research funding agencies are lower than those of the HRC, because HRC is expected to provide a high level of overhead costs on research grants. Given that the overall envelope of health research funding available to the HRC in New Zealand is already comparatively smaller than in most of these countries, the HRC's capacity to purchase high quality health research is all the more limited.

The report points to an urgent need to increase the present level of investment in health research. The level of funding available for health research in New Zealand has decreased over the past decade, is now well below international standards, and in serious danger of falling below a level necessary to sustain a functioning health research *system*. While the current level of funding has absorbed the implications of full cost funding for research grants, the overall support for health research has declined. This has placed further pressure on the system and, in particular, reduced the capacity of the system to support career structures through scholarships and fellowships.

We recognise the finite nature of funding resources. But New Zealand appears to marking time in terms of health research funding while other countries are developing bold plans for expanding investments. We also recognise that New Zealand has taken bold steps in terms of redesigning the funding framework. This includes implementing a clear and transparent mechanism for underwriting the full cost of health research, shifting from a disciplinary based funding system to a program and strategic objective system, and identifying and sustaining long term strategies for building a Māori research capacity.

In order to consolidate and take advantage from these developments we believe it is important to take immediate steps to introduce some additional funding to sustain the top band of high quality health research capability in the country, and to provide more coherent support for collaborative health research centres and partnerships.

Our recommendations suggest that an increase in the budget available to HRC of $20.1 million in 2005-06, rising to $34.3 million in 2007-08, is necessary to absorb the total impact of full cost funding and allow for the appropriate level of growth required to achieve these strategic objectives for health research.

These financial tensions appear to be exacerbated by structural features associated with organisational arrangements, coordination, and shared responsibilities for some elements of the health research investment system. New Zealand's arrangements seem more strongly compartmental than in the benchmark countries, in that there are not the strong cross cutting mechanisms evident in other systems. The comparatively small size of the New Zealand system presents an even stronger need for maximising coordination.

We do not consider that a substantially increased concentration of research funding through HRC would automatically produce benefits in terms of the coherence and coordination of health research. Rather the challenge is to make the various funding agents and policy departments (MoRST, Ministry of Health) work more effectively together within a plural system, as is the case in many of the benchmark countries. The evaluation draws attention to the need to enhance coordination between agencies, in terms of developing a published national health research strategy, implementation and evaluation.

Our main recommendation here is for an interagency coordinating committee for health research in which HRC would play a leading role.

The HRC approach to monitoring and evaluation is impressive by international standards and should provide the basis for systematic national health research evaluation and reporting. In particular, we propose a health research 'scorecard', of benefit to HRC, MoRST and the Ministry of Health, to provide an appropriate baseline against which New Zealand's health research investments and returns can be regularly assessed.

We believe that New Zealand is at the stage where an increased funding commitment, together with increased capacity for coordination, monitoring and evaluation will enhance return on investment in health research. Our recommendations for improvement to the health research investment system follow.

Recommendations

An appropriate policy and investment framework

1. We **consider** that the establishment of a single research agency, responsible for funding all health research, broadly defined, would *not* be in the best interests of the New Zealand research system overall. We **recommend** the maintenance of diversity in the funding base provided through different agencies. However, we also **propose** an enhanced role for HRC in steering research policy, coordination, and evaluation toward strategic national goals.

2. We **recommend** that MoRST establish an interdepartmental health research coordinating committee including the Ministries of Health and Education. The HRC should have a lead role in the committee.

The future vision for health research

3. We **recommend** that HRC should instigate a consultative priority setting exercise for future Partnership/Joint Venture investments that involves a wide range of stakeholders including researchers, policy agencies, other potential funders and the health industry. The exercise should consider both the feasibility of research and the potential outputs and outcomes of the investment in the research.

4. We **recommend** that HRC should develop proposals for a National Health Research Centre grant scheme, complementary to those funded by CoRE and FRST, for consideration by MoRST. The adoption of this recommendation should be on the basis of HRC receiving additional funding and should not draw on existing funds.

5. We **recommend** that the government should accept the principle that the HRC should receive full budget supplementation for any increase in costs arising from the 'full cost funding' policy.

6. We **recommend** that the HRC should maintain discussions with the universities to ensure that full grant costs are effectively applied to the infrastructure and facilities required by health researchers. The universities should be obliged to report on their use of these funds, against agreed performance indicators.

7. We **recommend** that HRC should be provided with information to enable the Council to monitor the effect of the PBRF on health research funding and research groups.

8. We **recommend** that the HRC, in consultation with the proposed health research coordinating committee, establish a set of performance indicators for target population groups that, as far as possible, allow for international comparison.

9. There is clear benefit to New Zealand in the high standard of assessment and evaluation for health research set by HRC and we **recommend** that these processes should be maintained.

10. We **recommend** that HRC should give further consideration to the relationship between its project and programme funding, and between programme grants and the proposed National Health Research Centres scheme.

11. We **recommend** that HRC should coordinate the publication of a National Health Research Strategy (or Strategies) to complement the New Zealand Health Strategy and that the Council be adequately resourced for this task.

12. We **recommend** that HRC should collaborate with FRST to provide advance warning of those health researchers working on technologies or research outcomes with potential for commercial exploitation.

13. We **recommend** that HRC should instigate an international collaboration grant scheme for individual health researchers and teams to complement the support and grants offered by MoRST and the FRST. These could be targeted for HRC project and program grant holders or more widely. Funds from the new 'Developing International Linkages' output class should be made available for this purpose.

14. We **recommend** that MoRST review the procedures for reporting current health research expenditure data to the OECD and for ensuring that this data is presented in a manner that provides for international comparison of research effort.

15. We **recommend** that the coordinating committee proposed in Recommendation 2 should have a specific mandate to coordinate and develop a national health research reporting strategy and develop performance indicators for monitoring system wide outcomes and impact against national strategic objectives. The HRC should provide the lead in this activity.

16. We recommend that HRC be mandated to produce a New Zealand health research system **scorecard report** every three years.

The level of investment required

17. We **recommend** that MoRST adopt a *target* budget for the HRC's Output Classes (the HROC + Māori OC [health] + SPI OC [health]) of **a *real increase*** of 0.01% of GDP **over the next four years**.

1. Introduction: Health Research in the 21st Century

Background

During the past decade there have been major developments in the way that research investments have been monitored and evaluated. While there are differences in the ways governments fund research around the world, and a diversity of approaches to evaluation, there are a number of common themes that can be observed in national experiences. As the importance of evaluation increases, the gap between current practice and best practice becomes more significant, and the need for comparative study and methods development grows. Current international 'better-practice' approaches to research evaluation and performance indicators reflect two important considerations. First, they make a clear distinction between input, output and outcome indicators and assessments of impact. Only limited refinements have occurred in recent years in input and output performance indicators. However, quite considerable developments have occurred in relation to the development of indicators and approaches for assessing the outcomes and impact of research.[1] Second, evaluation and reporting mechanisms vary considerably according to the intended audience for the reporting. In particular, as nations move toward strategically targeting limited government research resources reporting demands at the programme level, and for specific stakeholder groups becomes all the more pressing.

Evaluation of Health Research

As part of this on-going process, governments around the world have been reinforcing legislation to require research funding agencies to be more specific in reporting their research programme outcomes. In this context, the World Health Organisation and the OECD have been working for several years on improving the information available on the national funding of health research. The US Government Performance and Reporting Act (GPRA) for example, which has been in operation for a number of years, has significantly changed evaluation and reporting mechanisms for national funding agencies including the National Institute of Health (NIH). Under the Bush administration GPRA is already steering a new wave of research evaluation. This has led to a considerable refinement of research performance indicators within many agencies and across various countries.

The New Zealand Ministry of Research, Science and Technology (MoRST) is committed to performing an evaluation of the "effectiveness and efficiency of research carried out under the **Health Research Output Class** (HROC), and report to the Minister on achievements against comparable international experiences. The Health Research output class is currently administered by the Health Research Council (HRC) of New Zealand, which reports on the outcomes of the investment. However, while HRC is the major health research purchase agent, MoRST has indicated that the evaluation should consider the wider set of assessment objectives related to achievement of goals, past investments and future opportunities.

The evaluation of New Zealand's Health Research output class, reported here, takes into account these broader international developments. International comparisons of research

[1] See for example European Commission (c2003)

funding and strategies are used throughout this report in order to provide an international policy perspective against which the New Zealand system can be assessed.

Scope and terms of reference

The evaluation was aimed at assisting MoRST to evaluate the efficiency and effectiveness of the research carried out under the Health Research Output Class of Vote RS&T (currently approximately $42 mill. annually). The terms of reference for the evaluation are reproduced in Box 1.1. The Australian Expert Group in Industry Studies (AEGIS) at the University of Western Sydney was commissioned to carry out a study covering terms of reference 2, 5,6,7,8,9 (the shaded areas in the box). The activities and findings from that study are presented in the body of this report. Terms of reference 3 and 4 were addressed through a separate exercise carried out by MoRST. A report of that work, directed toward terms of reference 3 and 4 and the findings with respect to the first terms of reference, is attached to this report as Appendix 6.

Box 1.1: Terms of Reference for the Health Research Evaluation

1. Determine the extent to which the investment in health research is contributing to the delivery of Government objectives as defined by the Health Research output class and make recommendations on opportunities for improvement.
2. Assess whether the investment in the health research output class is managed through an appropriate policy and investment framework and compare this to international best practice for investment decision making in health research.
3. Determine the extent to which research outputs are accessible and assess levels of uptake.
4. Determine the current capabilities, capacity and areas where internationally recognised research excellence exists within the system.
5. Compare the performance and investment in New Zealand health research with that of comparable OECD countries, where possible.
6. Assess the future characteristics of the health research system as defined in HRC's Strategic Plan 'Vision 2008'; the resources required and benefits to New Zealand arising from its implementation.
7. Assess whether the investment in health research is at a level appropriate to the objectives set.
8. Establish a set of indicators that will allow progress against these strategic objectives to be measured.
9. Consider whether the Government's investment in health research should be managed by a single health research purchase agency.

Note: Shaded areas identify the terms of reference covered in the body of this report.

The evaluation, reported here, relates to the *appropriateness* of the New Zealand Government's strategic investment and management framework in health research (in all its aspects). The benchmark of appropriateness (both for level of investment and investment management models) is taken as 'comparable OECD countries'. The main countries selected for international benchmarks are Australia, Canada, Ireland, the Netherlands, Sweden and the United States. There is no single ideal comparator country.

However, the first five present a range of experiences that offer some similarities including similar levels of industrial development, population sizes and characteristics, institutional histories, industrial structure and national approaches to public R&D investment. The US was included because since the introduction of the Government Performance and Results Act (GPRA) extensive effort has been directed toward improving research evaluation and reporting, particularly within the NIH (Cozzens 2000). Reference to other countries is included, where appropriate, to provide additional points of comparison on specific research issues.

The objective of the evaluation was to contribute to a better understanding of the Health Research Output Class in order to better inform future policy interventions. The Health Research Council (HRC) allocates HROC funding and contributes approximately 65 per cent of New Zealand's public funding for Health Research. The study explicitly considers the future organisation and management of Health Research investments, including the question of whether there ought to be a single health research 'purchase agency'. In designing the study MoRST has emphasised the need to suggest changes that would be incremental in nature rather than a radical redesign of the system'.[2]

Recent introduction and subsequent development of the Māori Knowledge and Development Output Class (2000) and publication of the Māori Health Strategy (2002) are important strategic features of the present funding framework. Specific attention has therefore been given to the present arrangements for Māori health research in the study.

Recommendations emerging from the study are focused on opportunities and options for *improving* future health research outcomes. The terms of reference have demanded consideration of the level of resources that are likely to be required to implement the Health Research Council's 'Vision 2008' Strategic Plan and an identification of what benefits might be expected from an increased investment. However, by focusing on the health research system as a whole we have sought to explore options for improving efficiency through coordination and improvements to the general funding framework. The study is also directed toward assessment of strategies for the development and application of performance indicators for tracking progress against these strategic goals.

It is important to stress that the study is *not* intended to be a comprehensive inquiry into the health research funding system in New Zealand, nor an evaluation of the HRC. Rather, the study aims to identify, through international comparisons, aspects of the current health research investment system where improvement could be usefully pursued. These recommendations will require further consideration by MoRST, the New Zealand government and the health research community. In developing these proposals, the authors have held discussions and briefings with a range of health research purchase agencies, policy makers and performers, including HRC, the Foundation for Research, Science and Technology (FRST), the Royal Society of New Zealand (RSNZ), the Ministry of Health (MoH), the New Zealand Vice-Chancellors' Committee, and researchers at Auckland, Otago and Massey Universities. A full list of people who contributed at the meetings is included in Appendix 4.

[2] Terms of Reference p.1.

Approach to the tasks

The broad tasks presented therefore were to:

1. assemble comparable information and performance indicators collected by medical research funding organisations in other comparable countries;
2. collect current data, background information and views of stakeholder groups about the current arrangements and levels of funding for investing in health research in New Zealand;
3. compare and contrast New Zealand's health and medical research sector investment framework and performance with comparable sectors and agencies in other countries; and
4. make recommendations on opportunities for improvement in New Zealand policies, organisational arrangements, levels of investment, evaluation frameworks and management indicators for health research.

International data collection

International comparative data was collected through three mechanisms. International data sets compiled for OECD countries provide general comparative data. The difficulty with these data sets is that fully comparable data is usually well out of date by the time it is published, for example the latest OECD health research statistics for New Zealand refer to the year 1999. However, more current data for New Zealand was used to provide a reference point for comparison with other countries where available.

For the benchmark countries, international reports containing statistical information, funding investment strategies, and annual reports were collected from web-sites and through direct contact with representatives from health research funding agencies. This process yielded background information for the cross-country comparisons. Follow-up information from these agencies was collected through e-mail, and in some cases telephone contact. A list of international respondents is also in Appendix 4. For Canada and the US Professor Susan Cozzens collated additional information in her role as collaborating consultant.

New Zealand data collection

Information on the health research system was collected through a variety of mechanisms. In New Zealand, data was provided by the Ministry of Research, Science and Technology (MoRST), the Health Research Council (HRC) and the Ministry of Health (MoH).

Further information was collected during a series of meetings and discussions in New Zealand with representatives from purchases agencies, universities, research groups and centres, and government departments. Further interviews were carried out through telephone and e-mail correspondence (see Appendix 4).

Throughout the process weekly telephone discussions were held with representatives of MoRST and the HRC who assisted the team by providing additional data and names of people who could provide relevant inputs.

New Zealand in the global research context

The present evaluation of the New Zealand health research system has been carried out in the context of international experiences. At a global level, national research policies are being formulated and implemented under conditions that are quite different from just two decades ago. There have been far-reaching changes in the relationships between science, industry and society, in the ways governments fund science, in the institutions that distribute funding, and in the organisations that host research laboratories and research practice. These changes can be summarised broadly as follows

1. Research has become increasingly multidisciplinary, and interdisciplinary research has come to assume a leading rather than supplementary role in scientific research;
2. The funding of scientific research has become more susceptible to market forces and community and political expectations;
3. International and occupational mobility of scientists has increased; and
4. New 'hybrid' organisational forms in which research is carried out are emerging and transforming the boundaries between public/private organisations and between disciplines;

A global review of national research strategies and research funding policies shows that most OECD countries have been amending their strategies in order to appropriately respond to this evolving research environment.[3] Flowing on from this is the new wave of research investment strategies overseas, which are:

- an increased emphasis on public–private *partnerships*;
- the provision of funding support to underpin *'networks'* and new organisational structures that are complementary to project funding;
- the formation of *coordinating mechanisms* to ensure lateral links between funding agencies and between programs within agencies;
- a focus on designing funding initiatives that collectively span *'whole of career'* options for scientist's; and
- the introduction of common *evaluation mechanisms* and performance indicators.

The New Zealand research system, as in other OECD countries, is linked to the global science and research endeavour and subject to similar pressures for change. However, there are a number of socio-economic features that place New Zealand in a particular structural position with respect to international health research.

- New Zealand is a small economy with limited economic capacity to fund research across all areas of health research;
- The country's industrial and business structure, dominated by a large number of small companies with historically low investments in R&D, limits the capacity to engage the private sector in health research and the commercialisation of research outcomes;

[3] See for example OECD (2001a).

- In spite of the small population New Zealand has a strong scientific education and research base and makes a comparatively strong contribution to international scientific output;
- Like many other small nations, New Zealand faces strong international competition to retain and attract leading international researchers; and
- The multicultural characteristics of the population place complex and competing demands on achieving equitable health outcomes across population sub-groups.

It is important, therefore, to consider these general features and global trends while discussing the Health Research Output Class. New Zealand must not only respond to the changing international environment but must also confront these changes in a way that maximises outputs and outcomes from the nation's investment in health research and also maximises the capture of benefit from global advances in health research. This may demand new ways of thinking about health research policies and management systems.

The report is organised in three parts: current status and environment for health research investment (Chapter 1 and 2); international benchmarks (Chapters 3, 4, and 6) and the future vision for health research investment (Chapters 5, 6, 7 and 8) Chapter 2 proceeds with a brief overview of the New Zealand health research investment framework. In Chapter 3 a review of the health research systems in six other OECD countries is presented and some general observations are made about international trends and New Zealand's contemporary position vis a vis these trends. Chapter 4 provides a more detailed analysis of international levels of health research investment, again drawing some comparison with the current situation in New Zealand. Chapter 5 turns to the current strategic framework for health research investment in New Zealand, while Chapter 6 provides some international comparisons and conclusions in relation to New Zealand's specific commitment to developing Māori health research capability. In Chapter 7 a number of issues are developed that flow from the international comparisons and responses from New Zealand health research stakeholders. A number of recommendations are offered here for improving the present structural arrangements and coordination mechanisms. Finally, in Chapter 8 the main observations are summarised and presented together with the recommendations developed through the earlier sections of the report.

2. New Zealand's Health Research Investment System

Introduction

New Zealand has developed a particular approach to the funding and management of health research that in several aspects differs from the situation in comparable OECD countries. This chapter provides a brief introduction to the health research investment system in New Zealand and shows the roles of the main institutional 'actors'. Specific programmes of relevance are discussed in more detail throughout the report.

The current structure of health research support in New Zealand is the outcome of major changes to the public research system over the last 15 years that mirror broader public sector reform in the country. At the core of the reform is the application of 'principal-agent' theory: 'the idea that interchange between parties can be characterized as a series of contracts, where one party, the principal, enters into agreements with another, the agent, who agrees to perform tasks on behalf of the principal, in return for compensation' (Bale and Dale 1998). The catalysts of these reforms, as applied to science and research, were the Beattie Committee (which reported in 1986) and subsequent lobbying by the Science and Technology Advisory Council – STAC (Palmer 1994). The overall thrust of the reforms has been to *separate* the organisational responsibilities for policy advice, funding and delivery of research, science and technology (RS&T) in order to create clear lines of accountability.

This separation of responsibilities is more marked than in the benchmark countries in this report. It can be argued that it has had the effect of making New Zealand health research investment activities more strongly *compartmental* than in many of the comparator countries in the current study, at a time when organisational boundaries between funding agencies in other countries are breaking down as a result of growing coordination and collaboration.

Recent evolution of the research investment system

The Ministry of Research, Science and Technology (MoRST) was created in 1989 as the main organisation responsible for RS&T policy. A separate organisation, the Foundation for Research, Science and Technology (FRST) was set up by an Act of Parliament the following year to manage the Government's funding of RS&T and to advise on national research priorities. FRST remains the largest 'purchase agent' for research, with other specialist funding organisations for health research (the Health Research Council of New Zealand – HRC), for fundamental research (the Marsden Fund, set up in 1994 and administered by the Royal Society of New Zealand), and for technology (the Technology New Zealand programme established in 1997, within FRST.

Parallel reforms took place in the science organisations (Palmer, 1994). Focused, performance oriented operating agencies replaced a system formerly 'dominated by a small number of large government departments with mixed roles and direct funding' (MoRST, 1994: 2). In 1992, ten new Crown Research Institutes (CRIs) were created from the former Department of Scientific and Industrial Research (DSIR – founded in 1926) and research

institutes in other ministries (including the Communicable Disease Centre in the Ministry of Health)[4]. The CRIs and other 'science providers', such as universities and research associations, were drawn into competition for contracts for contestable funds from the 'purchase agents' with the goal of achieving a more open and flexible research system. Importantly, ownership of the CRIs (and other 'Crown Companies') is vested in the Treasury, not in MoRST. However, the current CRIs play a relatively minor role in health research , with most of the active health researchers based in New Zealand's seven universities, notably the University of Auckland and University of Otago.

Recent years have seen reform of the university sector bringing greater scrutiny of research performance. Funding for academic research is becoming largely divorced from student load and is moving towards a system which rewards performance in research and research training, and is assessed by specific criteria. Seven Centres of Research Excellence (CoRE) – two of them in health – have been established under a new fund.

MoRST has been the main coordinating agency for New Zealand's public sector R&D through the 1990s through a series of planning and priority setting activities. In 1995, the government adopted a goal of increasing public sector investment in science from 0.6 per cent of GDP in 1993 to 0.8 per cent of GDP by the year 2015. This goal specifically *included* funding of health research (MoRST, 1995: 37). In 2000, MoRST consolidated its science and research funding into a series of output classes based on research disciplines or research objectives. The Output Classes represent specific parliamentary appropriations ('line items' in Australian government parlance). These replaced an omnibus Public Good Science Fund with allocations based on strategic priority setting against objectives. The PGSF did not incorporate health research funding and thus health research was explicitly excluded from the National Science Priorities and from MoRST's strategic planning until the late 1990s.[5]

Table 2.1 shows the current Output Classes under Vote RS&T and their funding allocations for 2003-04 (Minister of Research Science and Technology 2003).

[4] A list of other R&D agencies within the Health Ministry prior to 1990 may be found in Science and Technology Advisory Committee (1988: 20-21)

[5] Science policy and research priorities (including health) were however coordinated at Cabinet level (Palmer 1994).

Table 2.1: MoRST Output Classes, 2003-04

Output Class	Nominated Purchase Agent(s)	Budget 2003-04 ($ mill)	% of Vote RS&T
Knowledge Investments		**150.95**	**27.1%**
Output Class O1: Marsden Fund	RSNZ	32.79	5.9%
Output Class O2: Non-Specific Output Funding	FRST	28.53	5.1%
Output Class O3: Supporting Promising Individuals	FRST, **HRC,** RSNZ	14.55	2.6%
Output Class O4: Promoting an Innovation Culture	MoRST, RSNZ	2.72	0.5%
Output Class O6: New Economy Research Fund (NERF)	FRST	63.88	11.5%
Output Class O11: Māori Knowledge & Development Research (est. 2000)	FRST, **HRC**	5.48	1.0%
Output Class: Developing International Linkages (est. 2003)	MoRST, RSNZ	3.00	0.5%
Economic Investments		**238.95**	**42.9%**
Output Class O7: Research for Industry	FRST	185.04	33.2%
Output Class O8: Technology New Zealand	FRST	44.03	7.9%
Output Class O9: Grants for Private Sector R&D	FRST Merged with OC O8 in 2003-04	-	-
Output Class O10: National Measurement Standards	IRL	5.08	0.9%
Output Class: Pre-seed Accelerator Fund (est. 2003)	FRST	4.80	0.9%
Environmental		**88.62**	**15.9%**
Output Class O14: Environmental Research	FRST	88.62	15.9%
Social		**48.82**	**8.8%**
Output Class O12: Health Research	**HRC**	42.23	7.6%
Output Class O13: Social Research	FRST	6.59	1.2%
System investments		**29.46**	**5.3%**
Output Class O5: Research Contract Management	FRST, **HRC,** RSNZ	17.38	3.1%
Venture Investment Fund - Governance & Operation	NZVIF	1.22	0.2%
Other	MoRST	10.86	2.0%
TOTAL		**556.80**	**100.0%**

The health research investment system

In common with countries such as Australia and the United Kingdom, New Zealand constituted a body with specific responsibilities for health research in the first half of the 20th century. The Medical Research Council (MRC) was established in 1937 as a departmental committee within the Ministry of Health. The MRC gained statutory status as an autonomous agency in 1951. In 1990, the then Minister for Health abolished the MRC and legislated to set up the Health Research Council of New Zealand (HRC) as a Crown entity owned by the Minister of Health.[6] This move reflected the wider reforms of New

[6] One of STAC's recommendations had been the establishment of a National Research Council with transfer of some funds from other agencies, including MRC. The proposal that won the day however was that of the Stewart Review (1989) that led to the foundation of the HRC, funded through Vote Health (Palmer 1994).

Zealand's public research system. Like many medical research agencies internationally, the HRC took on a broader responsibility for public health research and its application at that time: its statutory mandate is to support research not simply in medicine, but in all areas of biomedical and public health. The 1990 Act also gives the Council statutory responsibility in relation to Māori health research and health research ethics. As the Council notes, this 'saw a major shift in the focus of the organisation, broadening the remit and substantially increasing the investment in the more applied end of the spectrum, particularly public health research' (HRC, 2002a: 91)

In 1998, HRC's core funding (amounting to, $20 million) was transferred from Vote Health to Vote Research, Science and Technology. Its main source of funding is the Health Research Output Class (HROC) administered by the Ministry of Research, Science and Technology (MoRST). The Health Research Council is the sole purchase agent for HROC and the principal funding body for health and medical research in New Zealand. The Council acts as the national coordinating body for health research. HRC's overall strategies are set by formal agreements with the Ministry of Health and through priorities and allocations attached to MoRST's Output Classes. As a Crown entity, the Council is responsible for how it meets the statutory responsibilities within its mandate, giving regard to the views of the Minister (HRC, 2002a). As such, the Council sets its own strategies following nationwide consultation with a broad range of stakeholders. HRC also enters into an 'output agreement' with MoRST, which is renewed annually.

As noted above, MoRST has established a specific output class for health research. The Health Research Output Class accounts for 7.6 per cent of Vote RS&T committed expenditure for 2003-04. In addition, HRC has access to a share of funding through several other output classes, namely Supporting Promising Individuals, Māori Knowledge and Development Research, and Research Contract Management. Together, these classes amount to a further 6.7 per cent of Vote RS&T commitments. HRC receives 14 per cent of the SPI Output Class and 40 per cent the Māori Output Class. HRC's total envelope is equal to 8.3 per cent of Vote RST.

Box 2.1 The Health Research Output Class (HROC)

- The purpose of HROC is: 'to support research programs that have the greatest potential to improve the health and quality of life of New Zealanders'
- 'The objective of this output class is for RS&T to improve the health status of New Zealanders'
- The nominated outputs are:
    - 'Knowledge and understanding of the factors influencing health status, including health disparities between New Zealanders'; and
    - 'Technology, products and services for improving health status and reducing health inequalities'.

As Box 2.1 shows, the objectives of the HROC are focussed as much on terms of benefit to the nation as knowledge generation. In recent years, the HRC has moved from a system of

disciplinary based funding to a portfolio investment model which comprises both disciplinary and outcome focused objectives. In 1999 the Council developed and implemented an outcome-focused Research Portfolio framework for its investment in research. The Research Portfolio framework has been reviewed and 'fine tuned' subsequently with consequential change in the scope and priorities. The current Portfolios (Box 2.2) and their contents are expected to remain stable for the next three years. The Council has given high priority to the development of health research capabilities of relevance for Māori , Pacific and other population groups identified as priorities in the New Zealand Health Strategy. Since 2000, Māori Health Research has been supported via MoRST though a new Output Class.

Box 2.2 HRC Research Portfolios, 2003

- Biological Systems and Technologies
- Communicable Diseases
- Determinants of Health
- Health and Independence of Population Groups
- Health Sector Management and Services
- Injury and Rehabilitation
- Mental Health and Neurological Disorders
- Non-Communicable Diseases
- Rangahau Hauora Māori (Māori Health Research and Development)

HRC has also negotiated a number of innovative Partnership and Joint Venture arrangements, initially with the Ministry of Health and a range of public sector agencies, to leverage funding in applied health research from sources other than MoRST. The major Partnerships and Joint Ventures are shown in Box 2.3

Box 2.3 HRC Partnerships and Joint Ventures

Established:

- Environmental Health Joint Research Portfolio
- Immunisation Joint Venture
- Māori Health Joint Venture
- Exploring the Māori Health and Disability Workforce Joint Venture
- Māori Knowledge and Development Research
- Mental Health Research & Development Strategy
- National Diabetes Research Strategy
- Occupational Health and Safety Joint Research Portfolio
- Pacific Health Joint Venture
- Primary Care Joint Venture
- Problem Gambling Research Initiative
- Socio-economic Determinants of Health Joint Research Portfolio

Planned:

- Cancer Control
- Disability
- Rehabilitation
- Food, Nutrition and Health
- Biotechnology

Source: HRC Investment Strategy, 2003/04

Around 35 per cent of health and medical research is funded outside the HRC. The **Royal Society of New Zealand** (RSNZ) administers the **Marsden Fund** for fundamental research (financed by a special MoRST output class and overseen by the Marsden Fund Council). Marsden funds are specifically not targeted for particular research disciplines or social objectives. Grants are large and fund both international linkages and postdoctoral researchers, but the success rate is low (around 10 per cent) and funding is 'one off'. They may be better regarded as 'prizes' for excellent science.

The Ministry of Education's **Centres of Research Excellence** (CoRE) fund also provides significant support for health researchers and has provided a large injection of capital funds. Although there has been a staged move towards full funding of research projects by the purchase agencies, academic researchers also receive substantial support through Vote Education's funds to universities. Increasingly, these university funds are being allocated on the basis of research performance through a performance based research funding model (PBRF).

As noted, the Government's principal research purchase agent is the Foundation for Research, Science and Technology (FRST). FRST is responsible for many of the output classes shown in Table 2.1, notably those relating to industrial technology development, the new economy and the environment. Table 2.2 shows the Foundation's emphasis on economic and environmentally oriented research and technology, with three-quarters of its investment in these two areas. Most of the Foundation's remaining investment is in 'knowledge', but again focused on areas like knowledge based industries with potential economic return, or in capability building scholarships and networks. Less than two per

cent of FRST's investment is for 'social' objectives (including health). FRST reports nil expenditure against HROC in 2003-04. FRST does however play an important role in the application of health research in areas such as biotechnology, and through its investment programmes it has provided support to some of New Zealand's best health researchers. FRST has also commenced funding clinical trials of pharmaceutical products.

Table 2.2 Broad investment priorities of the Foundation for Research, Science and Technology

The Government's RS&T Goals (approx. % of FRST funding)	*The Foundation's strategic focus*	*Investment programmes (Output Classes)*	*Funding 2003-04 ($ mill)*
Economic Goal (54%)	• Focus on value-added exports: • Add value within existing sectors • Springboard from existing strengths • Back emerging opportunities	Research for Industry Technology New Zealand (incl. Grants for Private Sector R&D)	185.0 44.1
Environmental Goal (21%)	• Focus investment on key national priorities (in environmental strategies) • Be at the forefront, anticipating and discovering the environmental issues of the future • Engage key stakeholders in environmental research and its use	Environmental Research	88.2
Social Goal (<2%)	• Invest to support the Government's seven social research themes • Take a catalytic role to leverage others' investment	Health Research Social Research	* 0.0 6.6
Knowledge Goal (23%)	• Create knowledge networks and pathways • Focus basic research in areas likely to create new knowledge-intensive enterprises • Contribute to Māori advancement and development • Support human capital development	New Economy Research Fund (NERF) Non-Specific Output Funding Supporting Promising Individuals (Scholarships and Fellowships) Māori Knowledge and Development Research	63.9 28.5 8.3 3.3

*Note: * Funding for HROC in 2002-03 was $1.1 million.*
Source: FRST (2003)

A recent report by Investment New Zealand identifies several areas of excellence within the field of biomedical R&D within public research groups and biotechnology companies (Box 2.4).

Box 2.4 Biomedical R&D strengths identified by Investment New Zealand

- Oncology/cancer
- Diabetes and cardiovascular disease
- Neurological diseases
- Immunological diseases
- Biomedical imaging and bioengineering
- Infectious diseases
- Osteoporosis and bone health
- Eye research
- Free radical biology

Non-government funding

Non-government sources of health research funding include Lotteries Health Research, national charitable organisations such as the Cancer Society, the National Heart Foundation, the Neurological Foundation, the Multiple Sclerosis Society and local foundations such as the Canterbury Medical Research Foundation (Richards 2000). The Malaghan Institute of Medical Research is an independent health research organisation, which in 2001 had a capital endowment fund of $2.7 million. The big disparity between New Zealand and other OECD countries lies in the R&D activities of the business sector, which invests less than one-third of the proportion spent in most OECD countries. Public biomedical research funding has laid the basis for New Zealand biotechnology companies including Genesis R&D, NeuronZ (a University of Auckland spin-off company), BrainZ, EndocrinZ, Pacific Edge Biotechnology, BLIS Biotechnology and ProActa Therapeutics Ltd (also based on University of Auckland research) (HRC 2003a; Richards 2000). International companies are investing in New Zealand's top health research groups. Pharmaceutical companies contract research participation in trials, but are being discouraged from broader investment in part by government purchase arrangements for prescription medicines.

Summary

In common with most of the comparator countries, New Zealand has an independent organisation for health research funding within a plural system for health research support. There is a long-established and effective research council for health and medical research the HRC which is the principal, but not sole, actor and the HROC is the largest, but not only, source of funds. Health research investment has remained separate from the aggregation of the majority of government research purchasing within the FRST. While in the early 1990s health research was excluded from MoRST's priority setting exercises, a closer relationship between MoRST and HRC has existed since 1998, and with it the potential for closer collaboration in relation to national research priorities and joint action with other purchase agents. Notwithstanding the 'output class' framework, emerging areas

of opportunity (like biotechnology and clinical trials) are blurring the boundaries between the responsibilities of the different purchase agents (HRC and FRST).

Where New Zealand differs notably from the larger OECD countries is in the relatively weak business (and non-profit sector) investments in health research and the strong concentration of research capability within the university sector (notably within the University of Auckland and University of Otago medical schools).

3. International Benchmarks I: Comparative National Health Research Investment Systems

Choice of benchmark countries

The present evaluation of the New Zealand Health Research *output class* draws on the experiences of health and medicine research systems in other countries. In this context the study has sought to make comparisons mainly with the smaller OECD countries that have some socio-economic features in common with New Zealand. There is, of course, no directly comparable system. Each country has unique historical economic and institutional experiences. Nevertheless, it is possible to make some general observations about levels and sources of funding, policies, and mechanisms for managing investment while taking into account the structural differences.

In Chapter 4 we make some international comparisons of national levels of health and medical research funding in terms of health research as a proportion of GDP, as a proportion of total research funding and as expenditure per capita of population. Before presenting those comparative data it is necessary to describe the structural arrangements for funding health research in the comparator countries. The main benchmark countries used for this analysis are: Australia, Canada, Ireland, the Netherlands, Sweden and the United States. The principal countries selected for comparisons of health research investment levels with New Zealand are the same, with the addition of the United Kingdom. The countries were selected as benchmarks in consultation with MoRST and HRC largely because of the similar scale and structure of their health research systems. Clearly, with the larger countries (particularly the USA and UK), due regard must be given to the absolute size of their research systems. The comparisons in Chapter 4 include data on a range of other OECD countries where these are helpful and readily available.

Health Research Investment in Australia

Policy directions

Like New Zealand, Australia has a long history of commitment to and investment in health research. The National Health and Medical Research Council (NHMRC) was set up in 1936 (Australian Science and Technology Council 1978-1979), becoming a statutory body in 1992. Competitive grants for general academic research were introduced in 1966, and extended in 1988 with the establishment of the Australian Research Council (ARC). Several federal agencies thus fund health research. The major 'purchaser' is the NHMRC, but ARC and the Cooperative Research Centres (CRC) Program also play a role as do a range of other agencies and the State governments. Commercially oriented R&D is supported through AusIndustry's programs (although only those in pharmaceuticals and biotechnology are specifically health related).

The federal government continues to give strong emphasis to health and medical research. 'Promoting and maintaining good health' is one of four National Research Priorities (NRP) announced in December 2002. Four specific goals – infant and child health, ageing, preventive healthcare, and the social and economic aspects of health – are identified as

contributing to this priority. Research into biotechnology and genomics is included under other priority areas. The national research priorities make no specific mention of health research relating to or by indigenous Australians.[7]

Research issues currently under consideration by the Australian federal government include coordination mechanisms in relation to research priorities and collaborative research, and provision for research infrastructure.

National Health and Medical Research Council (NHMRC)

NHMRC is the major 'purchaser' of health research Australia with a current annual budget of nearly A$400 million. It is responsible for an estimated 32 per cent of Commonwealth Government expenditure on health R&D (National Health and Medical Research Council (2003c). NHMRC funds research undertaken in universities (45 per cent of its grants) and in other institutions including medical research institutes (38 per cent), teaching hospitals (13 per cent) and other health service providers. In addition, the Council has responsibility for the development of evidence-based health advice and provision of ethical guidelines for health and medical research (National Health and Medical Research Council (2003c). Specifically, the Council's statutory obligations under the *NHMRC Act* are:

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

NHMRC comprises several Committees, which report through the Council to the federal Minister for Health and Ageing. These are: the Research Committee (RC), the Australian Health Ethics Committee (AHEC) (both specified in the *NHMRC Act* the Health Advisory Committee (HAC), the Licensing Committee, the new Aboriginal and Torres Strait Islander Forum and several Expert Committees. The Research Committee merges the functions of the former Strategic Research Development Committee (SRDC) (National Health and Medical Research Council (2003c).

NHMRC's research investment activities have three main strategic goals: world-class **knowledge creation,** world-class **research capacity** (facilities and infrastructure, responsive work force) and translation of knowledge for **community benefit** (policy and practice, commercial development). The scope of the NHMRC's main research schemes is shown in Table 3.1.

[7] http://www.dest.gov.au/priorities/default.htm, 24/2/2004

Table 3.1: Main research investment activities of NHMRC

Scheme (No. and value of new grants in 2003, success rate in 2002)
NHMRC Project Grants (412, A$158.1 mill., 23% success rate. 57% of application were rated 'fundable')
Investigator-initiated project that is thought capable of providing solutions to the research questions within a relatively short time frame. More project grants are now for 4 or 5 years.
Program Grants (16, A$118.2 mill., 35%)
Substantial, long-term support to proven, multi-disciplinary research teams to collaborate to solve complex problems, contribute new knowledge and novel solutions at a leading international level in important areas of health research.
Strategic Research Development (30, A$19.1 mill.)
Centres of Clinical Excellence (8, A$16 mill.)
Enabling Grants (5, A$6.2 mill.)
Development Grants
Provide pre-seed development of research proposals. .
Public Health Capacity Building Grants and Priority Driven Research
Established to build critical mass in health services and population health research.
Program in Medical Genomics
Provides a platform to apply biotechnology to important areas of health and medical research.
Research Fellowships (48, A$26.7 mill., 28%)
Highly competitive, providing funding to the most distinguished health and medical researchers. Selection criteria include the achievement of health-related outcomes and are interlinked with the translation of research findings into health policy and practice.
Industry Fellowships (26, A$5.6 mill.)
Provide valuable experience in industry for researchers.
Practitioner Fellowships (31)
Allow health practitioners to remain active or to become active in research.
Burnet Awards (2, A$3.8 mill. – 2002)
Established to bring expatriate health and medical researchers of international standing back to Australia. Awarded to Nobel prize-winner Peter Doherty (immunology) and Tony McMichael (population health)
Career Development Awards (59, A$15.7 mill., 29%)
Build on previous postdoctoral support schemes by increasing the duration of the award and providing support for clinical and public health researchers.
Howard Florey Centenary Fellowships (20)
2 year fellowships for researchers returning from overseas
Training (Postdoc.) Fellowships (86, 50%)
Postgraduate Scholarships (163, A$9.8 mill., 54%)
Access to additional travelling awards

Source: National Health and Medical Research Council (2003b, 2003c), Pettigrew (2004).

In line with recommendations in the comprehensive *Health and Medical Research Strategic Review - the Virtuous Cycle* ('Wills Review') in 1999, NHMRC's grant funding has nearly doubled, to A$301 mill. in 2003, with further increase planned (National Health and Medical Research Council 2003b:131).

The Council has been phasing out block grants to the major medical research institutes, which were seen as a barrier to contestability and collaboration. There has also been a shift from small project grants to larger project and programme grants. Project grants accounted for 47 per cent of grant funding in 2003 compared with over 60 per cent in 2000. Funding for 'cross-discipline, international level collaborative high-impact research' has more than doubled, mainly through the five-year Programme Grants. NHMRC has increased the programme grants budget from 7.5 per cent of funding in 2000 to about 18.5 per cent in

2003 (National Health and Medical Research Council 2003b). Funding for strategic research has increased to around A$20 million, and increases are also seen in Development, Collaborative and Partnership Grants, from less than A$50,000 in 2000 to more than A$19 million in 2003. The Partnership Grants (to date in the areas of injury, mental health and diabetes) are intended to align NHMRC's priorities with those of other stakeholders.

Research priorities and collaboration

Following the Wills Review the NHMRC adopted a three-tiered framework for its strategic research program, as follows:

- Tier 1: the areas of ageing; mental health; systems of care for chronic diseases; oral health; and Aboriginal and Torres Strait Islander health.
- Tier 2: links the research priority areas as they relate to health services research, socio-economic determinants, rural health and palliative care.
- Tier 3: considers the need for capacity building, or whether targeted research is required.

By discipline area, by far the majority of new awards in 2003 were in Basic Science (52 per cent) and Clinical Medicine and Science (34 per cent).

Research priorities have reflected national health priorities and, more recently the National Research Priorities. The Council has also identified priority areas, most notable Aboriginal and Torres Strait Islander health. The federal and state governments have nominated seven National Health Priority Areas. These are: asthma, cancer control, cardiovascular health, diabetes mellitus, injury prevention and control, mental health, and arthritis and musculoskeletal conditions. In 2003, over 60 per cent of NHMRC funding was dedicated to research in these priority areas (National Health and Medical Research Council (2003a).

NHRMC sees itself as the lead agency in relation to the 'Health' NRP. In response to the NRP initiative, NHMRC established Strategic Research Networks (SRNs) in each of three health-related areas: *Healthy Start to Life*, *Ageing Well, Ageing Productively* and *Preventive Healthcare*. The Council has borrowed the concept of 'Consensus Conferences' from the US NIH with a view to developing further SRNs (National Health and Medical Research Council (2003a). Development of these priority areas will involve 'cooperation, collaboration and co-funding' (Pettigrew 2004), which has already commenced with the Australian Research Council as partner (see below). The NHMRC has many other formal and less formal collaborative partnerships within Australia and overseas.

The NHMRC still makes a huge investment in investigator-driven research project and programme grants, scholarships and fellowships, predominantly in basic health science and clinical research. These investments have the objective of knowledge generation and building a world-class health research capability. Increasingly, the Council is emphasising the application of research, such as through research centres, and is targeting priority areas through collaborative partnerships and other means. These priorities are steered by national health and research priorities and through the Council's own stakeholder consultations. NHMRC has been quite prepared to champion research priorities such as indigenous health

which are not specifically on the government agenda. Overall, the Council has managed to embrace application driven collaborative research investment quite convincingly, while at the same time continuing to underpin Australia's health research knowledge creation capability. Its challenge over the next few years will be in strengthening interdisciplinary, multi-institutional, and cross-sectoral centres and partnerships that address research priority areas.

Australian Research Council

The Australian Research Council's grant budget is on a par with NHMRC's, amounting to nearly A$300 mill. in 2002-03. About 5 per cent of ARC's funding is for research aimed at promotion and maintaining good health. Following Ministerial direction, the ARC allocated A$162 million, or 34 per cent of its funds in the 2003 funding round (over the five years to 2007), to priority areas including biomaterials and genome/phenome research (primarily plant genomics). In 2001 the ARC allocated around 4 per cent of its new funding to the priority area of 'Promoting and maintaining good health' with the proportion increasing to 6.4 per cent in 2003. ARC is also funding the new National Stem Cell Centre of Excellence jointly with Biotechnology Australia (Australian Research Council 2003c). The Chair of NHMRC is an ex officio member of ARC's Board.

Cooperative Research Centres Program

The Cooperative Research Centres Program (CRC Program) is the Commonwealth Government's largest investment in cross-sector (industry-university-government) R&D collaboration. The CRC Program is at heart a collaboration between different R&D sectors and institutions: universities, Commonwealth and State government research authorities, individual firms, and industry-led intermediaries such as the rural R&D corporations. Over the last 13 years it is widely credited with 'changing research cultures' and promoting increased and more effective cross-sectoral, multidisciplinary and multi-organisational research, technology development and commercialisation.

Now within the Education, Science and Training ministry, the CRC program currently supports nine centres in the health and medical area, with a new Centre in Oral Health successful in the 2002 funding round (Table 3.2). All CRCs are proposal driven, and assessed on the quality of their science, partners and strategies for application. The outcomes of the health related CRCs range from commercially applicable technologies (such as the cochlear implant and diagnostic technologies) to public health initiatives for Aboriginal populations.

Unlike the new Commonwealth centres of excellence, the CRCs are fully proposal driven rather than linked to national research priorities. Applications are assessed by one of two expert panels, one for the Life Sciences and the other for Physical Sciences and Engineering.

Table 3.2: Australian Cooperative Research Centres in Health (2004)

CRC for Aboriginal Health
CRC for Asthma
CRC for Cellular Growth Factors
CRC for Chronic Inflammatory Diseases
CRC for Cochlear Implant and Hearing Aid Innovation
CRC for Diagnostics
CRC for Discovery of Genes for Common Human Disease
Oral Health CRC (new)
Vision CRC (formerly Eye Research and Technology)
CRC for Vaccine Technology

Over the life of the entire programme, about 11 per cent of the researcher/years within CRCs has been related to health, with clinical research and public health research in about equal proportions (Turpin, Wixted et al. 2003). Under the NRP framework, the CRC Program calculates that A$128 million, or around 10 per cent of Commonwealth funds to the Program, will be dedicated to health research over the life of the current centres. This breaks down as shown in Table 3.3.

Table 3.3: CRC contribution to NRP over the life of current centres

National Research Priority	*Per cent of Commonwealth funds for CRC Program*
a. A healthy start to life	1.9%
b. Ageing well, ageing productively	5.1%
c. Preventive healthcare	2.4%
Total	**9.4%**

Indigenous health research

Although health research for indigenous Australians is not mentioned within the overall set of national research priorities, implementation agencies recognise its importance. These agencies include the Australian Institute of Health and Welfare (AIHW), which provides statistical and other data for health research,[8] and the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), which has a long history of involvement in indigenous health research. The NHMRC identifies Aboriginal and Torres Strait Islander Health in its Tier 1 strategic research program. The Council also hosted an Aboriginal and Torres Strait Islander Research Agenda Working Group (RAWG), which formulated the NHMRC 'Road Map' as a programme for health research of relevance to Australia's indigenous peoples.[9]

Infrastructure and overheads

[8] http://www.dest.gov.au/priorities/plans/AIHW.pdf, 24/2/2004
[9] www.health.gov.au/nhmrc/research/srdc/indigen.htm, 4/3/2004

The issue of 'marginal funding' of academic research by research councils and research corporations is again under review in the context of the development of a national research infrastructure strategy. In the past, the government has tended to prefer a model of research performance based block funding to universities, presumably in part because any move to full cost funding would require a substantial 'clawback' of institutional funding from the major research universities. As a result, in the view of the ARC, 'institutional and competitive funding mechanisms operate in a fragmented and unduly complex way within the university sector' (Australian Research Council 2003b:3). Currently,

> the competitive funding allocated by the ARC and the NHMRC covers only a part of the direct costs of the projects, programs, centres and fellowships that these agencies support, and very little or none of the indirect costs. The grants and centres programs of these agencies do not fund the salaries of Chief Investigators, which often are a significant component of the full costs of a research activity. Similarly, the ARC and the NHMRC meet none of the costs of project-specific infrastructure, nor those associated with infrastructure overheads. In universities, these costs are met by institutional block grants and other sources of funding, the allocation of which may be unrelated to ARC- and NHMRC-sponsored research outcomes. (Australian Research Council 2003b:32).

A further problem is that funding awarded competitively by the NHMRC to medical research institutes and other non-University organisations does not attract Commonwealth infrastructure funding in the same way that universities do (National Health and Medical Research Council (2003b).

In its submission to the infrastructure review, the ARC has proposed that responsibility for allocating funding for minor and project-specific infrastructure be transferred from Education to the ARC and NHMRC, and that a coordinated mechanism for funding medium and major infrastructure (both capital and recurrent costs) be established to be jointly managed by the two research councils. ARC has also advocated a fully contestable model of funding for research infrastructure accessible by universities, government research agencies and other research institutions. The ARC submitted that project-specific infrastructure overheads should be paid at a rate of at least 40 per cent of the associated grant (Australian Research Council 2003a:13).

The National Research Infrastructure Taskforce reported in March 2004, with a range of recommendations about investment in major research infrastructure. The taskforce also advanced a set of research infrastructure funding principles for adoption by all research funding agencies, universities and government laboratories. These deal with coordination and collaboration in the government's funding of infrastructure, and do not prescribe the level of infrastructure funding that should be made by the research councils. However, a further review of Australia's higher education research policies has recently recommended that 'that the Government provide increased funds to the Australian Research Council, the National Health and Medical Research Council and other granting bodies to allow them to provide increased funding to cover overheads associated with research projects' (DEST 2004: 54). This suggests that the Australian research councils will move in the direction of meeting a higher proportion of overheads and infrastructure costs.

Commercially Oriented Medical Research

AusIndustry administers a range of incentives for research and technology development within businesses, most of which are not specifically targeted at biomedical companies. The exceptions are the new Pharmaceuticals Partnerships Program (P3), commencing in July 2004, which aims to increase high quality pharmaceutical R&D activity in Australia throughout the value chain including biotechnology, originator and generic medicines companies. Participating companies will receive thirty cents for each *additional* dollar they spend on eligible R&D in Australia up to a maximum grant amount of A$10 million. The Biotechnology Innovation Fund (BIF) (now closed to new entrants) funded commercialisation of promising biotechnology at the 'proof-of-concept' stage.

The research councils have a mandate to support the scientific and technological base of commercial applications, but steer away from direct involvement in commercialisation. The NHMRC's position is quite clear: it 'has no direct function in the commercialisation of discoveries… Nonetheless the NHMRC has increasingly supported research that demonstrates commercial potential' (National Health and Medical Research Council (2003b:10). In 2001-02 the NHMRC and the ARC commissioned a joint survey with the CSIRO of research commercialisation activities in Australian universities, medical research institutes and CSIRO divisions. Biotechnology companies such as Proteome Systems Ltd (PSL) have been established on the basis of technologies funded by ARC in universities.

State government investment in health research

Australia's States are primarily responsible for the health care system. The larger States make substantial provision for health research, which tends to complement that provided by the Commonwealth agencies. In New South Wales, for example, NSW Health and NSW State Development offer a range of competitive health research grants including Capacity Building Infrastructure Grants, R&D Infrastructure Grants, Health Promotion Demonstration Research Grants (DRGS) and BioFirst Awards. The DRGS funds Area Health Services to conduct rigorously designed health promotion intervention research. Funding is modest – DRGS for example has a budget of around A$0.3 mill. in 2004-05.

Under the A$68 mill. BioFirst strategy, A$6 million has been allocated to provide 'top-up' funding to attract biotechnology researchers to NSW. It has also provided infrastructure in two of NSW's medical precincts – Westmead and St. Vincent's.[10] The intention of these BioFirst Awards was to attract 15 expatriate Australians or international experts to NSW within five years. The NSW Parliament's Standing Committee on State Development has recently completed an inquiry into science and commercialisation in NSW. The Committee criticised the BioFirst program for attracting only five researchers in its first 2.5 years and for being too research (rather than commercially) oriented. In 2003, the Minister for Science and Medical Research (a new portfolio) initiated a review of medical and health research, its terms of reference including priorities for health research funding in the State. The parliamentary Standing Committee has recommended dedicated administrative

[10] http://www.biofirst.nsw.gov.au/, 25/2/2004

support in order to make the Science and Medical Research portfolio effective.[11] A Ministerial Advisory Council on Medical Health and Research (MACMHR) contributes to the coordination of health research in NSW.

In summary, NSW is placing great emphasis on new initiatives in health research and biotechnology, experimenting with new funding and organisational structures that are still under review.

Coordination mechanisms

In recent years, coordination has centred on research priority areas and ad hoc cooperation between agencies. Attention has now turned to formal organisational coordination of activities of the research councils and other science agencies, and between the federal government and the states.

Consistent with their missions, all Australian Government research agencies and funding bodies are expected to implement the National Research Priorities announced in 2002. Each agency has been required to produce an implementation plan showing their commitment to appropriate goals.

In 2003, the Minister for Education, Science and Training instigated a review of the scope for greater collaboration between Australia's main publicly funded research agencies and universities, chaired by Donald McGauchie. The McGauchie report, released in March 2004 recommended that a Strategic Research Council (SRC) be established to enhance collaboration and coordination across the research system. As the CEO of the ARC puts it, 'the nature of research has changed and research is now addressing global and national issues which require enhanced collaboration and sharing of resources' (quoted in Illing, 2004). European and Scandinavian research councils (such as Sweden's Council for Planning and Coordination) are seen as role models. The intention is for an overarching body with advisory, coordination and investment roles to engender greater collaboration between research agencies and sectors. The proposed mandate of the SRC includes providing policy advice (especially independent advice on cross-boundary issues), complementing the roles of existing advisory bodies and research councils (ARC and NHMRC), setting broad research policy directions, overseeing implementation of the National Research Priorities, and assisting in developing a more unified approach to global markets. McGauchie also proposes that SRC should be responsible for a new contestable Collaboration Fund of A$500 million over 10 years. The Fund would finance world class, centres of excellence involving cross sectoral collaboration.[12]

There is already significant collaboration between NHMRC and ARC in relation to cross-disciplinary research. The councils are currently discussion appropriate funding models and projects in two nominated health related research areas: 'Thinking Systems/biological programming' and 'Ageing Well, Ageing Productively'.[13] The latter topic is already one of NHMRC's Strategic Research Networks (SRNs).

[11] 'NSW report calls for science system overhaul'. Australian R&D Review, Feb 2004, p 10.
[12] 'Reports reveal directions for new research system', *Australian R&D Review*, March 2004, p 1.
[13] 'ARC and NHMRC to jointly fund projects'. *Australian R&D Review*, Feb 2004, p2.

Federal-State cooperation in health research investment is achieved through the Priority Driven Research (PDR) Program under the aegis of the Australian Health Ministers' Advisory Council (AHMAC). Established in response to recommendations by the Wills Review, PDR commenced with a pilot program of A$5 mill. in 2001-02 and received A$13 mill. in ongoing funding from AHMAC in 2003. The second round of funding allocated A$4 mill. to research priority areas including future demands for aged care, high risk behaviours in young people and the effectiveness of preventive strategies for hepatitis C.[14]

Conclusions

There are many parallels between the health research investment systems in Australia and New Zealand. The ARC (although larger and less elite) has some comparable features with New Zealand's Marsden Fund in the proportion of 'quality led' health research investment that it funds, while, to some extent the role of AusIndustry parallels FRST's commercially oriented activities. New South Wales provides an example from a small jurisdiction where responsibility for health services and policy is separated organisationally from health research funding.

The Australian health investment system is at least as pluralistic as New Zealand's. However, an important difference is that the Australian federal research councils are not simply 'purchase agencies' and, particularly since amendments to ARC's legislation in 2001, have a very significant research policy advisory function.

The NHMRC is responsible to the Minister of Health, while the ARC and CRC programs come under Education. Coordination is always an issue. Arrangements have been effective, with cross membership of research council boards, and federal coordinating bodies at the ministerial and interdepartmental levels of government. Even so, collaboration is still seen to be inadequate and organisational changes are being considered. The way that Australia has handled Federal-State coordination, while not an issue in New Zealand, gives examples of the interleaving of health research support initiatives at the central and local level.

Health Research Investment in Canada

Medical research and Public health research

Canada has a complex system of funding sources for health and medical research. Although the Federal Canadian Institutes of Health Research (CIHR) is the most easily recognised component of the system, there are a number of other agencies involved. For the 2002-03, government appropriations for CIHR amounted to $651.2 million[15].

General research infrastructure to support R&D is provided by the Canada Foundation for Innovation (CFI).[16] This is an independent corporation created in 1997 by the Government

[14] 'New round of priority research funding'. *Australian R&D Review*, Feb 2004, p 19.

[15] CIHR Performance Report

[16] http://www.innovation.ca/index.cfm

of Canada to fund research infrastructure. The CFI's mandate is to strengthen the ability of Canadian universities, colleges, research hospitals, and other non-profit institutions to carry out world-class research and technology development. The CFI has a budget of C3.65 billion and funds up to 40 per cent of each project's infrastructure costs. These funds are invested in partnership with eligible institutions and their funding partners from the public, private, and voluntary sectors who provide the remaining 60 per cent of a project's cost. Based on this formula, the total capital investment by the CFI, the research institutions, and their partners, will exceed C$10 billion by 2010.

CFI also serves to support health research. For example the British Columbia Cancer Agency[17] has received grants between C$25 and C$30 million from CFI. In addition CFI has a special category for infrastructure support for research hospitals.

Another important initiative of the Canadian Federal Government in recent years has been the establishment of the Research Chairs program.[18] In 2000, C$900 million was allocated to establish 2,000 research professorships (Canada Research Chairs) in universities across the country". Canadian universities both nominate Canada Research Chairs and administer their funds[19]. Universities are allocated Chairs in proportion to the amount of research grant funding they have received from the three federal granting agencies: NSERC, CIHR, and SSHRC in the three years prior to the year of the allocation. Of the total 2000 Chairs, 1880 are regular allocations, distributed as follows:

- 846 Chairs (45 per cent) for research in natural sciences and engineering;
- 658 Chairs (35 per cent) for research in health sciences;
- 376 Chairs (20 per cent) for research in social sciences and humanities. [20]

'CIHR's 13 "virtual" institutes are not buildings or research centres, but networks of researchers from every possible discipline, brought together to focus on important health problems'[21]. As one example the Institute for Aboriginal Peoples' Health (IAPH) will fund excellent research in topics as diverse as health promotion strategies, diseases and injury and ethical considerations within research and care issues. Mostly, funding decisions are made at the level of the CIHR but the Institutes, like the IAPH, do have their own funding for strategic projects and capacity building.

The Canadian Provincial governments and not-for profit foundations also make a significant contribution to health research funding. A number of provincial governments have a 'foundation' to allocate their funding[22]. They fund about health research to an amount equivalent to about 41 per cent Federal Government's expenditure. Table 3.4 summarises the sources of funds for health related R&D in Canada. In addition Canada, like Sweden, has a considerable proportion of health research funded by the business sector. The proportion of business sector funding in Canada is similar to Sweden but

[17] http://www.innovation.ca/projects/index.cfm?websiteid=145
[18] http://www.chairs.gc.ca/
[19] http://www.chairs.gc.ca/web/program/index_e.asp
[20] These statistics apply to the 1035 Canada Research Chairs awarded from December 2000 to October 2003.
[21] http://www.cihr-irsc.gc.ca/e/institutes/9466.shtml
[22] For example, the Michael Smith foundation – British Columbia, http://www.msfhr.org/; the Alberta Heritage Foundation for Medical Research http://www.ahfmr.ab.ca/

considerably more than New Zealand. Table 3.5 shows the source of public sector funding for Canadian health research.

Table 3.4: Gross domestic expenditures on R&D (GERD) in the health field[1], 2002p (C$ mill.)

Funding sector	Performing sector					
	Federal government	Provincial governments	Business enterprise	Higher education[2]	Private non-profit	**Total**
Federal government	140	0	9	537	6	**692**
Provincial governments	0	42	5	218	16	**281**
Business enterprise	0	0	1,085	260	9	**1,354**
Higher education[2]	0	0	0	1,228	0	**1,228**
Private non-profit	0	0	0	327	25	**352**
Foreign	0	0	476	26	1	**503**
Total	**140**	**42**	**1,575**	**2,596**	**57**	**4,410**

1 As data are not provided specifically by "Health Field", this is STC's best estimate.
2 Includes teaching hospitals.
P – provisional.
Source: Statistics Canada 2003 Estimates of total expenditures on research and development in the health field in Canada, 1988 to 2002p.

Table 3.5: Non-business contribution to health research in Canada

Non-business as % of total health related research	57.9
Federal % of non-business health related research	27.1
Provinces % of non-business health related research	11.0
Higher Education % of non-business health related research	48.1
Non-profit % of non-business health related research	13.8
Provinces % of Federal funds health related research	40.6

Based on Table 3.4.

Commercially Oriented Medical Research

CIHR has a dual responsibility for funding knowledge creation and knowledge translation. It directly supports commercialisation through three programs[23]. The CIHR Small- and Medium- Sized Enterprises (SME) Research Program is a jointly funded partnership between CIHR and numerous Canadian biotechnology companies. The program encourages the development of innovative therapies. The CIHR SME program also strengthens Canada's technology-transfer capacity by providing support for research commercialisation in university institutions. The Proof of Principle (POP) Program supports research projects that require additional time and support to validate discoveries and thereby improve the likelihood of their ultimate commercialisation. The Intellectual Property Management (IPM) Program strengthens the ability of institutions to manage their research knowledge, attract potential users and promote the professional development

[23] Information from CIHR (2002) *Annual Report 2001-2002 Building for better health* Ottawa, CIHR pp22 & 23.

of personnel involved in intellectual property management. The program is managed jointly by Canada's three granting agencies: CIHR, the Natural Sciences Engineering Research Council of Canada (NSERC) and the Social Sciences Humanities Research Council (SSHRC).

Another avenue for assistance is Technology Partnerships Canada (TPC[24]). This program invests directly in efforts to develop and refine technology, pursue breakthroughs, build business alliances, and provide opportunities for highly skilled individuals. Technology Partnerships Canada (TPC) offers two main programs[25] The TPC R&D program supports pre-competitive projects across a wide spectrum of technological development, including environmental technologies, life sciences, information and communications technologies and advanced manufacturing. Support for small to medium-sized companies with projects valued under C$3 million is provided through the TRC-IRAP initiative.

The Canadian Networks of Centres of Excellence program[26] promotes partnerships among universities, industry, government and non-governmental organizations.[27]. An important coordination feature is that NCE centres are supported and overseen by the research councils (including CIHR) and Industry Canada. There are 7 NCEs related to health research.

Coordination Mechanisms

Canada's federally funded innovation system is very complex with a large array of different funding sources for research and related activities. This raises challenges for coordination. Coordination is primarily managed through structural ties for assessment and evaluation at the program level. This occurs at two levels: 1) coordination between programs; and through 2) joint funding and administration of a special program.

An example of the first approach is the performance based funding which links success in applications for research grants to other programmes. An example of the second type of coordination is the Networks of Centres of Excellence, which is funded and administered jointly by Canada's main research funding bodies.

Conclusion

Canada presents a considerably larger system than New Zealand. Like Sweden, Canada provides significant direct investment to the research infrastructure at universities. In the case of Sweden the allocation is disciplinary based. In Canada it is provided through research chairs, along broad disciplinary lines, i.e.. natural science and engineering; health sciences; and social science and humanities and via direct infrastructure support from CFI.

[24] http://tpc.ic.gc.ca/en/invest-health.html
[25] http://tpc.ic.gc.ca/en/about-program.html
[26] http://www.nce.gc.ca
[27] http://www.nce.gc.ca/about_e.htm

Health Research Investment in Ireland

The Irish research system

Total public expenditure on S&T in Ireland is classified under five broad headings:

- Research and development activities;
- Other S&T activities;
- Education and health;
- Other public service activities; and
- Economic and social activities.

The budget for research and development activities (i.e. the public sector component of the research funding system) was €342 million in 2001. This represents 23.6 per cent of the total S&T budget. The Irish system has continued to grow rapidly, increasing from €296 million in 2000.

Funding health research

The Department primarily responsible for health research is the Ministry of Health and Children. The Department of Enterprise, Trade and Employment is also responsible for National agencies such as Science Foundation, Ireland (SFI), and the Irish Council for Science, Technology and Innovation (ICSTI). These agencies also contribute to the health research investment through infrastructure, project funding and policy advice. The other important agency is the Higher Education Authority, under the Department of Education and Science, which also funds ICSTI.

The majority of health research funding in Ireland is provided through the Health Research Board which comes under the responsibility of the Minister for Health. The HRB was established in 1987 with the following functions.

- to promote, assist, commission or conduct medical, health and health services research;
- to promote, assist, commission or conduct such epidemiological research as may appropriately or necessarily be conducted at national level and to assist and support other health agencies with such research; and
- to liaise and co-operate with other research bodies in Ireland or elsewhere, in the promotion, commissioning or conduct of relevant research.

The HRB expenditure has increased rapidly over the past few years, from €5 million in 1997 to €22.5 million in 2002. The Post Graduate Medical and Dental Board allocated a further €5 million in 2001. Total government expenditure for science and technology expenditure for the 'health' objective health was €24,093,000. As the HRB has pointed out, the introduction of SFI and the funding provided through the Higher Education Authority's Program for Research has greatly enhanced the infrastructure available for health related research (HRB 2002)

In 2001 the Minister for Health and Children released a new strategic document to guide health research funding, *Making knowledge Work for Health – a strategy for health research.* This document emphasised a government commitment to 'investigator-led, bottom-up research, funded competitively and following national and international peer review and proposed significant increases in overall funding (HRB 2002). However, in spite of the growth in the health research budget ICSTI have proposed that health funding targets will not be achieved and that health research generally remains 'under-funded in terms of GDP/expenditure on health relative to other countries and has not kept pace with the overall increase in health funding over the past five years' (ICSTI 2003a).

Commercially oriented medical research

In 2000, the Government established Science Foundation, Ireland (SFI) as a sub-group within Forfás: The National Policy and Advisory Board for Enterprise, Trade, Science, Technology and Innovation. SFI specifically targets biotech and ICT and emphasises the basic building blocks, the scientists, keeping them in Ireland and ensuring the health of the science system. SFI also Supports Centres, Institutes and equipment and operates a Basic Research Grants scheme (Human Capital, Ideas and partnerships)

Coordination Mechanisms

The **Irish Council for Science, Technology and Innovation (ICSTI)** advises the Government on the strategic direction of science, technology and innovation (STI) policy. Its advice encompasses all aspects of STI policy including: primary, secondary and third-level education; scientific research; technology and research, development and innovation in industry; prioritisation of State spending and public awareness of STI issues. In 2001 the Council completed three priority areas of work:

1. Commercialisation of research
2. Biotechnology
3. Research evaluation

The growing number of agencies involved in funding or administering health related research funding has created debate around how best to coordinate the various agencies and their activities in order ' maximise synergies and reduce duplication of effort and funding' (HRB 2002:6) As one step toward achieving this an 'agreed statement' was signed in 2001 by the HRB, the higher Education Authority, the Irish Research Council for Science, Engineering and Technology, the Irish Research Council for Humanities and Social Sciences and Enterprise Ireland. The HRB was nominated to chair meetings of this 'coordinating group'.

Conclusion

Ireland presents a country that has rapidly increased its research funding capacity and from a comparatively low base. Although the overall health research budget remains small by international comparison it has increased at a faster rate than most other small countries.

Many of the structural features evident in the Irish system can also be observed in New Zealand. For example, they have moved away from a disciplinary based funding and toward strategic investments in priority areas. The support for biotechnology and innovation through the ICSTI reflects similar strategies adopted by NERF in New Zealand.

The HRB performs a key role in Ireland in coordinating health research overall and is consistent with an enhanced coordinating role proposed in this report for the New Zealand HRC.

Health Research Investment in the Netherlands

The Dutch research system

In the Netherlands public research funding is organised both along disciplinary lines and through various crosscutting support arrangements for the commercial and social application of knowledge and in support of S&T careers and infrastructure. The result is a highly pluralist system for funding, performing, evaluating and setting directions for health and medical research. The system appears productive and effective. The number of scientific publications per researcher exceeds the European average, and while the Netherlands has a similar share of international scientific publications to Australia (around 2.5 per cent of world total), their impact is higher than all countries save the USA and Switzerland (Netherlands Observatory of Science and Technology 2000).[28]

Basic and strategic health research

The Dutch national research council, the **Netherlands Organisation for Scientific Research** (NWO) under the Ministry of Education, Culture and Science, is responsible for about 20 per cent of total university research funding, although funding is only delivered through its Research Councils. Eight research councils within NWO represent the branches of science and humanities: There are several research institutes in the health field in the Netherlands, such as the National Institute for Public Health and the Environment (RIVM); these are financed directly by the Ministry of Health, Welfare and Sport rather than by NWO through ZonMw. The Royal Academy (KNAW) and government TNO and KNAW have their own institutes carrying out health related research (see below).

Traditionally, NWO's role has been to award investigator initiated proposals, but from the early 1990s has adopted a more strategic role: 'it has also taken up the responsibility for stimulating research in areas of socio-economic relevance, wants a larger share of funding to go to multidisciplinary research and, increasingly, allocates resources under "large grant schemes", and in some instances with co-funding of government ministries and industry' (Van der Meulen and Rip 2000). As NWO acknowledges, '[t]he awareness of the fading distinction between scientific and social inspiration has complicated NWO's policy environment'.[29] NWO continues to recognise that its 'core business' is 'quality:

[28] Impact is measured by the citation impact score, defined as the number of citations received from ISI listed publications, 1994-98. The Netherlands' impact score is 1.23, compared to the world average of 1.00. Slightly less than 40 per cent of Netherlands' publications outputs are in biomedical and health sciences. Of these by far the largest group is in Clinical Medicine, which has an impact score higher than the international average.

[29] http://www.nwo.nl/nwohome.nsf/pages/NWOP_5SRCB6_Eng [16/2/04]

challenging, high risk science' (Netherlands Organisation for Scientific Research (NWO) 1995). From 2002, a new career development scheme supports 150 researchers a year. This represents a substantial increase in career support from NWO. This 'new-style' Innovational Research Incentives Scheme is in collaboration with the universities and the Royal Netherlands Academy of Arts and Science (KNAW) and is also known as the 'Veni, Vidi, Vici' programme, as it supports researchers at three stages in their career.[30] NWO also offers career development schemes for women researchers (Apasia) and non-native Dutch researchers (Mosaic).

ZonMw, the Netherlands Organisation for Health Research and Development, is the NWO's medical and health research council, and also has a formal relationship with the Ministry of Health, Welfare and Sport (VWS). ZonMw was created through the amalgamation of ZON, the Health Research and Development Council within the Health Ministry, and NWO's former Medical Sciences Council.

ZonMw sees its mission as follows:

- To renew the system of health research and health care in the Netherlands;
- To operate integrated programs of research, development and implementation; and
- To intermediate between practice, policy and research.[31]

ZonMw supports research in the areas of health, prevention and care, covering basic scientific research through to applied research and development. ZonMw runs both proposal driven ('open response') and targeted special research initiatives. Fellowships, clinical research training grants, group and equipment grants are examples of the main instruments of support. Research is organised according to clusters (with broad average funding in recent years):

1. basic science and industrial innovation (€32.7 mill.).
2. research support for disease prevention (€24.0mill.).
3. support for research for 'long lasting care'(€8.8 mill.).
4. support for research and development for health care and cure including demand and societal factors (€8.4mill.).
5. support for research for quality and efficiency & effectiveness in health care and cure (€13.0 mill.)

The total spend is around €87 mill. The annual budget for science-driven research is about €21 million.

ZonMw's assessment procedures focus exclusively on scientific quality, including career perspectives for new researchers and track records for established investigators. An application is structured in two stages. Applicants first write a short Expression of Interest (success ratio 15 per cent). This is judged on quality and the researchers either invited to

[30] http://www.nwo.nl/nwohome.nsf/pages/NWOP_5SRC5E_Eng [16/2/04]
[31] Edvard Beem, ZonMw, pers. comm.

apply or advised that an application is unlikely to succeed. The success ratio for the second stage of applications is 37 per cent.[32]

The role of ZonMw has changed significantly over the last decade, paralleling developments within many health research councils internationally, including in New Zealand. These changes are summarised by Beem (pers. comm..)as follows:.. Health care and health research systems have become more strongly integrated compared to the former situation where the Health Ministry funded the former and NWO funded individual basic biomedical research projects. In parallel, a closer working relationship has developed between the Medical Faculties in the universities and the Academic hospitals, which formerly operated independently. Over the next decade ZonMw has set its sights on further integration of health R&D, strengthening health R&D infrastructure, implementation of R&D results (and translation of public health and health care needs into R&D programmes), and promoting a greater international orientation for Dutch health R&D. To achieve these goals, ZonMw aims to double its budget over the next decade.

The **Netherlands Royal Academy of Arts and Sciences** (KNAW) is responsible for a range of national biomedical research institutes and centres, including the Institute for Brain Research, the Interuniversity Cardiology Institute and the Ophthalmic Research Institute. KNAW has a discipline advisory Council for Medical Sciences and committee for Biochemistry and Biophysics. The Academy offers a range of stipends, overseas study and conference grants for medical researchers.[33] KNAW sees itself as a protector of basic research and plays a specific role in the evaluation of the quality of research (Rip and Van der Meulen 1995). KNAW accredits medical research schools and carries out discipline reviews in conjunction with the Association of Universities in the Netherlands (VSNU). The Council has recently reported on the impact of applied health research (Council for Medical Sciences 2002).

Commercially oriented medical research

The **Technology Foundation** (STW) has operated within NWO since 1990. STW is independent, but acts as the knowledge transfer agency for NWO. STW funds university research (and research in selected technology institutes) that meets two criteria: it must be of high scientific quality and directed towards practical application or utilisation i.e. 'the embedding of the results in society'.[34] Each criterion carries equal weight in the assessment. STW's budget in 2002 was about €46 million. Funding comes from the Ministry of Economic Affairs (EZ) (40 per cent) and from the Ministry of Science and Education (60 per cent), the latter via NWO. About 40 per cent of completed proposals are funded and it is firm STW policy to maintain the success rate at this level. The application process takes no longer than six months, and applications are considered at any time. Typical project funding is €0.4-0.5 mill.

STW welcomes applications from all fields, including health, medical and biotechnology. STW runs two programme streams. The first and largest the Open Technology Programme

[32] Stéfan Ellebroek, ZonMw, pers. comm. 2003.
[33] http://www.knaw.nl/cfdata/disciplines/medicine.cfm [16/2/04]
[34] http://www.stw.nl/stw/networking.html [10/02/2004]

(OTP), with over 85 per cent of budget, is for proposer driven projects in any field, while the second is for specific programmes nominated by STW (11 per cent of budget), the remaining 3 per cent of programmes are determined by NWO/EZ. These may arise from 'critical masses' generated in the OTP. Projects are collaborative in that researchers develop their proposals in consultation with people in industry and nominate industry or social representatives for a 'user committee', set up for each project by STW. Most project grants last 4-5 years and can fund equipment, PhD students and equipment. The Technology Foundation and the university jointly own any intellectual property from the project. Any royalties are returned to the project leader. One successful project has been the development of a novel prosthesis for leg amputees. Research into drug delivery and rheumatism diagnostic kits has led to new start-up companies.

The Netherlands Organisation for Applied Scientific Research (TNO) **Institute for Prevention and Health** is organised around two research clusters: the biomedical cluster (Pharma), which develops knowledge for the pharmaceutical and biotechnology markets, and the 'care' cluster, which is geared towards public market issues (TNO Prevention and Health 2002).

'BioPartner' is a Dutch government initiative, under the Ministry of Economic Affairs, that provides support for several stages of commercial development of the life sciences. While most assistance, such as networks, risk capital and 'BioPartner Centres', which are incubator building with some shared facilities, is aimed at start-up companies, BioPartner will also support researchers in public universities and laboratories to collaborate with start-up companies or to set up their own enterprises. For example, 'First Stage' grants are available for them to develop a feasible business plan from their research idea. The scheme also supports the purchase of specialised equipment for joint use by public sector research and start-up companies. The equipment is usually housed in the university or public laboratory.[35]

'Senter' is branch of the Ministry of Economic Affairs (EZ) with a brief to promote technology, energy, environment, exports and international cooperation. Senter manages grant schemes on behalf a number of government agencies. In addition, Senter supports national collaborative initiatives (for example in genomics), as well as sponsoring Dutch involvement in European and international aid projects in biomedicine and public health. Senter acts as a brokering agency by providing companies with information on Dutch and international grants and assistance, and provides a link between companies, universities, technology institutes and other knowledge institutions.[36]

Coordination mechanisms

Real cooperation is apparent between NWO, STW, Senter and BioPartner (STW 2003). Collaboration has started in the field of 'Genomics Technology', a sub-section of the Innovation Oriented Research Program Genomics (IOP Genomics) which is run by Senter. IOP Genomics and STW have each allocated €2 million for technology research in the

[35] http://www.biopartner.nl/asp/content.asp [10/02/2004]
[36] http://www.senter.nl/asp/page.asp [10/02/2004]

field. STW is also co-operating with ZonMw within the Tissue Engineering programme. Many STW grant recipients have been awarded BioPartner 'First Stage' grants.

A sectoral **Advisory Council on Health Research** (RGO) is established to advise the government (primarily the health and education ministries) on strategic issues. The RGO's main task is 'to set priorities for research aimed at the solution of problems in health and health services and to give recommendations on financial and infrastructural matters'. A recent report, for example, investigates the knowledge infrastructure for public health and proposes a series of initiatives at a cost of nearly €50 mill. over the next 5-8 years. [37]

Conclusions

The Dutch health research support system exhibits all the elements found in New Zealand, with the addition of a large government research institute (TNO) and specialised biomedical commercialisation agencies. The system has undergone many of the same changes faced in New Zealand: a system initially organised along the basic/strategic/applied divide, represented by KNAW/NWO-MW/STW and TNO, but which is now addressing social (and to some extent commercial) application of health research at all levels. This has required a high degree of cooperation and coordination. Dutch policy researchers have explained the coordination challenge as a process of 'heterogeneous aggregation' (Van der Meulen and Rip 2000). They note,

> The real importance however rests on the development within these interactions of shared frames of references and co-development of what can be called hybrid knowledge reservoirs: knowledge that comprises the scientific insights as well as practical knowledge and experiences, and last but not least insights how these two are interrelated (in some cases in a way that they are difficult to distinguish). Such hybrid knowledge reservoirs are needed to create effective communication and the ability of societal actors to become real users'(Van der Meulen and Rip 2000).

The level of coordination in the Netherlands and the mechanisms for achieving it – such as the presence of a cross-Ministry advisory council on health research – may offer some useful lessons for New Zealand –. This is discussed further in Chapter 7.

Health Research Investment in Sweden

The Swedish research funding system

Sweden maintains a pluralistic research funding system with numerous independent financiers. The situation is similar to the Netherlands but with a higher proportion of funding provided by private foundations and the business sector. Like New Zealand, most public funded research in Sweden takes place in the universities. The public sector (other than higher education) accounts for only around 3 per cent of national R&D expenditure. However, unlike New Zealand, a large proportion of national research funding is provided and carried out by the private sector. Nearly 70 per cent of all Swedish research funding originates from the private sector.

[37] http://www.rgo.nl/pdf/summary-publication-39.pdf [16/2/04]

Public funding is directed through two main mechanisms: through direct appropriations to higher education institutions, allocated to specified scientific fields; and by means of appropriations to Research Councils and sectoral research agencies to be distributed through competitive funding programs and investigator led bids. The strategy underlying this dual system is to provide a 'well-funded' collaborative research environment in the university system while at the same time providing flexibility through a competitive submission based processes.

Basic research

Funding to universities is allocated directly to universities across eleven 'scientific fields'. The strategy is to provide a sound infrastructure base across the disciplines. Medical research at universities represents the largest single concentration of government funds by field of research to universities. Total government research investment for medicine in 2003 was equivalent to €435 million[38] including the higher education allocation and government R&D grants (Statistics Sweden 2003). This investment accounted for 60 per cent of all medical research (Billig 2004). The Swedish Research Council has a funding base of around €262.8 million, approximately 16 per cent of which is distributed to medical research.

In 2001 a number of general reforms were introduced to increase interdisciplinary and cross-sector collaboration across the system. The reorganised Swedish Research Council now comprise of three research councils: humanities and social science; natural and engineering sciences; and medicine. In addition the SRC maintains an education 'committee'. The strategy behind these changes was to 'strengthen researcher control' and 'promote collaboration between different fields'. (Swedish Institute 2001)

The SRC holds responsibility for funding basic research and maintaining an international standard of research capability and excellence. It is also responsible for providing research policy advice. The Scientific Council for Medicine supports medical research throughout the field of medicine: medicine, pharmacology, odontology and healthcare sciences. During 2001, the Council for Medicine disbursed nearly €38 million for medical basic research. In addition, it administered nearly €3.3 million from other sponsors of joint research programmes.

Apart from the SRC there are other agencies that contribute to health and medical research. These include:

- The Swedish Council for Working Life and Social research
- The Swedish Foundation for Strategic Research
- The Knowledge Foundation
- The Swedish Foundation for Health Care Sciences and Allergy Research

Sweden's county councils and municipalities also finance R&D in health care. A significant component of medical research in Sweden is funded through non-government

[38] These figures are based on a 2003 exchange rate of 9.13 SEK.

foundations. For example, the Swedish Cancer Society distributes approximately €32.8 million annually.

Commercially Oriented Medical Research

The Swedish Agency for Innovation Systems aims to promote sustainable growth in business through innovation. It is a new agency financing 'needs based and development to support 'innovation systems, sustainable development and growth'. Some of these funds support R&D in medical related fields. It should be noted, however that the business sector accounts for around 70 per cent of all R&D carried out in Sweden and approximately 40 per cent of medical research. For this reason there is a strong emphasis placed on creating partnerships between universities and the business sector.

Coordination Mechanisms

Coordination of medical research as carried out two levels. The SRC has a coordinating role for its three councils and education committee. The SRC also has the general task of providing the government with research policy advice as well as promoting research cooperation. At a higher level, overall responsibility for the coordination of research policy is with the Ministry for Education and Science and through the Council for Planning and Coordination (FRN).

Conclusion

A major distinguishing feature of the Swedish health research system is the high proportion funded by the non-government sector, including firms and foundations. However, like New Zealand the majority of publicly funded research takes place in universities. The Swedish system could be characterised as a dual system, supporting disciplinary based clusters through university research funding and by investigator led funding through a peer reviewed grants based system.

Recent discussion in Sweden has drawn attention to a relative decline in Swedish health research funding. It has been pointed out that medical research has not kept pace with growth in other disciplines. On the other hand there is evidence of an increase in the number of new biotechnology companies(Billig 2004).

A new strategy, *Medical Research – for health, quality, Health Care and economic growth* is currently under discussion(Billig 2004).. The target identified in the draft strategy is to double the amount of funding for project support and to increase the level of funding among the top 10 per cent of projects.

Health Research Investments in the United States

The US funding system

The outstanding feature of the US system is its sheer size and the strength of the private sector in funding and carrying out research as well as providing a platform of research users. A consequence of the size of the economy and the history of medical research is the size and complexity of the National Institutes of Health (NIH). However, in spite of these major structural differences there are some useful lessons that might be drawn from the US experience.

Responsibility for basic biomedical research

The U.S. National Institutes of Health have lead responsibility for basic biomedical research in the United States. NIH consists of 27 institutes and centres, some focused on disease categories and some on general resources for biomedical research. The total budget requested for NIH for the coming fiscal year is US$28.8 billion, of which about 11% will be spent on NIH in-house laboratories and the rest in extramural grants to universities and medical schools. Because the NIH is so big, it is often asked to take on missions beyond basic research, and NIH directors have varied in their willingness to do so. The current director, Dr. Elias Zerhouni, has a roadmap for the biomedical enterprise that stresses translating basic research findings into clinical advances and human health.

Medical research

Beyond NIH, the U.S. Department of Health and Human Services includes about US$1 billion in research spending in more specifically applied agencies. The Veterans' Administration, for example, funds some health on issues relevant to those who have served in the military. The Agency for Healthcare Research and Quality supports health services research. Another US$1 billion or so is spent for health research outside HHS, for a total of US$30 billion requested in the next fiscal year's budget.

Public health research

The Centers for Disease Control and Prevention (CDC) has lead responsibility at the federal level for public health. It includes some research components, including intramural laboratories. The National Institute of Occupational Safety and Health (NIOSH), for example, is housed within the CDC, as are the laboratories that isolated and sequenced the SARS virus.

Commercially-oriented medical research

All biomedical research in the United States is available for commercialisation under the provisions of the Bayh-Dole Act. Even NIH intramural researchers are allowed to consult with industry. Some specifically commercial programs include the Small Business Innovation Research Program at NIH, the new Institute of Biomedical Imaging and Bioengineering at NIH, and portions of the Advanced Technology Program at the National Institute of Standards and Technology in the Department of Commerce. Biomedical inventions may also be commercialised in the SBIR programs of other agencies, such as Defense. Similar approaches can be observed in other countries such as the Swedish Agency for Innovation, the STW in the Netherlands, the ICISTI in Ireland as well as HRC and NERF in New Zealand.

Minorities health research

The US has in place a strategic research plan and budget directed toward 'the reduction and ultimate elimination' of health disparities (NIH 2002). The strategy includes increasing participation of minorities in clinical research and 'increasing the number of minority clinical and basic medical scientists in the system. The strategic plan focuses on three key goals: research; research infrastructure; and community outreach. The strategic plan also reflects work in progress toward development of a methodology the NIH can use to determine the amount of resources currently supporting health disparities research. NIH has established a Committee on Minority Health and Health Disparities Research Definitions and Application Methodology. However, under the US approach all minorities, including American Indians are combined to form a single target group under the 'health disparities research' policy.

New Zealand appears to have progressed further in strategic development for Māori health research and has already achieved significant outcomes in building a Māori health research community. The HRC has also been involved in the formulation of performance indicators for Māori and Pacific Health research through involvement in the PBRF. Considerable progress has been made in New Zealand in developing mechanisms for assessing research outcomes and impact from health research directed toward Māori. Further, indicators to monitor the number of Māori and Pacific researchers across the system have been used by the HRC to identify the overall numbers as well as monitor career progression.

Coordinating Mechanisms

Most of the health research enterprise is located within the Department of Health and Human Services, which provides some coordination. Interagency working groups tend to form in specific disease or problem areas. All the parts of the medical research enterprise in the United States are ultimately, but very loosely, coordinated by the White House Office of Science and Technology Policy, which works closely with the White House Office of Management and Budget. Most of health spending is authorized through the Subcommittee on Health of the House Committee on Energy and Commerce and through the Senate Committee on Health, Education, Labor, and Pensions.

Evaluation and GPRA (Government Performance Reporting Act)

Annual Performance Plans include performance goals that can be assessed through objective/quantitative measures and performance goals based on descriptive achievement criteria. Where objective/quantitative measures can be used, performance assessment is a process, principally, of comparing data on actual achievement with the target levels stated by the Annual Program Performance Plans. Where such measures are not available or judged not useful, GPRA (Government Performance Reporting Act) provides for an agency to define performance goals that rely on criteria that are descriptive in nature.

NIH has organized its performance goa1s under three Core GPRA Programs:

- Research Program
- Research Training and Career Development Program
- Research Facilities Program

NIH also focuses on communicating scientific results, promoting the efficient transfer of new drugs and other technologies, and providing effective research leadership and administration. Six goals for the Research Training and Career Development Program support research training and outreach designed to ensure a continuing supply of well-trained scientists. Eight goa1s for the Research Facilities Program focus on modernizing and improving intramural and extramural research facilities to ensure that the nation' s scientists have adequate facilities in which to conduct their work.

Conclusion

The US presents the world's largest national research system. There are few direct comparisons that can be made at a system level with New Zealand. However, there are some areas that provide some useful benchmarks. First, health research has only recently been brought under the national evaluation spotlight, through GPRA. New Zealand on the other hand has a quite well developed and transparent system for funding and reporting on output. The move to full cost recovery costing in New Zealand and the processes in place for assessing full-cost provide an opportunity to develop a robust and transparent evaluation system. The US has moved in the same direction and considerable effort has gone into developing methodologies for identifying strategic research inputs and outcomes. As this work deepens in the US new indicators for evaluation may emerge.

Summary Observations on International Health Research Systems

The review of country experiences emphasises a number of common features. There are significant socio-economic differences across the countries but there are some lessons that can be drawn from strategies, implementation and evaluation mechanisms and coordination.

While a variety of funding mechanisms are in place and managed by various agencies in other countries there is, as in New Zealand, usually a dominant agency (or in the case of Sweden, sub-council) carrying major responsible for national health research. Typically, other complementary agencies are focused on innovation and commercialisation, in collaboration with the private sector. The level of complexity and number of agencies is

largely a factor of size. The sheer size of the US contribution to health research presents the most complex system in terms of the numbers of agencies involved. However, even in comparatively small countries, such as Ireland, other funding mechanisms are in place to complement the work of the core funding agencies. The New Zealand system is consistent with this model. A key issue – one that most countries are grappling with – is the best way to manage the boundaries between funding mechanisms and the agencies administering them.

Thus, Australia has just raised a proposal for a cross-cutting Strategic Research Council to improve collaboration and coordination and to oversee the implementation of national research priorities. In Canada, collaboration can take the form of joint funding and administration of particular programmes, notably the Networks of Centres for Excellence. In Ireland, the Health Research Board chairs an interagency coordinating group on health research. The health research council in the Netherlands has become more strategically focused and collaborative, and there is also an sector council for health research to advise relevant ministries. Sweden has a longstanding research Council for Planning and Coordination.

The funding strategy within all countries has shifted, to varying extent, away from disciplinary based models toward broad objective based. The main distinction that predominates in funding strategy is not so much between disciplines but between biomedical science, clinical science and public health. The emphasis is thus on strategic objective rather than scientific base. A further distinction is between research supporting innovation in partnership with other sectors, especially the business sector, and research focused on centres of excellence.

All countries covered in the review have introduced new strategic plans for health research during the past four years. These reflect growing demands to account for the returns and value derived from research investments and to establish formal and transparent evaluation systems. In most countries changes have been introduced into the structure and mechanisms for health research funding. Sweden, for example, have revised their Research Council structure, Ireland has introduced a new agency for innovation research and the Netherlands have combined the activities of ZON (the Health Research and Development Council) with NWO's former Medical Science Council to create ZonMw (the Netherlands Organisation for Health Research and Development).

There is a trend in the benchmark countries towards building in infrastructure costs to investigator led research investments. New Zealand has progressed further down this path than other comparable countries. The full-cost-funding system as implemented by the HRC in New Zealand has not been achieved to the same degree in other countries (see Appendix 2). Its implementation provides a well-defined and transparent process for accounting for the various elements of total research cost some of which are provided through different investment mechanisms and agencies. The process provides for clarity between financial contributions from different sectors. It consequently provides a sounder base for evaluating the relationship between specific research inputs and outcomes. An important issue for New Zealand university based research is to ensure that with the introduction of full cost funding adequate resources are available for carrying out high quality medical health

research as well as maintaining the appropriate infrastructure within the university system on which it depends.

A feature of the most recent wave of strategic plans is an emphasis on target populations. New Zealand appears well ahead of the comparator countries in this regard. For example, it is now more than a decade since the Māori health research strategy was initiated. HRC also has extensive health research and capacity building programmes for Pacific peoples. The US, in contrast, has only now established a committee to define a methodology for accounting for research investments for minorities (see Chapter 6).

Research councils in all the benchmark countries support some combination of investigator led health research based on excellence and to varying extent relevance. In this regard, the HRC is closely in line with international practice. The New Zealand peer review system for health research is clearly of a high international standard, is transparent and is very highly regarded. Key stakeholders unanimously expressed confidence in this element of the system. The peer review system as it is currently in place identifies a considerably larger proportion of excellent fundable research projects than is presently funded under present budget constraints. Further, the HRC has clearly developed investment strategies, linked to target objectives for health outcomes. The HRC's research investment strategy and related issues are discussed in more detail in Chapter 5.

4. International Benchmarks II: Levels of Health Research Investment

Introduction

The question of the appropriate level of investment in health research in New Zealand is best considered by examination of investment decisions made in other countries that are facing similar health challenges. This chapter analyses the funding of health and medical research in New Zealand and a range of comparable industrialised (OECD member) countries.

Because the variations in the structure of research and investment systems (see Chapter 5), no single indicator of funding can be used as a definitive measure of the level of research funding. Thus a range of different measures of comparison has been developed to 'benchmark' New Zealand's health research investments against the comparator countries.

The analysis is divided into three sections. The first compares the overall funding of health and medical research in the comparator countries; the second investigates the degree to which national competitive grants fund health research; the third provides a brief analysis of the cost structures for medical research funding councils, since this affects the validity of comparisons based primarily on expenditure by the councils. Detailed notes on data used in the analysis can be found in Appendix 1. Each of these measures has particular benefits and limitation. These are discussed in Box 4.1.

Box 4.1: Measures of comparison: the pros and cons

1. Source of data

There are several choices – government budget data and survey data from institutions conducting research (e.g. the universities) are the main examples. The appropriate choice depends on the purpose. This report is an evaluation of the Health Research Output Class – a government budget item – so we are interested in equivalent government budget data from other countries.

2. Basis of indicators

There are several types of data and different means of transforming data into comparable indicators for cross-country comparison.

(a) Health research expenditure as percentage of Gross Domestic Product (HR/GDP).
This is the most widely adopted indicator. It is easy to use and can be applied to different research fields, sectors of activity (government, business, natural sciences and social sciences etc) and can be done for most countries. Data compiled by international organisations emphasise this indicator.

Limitation 1: is that when it is applied to particular funding categories, then there is an assumed equivalence of **purchasing power**. So for example the HRC expenditure as percentage of GDP when compared to other health research funding bodies does not take account of the HRC having to pay the universities a full cost overhead rate.

Limitation: 2 comes with the use of GDP as a denominator. If a country has a rapidly growing GDP then the ratio may fall – because it is difficult for Governments to expand research expenditure faster than GDP growth.

2. Share of Government expenditure on R&D devoted to a health research.

This approach overcomes the vicissitudes of GDP. It may also obviate the cost structure comparison problem (provided that all agencies are on the same cost basis). Thus this indicator is not without merit and has been included in this report, but it is not without difficulties.

Limitation 1. Finding cross-country comparable tables of Government S&T budgets can be very difficult (see OECD's approach in Box 4.2). Each country has idiosyncrasies in how they report budget funds. As this indicator is not used often by international sources it has to be extensively researched (as has been done for this report) but there is a risk of double counting or missing data.
Limitation 2. The indicator provides a good measure of the importance accorded to health research with respect to other fields, but the absolute level of government funding also needs to be considered.

Overall health research investment in OECD countries

Government outlays on health research – official OECD data

The first benchmark used in the level of government budget appropriations or outlays on R&D (GBAORD) in respect of health research. Before presenting the comparison, it worth noting how these data are derived (see Box 4.2). The validity of the comparison is influenced by the structure of national health research organisations, in particular, whether the **primary purpose** of an organisation is health research (if not, its funding may not be included). Where possible, the OECD also includes estimates of government funding of health research through other channels such as general university funding (GUF), 'non-oriented' research,[39]and R&D expenditure in hospitals. The OECD's detailed guidelines on the derivation of health R&D data from GBAORD are reproduced in Appendix 5.

[39] Formerly termed 'advancement of knowledge', i.e. research with no specific objective in mind other than advancement of knowledge– in this case advancement of knowledge in health and medical sciences.

Box 4.2: OECD calculation of GBAORD on health research.

The data on central government (eg federal) support for R&D are derived from budgets and are referred to as government budget appropriations or outlays for R&D (GBAORD). GBAORD can be broken down by socio-economic objectives (SEO), such as the protection and improvement of public health which is defined as follows: "This category covers research aimed at protecting, promoting and restoring human health broadly interpreted to include health aspects of nutrition and food hygiene. It ranges from preventative medicine, including all aspects of medical and surgical treatment both for individuals and groups and provision of hospital and home care to social medicine and paediatric and geriatric research." (*Frascati Manual*, OECD, 2002). The GBAORD health category is used here as a proxy for total central government funding of health R&D. However, it should be borne in mind that it only covers programmes for which health is the primary objective. Furthermore, the classification of programme and institutional funding depends on how governments present their R&D priorities as well as on the formal mandate of the institutions concerned. For example, long-term research may be the responsibility of a medical research body classified in health objectives (*e.g.* the National Institutes of Health in the United States) or of a general research council whose funds are mainly awarded for the advancement of research (*e.g.* the National Council for Scientific Research in France). Arrangements for funding R&D in hospitals also vary between countries. To address some of the limitations mentioned above and to provide a more complete picture of health related R&D, funding of medical sciences via non-oriented research and general university funds (GUF) are included when available as are other relevant funds, notably general support for R&D in hospitals. (OECD 2001b: 34)

Table 4.1 presents the official OECD data (direct GBAORD) on health research funding through government budgets in terms of absolute expenditure (as a proportion of GDP) and annual growth rates in expenditure over the last 5-7 years. As the OECD data for New Zealand are for 1999, we have added an estimate for New Zealand for 2003 based on HRC data. Countries are ranked by level of expenditure. The same data presented graphically makes it easier to grasp the differences in the relative levels of funding (Figure 4.1) and growth rates (Figure 4.2).

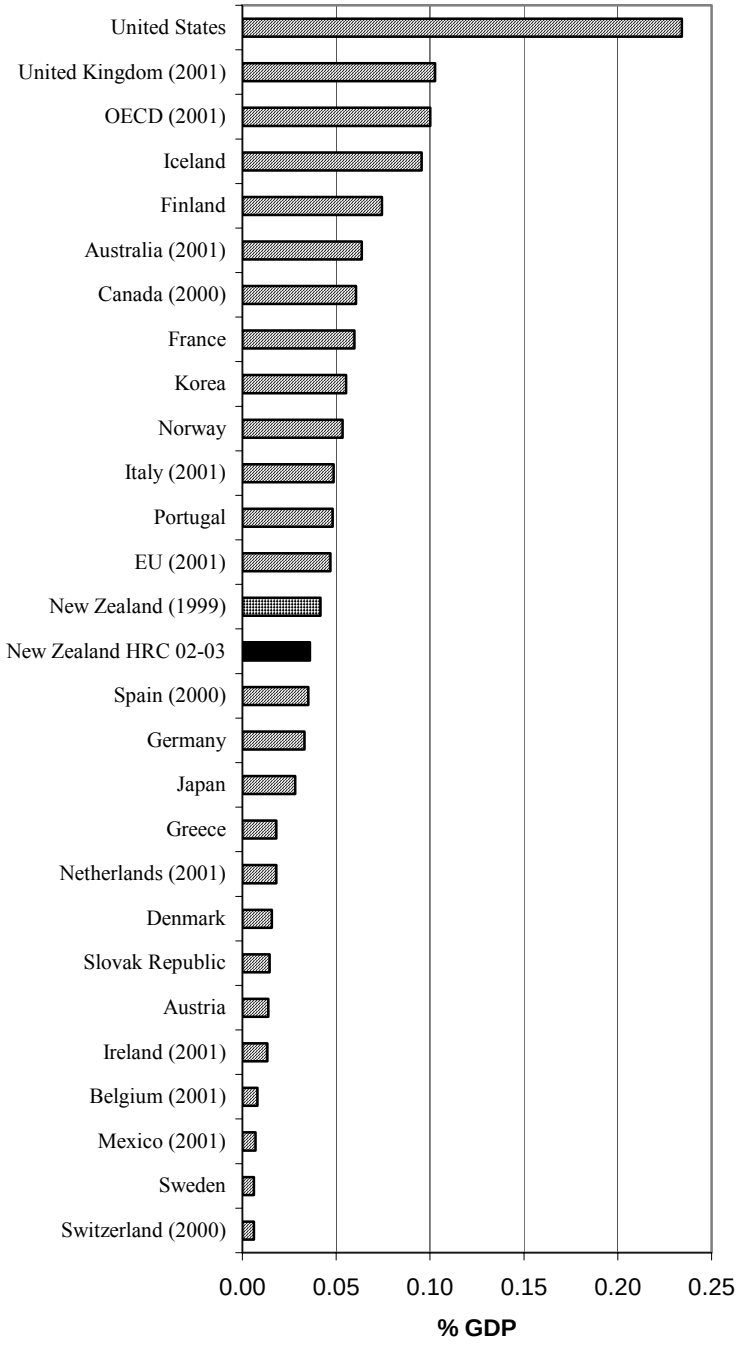
Table 4.1: Health R&D (direct GBAORD) for selected OECD countries (2002)

Country	Health GBAORD (% of GDP) 2002	Average annual growth rate, 1995-2002
United States	**0.23**	**9.17**
Iceland	0.10	26.68
OECD (2001)	0.10	..
United Kingdom (2001)	**0.10**	**2.18**
Finland	0.07	0.13
Korea	0.06	..
France	0.06	3.38
Canada (2000)	**0.06**	**8.64**
Australia (2001)	**0.06**	**11.69**
EU (2001)	0.05	..
Portugal	0.05	15.13
Italy (2001)	0.05	1.17
Norway	0.05	4.52
Spain (2000)	0.04	8.19
New Zealand (OECD 1999)	**0.04**	..
New Zealand HRC 02-03 (AEGIS estimate)	**0.036**	
New Zealand Health research 02-03 (AEGIS estimate HROC + SPIOC + Maori OC + Marsden)	**0.04**	
Japan	0.03	11.15
Germany	0.03	3.46
Denmark	0.02	7.76
Netherlands (2001)	**0.02**	**5.93**
Greece	0.02	5.98
Switzerland (2000)	0.01	..
Sweden	**0.01**	**-2.05**
Mexico (2001)	0.01	-2.66
Belgium (2001)	0.01	-6.72
Ireland (2001)	**0.01**	**21.1**
Austria	0.01	-0.56
Slovak Republic	0.01	-5.69

Source: OECD 2003. Notes: Growth rate: Australia, Belgium, Ireland, Italy, Mexico, Netherlands, United Kingdom (1995-2001); Canada, Spain (1995-2000); Finland (1997-2002); Iceland, Sweden, Switzerland (1998-2002).

Note The Aegis estimate includes funding from the Māori Knowledge Output Class and the Supporting Promising Individuals Output Class. This table does not take into consideration factors such as the differences in the overheads payment rate by research council in different countries.

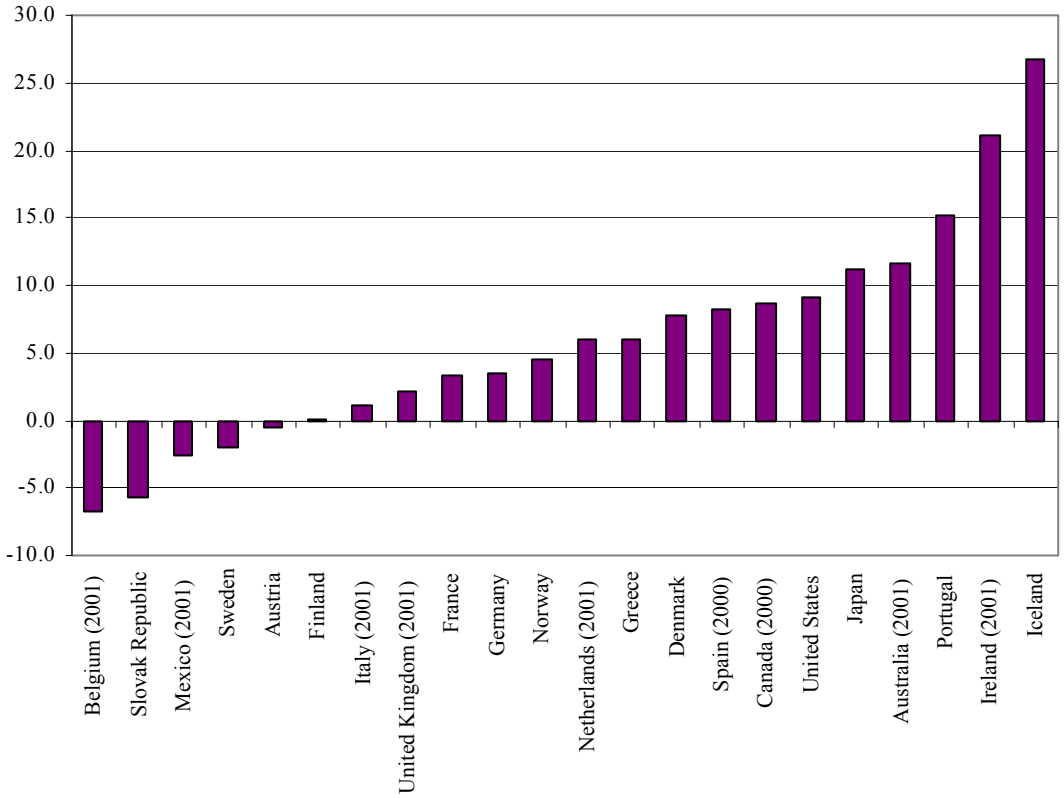
Figure 4.1: Health R&D (direct GBAORD) for selected OECD countries (2002)



Source: data from OECD 2003. NZ 02-03 calculations based on data from MoRST and Statistics New Zealand.

Note: This table does not take into consideration factors such as the differences in the overheads payment rate by research council in different countries.

Figure 4.2: Growth rate for health R&D (direct GBAORD) for selected OECD countries (2002)



Source: OECD 2003

Note: New Zealand is excluded here because it was not in the OECD tables.

At the gross level, the data appear to suggest the following conclusions.

- New Zealand in 1999 spent 0.04 per cent of its GDP on health research reported through Government budget expenditures. This amount was well below that of the USA and UK only two thirds of the expenditure by Australia and Canada (0.06 per cent) in the same year, but amounted to twice that of the Netherlands (0.02 per cent) and 2-3 times that of Sweden (note comments on Sweden below) and Ireland. New Zealand's expenditure was below the average for European Union countries (2001).

- Between the mid to late 1990s and early years of this century, life sciences became an important area for increased investment in research by government. Some countries rapidly expanded their health research capacity. Countries with annual growth rates in excess of 10 per cent included Ireland and Australia. Canada, the USA and the Netherlands experienced growth rates exceeding five per cent annually. Of the benchmark countries, only Sweden experienced a decline in funding, however this is largely an artefact of the OECD data set (see below).

OECD data evaluated

The validity of these conclusions rests on the comparability of the official OECD data. Such gross comparisons between countries can be misleading if the characteristics of their research systems are not taken into consideration. It is worthwhile therefore to examine the derivation of the data for the benchmark countries in greater detail (Box 4.3)

Box 4.3: Review of the limitation of OECD 'direct GBAORD' data for the benchmark countries and the United Kingdom.

Australia The OECD reports Australia's medical research funding as 0.06%GDP. This result appears to be on the high side if the NHMRC (the main funding body in Australia) alone is being considered. The 2001 result of 0.06 per cent of GDP would represent A$402.6m – whereas The Australian Government (Nelson 2003) reports A$247m and NHMRC (2003: 15) estimates the indicator to be about 0.035% of GDP. The latest data suggest that Australia has now climbed to nearly 0.05 per cent GDP for the NHMRC alone (NHMRC 2003). However, there are sources of direct funding other than just the NHMRC and so it is probably a reasonable estimate.
Canada The Direct GBAORD figure of 0.06 is quite close to our calculation of the CIHR budget plus other Federal Government programs.
Ireland The OECD reports Ireland's government medical research funding as 0.01 per cent of GDP. Based on data from the Health Research Board[40] of Ireland and the Central Statistics Office[41] of Ireland the apparent health research expenditure for 2001 was 0.013 and probably[42] reached around 0.015 in 2003.

[40] HRB (2003)

[41] http://www.cso.ie/

[42] In communications from HRB it is known that the budget for '2004 is EUR20.552 million, which represents an increase of 3-4 per cent on last year' and the GDP statistics were incomplete – therefore a conservative estimate of the average of the 2nd and 3rd quarter GDP was used to calculate 4th quarter GDP and thus provide a recent estimate for Ireland.

Netherlands

The OECD reports the Netherlands's public medical research funding as 0.02 per cent of GDP. ZonMw, the main medical research funding organisation, has a budget of €87 mill split between the following clusters.

Table 4.2: Funding clusters in ZonMw, 2002

Basic science and industrial innovation	(€32.7 mill.).
Research support for disease prevention	(€24.0mill.).
Support for research for 'long lasting care'	(€8.8 mill.).
Support for research and development for health care and cure including demand and societal factors	(€8.4mill.).
Support for research for quality and efficiency & effectiveness in health care and cure	(€13.0 mill.)

In general this level of funding would result in quite a low percentage of GDP for the Netherlands. However data on Dutch Government expenditure on medical research in 1997 looks to double the level of expenditure. If this structure remains accurate then the OECD data might be accurate.

Table 4.3: Health Research Expenditure in the Netherlands, 1997

	US$.mill.
Medical faculties	312
MHRC [medical and health research council]	60
Other governmental expenditures	67
Pharmaceutical industry	338
National charity funds	78
Total	855
Total health expenditure (trillion USD in 1997)	32.6

Source: Erica Hackenitz and Stéfan Ellenbroek of ZonMw.

New Zealand

For New Zealand, the OECD reports funding of 0.04 per cent of GDP[43] in 1999, which would equal $39.07 million. MoRST in its Progress and Achievements report (2003) does not itemise HRC funding for 1999, but for 2000-01 the Health Research Output Class was allocated $33.4 million (0.03% of GDP). The HROC has received $38.4 million (01-02) and $39.7m (02-03), representing 0.036% of GDP in 2002-03. For 2003-2004 the HROC class was allocated $42.2m from the budget. The OECD data perhaps includes the Marsden Fund expenditure on health research, which the HRC[44] has estimated to be approximately $6m. Therefore the New Zealand data reported by OECD may be accurate, although including more than just the funding for the HROC (HRC).

[43] GDP data from Statistics New Zealand website.
[44] HRC 2002 p10

Sweden

The OECD reports Sweden's medical research funding as 0.01% GDP, which is extraordinarily low by international standards. The Swedish Research Council's expenditure for Medicine was 382 million SEK in 2003 equal to 0.016 per cent of GDP (2002). This is reasonably close to the OECD estimate. However, it is important to note that in Sweden the university system receives significant stand alone funding. Statistics Sweden reports that government outlays for research in the medicine field of science is 3923 million SEK in 2003 or 0.15% of GDP. There would appear to be an order of magnitude difference between OECD and Swedish national data, which would put Sweden in the upper rank of public investors in health research. This conclusion shows the importance of considering 'other' sources of government funding in addition to 'direct GBAORD' (see Table 4.4).

United Kingdom

The OECD reports the UK's medical research funding as 0.1% GDP. This level of expenditure cannot be accounted for by the expenditure of the Medical Research Council alone. Official data (see Appendix 1) show MRC's budget as fluctuating between 0.035 and 0.04 per cent of GDP over the last 10 years, implying that MRC accounts only 40 per cent of government expenditure on health research. However, the UK as a large economy has complex array of public programs supporting health research, including some of the other Research Councils, and therefore and it is probable that the OECD figure is accurate.

United States

Direct GBAORD of 0.24 appears reliable. In 2004 the budget for NIH was US$28 bill.

Although the derivation of the data in Table 4.1 is sometimes unclear, it does not seem to be a fair reflection of government expenditures on health research for at least some of the benchmark countries (notably Sweden and the Netherlands). However, the OECD has attempted to compensate for the problems of research funding sources by adding in 'other' government sources of funding, which are indicated in Box 4.2 and described in detail in Appendix 5. As can be seen form Table 4.4, this addition has the effect of *promoting* benchmark countries, notably Sweden and the Netherlands, and other countries such as Germany, to significantly higher levels of expenditure. The OECD omits comparable figures for 'other' health R&D outlays for Australia and Canada. We have calculated proxy figures and included them in Table 4.4, but note that these data are not strictly comparable with the OECD-sourced data.. In the case of New Zealand, we cannot calculate a reliable 'Other' figure. However the total New Zealand health research effort in the universities (from all funding sources, not solely government) was equivalent to 0.076 per cent GDP in 2002.[45] This would place an upper limit on 'Other' of around 0.035 per cent of GDP (since the Direct Health GBAORD must be subtracted).

[45] Statistics New Zealand reported university health research expenditure of $93.3 mill. (Statistics New Zealand and MoRST 2003).

Table 4.4: Health R&D (direct GBAORD and 'other') for selected OECD countries (2002)

	Direct health GBAORD % GDP	*'Other' % GDP*	*Total (Direct GBAORD + Other) % GDP*
United States	0.24	0.01	0.24
France (2001)	0.06	0.14	0.19
Austria	0.01	0.17	0.18
Canada (2001) (AEGIS estimate for 'other') [46]	0.06	0.12	0.18
Sweden	0.01	0.16	0.17
Finland (2000)	0.07	0.08	0.15
Netherlands (1999)	0.03	0.12	0.15
United Kingdom (2000)	0.10	0.03	0.13
Germany (2000)	0.03	0.08	0.11
Denmark (2001)	0.04	0.04	0.08
Australia (DATE) (AEGIS estimate for 'other')[47]	0.06	0.053	0113
New Zealand (1999)	0.04	See text	0.06
Spain (1999)	0.03	0.03	0.06
Greece (2001)	0.02	0.03	0.05
Ireland (2000)	0.01	0.01	0.02

Source: OECD 2003 except as noted

Note. AEGIS estimates for Canada and Australia 'Other' category. The OECD estimates that New Zealand in 1999 had total expenditure of 0.06% GDP - see text.

What, then, is the most appropriate comparator for HRC and HROC in New Zealand – direct GBOARD, direct + 'other', or a third, adjusted figure? Table 4.5 summarises our judgements and comments on the data.

[46] Health expenditure data from Statistics Canada 2003 and GDP data from http://www.statcan.ca/Daily/English/040227/d040227a.htm

[47] Australian GUF RFCD Medical and health sciences $360,414,000 (ABS (2002) 8111.0 Research and Experimental Development Higher Education Organisations Australia 2000. GDP 2000-2001 = $671,120,000,000 (ABS (2003) 5204.0 Australian System Of National Accounts 2002 – 03 Canberra, ABS.)

Table 4.5 Most appropriate expenditure indicator for federally funded health research funding agencies like HRC

Benchmark country	*Appropriate comparator (Govt health R&D as of GDP)*	*Derivation and comments*
Australia	0.06	Direct GBAORD: is probably a fair estimate, even though NHMRC alone is somewhat lower.
Canada	0.06	Direct GBAORD of 0.06 is quite close to the CIHR budget plus other Federal Government programs.
Ireland (2000)	0.01	Direct GBAORD: HRB has a small budget.
Netherlands	0.15	Direct GBAORD + other funds: because there are multiple national agencies involved. This may overstate the situation but is better than the 'direct GBAORD' funding figure.
New Zealand (2002)	0.036 - 0.04	Current estimates by AEGIS. HRC by itself is about 0.036 but including estimates of other health related (SPI, Maori and Marsden) = about 0.04.
Sweden	0.17	Direct GBAORD + other funds: because of the funding structure for the universities.
USA	0.24	Direct GBAORD: because the federally funded NIH receives its funds direct each year from the US budget. Other Federal funding in the USA is comparatively small.
EU average	0.05	Direct GBAORD: The EU 15 consists of a number of small and larger member countries. This appears to be a fair estimate of an average for the group of countries.
OECD average	0.10	Direct GBAORD, despite some limitations: Data on 'other funds' are unavailable. *The reader should note that most countries spend less than this average indicating the significance of the larger players i.e. the USA and the UK.* The OECD average would be higher if expenditures in countries such as Sweden and the Netherlands had been fully included.

- **If the OECD data selected in Table 4.5 are an appropriate comparator of government expenditure on health research then it can been seen that New Zealand's public investment in health research is under-funded by comparison with most of the benchmark countries.**

- **Of the *benchmark countries* only Ireland invests a lesser proportion of GDP in health research funded by Government than does New Zealand.**

The OECD data allow a calculation of the additional investment that would be required to bring New Zealand to a funding level comparable with that of particular benchmark countries or groups of countries. In 2003 dollars, an increase in health research funding by

an amount equivalent to 0.01 per cent of GDP would represent an additional investment of $12.7 million.[48]

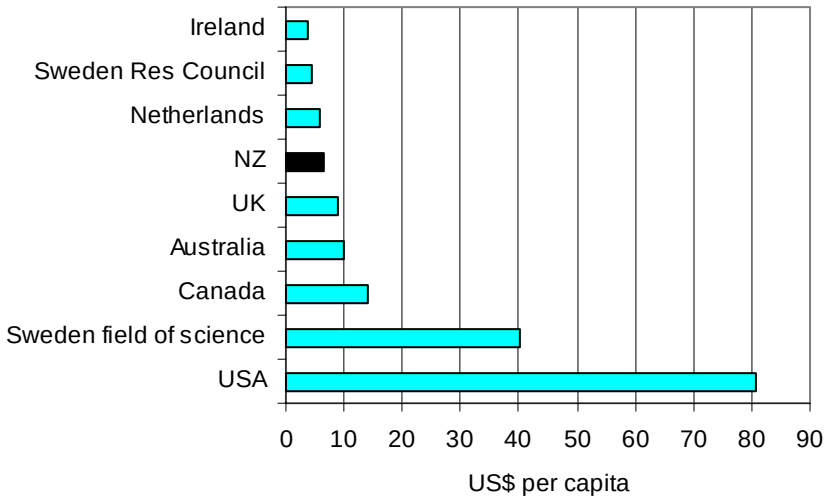
It is essential to note that the comparisons above do not take into account an important difference between New Zealand and the benchmark countries. The level of overhead costs funded through HRC grants has in recent years grown to be substantially higher than in comparable research councils in the benchmark countries. This must be factored into any comparison of current funding levels and of target levels for future funding. Before considering the issue of cost structures, however, we examine other possible comparisons of government health research funding.

Per capita comparisons of health R&D funding

Another way of developing funding indicators is to compare countries on the basis of per capita expenditure. Figure 4.3 shows per capita funding on health research for selected OECD countries on the basis of the most recent year available. Except for Sweden, these data cover funding through the research councils only. These data are not ideal, but due to a lack of internationally comparable 'field of science' data they are the most directly comparable. The data have a tendency to bias the comparison in favour of New Zealand because the other countries have very substantial other sources of funds apart from research council funding.

The data for the Netherlands is only on the basis of research council (ZonMw) expenditure and with the inclusion of 'other' funding would be higher. As discussed above, in the Swedish system, much of the research money is channelled through the universities and so the research council and total expenditure are included in the separately on Figure 4.3.

Figure 4.3: Health research funding per capita for selected OECD countries (PPP USD)



[48] Based upon New Zealand's GDP of $127 bill. for 2003.

The data in Figure 4.3 show a similar ranking to those in Table 4.1. On the basis of per capita funding, the UK's rank falls below that of Australia and Canada, and is fairly comparable with that of New Zealand. The UK data appear the most out of line. MRC funding in 2002 was equal to US$519m but for a population half as big again as Canada, whilst Canada was investing US$437m. Such a calculation is supported by Billig (2004).

- **On the basis of Figure 4.3, New Zealand would need to expend US$10 per capita to bring health research investment to the level of Australia, and US$14 per capita to bring it to the level of Canada (a doubling of expenditure).**

National research grant schemes and Health R&D

As has been noted already, funding for health research has been increased rapidly in some countries. This has translated into substantial increases in funding per capita to health research councils in some benchmark countries, notably Canada and the UK, in the past few years (Billig 2004).

Another way of understanding the national priority given to health research is to analyse it within the context of other research competitive grant schemes with each country. These are often managed through research councils such as HRC.

Such analysis has a few difficulties. The two primary ones are:

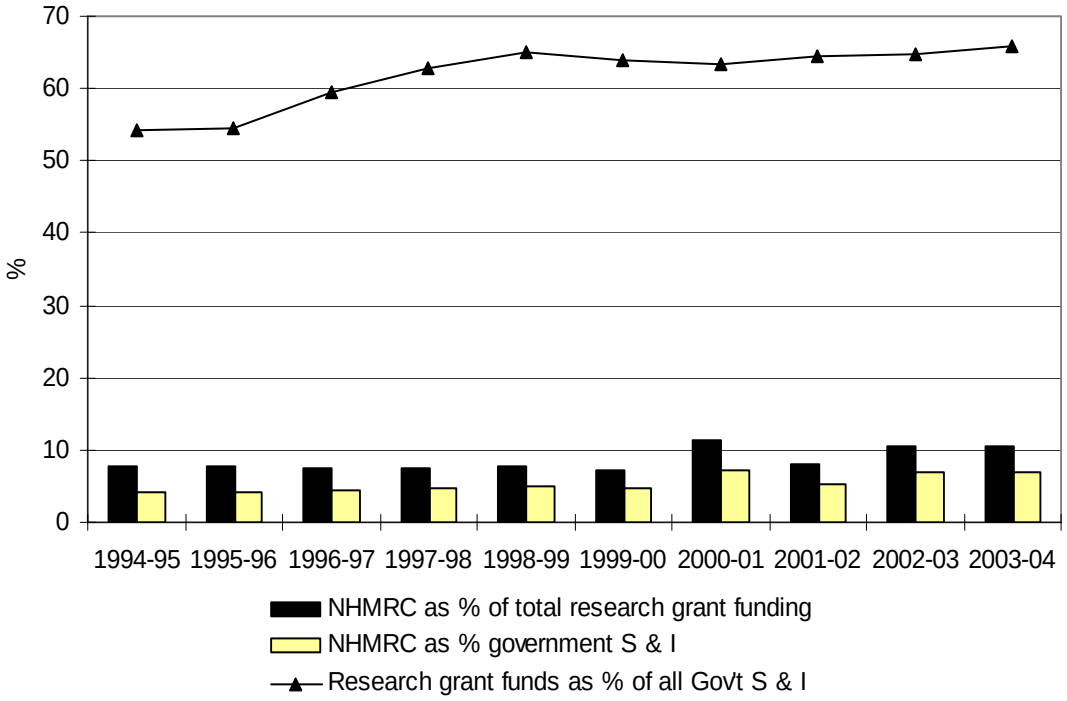
1) identifying 'relevant' research grant schemes; and
2) understanding the context of each system of funding – particularly as mechanisms for general university funding (GUF) vary markedly.

The following section examines trends in competitive grant and research council funding of health research in a few benchmark countries.

Australia

The research granting organisations are reasonably easily identifiable in Australia, the research councils do not generally pay high overheads rates and GUF is still a significant source of funding for research expenses (see Chapter 3). In Australia, the NHMRC has a lesser share of Federal grants and science and innovation investment than its counterpart in New Zealand. As can be seen from Figure 4.4 the NHMRC's share has grown, especially following the 1999 Wills Review, as has the government's overall emphasis on competitive grant funding for research.

Figure 4.4: Australia - NHMRC funding as a share of federal government research grants

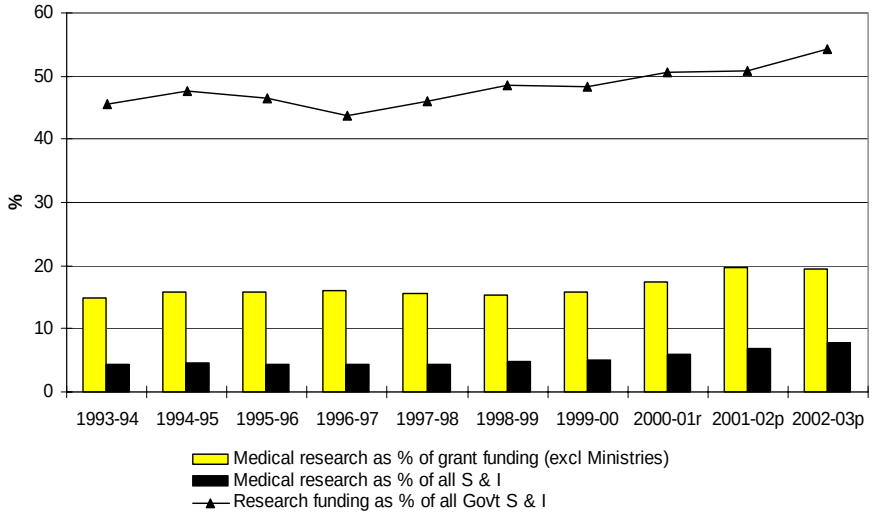


Notes: see Appendix 1.

Canada

In Canada, health research expenditure is on the increase as a percentage both of federally funded research system grants and as percentage of government investment in science and innovation (Figure 4.5). Interestingly, health research makes up about the same share of overall government support for research, science and innovation in Canada as it does in Australia but the health research share of research grants is much higher in Canada than in Australia.

Figure 4.5: Canada: funding of health research grants



Notes: R&D grants - see Appendix 1. (p) – provisional.

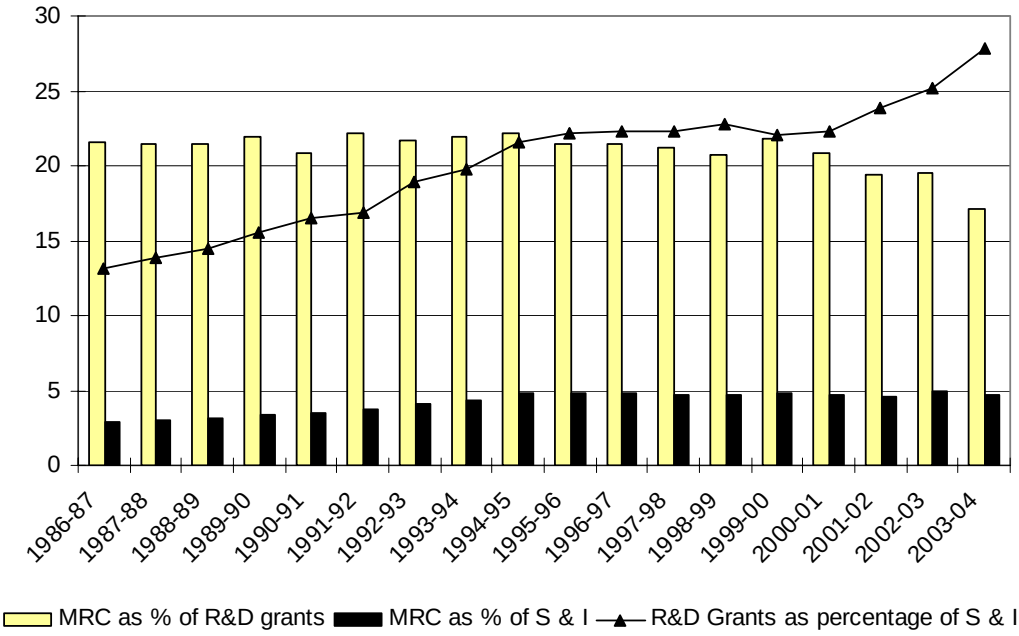
Sweden

Sweden's research council for medicine receives a budget share fairly similar to that of Canada at around 16 per cent of total research council funding (see Appendix 1).

United Kingdom

The United Kingdom an interesting case where grant based funds have been rapidly rising as a share of total government expenditure on S&I funds. In part this reflects a move towards full cost funding through the research councils, as is the trend in New Zealand. The Medical Research Council (MRC) has received substantial increases in funding in recent years, yet its share of Government Research grant money has dropped as a proportion over the last few years (light bar in Figure 4.6). This is despite the fact that MRC's share of Government expenditure on the science and innovation having been about the same since the middle of the 1990s.

Figure 4.6: United Kingdom: MRC funding within R&D structures



Sources and notes: see Appendix 1.

Comparison with New Zealand

It was not possible to construct a comparable time series for New Zealand. However, Table 4.6 provides a broad comparison with the other benchmark countries of gross share of competitive grant funding and of government budget for science and innovation.

Table 4.6: Health research share of research grants

	New Zealand HRC	Australia NHMRC	Canada CIHR	Sweden Medical in SRC	UK MRC
Health research as % of research grants	15.5	10.5	19.5	16.0	17.0
Health research as % of S & I	*8.1	7.5	8.0	n/a	5.0

*Notes: * See Table A1.4 for components of Vote RS&T included Figure is equivalent to the other reported comparisons in this section.*

New Zealand's health research expenditure as a share of research grants is lower than that of Canada, but higher than in Australia. HRC's expenditure as a share of Vote RS&T is on a par with Government support for science and innovation in Canada and Australia. These examples suggest that HRC's funding is a comparable proportion of the federally funded research system as its counterpart agencies research councils in the benchmark countries. This analysis is not inconsistent with the earlier evidence that New Zealand is under-funding health research in comparison with other countries because it is known that New Zealand overall government expenditure on R&D is *less* than for comparator countries.

However, before drawing such a conclusion definitively, one needs to bear in mind the cost structures build into various research councils' grants. By 'cost structure', we mean the level of direct costs (such as the salary of researchers) and indirect costs (overheads) of research projects that are funded by the research council, rather than through other channels, such as general university funds.

Evidence on trends in New Zealand Health research expenditure

HRC makes the point that taking into account the costs associated with the full cost funding (FCF) of projects, funding to the organisation as represented by the share of GDP has been in long term decline. The funding in real dollar terms (when full costs implementation and inflation are excluded) has been static since 1996-97. This evidence is corroborated by data on R&D performed in New Zealand's higher education sector.

The Ministry of Research, Science and Technology published R&D statistics for the year 1997-98 (MoRST 1999). It reported R&D expenditure by the socio-economic objective *health research* for that year in the universities of $94.1m (or 0.097 per cent of GDP). However for higher education R&D by the same socio-economic objective for the year ended 31 December 2002, Statistics New Zealand, reported expenditure of $93.3 mill, or only 0.076 per cent of GDP (Statistics New Zealand and MoRST 2003).[49]

Therefore expenditure on health R&D within the universities has fallen in absolute terms and as a proportion of GDP between 1997-98 and 2002. Using the Reserve Bank of New Zealand's[50] inflation calculator, for health R&D to have kept pace with inflation during this period expenditure would have had to have stood at $104.4 mill. in 2002. This represents a 'shortfall' of $11.1 million at 2002 prices.

Cost structures

Macro level indicators of funding are an important measure of comparative activity but they can be deceptive. Hidden by the comparisons are the actual cost structures faced by the different agencies. Research buying power is greatly influenced by government policy towards the contestable grant funding and by the level of overhead and infrastructure costs built into the grants. There are two micro indicators that have been collected for this project to help identify the amount of research that each research agency obtains from its investment, taking into account other contributions of funding.

The results of a survey of the health research councils in the benchmark countries (Table 4.7) shows that the research purchase agencies in New Zealand, and HRC in particular, are being called on to fund a higher proportion of the full cost of the research they support. Or, to look at it another way, each dollar of HRC investment leverages fewer dollars from other public sources than would be the case in Australia or Canada. As support for full cost funding (FCF) is being introduced progressively, this is less of an issue for the benchmark comparisons than for future funding targets.

[49] On the basis of Dec quarter 2003 reporting of GDP by Statistics NZ: 1997-98 health research $94.1m (0.0967% GDP) [GDP $97.23b]; 2002 health research $93.3m (0.0759 % GDP) [GDP $122.8b]
[50] http://www.rbnz.govt.nz/statistics/0135595.html

- **Institutional overhead costs**. New Zealand's universities directly charge research granting bodies an overhead rate on research project salary costs. This overhead rate is developed from an auditable process but is on a 'full cost basis'. Internationally, the practice of charging projects at a full cost rate is rarely used and even having any on-cost component is not universal.
- **Chief investigator salary payments**. In New Zealand's system of full cost payments principal researchers are paid for their time on projects. In some systems these researchers are not paid out of project grants. As it would be expected that these faculty would have high direct salary costs and thus high overheads – including or not including payments for their time could significantly impact on project funds availability.

Table 4.7: Summary of research grant cost structure in selected OECD countries

Country	*Overhead charge rate*	*Chief Investigator payments*
Australia	Marginal costing but likely to increase	✓
Canada	0%	×
Ireland	10%	×
Netherlands	0%	✓
New Zealand	114+	✓
Sweden	30%	×
United Kingdom	46%, with proposal to rise to 65%	×
USA	Variable 50%av	✓

Source: The data for were collected from the individual health research councils in each country. Full text of the responses is at Appendix 2.

A current estimate of the implications of the implementation of full cost funding (FCF) in New Zealand is that by 2006-07 (when most grants will receive FCF) HRC would need to receive $16.5 million in additional funding **each year** than its current budget to be in exactly the same position. As this re-financing is already assumed, future international comparisons will show New Zealand's government health research investment increasing by about 0.01 per cent of GDP towards 0.05 per cent but of course *without* any additional capacity being created.

To maintain a real increase we propose that the funding target recommended in the current report be augmented by a further amount to cover the implications of FCF. In determining an appropriate loading, we use HRC's estimates. The estimate of $16.5 million represents an amount equivalent to nearly 40 per cent of HROC funds for 2003-04. We have therefore applied a loading of 40 per cent to suggested future targets for health research investment in New Zealand. Should the estimates of the cost of FCF prove incorrect, we note that our recommendations are for a real increase in funding over and above the implementation of FCF on health research grants.

Conclusions and recommendation

Three main observations can be made on level of health research funding in New Zealand by comparison with the benchmark countries.

- Taking all the comparisons into account, New Zealand's current level of public investment in health research is **substantially lower** than almost all the benchmark countries. Of these countries only Ireland spends less, proportionally, on health research and development.

- Most of the benchmark countries are **increasing their investment** in health research – some by as much as 20 per cent per annum. By contrast, there is no evidence of sustained increase in health research investment in real terms in New Zealand in recent years Indeed, national data on health research in the university sector provide clear evidence of a decline in New Zealand's expenditure on health research, as a proportion of GDP.

- The cost structures of many of the comparator health research funding agencies are lower than those of the HRC. The move towards full cost funding (FCF) will lead to a spurious improvement in the 'health research as a per cent of GDP' indicator. Given that the overall envelope of health research funding available to the HRC in New Zealand is already comparatively smaller than in most of these countries, the cost structure in New Zealand means that the HRC's capacity to purchase high quality health research is all the more limited.

Any target for investment is arbitrary. In the New Zealand case the problem of suggesting a target increase is particularly difficult. Even were the HRC to receive no more funds beyond FCF supplementation, the international comparisons would improve - but with no additional research being done than is now being conducted. Our estimate is that FCF supplementation alone would make it *appear* that New Zealand funding eclipses the level of the EU (15) and trends towards that of Australia within a couple of years.

On the other hand, we know that (a) the level of research funding reported in the universities fell by over $11 million in real terms between 1997 and 2002 and that (b) the EU (15) average (which includes a basket of small and large countries) for direct funding is about 0.01% of GDP ($12.7 mill.) higher than the current New Zealand position. Under normal circumstances, we consider that the EU (15) average (*not* an average based on the expanded EU (25) as it will soon become) would represent a reasonable benchmark because of the mix of developed economies it represents. The OECD average is too strongly influenced by the high funding nations such as the USA and there are problems identifying the real level of government expenditure in other potential benchmark countries such as the Netherlands. We have chosen Government health research outlays as a proportion of GDP as the appropriate indicator for comparison, since a figure related to GDP is the best measure of a country's ability to invest. On this basis, New Zealand's investment would need to increase by about 0.01 per cent of GDP from the current level of about 0.4 per cent. However, as noted above, a target of 0.05 per cent does not allow for the effects of FCF of research grants by HRC, either in the current comparison, or in any future increase.

We therefore suggest that (a) the target be set as a *real increase* of 0.01 per cent, and (b) a loading be added to this target to cover the probable costs of FCF on the increase.

We **recommend**

- **that MoRST adopt a *target* budget for the HRC's Output Classes (the HROC + Māori OC [health] + SPI OC [health]) of a *real increase* of 0.01% of GDP over the next four years.**

We note that for the year 2003 such a target would have required a ***real increase*** above full cost funding supplementation of about $17.8 million, calculated as $12.7 million (0.01 per cent of GDP, 2003) + $5.1 (40 per cent loading on this sum to cover FCF on the new funds). By itself, an increase of $12.7 million above FCF would *not* in the current funding model deliver the full benefits required.

Noting the lack of currency of the New Zealand health research data published by the OECD and the implication of full cost funding on international comparability, we recommend:

- **That MoRST review the procedures for reporting current health research expenditure data to the OECD and for ensuring that these data are presented in a manner that provides for international comparison of research effort.**

In the medium term the health research performance indicator reports should compare funding on the basket of small to medium sized countries and including non-agency public sector funds (ensuring Sweden is included). We expect that over the next few years with increased interest by WHO (via its Department of Research Policy and Cooperation)[51] and the OECD better data will become increasingly available. During 2003, alone, there was a noticeable improvement in data availability.

[51] World Health Organisation. Health Research System Analysis Initiative, Department of Research Policy & Cooperation. http://www.who.int/rpc/researchsystemsanalysis/index.en.shtml

5. The Vision: Where is New Zealand's health research going?

Strategy and Priority Setting

As noted, the bulk of health research investment in New Zealand is channelled through the HROC, almost all of which is allocated by the HRC. The HRC's strategic planning processes and nominated priorities are thus central to any consideration of the appropriateness of national health research goals and the resources required to achieve them. This section attempts to assess the future characteristics of the health research system as defined in the Health Research Council's Strategic Plan 'Vision 2008', the benefits to New Zealand arising from its implementation the scale of resources likely to be required for its implementation.

Before considering these strategies in detail, it is important to recognise that HRC's strategies sit within a broader environment of planning firstly for RS&T and secondly for health. The funding envelope for HRC is set by MoRST through the budget allocations to the output classes that HRC has access to. These are primarily HROC, but also include the Māori Knowledge and Development Research OC and Supporting Promising Individuals OC. Clearly, the lever of funding for specific activities has a strong influence on overall priorities, for example in supporting HRC's Māori Health Research portfolio.

The second influence on HRC's priorities is the policy of the Ministry of Health. The Minister of Health transmits an annual 'letter of expectations' to the HRC. The HRC is also required to furnish an annual Statement of Intent (SOI) for the financial year, which the Minister is required to approve. The SOI describes the output classes in place and the performance indicators used to measure their achievement. While these are potentially substantial ways that the Minister can steer HRC's priorities, they have not been used in this way. The way that the Ministry of Health has more strongly influenced HRC's priorities is through the New Zealand Health Strategy (NZHS), although the Strategy barely mentions the contribution of research.

- **HRC has adopted its research priorities following broad consultations between the Council, MoRST, MoH, District Health Boards and their constituencies. There may be benefit in making this process a more explicit one (HRC Strategy 1d) and setting HRC's priorities in the context of a national 'Health Research Strategy', coordinated by HRC**

HRC's Strategic Plan 'Vision 2008'

IMPORTANT NOTE: The details of HRC's Strategic Plan documents are CONFIDENTIAL to the Council until release of the final Plan

Introduction

HRC's Strategic Plan 'Vision 2008', which is currently under development, sets out strategic goals for the Council. These are:

1. Maximising New Zealand's potential to conduct **excellent and relevant health research**
2. Fuelling the engine for health R&D through **investment in people**
3. Bridging the gaps in **careers** for health research
4. Ensuring that health research contributes to **improved health and wellbeing** for all New Zealanders
5. Taking advantage of New Zealand's **unique opportunities**
6. Using **cross-sectorial research partnerships** to produce knowledge of benefit to New Zealand
7. **Global connections**: strengthening networks, adding value and raising New Zealand's profile
8. Ensuring that the **economic benefits** of health research are captured for New Zealand
9. Ensuring New Zealand has the **infrastructure** to support high quality **health research**

Appendix 3 shows the goals, strategies and performance measures in detail (note that this is based on an earlier draft of 'Vision 2008').

The sections, which follow, consider the future characteristics, resources and benefits implied by each goal. The comments made are intended to assist in achieving the maximum benefit from the strategies proposed by HRC.

GOAL 1: Excellent and relevant research

Focus on excellence and relevance

The health research councils in all the countries surveyed were set up with mandate to select and fund the highest quality research. In any field, poor science is a poor investment, nowhere more so than where it may affect human health interventions. The study found no evidence in any country of health research councils reducing the level of peer assessment of research proposals or of reducing the emphasis on excellence. The HRC's comprehensive peer review system for assessing the scientific excellence of research proposals is central to maintaining the quality of research funded and is of a clear and continuing national benefit and receives strong endorsement from the research community. The system is of necessity resource intensive, as international experts play a large part in the assessment. However the operation of best practice assessment and evaluation processes within HRC is also vital in leveraging funding from other sources, such as international partners.

- **There is clear benefit to New Zealand in the high standard of assessment and evaluation for health research set by HRC and this assessment process should be maintained.**

In common with overseas health research councils, HRC is now giving greater weight to the relevance and application of research that has been assessed as of high scientific excellence. The HRC has four statutory committees, two of these – Biomedical Committee

and the Public Health Committee – being disciplinary based. In the past these Committees have apparently operated largely independently. Over the last few years, the HRC has introduced an investment portfolio model (Research Portfolio) to augment the discipline based allocations of funds. The portfolios currently in place are shown in Box 2.2. (Chapter 2).

HRC's Research Policy Advisory Committee (RPAC) has overseen the development and modification of the portfolios. Each portfolio has a Portfolio Advisory Group (PAG) that, along with wider consultation, has helped shape the scope of each portfolio. An RPAC member commented that the portfolio process has improved priority setting, but that there were few 'discretionary' funds available once funding for core outputs had been allocated. The HRC retains the two discipline based committees.

The benefits of this approach are several. First, it has made it possible to implement specific national research priorities, such as that for Māori Health Knowledge and Development. Second, it has allowed HRC to establish and monitor output oriented priority areas, such as Health Sector Management. Third, in the process, it has engendered greater collaboration between the biomedical and public health activities of the Council.

HRC's development of outcome oriented investment portfolios is in line with international developments. It could be argued that HRC portfolios are not yet as 'outcome oriented' as they could be – i.e. they comprise both social objectives (potential outcomes) and health disciplines (which do not necessarily specify particular outcomes). This is the case for comparable agencies overseas, such as the virtual institutes within Canada's CIHR (see Appendix 1). We would expect that all health research councils will increasingly move towards investment programmes based on health outcomes in line with the trend towards 'application based' research structures.

HRC's dual assessment process of quality (through discipline based panels) and application (by reference to criteria of relevance) is also in line with models overseas. Such a process was in early use by the US NIH and has been subsequently adopted by many health funding agencies. Most overseas research councils have retained and strengthened their discipline based panels for the purpose of assessing research excellence. Australia's NHMRC is an example where discipline based assessment panels have replaced former regionally based panels.

The move to outcome oriented Research Portfolios has entailed resources for advisory committees (RPAC) and an extensive national consultation process that has underpinned priority setting. Monitoring and modifying the portfolios in the future will require similar consultation and analysis which can be justified by the benefits of an outcome focused strategy.

- **HRC's move towards investment portfolios focused on health outcomes is in line with trends in the benchmark countries and should receive continued support.**

Investment in Research Portfolios

'Vision 2008' argues for increased funding for all of the nine investment portfolios (Strategy 1a). HRC notes that, with the exception of Rangahau Hauora Māori , all Portfolios are significantly over-subscribed with research deemed fundable. Across all portfolios, the 2001/02 funding allocations covered 55 per cent of fundable proposals while in 2002/2003, this figure was only 40 per cent. The success rates for fundable proposals was lowest in Non-Communicable Diseases, the largest Portfolio, where the proportion funded fell to 27 per cent in 2002/03 compared to 56 per cent in the previous year.

The argument for any increase in funding relies variously on justifications of quality, importance for broadly based health research capabilities or capability building and national relevance of the research. For example, an increase in funding for research into Non-Communicable Diseases could be justified on the basis of providing stability of funding for an existing, productive community of researchers as well as the relevance to national priorities in combating diseases such as cancer and diabetes. Increase in funding for Māori Health Research is driven by a specific national research priority and identified funding. The case for funding Pacific health research rests on an identified need, and the requirement to build research capability to meet that need.

- **HRC's case for increased funding would be strengthened if the Council set quantitative or qualitative targets and timelines for some of the key performance indicators. For example, the target numbers of fellowships or scholarships, or the number of world-class research groups identified who were likely to be eligible for Programme Grants.**

In discussions with researchers, much emphasis was given to 'success rates' in winning HRC grant funds. Most Research Portfolios are significantly over-subscribed with research deemed fundable by the HRC. The data suggest that the Council could spend at least *double* the current annual budget on high quality research – a level not uncommon in the benchmark countries. Success rates in grant applications do appear to have declined, fuelling, as one researcher commented, 'the cycle of disappointment'.

The study surveyed research councils in the benchmark countries about their grant application success rates. Their responses are summarised in Appendix 2, Table A2.3. It is difficult to draw robust conclusions based on year-to-year data from one research council, let alone make valid international comparisons. Factors influencing outcomes include the quality of the pool of applications (which may be affected by perceptions of the success rate), and whether there is a 'first stage' culling process (as in the Netherlands ZonMw), which of course inflates the 'second stage' success rate. It is not common for research councils to set target success rates. The Netherlands STW effectively does so for 'complete' (i.e. second stage) proposals. Several councils have a policy of a fairly high rate for scholarship applications (often around 50 per cent of qualified applicants). For research grants, it seems common for research councils to fund around 40 per cent of proposals that make it past the first stage of assessment. Raw success rates (percentage of total applications) vary widely

The view was put to us by researchers was that HRC's support for biomedical research is 'teetering on the sub-critical' and cannot provide the prospect of a reasonable chance of continuing funding for the best researchers. The most compelling argument therefore is that such increase is required to retain existing research capability in the country and to build up the research teams and facilities that would attract expatriate and overseas researchers. The HRC in its Strategic Plan argues for an increase of the order of $10.5 mill. in 2004-05 to achieve sustainable outcomes. The HRC has the assessment processes in place to handle some increase in grant applications that might flow from such an increase. Substantial resources may be wasted on preparing and assessing high quality research proposals for which there is little prospect of funding.

- **An increase in resources for HRC's current research project grant, research programme grant, and scholarship and fellowships schemes is necessary to ensure the sustainability of New Zealand's capability in world class health research.**

A discussion of the level of funding required to restore the 'health' of the health research system may be found in Chapter 8. In summary, there is no simple calculation. The case for increased funds therefore rests on international comparisons of the level of funding that overseas agencies with a similar health research funding mandate require to achieve their objectives.

Where there are specific national priorities that HRC is required to fund, the solution adopted for Māori Health Research is probably the most appropriate – i.e. specifically earmarked funding, at least in the 'development' phase of support.

Investment in Research Programmes

HRC's Research Programmes are six-year contracts that support research teams with a track record of high achievement recognised by their peers, in contrast to the three-year research project contracts. HRC Programmes are awarded to well-established, world-class research groups. The Programmes amalgamate at least three project grants and can provide assistance for multidisciplinary teams, for research training and for international collaboration. The initial requirement for success in winning three separate projects is an uncommon practice overseas, and could be a potential disincentive to some applicants.

According to HRC, funding for research programmes of research is highly oversubscribed. In the2002/03 funding round 16 programmes were submitted but only six were funded due to lack of resources. The only portfolios that did not include a programme component were Health Sector Management and Services and Communicable Diseases. The twelve programme components in Non-Communicable Diseases suggests that there is greater critical mass of well-established research teams working on issues of primary relevance to this portfolio (such as asthma, cancer, diabetes and bone disease).

HRC has set a target for programme funding at 50 per cent of total grant expenditure, provided this does not reduce the funds available for project grants below $20 mill. per annum. Currently 33 per cent of grant funding is allocated to programmes. This implies an absolute increase in programme funding, which requires specific justification. Certainly,

overseas research councils have been moving to increase the proportion of longer term funding they provide to established health researchers. In Australia, the NHMRC budgets about one-fifth of grant monies on research programmes. By some standards, then, the proportion of HRC programme funding is already relatively high.

HRC's research programme funding provides longer stability of funding for research groups, and provides opportunities for synergy between interrelated, often multidisciplinary projects. They also provide greater opportunity for research training activities. However, we believe there would be a stronger case for increased programme funding if the research programmes had a character that was clearly differentiated from project grants. Practice in other countries has been to provide programme grants to established teams of researchers that are not tied to specific projects, but rather to an agreed research theme. Options for consideration could include four or five year project grants, 'conversion' of several projects to a programme grant, rolling programmes reviewed after 3, 5 and 7 years, and programme grants for broad themes of research. A further use of programme funding is to promote the formation of new, multidisciplinary research teams.

- **HRC should give further consideration to the relationship between its project and programme funding, and between programme grants and the proposed National Health Research Centres scheme.**

Development of competitive advantages

The development of competitive advantages means adequately supporting world-class research groups as identified by their peers. There is clear benefit in identifying and provided support to such teams – the Dunedin Multidisciplinary Study is an oft-quoted example of world recognised research investment.

- **The Strategy could usefully indicate how world class research groups are to be identified (e.g. through bibliometric studies, through the PBRF assessment exercise or otherwise) and what preferential support these groups should receive.**

Practice in some countries (e.g. Canada) has been to tie success in one research funding competition with matching funds from another source. This is one model that HRC could follow for the identified research groups. This strategy perhaps better fits under Goal 4.

Working with other agencies

A coordinated and collaborative approach to the strategic management of all New Zealand's health research effort is clearly essential given the small scale of the system. The other countries reviewed operate with a similar range of funding organisations. What is noticeable however is the greater extent of formal interagency cooperation and collaboration than appears to be the case in New Zealand. There is a more convincing case for HRC to be the lead agency in relation to assessing and approving clinical trials, on the basis of the expertise that the Council commands and the scientific rigour required for

effective trials. Again, FRST is starting to fund extensive clinical trials, so the issue is one of coordination and collaboration.

- **We do not believe a substantially increased concentration of research funding through HRC would automatically produce benefits in terms of the coherence and coordination of health research. Rather the challenge is to make the various funding agents and policy departments work more effectively together within a plural system, as is the case in many of the benchmark countries.**

The performance measure proposed (per cent of health research funding flowing through HRC) is not as appropriate as indicators that measure the degree of cooperation between purchase agents.

GOAL 2: Investment in people

Re-establishment of fellowships and scholarships

In 2003-04 the HRC is offering the following career development awards:

(i) Masters Scholarships for Māori and Pacific graduates
(ii) PhD Scholarships for Māori and Pacific graduates
(iii) Postdoctoral Fellowships for Māori and Pacific graduates
(iv) Sir Charles Hercus Health Research Fellowship

As part of the requirement to pay increased overhead costs to the universities (see Chapter 7) several other types of fellowships and scholarships formerly funded by HRC have been transferred to the universities. We consider that, while universities may use these funds for fellowships and scholarships, HRC has a crucial role in supporting health research careers (including technical staff and clinical practitioners) and should be the prime purchaser for scholarships and fellowships in health research. The overseas research councils studied all provide forms of direct support for researchers in their careers. There is some evidence that the level of support is increasing. In Australia, for example, the NHMRC proposes to increase the proportion of funding for 'people' from 21 per cent of its funds in 2000, to 30 per cent in 2005 (National Health and Medical Research Council 2003c).

Prior to the introduction of full cost funding, HRC spent up to 10 per cent of its budget on scholarships and fellowships. The comparable figure for Australia's NHMRC is closer to 20 per cent. HRC estimates the resources required to reinstate the scholarships and fellowships nominated in 'Vision 2008' as around $1.2 mill annually.

- **HRC requires additional funding to invigorate its fellowship and scholarship programmes (including biomedical and public health training awards). Overall, the target for the proportion of HRC expenditure on 'people' needs to be set at 20-30 per cent of budget if it is to reach norms common in some of the overseas research councils studied.**

Career development programmes for Māori and Pacific peoples

HRC has made substantial progress in both of these national priority areas, particularly for Māori career development programs. The HRC has identified serious Pacific research workforce capacity issues which the Council is trying to address thorough its partnership strategies and strategies such as the new Pacific Placement Programme (dependent of funding increases in 2004-05) and Summer Studentships. These are innovative attempts to develop capability without lowering standards required of health researchers. They deserve appropriate earmarked funding.

- **There is benefit in having separately identified funding for both Māori and Pacific health research career development programmes.**

Linkage of fellowship and research funds

HRC proposes to provide grants of up to $125,000 over three years for successful scholarship and fellowship applicants. This approach is fairly common in the benchmark countries, where success in one competitive funding round provides either parallel funds or the 'entry ticket' of eligibility for them. At the institutional level, an example is in the allocation of Canada Research Chairs (see Chapter 3).

GOAL 3: Health Research Careers

HRC's aim is particularly to retain and attract experienced mid-career researchers. The intention is to offer a senior fellowship, similar to Australia's Burnet fellowship; to expand the Sir Charles Hercus Fellowships (4 year postdoctoral) to at least eight fellows by 2005; and new awards for Māori PDFs and a clinical research fellow. HRC also funds the Foxley Fellowships and Summer Studentships.

There is obvious benefit to New Zealand in each of these proposals. For example, a Burnet Fellowship has brought Nobel laureate Peter Doherty back to Australia. The Burnet fellowships commenced in 2001.

The level of investment required for 'star' fellowships is quite small in relation to the potential benefit. Outlay is around A$0.4 mill. per fellowship year in the case of the Burnet scheme. Evidence suggests that expatriate researchers are attracted not by salaries, but the opportunity to work with world class colleagues and facilities. Rather than announce 'generic' fellowships, as the contestable pool of researchers is small, a more effective strategy may be to target particular individuals and negotiate a package which comprises salary, facilities and supporting researchers and staff. The estimated cost is $0.8-1.0 mill. per annum per fellowship.

We understand that HRC is no longer funded for public health and biomedical Career Development Awards. The tertiary institutions are now responsible for career development in these areas. As indicated under Goal 2, these fellowships should be brought back under the control of HRC, with additional funding if necessary.

GOAL 4: Improved health and well-being

There is clear benefit in linking HRC research investments with national health goals in relation to medicine, public health and disability/rehabilitation. Indeed, this must be one of HRC's major goals. There is a strong nexus between HRC's priorities and national health planning, but one which could be made more explicit to both policy makers and the research community.

The New Zealand Health Strategy (NZHS) comprises 61 overall objectives and 12 'priority health gain areas'. These include: Reducing smoking; Improving nutrition; Reducing obesity; Physical activity; Suicide; Alcohol and illicit drugs; Cancer; Diabetes; Oral health; Violence; Mental illness; and Child health services. Surprisingly, the Strategy makes scant mention of the contribution of research to achieving its objectives. However, we were told that the daughter strategies in preparation for several of the main priority areas do or will address the role of research in their achievement. Some of these are more detailed policy documents. Others are active programmes of R&D: the Mental Health R&D Strategy, developed through HRC and MoH, is an example of the latter.

The HRC has the statutory responsibility to advise the Minister of Health on national health research policy. Section 34a of the Health Research Council Act 1990 requires that 'the Council shall set up formal mechanisms of liaison to develop a national health research strategy for New Zealand'. The HRC notes that the NZHS is a good measure of national health research priorities because it was based on an extensive consultation process in which a broad range of stakeholders, including the HRC, participated. Certainly, the government's health strategy has been 'fundamental' to the HRC's development of the research portfolios in the sense that the Council has aligned its strategies with the NZHS. However, there are a number of important research areas that are not covered by the NZHS, such as evaluation of health sector reforms. Conversely, there may be health priorities that do not require substantial research before action can be taken.

We **consider** that there is a strong case for a published **national health research strategy** (or strategies) to complement and extend HRC's existing nine strategies, which refer to the Council's own activities.

- **·We consider that there should there be more explicit articulation between the New Zealand Health Strategy (NZHS) and health research priorities. This could be achieved by nominating specific research priorities/needs within future NZHS or through separate published national health research strategy(ies). We recommend (see Recommendation 4) that HRC should coordinate these strategies. This would require adequate resources for HRC to carry out this task.**

GOAL 5: Unique opportunities

The strategies under this goal address two concerns. The first is to ensure the application of health research by and for Māori , Pacific peoples and particular target groups in society. These may be termed 'needs driven' opportunities. The second is to exploit New Zealand's competitive advantage in particular areas of world class research, such as foetal

development models and very long term epidemiological studies ('strength driven'). The rationale and benefit for each is rather different, as are the strategies that could be effectively adopted. In the first case, the benefit lies in improved health outcomes for significant population groups, social equity, and expanding the pool of qualified researchers from different cultures. HRC comments that research capacity appears to be a major barrier to funding more research of relevance to Pacific peoples and people with disability. Capacity and capability building strategies are therefore appropriate, which is different from the requirement in established areas of strength. The issue of indigenous health research is further discussed in Chapter 6.

In the second case the benefits deriving from a competitive advantage in health research may be commercial exploitation, or scientific reputation. (See also GOAL 1: Development of competitive advantages).

- **HRC should collaborate with FRST to provide advance warning of those health researchers working on technologies or research outcomes with potential for commercial exploitation.**

GOAL 6: Using cross-sectoral research partnerships

The HRC's Partnership Programme is being used effectively to deliver cross-government solutions for evidence-based health practice. This Goal also recognises the need to work together with Foundation for Research, Science and Technology (FRST) on development of co-investment opportunities and to recognises and capture of sector convergence opportunities which flow from discoveries in the life sciences sector.

These strategies reflect a 'top down' approach to cross sectoral research partnerships, which is clearly an effective approach in areas of national priority and immediate user needs. The HRC's Partnership Programme has been used most innovatively and effectively to leverage funding from sources apart from the HROC.

Most of the benchmark countries have also established schemes to support 'bottom up' (research partner/user) driven cross sectoral research partnerships.

- **Support for 'bottom up' cross sector partnerships or centres is a significant gap in HRC's health research investment strategy, one which is likely to require substantial additional funding to rectify.**

This need could be met through support for National Health Research Centres (see Chapter 7) to complement existing CoREs and FRST consortia. HRC has indicated that it supports the establishment of National Research Centres in principle as a strategic initiative, but has indicated that it cannot provide funding support in 2003-04 given the current funding environment (HRC 2003e: 14). The issue of partnerships and cross-sectoral research support is discussed further in Chapter 7.

GOAL 7: Global connections

New Zealand's small size and geographic location mean that international collaboration is especially important. HRC is supporting international networks and partnerships through specific international initiatives in joint research funding, clinical trials and epidemiological studies, and through research programme grants. These initiative are appropriate and of benefit, but could be usefully extended. Given the scope for potential strategic linkages, they obviously require careful selection.

- **HRC should instigate an international collaboration grant scheme for individual health researchers and teams to complement the support and grants offered by MoRST and the FRST. These could be targeted for HRC project and program grant holders or more widely.**

- **Funds from the new 'Developing International Linkages' output class should be made available for this purpose.**

The estimated cost of these initiatives would be of the order of $0.5 – 0.75 mill per annum.

GOAL 8: Capturing economic benefits of health research

As currently stated, Goal 8 in relation to 'ensuring the economic benefits of health research are captured' would not be achievable without a substantial reorientation of HRC's activities. HRC's investments are undoubtedly essential to ensuring the health research capabilities that underpin economic benefit, and the Council should certainly invest in research that may have significant economic potential. However, under current arrangements, schemes that aim to derive direct economic benefit from research are managed by the FRST. This follows the practice in countries such as the Netherlands where support for near-commercial application is the responsibility of separate government agencies with specialist expertise. Collaboration between FRST and HRC towards this and other goals should be strongly encouraged (Appendix 3, Strategy 1d). We **suggest** that this goal be reworded to reflect current arrangements.

HRC notes that the majority of intellectual property arising from HRC-funded research in 2001-02 arose from contracts funded under the Biological Systems and Technologies, and Non-Communicable Diseases Research Portfolios. This emphasises the need for adequate funding to these commercial 'seed' areas of fundamental research. As indicated above, we see this as HRC's appropriate contribution to national economic benefit in medical biotechnology and other areas, not the support of 'near commercial' development (except in respect of clinical trials). Internationally, the trend is for 'commercialisation' agencies to provide support for academic researchers to test the economic potential of their research. An example is the 'BioPartner' programme in the Netherlands. Biotechnology is a field where innovative collaborations between research councils and more commercially oriented technology funding agencies are emerging. The new Stem Cell Centre of Excellence in Australia is an example.

- **HRC has a crucial role in supporting research with commercial potential and supervising clinical trials. These activities require close cooperation with other purchase agents, notably FRST.**

GOAL 9: Infrastructure for health research

This issue is discussed in Chapter 7.

Conclusion: the Future Vision

'Vision 2008' is a document that will be central to the development of health research in New Zealand over the next five years. HRC is to be congratulated on producing a strategy that is soundly based on analysis, recognises the particular contribution that the Council makes and is consonant with and responsive to the government's health and research priorities. We consider that the plan should be widely used and publicised, and could usefully form the basis for a broader **national health research strategy**, coordinated by HRC which covers not only the activities of the Council but all publicly funded health research in the country. This would require close collaboration between HRC and other purchase agents and policy ministries.

We found some evidence in our discussions that HRC's Strategy and the rationale behind it does not seem to be widely understood within the research community. 'Vision 2008' nominates nine Goals and more than 30 specific strategies flowing from these goals. We identify two types of goals, one of which is closely related to the Council's mission, and the second of which is essential in fulfilling that mission. These might be termed overarching and structural (or instrumental) goals respectively. It is not immediately clear from the document the relative importance or ranking that HRC attaches to each of the nine goals. We consider there would be benefit for HRC's stakeholders understanding of the Strategy if the Council were to structure and prioritise the goals within the Strategy.

- **We suggest that HRC consider presenting the Strategy in terms of overarching goals (or missions) and crucial structural goals, possibly such as shown in Table 5.1, and give consideration to ranking their importance.**

Each of these strategies has clear benefit for New Zealand. It is not however possible to quantify these benefits in advance and HRC will undoubtedly monitor their effectiveness and impact using appropriate performance indicators (see Appendixes 3 and 5) as the Council has with past investments (HRC 2002a). HRC's performance measures and evaluation practices are well developed and appear the equal of those we have examined in the benchmark countries. Chapter 7 addresses the specific question of appropriate performance indicators.

Table 5.1: Suggested overarching goals and structural goals for HRC

Overarching Goals	*Structural Goals*
Investing in **excellent and relevant** health research	Fuelling the engine for health R&D through **investment in people**
Ensuring that health research contributes to **improved health and wellbeing** for all New Zealanders	Bridging the gaps in **careers** for health research
Taking advantage of New Zealand's **unique opportunities** [in health research]	**Global connections**: strengthening global networks
Capturing **economic benefits** of health research	Ensuring New Zealand has the **infrastructure** to support high quality health research Using **cross-sectorial research** partnerships to produce knowledge of benefit to New Zealand

Effective implementation of the Strategy will require additional resources, some of which we indicate in this Chapter. The resources required to achieve some Goals (such as 'excellent and relevant health research) are not specifically quantifiable without reference to the level of funding that seems to be required to achieve similar goals in other countries. The question of an adequate level of funding to achieve the objectives is discussed further in Chapter 8, and summarised in Table 8.1.

6. Health research priorities for Māori and other priority population groups

Overview

Because of its treaty with Māori (The Treaty of Waitangi [Te Tiriti o Waitangi]) New Zealand Governments have arguably been more sensitive to the needs of the indigenous population than many other countries. Health statistics reveal that Māori and other population groups (such as Pacific peoples) in general suffer from poorer health than for the non-Māori population.[52] The Health Research Council has thus devoted significant effort in developing a health research capacity within the Māori community - *by Māori for Māori*, and is now extending its model to Pacific peoples.

The three 'New World' countries compared through the present study also have identified the health of indigenous populations as specific targets for health research investments. These are Canada, Australia, and the United States. In spite of specific investments through indigenous health programs in these countries health outcome disparities have persisted, and in some specific areas widened (NIH 2002). As a response to these disparities health research investment frameworks across all four countries have attracted considerable attention. This chapter reviews the strategic frameworks and structures in place for such investments.

Because of the differences in demographic structures in each country, specific community health issues, socio-economic position of minorities in the overall populations and the socio-political structures for dealing with 'minority' health policies it is problematic to make direct comparisons of levels of funding. For example, in New Zealand Māori represent 14.7 per cent[53] of the population (about 570,000 persons). In Canada 'First Nations' represent about 3 per cent of the population[54] (about 800,000 persons). Australia's indigenous population is estimated to be about 460,140 people, a similar overall number of persons to New Zealand, but only 2.4 per cent of the population, more similar to Canada. In the US American Indians and the indigenous people of Alaska (AIAN) are considered to comprise the indigenous population, but together, they comprise only 0.9 per cent of the U.S. population, but approximately 2.6 million persons. Not surprisingly these differences contribute to different proportions of funding within each health research system. However, it is helpful to review the comparative approaches to indigenous health research policies and, as far as possible, the outcomes achieved in terms of the strategic objectives.

By international comparison New Zealand has made significant progress in developing its Māori health research strategy. Māori health research has been identified as a high priority issue by the HRC for over a decade. Current information suggests that the complementary objectives of capacity building, and project, programs and partnership have begun to show good returns on investment.

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[52] Ministry of Health's *Maori Health* website http://www.maorihealth.govt.nz/cgi-bin/p/viewnews.cgi?newsid990594000,42195,

[53] http://www.stats.govt.nz/domino/external/pasfull/pasfull.nsf/7cf46ae26dcb6800cc256a62000a2248/4c2567ef00247c6acc256bf900106d00?OpenDocument

[54] http://142.206.72.67/02/02a/02a_009_e.htm

New Zealand, like some of the comparator countries described in this chapter, has also identified other priority population groups as part of their overall health research strategy. As this 'target group' strategy develops there are two areas where New Zealand might draw some useful lessons from other countries.

Australian health research investments and strategy for Aboriginal and Torres Strait Islander peoples

In Australia funding for health research to benefit Aborigines and Torres Strait Islanders (ATSI) is provided through a number of agencies. The National Health and Medical Research Council has recently put together its Roadmap document. In addition, funding is allocated through the CRC program, *The CRC for Aboriginal Health*, The Australia Institute of Aboriginal and Torres Strait Islander Studies (AITSIS) as well as funding provided through individual State Governments and the higher education system more generally.

Because of the multiplicity of agencies involved it is difficult to identify the total overall level of Aboriginal health research investments in Australia. The level of State Government expenditure is particularly difficult to determine because it is often provided through a range of state government programs.

The NHMRC has a number of legislated roles in terms of contributing to national indigenous health research policy. These include advising on government and the community on matters relating to, the improvement of health, the prevention, diagnosis, and treatment of disease and the provision of health care. The Council is also mandated to report on issues concerning public health and medical research and ethical issues relating to health. Within these roles the Council provides advice and recommendations to the Commonwealth on matters concerning, public health research and training, medical research and training and the application of the 'Medical Research Endowment Account'. These are essentially the same roles as the HRC performs in New Zealand.

The NHMRC released its 'Roadmap' for improving Aboriginal and Torres Strait Islander health through research in 2002. The Roadmap outlined what the NHMRC perceived as the issues for Australia's indigenous peoples' health and provided a proposed research agenda for improving the situation. A central plank in the strategy was a nominated target of 5 per cent of the Council's budget for expenditure on health research for Aboriginal and Torres Strait Islander peoples.

Roadmap of research

The proposed research agenda framework was comprised of six key elements. These are:

1. Descriptive research to identify patterns of health risk, disease and death. Information derived from this research is intended to inform the development of preventive action and treatment.

2. A research focus on the factors and process that promote good-health particular during the periods of pregnancy, infancy, childhood and adolescence.

3. A research focus on health services to describes the best means of delivering preventive, diagnostic and treatment.

4. A research focus on the association between health and related policy and programs that otherwise lie outside the direct influence of the health sector.

5. A focus on action research in previously under-researched areas concerning Aboriginal and Torres Strait Islander communities.

6. The development of the nation's Aboriginal and Torres Strait Islander health research capacity, with a particular emphasis on raining and practice for and by Aboriginal and Torres Strait Islander researchers.

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Outcomes Against Objectives

In 2003 NHMRC directed A$12.7 mill. or 4.2% of funds toward the above objectives. This was close to, but short of the target of 5 per cent target identified in the roadmap (Cunningham et al 2003). In terms of the overall target population this figure represents A$27.6 per head of the Aboriginal and Torres Strait Islander population. Of the A$12.7 million, 5.3 per cent (A$680,000) was spent on training and 4.6 per cent on public and population health (A$590,000).[55] A total of A$2.5 million (19.7 per cent of the A$12.7 million) was allocated to health research partnerships in mental health.

In summary Australia has a well structured research agenda that has been developed through consultation with indigenous populations and health research stakeholder groups. The 'Roadmap' identifies the need to develop indigenous research capacity but achievements toward this appear weaker compared to advances in New Zealand and Canada. Capacity building is clearly underway through many programs such as the Menzies School of Health Research, the CRC for Aboriginal Health as well as through the NHMRC. However, in Australia there appears a long way to go before Aboriginal health research can be defined in the same terms as Māori health research is in New Zealand. That is with Māori, for Māori and by Māori, as is set out in the framework that is used to purchase Maori health research in New Zealand eg Maori advancement and Maori development (explained in the HRC's Maori Health Strategic Plan and in the HRC's Investment Strategy).

Canada's research investments in First Nations and Inuit health

Despite improvements in some areas of indigenous health, First Nations and Inuit continue to live in poorer environments than the overall population. This disparity places them at greater risks and results in poorer health. The prevalence of chronic disease in First Nations and Inuit is high and appears to be increasing.[56] Although some advances have been made in the reduction of mortality and morbidity from infectious disease, the number of deaths due to accidents and violence, especially suicide, have risen[57].

[55] See Table MM, in Cunningham et al 2003.
[56] A Statistical Profile On The Health Of First Nations In Canada
[57] From http://www.hc-sc.gc.ca/english/budget/2000/firstnations.htm

Research agenda

Like Australia, Canada funds health research through a national funding body as well as through funding provided by the Provinces. There is a national strategic plan that guides indigenous health research. The plan is focused on targeting direct health research investments through institutes as well as building indigenous health researcher capacity.

CIHR funds Native peoples' health research directly through its 'virtual institutes' it also funds the Institute of Aboriginal Peoples Health (IAPH) to develop research capacity.[58] IAPH in turn is responsible for the Aboriginal Capacity Developmental Research Environments (ACADRE) centres which are intended to play a major role in encouraging the development of indigenous researchers.

The IAPH provides the lead in Canada for developing 'aboriginal' health research policy and funding strategies. Target health research investment areas include clinical research, public health and population research as well as clinical trials and research into health care service delivery. The Institute is also responsible for culturally relevant ethical issues and international studies into health research and health outcomes of indigenous populations world-wide. Canada is also a partner in a tripartite indigenous health research program involving Australia and New Zealand.

CIHR has several programs, including open competitions for industry-partnered, proof of principle, research, and training projects; and strategic competitions in priority areas identified in collaboration with other institutes. IAPH appears mostly to solicit applications for research grants in specific areas, such as privacy and aboriginal community-based research.

In Canada, as in Australia, it is difficult to identify total national levels of investment for indigenous health research. Data are available, however, for CIHR funding to Aboriginal Peoples. For the year 2001/2 this amounted to C$4.8 million and represented 1 per cent of the CIHR budget. Investment in grants and awards through IAPH amounted to C$320,321, most of which was directed toward capacity building.[59]

In summary CIHR contributes a comparatively small proportion of its overall budget directly to Aboriginal health research, but performs a key role in developing health research policy. It appears that provincial governments make significant investments but it is difficult to identify the total contribution from the provinces.

USA: American Indian and Alaskan Native (AIAN) health research

The health challenges of the AIAN population have been well documented. The population sub-group experiences lower life expectancy than other Americans. The chief causes of death are unintentional injuries, cirrhosis, homicide, suicide, pneumonia, and

[58] See for example http://www.cihr-irsc.gc.ca/e/institutes/iaph/8668.shtml.
[59] IAPH (n.d.).

complications of diabetes.[60] The US strategic plan for health in the United States calls for eliminating such health disparities and US federal agencies including research agencies are consequently required report on their contributions toward this objective.[61]

The major agency funding research for AIAN health is the National Institutes of Health. The central organization there is the National Center on Minority Health and Health Disparities, but grants and programs exist across the various NIH Institutes. The total NIH budget for health disparities research was estimated at US$2.9 billion in FY 2003, but the AIAN research component is only one part of this investment.
The budget of the Indian Health Service, which has responsibility for the delivery of health services and which does not have a significant research funding system was US$2.6 billion in 2001.

In 2004, NIH had somewhere between 300 and 500 active grants for research on AIAN health problems. These were of many different types, from standard grants, centres grants and training grants.[62] The NIH on latest available figures allocates 10.6 per cent of budget to the elimination of health disparities, a proportion of which is directed toward indigenous health research (NIH 2002).

NCMHD uses only three types of awards: a loan repayment program for training, and 'endowment' grant to eligible minority-serving institutions, which can be used for a number of purposes; and centres of excellence. The centre makes no standard grants.

NCMHD promotes minority health and leads, coordinates, supports, and assesses the NIH effort to reduce and eventually eliminate health disparities in the United States. [63] The Center supports basic, clinical, social, and behavioural research, promotes infrastructure and training, fosters emerging programs, disseminates information, and reaches out to minority and other health disparity communities. The overall budget is in excess of US$185 million. Three programs form the core of the investment strategy: a centres of excellence program, loan repayments for capacity building among minority health professionals; and a research infrastructure program for capacity building in 'minority' institutions. The NCMHD supports partnership initiatives involving several other agencies. There are also cross-cutting programs for minority health research initiatives across various NIH Institutes.

The Indian Health Service (IHS)[64] is an agency within the Department of Health and Human Services. It is responsible for providing federal health services to American Indians and Alaska Natives. The IHS is the principal federal health care provider and health advocate for Indian people providing health services to approximately 1.5 million American Indians and Alaska Natives who belong to more than 557 federally recognized tribes in 35 states. Consequently provides input to health research policy.

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[60] American Indian and Alaska Native Health (CBM 96-6). The data are for 1990.
[61] http://www.healthypeople.gov/.
[62] This list of grants was generated from the NIH database CRISP http://crisp.cit.nih.gov/crisp/crisp_query.generate_screen., using the terms American Indian, Native American, and Alaska Native, with stem expansion.
[63] http://ncmhd.nih.gov/default.html
[64] http://www.ihs.gov

The Native American Research Centers for Health

The Native American Research Centers for Health (NARCH) grants were established as a result of an ongoing collaboration between IHS and NIH. The NARCH initiative is aimed at developing a population of Indian researchers and health professionals engaged in biomedical, clinical, and behavioural research. Tribal partnerships with academic research centres are encouraged as a basis for cooperative competitive research bids on health conditions of importance to American Indian and Alaska Native people. IHS is responsible for the program overall with funding contributions from NIH's National Institute of General Medical Sciences, National Institute of Allergy and Infectious Diseases, National Institute of Drug Abuse, National Institute of Dental and Craniofacial Research, and the NIH Office of Behavioural and Social Sciences Research.

In summary, overall strategic planning and reporting on minority health research inputs and outcomes in the US is a comparatively new development. Government legislation in the US requires NCMHD to report to congress with recommendations for a methodology that the NIH can apply to determine the actual amount of NIH resources directed toward eliminating health disparities. This is an ongoing process but one which New Zealand might monitor closely in terms of identifying useful internationally comparable performance indicators.

While it is too early to identify outcomes from the US minorities strategies there is evidence of progress toward strategic reporting and monitoring for assessing progress toward the key goals: research; research infrastructure; and community outreach.

New Zealand investments in Māori health research

Improving Māori health has been identified as an important priority for the New Zealand health system.[65] As part of that process New Zealand's HRC has set in place a clearly articulated philosophy, policy and practice for the development of Māori health research capability. The strategy has been emerging progressively over the past decade and has been covered by two successive strategic plans 1998-2002 and 2004-2008 (HRC 2004a). The strategic areas for Māori health research development in this plan include:

- development of the ability of tangata whenua communities to undertake research projects;
- to ensure Māori health research is innovative and opportunities to contribute to economic goals are exploited where appropriate;
- to ensure Māori have the ability to engage in the debate on the development and implementation of new health research technologies;
- to ensure research collaborations with other indigenous peoples are fostered, and

[65] See Priorities for Māori and Pacific Health: Evidence from epidemiology, downloaded from the Ministry of Health's Māori *Health* website http://www.maorihealth.govt.nz/cgi-bin/p/viewnews.cgi?newsid990594000,42195

- to ensure Māori ethical issues are part of the debate and discussion on health ethics in Aotearoa - New Zealand.

This will be achieved through the HRC investment framework for Māori research.

- Investment in quality health research and related initiatives.
- Implementation of a programme of career development awards to build a trained Māori health research workforce.
- Development of strong and meaningful relationships with tangata whenua.
- Development of partnerships and strong relationships with health and research stakeholders to add value to HRC's investments.
- Identification and adoption of new health research relevant to improving Māori health and well-being.

The New Zealand HRC has devoted significant effort to delivering a conceptual model appropriate for the development of a health research capability for Māori and is now identifying actions for Pacific peoples. The framework for investment in Māori health research identifies three basic platforms for development: capacity building for a Māori research community; investigator led research for Māori health; and program partnerships for Māori health. The framework incorporates a national plan locating points of contribution from a variety of agencies and research output classes. The key agency in terms of planning and research purchasing is the HRC.

(Māori research for Māori and by Māori) amounted to approximately $4 million for 2002/3, approximately 7 per cent of the total HRC budget. Research funding can be classified in two ways. Firstly research investments through the Māori research portfolio (the HRC's research portfolio for Maori Health Research funded in the annual funding round is the Rangahau Hauora Maori Research Portfolio) Current investments in Māori Career Development awards amounts to $1.7 per annum. Many of these scholarships are for current PhD candidates. Since 1995 the HRC has funded 45 [66] PhD scholars, 13 of whom have graduated to date.

Another classification for reporting on Māori health research is 'research that contributes to outcomes for Māori '. A total of $12 million representing 26 per cent of HRC total expenditure can be counted in this category and includes HRC's contribution to the Māori research joint ventures with FRST and MoH. Total investments within these classifications is presented in Table 6.1. These data also show the progressive growth in investment in this portfolio area over the past six years. However, as discussed below it is important to be able to consolidate these gains in order to convert these longer-term investments into improved health outcomes for Māori .

[66] Data from presentation to evaluation team (HRC 2004d).

Research capability development is described as a progressive process initially through research that is relevant for indigenous populations to research through partnerships and moving toward research carried out by Māori for Māori (governance).[67]

Table 6.1: HRC expenditure (1998/99 to 2003/04) on health research and career development awards which contribute to outcomes for Māori [68] HRC expenditure ($M GST exclusive)

Program	*98/99*	*99/00*	*00/01*	*01/02*	*02/03*	*03/04*[69]
Māori Development Research[70]	1.14	1.29	2.15	1.90	1.85	2.56
Māori Advancement Research[71]	2.00[72]	2.00[5]	2.73	4.14	6.00	7.50
HRC – FRST Joint Research Portfolio[73]	-	-	-	0.13	0.45	0.70
HRC – MoH Joint Venture[74]	-	-	-	-	-	0.16
Total Māori Health Research	3.14	3.29	4.88	6.17	8.30	10.92
Māori Career Development Awards[75]	0.76	0.71	0.89	0.87	0.85	1.07
Total for Health Research & Awards	**3.90**	**4.00**	**5.77**	**7.04**	**9.15**	**11.99**
Total (%) [76]	12.3%	10.1%	13.9%	19.4%	24.4%	27.4%

Source: HRC, 2004

Consolidating and sustaining the Māori health research strategy

During the present evaluation a number of respondents expressed confidence and support in the way the HRC Māori research strategy had been developed and its application over the past decade. By devoting significant effort to workforce issues, the HRC is developing a pool of talent that will eventually be able to generate their own research proposals of relevance to their own communities and compete successfully for project funds. There is clear evidence that the capability development strategy is shifting from individual awards and grants toward more sustainable programs. During the past decade the graduate base has increased significantly and, according to the HRC, the number of fundable Māori

[67] HRC presentation to the evaluation team

[68] Expenditure which contributes to outcomes for Māori is inclusive of investments in biomedical, clinical and public health disciplines.

[69] $ for 2003/04 are HRC's projected expenditure based on contractual commitments

[70] Māori Development Research is primarily funded from Rangahau Hauora Māori Research Portfolio.

[71] Māori Advancement Research is funded from all HRC Research Portfolios except Rangahau Hauora Māori.

[72] Expenditure on Māori Advancement Research shown as estimate

[73] Table shows the funding with JRP administered by HRC

[74] Value of Joint Venture includes both HRC and MoH funds

[75] Māori Career Development Awards include Summer Studentships, Masters and PhD Scholarships and Postdoctoral Fellowships

[76] Percentage of HRC expenditure associated with Māori initiatives in Output Classes Public Good Health Research, Māori Knowledge and Development and Human Resource Development.

research projects has increased. A Māori Health Research Centre has recently been awarded funding in open competition.

The challenge for the future will be to maintain career structures and opportunities for promising new Māori researchers. As noted in previous chapters the overall level of funding for health research in New Zealand has not grown in real terms. Already a considerable proportion of fundable projects assessed by the HRC remain unfunded. Unless there is growth in the system overall the capacity to consolidate the gains already made in Māori health research can only be achieved at the expense of other areas. During the interviews for the present study attention was drawn to growing perceptions that Māori health research was already at the expense of other research portfolios. Increased competition for funding inevitably leads to these sorts of tensions.

We note that in comparison with other national experiences, the development and implementation of the Māori health research strategy has met with considerable success. However, urgent funding increases for the system overall are now required to consolidate the gains already made and reduce unproductive tension within the system.

Although Australia seems to be behind New Zealand in terms of capacity building it has, however, a well articulated set of priorities for strategic Aboriginal health research. This appears to be the main strength of the Australian *Roadmap*. As an appropriate pool of talent begins to emerge, HRC might consider developing a process that identifies strategic research that needs to be conducted in New Zealand. The HRC has already nominated such an activity within its plan for Māori health research (HRC 2004f). We endorse the approach marked out for these next steps, however, as noted above it will be difficult to establish achievable goals for this unless there is growth in the overall system.

- **In parallel with this strategic development we recommend that the health research coordinating committee proposed elsewhere in this report establish a set of performance indicators that, as far as possible, allow for international comparison.**

The HRC's research capacity building for Pacific peoples and other proirity population groups

The HRC has now begun to develop a health research capacity building framework for Pacific peoples. The Pacific peoples framework is constructed around research programmes that are *relevant* to this group, in *partnership* with this group and research that is for and by Pacific peoples (*governance*).

- **This framework appears thoroughly appropriate and we encourage the HRC to continue in this direction.**

Alongside Māori and Pacific, the HRC nominates other population groups (older adults, children and youth, and people with disability) for attention. It was noted during interviews with stakeholders that the disability category, in particular, is languishing. However, HRC's strategy and performance for these groups was not a focus for the present

evaluation. However, we draw attention to the need to monitor research outcomes for all target sub-groups and in particular, to identify the flow of benefits achieved for the health system most generally from research investments targeted toward such groups.

At present HRC is devoting considerable effort in developing research capability for Māori and Pacific peoples. However, HRC nominates a number of population groups, some of which such as the disability sub-group do not appear to have such well developed strategic frameworks. While these population groups remain a defined target for HRC's funding framework similar development strategies should be set in place with similar emphasis on building research capacity and evaluation measures.

7. Emerging Issues

In Chapters 5 and 6 the current status of the New Zealand health research strategy was discussed. A number of observations were offered including the level of funding required to meet the strategic objectives. Both Chapter 3 and 4 provided a base for comparing New Zealand's health research system with the investment frameworks in other countries. It was observed that while the New Zealand approach was consistent with international trends and indeed, in some areas, was at least equal to or leading international policy practice, there were some international lessons that could be drawn to improve the system. Our overriding observation from meetings with stakeholder groups in New Zealand is that there are some tensions in the system associated with the level of project and program funding available for health research. In part, this is also associated with recent changes in funding arrangements. While there was general consensus among health researchers that the HRC has developed an efficient, transparent and internationally comparable set of procedures for delivering funds, there were a number of issues raised as to how the overall health research system might be improved. That is the subject of this Chapter.

One of the key tasks set for the present evaluation was to report on whether the investment in the health research output class is managed through an appropriate policy and investment framework. Associated with this issue was the task of considering whether the Government's investment in health research should be managed by a single health research purchase agency. In coming to a position on these issues the present evaluation considered (a) the structural arrangement of purchase agencies; (b) coordination between agencies and output classes; and (c) the relationship between HRC, MoH and MoRST; and (d) the current status of collaborative research; and (e) the role of the higher education system in delivering outcomes from health research investments. Each of these issues is discussed below together with some recommendations for improvement.

Structural arrangement of purchase agencies

The New Zealand health research funding system offers a range of funding options for health researchers. The majority of funding is provided through the HRC. Approximately 60 per cent of all health research in New Zealand is purchased by the HRC, which is responsible for all of the Health Research *Output Class.* Other key purchase agencies that also contribute to health research include FRST and the Marsden Fund. It has been estimated elsewhere that around 5 per cent of FRST and 20 per cent of Marsden funding budgets also contribute to health related research (HRC 2002c). However, while HRC is clearly the dominant agency in terms of health research funding, research providers appear to be quite discerning in strategically exploiting various funding options. That is, they appeared to make quite sharp distinctions between the objectives and strategies directing funding from different sources. Thus, while both FRST and Marsden have missions and objectives that differ from the HRC and are responsible for different output classes, there is potential complementarity. However, there is also the potential to overlap.

In 2002 the HRC put forward a proposal to establish a single specialised health research agency (HRC 2002c). It was proposed that all 'health' research funds, irrespective of the RS&T goal (i.e. knowledge, social/health and economic) should be invested through a

single purchase agency. While the core objectives of HRC, FRST and Marsden are different there are clearly areas where there is overlap. The HRC refers to this overlap as the 'contested space'. However, based on our interviews, with stakeholders across the health research system and our observations from international experiences we believe that the contested space is a natural outcome of transgressing disciplinary boundaries in research. The HRC, like its counterparts overseas has moved strategically toward a multidisciplinary portfolio based strategic approach. Indeed by international comparison this has been effectively embedded in strategic planning, policy making and *ex-ante* research evaluation. The effectiveness of this shift from disciplinary to strategic objective was evident from some of the health research providers who, for different strategic reasons, had received funding separately from Marsden, HRC and most recently FRST. One researcher, in particular, noted that his career path from 'blue-skies researcher' to director of a biomedical company was possible only because of the range of funding available.

In addition to HRC, FRST and Marsden, there are various foundations that contribute to the overall health research effort. These include the National Heart Foundation, the NZ Lotteries Fund and the Medical Research Foundations. Underpinning NZ health research are the higher education, the hospital and health delivery systems. While the objectives and functions of these agencies are somewhat different they each contribute to the environment in which health research is developed and carried out. HRC and Marsden grants, for example, have underpinned the formation of a number of new biotechnology companies through the 1990s, while NERF grants have reportedly underpinned subsequent commercial development (HRC 2002b).

Thus health research in New Zealand, as in most other OECD countries, needs to be understood not as a single system but as the product of the intersection of various systems. An evaluation of the health research output class and the policies and strategic management that drive it need to take into account this inter-sectoral reality.

This multi agency approach is similar to other comparable countries. New Zealand, however, is a small country and this, as elsewhere, presents a challenge for determining appropriate concentration of investment in the various agencies and how the boundaries between agencies and programs should best be managed. In particular, questions emerge as to how policy is devised and managed, how it is monitored and coordinated. This boundary management not only concerns funding decisions but also the development, implementation and evaluation of the overall funding framework.

In Sweden, like New Zealand most research is carried out in the University sector. Basic medical research is funded through the SRC Medicine Council which in 2001 disbursed SEK 350 million for basic medical research and administered SEK30 million on behalf of other agencies. However, this was approximately only 10 per cent of total medical research expenditure in the higher education system. The Irish HRB has a comparatively small but growing medical research budget. The SFI in Ireland, which has two strategic priorities (biotech and IT), performs a complementary role emphasises the basic research building blocks: the scientists, 'keeping them in Ireland' and 'ensuring the health of the science system' (ICSTI 2003a).

A distinguishing feature of health research in New Zealand is the comparatively minor involvement of the private sector. Other countries faced with similar challenges, such as Ireland and Australia, has placed considerable emphasis on collaborative programs to build bridges between a multidisciplinary science base at universities and the private sector. The objective has been to create structures to involve the business sector more directly in the national health research effort. Australia has focused on the cooperative research centres as a mechanism for achieving this objective. In Sweden and Canada, where there is significant involvement of the private sector, collaborative grant programs are used to maintain a flow of new knowledge between universities and industry. In small economies where there is a need for government interventions to strengthen the role of a weaker business sector collaborative funding mechanisms are all the more critical.

- In the light of these observations we **recommend** (in Recommendation 1) the maintenance of diversity in the funding base provided through different agencies. However, we also propose an enhanced role for HRC in steering research policy, coordination, and evaluation toward strategic national goals.

There are three key issues we consider need to be addressed in order to ensure national benefit flows from this diversity:

1. the proportion of health research funding distributed through each purchase agency;

2. the level of coordination between agencies, strategies and reporting mechanisms; and,

3. the further development of common reporting indicators, taking into account the strategies and funding mechanisms of each agency.

Proportional distribution of health research funding

The HRC is now responsible for the entire Health Research Output Class, around $42 million, as well as approximately $2 million from the Supporting Promising Individuals Output Class and $2.2 million from the Māori Knowledge and Development Output Class. While definitive figures are not available for health research purchased through FRST or Marsden the HRC has estimated amounts of $15-20 million through FRST (New Economy Research Fund - NERF) and about $6 million for Marsden. Thus it can be estimated that HRC is responsible for around 66 per cent of government's health research purchase. It was pointed out to the evaluation team that HRC funds pure basic research in the Biological Systems and Technologies Research Portfolio and that in some cases research groups are funded by Marsden, HRC and FRST. From our international review this is a common experience, reflecting the multidisciplinary contributions of the biological sciences and the ebb and flow between basic and applied research. It is our view that a proportion of somewhere between 60 and 70 per cent of health research (broadly defined) through the HRC is appropriate and that the balance allocated through FRST and Marsden are appropriate proportions to allocate to innovation/new economy and pure basic research, respectively. By international comparison this appears an appropriate mix. As discussed below, the critical issue is to maximise coordination of investments and to maximise the

contribution of HRC in areas such as clinical trials where the Council has particular expertise and responsibilities.

The recent introduction of fully costing project and program grants, while an important development, places new responsibilities on universities for maintaining appropriate levels of creativity and flexibility. In this context the role of project and programme grants through the HRC, and to some extent Marsden and FRST, in offering complementary but diverse options for research investment, is all the more critical for maintaining a dynamic health research system in New Zealand.

- **A single research agency, responsible for funding all health research, broadly defined, would not be in the best interests of the New Zealand research system overall. However, we propose an enhanced role for HRC in the coordination, strategic planning and evaluation of health research.**

Coordination (between purchase agencies and output classes)

Maintaining diversity in funding streams and maintaining direction in strategic objectives requires coordination. A point to note from the Swedish system is that FRN maintains a strong policy and coordinating role across multiple funding options. In Ireland the SFI seeks an integrated approach by offering funding support for centres, institutes and equipment, project grants and partnerships. In cases where these various 'blocks' are funded through a single agency allocations can be coordinated within that agency. But where there are cross agency complementarities, such as between biotechnology and health research, there is a need for inter-agency coordination

In New Zealand the major focus of the HRC is on project grants with a complementary and growing emphasis on programmes and partnerships. While infrastructure, including personnel and equipment costs are required to be identified through the full-cost funding requirements, it is the universities that finally allocate the infrastructure resource. This raises the need to ensure coordination and reporting on final inputs and monitoring and evaluation outcomes. In particular we note a need to:

1. enhance coordination between the research purchase agencies whose investments contribute to health research; as well as,

2. coordination across other relevant Votes such as higher education and output classes such as Māori knowledge and development.

Our discussions with stakeholder groups suggest that while there is a level of coordination between agencies at a senior planning level, coordination is weaker at the program or portfolio level. Clearly some important advances have been made in strategic portfolio areas such as Māori heath and mental health. The challenge, however, is to press such strategic program development further.

- **In our view coordination could be strengthened both between purchase agencies and at strategic program levels by ensuring HRC more central in the development and coordination of the national health research strategy. This**

would require deepening the structural relationship between HRC, MoRST and MoH.

Proposals for achieving this are discussed below.

Enhancing the relationship between MoRST, MoH and HRC

The three key agencies concerned with health research and policy are HRC, MoH and MoRST. In essence HRC serves two interrelated but separate interests: national delivery of health services including public health research (MoH) and national science for underpinning advancements in science and innovation, including new insights into health and disease and health services (MoRST). While HRC currently makes a major contribution in all areas their lead coordinating role does not appear to be formally acknowledged. For example, while Statements of Intent are developed in collaboration with MoH and MoRST and are signed off by both responsible Ministers this does not necessarily constitute a national health research strategy. Further, there does not appear to be any formal coordinating structure in place to specifically manage cross agency contributions to health research.

- **We recommend that MoRST should establish an interdepartmental health research coordinating committee including MoH and Education. HRC should have a lead role in the committee.**

Further to our recommendation for an enhanced coordinating role for HRC we note a need for their more direct engagement, together with MoH and MoRST, with the higher education sector, FRST and Marsden. During our interviews with stakeholders there is a perception that HRC is to some extent 'remote' from implementation agencies. Although this may be perception more than reality, effective coordination requires confidence at all levels. Some researchers, during the evaluation meetings, offered the view that the location of HRC in Auckland inhibited interagency coordination proposing that relocation to Wellington would improve the situation. In considering this issue we note that a review of the feasibility of relocating HRC in Wellington was carried out in 2000. While that review did not recommend a move to Wellington it did draw attention to a potential increased capacity to 'influence change', 'pick up information' and be 'involved in policy and strategy development discussions' that such location might offer (Calverley 2000). We believe that the formation of the health research coordinating committee proposed above will assist HRC in further developing this capacity.

Indicators for monitoring and evaluating health research

There is a range of internationally accepted indicators for assessing the quality of research. Typically these include publication counts, citations and international awards. The HRC has a well developed peer review system for *ex ante* and to some extent *ex post* research evaluation. There was virtually unanimous confidence expressed by researchers in this part of the system. However, in reporting on relevance and contributions to strategic objectives, New Zealand, like other countries, is struggling to establish indicators, appropriate for application across all agencies, for assessing outcomes and impact against strategic objectives. HRC appears to be well advanced, by international standards, in developing

portfolio based indicators and is contributing to the WHO global project on evaluation of national health research systems. The task ahead is to put in place a system of indicators (covering everything from inputs and resources through to outcomes) that can be applied systematically by all agencies and institutions contributing to health research, and that can be reported regularly. We note that while comparator countries are also struggling with this task there has been considerable progress toward this goal, particularly in the US, UK and the Netherlands.

The HRC's Progress and Achievements Report identifies the considerable work in the development and application of input and output indicators already under way for monitoring and evaluation of HRC's research investments. Appendix 5, reporting on terms of reference 3 and 4, make extensive use of these indicators. Case-studies and additional survey work also contribute to the assessment of health research outcomes. This work stands up well against similar work carried out in the benchmark countries. The progress already made by HRC in monitoring and evaluating health research could be further enhanced by providing the Council with a clearer structure and mandate for coordinating health research evaluation across the system and the design of reporting systems.

- **We recommend that the coordinating committee proposed above should have a specific mandate to coordinate and develop a national health research reporting strategy and develop performance indicators for monitoring system wide outcomes and impact against national strategic objectives. The HRC should provide the lead role in this activity.**

Some further suggestions for consideration and action are proposed in the concluding section of this chapter.

Supporting Collaborative Research

New Zealand is experimenting with various models for collaborative research. The current purchase agency arrangements, which are organised to provide support for basic-fundamental research (Marsden) strategic-public good research (HRC) and commercially applied research (FRST), or support to a particular sector (CoRE and PBRF) carries the potential to create competition and counter-productive boundaries as different approaches develop.

The Education Minister established the Centres of Research Excellence (CORE) Fund in 2001. Funds of $38 million were allocated over 4 years, with an additional $20 million for capital asset purchases. The principal objectives of the fund are 'to promote excellent research, undertake research that can contribute to New Zealand's future development and undertake research that incorporates knowledge transfer activities in training'. Seven Centres have been funded, with no current expectation of more. Two of the centres support health or biomedical research (Table 7.1)

Table 7.1: Core Centres of Research Excellence in Health

Centre	*Host Institution/Partners*	*Operational Funds*
Centre for Molecular Biodiscovery	University of Auckland	$8,900,000 over three years Capital Funds: $4,314,043
National Centre for Growth and Development	University of Auckland; University of Otago; Massey University	Operational Funds: to be negotiated Capital Funds to be approved

Source: TEC

Internationally, research policy is increasingly emphasising research activities that contribute to economic and social outcomes. This is certainly the case in New Zealand, where, for example, MoRST's Output Class approach reflects the requirement for the RS&T system to 'catalyse and accelerate economic, environmental and social development' (Minister of Research Science and Technology 2003).

Hand in hand with this focus on socio-economic outcomes comes an organisational change in the way that research is carried out. Put simply, the organisational forms that were effective for disciplinary based academic research and for applied research in large manufacturing companies' laboratories no longer work. What has changed? There are many factors at play, including the distribution of knowledge production (through mass tertiary education), the globalisation of business, the nature of emerging technologies and the facilitation of distributed knowledge intensive collaboration through information and communication technologies.

International experience shows that research is increasingly being carried out in organisational forms built around cross-sectoral (government, academic, private) and transdisciplinary teams with well-defined national social, economic or environmental objectives in mind. These teams go beyond 'applied research' in the accepted sense to span fundamental research and the applied knowledge.

Two influential models have been developed to explain the institutional configuration of knowledge-based innovation systems that can be observed in many countries today. The 'triple helix' model of university-industry-government relations advanced by Etzkowitz and Leydesdorff premises that the university can play an enhanced role in innovation in increasingly knowledge-based societies. Gibbons and his co-authors propose a Mode 2 of knowledge production which they term 'science in the context of application'. This contrasts with, and appears to be supplanting, traditional Mode 1, that is, internally focused scholarship controlled by strong disciplinary peer groups.

Each of these models implies a challenge to the traditional research structures. As a result, new and unfamiliar forms of organisational arrangements are emerging in universities and elsewhere. These have been variously termed 'hybrid' or 'parasitic', depending on the analyst's perspective. Both description has an element of truth. Collaborative research centres are hybrid in the sense that they embody some of the culture and processes of all partners. But they are also 'parasitic', in the sense that their existence depends both on the maintenance of the 'host' institutions while at the same time changing the character of the host institution.

A trend in support of collaborative research arrangements is clearly evident in New Zealand science and research policy. In the universities, several CoRE have been established. The HRC has a new and expanding Partnership scheme. The objective behind this scheme is similar to many overseas agencies, for example, the Irish partnership program. However, the mechanism for driving the focus and funding of partnerships in New Zealand is somewhat different. The Irish and Swedish approach to research funding is to engage the research providers, as far as possible, in determining the focus of research. The HRC project and program grants certainly follow this trend as they are submission based. FRST is also developing its model of research consortia.

Increasingly, then, health research support is built around interdisciplinary, cross-sectoral research centres with a focus on the application of the research, funded for 5-7 years. New Zealand cannot afford to be without such centres in health research. To some extent they are emerging, through the CoRE programme, thorough FRST's consortia, and by the initiative of individual research groups and universities. This in itself is evidence of a gap in the current investment system. HRC must be involved in the development of such centres. Their themes could be 'investigator driven' or nominated. In many benchmark countries, national centres are being jointly funded by several research councils. Networked Centres of Excellence in Canada and Cooperative Research Centres and Centres of Excellence in Australia are examples – see Chapter 3).

HRC's Partnerships and Joint Ventures appear to have been very effective in marshalling both funds and research expertise around defined research priorities. This innovative arrangement works extremely well where the HRC has an unchallenged mandate to pursue these priority areas, for example where they reflect key national priorities for health.

As a general approach to collaborative research, however, we see several potential issues with the current HRC Partnership scheme. First, while the choice of researcher is fully contestable, the choice of priorities for funding is not necessarily so. Current priorities are determined by the degree to which the HRC is able to identify appropriate stakeholders, funders and health issues that are amenable to research led solutions to pursue. While we have no grounds to question the effectiveness of the existing Partnerships, HRC's Partnerships appear to have been very effective in marshalling both funds and research expertise around defined research priorities. This innovative arrangement works extremely well where the HRC has an unchallenged mandate to pursue priority areas that reflect key national priorities for health. However, HRC could be challenged on why it selected a particular topic rather than an alternative one with equal potential As the partnership program develops we note a need for on-going planning and targeting of the programme. A 'priority setting exercise' would help ensure the most effective alignment between national research capabilities, funding support and the application of research outcomes.

- **HRC should instigate a consultative priority setting exercise for future Partnership/Joint Venture investments that involves a wide range of stakeholders including researchers, policy agencies, other potential funders and the health industry. The exercise should consider both the feasibility of research and the potential outputs and outcomes of the investment in the research.**

Second, overseas experience suggests that cooperative research has a successful outcome when both the researcher and the user of the research are involved in defining the problem and the solution. As noted above, there is substantial international experience to draw upon in the construction and management of collaborative research organisations (see Chapter 3). It is important to note that schemes such as the Australian CRC Program support both industrially oriented and public good research. In the latter category, the CRC for Aboriginal Health involves partners including universities, State government health departments and Aboriginal organisations such as the Central Australian Aboriginal Congress.

We consider that MoRST should explore with HRC, FRST, the Ministry of Education and RSNZ the potential benefit of establishing a new cross-cutting arrangement to support long term university-industry/user cooperation in health research. This may require a new National Collaborative Research Centres Output Class under Vote RS&T. HRC would be the primary purchase agency for health related centres and purchase agencies would jointly fund Centres where the Centres met the objective of several purchase agencies. Some co-funding would be required from Centre partners.

We **recommend** that:

- **HRC should develop proposals for a National Health Research Centre grant scheme, complementary to those funded by CoRE and FRST, for consideration by MoRST. The adoption of this recommendation should be on the basis of HRC receiving additional funding and should not draw on existing funds.**

Without prescribing the form of such a scheme, it would be 'bottom up', 'proposal driven' collaborative research support scheme where researchers and potential users develop proposals for assessment and support by HRC. We expect that the Research Centres (which could be physical or virtual) would be (i) application oriented, (ii) involve interdisciplinary and/or inter-institutional collaboration, and (iii) include cross sector partners (academic, business – where appropriate – and CRI). Centres should be awarded stable long term funding (5-7 years) subject of course to periodic review of performance. Some element of co-funding by the partners in the centres should be required.

We do not intend by this recommendation to imply that HRC should have its own version of the Technology for Business Growth scheme that supports business investment in technological development run by FRST. Rather, we suggest complementarity that will assist businesses to buy into some medical research partnerships to boost resources and the spread and speed of innovation.

Health Research Infrastructure in the Universities

Almost all health researchers are in the university system. As a consequence university research policy has an implication for health research activities. This situation parallels experiences in countries such as Sweden, the Netherlands and Ireland.

HRC project and programme funds are fully contestable, i.e. any qualified researchers can bid for them. In practice, few Crown Research Institutes are involved in health and medical research. Researchers in New Zealand's universities thus carry out the great majority of publicly funded health research. A strong relationship exists between HRC and the main universities with capabilities in health research: the University of Auckland and the University of Otago. For example, the HRC allocated about 80 per cent of its project and programme funding to these two universities in 2003-04 and is the single largest external research funder for the University of Otago (Richards 2000). The independent Malaghan Institute of Medical Research is located in the Wellington School of Medicine and has close links with the University of Otago.

As a result, any changes to HRC funding have substantial implications for university health researchers, and changes to the structure of research support within the higher education system may have a significant impact on the management of HRC's funds.

Three notable changes have occurred in recent years in the arrangements for funding university research. The first is the application of full cost funding, the second is the establishment of a Performance-based Research Fund (PBRF) for academic research, and the third is the establishment of Centres of Research Excellence (CoRE). A further issue is that of provision of capital infrastructure (equipment, buildings, major facilities etc) for health research.

Full cost funding

Government policy requires the purchase agencies to move towards full funding of the research they support by providing for investigators' salaries, salary on-costs, project direct costs and an appropriate level of institutional central overhead costs. The policy applies to new contracts only. Universities have set the level of institutional overheads, at differing rates. For example, at the University of Auckland, the rate is now 121 per cent of salary costs, while at the University of Otago the rate stands at 114 per cent. These rates are based on actual costing exercises, subject to audit by Audit New Zealand and reviewed every three years. HRC has agreed, following negotiations with institutions, to increase the level of overheads included in project and programme grants from zero in 1996-97 to 85 per cent in 1997-98 and 103 per cent in 2003-04. These increases have contributed significantly to the growth in the average cost of a project funded by HRC, which has risen from $127,000 in 1996-97 to $847,000 in 2002-03 (although the average is skewed by several very large projects).

HRC's budget growth has not increased at a rate sufficient to cover these costs. The accumulated shortfall is estimated at around $5.5 million and without supplementary funding will increase by $5.5 annually. While full cost funding has now been implemented by HRC and adjustments made to transfer funds to cover the new requirements, this has not provided for any growth in project and program funding. As a consequence, the HRC is funding a smaller proportion of 'fundable projects'. Thus while there is now more accountability for the overall cost of health research, it was pointed out to the evaluation team this has been in parallel with a reduced opportunity to adequately fund the top end of New Zealand's health researchers.

HRC is ultimately responsible for the effective application of funds from HROC provided to the universities, and is required to report on outputs gained from these funds. In order to enable the HRC to fulfil this obligation there will need to be supporting obligations placed on the universities. In order to ensure these changes adequately support the infrastructure underpinning health research in universities it will be necessary for the internal allocation of research funds and facilities within universities to be closely monitored.

International practice

International practice varies very widely as it is contingent on the funding model adopted for research activities within the higher education sector. This ranges from funding research almost entirely from block funding to the universities through the education ministry (a model that is less common than in the past) to full funding of all project costs via separately budgeted grants from special research granting agencies. In practice, most countries operate a variant of the 'dual funding' model where both streams of research funding contribute. The practices of HRC's sister research councils overseas are summarised in Appendix 2. While there are moves in traditionally 'marginal funding' agencies such as the UK MRC and Australia's ARC and NHMRC to fund a proportion of full costs, the level of overhead costs being mooted is around the 40-45 per cent level, not the 100 per cent plus in place in New Zealand. We also observe that agencies that fund overheads (not necessarily the research council itself) usually require that application of the funds be assessed through a range of performance indicators, which the universities agree to report upon.

Our **recommendations** for enhancing health research infrastructure at universities are as follows.

- **The government should accept the principle that the HRC should receive full budget supplementation for any increase in costs arising from the 'full cost funding' policy. We understand that the Ministry is aware of the position that HRC is facing in respect of full cost funding and is considering the issue favourably.**

- **The HRC should maintain discussions with the universities to ensure that full grant costs are effectively applied to the infrastructure and facilities required by health researchers. The universities should be obliged to report on their use of these funds, against agreed performance indicators.***

* Further to our proposals for coordinating research evaluation through an interdepartmental health research coordinating committee we suggest that an overview of university infrastructure funding be available to this group.

We were advised that the full cost funding policy allows for arrangements of fully costed projects to be co-funded by the HRC and the host institution (or other partner). This should be encouraged where appropriate.

Performance-based research funding

The government's 2002 Budget announced an Integrated Funding Framework for higher education, an integral component of which is a Performance-based Research Fund (PBRF) to be introduced progressively from 2004. This arrangement allows the newly established Tertiary Education Commission (set up in 2002) to separate research funding from the student-centred funding of the universities and to reward the better performing institutions. The fund is aimed at:

> rewarding *researcher excellence and excellent research*, defined in terms of: producing and creating leading-edge knowledge; applying that knowledge; disseminating that knowledge to students and the wider community; and supporting current and potential colleagues to create, apply and disseminate knowledge. (Ministry of Education 2002)

Education Ministry funds for research and research training will be transferred to the PBRF by 2007. The PBRF pool is made up from a 'clawback' from enrolment-based funding of around $114 million with about $20 million of new money (Ministry of Education 2002: 3). The fund is expected to have a strong effect on the research income of the universities and according to the Ministry of Education 'should provide significantly more funding to academics assessed as being at the highest levels of excellence' (Ministry of Education 2002:1). A funding model with three elements is being used: quality of academic researchers, (60 per cent of the total PBRF); research degree completions (25 per cent); and external research income (15 per cent).

Given the high level of excellence shown by health researchers, the PBRF may have a positive effect on funding for health research in New Zealand's universities. However, while the funds may serve to enhance the strategic research capacity of universities generally, they will not automatically translate to benefits in health research. There are several possible reasons for this. First, health faculties have contributed proportionally less than other disciplines to the 'top up' fund; and second, it is quite likely that universities will chose to invest the PBRF funding to develop research capabilities rather than to support strong researchers with the ability to win external grant funds. We therefore recommend below specific action to monitor the impact of PBRF on health research.

International practice

The PBRF is similar to arrangements for general university research funding in several countries and the design drew upon analysis of policies in the United Kingdom, Hong Kong and Sweden (Boston 2002). The assessment model appears based on the United Kingdom's periodic research Assessment Exercise (RAE), while the funding model is similar to that adopted by the federal Department of Education, Science and Training in Australia. The Australian model uses only publication counts as a measure of excellence. These arrangements have promoted concentration of research strengths within the university system and the performance indicators used have almost certainly influenced the research and publication behaviours of academics.

It is desirable that the reporting system and performance measures required of university grantees through PBRF should as far as appropriate, be consonant with those applying to those in receipt of HRC funds.

- **We recommend that HRC should be provided with information to enable the Council to monitor the effect of the PBRF on health research funding and research groups.**

Appropriate performance indicators

This section considers the further development of performance indicators for the New Zealand health research system. It discusses the international experience with the use of health research indicators, briefly reviews current activities being undertaken by the HRC and presents proposals for further development.

The international experience

While the terminology of research performance measurement is by no means standardised, most authors agree that there is a spectrum of indicators and qualitative measures that can be used to assess the level of research resources (*inputs)*, and quantity and effectiveness of research 'results' (*outputs*, *outcomes* and *impacts)*. These may be defined as follows (Garrett-Jones 2000):

- **Inputs** are the resources made available to the research community and the costs associated with providing those resources.
- **Outputs** are the routine *products* of research activity, (e.g. publications, conference papers, data sets, training courses and research degrees etc.).
- **Outcomes** are the *achievements* of the research activity, whether conceptual (a new theory), practical (a new analytical technique) or physical (a new device or product – although some authors regard this as an output). Research outcomes are potentially available for *use*.
- **Impact** is a measure of the *influence* or *benefit* (economic, social or environmental benefit, and either realised or expected) of the research outcomes, either within the research community itself, or in the wider society. Impact measures the scale, effects or implications of use.

As one moves from outputs to impacts, the results of research activity are generally broader in their effect, take longer to manifest themselves, are harder to quantify and are less readily traceable to particular research projects, funding programs or agencies. This is the so-called 'attribution factor': while desired impacts may be seen, they clearly have a plurality of causes, the individual contribution of which is not readily measurable. For example, while it may be possible to demonstrate statistically a decline in mortality or morbidity from a particular disease, it is in most circumstances impossible to attribute this with any confidence to a single cause, such as a major research council research program on the topic.

Input, output and outcome indicators are all vital for signalling to policy makers and managers the health of particular systems – revealing whether they are improving or providing early warning signs that they are in trouble. As Godin (2001:6) points out science and technology indicators can generally demonstrate a system's 'strengths and weaknesses and follows its changing character notably with the aim of providing early warning of events and trends which might impair its capability to meet the country's needs'.

To perform this function indicator must meet a number of criteria to be useful, Godin (2001:5) nominates the following:

- Indicators measure dimensions of a phenomenon in order to warn about changes;
- Statistics that must be recurrent – to measure change rather than to present a 'snapshot'; and
- Indicators usually appear as a collection of statistics: a lone statistic can rarely be a reliable indicator – usually the analyst is seeking 'converging indicators'.

While the performance of many science and engineering disciplines resourced both by government and business has been scrutinised closely over the last twenty years, relatively few national health research organisations have established comprehensive public reporting of measures of the performance of health research.

This bias against reporting health research indicators is obvious by their lack of development in international data. Each two years the OECD publishes its science and technology scoreboard publication (OECD 2003) that has a heavy emphasis on comparisons across countries of expenditure with relevance to industrial technologies - business R&D, patenting and high technology trade. Only government budget expenditure towards health research is reported, whilst another OECD report (OECD 2001b) reveals that there are systematic difficulties in even reporting simply the total health research expenditures across the OECD.

Turpin et al (2003) surveyed the performance reports of health research councils in several countries to assess the range of indicators used. Most councils used data on publications (or were planning to), several reported on local patent activity, whilst a few were reporting international patenting comparisons. At the time of the review one county reported on commercialisation income, while several councils agencies reported on the number of licenses and assignments. Surprisingly few councils reported their funding against international disease classifications.

However, the range of health research performance indicators available internationally is expanding. Australia recently released a Performance Measurement Report covering a range of topics (National Health and Medical Research Council 2003b) as well as a bibliometric study of NHMRC supported research (Butler 2003). In Canada the CIHR's predecessor research council had developed an indicators system and the CIHR is currently going through the process of establishing organisational wide indicators. Importantly, the trend towards more detailed reporting of indicators is likely to gather strength. The prime reason for this is that many health research agencies in OECD countries have received

substantial increases in funding over the last half-decade or so, partly on the expectation of economic returns. Governments are demanding increased accountability for those funds. The decision by the WHO to focus its 2004 World Health Report on research, and its work on the *Health Research System Analysis Initiative*, are significant moves.

The HRC's current performance indicator reporting and activities

In New Zealand, the HRC has already taken significant steps towards improved indicator reporting and collaboration with other purchase agents on data availability. Some of these achievements are:

- The health research outputs reporting database HEARD has been implemented, and will be developed further into a national health research database;
- Plans to present HRC relevant bibliometrics in future (similar to Butler's work for the NHMRC). The evaluation team did not see a copy of the draft national bibliometrics study;
- 'Vision 2008' nominates a range of performance indicators against its goals and strategies (see Appendix 3);
- The recent national consortium that fund a national bibliometrics analysis; and
- A workshop to discuss evaluation being undertaken by purchase agencies and MoRST, and the potential for coordination of researcher surveys being conducted by the purchase agents (HRC 2003d:94).

The evaluation team also acknowledges HRC's efforts to monitor the balance of its research funding across the spectrum of portfolios, level of science (basic to applied) and on a time basis to ensure it maximises its expenditure.[77] We commend these developments and encourage future activity in these areas in line with international practice and developments. HRC's performance assessment work is of high quality and deserves a wider audience.

Comments on specific indicators currently used, and suggestions for their improvement, may be found in Appendix 3.

Future development of health research performance indicators

This report recommends substantially increased investment in health research in New Zealand. It also recommends that HRC take on a greater role in facilitating the coordination of strategy development for New Zealand's health research system. A consequence of both recommendations is the need for best practice reporting upon the performance and achievements of the health research system. We would emphasise here

[77] 'The HRC's Research Policy Framework' – presentation to the evaluation team by Dr Patricia Anderson.

that it is those on the inside of the research system who are is best place to design specific indicators, as is apparent from ongoing discussions within CIHR.[78]

In this section we propose the third 'leg' of such a system enhancement. We propose that HRC in collaboration with other agencies be mandated to produce a '**scorecard report**' for the New Zealand health research system every three years. The first edition of the report could be produced in time for the next review of the Health Research Output Class. The current performance reporting activities of the HRC will of course contribute strongly to the proposed report, but the scorecard would include material from the three main purchase agents as it relates to health and perhaps contextual material on the health status of New Zealanders. In turn, the scorecard would form a resource for the New Zealand Health Strategy , the proposed a New Zealand health research strategy and other priority setting exercises.

We offer Table 7.2 as a starting point for discussions about the scope of the scorecard report. The proposed scorecard is only partially an evaluation tool for monitoring the HROC. It should be wider in scope to allow the government to monitor the health of the health research system in toto, and to inform the New Zealand community.

Table 7.2 Possible scope of performance indicators in the proposed New Zealand Health Research Scorecard

Theme	*Area*	*Concept and rationale*	*Indicator and comparison*
Inputs			
	Funding the system	Health research funding over time – various measures to report on international comparisons and local trends.	• OECD GBAORD Stats (hopefully including updated for NZ) • HRC funds as a percentage of NZ GDP. (time series) compared against OECD GBAORD estimates [the latter will probably be published every 2 yrs in the OECD STI scorecard] • HRC share of MoRST funds to purchase agents – which are available as competitive research grants. • All medical & health (HRC, FRST and Marsden as % GDP). • Stats NZ reporting of total health research in universities – time series.
	Administrative costs		• Percentage of HRC funds devoted to administration compared to

[78] http://www.cihr-irsc.gc.ca/e/publications/20394.shtml

Theme	*Area*	*Concept and rationale*	*Indicator and comparison*
			other organisations overseas.
	Active research workforce	Active researchers by field of research	• Australia uses a measure of active research as ➢ A certain number of publications ➢ Some external income ➢ Post-graduate completions
	Project external income	The ability of projects to get outside money (public or private is an indicator of the external environment's assessment of the value of the research.	• Leveraged funds as percentage of project and programme grants.
	Business activity	Business activity is an importance indicator of the health of the local environment for the commercialisation of health research. It is not a measure of the HRC but a measure of the health research system.	• Business expenditure on R&D in NZ on pharmaceuticals and clinical trials.
Outputs			
	Post graduate & fellowship completions	HRC categories according to its funding and strategies.	• Suggested design of the indicators would be along the lines of: ➢ category completions as percentage of postgraduate fellowships. ➢ category completions as share of the workforce in various research portfolios.
	Bibliometrics	We support the planned developments.	• Publications by field • Citation rate • Publication impact factors
	Commercialisat -ion	Patents	• Trend in NZ patenting in NZ • Data on international patenting (NSF data, USPTO etc)
		FRST grants to health researchers. As FRST has a primary responsibility for funding commercialisation	• Health researchers as percentage of all university academics applying for FRST funds in

Theme	*Area*	*Concept and rationale*	*Indicator and comparison*
		activities in New Zealand then FRST should be included in the scorecard. HRC should see itself as successful if a health researcher gets a FRST grant. Such a perspective might help develop the greater collaboration between HRC and FRST.	commercialisation categories. • $ value of FRST grants to health researchers as percentage of FRST grants.
	Other outputs		
			• Electronic products – software & multimedia. • Training courses
Outcomes			
	Commercialisat -ion		
		Business start-ups	• Mapping new business activity from Marsden, FRST and HRC support – in the health research field.
Impact			
		We acknowledge that researchers have been surveyed on whether they think they have made an impact.	• We support this move but also suggest that HRC look for additional measures for more objective changes through actual policy changes, new government programmes or health outcomes surveys.

8. Conclusions and summary of recommendations

This report provides an evaluation of the New Zealand Health Research Output Class and the health research investment framework in the context of international experiences across a range of other OECD countries. It was observed through earlier chapters that in terms of strategy and delivery of programs the New Zealand health research system stands up well against international experiences.

However, the evaluation identified growing tensions within the system. At one level these tensions were associated with a contradiction between the ability to develop, assess and carry out high quality health research and the ability to deliver adequate funding to support such research. These tensions appear to be exacerbated by some structural features associated with organisational arrangements, coordination and shared responsibilities for some elements of the health research system. New Zealand's health research investment system seems more strongly compartmental than in the benchmark countries, **to the point where it risks failing to act as a cohesive system**, as it lacks the structural linkages between purchase agents that are evident in countries like Australia and Canada.

We recognise the finite nature of funding resources. But New Zealand appears to be marking time in terms of health research funding while other countries are developing quite bold plans for expanding investments. We also recognise that New Zealand has taken some bold steps in terms of redesigning the funding framework. This includes implementing a clear and transparent mechanism for assessing the full cost of health research, shifting from a disciplinary based funding system to a program and strategic objective system, and identifying and sustaining long term strategies for building Māori research capacity.

In order to consolidate and reap advantage from this development we believe it is important to take some immediate steps to introduce some additional funding to sustain the top band of high quality health research capability in the country and to provide more coherent support for collaborative health research.

However, at the same time we believe making some readjustments to organisational arrangements can enhance the outcomes and impact of health research investments. We believe that New Zealand is at the stage where an increased funding commitment, together with increased capacity for coordination, monitoring and evaluation will enhance return on investment. The options and recommendations for achieving this have been discussed in the preceding chapters. They are summarised below under three general headings that reflect the main terms of reference for the study:

1. An appropriate policy and investment framework
2. The future vision for health research (including appropriate performance indicators); and
3. The level of investment required.

The final section considers the costs and appropriate timeframe for implementation the recommendations of the report.

An appropriate policy and investment framework

Structural arrangement of purchase agents

The health research system in New Zealand, as in other OECD countries, needs to be understood not as a single system but as the product of the intersection of various systems. The multi agency approach to the health research investment in New Zealand is similar to other comparable countries. New Zealand, however, is a small country and this, as elsewhere, presents a challenge for determining appropriate concentration of investment in the various agencies and how the boundaries between agencies and programs should best be managed. We **do not consider** that a substantially increased concentration of research funding through HRC would automatically produce benefits in terms of the coherence and coordination of health research. Rather the challenge is to make the various funding agencies work more effectively together within a plural system, as is the case in many of the benchmark countries.

1. We **consider** that the establishment of a single research agency, responsible for funding all health research, broadly defined, would *not* be in the best interests of the New Zealand research system overall. We **recommend** the maintenance of diversity in the funding base provided through different agencies. However, we also **propose** an enhanced role for HRC in steering research policy, coordination, and evaluation toward strategic national goals.

Coordination (between purchase agents and output classes)

The evaluation draws attention to the need to enhance coordination between purchase agents, both in terms of developing health research strategy and in implementation. The HRC is in a good position to contribute to the overall strategic planning, coordination and evaluation of New Zealand health research in line with its statutory responsibilities. This role should be strengthened where possible.

Coordination could be strengthened between purchase agencies and at strategic program levels by supporting HRC as the lead agency for developing and coordinating a high profile **national health research strategy** (see Recommendation 11). This would require deepening the structural relationship between HRC, MoRST and MoH.

2. We **recommend** that MoRST establish an interdepartmental health research coordinating committee including the Ministries of Health and Education. The HRC should have a lead role in the committee.

The future vision for health research

Building partnerships for collaborative research

HRC's Partnerships and Joint Ventures have been very effective in marshalling both funds and research expertise around defined research priorities. This innovative arrangement works extremely well where the HRC has an unchallenged mandate to pursue these

priority areas, for example where they reflect key national priorities for health. As the partnership program develops we note a need for on-going planning and targeting of the programme. A 'priority setting exercise' would help ensure the most effective alignment between national research capabilities, funding support and the application of research outcomes.

3. We **recommend** that HRC should instigate a consultative priority setting exercise for future Partnership/Joint Venture investments that involves a wide range of stakeholders including researchers, policy agencies, other potential funders and the health industry. The exercise should consider both the feasibility of research and the potential outputs and outcomes of the investment in the research.

Overseas experience suggests that cooperative research has a successful outcome when both the researcher and the user of the research are involved in defining the problem and the solution. We consider that MoRST should explore with HRC, FRST, the Ministry of Education and RSNZ the potential benefit of establishing a new cross-cutting arrangement to support long term university-industry/user cooperation in health research. This may require a new National Collaborative Research Centres Output Class under Vote RS&T. HRC would be the primary purchase agency for health related centres and purchase agencies would jointly fund Centres where the Centres met the objective of several purchase agencies. Some co-funding would be required from Centre partners.

4. We **recommend** that HRC should develop proposals for a National Health Research Centre grant scheme, complementary to those funded by CoRE and FRST, for consideration by MoRST. The adoption of this recommendation should be on the basis of HRC receiving additional funding and should not draw on existing funds.

Without prescribing the form of such a scheme, it would be 'bottom up', 'proposal driven' collaborative research support scheme where researchers and potential users develop proposals for assessment and support by HRC.

Health Research infrastructure in the university system

Almost all health researchers are in the university system. As a consequence university research policy has an implication for health research activities. Government policy requires the purchase agencies to move towards full funding of the research they support by providing for investigators' salaries, salary on-costs, project direct costs and an appropriate level of institutional central overhead costs. But HRC's budget growth has not increased at a rate sufficient to cover these costs.

5. We **recommend** that the government should accept the principle that the HRC should receive full budget supplementation for any increase in costs arising from the 'full cost funding' policy.

HRC is ultimately responsible for the effective application of funds from HROC provided to the universities, and is required to report on outputs gained from these funds. In order to enable the HRC to fulfil this obligation there will need to be supporting obligations placed

on the universities. To ensure these changes adequately support the infrastructure underpinning health research in universities it will be necessary for the internal allocation of research funds and facilities within universities to be closely monitored.

6. We **recommend** that the HRC should maintain discussions with the universities to ensure that full grant costs are effectively applied to the infrastructure and facilities required by health researchers. The universities should be obliged to report on their use of these funds, against agreed performance indicators.

Further to our proposals for coordinating research evaluation through an interdepartmental health research coordinating committee (Recommendation 2) we **suggest** that an overview of university infrastructure funding be available to this group.

The full cost funding policy allows for arrangements of fully costed projects to be co-funded by the HRC and the host institution (or other partner). This should be encouraged where appropriate.

Given the high level of excellence shown by health researchers, the Performance-based Research Fund (PBRF) to be introduced progressively from 2004, may have a positive effect on funding for health research in New Zealand's universities. However, while the funds may serve to enhance the strategic research capacity of universities generally, they will not automatically translate to benefits in health research. It is desirable that the reporting system and performance measures required of university grantees through PBRF should as far as appropriate, be consonant with those applying to those in receipt of HRC funds.

7. We **recommend** that HRC should be provided with information to enable the Council to monitor the effect of the PBRF on health research funding and research groups.

Consolidating and sustaining the Māori health research strategy

As noted in previous chapters the overall level of funding for health research in New Zealand has not grown in real terms. Already a considerable proportion of fundable projects assessed by the HRC remain unfunded. Unless there is growth in the system overall, the capacity to consolidate the gains already made in Māori health research can only be achieved at the expense of other areas.

We note that in comparison with other national experiences, the development and implementation of the Māori health research strategy has met with considerable success. However, urgent funding increases for the system overall are now required to consolidate the gains already made and reduce unproductive tension within the system (see Recommendations 5 and 17). The HRC has already nominated a priority setting process within its plan for Māori health research. We endorse the approach marked out for these next steps, however, we **consider** that it will be difficult to establish achievable goals for this unless there is growth in the overall system.

At present HRC is devoting considerable effort in developing a research capability for Māori and Pacific populations. However, HRC nominates a number of population groups, some of which (such as the disability) sub-group do not appear to have such well-developed strategic frameworks. While these population groups remain a defined target for HRC's funding framework similar development strategies should be set in place with similar emphasis on building research capacity and evaluation measures. We suggest that the HRC consider developing a process that identifies the strategic research that needs to be conducted in New Zealand for all priority populations.

8. We **recommend** that the HRC, in consultation with the proposed health research coordinating committee, establish a set of performance indicators for priority population groups that, as far as possible, allow for international comparison.

Supporting the HRC research investment strategy

The HRC's comprehensive peer review system for assessing the scientific excellence of research proposals is central to maintaining the quality of research funded and is of a clear and continuing national benefit and receives strong endorsement from the research community. The operation of best practice assessment and evaluation processes within HRC is also vital in leveraging funding from other sources, such as international partners.

9. There is clear benefit to New Zealand in the high standard of assessment and evaluation for health research set by HRC and we **recommend** that these processes should be maintained.

HRC's move towards investment portfolios focused on health outcomes is in line with trends in the benchmark countries and should receive continued support.

The view was put to us by researchers was that HRC's support for biomedical research is 'teetering on the sub-critical' and cannot provide the prospect of a reasonable chance of continuing funding for the best researchers. The most compelling argument therefore is that such increase is required to retain existing research capability in the country and to build up the research teams and facilities that would attract expatriate and overseas researchers. The HRC in its Strategic Plan argues for an increase of the order of $10.5 mill. in 2004-05 to achieve sustainable outcomes. The HRC has the assessment processes in place to handle some increase in grant applications that might flow from such an increase.

We **consider** that an increase in resources for HRC's current research project grant, research programme grant, and scholarship and fellowships schemes is necessary to ensure the sustainability of New Zealand's capability in world class health research. HRC requires additional funding to invigorate its fellowship and scholarship programmes. Overall, the target for the proportion of HRC expenditure on 'people' needs to be set at 20-30 per cent of budget if it is to reach norms common in some of the overseas research councils studied.

HRC's research programme funding provides longer stability of funding for research groups, and provides opportunities for synergy between interrelated, often multidisciplinary projects. They also provide greater opportunity for research training activities. However, we believe there would be a stronger case for increased programme

funding if the research programmes had a character that was clearly differentiated from project grants. We suggest a review of the scope and objectives of the various schemes.

10. We **recommend** that HRC should give further consideration to the relationship between its project and programme funding, and between programme grants and the proposed National Health Research Centres scheme.

The HRC has the statutory responsibility to advise the Minister of Health on national health research policy. Section 34a of the Health Research Council Act 1990 further requires that 'the Council shall set up formal mechanisms of liaison to develop a national health research strategy for New Zealand'. We **consider** that there should there be more explicit articulation between the New Zealand Health Strategy (NZHS) and health research priorities. We also **consider** that, towards this end, there is a strong case for a published **national health research strategy** (or strategies) to complement and extend HRC's existing Strategy documents, which refer to the Council's own activities.

11. ·We **recommend** that HRC should coordinate the publication of a National Health Research Strategy (or Strategies) to complement the New Zealand Health Strategy and that the Council be adequately resourced for this task.

The benefits deriving from a competitive advantage in health research supported by HRC may be or scientific reputation, social application, or commercial exploitation. We **note** that HRC has a crucial role in supporting research with commercial potential and supervising clinical trials. These activities require close cooperation with other purchase agents, notably FRST.

12. We **recommend** that HRC should collaborate with FRST to provide advance warning of those health researchers working on technologies or research outcomes with potential for commercial exploitation.

New Zealand's small size and geographic location mean that international collaboration is especially important

13. We **recommend** that HRC should instigate an international collaboration grant scheme for individual health researchers and teams to complement the support and grants offered by MoRST and the FRST. These could be targeted for HRC project and program grant holders or more widely. Funds from the new 'Developing International Linkages' output class should be made available for this purpose.

Indicators for monitoring research investments and outcomes

Noting the lack of currency of the New Zealand health research data published by the OECD and the implication of full cost funding on international comparability;

14. We **recommend** that MoRST review the procedures for reporting current health research expenditure data to the OECD and for ensuring that these data are presented in a manner that provides for international comparison of research effort.

Performance indicators of various types are already widely used in the evaluation of purchase agents within the New Zealand system. The HRC has made excellent advances in establishing appropriate qualitative and statistical measures of health research performance and outputs. International practice in health research performance assessment is developing rapidly and should be monitored closely by New Zealand.

15. We **recommend** that the coordinating committee proposed in Recommendation 2 should have a specific mandate to coordinate and develop a national health research reporting strategy and develop performance indicators for monitoring system wide outcomes and impact against national strategic objectives. The HRC should provide the lead in this activity.

The indicators being developed alongside Vision 2008 are moving in the appropriate direction as accountability indicators. Such indicators will be useful for measuring HRC's performance for the annual agreements between it and MoRST and with the Ministry of Health. However, they could be extended in terms of monitoring the overall status of the health research system.

16. We recommend that HRC be mandated to produce a New Zealand health research system **scorecard report** every three years.

This reporting framework for the scorecard would differ from that already being developed for the strategic plan. The scorecard, unlike the micro indicators proposed against the Strategy's goals would have three dimensions: inputs, outputs, and outcomes.

The level of investment required

Three main **observations** can be made on level of health research funding in New Zealand by comparison with the benchmark countries.

- Taking all the results into account. New Zealand's current level of public investment in health research is **substantially lower** than almost all the benchmark countries. Of these countries, only Ireland spends less, proportionally, on health research and development.

- Most of the benchmark countries are **increasing their investment** in health research – some by as much as 20 per cent per annum. By contrast, there is no evidence of sustained increase in health research investment in real terms in New Zealand in recent years. Indeed, national data provide clear evidence of a **decline** in New Zealand's expenditure on health research, as a proportion of GDP.

- The **cost structures** of many of the comparator health research funding agencies are lower than those of the HRC. Given that the overall envelope of health research funding available to the HRC in New Zealand is already comparatively smaller than in most of these countries, the cost structure in New Zealand means that the HRC's capacity to purchase high quality health research is all the more limited.

We **note** that the HRC will need funding increases for the next three year to implement full cost funding. By the end of the period HRC will require about $16.5m more than the current budget for this policy. Such funding budget increases will only **maintain** the system at its current level.

We **consider** that on the basis of international comparisons and the recent history of static to declining funding in real terms in New Zealand that the system requires a substantial increase in expenditure **above** full cost supplementation.

17. We **recommend** that MoRST adopt a *target* budget for the HRC's Output Classes (the HROC + Māori OC [health] + SPI OC [health]) of **a *real increase*** of 0.01% of GDP **over the next four years**.

Over the next four years (i.e. by 2007-08) this would require a **real increase** in HRC's annual budget of at least $17.8 million over the current year (2003-04). This costing is based on New Zealand's GDP of $127 billion in 2003 and includes an adjustment of 40 per cent to take into account the higher research cost structures faced by HRC. This recommendation is for dollars in **addition** to any supplementation of the HRC's budget to cover the full cost funding of grants (Recommendation 5).

Financial implications and priority timeframe

A timeline and cost estimate for implementing the report's recommendations are shown in Tables 8.1 and 8.2. The cost estimates provided are a first approximation, offered as the basis for further discussion.

Table 8.1: Estimated costs of recommendations and timing of implementation

Recommendation No.	*Estimated Annual Cost*	*Potential source of funds*	*Timing of implementation*
1. Maintain diversity in the funding base	nil	Existing OCs	continuing
2. Establish interagency coordinating committee on health research	$100k	Vote RS&T	2004-05
3. Priority setting exercise for future Partnerships	$25k	HRC	2004-06
4. Develop National Health Centre Research Grant Scheme	$200k (proposal) $2-3 mill. annually (Centres)	HROC (new funds) or a new Collaborative OC	2005 (proposal) 2-3 years
5. Budget supplementation for full cost funding	$5-6 mill. annual increase. Note that these costs are **included** in the estimates at Recommendation 17)	Vote RS&T	From 2004-05
6. Liaison with universities on full costs	minimal	HROC	2004-05
7. Information sharing on	minimal	MoRST/Ministry	2004-05

Recommendation No.	*Estimated Annual Cost*	*Potential source of funds*	*Timing of implementation*
PBRF		of Education	
8. Performance indicators for target populations	$120k	HROC; HRC Partnerships	2004-05 – 2006-07
9. HRC research assessment and evaluation	existing funds	HROC	continuing
10. Programme, project, centres scoping	$100k	HROC	Prior to any proposal under Rec. 4
11.National Health Research Strategy	$450k	HRC Partnership	For discussion
12. Commercial advance warning exercise	Requires further assessment	Existing funds, HRC Partnership with FRST	2005-06
13. HRC international grant scheme	$0.5-0.75 mill.	DIL OC	2004-05
14. OECD statistical data reporting	Requires further assessment	MoRST	immediate
15. Coordination of health research performance indicators	$200k Uses Coordinating Agency funds	HROC, MoRST	2004-05
16. NZ Health Research Scorecard report	$250k	HROC, HRC Partnership	First report by 2006-07
17. Growth in health research system capacity – budget increases for HRC project grants, programme grants, scholarships and fellowships	Funding **target**: achieve 0.01% GDP real increase above full cost supplementation = $17-20 mill. + $16.5mill. for FCF supplementation over 2003-04 by 2007-06. Estimated **annual cost**: 2005-06 = $20.1 mill. 2006-07 = 26.3 mill. 2007-08 = 34.4 mill. (see Table 8.2 for derivation)	To HROC, Māori OC and SPI OC	Phased in over 4 years – (see indicative annual budget in Table 8.2)

Table 8.2 Indicative annual budget for HROC, based on implementation of the recommendations

	Incr. over base year (2003-04)					
	(a) FCF supplement-ation (Rec. 5) *	***(b) GDP based increase (raw) (Rec. 17)***	***(c) 'Cost structure' adjustment on GDP based increase (40%)***	***(d) Sub-total GDP based increase (b+c)***	***(e) Total (a+d) (increase over base year 2003-04) #***	***Indicative Budget, HROC***
2003-04^						42.2
2004-05^	5.5				5.5	47.7
2005-06	11.0	6.5	2.6	9.1	20.1	62.3
2006-07	16.5	7.0	2.8	9.8	26.3	68.5
2007-08	16.5	12.7	5.1	17.8	34.3	76.5

* FCF = Full cost funding. FCF figures from HRC for 2004-05 to 2006-07. Figure for 2007-08 is assumed similar to previous year, but will be subject to review.
# Total as per table 8.1
^ Indicative only – not part of our recommendations.

Appendix 1: Additional Data

Canada

Table A1.1: Canadian research funding schemes providing research grant opportunities

CFI	Canadian Foundation for Innovation
CIHR	Canadian Institutes of Heath Research
CSA	Canadian Space Agency
MRC	Medical Research Council – renamed Canadian Institutes of Heath Research
NRC	National Research Council
NSERC	Natural Sciences and Engineering Research Council
SSHRC	Social Science and Humanities Research Council

Source: Data from Statistics Canada 2003, choices of research grants by evaluation team.

Other sources of funding, although, providing valuable sources of funds for some researchers has not been included.

Table A1.2: Canada - R&D funding sources not included in the grants list

EMR	Energy, Mines and Resources (Ministry) renamed Natural Resources Canada)
F&O	Fisheries and Oceans (Ministry)
IND3	Industry Canada (Ministry)
NRCan	Natural Resources Canada

Original source data: Statistics Canada 2003 Federal government expenditures and personnel in the natural and social sciences, 1993-1994 to 2002-2003 Table 8 Cat. No. 88F0006XIE2003009 Statistics Canada May 2003 www.statcan.ca

The CIHR has a set of virtual institutes that capture its priority fields.

Table A1.3: Canada - Affiliation of Grants and Awards to Institutes (Year 2001–2002)

INSTITUTE	No. of Grants & Awards	Total Funded (in 000s of dollars)	Per cent of Total
Aboriginal Peoples' Health	39	4,577	1.0
Aging	82	7,730	1.7
Cancer	461	33,558	7.5
Circulatory & Respiratory Health	667	51,667	11.5
Gender & Health	57	3,790	0.8
Genetics	429	40,256	9.0
Health Services & Policy Research	191	12,040	2.7
Human Development, Child & Youth Health	282	23,412	5.2
Infection & Immunity	538	42,662	9.5
Musculoskeletal Health & Arthritis	248	16,605	3.7
Neurosciences, Mental Health & Addiction	909	66,121	14.7
Nutrition, Metabolism & Diabetes	404	31,265	7.0
Population & Public Health	206	14,481	3.2
Unable to allocate	166	8,015	1.8
Unallocated	2,015	92,352	20.6
	6,694	448,531	100.0

Note: These figures exclude the Networks of Centres of Excellence Program and the Canada Research Chairs Program.

Source: CIHR annual report 2001-2002.

Ireland

The Irish Council for Science, Technology and Innovation (2003) notes:

> The implementation of the science for health elements of the Strategy for Health Research would require annual revenue expenditure of €33 million in 2001 prices by 2006, compared with just under €15m in 2003. The establishment of an R&D function in the health services would mean an increase in annual revenue expenditure from €3 million in 2003 to €44 million by 2006.
>
> Estimated expenditure on health research in Ireland in 1998 was equivalent to 0.3% of public health expenditure, compared with 1.7% in the US, 1.9% in the UK and 2.3% in Finland.

New Zealand

There are two broad ways of calculating this Government expenditure on science and innovation. The first relies upon the identification of stand alone government programs to fund any of; research, science, development, technology and innovation. This seems to most closely align to the Vote RST expenditure. The second way is to survey government to collect data on all science and innovation related funding and expenses. MoRST (2003: 13) estimates this total NZ government science and innovation envelope to be $767.4m.

The international comparisons presented in this report are typically reflective of approach 1.

Table A1.4: New Zealand R&D grants

Output classes	*Included Grants*	*Funding not included*
Health research	$42.23m	
Social research	$6.59m	
RS&T Policy Advice		$7.28m
RS&T Contract Management		$0.57m
Growth and Innovation Advisory Board		$1.33m
4th APEC Science Ministers' Meeting		$1.68m
Research Contract Management		$17.38m
Venture Investment Fund - Governance and Operation		$1.22m
Marsden Fund	$32.79m	
Non-Specific Output Funding	$28.53m	
Supporting Promising Individuals	$14.55m	
Promoting an Innovation Culture	$2.72m	
New Economy Research Fund	$63.88m	
Maori Knowledge and Development Research	$5.48m	
Developing International Linkages	$3.00m	
Research for Industry		$185.04m
Technology New Zealand		$44.03m
Pre-Seed Accelerator Fund		$4.80m
National Measurement Standards		$5.08m
Environmental Research	$88.62m	

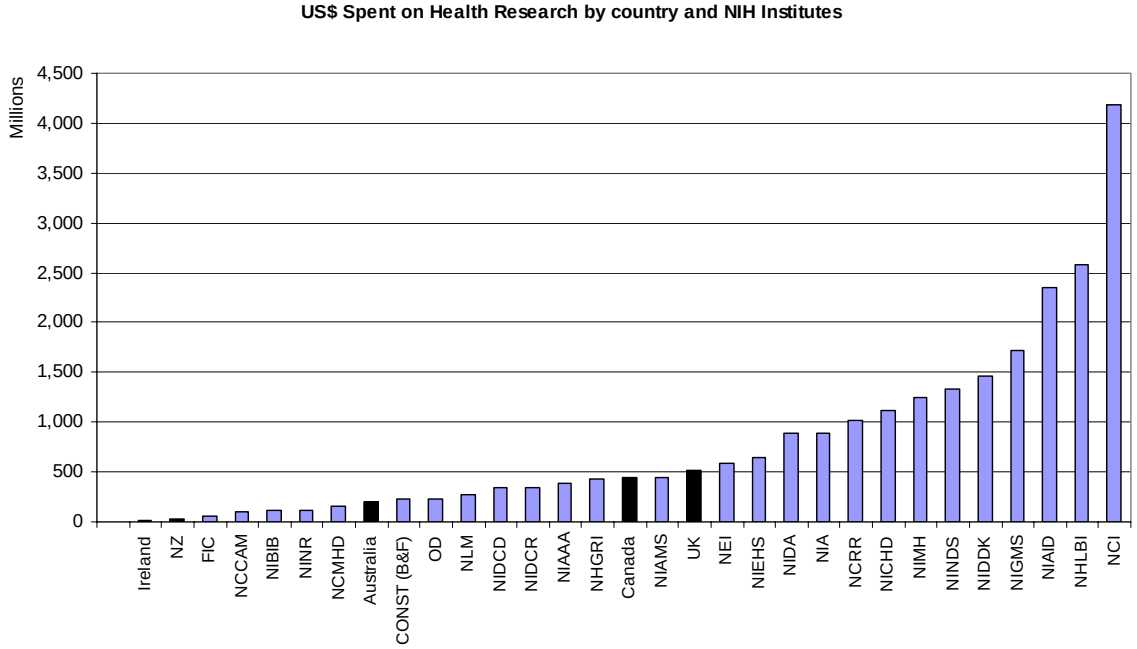
United Kingdom

Sources for data presented are:

- Science and innovation budget data from Office of Science and Technology.
- http://www.ost.gov.uk/setstats/index.htm
- GDP data: National accounts: GDP: expenditure at current market prices 1946 – 2003 from http://www.statistics.gov.uk/STATBASE/tsdataset.asp?vlnk=208

United States

Figure



A1.1: Real $ expenditure on health research - National agencies and NIH institutes

NIH Research Studies

Sample Programs – Research. The research programs listed below are a representative example of the variety of ongoing and new research studies that NIH supports as part of its strategic plan for understanding and reducing health disparities among ethnic and racial minorities and other populations (NIH 2002).

Selected Examples of Measuring Program Performance

- Track the number of articles published in scientific journals
- Percentage increase mechanisms for healthcare providers to better diagnose, prevent, and treat minority health and health disparities
- Percent of studies which are "targeted studies"
- Percent of studies that are "Inclusion studies"
- Percent of total research budget spent on addressing minority health and health disparities
- Percentage research that influence policy
- Track rates of health disparity indicators and project a percent reduction of the those rates over a set period of time

Sample Programs – Infrastructure. Ongoing research infrastructure programs provide selected examples of the variety of ongoing and new research infrastructure activities that

the NIH will support as part of its strategic plan for understanding and reducing health disparities among ethnic and racial minorities.

Selected Examples of Measuring Program Performance

- Monitor number and progress of minorities entering training programs (% increase in minorities entering training programs over previous years and number completing training programs)
- Increase and track the number of minority scientists engaged in research (establish targets)
- Increase and track minority subjects enrolled in research and clinical trails
- Percentage increase in partnerships with minority institutions
- Increase number of research projects addressing minority health and health disparities
- Track the number of articles published in scientific journals by minority investigators
- Number of minority faculty, post doctoral fellows, and graduate students trained while conducting research
- Number of competitive grants issued to minority researchers

Sample Programs – Outreach. NIH is continuing its efforts to translate highly technical research advances into clear, culturally relevant explanations of the steps individuals can take to improve their health.

Selected Examples of Measuring Program Performance

- The number of materials developed or adapted for minority and underserved populations
- Linkages with minority organizations

Appendix 2: Survey of Cost Structures and Success Rates for Health Research Councils in Benchmark Countries

Table A2.1: Comparisons of overheads payments by health research councils

Country	Overhead charge rate	Comments
Australia[79]		The overheads rate is pre-built into the application. The NHMRC specifies the total cost of researchers at different levels. Applicants must specify project requirements using the table provided by NHMRC. NHMRC payments are marginally costed. http://www.nhmrc.gov.au/research/project/budget4.htm
Canada[80]	0%	Universities do not "impose" any indirect or overhead costs. Last year, the government of Canada agreed to provide effectively a 20% overhead for indirect costs.
Ireland[81]	10%	Up to this year the HRB, similar to most other Irish funding agencies, did not pay any overheads. However in 2003 Forfás and the Higher Education Authority produced a report with recommendations for payment of overheads by Irish funding agencies. The HRB was involved in the steering group and have agreed to implement the recommendations in the report. The report recommends that overheads should be paid at 30% on modified total direct costs (i.e. direct costs less equipment) for laboratory based research and at 25% for desk based research. The report also proposed an implementation timetable with introduction of the new system on a phased basis up to 2006. To that end the HRB has committed to paying 10% overheads on 2004 awards.
Netherlands[82]	0+%	Generally, the money from the department of science doesn't include overhead of any kind (except for social insurances such as health insurances). The universities have to pay for all bench fees, usage of equipment and buildings. Which means that in those schemes the universities pay more or less half of the real costs. In most of the schemes paid by the ministry of health (mostly strictly subject-directed), applicants more or less can apply for all overhead costs they want, but next to quality, these applicants (which could even be commercial parties) are evaluated for 'value for money' which means that the best and best fitting in the chosen subject AND cheapest party will be awarded. The way to remain cheap is not to apply for too many overhead costs, something most commercial parties of course cannot do.
New Zealand	114%+	Full cost. (contract FTE)
Sweden[83]	30%	The University overhead cost is approximately 30%.
United Kingdom	46%	As part of the UK dual support system all Research Councils pay all Universities a flat rate on the salary component of all grants. This rate is determined by the government .For some time there has been concern that this is insufficient to sustain investment by Universities in the research they undertake and a recognition that this would have to

[79] Comments provided by Roland Wise.
[80] Correspondence with Dr Alan Bernstein, President of the CIHR.
[81] Comments provided by Dr Norma O'Donovan Evaluation Officer, Ireland's HRB.
[82] Communications with Stefan Ellenbroek of ZonMw.
[83] Comments provided by Maria Starborg, Scientific secretary, Swedish Research Council.

		increase. The Universities pressed for an increase to at least 100%.This was not adopted as it was considered that a % based on salaries provided an incentive to maximise staff on grant applications and universities took on research without knowledge of the full cost. It was therefore decided that all Universities be required to move to a system of full project costing known as TRAC and to submit grant applications based on full economic costs from Sept 2005.The Research Councils will then pay a percentage (yet to be determined but probably about 65%) which means that Universities must know that they can find the remainder from their own resources before applying for grants. As part of this process it has been agreed that the proportion of PI time on the grants can be included. MRC understands this is going to be based on some form of broad brush arrangement in Universities to avoid the need for timesheets in universities but this will need to be monitored and audited!
USA[84]	30-100%	Overhead costs (AKA indirect costs or F&A costs - Facilities and > Administration) vary from institution to institution, and are sometimes capped for certain grant mechanisms (e.g., 8% for training and career > development awards). The rates are negotiated periodically and can be as low as 30%, and sometimes be 100% or more. The average these days is > probably around 50%.
Comments	Av approx 0-30%	A number of countries do not have on-costs charged to the research council. Where the system is used they are usually 30% or below (with the exception of the USA). The lower overhead charge rates in the countries studied allows the medical research funding bodies to purchase significantly more research per $ spent.

Table A2.2: Payments to Chief investigators

Country	***Chief Investigator payments***
Australia	There is provision within the Project Grants scheme for a Chief Investigator to seek to have his/her salary covered by the budget of a grant although justification for that request is required and approval is subject to the Grant Review Panel's consideration of that request. Salary is paid as a package which covers all on-costs and is based on the relative experience of the Chief Investigator.
Canada	CIHR does not pay a protected time allowance. We do have a completely separate awards competition to fund partially the salary of some of Canada's top investigators[85]. http://www.cihr-irsc.gc.ca/e/services/3736.shtml# Principal Applicants may not receive a salary, stipend, or honorarium from any CIHR grant. They may hold a CIHR salary award (e.g., an investigator award) or an award from a CIHR program, that explicitly allows for salary support of investigators (e.g., within a New Emerging Team.) co-applicants may not receive a salary, stipend, or honorarium from CIHR grants on which they are co-applicant.
Ireland	We have a number of different grant schemes which can be divided into 3 categories: research project grants, programme grants and fellowships. On research project grants and programme grants the chief investigators cannot apply for funding for their own salary. For the fellowship schemes the investigators full salary is paid.

[84] Comments provided by Minerva Rojo Director, Division of International Relations (NIH).
[85] Correspondence with Dr Alan Bernstein, President of the CIHR.

	Also it is hoped that a new clinician scientist scheme will be introduced which would cover part of the clinician's salary in order to free up some of their time for research.
Netherlands	The applicants themselves can apply for the support they need. As long as they remain between the boundaries of the granted funds, they themselves are free to request for the personnel they need[86].
New Zealand	Provides payments to Chief Investigators for the time on projects.
Sweden[87]	Research Council project grants do not cover payments for the principal investigator's (applicants) salary.
United Kingdom	
USA	Yes, for the per cent effort expended. The rate at which they are paid, however, cannot exceed the salary for employees in Executive Level I,
Comments	Canada, Ireland and Sweden do not provide payments to Chief Investigators on project grants. Australia, the Netherlands, New Zealand and the USA do provide payments to CIs on project grants.

Table A2.3: Grant application successes

Country	*History*	*Current*
Australia[88]	Projects funded in 2000 = 30% Projects assessed as fundable but not funded 37%	Projects funded in 2002 = 23% Projects assessed as fundable but not funded 34%. 57 % of projects applications are rated as fundable. Australia is funding 40% of fundable research.
Canada	Results of the September 1995 Operating Grants Competition 04/19/96 Council is pleased to announce that 203 of the 946 applications in the September 1995 Operating Grants competition have been approved for funding (see full list below). Funding of this number was made possible by a decision of Council to cut budgets to 77%, on average, of the amounts recommended by peer review committees. Council deeply regrets that, due to budget limitations, it has not been possible to fund a considerable number of applications that achieved high ratings in this competition. http://www.cihr-irsc.gc.ca/e/publications/2376.shtml	Currently[89], CIHR's overall success rate for project applications is 29%. This number is largely based on the results of our open competition – success rates for RFAs, Awards , equipment, etc will vary from this number. But the29% figure is a good measure of what the community looks at and certainly represents our largest investment.
Ireland	In 2000 Ireland was funding 25% of project grants.	In 2003 Ireland HRB funded 13% of project grant applications.
Netherlands		One of our biggest Schemes, our so

[86] Communications with Stefan Ellenbroek of ZonMw.
[87] Comments provided by Maria Starborg, Scientific secretary, Swedish Research Council.
[88] Data from NHMRC 2003 Performance measurement Report p34.
[89] Correspondence with Dr Alan Bernstein, President of the CIHR.

		called Open Competition (dep. of Science) has i.e. a score of ~15% in initial (short) applications; these applications are pre scanned, after which the most of the people who get the advise not to write a full application, don't write a full proposal. This means that ~40% of the full applications can be awarded. For other schemes, the success ratio differs greatly, but I think that the highest success ratio is somewhere between 50-60%, but this is in schemes in which only a selected number of institutes is requested to apply (mainly in dep. of health schemes).
New Zealand[90]	A high rate of 40% in 1996-97. A low rate of 20% in 2000-01.	The project application success rate currently stands at 23%[91] 2002-2003.
Sweden		61.7 % of projects applications are rated as fundable. 17% are getting funded. 28% of fundable research is getting funded[92].
United Kingdom		Overall total eg in 2002/3 strategic grants were 30% Cooperative components were 18% and the overall was 24%.
USA		A ballpark average is about 30%.

[90] HRC December 2003.

[91] Data from the HRC table *HRC Investment in Project Contracts through the Annual Contestable Funding Round 1993/94 – 2002/03*.

[92] Calculations based on data in the presentation to the Evaluation team by HRC staff "Annual Contestable Funding Round Overview: by Dr Andre George.

Appendix 3: The Health Research Council's goals, strategies and performance measures
(from 'Vision 2008', Oct 2003 draft, slightly abridged)

IMPORTANT NOTE: The details of HRC's Strategic Plan documents are CONFIDENTIAL to the Council until release of the final Plan

Goals	Strategies	Performance measures proposed	Consultant's comments
1. Maximising New Zealand's potential to conduct **excellent and relevant health research**	a) **increase investment** in all nine HRC **Research Portfolios** to support excellent quality relevant research b) **increase investment** in **research programmes** to 50% of total expenditure to enhance quality and quantity of research outcomes c) ensure all areas in which New Zealand has a **competitive advantage** are developed d) work with MoRST and other RS&T purchase agencies to ensure that **investment** in health research is **strategically managed through the HRC**	• number of contracts by **Research Portfolio**, by **discipline** and **type** of research • number of research **Programmes** and funding as **% of total** expenditure • number and **quality** of research outputs (**publications** and **patents**) • number of **research groups** identified as being **world-class** by their peers • investment in health research through **HRC as % of total government expenditure**	Proportional and normalised targets generally more useful. Goal to increase absolute funding on programmes more appropriate. For academic researchers, could be linked to the PBRF assessment process. Some measure of cooperation would be a more effective goal and indicator.
2. Fuelling the engine for health R&D through **investment in people**	e) re-establishment of **training fellowships** in **clinical research** f) re-establishment of **post-doctoral fellowships and PhD scholarships** in specific discipline areas of **biomedical** and **public health** research g) ongoing	• number of **clinical fellows** successfully completing training programmes • number of **Māori scholars and**	No. of PDFs and PhD scholarships in each area. Some measure of the **retention rate** in health research, career paths etc

Goals	Strategies	Performance measures proposed	Consultant's comments
	development of a **career development** programme for **Māori** h) ongoing development of a **career development** programme for **Pacific peoples** i) linkage of **research funding for fellows** to their fellowship support	**fellows** successfully completing training programmes • number of **Pacific scholars and fellows** successfully completing training programmes • number of **research outputs** arising from investment in research support for **scholars and fellows**	
3. Bridging the gaps in **careers** for health research	j) establishment of **fellowship(s)** to attract world-class **mid-career scientist(s)** to New Zealand k) expansion of the HRC's **Hercus Fellowship** which provides advanced post-doctoral support l) identification of **gaps** in national health research capability and investment in programmes to **build** the needed **capacity** m) development of **partnerships** with other funding agencies and research provider institutions to **attract health research scientists** to New Zealand n) **increased investment** in **Research Programmes** creating opportunities for **research teams** to expand their workforce	• number of excellent trained health research **scientists recruited** to or **repatriated** to New Zealand • number of **Hercus Fellows** appointed by HRC • evidence for implementation of **strategies** in areas of identified research capacity and capability needs • number of **partnerships with research providers** to attract scientists to New Zealand • number of **scientists recruited** from overseas on **research programme** contracts	Numbers are likely to be small. Qualitative measures of outcomes are needed too. (see 3j) Publications outputs of previous award holders (see 3j) (see 3j)

Goals	Strategies	Performance measures proposed	Consultant's comments
4. Taking advantage of New Zealand's **unique opportunities**	o) investment in research to develop Matauranga Māori (**Māori generated knowledge**) and to improve **health outcomes for Māori** p) investment in health research which addresses the **needs** and diversity of **Pacific peoples** in New Zealand and in the **region** q) investment in health research which addresses the needs and diversity of **other populations** (e.g. Asians, migrants, refugees) in New Zealand [93] r) exploitation of expertise and knowledge held in New Zealand (e.g. **sheep** models for foetal development) s) taking full advantage of the **significant international links** which exist for New Zealand health research scientists	• number of contracts supporting **Māori development and health outcomes** for Māori • number of contracts supporting **health outcomes for Pacific peoples** • number of contracts exploiting technology **platforms and expertise unique** to New Zealand • number of **international collaborative research** links	Capability development strategies are appropriate. Collaboration with FRST to identify exploitable technologies Include under Goal 5
5. **Global connections**: strengthening networks, adding value and raising New Zealand's profile	t) establishment of **international funding partnerships** to enhance research collaboration u) development of a **strategic partnership with NHMRC** to strengthen trans-Tasman health research initiatives v) enhancement of	• number of **international research funding** partnerships established • number of **joint initiatives** established by HRC and **NHMRC** • number of	Value of partnerships as percentage of project+ programme funds

[93] HRC **Priority population groups** are: Maori; Pacific peoples; Children & youth; Older adults; People with disability

Goals	Strategies	Performance measures proposed	Consultant's comments
	New Zealand's health research capability through participation in **bilateral and international networks** w) **increased** participation in **international clinical trials** and epidemiological studies	**international networks** for health research involving New Zealand • number of **international clinical trials** involving HRC	
6. Investment in research which contributes to **health sector policy and practice**	x) investment in **research to enhance** the delivery of key **health sector strategies** **y)** use HRC's **Partnership Programme** to deliver **cross-government solutions** for key evidence needs **z)** investment in **translational research** to enhance transfer of research findings to **clinical outcomes** aa) recognition and capture of the sector **convergence** opportunities from discoveries in the **life sciences** sector	• number of contracts linked to **priorities of New Zealand Health Strategy** • number of **Joint Ventures** established in **Partnership Programme** • number of contracts and funds invested in **clinical research** • number of contracts arising from research originally conducted in **biological / life science** sector(s)	Include under Goal 8
7. Ensuring New Zealand has the **infrastructure** to support high quality **health research**	bb) inclusion of the **health research** sector as a priority for **infrastructure** investment cc) development of **national and international** partnerships to facilitate access to **new technology platforms**	• evidence that **infrastructure needs** for a globally competitive health research sector are in place • number of **national collaborations** providing to health researchers access to technology platforms • number of **international**	

Goals	Strategies	Performance measures proposed	Consultant's comments
		partnerships providing to health researchers access to technology platforms	
8. Ensuring that the **economic benefits** of health research are captured for New Zealand	dd) investment in **translational research** which "adds value" to HRC funded research outputs ee) working with research providers to ensure timely protection and development of **intellectual property** from HRC research investments ff) HRC to actively participate in the implementation of the New Zealand **Biotechnology Strategy** gg) HRC to contribute to the development of a **regulatory and ethical framework** for conduct of biotechnologies relevant to health	• number of contracts in which research outputs contribute to **social knowledge and economic goals** • evidence of HRC's involvement in New Zealand **Biotechnology Strategy** initiatives • evidence of HRC's role in development of the **regulatory and ethical framework** for health **biotechnology**	

General Comments on improved performance indicators

Indicator development and reporting is a resource intensive and requires specific expertise. Generally, indicator collections need to maximise the use of:

- Time series
- System comparisons for meaningfulness.
- International comparisons

For each of these, examples of HRC current and proposed reporting practices are taken as examples, with suggestions then made on how they could be improved with a minimum of effort. The following discussion is not intended as a criticism of current practices but to show how with some modification, the presentation of information can be further improved.

Time series

The example for time series presentation comes from the HRC PAR 2002 and PAR 2003 documents. Both documents present a range of data but typically for only the last year. It is noted

that the [confidential] evaluation of the research portfolio system does present some time series data. However, in PAR 2002 and PAR 2003 the number of journal papers is reported for only one year. Any reader of both documents would notice that for the period June 2001 – June 2002, '768 journal articles were cited in annual reports received for the period' (HRC 2002b: 96), whilst for the period September 2002 – September 2003 '670 journal articles were cited by researchers as outputs of HRC funded research' (HRC 2003d: 79). These two data points may be incomparable for any number of legitimate reasons. However, there is no discussion of previous journal output performance in the latter report. If the numbers are developed on a different basis then the reader should be alerted; otherwise there should be some presentation of the time series. In fact, given the funding constraints there might be an expectation of falling journal output – but without presenting the data it is not possible to begin thinking about the drivers of the system.

System comparisons

Currently, the 'measures' that HRC has nominated in its Vision 2008 document are couched as simple numbers for various objectives. Being able to find out what the actual number of people involved or dollars spent (rather than indicators) is more important in a small system than for a large one, but they are also more prone to fluctuations. We would suggest that as they stand these measures could be supplemented to give greater insight and potential for evaluating performance. Some examples chosen from Vision 2008 with our commentary follows.

Vision 2008 Goal: *investment in people* – current proposed measures include:

- number of clinical fellows successfully completing training programmes
- number of Māori scholars and fellows successfully completing training programmes
- number of Pacific scholars and fellows successfully completing training programmes

Comments: Geisler (2000:75) points out 'a measure is simply a given quantity … conversely an indicator is a measure earmarked for the description or representation of a given event or phenomenon'. Therefore in this situation the number per se is not helpful. Budget constraints, difficulties recruiting potential applicants or any other factor may force a decline in the number of people completing their training. What might be a better indicator over time is:

- the number of completions over the number of positions funded.

This provides a benchmark indicator that informs HRC and other interested parties whether an improvement is necessary or whether the system is finetuned.

Vision 2008 Goal: *Investment in research which contributes to health sector policy and practice* – measures include:

- number of contracts linked to priorities of New Zealand Health Strategy
- number of contracts arising from research originally conducted in biological / life science sector(s)

Contract numbers alone says nothing about their value. The number could be increasing and the value decreasing. A possible change would be:

- percentage of overall expenditure that is linked to priorities in NZHS (or arising from life sciences sector. etc.

Such indicators build a capacity for monitoring the profile of the funding system over time.

International comparisons

The initiation of the national bibliometrics consortium is an excellent initiative. However, other international data are also available to compare systems. Organisations such as the US National Science Foundation and other health research councils have some useful performance measures. We note that HRC has in the past produced reports with international comparisons – e.g. *New Zealand Health Research: Putting excellence into practice* (HRC 2002a) – and encourage further international collaboration on health research performance measures.

Appendix 4: Consultations

The following tables list those people that the evaluation team contacted for data or held discussions with during the course of the project.

Health Research Council of New Zealand

HRC team	*Title of presentation*
Dr Bruce A Scoggins CEO HRC	HRC's Strategic Plan 2004-2008 "VISION 2008"
Dr Patricia Anderson Group Manager, Research Policy	The HRC's Research Policy Framework
Louisa Wall	A Strategic Framework for Māori Health Research
Karlo ('Ulu'ave) Mila-Schaaf Manager, Pacific Health Research	Pacific Health Research at the HRC
Sharon McCook Project Manager Partnership Programme	Catalysing Collaboration between Agencies: The HRC's Partnership Programme
Dr Andre George	Annual Contestable Funding Round Overview

New Zealand National Contacts

Interviewee	*Position*
Dr Anthony Rodgers	Co-Director Clinical Trials Research Unit University of Auckland
Professor Richard Faull	Head of Department Division of Anatomy with Radiology Faculty of Medical & Health Sciences University of Auckland
David Schaaf	Division of Community Health, FMHS University of Auckland Private Bag 92019
Dr Nigel Murray	General Manager, Building Programme Auckland District Health Board
Professor Norman Sharpe	Medical Director National Heart Foundation
Professor John Fraser	Head of School of Medical Sciences Faculty of Medical & Health Sciences University of Auckland
Professor Rod Jackson	Head of Department Department of Social and Community Health School of Population Health

Interviewee	*Position*
	University of Auckland
Professor Peter Smith	Dean Faculty of Medicine and Health Sciences University of Auckland
	MOH
Dr Don Smith (tel.)	Manager, Marsden Fund
Professor Graeme Fraser	Chair of the HRC
Dr John Smart	Foundation for Research, Science and Technology
Professor Linda Holloway	Assistant Vice Chancellor University of Otago Division of Health Sciences
Professor Chris Cunningham	Māori HRC Board
Professor David Green	University of Otago School of Medical Sciences
Professor Warren Tate	Department of Biochemistry University of Otago
Professor John Tagg	Department of Microbiology Founder of Blis
Dr Richie Poulton	Director Dunedin Multidisciplinary Health and Development Research Unit Dunedin School of Medicine University of Otago
Professor Mark Richards	Christchurch School of Medicine, University of Otago
Professor Christine Winterbourne	Christchurch School of Medicine, University of Otago
Michael Peters	NZVCC, Wellington
Professor Vernon Squire	PVC Research , Otago University

Ministry of Health

Elizabeth Knopf	Sector Policy
Paola Serle	Māori Health Directorate
Stephen Rungley	Sector Policy
Pam Fletcher	Sector Policy
Francis Dickson	Public Health Div.
Damien Zelas	DHB F&P
Francis Graham	Public Health
Cynthia Maling	Public Health
Carmel Peteru	Public Health
John Hobbs	Sector Policy

International Contacts

Roland Wise	National Health and Medical Research Council AUSTRALIA
Professor Kerin O'Dea	Director, Menzies School of Health Research AUSTRALIA
Dr John Condon	Research Fellow, Menzies School of Health Research AUSTRALIA
Dr Danielle Smith	Menzies School of Health Research AUSTRALIA
Dr Alan Bernstein	President Canadian Institutes of Health Research CANADA
Dr Norma O'Donovan	Evaluation Officer Research Funding and Policy Division Health Research Board IRELAND
Dr. Edvard P. Beem	Co-director ZonMw The Netherlands Organisation for Health Research and Development THE NETHERLANDS
Dr Stefan Ellenbroek	Staff member Strategic Policy and Board Affairs of the Netherlands Organisation for Health Research and Development ZonMw THE NETHERLANDS
Dr Maria Starborg	Scientific Council for Medicine The Swedish Research Council SWEDEN
Dr Peter Dukes	Strategy Manager for DH Partnerships and Foresight Medical Research Council UK
Dr Robert Eiss	Senior Advisor for Strategic Initiatives Fogarty International Centre (NIH) (currently on secondment to WHO) USA
Dr Minerva Rojo	Director, Division of International Relations Fogarty International Center U.S. National Institutes of Health USA
Alison Young	Consultant to the OECD and the Global Forum for Health Research

Appendix 5: OECD 'Frascati Manual' guidelines on identifying health-related R&D in GBAORD

8. Those seeking data on government funding of health-related R&D are often drawn to GBAORD because there is a specific category of socio-economic objective for this topic. However, they may not realise that this category only covers R&D whose primary purpose is the protection and improvement of human health (NABS 4) and that funds for relevant activities may be included in other categories.
9. The most important additional category is "General university funds and non-oriented research". The core coverage recommended for health in GBAORD is therefore:

– Health.

– General university funds and non-oriented research: medical sciences.

10. Health-related research funded for other objectives, for example military medical research, health and safety research at nuclear establishments or support for relevant enterprise R&D as part of industrial policy should also be included when available.
11. Countries that collect and report two-digit NABS data to Eurostat may include two sub-categories of aid to industry (Table 1):

– Manufacture of pharmaceutical products (NABS 0742).

– Manufacture of medical and surgical equipment and orthopaedic appliances (NABS 0791).

Table 1. **Identifying health-related R&D in GBAORD**

One-digit NABS	For countries using detailed NABS
Protection and improvement of human health	All
Non-oriented research	Medical sciences
General university funds	Medical sciences
Industrial production and technology	Support for the pharmaceutical industry Support for the medical instrument industry

Source: OECD.

12. Perhaps the most important gap is the health-related R&D included in general university funds or non-oriented research elsewhere than in the medical sciences, especially in the biological sciences. Where any R&D funded by health research councils or similar research programmes is included in non-oriented research, it may be possible to identify the health-related element of biology to be included.
13. Health-related R&D data derived from GBAORD give an incomplete picture of total public funding of such R&D, as GBAORD only covers the central government budget. Some health R&D may be funded by extra-budgetary public sources such as social security funds. Provincial and local governments may fund health R&D, particularly when they are responsible for higher education or for general hospitals. Where these sums are significant, an effort should be made to add them to the data derived from GBAORD in order to obtain a figure for total government funding of health-related R&D.

OECD (2002: 182-3)

Appendix 6: An evaluation of HRC-funded research

Terms of Reference

1. Determine the extent to which research outputs are accessible and assess levels of uptake.

2. Determine the current capabilities, capacity and areas where internationally recognised research excellence exists within the system.

An evaluation of HRC-funded research.

A key aspect of the Health Research Evaluation is to provide evidence and information on the benefits of investing in health research. The following section presents a number of the evaluative studies that the HRC has conducted to determine the outcomes of HRC-funded research.

The extent to which research outputs are accessible, and the level of research uptake
To identify the accessibility of research outputs and the uptake of research the HRC has adopted a set of performance indicators that provide quantifiable information on the outputs of its current research investment, case studies of research funded within the portfolio framework are also conducted, as are retrospective evaluations of research outcomes. The performance indicators employed by the HRC are collected each year through researchers' annual and final reports. All reports are peer-reviewed, while the information that is gathered on performance indicators is used collectively to identify the intermediary outputs of research. These outputs fall within the following themes: policy impact of research; research dissemination; commercialization of research; and research recognition[94].

The accessibility of research is identified through the dissemination of research findings to appropriate audiences, such as policy makers, stakeholders, other researchers, practitioners, and participants. Researchers are required to disseminate the findings of their research to appropriate audiences, and this is reported annually. The HRC's surveys on biomedical, clinical and public health research funded through Output Class 2 also provide evidence of the dissemination of research and accessibility of research outputs, including the ways in which research has been taken up into policy and practice. Included in this section are examples from these surveys that highlight the uptake of research into practice, and the impact that HRC-funded research has had on policy. This uptake is seen in the application of research into clinical practice, and its incorporation in clinical guidelines, as well as the engagement of researchers in groups developing policy and the implementation of research in health services.

Current research capabilities, capacity and areas where internationally recognised research excellence exists within the system
The HRC has conducted a number of case studies that highlight internationally recognised research, with the case studies included in this Annex identifying just some of the research

[94] An explanation of the indicators that are used within these themes is provided under the heading of *'Quantifying the Impact of HRC-funded research'*.

capabilities present in the national health research sector. The health research sectors' capacity and the growth of this capacity through HRC-funded research is also identified through the surveys of Output Class 2, while the HRC's annual workforce analysis[95] provides an overview of the current HRC workforce, identifying both the capacity and capability of this workforce.

The international standing of health research is also evidenced in the numerous collaborative relationships HRC-funded researchers have formed with international research groups, as well as the contribution researchers make to multinational organisations (such as the World Health Organisation), and input into policies and guidelines at a local, national and international level. These international collaborations provide the RS&T sector in New Zealand with access to new technologies and resources, as well as providing opportunities for researchers that, in turn, strengthens RS&T capacity in New Zealand.

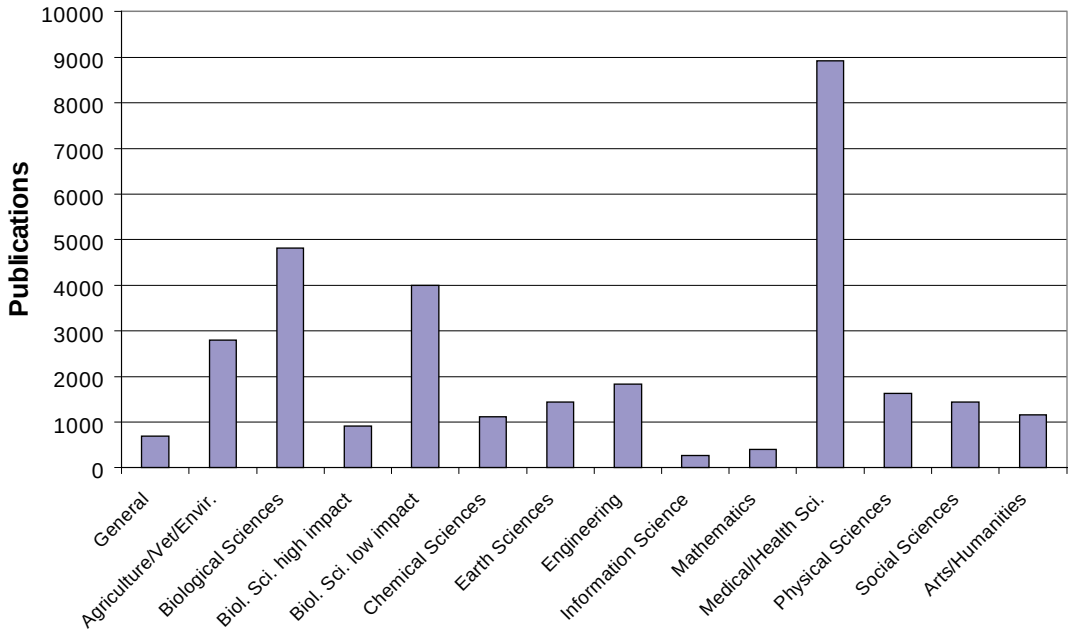
In 2002 the HRC, with the Foundation of Research, Science and Technology (FRST), the Royal Society of New Zealand (RSNZ) and MoRST undertook a bibliometric analysis of the Research, Science and Technology Sector. This analysis identified the performance of health research in terms of peer-reviewed publications, and areas of research strength were identified based on this quantitative measure. The following presents an overview of the findings of this study.

National Bibliometric Study

In total, 23,757 New Zealand-authored research publications were indexed in the ISI 1997-2001 National Citation Report database. The highest publication output for a subject was nearly 9000 papers for 'Medical Science' in the 5-year period from 1997 to 2001 – accounting for over a third of the total publications. The second largest subject field was 'Biological Sciences' (approximately 4800 papers), in which a number of publications relate to health research.

[95] The HRC"s annual Progress & Achievements Report presents the current HRC workforce. These documents are available from the HRC website: www.hrc.govt.nz.

Figure 1: Subject distribution of New Zealand-authored research publications, 1997-2001.



For the purposes of this analysis, health research publications were defined as all publications with a hospital and/or medical school address, plus those papers that were included within the ASRC 'medical/health science' category. In terms of citations by sector, the highest citation rate per paper was in the health sector (7.5), followed by the private sector (6.4), the tertiary sector (6.1), then CRIs (5.9).

Under a subject-based definition of health research (the ASRC medical science category), 1675 ISI-indexed health research papers were published in 2001, which represents 35 percent of New Zealand publications for that year.

In terms of collaboration, as identified by co-authorship, the largest degree of collaboration with overseas co-authors (48 percent) occurred in the health sector (New Zealand hospitals and medical schools). There was also a high degree of intra-sector collaboration, with 44 percent of collaborations occurring between two institutions within the health sector.

Health Research Council's Performance Indicators

The following information presents the indicators for research outputs that are collected annually for HRC-funded research. These outputs give some indication of the ways in which research is being disseminated, the engagement of research in policy, as well as the commercial application of research and the formation of research networks and collaborations.

Bibliometric Outputs from HRC-funded Research Between September 2002 and September 2003.

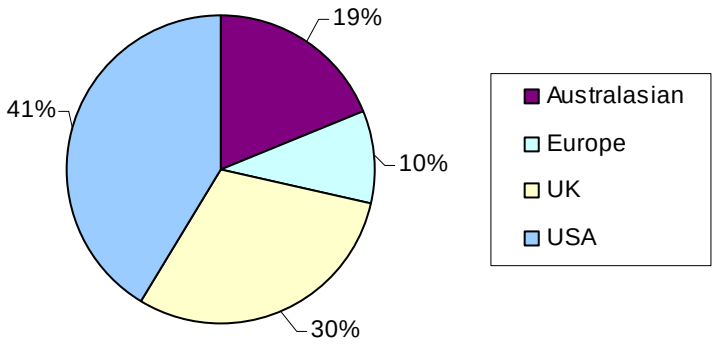
Journal articles
A total of 670 journal articles were cited by researchers as outputs of their HRC-funded research. Articles were only included in this analysis if they were published or 'in press' and were classified according to whether they were indexed (580 articles) or not (90 articles) by ISI, or Medline. An analysis of impact factors was undertaken on the 580 articles in peer-reviewed, indexed journals. The increase in this number over last year's analysis may be due to the HRC's new reporting database, which has improved the system for recording outputs from research contracts i.e. all outputs are submitted electronically by researchers into specific output fields.

The analysis captures all journal articles published during the contract, rather than the total number of publications that occur as a result of this research. As is evidenced in the research outcomes surveys for biomedical, clinical and public health, the publication of research findings is likely to continue for a number of years following the completion of a research contract. Consequently, analysis of outputs generated whilst the research is ongoing captures only a fraction of the outputs overall.

Articles were published in 276 different journals, with impact factors ranging between 0.147 for the *New Zealand Journal of Psychology* and 28.66 for the *New England Journal of Medicine*. The average impact factor across all publications was 3.64, with the greatest number of publications recorded in the *New Zealand Medical Journal* (58 in total). Australasian journals, as well as non-indexed journals, play an important part in disseminating research to stakeholders and end-users, and the majority of articles published in these journals are likely to impact on health sector management and services in New Zealand.

A large proportion of non-indexed journal articles were published in Australasian journals, but less than a quarter of indexed, peer-reviewed articles were published in these journals. Almost three quarters of the indexed articles were published in journals from the USA and the UK, with the remainder attributed to journals published in Australasia and Europe (*see* Figure 2 for a breakdown of journal by country).

Figure 2. A breakdown of articles according to the country of origin in which the journal is published.



The international recognition of New Zealand research is evidenced in the number of articles that researchers publish in prestigious, peer-reviewed journals such as *Nature Medicine* and *Science.* A list of the top 10 high impact publications arising from HRC-funded research in 2002/2003 is provided below, with the impact factor for the journal of publication and the primary Research Portfolio from which the contract was originally funded:

Sears MR, Greene JM, et al. A longitudinal, population-based, cohort study of childhood asthma followed to adulthood. *N Engl J Med* 2003; **349**(15):1414-22.
Research Portfolio: Determinants of Health [Impact Factor: 28.66]

Reid IR, Burckhardt P, Brown JP, et al. Bisphosphonates and osteoporosis. *N Engl J Med* 2002; **346**:2088-2089.
Research Portfolio: Non-Communicable Diseases [Impact Factor: 28.66]

During MJ, Cao L, Zuzga DS, et al. Glucagon-like peptide-1 receptor is involved in learning and neuroprotection. *Nat Med* 2003; **9**(9):1173-9.
Research Portfolio: Non-Communicable Diseases [Impact Factor: 27.93]

Caspi A, Sugden K, Moffitt TE, Taylor A, et al. Influence of life stress on depression: moderation by a polymorphism in the 5-HTT gene. *Science* 2003; **301**(5631):386-9.
Research Portfolio: Determinants of Health [Impact Factor: 24.38]

Roos D, Winterbourn CC. Immunology. Lethal weapons. *Science* 2002; 296(5568): 669-71.
Portfolio: Biological Systems and Technologies [Impact Factor: 24.38]

Bloomfield FH, Oliver MH, Hawkins P et al. A periconceptional nutritional origin for noninfectious preterm birth. *Science* 2003; 300(5619):606.
Portfolio: Health & Independence of Population Groups [Impact Factor: 24.38]

Loh J, Fraser J. Metal-derivatized major histocompatibility complex: zeroing in on contact hypersensitivity. *J Exp Med* 2003; 197(5):549-52.
Portfolio: Communicable Diseases [Impact Factor: 15.88]

Ishii H, Zanesi N, Vecchione A, Trapasso F et al. Regression of upper gastric cancer in mice by FHIT gene delivery. *FASEB J* 2003; 17(12):1768-70.
Portfolio: Non-Communicable Diseases [Impact Factor: 13.86]

Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S et al. Selected major risk factors and global and regional burden of disease. *Lancet* 2002 Nov 2; 360(9343):1347-60.
Portfolio: Non-Communicable Diseases [Impact Factor: 11.79]

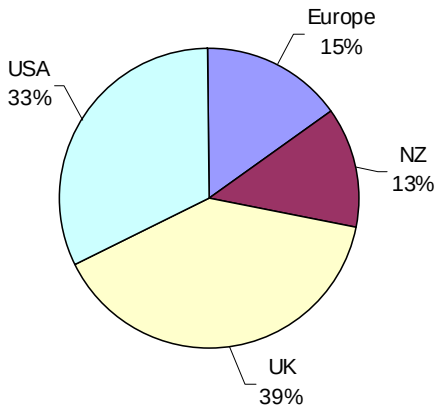
Poulton R, Caspi A, Milne BJ. Association between children's experience of socioeconomic disadvantage and adult health: a life-course study. *Lancet* 2002; 360(9346):1640-5.
Portfolio: Determinants of Health [Impact Factor: 11.79]

Books

A total of 46 books and book chapters were published, 39 book chapters and 7 books. These books cover a range of topics, from fetal nutrition, through to air quality and health, and biological agents. The majority of these books were published internationally (87 percent), with only six published in New Zealand. Figure 6 shows a breakdown of the countries in which these books were published, with almost three-quarters published in the UK and the USA (72 percent).

The list of publishers includes many well-known publishing houses, such as Cambridge University Press, Oxford University Press, and J Wiley & Son, and is an indication of the recognition that is given to New Zealand research internationally.

Figure 3. A breakdown of the country of publication of books published over the past 12 months, to which HRC-funded researchers have contributed.



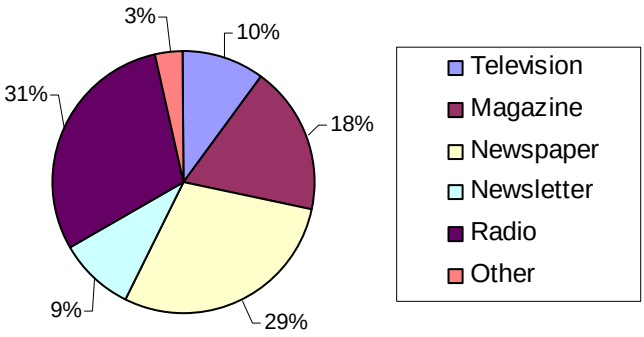
Media

Researchers were involved in a number of media events, with 117 individual outputs identified through this medium of dissemination. This figure is not representative of all outputs generated in this area, as for many researchers it is difficult to quantify these types of outputs, which occur relatively regularly. This information does, however, provide us with an overview of the types of dissemination HRC-funded researchers are undertaking, and how they actively engage a wider audience through the public dissemination of their research findings.

While the majority of these outputs occurred at a national level, HRC researchers also disseminated their findings internationally. This included articles published in *The Economist*, the *New Scientist* and the *New York Times*, as well as radio interviews in the USA and Singapore, and television appearances on Australia's ABC Science Online. One researcher also had their research chosen by organisers of the European Society of Cardiology for European press release.

Newspaper articles (29 percent) and radio broadcasts (31 percent) were the most common medium through which researchers disseminated their research to the public, followed by magazine articles (18 percent). Researchers had their work profiled in magazines such as the *National Business Review*, *Metro*, and *North & South*. A breakdown of the media dissemination is provided in Figure 4.

Figure 4. A breakdown of all media outputs generated from current HRC contracts.



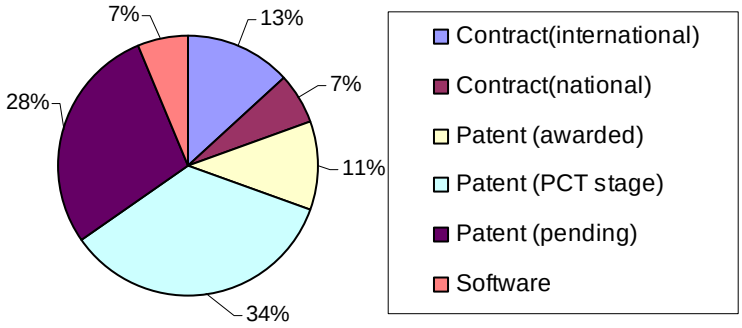
Commercial Application

There were 46 outputs indicating the potential and successful commercial application of HRC-funded research in the 2002/2003 period. Almost a third of these outputs are patents at the Patent Corporation Treaty (PCT) stage, followed by patents pending, and international contracts. The outputs recorded are primarily in the area of fundamental biomedical research, and include research groups led by Associate Professor Christopher Williams, Professors Bill Wilson and William Denny, and Dr Alistair Gunn.
Examples of these outputs include:

- the development of software for clinical analysis of cardiac magnetic resonance images;
- a contract with Pfizer Global Research for the structure-based design of anti-cancer drugs;
- a contract with Exelixis, Inc USA to generate transgenic zebrafish for biodiscovery research;
- patents awarded for the preparation of prodrugs, and
- a patent to cover research that is developing methods of enhanced delivery of candidate antigens using modified superantigens.

A breakdown of the types of commercial applications from HRC-funded research is provided in Figure 5.

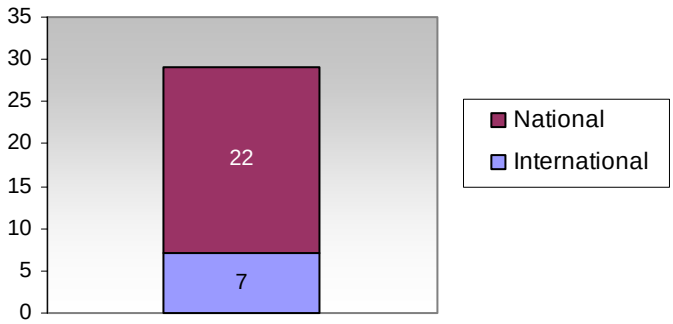
Figure 5. Breakdown of commercialisation outputs from HRC-funded research for 2002/2003.



Recognition of Research Accomplishments

Recognition of a researcher's accomplishments in their field of research comes in a variety of forms, one of which is the receipt of an award. Of HRC-funded researchers, 29 recorded the recognition of their research through the receipt of an award. These awards were both national and international (*see* Figure 6), including awards for best poster or presentation at a conference, the Health Innovation Award, appearing in the Queen's Birthday Honours List, the receipt of the Royal Society of New Zealand Award, as well as a number of study and travel awards through universities, the medical foundations, and charitable organisations such as the National Heart Foundation of New Zealand, and the Maurice & Phyllis Paykel Trust.

Figure 6. Breakdown of national and international awards



Policy Impact of HRC-funded Research

The impact of HRC-funded research on policy occurs through a number of mediums, including: submissions to parliamentary bills; membership on advisory committees; participation in policy workshops; guidelines; and commissioned reports, to name but a few. The HRC collects these

inputs and aggregates them on a local, national and international level, as well as the medium through which this policy impact is occurring. Although journal articles and books undoubtedly feed into policy, for the purposes of this analysis, policy impact is measured as information that is directly targeted at developing policy through governmental departments, and multinational organisations, such as the WHO.

In total, 78 outputs were attributed to policy development, with two thirds of these outputs impacting on national policy. While this number is higher than reported in previous years, it is still well below what we believe is the actual involvement of researchers in policy development. However, the outputs reported illustrate the diverse range of activities that researchers are involved in, in terms of influencing and informing policy development.

The majority of the input to national policy was provided through the involvement of researchers in the drafting of ministerial reports (23), and on advisory committees (10). Researchers made the greatest contribution to international policy development through reports. A breakdown of all policy outputs is provided in Figure 7, with a breakdown of national and international policy outputs given in Figure 8.

The impact of research on policy development covered a broad range of stakeholders, including DHBs, the Ministry of Health, the Ministry of Youth Affairs, the Treasury, the Ministry for the Environment, and the Ministry of Social Development. The topics covered were similarly varied, and included the following reports: '*Nga Ahuatanga Noho o te Hunga Pakeke Maori: Living Standards of Older Maori'* (Ministry of Social Development); '*Nutrition and the Burden of Disease: New Zealand 1997-2011'* (Ministry of Health); and '*Health Effects Due to Motor Vehicle Air Pollution in New Zealand*' (Ministry of Transport).

Figure 7. Breakdown of the type of outputs that have impacted on policy in the last 12 months.

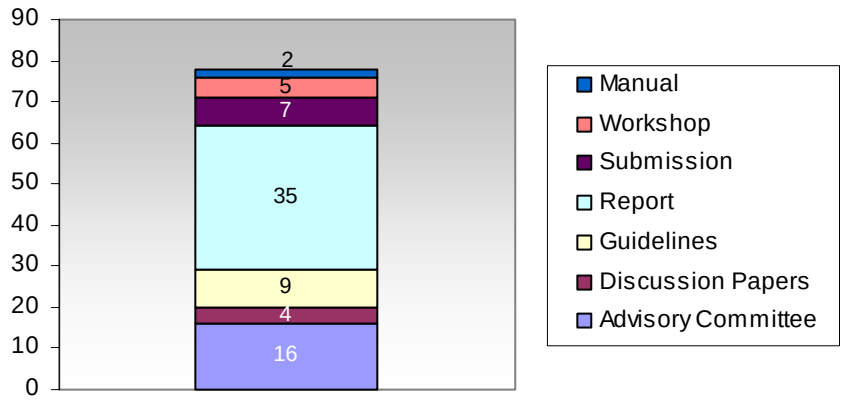
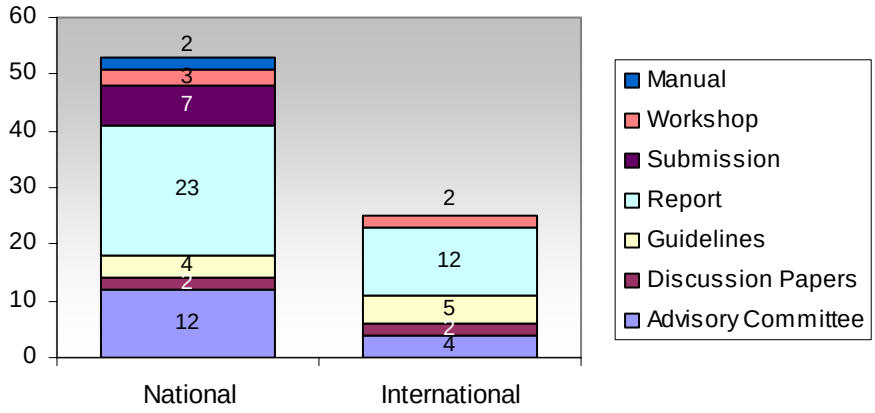
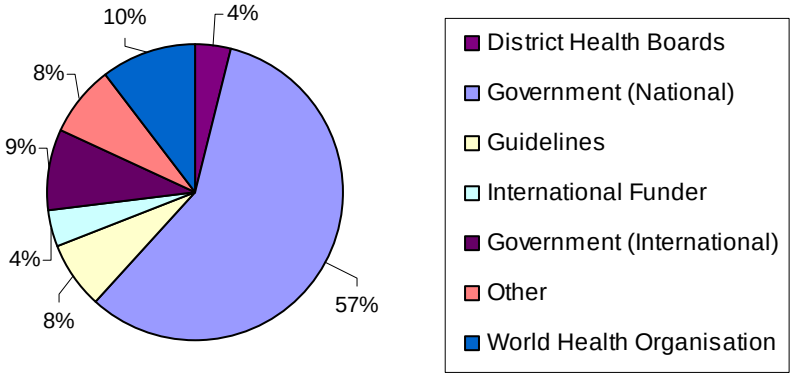


Figure 8. Breakdown of the type of outputs that have impacted on policy at a national and international level in the last 12 months.



Internationally, researchers have also contributed to the development of policy through eight WHO reports, government reports and membership of expert working groups. A breakdown of the agencies and stakeholders that HRC-funded researchers have contributed policy advice to is provided in Figure 9.

Figure 9. Breakdown of the type of outputs that have impacted on national and international government policy in the last 12 months.

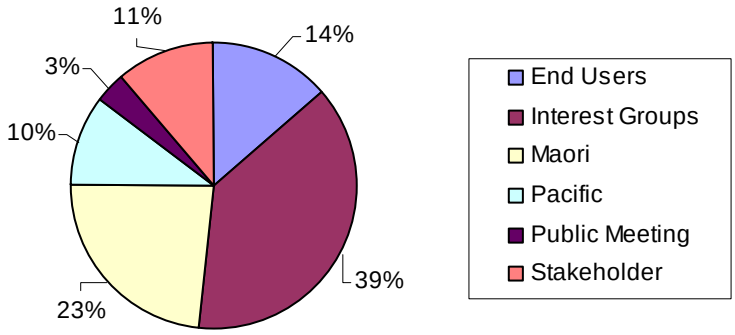


Meetings, Hui and Fono

In 2002/2003 researchers presented their research at 212 national (64 percent) and international (44 percent) hui, fono and meetings (including scientific meetings). Research findings reached a broad audience that included stakeholders (e.g. the Ministry of Youth Affairs and the Ministry of Health); and interest groups (e.g. the Lions Club and the Rotary Club); as well as end-users (e.g. primary community services and Plunket nurses); and research participants.

The majority of international meetings were scientific meetings. Figure 10 provides a breakdown of meetings held to disseminate research findings in New Zealand, and provides comparable information to the analysis of meetings, hui and fono provided in the Progress and Achievements Report in 2002. In total, researchers have recorded 116 national meetings. Research was most widely disseminated to interest groups (39 percent), closely followed by Maori and Pacific Peoples (33 percent).

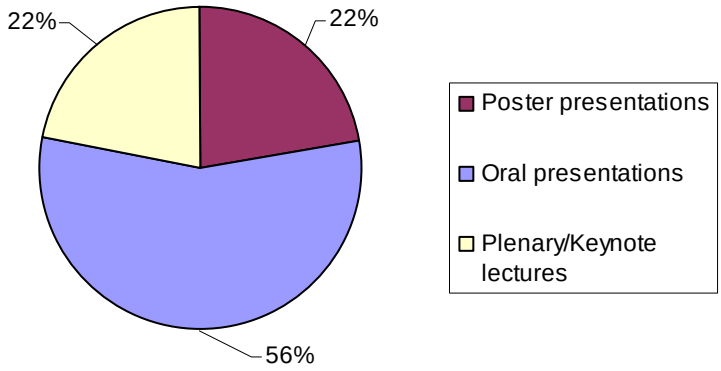
Figure 10. A breakdown of meetings to disseminate research findings in New Zealand, by target audience.



Conferences

During the 2002/2003 reporting period, HRC-funded researchers recorded 596 contributions in relation to national and international conferences. These contributions included the delivery of keynote or plenary lectures (69), oral presentations (456) and poster presentations (71). From these presentations 282 conference proceedings were published. Figure 11 provides a summary of these contributions (excluding conference proceedings, which are included in the total for oral and plenary presentations).

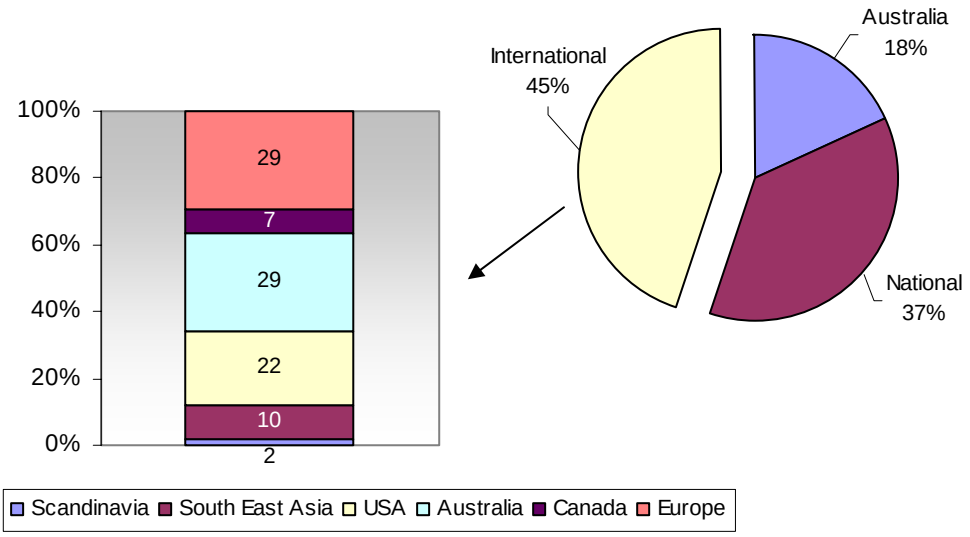
Figure 11. A breakdown of the types of contribution to national and international conferences made by HRC-funded researchers in 2002/2003.



A significant number of these presentations were keynote or plenary addresses, which serve as an indication of the quality of HRC-funded research in the international context. These keynote addresses were presented at a number of conferences, including the Xth Annual International Conference in Advances in Pediatric Neonatology, the Food for Life International Conference, and the Shaping the Future, Contemporary THEMHS in Mental Health Services Conference.

International conferences accounted for over half of all conference outputs (63 percent). It is pleasing to note the wide dissemination of HRC-funded research, and the opportunity that affords for the development of research networks and the establishment of research collaborations. Evidence of the importance of conferences in terms of building research networks is peppered throughout the research profiles. Figure 12 presents a breakdown of the regions in which these international conferences were held.

Figure 12. Location of conferences in which HRC-funded researchers have presented their research.



Note: This includes oral presentations, keynote or plenary lectures, and poster presentations (these figures do not include conference proceedings).

Collaborations

In total, researchers reported 217 collaborative ventures (on average, 50 percent of contracts involve an international collaboration). More than half of these collaborations involved international researchers, and the remainder were split equally between local and national collaborations (*see* Figure 13 for a breakdown of these collaborations). Of the collaborations formed with international groups, the greatest numbers were with groups in the United States (38 in total), followed by Australia (23 in total) and Europe (23 in total). A breakdown of collaborations by country is given in Figure 17. Examples of these collaborations include: researchers based at the University of the South Pacific, Samoa's Ministry of Health, researchers at Stanford University, researchers based at the National Institutes of Health in the United States, and the World Health Organisation.

Local and national collaborations were predominantly with university-based researchers (77 percent in total), with the remainder of research collaborations formed with community groups and iwi, District Health Boards, the Ministry of Health, Crown Research Institutes, NGOs, and one collaborative venture with industry (Healtheries of New Zealand Ltd).

Figure 13. HRC-funded research and local, national and international collaborations.

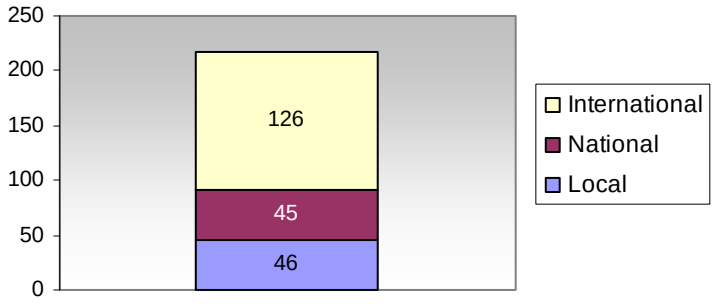
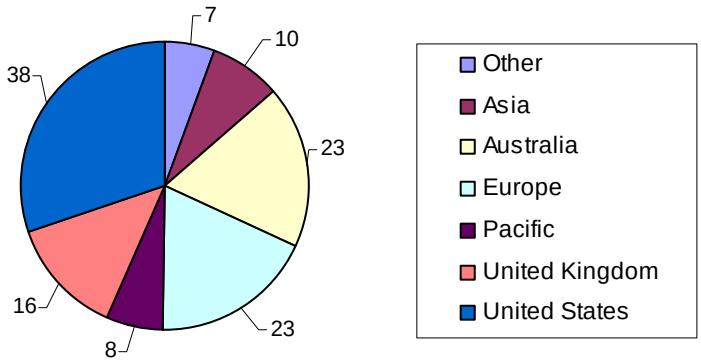


Figure 14. A breakdown of international collaborations by country.



The Outcomes of Biomedical, Clinical and Public Health Research

In 2002 and 2003 the HRC undertook a survey of biomedical, clinical, and public health research with an expiry date between 1994 and 1999. These surveys used both quantitative and qualitative methods to collect information on the outputs and outcomes of HRC-funded research during this period. The following section outlines just some of the examples in the survey results of the application of HRC-funded research, and the capabilities in the health research sector.

NB. The following section consists of extracts from all three surveys that address aspects of the Terms of Reference 3 and 4. This section does not present the surveys in their entirety.

Public Health Research Outcomes Survey

Main Findings of the Self-administered Questionnaire:

Almost all first named investigators that responded to the questionnaire had reported the findings of their research (97%), with the most common output for both contract types (public health limited budget projects and project contracts) being peer-reviewed publications (87%). More than three quarters of the respondents (80%) believed that their research had influenced policy to improve public health, and 67% thought that their research had influenced practice. Three quarters of the respondents (76%) stated that their contracts had led to further research.

Building Capacity and Capability

Half of all research projects contributed to the building of research capacity through postgraduate training, with a total of 40 postgraduate qualifications attained. Projects accounted for 65% of these qualifications, the majority of which were PhDs (55%), while limited budget projects accounted for the remaining 35%. In terms of building the capacity of the Maori and Pacific research workforce, 18% of research contracts included Maori within their research team, while 7% included Pacific peoples.

Public Health Research Outcomes Survey - Interviews

The interviews were aimed at gathering more in-depth information on a number of the themes that were covered in the questionnaire, and were not intended to provide comparative information on limited budget projects and project contracts. In total eight semi-structured interviews were conducted. An analysis of the interviews divided these themes into eight categories: research and its application in policy and practice; the dissemination of research and strategies for its enhancement; the forming of collaborations and networks during research; career development and the building of group capabilities as a result of research; access to policy makers; further research funding opportunities; as well as the progression to further research as an outcome of the initial research contract.

Interviews

All researchers interviewed considered their research to have had an impact on policy or to have been taken up into practice. The utilisation of the research would often become apparent at a later date, with one researcher who did not initially feel their research had any impact, subsequently finding that people were referring to their research, and that it had been used for a similar study in Denmark. Likewise, an epidemiological study that was conducted in 1998, and was of relevance to Maori and Pacific peoples, was still generating

interest from people in Canada and Alaska in terms of its applicability to the Inuit populations of these countries.

The utilisation of research is often dependent on the nature of the research, with applied research, such as that which aims to improve health service delivery more likely to impact on policy or practice. For one interviewee working in this area, they considered their research to have failed if it was not utilised. The applicability of research into practice was a consideration for researchers during the conduct of their research, and for one researcher stakeholder involvement improved the chances of this happening:

… "we're always looking for research opportunities which will offer both an opportunity to enhance basic science and an opportunity to provide some practical input to the people that we're studying. Because this is workplace research it's obvious that there's going to be implications always for the workforce involved, and that's why we work wherever possible in collaboration with the workforces – the workforce representatives and management representatives involved in the studies – so that we can all be looking with an eye to how change can be made on the basis of results."

Researchers noted the impact of their research on policy and practice both nationally and internationally. In a two-year project that expired in 1995, a publication resulting from this research had been referred to in a number of background papers in relation to UK policy, as well as being published by UNICEF, while nationally the research findings had been included in a number of the Ministry of Health's strategic documents.

Those interviewed attributed their research to the development of interventions, and as resource tools for the training of medical students, as well as the improvement of health service delivery.

The majority of researchers interviewed considered it relatively easy to disseminate information to policy makers, with access resulting from the involvement of researchers on advisory committees, as well as personal networks and approaching the *"right people with the right information"*. One researcher felt that it was often the case that you needed to be involved in advisory groups to have your research noticed by policy makers. A researcher who had previously worked for an NGO did not consider it to be easy to access policy makers within government departments, and found NGO's were more likely to take notice of their research results.

The importance of disseminating research in peer-reviewed journals was noted by researchers, as was the need to disseminate results on a national and local level to end users and stakeholders, as well as the participants and communities involved in or affected by the research.

"From my perspective there are two target audiences, the first are participants, to whom I think we have an obligation to get information back in an understandable and useful form, and the second is to scientific peers, so that the work will have more impact and become part of the body of knowledge."

As with the applicability of research in policy development or its uptake into practice, the means of dissemination is integrally related to the type of research conducted. For researchers involved in studies that had an impact on communities, it was important to them that their findings reached these groups. Community feedback involved fact sheets and newsletters, as well as community meetings, and media work to inform the community involved of the findings. For another researcher the involvement of stakeholders in the research, which included a Pacific cohort, ensured that the research was disseminated to the Pacific community and end-users.

The importance of disseminating results in national journals was raised by two researchers, as was a dilemma in relation to disseminating in national as opposed to high impact international journals. For both researchers it was important to publish in national journals so that there was the opportunity for the research to have an impact at this level. The dilemma was raised in relation to publishing in prestigious international journals that reflected well on a researcher's CV, but did not carry the same weight in terms of influencing factors as national journals.

A number of themes emerged in terms of enhancing the dissemination of research results, including media training of researchers, time allocated to the writing up of results, as well as an increase in funding for international conferences. Three researchers felt that funding for international conferences should be made available and/or increased, as conferences provided researchers with opportunities to develop networks with other researchers working in their field. In terms of the importance of conferences, one researcher considered it to be:

… "the networking – you find out whose doing what; what work is going on that hasn't been published that you don't know about; where you might link in with that; whether there are comparisons to be made; whether or not you could work together, and that in turn can be a catalyst to further research."

Two researchers commented that the HRC's allocation for conferences was insufficient for the cost of attending an international conference, and that this was a deterrent in attracting postdoctoral fellows, for whom conferences acted as an incentive in terms of career development mechanisms. Time and/or budget restrictions were also cited as issues in relation to writing up research results.

Half of the researchers noted the important role the media played in the dissemination of research findings, and felt that researchers should be given training in terms of media liaison. The HRC's media guidelines document (HRC, 2000) was cited as a useful resource, while suggestions to enhance dissemination via the media included the introduction of researchers to 'responsible' journalists, and support for researchers in disseminating their findings through this medium. Other suggestions for dissemination included a summary of HRC-funded research on the HRC's website.

All researchers interviewed had formed networks with other researchers, and these included informal networks based on a shared research interest, as well as both national and international collaborations involving the actual design and methodology of the research and its implementation.

Four research projects had involved collaborations with stakeholders and end-users and another had involved researchers based overseas. Research looking at health service delivery included collaboration with a number of the agencies under review, with advisory committees made up of individuals from each agency, as well as Maori, Pacific and consumer representatives. These collaborations were considered to have influenced the dissemination of the research findings and their application:
… "they had a major influence on the research design itself, in that the questionnaires, the topics that were covered and the interviews and so forth were shaped by them… We wanted to ensure that the questions we were asking would be of relevance to the people in those agencies."

In terms of career development, the majority of the research projects contributed to the training of researchers and their attainment of qualifications. Two of the limited budget projects had contributed to the named investigators' PhDs, while one limited budget project had contributed to a PhD, an Honours dissertation, and three Masters theses. Two of the named investigators interviewed did not consider their research projects to have contributed to career development, although one of these projects did in fact support and train a young Pacific researcher who has continued their involvement in research. Two of the researchers considered their projects pivotal in their career development, with one researcher crediting their HRC contract with a change in career, and the other for establishing their research career.

In terms of developing the capabilities of research groups, HRC funding was cited as being fundamental in the establishment and growth of one research group. The leader of this research group originally came back to New Zealand on an HRC Repatriation Fellowship and set up their group, which to date has included two HRC Training Fellows, both of whom completed PhDs, and a PhD candidate with an HRC Maori Health Postgraduate Scholarship.
All researchers reported that their research had led onto further research in the area, if not the actual topic itself.

… "the limited budget grant seeded a bigger study and this following piece of research contributed to PhD theses. One of these theses was completed last year and the data has been disseminated through a number of avenues… this second study has again generated data that has led to another study. So from that original limited budget grant a whole series of studies has evolved."

For one researcher working with Pacific communities, although the research that was conducted did not lead onto further research in the area, it was invaluable in terms of forming relationships with the communities involved, with research in other areas developing from these connections.

Five of the researchers interviewed felt that HRC funding had provided them with further opportunities for funding from other agencies. Two researchers did not feel that their research funding had opened any doors with regards to funding from other organisations, while one researcher had not required further funding. Of those researchers who considered that their HRC funding had played a part in allowing them access to further

funds, the reasons given were based on the success associated by other organisations in acquiring HRC funding, and the credibility of the HRC's peer review process:

… "my perception is that the HRC funding, because of its rigorous peer review process is highly regarded, and if you pass that hurdle than that's a tick in your credibility box so to speak, in terms of the quality of what you do."

Biomedical Research Outcomes Survey

Results of the Self-administered Questionnaire:

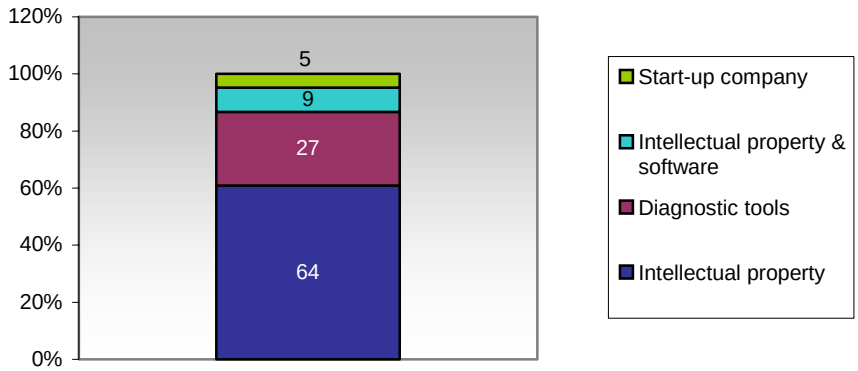
The following section presents the results of the biomedical self-administered questionnaire and extracts from the case studies that address objectives 3 and 4 of the Health Evaluation.

NB. The following are extracts only, and are not presented in their entirety.

Application and commercialisation of research

Seventeen percent of research had led to the development of software, intellectual property or diagnostic tools. Of this research, 64 percent of projects had led to the development of intellectual property (e.g. patents, licenses), 27 percent to diagnostic tools, and 9 percent to both intellectual property and software. Five percent of the research had led to the development of a start-up company.

Figure 15. A breakdown of the commercial applications reported by respondents as arising from their HRC-funded biomedical research.



Examples of the commercialisation and application of research included diagnostic tools for automated (CAG) repeat length determination relevant to Huntington's disease, the development of software for use in clinical testing, and the licensing to a company in the United States of a monoclonal antibody to lens Connexin 50.

Significant Advances in Research

Researchers were asked to report on any significant advances that they considered their research had made to their field of study, as well as unexpected findings that had resulted from the research and were likely to advance knowledge in this area. Respondents who did not specify these advances or findings were not included in the analysis below.

Eighty-five percent of researchers felt that their findings had contributed to significant advances in their research field, while 64 percent of researchers said that their research had resulted in unexpected findings.

The following are just some of the responses that respondents gave when asked to provide details of key findings from their HRC-funded research:

- The research demonstrated an entirely new mode of action through which superantigens attack the human immune system. The research also revealed the basis by which the toxin SpeB triggers off the "flesh-eating" disease necrotising fasciitis.

- The research demonstrated that the natriuretic peptides, hormones recognised primarily for their role in control of blood pressure and volume, are expressed in the brain in regions not traditionally thought of as cardiovascular control centres. Furthermore, physiological challenges to salt and water balance resulted in changes in natriuretic peptide expression in the hippocampus (memory), cerebellum (motor control) and sensory facial nerves.

- The research contributed to knowledge of the bacteriocins of Streptococci and their potential role in control of infections in humans.

- The research resulted in the establishment of a clinical MRI facility for research and clinical use in Auckland; with two new methods for analysing magnetic resonance images developed. The development of analysis software resulted in 10 times improvement in speed.

- The research provided a detailed understanding of the chemical, cellular, and molecular pathology in the human brain in Huntington's disease and Alzheimer's disease, showing that brain cells die by apoptosis in these diseases. It also demonstrated that transplanted fetal neurons grow, survive and form replacement brain cells in an animal model of Huntington's disease. In addition, the research showed the localisation of marijuana (cannabinoid) receptors in the human brain.

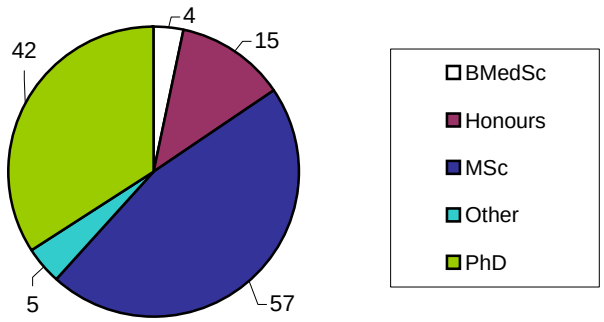
- The research developed the concept of purinergic regulation of hearing sensitivity. A new discovery in how the cochlea regulates the electrochemical driving force for sound transduction and how ATP provides a co-transmission/neuromodulatory role in auditory neurotransmission.

- The research provided the first detailed sequence (109,000 base pairs) of a large human intron that appeared to be involved in the aetiology of Duchenne Muscular Dystrophy. It showed that this intron (in contrast to neighbouring introns) has increased steadily in size over a period of 100,000 years and first suggested the hypothesis (expanded in later research) that the instability of this portion of the genome might be a consequence of distortion in chromatin structure.

Building research capacity

In total, 75 percent of research contracts had contributed to the training of postgraduates. Respondents reported the successful completion of 123 academic qualifications by students working on their HRC-funded research. Figure 16 presents a breakdown of the academic qualifications gained as a result of this research funding. In addition, thirty-two postdoctoral fellows were supported through the respondents' contracts.

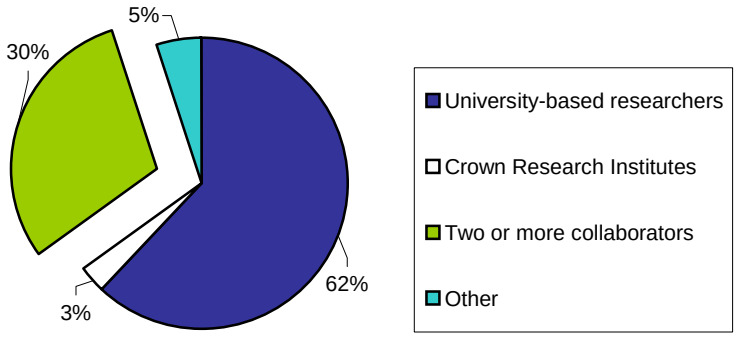
Figure 16. Academic qualifications gained by students working on HRC-funded research contracts.



Establishment of Networks

Sixty-two percent of respondents said that their research was part of wider national or international research collaborations. Of these collaborations, 59 percent were international, 30 percent were national, and 11 percent were both national and international. Nearly a third involved university-based researchers (62 percent), with 30 percent involving more than two collaborators (*see* Figure 17).

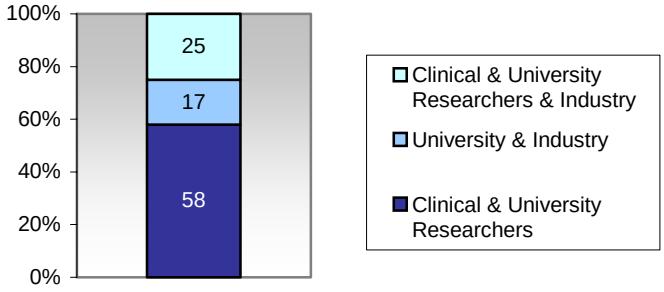
Figure 17. Research collaborations formed by HRC-funded biomedical researchers



Three percent of collaborations involved Crown Research Institutes (CRIs), while 5 percent did not fit within the categories defined in the survey[96]. Figure 18 illustrates the types of research collaborations that involved two or more collaborators.

[96] Collaboration categories included university-based researchers, clinical researchers, industry, and CRIs.

Figure18. Research collaborations involving two or more collaborators.



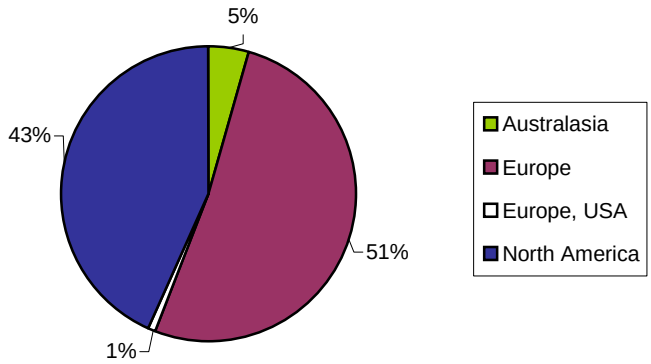
Dissemination of Research

Nearly all respondents (98 percent) had reported the results of their research, with half of these researchers anticipating that further publications would arise. Almost all had published their research findings in peer-reviewed articles (97 percent), with 475 peer-reviewed journal publications listed by researchers - an average of 8 publications per research contract. The maximum number of publications to result from a research contract was 36.

Out of the 475 peer-reviewed journal articles reported, researchers provided information and copies for 396 articles that were indexed by the National Library of Medicine and the ISI citation indexes. These 396 articles were spread across 166 journals in total, with the majority published in North American or European journals (only 5 percent were published in Australasian journals in comparison to 32 percent for the public health research outcomes survey), see Figure 19. The journal that published the greatest number of articles was Biochemistry (14 articles in total) followed by the Journal of Molecular Biology (11 articles in total), see Table 1.

A quarter of researchers reported publications in other journals and professional magazines, with almost a third (27 percent) reporting outputs in the form of books and book chapters. Three quarters of researchers had reported the results of their research at conferences, both with published proceedings (62 percent) and without published proceedings (65 percent).

Figure 19. A breakdown of the country/region of publication for journals in which articles arising from the research were printed.

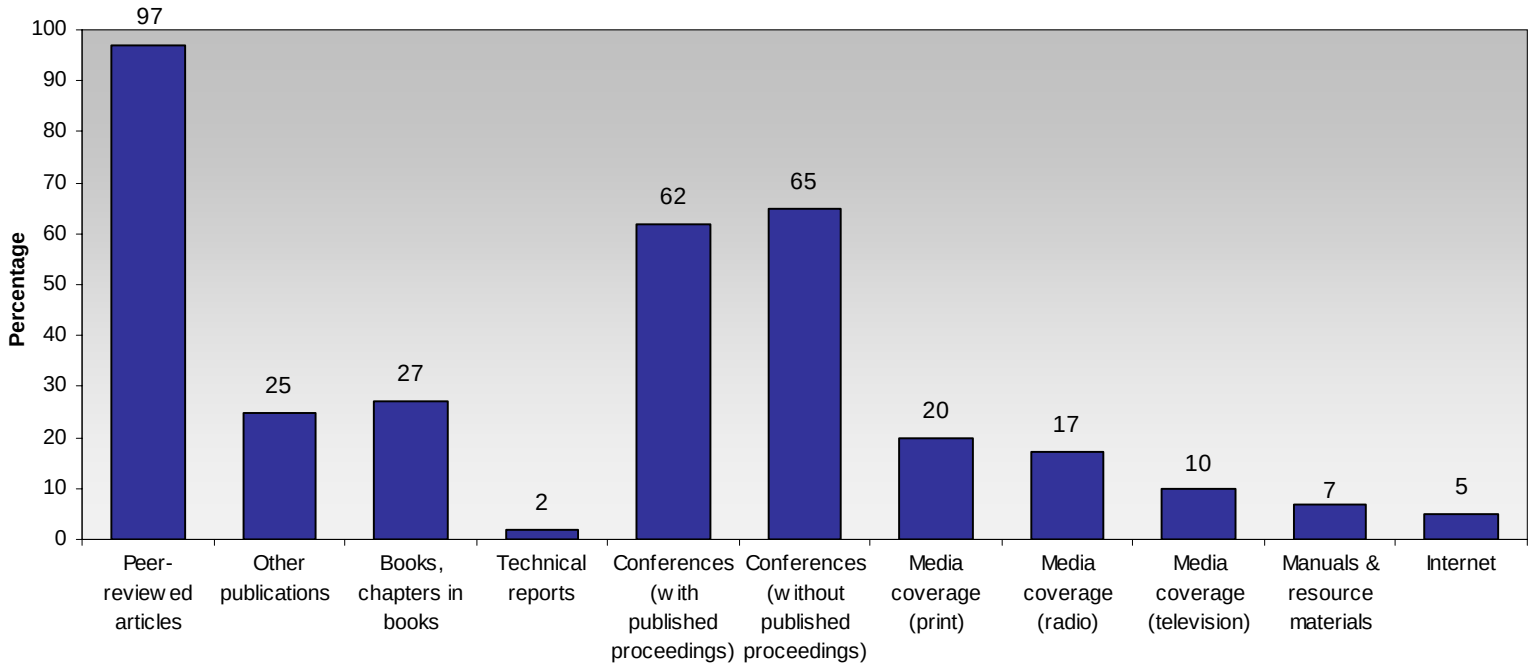


Media coverage was a dissemination medium used by just under a quarter of researchers, with the majority of coverage attributable to printed media material (20 percent), followed by radio coverage (17 percent) and television coverage (10 percent). Less than 10 percent of research contracts led communications in the form of manuals and resource materials (7 percent), and the Internet (5 percent), with 2 percent attributed to technical reports. See Figure 20 for a breakdown of the different types of dissemination output.

Table 1. Journals publishing HRC-funded biomedical research.

Journal	Number of articles
Biochemistry	14
Journal of Molecular Biology	11
Neuroscience	10
Hearing Research	10
American Journal of Physiology	10
Clinical and Experimental Pharmacology and Physiology	9
Acta Crystallographica Section	9
Others (7 or less publications each)	323

Figure 20. Outputs arising from HRC-funded biomedical research.



Clinical Research Outcomes Survey
Results of the Self-administered Questionnaire:

The following section presents the results of the clinical research self-administered questionnaire and extracts from the case studies that address objectives 3 and 4 of the Health Evaluation.

NB. The following are extracts only, and are not presented in their entirety.

Establishment of Networks
A third of those interviewed said that their research had been part of a wider national or international collaboration. Of these collaborations, 53 percent were national collaborations, while 47 percent involved international collaborators. The majority of these collaborations involved more than two collaborators, with 16 percent involving collaboration with university–based researchers, and 5 percent each attributable to health practitioners, industry or 'other'. Figure 21 provides a breakdown of these collaborations, and Figure 22 provides the same level of detail where two or more collaborators were involved.

Figure 21. Research collaborations formed by HRC-funded clinical researchers.

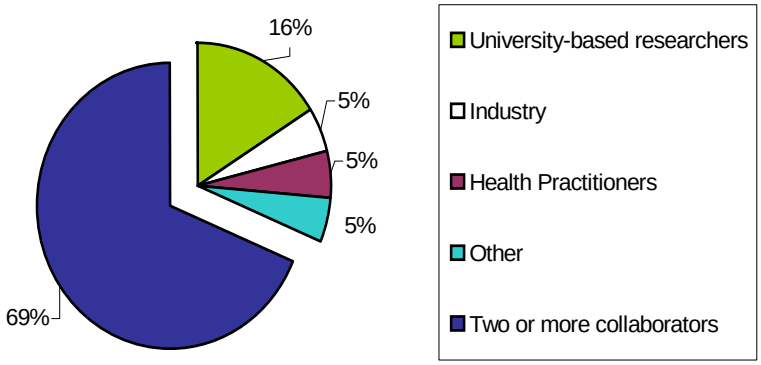
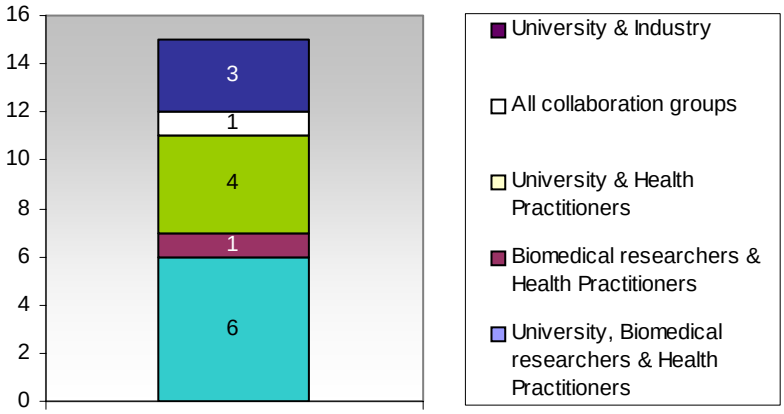


Figure 22. Clinical research collaborations involving two or more collaborators.



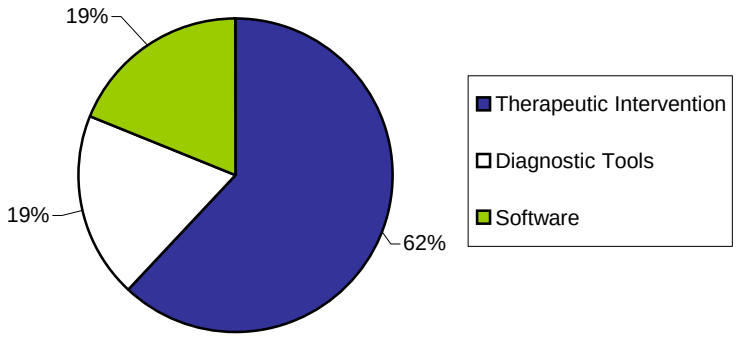
Clinical application of research

Almost a quarter of respondents (21 percent) reported that their research had resulted in the development of therapeutic interventions, such as diagnostic tools and/or software, with the majority of these developments being therapeutic interventions. None of the research had contributed to changes in systems management. Figure 23 provides a breakdown of the outputs within this category.

Examples of these developments include:

- interventions that impacted on shearing industry training;
- the identification of a genetic variant that may influence the risk of side effects with tricyclic antidepressants;
- the clinical use of BNP and NEP inhibitors in the treatment of cardiovascular disease;
- the identification of low selenium levels in babies on formula feeding resulting in at least one manufacturer supplementing their formula;
- the development of a polymerase-chain-reaction assay for diagnosing B. pertussis infection, and
- the use of low-dose aspirin for prevention of deep vein thrombosis.

Figure 23. A breakdown of the commercial applications reported by respondents as arising from their HRC-funded clinical research.

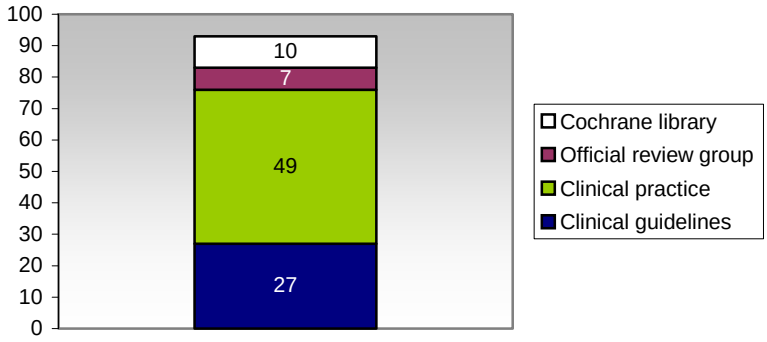


Uptake of Research into Practice

Respondents were asked a number of questions in relation to the broader dissemination of their research and its potential impact on clinical practice. It was pleasing to note that half of all researchers considered their research to have resulted in changes to clinical practice (49 percent), and that almost a third of this research had contributed to clinical guidelines (27 percent). In the analysis of these results, only respondents who had specified these contributions were considered to have contributed to clinical guidelines or changes in clinical practice (*see* Figure 24).

A small number of respondents had participated in official review groups, such as the Cochrane Collaboration Group (7 percent), with 10 percent of respondents being aware of the inclusion of their research in the Cochrane Library. It was apparent from comments made on the survey forms that researchers were not always aware of the impact of their research, in terms of the questions that were posed.

Figure 24. Percentage of contracts contributing to the uptake of research into practice.



In future analyses, it would be worthwhile to establish the number of publications resulting from research included in reviews and guideline documents. This was beyond the scope of the present survey.

Dissemination of research

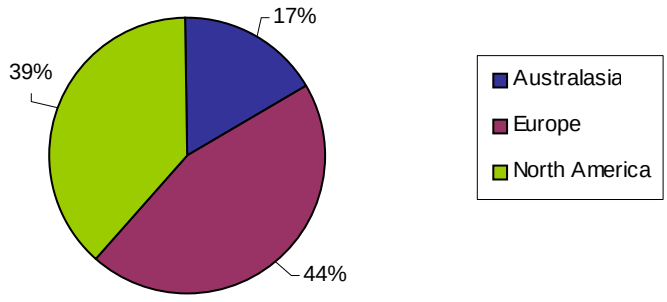
Nearly all researchers (93 percent) had reported the results of their research, with half of these researchers (51 percent) anticipating that there would be future publications from it. The majority of respondents had published their research findings in peer-reviewed articles (84 percent), and in total 264 peer-reviewed publications resulted from 57 contracts - an average of five publications per research contract. The maximum number of publications to result from a research contract was 47, arising from a Training Fellowship. The maximum number of peer-reviewed publications to arise from a project contract and a Limited Budget contract was 33 and 18, respectively.

Out of the 264 peer-reviewed journal articles reported, researchers provided information on and copies of 236 articles that were indexed by the National Library of Medicine or the ISI citation indexes. These 236 articles were published in a total of 111 different journals, almost half of which were European journals (44 percent). Figure 25 provides a breakdown of the country of publication for the journals printing articles arising from clinical research. The journal that published the greatest number of articles was the Journal of Hypertension (15 articles in total) followed by the Australian and New Zealand Journal of Medicine (12 articles in total), see Table 2.

Table 2. Journals publishing articles on HRC-funded clinical research.

Journal	Number of articles
Journal of Hypertension	15
Australian and New Zealand Journal of Medicine	12
Lancet	9
European Heart Journal	9
Journal of the American College of Cardiology	8
Journal of Affective Disorders	8
New Zealand Medical Journal	8
Circulation	6
The Australian and New Zealand Journal of Surgery	5
Others (4 or less publications each)	156

Figure25. A breakdown of the country/region of publication of journals printing articles arising from HRC-funded clinical research.



Almost a quarter of researchers (23 percent) reported publications in other journals and professional magazines, with 18 percent of researchers reporting outputs in the form of books and book chapters.

Published conference proceedings were the second most popular medium for dissemination, with three-quarters of researchers reporting their findings through this avenue (70 percent). Conferences

without published proceedings were a mechanism for dissemination for almost half of the respondents (46 percent).

Media coverage was a medium used by a quarter of researchers, with the majority of coverage attributable to printed media material (32 percent), followed by radio coverage (26 percent) and television coverage (16 percent).

Less than 20 percent of this research led to other communications such as manuals and resource materials (16 percent), or the Internet (9 percent), with 12 percent producing technical reports. See Figure 26 for a breakdown of dissemination outputs.

Building research capacity

It was pleasing to note that half of the respondents reported that postgraduate students had received research training through their research (55 percent), and that 18 postdoctoral fellows had been employed on research contracts. In total, 47 academic qualifications resulted from this research, with the greatest number of qualifications being PhDs (23 in total), followed by Masters degrees (8 in total). A breakdown of the qualifications that were successfully completed by students on clinical research contracts is provided in Figure 27.

Figure 26. Dissemination outputs arising from HRC-funded clinical research.

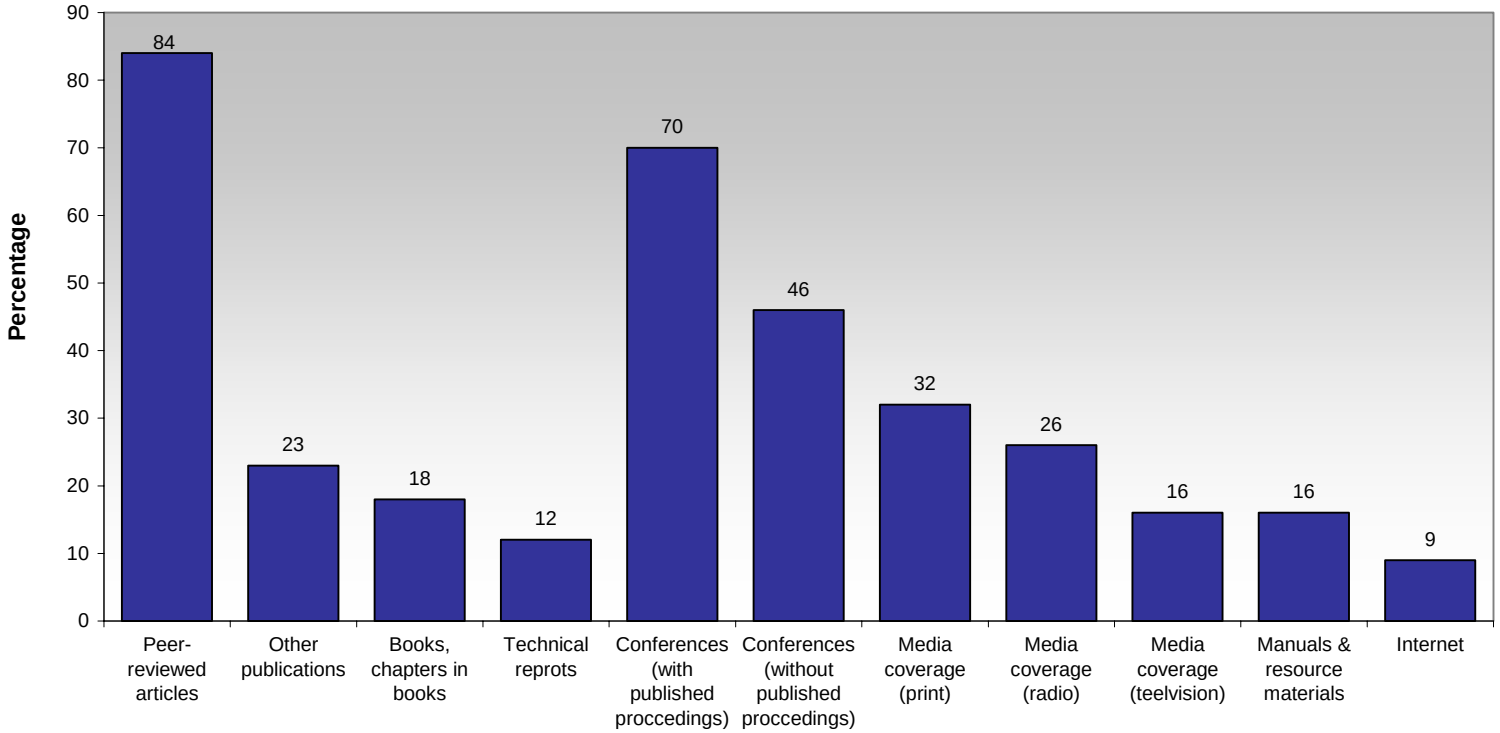
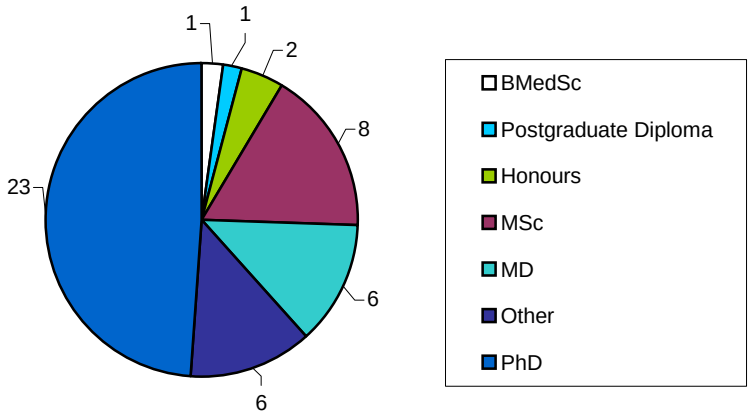


Figure 27. Academic qualifications completed by students working on clinical research contracts.



Only a small percentage of contracts had contributed to building research capacity for Maori or Pacific researchers. In total, nine percent of respondents had employed Maori researchers on contracts, partly contributing to one academic qualification. While, 7 percent of respondents had employed Pacific researchers on contracts, none of these individuals had gained an academic qualification through the research.

Biomedical and Clinical Case Study Results

The following section is an overview of the case studies conducted as components of the biomedical and clinical surveys. Case studies were conducted for five biomedical and clinical researchers, who addressed among other issues the impact of their HRC-funded research in building research capacity and capability, the dissemination of their research findings, as well as the uptake of their research into practice.

Research Uptake into Practice

The five biomedical and five clinical HRC-funded researchers interviewed following their completion of the respective surveys, identified and discussed a number of avenues through which they felt the outcomes of their research had been taken up. The researchers described both the traditional or expected pathways for the transfer of research knowledge, namely contributions to policy, clinical practice and the development of guidelines, as well as several less expected and tangible sources of informational transfer and influence.

Generally speaking, the biomedical researchers interviewed talked about the ongoing development of their research and the potential future implications the knowledge being generated and accumulated would have in the future. However, there was evidence that the outcomes of research even at the more fundamental end of the spectrum were having an impact on policy and practice. One biomedical researcher identified and provided examples of some of the ways the research they were undertaking had both influenced and directly sped up the introduction of therapy into clinical practice. Examples demonstrating the application of the outcomes of their research being taken up into practice included the introduction of flow cytometry as a routine analysis for blood leukocytes and cancer diagnosis, as well as the introduction of DNA testing for histocompatibility. Indeed, this technology has been transferred to the haematology diagnostic area and has impacted on the diagnostic practices employed.

The clinical researchers interviewed outlined how the outcomes of their research had both influenced and contributed to clinical practice, treatment protocols, and the management of patients. One clinical researcher, who collated retrospective data regarding the case history and tubal microsurgical outcomes for a group of over 900 women over four years, indicated the results of his research have enabled surgeons to better determine who will benefit most from microsurgery, or alternatively, who is a more suitable candidate for IVF. In this regard the results have become a valuable clinical aid in surgical case management and treatment.

A further two clinical researchers outlined how the results of their research had provided the evidence base to either support, or contradict, current clinical treatment and drug administration approaches. In the first instance, one researcher indicated that the findings generated by his teams' research into the drug therapy used to treat bronchial asthma provided the evidence base to support the way drug therapies were being administered in clinical practice for the treatment and prevention of asthma. In the second instance, another researcher described how her research demonstrated that the use of low-dose aspirin as a therapy for pregnant women who were carrying small for gestational age babies was of no benefit, as the introduction of aspirin once signs of abnormal fetal development have been identified, is too late.

Network Building and Collaborations

All of the biomedical and clinical researchers interviewed provided in-depth information on the collaborations that existed or evolved as a result of their respective research projects. Generally speaking, the information provided by researchers concerned the means by which the collaborations they were involved with developed, the opportunities provided by these research collaborations, and the outcomes and ongoing research generated by these respective national and international collaborations.

The Opportunities Provided by Collaborations

Involvement in both national and international collaborations was identified by the clinical and biomedical researchers interviewed as providing vital training and knowledge building opportunities, as well as important access to new knowledge and techniques. Significantly, the development and maintenance of the professional contacts and collaborative relationships of the Primary Investigators interviewed also provided several important research training opportunities for students working on the research contract concerned. The researchers indicated that through these mechanisms, the potential and the capacity for New Zealand to both generate and be involved in world-class health research, is greatly enhanced. Several of the researchers interviewed alluded to the importance of student's having these international research training opportunities. The majority also expressed the view that making such international training opportunities available did not simply amount to exporting our best and brightest for the benefit of others.

"It is absolutely critical for students to go overseas, and it is kudos for this country that our students are so sought after, and they actually do come back, and science is all about having open boundaries. And you never know when that New Zealander over in a lab in Switzerland, or Lund in Sweden, or Cambridge in the UK is going to apply a unique attitude, which New Zealanders have for advancing science. You never ever lose graduates, and they do come back ... so it's not a brain drain, it's a brain gain."

In this instance, two PhD students working with the Primary Investigator on this contract had returned from research positions overseas are were looking to continue the next phase of the research in New Zealand, using their newly acquired skills in genetic engineering.

"They've rejoined the group as senior investigators on the research programme, and bring with them expertise that the group did not previously have."

Another feature of the information generated by the interviews with researchers was the frequent necessity of developing collaborative research relationships, given the size, location and access to

resources afforded within New Zealand. Several of the researchers described how their research projects relied heavily on collaborations with others regarding access to technology, techniques and samples, as well as drawing on the experience, knowledge and expertise of others.

Examples of the resources and opportunities made available through the collaborations developed by the researchers interviewed include:

- Obtaining the clone for a gene being sequenced and gaining access to a large enough sample of DNA to be able to determine the intron structure of the gene that is responsible for Duchenne Muscular Dystrophy;
- Enabling the delivery of prodrugs to the site of tumours through the use of a vector system developed by another research team so that the effectiveness of the gene-directed enzyme prodrug therapy (GDEPT) could be evaluated;
- Gaining access to a technique used to analyse tissue from airway inflammation that was more advanced than what was currently available and in use in New Zealand, and
- Having access to a large enough pool of families with a history of premature menopause in order to undertake a study on the genetic analysis of premature ovarian failure.

Issue 7.

The Outcomes of Collaborations

As discussed above, one of the most significant outcomes of the development of collaborative research relationships was the access generated through the collaborations formed by these researchers, to new technologies and techniques, to clinical samples and families, and to the diverse skill base required to implement the research. However, some of these collaborations also produced valuable resources in their own right. In one project, the national and international collaborations developed through the course of the research resulted in the accumulation of one of the world's largest international collections of patient samples for the genetic exploration of premature menopause.

In another project, the extensive collaborative relationship and the networks built between the researchers and the Huntington's disease community and people with neurological disorders and their families, has been the advent of the Brain Bank. On an international scale, the Brain Bank constitutes a highly unique and valuable resource. This research project represents one of the most successful models used in the study neurodegenerative diseases of the brain, and the development of the Brain Bank is a clear indication of the effort that has been made to engage both the community and individual families with the research.

Building Research Capacity and Expertise

The vast majority of the clinical and biomedical researchers interviewed believed that the research project they led had made a significant contribution to building research capacity. A number of students working with the Primary Investigators on this contract had gained Masters, MD's and PhD's, across a variety of disciplines. The number of people employed on the research contracts of those interviewed ranged from one to thirty-five, and supported individuals working at honours level through to postdoctoral fellows. Importantly, the researcher who constituted the sole employee on a contract also felt that the research project had contributed significantly to building her own research capability by greatly enhancing her ability to design clinical trials and analyse complex statistical data.

The Success of Research Projects in Attracting and Training Students

The training potential offered by the research projects undertaken was alluded to many of the researchers. One of the Primary Investigators interviewed described the research project as providing *"a tremendous training ground for postgraduate researchers"*, adding that the ability to obtain research funding *"has a real impact on the potential to train researchers coming through"*.

In relation to capacity building, several of the researchers also discussed how successful the research projects had been in attracting the highest calibre of students, with many having to turn highly capable and talented students away. In this vein, several of the Primary Investigators also

referred to the invaluable contribution made by the students and fellows involved on their projects. So while several of the researchers interviewed drew attention to the exciting skill and knowledge development opportunities afforded to students involved in their research, they were also aware of the value of the skill and commitment demonstrated by the students in this context.

The Benefits Available to Students Involved on Research Projects

In the majority of cases, international research collaborations and networks provided a number of unique overseas training and mentoring opportunities for a large number of the students and postdoctoral fellows who had worked on the research contracts led by the clinical and biomedical researchers interviewed.

Postdoctoral fellows working with the Primary Investigator involved in the largest study have gone on to work in the laboratories of international research teams that the researcher in question formed collaborations with. A close collaboration with a group in Cambridge University has resulted in two postdoctoral fellows working with this group, and a third due to go over this year. There are also New Zealanders who have been associated with the research group now working in Wales, while a PhD student who will finish early next year is going to work in Lund in Sweden. At present, 15 PhD students are associated with the programme and at least 10 to 12 PhD students have graduated over those last 5 or 6 years.

However, these opportunities were frequently still available through the collaborative networks established by researchers who in terms of funding levels, would be regarded as leading smaller research projects. As a result of their involvement in one such project, a PhD student is currently working with a research team in Australia, while another student on a Summer Scholarship has had the opportunity to visit and work in a research lab in the United Kingdom. Meanwhile, other students working with these researchers have both attended and presented at international conferences, have been accepted into advanced surgical or clinical training, and/or have gone on to secure their own research project funding.

Knowledge Transfer and Dissemination

The clinical and biomedical researchers interviewed described disseminating the results of their research through many of the traditional and expected academic channels, including publishing peer-reviewed articles in relevant journals, making oral or poster presentations at national and international conferences, writing chapters in books, contributing to annual health reports, and participating in departmental seminars. The following were described as forms of dissemination used by the researchers that were interviewed:

- The results of the research project exploring the chemistry, anatomy and molecular biology of basil ganglia in the human brain have thus far been published in 29 international peer-reviewed journals, have been presented at 29 conferences, and have resulted in three book chapters.
- The findings from the research project on the design and evaluation of prodrugs for the gene-directed enzyme prodrug therapy (GDEPT) for cancer, have continued to be published up until the present, resulting in 14 international peer reviewed publications, as well as four patents.
- The results of the research project on the diagnosis, treatment and outcome of infertility regarding structural disorders of the fallopian tube, have been disseminated in the form of publications in two peer-reviewed journals, namely *Assisted Reproductive Reviews* and *Fertility and Sterility*. The Primary Investigator also attended two conferences in the United States, and after being placed in the top three submitted posters, was asked to make an oral presentation at the international Fertility and Sterility Conference.
- The results of the research project on the interaction between beta-agonists and inhaled corticosteroids and their effect on the control of bronchial asthma, were published in the third most prestigious international respiratory journal. In addition, the findings, which

supported the combined use of beta-agonists and corticosteroids, were incorporated at Step 3 of international guidelines for the treatment of asthma.

- The results of the pilot study exploring metabolism and nutrition following liver transplantation, which included a full time-series assessment of fifteen patients' body composition and nutritional status, have been published in a peer-reviewed journal, with abstracts in three other journals. The results have also been presented orally to the American Society of Transplant Physicians Scientific Meeting in Chicago, 1999.
- The findings from a study on the role of Doppler in small for gestational age fetuses and their subsequent postnatal growth and development, have been published in five peer-reviewed journal articles and presented at an international conference on Maternal Fetal Medicine in the United States. Presentations of the results have also been made to the Australian and New Zealand Perinatal Society Meetings as well as local Perinatal Society meetings. The research has also received media coverage in the mediums of both print and radio.

In conjunction with these more traditional outputs and avenues for dissemination, the researchers also made reference to their engagement in several alternative means of knowledge transfer. It was evident from discussions with the researchers that engaging with the relevant health communities, with clinicians, affected families and the wider public, was a very significant part of the research teams' dissemination strategies. An example from one of the research projects was the use of educational seminars, which proved to be highly successful in raising awareness among clinicians, which in turn affects the quality of clinical care. Researchers who specifically targeted dissemination towards clinicians indicated that providing clinicians with latest science and being available to answer their questions greatly enhanced the uptake of research findings into clinical care.

Several of the researchers interviewed had also taken steps to directly disseminate their research findings to the relevant health related community. The measures taken to achieve this included involving target communities in monthly seminars and attending the meetings of relevant interest groups. Several researchers also specifically sought input and feedback from these communities at various junctures throughout the research process. Some of the researchers took a broader educational approach to dissemination again and were involved in informing the general public as to how basic research impacts on medicine and the uptake of technology into practice. In most instances, this contact with the wider public occurred on a regular basis through formalised channels implemented by their respective University Departments and Faculties.

It was very apparent that the dissemination of the research findings as well as associated activities promoting the transfer of knowledge spanned a number of forums. An example illustrating the breadth of this process from an interview with one of the clinical researchers, included writing accessible articles for publication in General Practitioners and Women's Health magazines, responding to media enquiries, educating post-graduate doctors in teaching forums about premature menopause, providing information and detailed feedback to clinicians as well as women who may have the condition, initiating and participating in a support group for women, and engaging in any opportunity to raise the level of awareness about premature menopause in the wider community. Underlying many of the discussions with researchers regarding strategies for dissemination was an awareness of the pivotal role dissemination plays in facilitating and promoting the uptake of research. Generally speaking, these researchers indicated that the broader and more diverse the dissemination opportunities available were, the more influence the research findings were likely to have on policy and practice.

Impact of Research Project on Career

There was a clear indication that undertaking these research projects had had an impact on the careers of the researchers, and in some instances had influenced both the direction and the emphasis of their research careers. Several of the researchers interviewed had gained international

recognition on the basis of both the specific project in question, as well as from their cumulative body of research work. Recognition and esteem was evident in these researchers invitations to present at international conferences; lead international workshops; participate on expert advisory panels co-opted by the World Health Organisation; and be included in the Cochrane Library.

Case Studies - Biotechnology and biomedical research in New Zealand

The following case studies present examples of HRC-funded researchers who are leaders in their field. In many cases their research has moved beyond the laboratory into clinical application, with a number of the case studies highlighting research that has culminated in the launching of innovative companies to commercialise their discoveries.

The case studies highlight: national research teams involved in global consortiums that are using the bacterial genome to identify potential new drug targets in the fight against TB; research that was the first to identify that the adult human brain is capable of repair; research that has led to the development of a monitor with the potential to detect brain injuries at an early stage in preterm and newborn babies; that cooling the brain after severe hypoxia-ischemia can dramatically improve outcome; that under-nutrition throughout pregnancy results in offspring who are susceptible to diabetes, obesity and hypertension; a new treatment for osteoporosis; the benefits of aspirin in preventing blood clots after surgery; and research that is uncovering the complex interplay between genes and life experiences in the prediction of outcomes such as violence and depression.

Medical molecules – Professor Ted Baker – University of Auckland

Unravelling the molecular mysteries of disease is giving a group of University of Auckland researchers a deeper understanding of the causes of disease and helping them in the search for new therapeutic targets.

Professor Ted Baker and his colleagues, Drs. Peter Metcalf, Shaun Lott and Vickery Arcus, from the School of Biological Sciences, are particularly interested in proteins because they are the molecules which carry out all the essential processes in living things.

Developing their knowledge of the three-dimensional structures of proteins may open the way for controlling biological activities through structure-based drug design or protein engineering.

"Structural biology is an extremely fast growing, fast evolving area of research," Professor Baker says. "The advances in genome sequencing have further accelerated this. We now use structural biology to help discover the functions of the many genes and proteins whose functions are a mystery at present."

He says that there are basically two strands to this research: "One is to understand disease at the molecular level by looking at the structure and function of key proteins, and the second is to use the proteins themselves as the target for new drugs."

The team uses X-ray crystallography to work out a protein's precise three-dimensional structure, then collaborates with other biomedical researchers to further this work. For example, their work (with a Massey University team) on the kiwifruit enzyme, actinidin, was used in the design of anti-malarial drugs by San Francisco researchers.

Professor Baker's group is also part of an international group of more than 40 labs world-wide known as the International TB Structural Genomics Consortium. Researchers in this consortium work together in a co-ordinated way, using the bacterial genome to identify potential new drug targets against TB, and then analysing their three-dimensional structures.

"Our lab has recently solved the precise atomic structures of several enzymes essential for the viability of the bacterium. We believe that these are good drug targets because they are essential for the bacterium but they are not present in humans."

Professor Baker's team has also been working with the laboratory of Professor John Fraser, at the School of Medical Sciences, to determine the structures of superantigens and other toxins from the common human pathogens Staphylococcus aureus and Streptococcus pyogenes.

They are also investigating proteins that cause antibiotic resistance, and understanding proteins that act on folic acid and may be useful in designing more effective anti-cancer drugs.

Neuronal rescue thearapies – Professor Peter Gluckman – University of Auckland

Neuronal rescue therapies developed by University of Auckland researchers offer a whole new approach to preventing brain cell death caused by acute neurological injuries. These injuries cover a whole range of problems such as stroke, head trauma, perinatal asphyxia, or neurodegenerative diseases such as multiple sclerosis, Alzheimer's and Parkinson's.

The key discovery, made by a team headed by Professor Peter Gluckman, Liggins Institute, University of Auckland, was that brain cell death is not immediate after injury but actually takes place over hours or days, providing a window for intervention.

The research team has identified growth factors and small molecules that have important therapeutic applications for both acute and chronic neurodegenerative conditions. They have also demonstrated that administering growth factors after injury can prevent cell death.

Neuronal rescue therapies target both acute brain juries and chronic neurodegenerative disease. In the case of acute brain injuries, they intervene in the pathological process that leads to cell death and assist recovery by augmenting neuronal function.

In the case of models of neurodegenerative disease, neuronal rescue agents are able to prevent the death of neurons that have been exposed to the pathological processes caused by the disease. They also enhance functional recovery, underlying their potential for treating cognitive dysfunction in ageing, for example, memory, reasoning and attention. Because the therapy uses the growth factors and small molecules that are the recovery mechanisms intrinsic to the brain, Professor Gluckman's group believe they may be safer than other therapies under development.

The technology developed by the research team includes a Brain Rescue Monitor (under development by Tru Test Ltd) that tracks evolving brain injury and the factors that influence treatment. Real time information enables physicians to predict outcomes, decide on treatment and monitor the effects of neuronal rescue therapy. The monitor has shown promising results in clinical trials detecting brain injuries at an early stage in preterm and newborn babies.

The research team showed that many brain injured babies appear to rally in the first few hours after birth, but later succumb to brain damage as cells commit 'cell suicide'.
A biotechnology company, NeuronZ Limited, was established and it has now merged with EndocrinZ to become NeurocrinZ Limited. The company has attracted co-investments from national and international sources to enable the further development and ultimately the clinical trial of neuronal rescue therapies.

Using cooling to counteract brain damage in premature infants – Dr Alistair Gunn – University of Auckland

Clinically induced hypothermia and the use of endogenous growth factors both offer hope as ways of countering brain damage in premature infants.

Infants between 23 and 30 weeks premature often suffer poor neurodevelopment, with about five per cent developing severe handicaps such as cerebral palsy.

Dr Alistair Gunn, director of a programme of research in preterm brain injury at the University of Auckland, points out that there is also a lot of concern about less noticeable effects that may not become obvious until the child gets older.

“We are now tending to see less severe disabilities, but we are seeing more subtle problems such as learning difficulties and attention deficit disorder hyperactivity which surface later in life. That's not five per cent, that's half or more."

The Auckland group has already discovered that active, ongoing damage means that premature infants with white matter brain damage in the first week or two after birth have smaller or less complex brains when they reach full term. This makes finding ways to disrupt or even reverse this damage even more vital.

Dr Gunn’s focus is on hypothermia, which has already been shown to interrupt cell death after asphyxia, leading to a major clinical trial whose results are expected soon. He is now investigating whether early cooling can interrupt the early phase of cell death in premature infants and improve long-term development.

Co-researcher Dr Laura Bennet is, meanwhile, looking at the possibility of using endogenous growth factors in the brain to halt ongoing damage and help the brain repair itself.

“The immature brain is very plastic, it is still producing new cells which help build the brain. We can use that plasticity to kick-start the process of helping regrow damaged brains," she says.

"Whether we will ever be able to do that is another matter but our preliminary data show very excitingly that we can in fact stop the evolving process of damage and improve brain activity, suggesting that not only are we saving cells but they are doing something useful."

Impaired fetal growth – its costs and consequences – Professor Jane Harding – University of Otago

Poor fetal growth is known to cause a range of major problems, including increased risk of stillbirth, pre-term delivery, and neonatal illness.

University of Auckland Liggins Institute researcher and Professor of Neonatology, Jane Harding, explains that researchers have also become increasingly aware that the consequences can reach not only into childhood but also later life in what is now known as the fetal origins of adult disease (FOAD).

"There are difficulties with growth and with learning in childhood, and they are at risk of diseases in adult life, particularly diabetes and heart disease."

The Liggins Institute's current programme includes three projects designed to explore the mechanisms involved in slow fetal growth or intra-uterine growth restriction (IUGR) and how these can be prevented or treated.

Professor Harding says that the first of their three projects looks at possible approaches to reversing impaired growth in the womb. A number of naturally occurring growth hormones have already been identified and they are looking at these as possible means of treatment.

The group's second project is expanding on earlier work they have done which showed that nutrition around the time of conception alters a range of aspects of fetal development in late gestation.

"It alters growth, it alters metabolism, it even alters time of birth," Professor Harding says. "We are interested in what the long-term consequences of those changes are."

Science Journal recently published an article by Professor Harding in collaboration with researchers at the Liggins Institute, University of Toronto, and Monash University, which showed that in sheep, just a modest reduction in food intake prior to conception and for 30 days after led to premature delivery.

If these findings are applicable to human pregnancies then they could have significant implications in combating one of the major causes of pre-term birth, especially given that an estimated 50 per cent of pre-term deliveries are idiopathic – not attributable to a known cause such as infection.

Knowing the best time to treat is all important if there is to be any sort of successful public health strategy, Professor Harding explains. "If it turns out that the critical time is actually before you become pregnant that has very different implications from if the critical timing is in the mid trimester," she says

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The Liggins Institute's third project is examining nutrition during pregnancy, because past studies have shown that in rats, under-nutrition throughout pregnancy results in offspring who exhibit the "couch potato syndrome". They are susceptible to diabetes, obesity and are hypertensive.

Professor Harding points out that all these abnormalities seem to be linked, so the group are interested in understanding what underlying mechanisms are disturbed. Eventually understanding these mechanisms may point the way to possible interventions.

Finding answers to neurodegenerative diseases – Professors Mike Dragunow and Richard Faull – University of Auckland

Two University of Auckland researchers are examining opposite sides of the same coin in an effort to fight neurodegenerative diseases such as Alzheimer's, epilepsy, Huntington's and Parkinson's.

Professor of Pharmacology Mike Dragunow is looking at the mechanisms of brain cell death, while Professor of Anatomy Richard Faull is looking at ways the brain generates new cells. Both are looking for ways to combat the debilitating effects of these brain wasting diseases.

Professor Faull's work on Huntington's disease has uncovered evidence that the brain is trying to repair itself by using adult stem cells and by forming new neurones.

"It could mean that instead of transplanting embryonic stem cells you could use the adult stem cells. So we want to find out what causes them to multiply and form new brain cells."

This also raises the possibility that similar repair mechanisms could be at work in other neurodegenerative conditions. Using existing adult stem cells is also a far more attractive proposition than having to harvest embryonic stem cells.

Colleague Professor Mike Dragunow, meanwhile, is looking at the whole question of what causes brain cells to die in diseases like Alzheimer's, Parkinson's and Huntington's. His team is particularly interested in brain cell apoptosis, where the brain cell appears to be programmed to commit suicide. They already know that nerve cell death is not a random process in these diseases so are looking at the molecules controlling the genetic cell death programme.

"We've identified one that seems to be associated with nerve cell death and one which seems to be associated with nerve cell life and we are looking to see exactly how they control this."

They are now looking at those same molecules in human brain material to see if they are either underactive or overactive in diseased brains.

Professor Dragunow says that they are also looking at what appears like an immune reaction in the brains of people with Alzheimer's and Parkinson's, which may actually worsen the damage, because molecules released by the immune cells go on to kill more nerve cells.

His team has successfully developed an experimental cell line that secretes molecules, which kill nerve cells. The team is working to identify those molecules.

The New Zealand Neurological Foundation Brain Bank, built up through bequests from patients who die with diseases such as Parkinson's, Huntington's, Alzheimer's and epilepsy, has proved to be a huge asset in the work of both groups.

Fighting osteoporosis

Osteoporosis and Paget's disease top the list of bone and calcium problems faced by New Zealanders.

Osteoporosis causes approximately 15,000 fractures a year while the less well-known Paget's disease affects 5-10% of older New Zealanders, leading to bone deformity, bone pain, fractures, premature hip joint wear and other similar conditions.

The University of Auckland's Bone Research Group, led by Professors Ian Reid and Jill Cornish, is a multi-disciplinary group which researches the biology of bone growth, examines animal models of bone disease and undertakes clinical studies.

They were the first to demonstrate that calcium supplements could significantly slow bone loss in normal older women and also result in fewer fractures. More recently, they have shown that calcium supplementation in normal older women significantly improves their blood cholesterol pro-files, so much so that long term use could produce a 20–30 percent decrease in heart attacks. They are now examining the effects of calcium supplements on the cardiovascular and bone health of men.

Intellectual property from this work has been licensed to Mission Pharmacal, the largest producer of calcium supplements in the United States. The group is also trialing novel drugs to combat osteoporosis. Another avenue of research is the regulation of the cells that make bone and the cells that break it down - activity that determines how much bone develops, how strong it is and how well it works.

The group discovered two new receptors on bone cells, known to play an important part in other cells. They are believed to be key regulators of bone cell growth, and the group is examining them as potential therapeutic targets. They also identified the cause of a rare bone weakening condition, which has led to effective treatment of this problem for the first time, and provided further understanding of normal regulation of bone cell activity.

Their work on Paget's disease focuses on identifying what switches on the abnormal bone cell activity in this condition, so they can look for a therapy to switch it off again.
The group is also examining the link between fat mass and bone mass to understand why fatter people have stronger bones.

"We identified a number of different hormones that are low in thin people and appear to be important in maintaining bone growth. A number of those hormones are now being actively investigated as potential treatments for osteoporosis and that intellectual property has been licensed to a pharmaceutical company." They have also been in negotiation with a California biotechnology company about licensing further intellectual property for other bone growth promoting proteins.

Dunedin study readies for age 32 assessments

It is widely recognised as one of the world's foremost longitudinal cohort studies – following the lives of close to 1,000 people born in Dunedin nearly 32 years ago.

Over the years the Dunedin Multidisciplinary Health and Development Study has generated more than 400 international and 81 New Zealand scientific journal articles.

Plans are well underway for the next assessment as part of the HRC funded programme.

Study Director Associate Professor Richie Poulton says that participants will return to their birthplace from all over New Zealand and the world to complete the comprehensive eight-hour assessment.

Information will be gathered on cardiovascular health, respiratory and pulmonary function, mental health, anti-social behaviour, oral health, living arrangements, relationships, religious beliefs, disability, sexual and reproductive health, and self-harm behaviour. Blood samples will also be taken for several biomedical studies.

Associate Professor Poulton says that the focus is now on understanding the development of risk for the major diseases that impact upon the health of a population, which will require studies that range from the genetic right through to the sociological.

"We want to obtain a holistic picture of influences on a person's health using a life course approach, so we use all the information about our group of a thousand people gathered over the first 25 years to understand why people end up where they do in their early 30s."

Associate Professor Poulton says that it is also a point along the way to understanding why people end up the way they do at 40 and 50 and seeing how far back the first signs become noticeable.

"The earlier you know, in theory at least, the easier it is to intervene to mitigate the long-term negative consequences and maybe even prevent them altogether."

Another development is the appointment of a senior Maori health researcher, Dr Joanne Baxter, and a junior research fellow who will examine the potential of the study's data for informing policy relevant to Maori.

Researchers in the US and the UK are conducting studies drawing on information from the families of the multidisciplinary study's participants.

They now have a next generation study going, where they visit the firstborn three year-olds of their study members at home to understand why parents parent the way they do. Essentially, three generations are now involved.

Worldwide CV for clinical trials research unit

The University of Auckland's Clinical Trials Research Unit has carved out a niche for itself co-ordinating trials involving tens of thousands of patients around the world.

The unit, co-directed by Dr Anthony Rodgers and Professor Craig Anderson, has been involved in a range of large-scale research projects in the area of cardiovascular disease.

Its glowing CV includes the Perindopril Protection Against Recurrent Stroke Study (PROGRESS), involving more than 6,000 patients worldwide, which showed major new benefits for blood pressure lowering treatments in stroke patients. A 17,000 patient trial showed the benefits of aspirin in preventing blood clots after major surgery. The CTRU has recruited 6,500 participants from throughout the Asia Pacific region for ONTARGET, a major trial of new treatments in high-risk patients.

The Asia Pacific Cohort Studies Collaboration has brought together data from 50 studies involving 600,000 participants allowing them to gather information on cardiovascaulr determinants such as blood pressure, cholesterol and body weight for the Asia Pacific region. This is one of several collaborations with the Institute for International Health in Sydney.

They are also collaborating on the China Salt Substitute Study, looking at a low-sodium, high potassium salt substitute and its effect on blood pressure and stroke risk, and a study looking at the effects of different classes of blood pressure lowering drugs on cardiovascular outcomes.

There is also a diverse range of New Zealand-based trials such as ECHO, testing the effectiveness of the Chitosan over-the-counter weight loss supplement, and FITNESS, the Frailty Interventions Trial in Elderly Subjects Study.

Ongoing studies include ARCOS, the Auckland Regional Community Stroke Study, FOILS, the fish oils in stroke study, and HALT, the Honey as Adjuvant Leg Ulcer Therapy Trial, which will evaluate manuka honey as a treatment for leg ulcers.

The unit is also conducting a follow-up of babies involved in the 1969-74 Auckland antenatal steroid study, designed to determine the long-term outcomes for babies exposed to the corticosteroid betamethasone in utero.

The Stop Smoking with Mobile Phones Trial (STOMP), evaluated mobile phone text messages as a way to motivate and educate people trying to quit smoking. This world-first trial involved 1700 New Zealanders. Results will be reported in the New Year.

CTRU research has impacted on both policy and practice. Dr Rodgers was principal author on the WHO's main annual publication, the World Health Report in 2002. This research assessed burden of disease from major causes globally. The methods were adapted for the 'Nutrition and the Burden of Disease: New Zealand 1997-2011' report released last year, which has fed in to the Ministry of Health's 'Healthy Eating - Healthy Action Oranga Kai - Oranga Pumau: A strategic framework'.

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