

Cancer research in Australia:
An overview of cancer
research projects
and research programs
in Australia
2003 to 2005

Cancer research in Australia: An overview of cancer research projects and research programs in Australia 2003 to 2005

Acknowledgements

Development of the strategic approach to the National Audit of Cancer Research Projects and Research Programs, collection and analysis of data, and drafting of this report was carried out by Cancer Australia: Dr Paul Jackson, Dr Cleola Anderiesz and Dr Janelle Nunan, with assistance from Mr Charles Lang and Mr Alessandro Blasetti, and guidance from the Deputy Chief Executive Officer, Dr Joanne Ramadge, and the Chief Executive Officer, Professor David Currow.

We sincerely thank all funding agencies for the information they provided. We acknowledge that this task required a considerable investment of time and effort on their part.

All aspects of data collection, analysis and report preparation were overseen by the Audit Steering Committee derived from members of Cancer Australia's National Research Advisory Group and a nominee of the Chairs of the National Cooperative Clinical Trials Groups.

Members of the Audit Steering Committee

Dr Ian Roos	<i>National Research Advisory Group representative</i> Consumer Nominee Chair, Cancer Voices Victoria
Professor Joe Sambrook	<i>National Research Advisory Group representative</i> Distinguished Fellow, Peter MacCallum Cancer Centre
Associate Professor John Seymour	<i>National Research Advisory Group representative</i> Chair, Australasian Leukaemia and Lymphoma Group
Dr Guy Toner	<i>Nominee – Chairs of the National Cooperative Clinical Trials Groups</i> Head, Medical Oncology Unit Peter MacCallum Cancer Centre and Chair, ANZ Germ Cell Cancer Trials Study Group
Ms Katrina Watts	<i>National Research Advisory Group representative</i> Consumer Nominee
Dr David Whiteman	<i>National Research Advisory Group representative</i> Cancer and Population Studies Group, Queensland Institute of Medical Research

We would also like to thank all members of the National Research Advisory Group and Cancer Australia's Advisory Council, for their review and feedback on the Audit report.

CONTENTS

Acronyms	vi
List of figures and tables	vii
Executive summary and key messages	1
1. Introduction	5
1.1 Background to the National Audit	5
1.2 Importance of a National Audit	7
1.3 Objectives of the National Audit	7
2. Methods	9
2.1 Approach to the National Audit	9
2.2 Sources of data	9
2.3 Approach to data collection and overall response	10
2.4 Coding and classification – use of the Common Scientific Outline	10
2.5 Ownership and subsequent access to more specific data	11
2.6 Which data are not included in the National Audit?	11
2.7 Direct funding to cancer research by the pharmaceutical industry	12
2.8 Oversight of the National Audit	12
3. Results – Overall picture of cancer research projects and programs in Australia, 2003–05	13
3.1 Total funding	13
3.2 Where does the research funding go?	14
3.3 What research is done in Australian states and territories?	15
3.4 Collaborations	17
3.4a Research projects and research programs with a single named collaborator	18
3.4b Research projects and research programs with multiple named collaborators	18
3.5 Broad source of direct funding by sector	18
4. Results – Description of cancer research projects and research programs in Australia	22
4.1 Classification by Common Scientific Outline	22
4.2 Analysis of direct funding in CSO Biology	23
4.3 Classification by area of research	24
4.4 Funding focus area by CSO classification	25
4.4a Basic science studies	25
4.4b Tumour site-specific studies	25
4.4c Non-site-specific studies	25
4.5 Research in specific tumour streams and sites	27
4.5a Burden of disease and overall direct funding to cancer research projects and research programs	29

4.5b	Burden of disease and direct funding per individual with disease/per death/and per Person Years of Life Lost to 85 years of age, for specific tumour sites	32
4.6	Patterns of cancer research projects at specific tumour sites	35
4.7	Direct funding to cancer research from organisations raising funds for specific tumour types	37
5.	Results – International comparisons	38
6.	Discussion	40
6.1	Overall figures.....	40
6.2	Are we collaborating?.....	41
6.3	Cancer research projects and research programs.....	42
6.4	Possible reasons for funding of research into specific cancers	43
6.5	Conclusions	43
7.	References	44
	Appendixes	45
Appendix A:	Organisations invited to provide details of their funding to cancer research for the National Audit of Cancer Research Projects and Research Programs.....	45
Appendix B:	Email Introduction to Audit	48
Appendix C:	Invitation from CEO of Cancer Australia to Cancer Research Funding Agency	49
Appendix D:	Common Scientific Outline (CSO) classification of cancer research	51
Appendix E:	Tumour streams and disease site codes	63
Appendix F:	Breakdown of identified direct funding to cancer research projects and research programs by all CSO categories	62

ACRONYMS

AIHW	Australian Institute of Health and Welfare
ANZ	Australia and New Zealand
ARC	Australian Research Council
CCRA	Canadian Cancer Research Alliance
CI NSW	Cancer Institute New South Wales
CRC	Cooperative Research Centres
CSO	Common Scientific Outline
EEC	European Economic Community
EU	European Union
MBS	Medical Benefits Schedule
MTF	Medical Task Force
NCCI	National Cancer Control Initiative
NCI	National Cancer Institute
NCRI	National Cancer Research Institute
NHMRC	National Health and Medical Research Council
NRAG	National Research Advisory Group
NSW	New South Wales
PYLL	Person Years of Life Lost

LIST OF FIGURES AND TABLES

- Figure 1 Top 10 cancers in Australia, 2003, by incidence
- Figure 2 Top 10 cancers in Australia, 2003, by mortality
- Figure 3 Distribution of identified direct funding to cancer research projects and research programs across Australia from 2003 to 2005, by location of Chief Investigator
- Figure 4 Pattern of direct funding to cancer research projects and research programs in Australian States and Territories, 2003 to 2005 classified by main category of Common Scientific Outline
- Figure 5 Proportions of cancer research projects and research programs in Australia 2003 to 2005, with no collaborators, a single collaborator or multiple collaborators
- Figure 6 Details of named collaborators on cancer research projects and research programs in Australia 2003 to 2005
- Figure 7 Locations of named collaborators on cancer research projects and research programs in Australia 2003 to 2005, with a single collaborator (A) or multiple collaborators (B).
- Figure 8 Identified direct funding to cancer research projects and research programs in Australia 2003 to 2005, by broad funding agency
- Figure 9 Identified direct funding to cancer research projects and research programs in Australia 2003 to 2005, by main category of Common Scientific Outline
- Figure 10 Identified direct funding to cancer research projects and research programs by NHMRC versus other funders in Australia 2003 to 2005, classified by main Common Scientific Outline categories
- Figure 11 Identified direct funding to cancer research projects and research programs in the Biology subdivision of the Common Scientific Outline in Australia, 2003 to 2005.
- Figure 12 Project focus of the direct funding to cancer research projects and research programs in Australia 2003 to 2005
- Figure 13 Distribution by study focus area of identified direct funding to cancer research projects and research programs in Australia 2003 to 2005 by the NHMRC and all other cancer research funders
- Figure 14 Proportion of funding in the main categories of the Common Scientific Outline to basic science cancer research projects and research programs in Australia, 2003 to 2005
- Figure 15 Proportion of funding in the main categories of the Common Scientific Outline to tumour site-specific cancer research projects and research programs in Australia, 2003 to 2005
- Figure 16 Proportion of funding in the main categories of the Common Scientific Outline to non-site specific cancer research projects and research programs in Australia, 2003 to 2005
- Figure 17 Identified direct funding to cancer research projects and research programs in Australia 2003 to 2005, classified by tumour stream
- Figure 18 The top 20 tumour sites classified by direct funding to cancer research projects and research programs in Australia, 2003 to 2005
- Figure 19 Direct funding to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by overall incidence in Australia in 2003
- Figure 20 Direct funding to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by mortality in Australia in 2003
- Figure 21 Direct funding to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by Person Years Life Lost (PYLL) to 75 years of age in 2003

- Figure 22 Direct funding to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by Person Years Life Lost (PYLL) to 85 years of age in 2003
- Figure 23 Direct funding per person to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by incidence in 2003
- Figure 24 Direct funding per cancer death to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by mortality in 2003
- Figure 25 Direct funding of cancer research projects and research programs per Person Year of Life Lost to age 85 years in Australia in 2003 to 2005, compared with the top 20 tumours by Person Year of Life Lost in 2003
- Figure 26 Funding to cancer research projects and research programs in specific cancer sites across Australia in 2003 to 2005, classified by main category of Common Scientific Outline
- Figure 27 Proportion of direct funding to cancer research projects and research programs in Australia 2003 to 2005 provided by organisations raising funds for specific tumour sites
- Figure 28 Pattern of direct funding to cancer research projects and research programs in Australia, 2003 to 2005, classified by main category of Common Scientific Outline and compared with patterns obtained from international cancer research surveys
- Table 1 Annual direct investment in cancer research projects and research programs in Australia 2003 to 2005

LIST OF APPENDIXES

- Appendix A Organisations invited to provide details of their funding to cancer research projects and research programs for the National Audit of Cancer Research Projects and Research Programs
- Appendix B Email introduction to Audit
- Appendix C Invitation from CEO Cancer Australia to Cancer Research Funding Agency
- Appendix D Common Scientific Outline (CSO) classification of cancer research
- Appendix E Tumour streams and disease site codes
- Appendix F Breakdown of identified direct funding to cancer research projects and research programs by all CSO categories



EXECUTIVE SUMMARY AND KEY MESSAGES

Cancer research in Australia is funded by the National Health and Medical Research Council, state and territory Cancer Councils, a large number of charitable organisations, government and non-government organisations, companies and individuals. Research is undertaken across Australia by a variety of individuals and groups of differing size, and in different settings such as institutions, hospitals and universities. There is little coordination of the provision of research funding at the national level and opportunities to foster more collaboration among researchers are possible.

Cancer Australia was established to help reduce the impact of cancer in the community. Its purpose is to provide national leadership, to increase coordination of cancer control initiatives and improve outcomes for people affected by cancer. An initial priority of Cancer Australia was to review current national cancer control and cancer research activities.

National Audit of Cancer Research Projects and Research Programs

Between April and June 2007, Cancer Australia undertook a National Audit of Cancer Research Projects and Research Programs^a. Previous surveys have examined cancer research in Australia. These surveys have sought information on the scope of cancer research being undertaken, the funding provided to research projects and research programs, personnel, training, equipment and infrastructure, as well as sources of funding, by requesting such information from cancer researchers via questionnaires. Results of these surveys have provided important information on cancer research at the state and territory level, but at a national level we do not know the full extent of funding to cancer research, the proportion of funding or research effort that is distributed across different tumour sites or where the research occurs across the spectrum of cancer care. This national audit is the first survey to examine national and international government and non-government funding provided directly to cancer research projects and research programs at the national level. It provides, for the first time, an overview of cancer research projects and research programs across Australia, and outlines how and where funds were being spent across different tumour streams and the continuum of cancer research.

Methods

Eighty national organisations and 19 international organisations that funded Australian researchers were invited to participate in the audit. Ninety-six organisations provided information on cancer research funding in Australia. Sixty-eight organisations directly funded research projects and research programs between 2003 and 2005. Information on these cancer research activities was provided by funders in the form of a common data set. For each research project and research program funded, information was collected on the Chief Investigator, named collaborators, an abstract of the research activity and exact details of funding for the years 2003, 2004 and 2005. Organisations provided information on the value of funding allocated between 2003 and 2005. Estimates or extrapolations of funding were not undertaken.

Every cancer research project and research program was also classified by the internationally recognised Common Scientific Outline (CSO; a classification system that categorises cancer research into specific research areas) and Disease Site codes.

This audit did not collect information on funding assigned to infrastructure, equipment, person support, fellowships or scholarships, in-kind support, routine clinical care, support services, data collection or ongoing monitoring of service delivery and outcomes. Funding to cancer research provided by philanthropy and by the pharmaceutical industry was not specifically addressed. However, it is acknowledged that these are major areas of funding for cancer research in Australia.

^aProject grants support individuals and small teams of researchers undertaking research in Australian universities, medical schools, hospitals and other research institutions. Program Grants provide support for teams of high calibre researchers to pursue broadly based collaborative research activities.

Audit report

This report is a descriptive analysis of the data from the National Audit of Cancer Research Projects and Research Programs. The report describes the data collected and provides a national overview of the direct funding to cancer research projects and research programs from 2003 to 2005. This is a foundation report, and as such, there is no interpretation of the data presented. Specifically the report outlines the funding provided to cancer research projects and research programs from both national and international funders, describes the pattern of funding by research categories and Disease Site classification systems, provides details of geographical distribution of research funding across Australia, details the patterns of research collaboration, and compares the patterns of research funding in Australia between 2003 and 2005 with international data from the United States, Europe and the United Kingdom.

Direct funding to cancer research projects and research programs

The audit identified direct funding to cancer research of \$84.9 million in 2003, \$91.7 million in 2004 and \$115.1 million in 2005. This funding supported 1 332 cancer research projects and research programs.

This level of funding is not compared with funding to research in other Australian Government Health Priority Areas because data regarding national funding to research in other Health Priority Areas are not currently available.

The pattern of direct funding across Australia generally reflected distribution of the research workforce, with the majority of funding in the eastern states. Specifically, 84 per cent of identified research funding was distributed to Chief Investigators and Administering Institutions in Victoria, New South Wales and Queensland.

The Australia Government provided 66 per cent (\$190.3 million) of the direct funding to cancer research projects and research programs in 2003 to 2005, of which the majority was to research projects and programs funded by the National Health and Medical Research Council (NHMRC; \$165.8 million). A further 20 per cent of funding (\$56.2 million) was provided by Australian non-government organisations, including the state and territory Cancer Councils. International funding agencies provided 13 per cent (\$37.6 million) of the direct funding to cancer research in Australia between 2003 and 2005.

Collaborations

Fifty-eight per cent of all research projects and research programs named collaborators. The majority of named collaborators on projects and research programs were from the same institution or state and territory as the Chief Investigator. Seventy-three per cent of collaborators were based in the eastern states. Multiple collaborations in a research project or research program were associated with increased average funding.

Tumour types and research areas

The audit shows that in Australia, the largest proportion of funding allocated between 2003 and 2005 was in the field of Biology (51 per cent of funding), but research into Cancer Treatment was also well supported. Funding of research into the causes of cancer (Aetiology), cancer prevention, early detection, diagnosis and prognosis, and cancer control, survivorship and outcomes research was relatively low by comparison.

Forty per cent of identified cancer research projects and research programs were tumour site-specific. Of the direct funding to these projects and programs, 80 per cent was to research in breast cancer, leukaemia, colorectal cancer, prostate cancer and melanoma.

Compared with their burden on the Australian community, cancers with proportionally lower levels of funding were lung cancer and mesothelioma, cancers of unknown primary site, pancreatic cancer, lymphoma and cancers of the bladder and brain.

International comparisons

Australia's pattern of identified direct funding for cancer research, in 2003 to 2005, was similar to the funding in cancer research by the United Kingdom, the European Union and Canada.

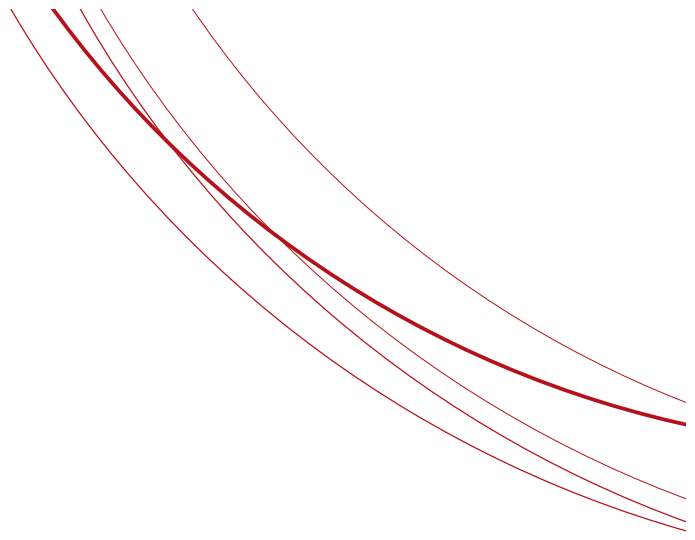
Future directions

This report describes the results of the National Audit of Cancer Research Projects and Research Programs. As the audit did not measure the impact of the funded research, this report does not discuss the significance of the funding provided to different tumour types or research areas. However, it is intended that the contents of this report will help identify areas for future investment and for planning cancer research.

From the data collected, we have identified the following key messages.

Key messages

1. Direct funding to cancer research projects and research programs in Australia was \$84.9 million in 2003, \$91.7 million in 2004 and \$115.1 million in 2005, not including fellowships, infrastructure and equipment.
2. Numerous organisations make significant contributions to cancer research across Australia.
3. Australian Government funding accounted for 66 per cent of the direct funding to cancer research projects and research programs identified in this audit. This funding was predominantly provided by the NHMRC. A further 20 per cent of funding was provided by Australian non-government organisations, including the state and territory Cancer Councils. International funding agencies provided 13 per cent of the direct funding to cancer research in Australia.
4. By cancer site, the highest levels of funding were to breast cancer, leukaemia, colorectal cancer, prostate cancer and melanoma.
5. Compared with their burden on the Australian community, cancers with proportionally lower levels of funding were lung cancer and mesothelioma, cancers of unknown primary site, pancreatic cancer, lymphoma and cancers of the bladder and brain.
6. The proportion of direct funding to research in aetiology, prevention, early detection diagnosis and prevention, and cancer control, survivorship and outcomes is low compared with the proportion of funding to research in biology and treatment.
7. This audit is one of several recent evaluations of funding to cancer research in Australia, and provides an important benchmark on the national patterns of direct funding to cancer research. The outcomes and impact of this funding will need to be evaluated and long-term investment secured to ensure that the outcomes translate into a reduced burden of cancer on the Australian population.
8. This National Audit of Cancer Research Projects and Research Programs can provide the first step towards planning and coordination of cancer research funding in the future.



1. INTRODUCTION

1.1 Background to the National Audit

Cancer in Australia

Cancer has a major impact on the Australian community. At current incidence rates, one in three men and one in four women in Australia will develop cancer by age 75.¹ In 2003, there were over 93 000 new cases of cancer, almost 38 000 deaths, and over 500 000 Person Years of Life Lost (PYLL) due to cancer.¹ It should be noted that the incidence figure excludes non-melanocytic skin cancers (NMSC) because data are not routinely collected; however, it has been estimated that 374 000 people in Australia were diagnosed with basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) in 2002.²

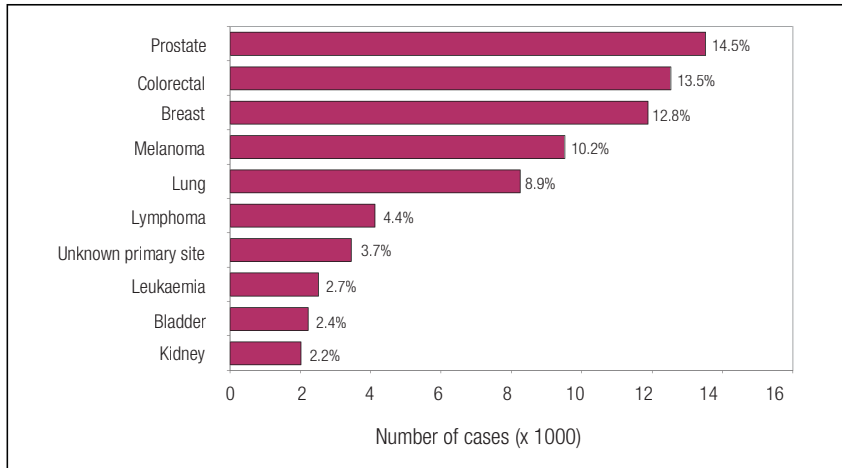
A diagnosis of cancer affects not only the individual but also their family, the community and the health system.³ Government expenditure for cancer and other neoplasms in 2000–01 was \$2.9 billion, 5.8 per cent of total health expenditure allocated by disease.⁴ Health system expenditure on cancer during 2000–01 was divided among the seven health sectors as follows: hospitals (\$1988 million), out-of-hospital medical services (\$343 million), total research (\$215 million), total pharmaceuticals (\$183 million), aged care homes (\$37 million), dental and other professional services (\$24 million), public health programs (non–MBS; \$130 million).

The total number of cancers diagnosed was 26 per cent higher in 2003 than in 1993, compared with a 12 per cent increase in the Australian population during this period. However, the age-standardised incidence rate for ‘all cancers’ was 0.7 per cent lower in 2003 than in 1993. The annual age-standardised incidence rate (1999–2003 using the World Health Organization world standard population) was 457.4 per 100 000 people. It is estimated that in 2004, over 338 000 persons were living with malignant cancer in Australian households.³ Despite improvements in therapy, cancer is Australia’s leading cause of death among 45–64 year olds and causes more premature deaths and overall disease burden than cardiovascular disease.⁵ The ten leading cancers by incidence and mortality are illustrated below in Figures 1 and 2.

INCIDENCE

Figure 1 Top 10 cancers in Australia, 2003, by incidence¹

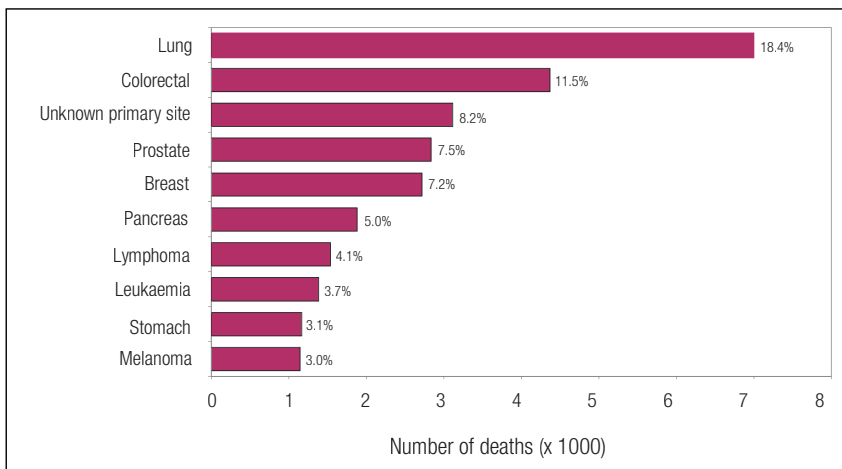
Percentages shown at the end of each bar represent the proportion of all cancer incidence



MORTALITY

Figure 2 Top 10 cancers in Australia, 2003, by mortality¹

Percentages shown at the end of each bar represent the proportion of all cancer mortality



Overall, survival from cancer in Australia has improved in recent years. Latest available data⁶ demonstrate continuing gains in survival for most cancers across most age groups, with greatest gains in the 50–59 and 60–69 age groups. In males, improvement in 5-year survival has occurred particularly for prostate cancer (57 per cent in 1982–1986 to 85 per cent in 1998–2004), kidney cancer (45 per cent in 1982–86 to 66 per cent in 1998–2004) and non-Hodgkin's lymphoma (46 per cent 1982–86 to 62 per cent in 1998–2004), while in females the biggest improvements have been kidney cancer (49 per cent in 1982–86 to 66 per cent in 1998–2004); breast cancer (72 per cent in 1982–86 to 88 per cent in 1998–2004) and non-Hodgkin's lymphoma (48 per cent in 1982–86 to 63 per cent in 1998–2004). However, the data also show lack of progress in improving survival for some cancers, including cancers of the brain (no change in 5-year survival 1982–86 to 1998–2004) and decreased survival for bladder (69 per cent in males and 65 per cent in females, 1982–86) to (62 per cent in males and 55 per cent in females, 1998–2004).

Improvements in survival reflect prior investment in cancer research. The importance of cancer research per se cannot be underestimated. It provides the basis for increasing our understanding of the basic mechanisms underlying cancer but also offers opportunities for development of new approaches to prevention, detection, diagnosis, treatment, and supportive and palliative care, which can lead to improvements in survival from cancer. However, there is a considerable lag time between research and changes in outcomes.

Cancer Australia

Cancer Australia⁷ is an Australian Government agency established in 2006 as part of the Commonwealth's Strengthening Cancer Care initiative⁸ to help reduce the burden of cancer in Australia. Its role is to provide national leadership in cancer control and to improve coordination of and collaboration between all stakeholders, including people affected by cancer, health professionals, researchers, cancer organisations and governments.

An initial priority of Cancer Australia is to review current national cancer control and cancer research activities. This audit provides important national baseline data on the investment in cancer research projects and programs at the national level.

1.2 Importance of a National Audit

Recent surveys have examined cancer research in Australia at the state and territory level.^{9,10} These surveys have sought information on the scope of cancer research being undertaken, the funding provided to projects, personnel, training, equipment and infrastructure, as well as sources of funding, by requesting such details via questionnaires to cancer researchers. Results of these surveys have provided important information on cancer research at the state and territory level, but at a national level we do not know the full extent of funding to cancer research, the proportion of funding or research effort that is distributed across different tumour sites or where research occurs across the spectrum of cancer care.

The National Audit of Cancer Research Projects and Research Programs will provide, for the first time, baseline data on the range of cancer research funded in Australia. In particular, the audit will identify the pattern of direct funding to cancer research projects and research programs by tumour site and the continuum of cancer care.

While the audit looks at research funding within the categories of tumour site, it is recognised that outcomes of research undertaken at specific tumour sites and in specific research areas can also provide important directions for research in other tumour sites. These positive flow-on effects have not been specially addressed in this audit.

1.3 Objectives of the National Audit

The present audit focused on a survey of national and international, government and non-government funding that was provided directly to cancer research projects and research programs in the years 2003 to 2005 inclusive. The audit also captures some clinical trials activity funded during this period.

The audit captures clinical trials activity that was directly funded through project and research program grant funding but does not capture trials activity that did not receive specific grant funding or trials funded by industry. The present audit did not directly seek information on funding provided for:

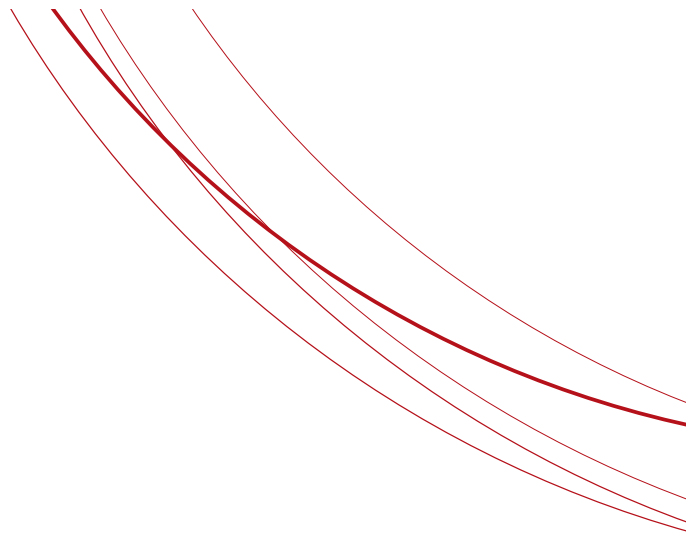
- infrastructure;
- equipment;
- fellowships awarded to individuals;
- scholarships for training;
- in-kind support by staff in cancer research; and
- routine clinical care, support services, data collection and ongoing monitoring of service delivery and outcomes

As such, it is acknowledged that these are major areas of funding for cancer research in Australia and may be the subject of subsequent audits.

Philanthropic support for cancer research and funding provided by the pharmaceutical industry were also not a focus of this present audit; however, an estimate of the investment of the pharmaceutical industry to cancer research in Australia was obtained directly from specific companies.

It is important to emphasise that information obtained in the National Audit provides a specific snapshot of funding to cancer research projects and research programs at the national level and offers some detail on how much of that investment was provided to different tumour sites and across the continuum of cancer care. It should also be noted that the majority of projects and research programs were investigator-initiated and information on funding specifically allocated to policy initiatives or practice imperatives was not requested. While other elements of research investment, such as infrastructure support and fellowships, contribute significantly to supporting and undertaking cancer research, these investments are generally less attributable to specific tumour sites or precise points on the continuum of care.

It is anticipated that the information provided from the National Audit of Cancer Research Projects and Research Programs will help identify areas for future funding.



2. METHODS

2.1 Approach to the National Audit

After assessing approaches to recent cancer research audits undertaken by other cancer agencies in Australia and around the world (including the Ministerial Taskforce for Cancer of Victoria⁹, The Cancer Control Council of New Zealand¹¹, the National Cancer Research Institute of the United Kingdom¹² and the National Cancer Control Initiative¹³), a ‘top-down’ approach to the survey was used, by requesting information from organisations likely to directly fund cancer-related research projects and research programs rather than approaching the fund-holders themselves.

As described above, funding for cancer research is composed of different components, including the direct spend on programs of research, funding to individuals in the form of fellowships/scholarships etc, and funding to infrastructure, equipment, support services and laboratories. The focus of this audit was the direct funding provided to cancer research projects and research programs. This approach provides detailed baseline data on the research funding allocated to tumour types and different areas of cancer research and, as such, will help identify areas for future investment.

A survey restricted to a single year may poorly represent continuing research projects and research programs. For this reason, this report contains an analysis of the direct funding component to cancer research projects and research programs funded in Australia in the three years from 2003 to 2005.

The report describes the pattern of cancer research projects and research programs across Australia in 2003 to 2005, compares this pattern of spending in an international context, and highlights areas where there may be opportunity for cooperation between different funding agencies and for collaborations between researchers.

2.2 Sources of data

The exact number of organisations and groups who provide funding for cancer research is unknown. A search of annual research reports and websites from major medical research institutions within Australia identified 80 Commonwealth, including the NHMRC and the Australian Research Council (ARC), and non-government organisations (including state and territory Cancer Councils), cancer charities, foundations and medical research institutes that provided funding support to Australian researchers. An additional 19 international funding agencies were also identified as directly funding Australian cancer researchers.

For an indication of the contribution to cancer research from smaller trusts and bequests, we invited seven research-intensive universities for details of funding provided by these sources allocated to cancer research.

To determine the investment by the pharmaceutical industry to cancer research in Australia, an initial invitation was made to Medicines Australia. Subsequently, invitations were made directly to pharmaceutical companies.

An invitation to each of the National Cooperative Oncology Groups was made to obtain an indication of sources of funding for clinical trials activities across Australia.

2.3 Approach to data collection and overall response

In April to June, 2007, a total of 99 organisations were invited to provide details of their direct funding to cancer research (Appendix A). This included funding provided for both research project grants and research program grants. Each funding organisation was approached with an introductory email to the Chief Executive Officer or equivalent from Dr Paul Jackson of Cancer Australia (Appendix B), to which was attached a formal invitation from Professor David Currow, Chief Executive Officer, Cancer Australia (Appendix C). Information was requested to be supplied in the form of a common dataset including details of the Chief Investigator and named collaborators (where available), an abstract of the research activity and exact details of funding awarded in 2003, 2004 and 2005.

Two weeks after initial invitation, follow-up telephone calls were made to each of the 99 funding organisations to verify that the request had reached an appropriate departmental contact, and to clarify any concerns raised. A second courtesy call was made after another two weeks to identify any difficulties an organisation might have encountered in providing data within the requested timeframe. Further telephone contact was made every two weeks to ensure data would be provided as promised. Late responders were also followed up by telephone in an effort to ensure submission of their funding information.

After submission, data were transferred to a uniform and standardised electronic format to facilitate entry into the analysis program.

Of 99 organisations that potentially provided funds directly to cancer research projects and research programs, 98 responded. Of these respondents, only two organisations declined to provide details of funding. These two organisations were not large government or non-government funders of cancer research. Of the 96 organisations who agreed to provide data, 10 indicated that they had not allocated funds to cancer research in 2003, 2004 or 2005, 2 organisations could not provide details of funding to specific research projects or programs, 7 organisations reported funding only for infrastructure, equipment or people support, 5 organisations allocated their research funding to cancer research via another funding organisation, and 4 organisations reported that they did not directly support cancer research.

Medicines Australia approached its members to identify their investment in cancer research between 2003 and 2005. Cancer Australia also directly approached 19 pharmaceutical companies that had invested in cancer research during 2003 to 2005. These companies were asked to provide an indication of their investment in cancer research by an invitation to the Managing Director.

All data received were entered into an SPSS (SPSS for Windows® version 15.0®) database for analysis.

2.4 Coding and classification – use of the Common Scientific Outline

In order to be able to interrogate the database in an accurate and reproducible way, each research project and research program, including clinical trials research, entered into the final analysis was classified according to an internationally recognised coding system: the Common Scientific Outline (CSO) and Disease Site code. These systems were chosen for the following reasons.

- The CSO is a classification system specific to cancer research.
- CSO is easily understood and used by several national organisations around the world.
- CSO and Disease Site codes allow accurate and meaningful comparisons with similar surveys carried out by international cancer research organisations, such as the National Cancer Institute (USA), the European Union and the National Cancer Research Institute (UK).

The CSO¹⁴ is a classification system of easily applied cancer-related research terminology that has been developed by an international partnership that includes the US National Cancer Institute, other US cancer research funding agencies and the National Cancer Research Institute (UK). Individual projects can be classified by Disease Site code and then into one or more of seven broad areas of cancer research defined by the CSO: Biology; Aetiology;

Prevention; Early Detection, Diagnosis, and Prognosis; Treatment; Cancer Control, Survival and Outcomes Research; and Scientific Model Systems. Each of these codes is then subdivided giving a final figure of 38 individual CSO codes (listed in Appendix D). Disease Site codes are listed in Appendix E. It should be emphasised that codes assigned to infrastructure and person support (CSO codes 1.5, 2.4, 3.6, 4.4, 5.7, 6.9, 7.3) will not be represented in the present audit because these data were not sought.

Coders classified each research project, research program or trial using Disease Site and CSO codes. Each entry was first classified by tumour stream (Appendix E) and then by specific Disease Site code(s). CSO codes were then assigned to all entries: one main CSO category for a research project or research program with single focus, and one main CSO category with up to three additional CSO categories for multi-focus research projects and programs.

Following initial coding, a random sample (25 per cent) of entries was independently recoded as cross-check. Where coding categories differed between cross-checked entries (< 5 per cent) final coding categories were assigned after consensus between all CSO coders.

Analysis of audit data was processed using Microsoft Excel and SPSS for Windows® version 15.0®

2.5 Ownership and subsequent access to more specific data

The data supplied by participants are held in confidence by Cancer Australia. Access to identifiable information is limited to Cancer Australia staff involved in the audit. Details of individual research projects and research programs at the state or territory, organisational and individual levels or identifiable funding will not be published or accessible unless agreement is obtained in advance from the organisation(s) supplying the data.

2.6 Which data are not included in the National Audit?

The aim of this audit was to obtain an initial indication of the scope of direct funding on cancer research projects and research programs in Australia at a national level. The data used for analysis focus on cancer research where funding could be directly attributed to specific cancer research projects and research programs including clinical trials research, but should not be regarded as a record of all types of cancer research funding in Australia.

The audit does not include funding assigned to infrastructure, equipment, person support, fellowships or scholarships, in-kind support, routine clinical care, support services, data collection and ongoing monitoring of service delivery and outcomes. In addition, the audit does not include direct funding from organisations to cancer research where allocations to specific research projects could not be identified. Funding within these categories includes: funding of in-house research by some state and territory Cancer Councils, funds provided to research institutes by their internal foundations, and Commonwealth-funded cancer-related Cooperative Research Centres (CRCs). These CRCs are for Cellular Growth Factors, Discovery of Genes for Common Human Diseases, Biomedical Imaging Development and Cancer Therapeutics.

In addition, we invited a representative group of universities and hospitals for funding provided by small charities and trusts.

Cancer Australia recognises the contribution to cancer research in Australia from philanthropic donations but details of funding from this source were not directly addressed by this audit.

2.7 Direct funding to cancer research by the pharmaceutical industry

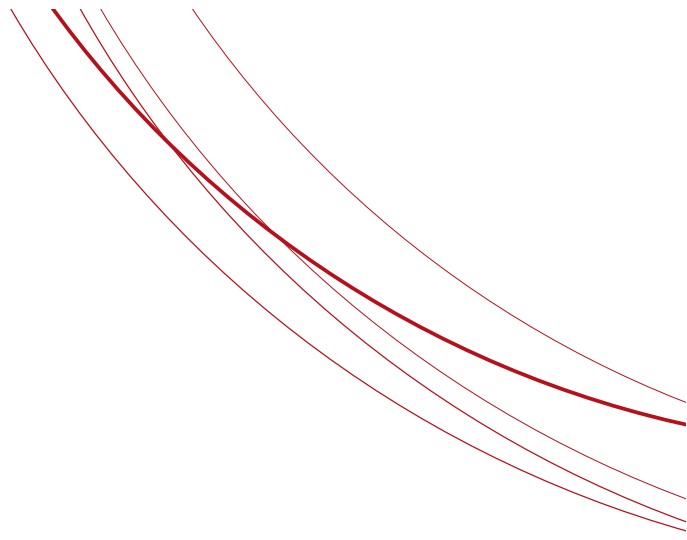
The pharmaceutical industry often funds research in common malignancies. Cancer Australia directly invited 19 pharmaceutical companies identified as supporting cancer research in Australia for details of their funding to cancer research. We received information from eight of these companies. The combined funding total to cancer research reported by these eight companies was approximately \$100 million for the three years of our audit window. However, it should be cautioned that:

- The level of detail provided to Cancer Australia greatly varied between the eight companies.
- The details of funding provided by some, but not all companies, included several categories not specifically addressed in the request for information, such as advisory and internal staffing, and administration costs.

As such, we would caution that the \$100 million to cancer research identified by our approach may be an underestimate of the total funding to cancer research from the eight pharmaceutical companies who provided funding details.

2.8 Oversight of the National Audit

The initial scope and methodology of the audit was outlined after discussions with members of Cancer Australia's National Research Advisory Group (NRAG). This group is composed of members with international reputations for excellence, and extensive expertise across the cancer control spectrum. The NRAG also includes consumer representatives. Throughout data collection and analysis all steps were undertaken with advice from a Steering Committee composed from members of NRAG. This Steering Committee advised on specific data to be collected, potential funding sources to be approached, which data should be included or excluded from analysis, and specific analyses of the final data set.



3. RESULTS – OVERALL PICTURE OF CANCER RESEARCH PROJECTS AND PROGRAMS IN AUSTRALIA, 2003–05

3.1 Total funding

The first National Audit of Cancer Research Projects and Research Programs is designed to provide an overview of cancer research projects and research programs funded in Australia. This report concentrates in particular on the pattern of identified direct spending by Common Scientific Outline (CSO) and Disease Site classification systems. A broad geographical distribution of research funding across Australia is also presented. In the future it may be possible to undertake detailed and comprehensive analysis within specific research areas encoded by these categories and to collect data on funding for infrastructure, equipment and personnel, but that is beyond the scope of this current audit.

Funding details from a final total of 68 organisations (as outlined above) were entered into software programs used for the analysis. Where funding from international organisations is included, the funding amount was converted to Australian dollars using the average exchange rate for the Australian dollar in the year funding was awarded. No adjustment has been made for parity pricing. The funding provided by these 68 organisations ranged from \$3000 to \$165.8 million.

Our database for analysis contained details of **1 332 cancer research projects and research programs**. A total cancer research direct spend of **\$291.50 million** was identified. Funding allocated in each of the years 2003, 2004, and 2005, as well as the overall mean investment per year over the three years, is shown in Table 1.

Table 1: Annual direct investment in cancer research projects and research programs in Australia 2003 to 2005

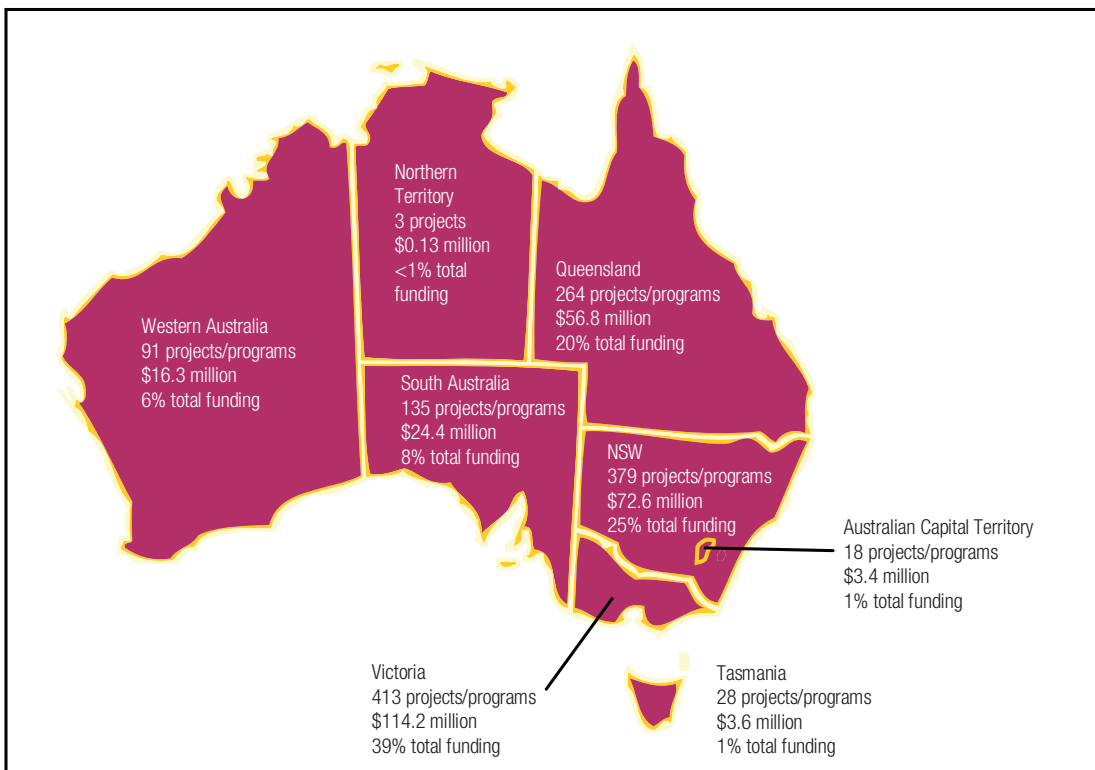
Year	Funding
2003	\$84.88 million
2004	\$91.67 million
2005	\$115.10 million
Total	\$291.50 million
Mean	\$97.17 million

The total direct funding on cancer research projects and research programs identified in this audit increased by 8 per cent from 2003 to 2004, and a further 26 per cent from 2004 to 2005. No adjustment has been made for inflation in these figures.

3.2 Where does the research funding go?

The investment was analysed by administering institution of the named Chief Investigator for each funded research project or research program. The geographical distribution of cancer research funding is shown below in Figure 3. The Chief Investigator was located in Victoria or New South Wales in 792 of the 1332 research projects and research programs, accounting for almost 64 per cent of funding (\$187 million). Victoria had 39 per cent of funding (\$114.2 million) and 413 cancer research projects and research programs. New South Wales had 25 per cent of funding (\$72.6 million) and 379 cancer research projects and research programs. Chief Investigators based in Queensland received approximately 20 per cent of funding (\$56.8 million) for 264 research projects and research programs. Chief Investigators located in South Australia and Western Australia were awarded similar but lower levels of research funding, accounting for 14 per cent of the total investment. South Australia was awarded \$24.4 million to 135 cancer research projects and research programs, and Western Australia received \$16.3 million for 91 research projects and research programs. Chief Investigators based in Tasmania and the Australian Capital Territory each accounted for approximately 1 per cent of total investment and 2 per cent of research projects and research programs, respectively. Tasmania received \$3.6 million for 28 cancer research projects, and the Australian Capital Territory received \$3.4 million awarded to 18 cancer research projects. Investment to Chief Investigators based in the Northern Territory was limited to three specific projects and \$0.13 million (< 1 per cent of total spend).

Figure 3 Distribution of identified direct funding to cancer research projects and research programs across Australia from 2003 to 2005, by location of Chief Investigator



When analysed on a *per capita* basis, there was a range of direct funding to cancer research projects and research programs across the states and territories in 2003 to 2005, from \$0.63 to \$23.00 per person.

It should be cautioned, however, that this range does not reflect the full funding to cancer research awarded to researchers across all states and territories. In addition, factors such as available facilities and infrastructure, and research workforce will have a large impact on the overall funding to cancer research in different states and territories.

3.3 What research is done in Australian states and territories?

Classification by CSO provides an indication of broad research trends but is not an exact measure of research undertaken in any one area – it describes the ‘centre of gravity’ of any particular study rather than a comprehensive analysis of all studies associated with a particular project.¹⁰

Cancer research projects and research programs for each state and territory identified by this audit were classified by main CSO category reflecting the primary focus of the research project or research program (Figure 4).

For Victoria, New South Wales, Queensland, South Australia and Western Australia, which together received 98 per cent of direct funding to cancer research projects and research programs, the patterns of research across CSO categories was generally similar, with the majority of funding to projects and programs in Biology (33.5 per cent to 64 per cent of total funding per state), and Treatment (13.5 per cent to 26 per cent of total funding per state). Studies in the following areas were also well represented:

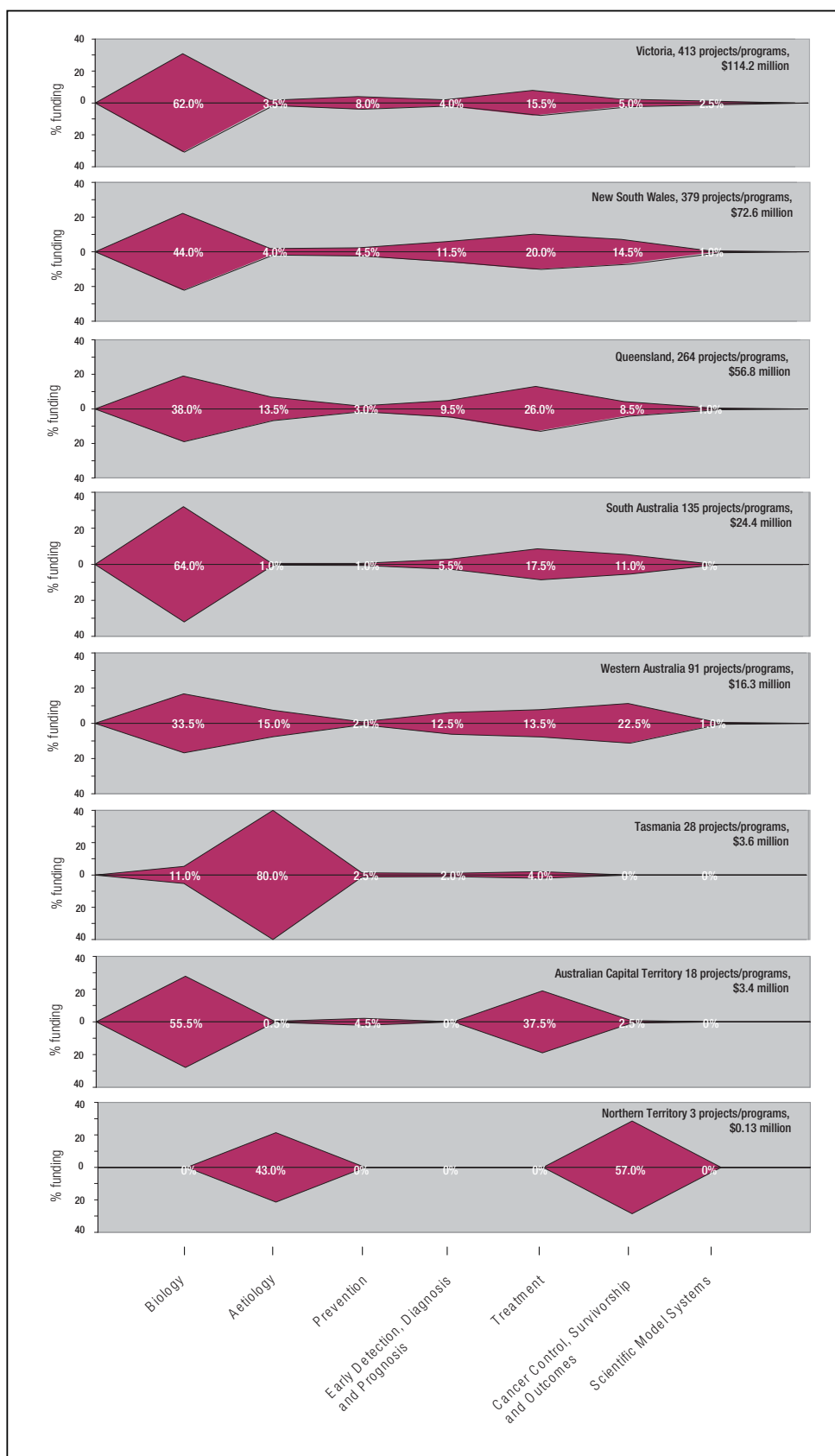
- Aetiology (15 per cent of funding in Western Australia and 13.5 per cent of funding in Queensland)
- Early Detection, Diagnosis and Prognosis (9.5 per cent of funding in Queensland, 12.5 per cent of funding in Western Australia, and 11.5 per cent of funding in New South Wales)
- Cancer Control, Survivorship and Outcomes research (11.0 per cent of funding in South Australia, 14.5 per cent of funding in New South Wales and 22.5 per cent of funding in Western Australia).

Tasmania and the Australian Capital Territory each received approximately 1 per cent of the direct funding to cancer research projects and research programs. In Tasmania, 80 per cent of this funding went to Aetiology. In the Australian Capital Territory the majority of funding (93 per cent) was divided between Biology (55.5 per cent) and Treatment (37.5 per cent).

The Northern Territory received less than 1 per cent of direct funding to cancer research and this funding was divided between Aetiology (43 per cent) and Cancer Control, Survivorship and Outcomes research (57 per cent).

It should be cautioned that the narrow distribution of cancer research projects and research programs across CSO categories described for Tasmania, the Australian Capital Territory and the Northern Territory may reflect the small numbers of cancer research projects and research programs supported in these states and territories.

Figure 4 Pattern of direct funding to cancer research projects and research programs in Australian States and Territories, 2003 to 2005 classified by main category of Common Scientific Outline



3.4 Collaborations

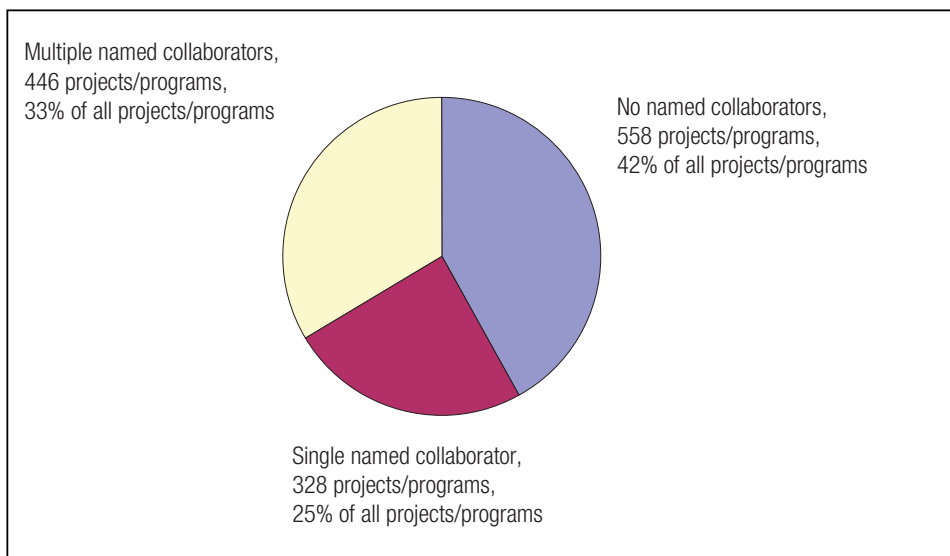
The ability to collaborate with researchers within the same institution, across states and territories and at an international level offers the opportunity to generate 'critical mass', better coordinate research projects, maximise research effort and avoid duplication.

Details of named collaborators on cancer research projects and research programs were requested from funding organisations. It should be noted that:

- Named collaborators provided by funding agencies may or may not also have been co-investigators on the original applications for research funding.
- An absence of a named collaborator does not necessarily equate with a lack of collaboration in the conduct of the research.

Of the research projects and research programs in our database, 558/1332 (42 per cent) had no named collaborators, 328/1332 (25 per cent) had a single named collaborator and 446/1332 (33 per cent) had multiple collaborators (Figure 5).

Figure 5 Proportions of cancer research projects and research programs in Australia 2003 to 2005, with no collaborators, a single collaborator or multiple collaborators



Fifty-eight percent (774/1332) of all research projects and research programs involved named collaborators and more than 80 per cent had one to three collaborators (Figure 6A). Almost 80 per cent of projects and programs had collaborators in the same state or territory (either within the same institution or within the same state/territory; Figure 6B). Another 18 per cent of projects and programs had interstate collaborators and 5 per cent had named overseas collaborators. When analysed by location of collaborators within Australia, the pattern was generally similar to the general funding distribution, with the majority of collaborators being located in the eastern states of Australia; 73 per cent of collaborators were based either in Victoria (32 per cent), Queensland (24 per cent) or NSW (17 per cent; Figure 6C).

Average funding per research project for projects without named collaborators was \$210 999, and for projects with a single collaborator was \$163 000. Projects with multiple collaborators were associated with increased average funding per project (\$268 000). Association between multiple collaborators and increased funding was most prominent in projects with more than six collaborators because these were commonly funding of specific cancer research program grants.

3.4a Research projects and research programs with a single named collaborator

An analysis of where collaborators were located in projects and programs with a single named collaborator (328 projects; Figure 7A) indicated that the majority of collaborators were from the same institution as the Chief Investigator (174 projects and programs; 53 per cent). A further 32 per cent (106 projects and programs) of single collaborator projects and programs had named collaborators who were from within the same state, 10 per cent (31 projects and programs) had collaborators interstate and only 12 projects and programs (4 per cent) had international collaborators.

3.4b Research projects and research programs with multiple named collaborators

Figure 7B illustrates all possible combinations for the locations of collaborators on cancer research projects and research programs with multiple collaborators (446 projects and programs). Of these 446 projects and programs, 110 (25 per cent) were associated only with collaborators from the same institution as the Chief Investigator.

When analysing the overall distribution of named collaborators in the 446 projects and programs with multiple named collaborators (Figure 7B), 273/446 projects and programs (61 per cent) included collaborators from the same institution, 239/446 projects and programs (54 per cent) included intrastate collaborators and 150/446 projects and programs (34 per cent) included interstate collaborators. International collaborators were named on 44/446 projects and programs (10 per cent) with multiple collaborators.

Only 22/446 projects and programs (5 per cent of all projects and programs with multiple collaborators) involved collaborations between named investigators within the same institution, the same state and interstate.

Two projects (0.5 per cent of all projects with multiple collaborators) had named collaborators from within the same institution, intrastate, interstate and international.

3.5 Broad source of direct funding by sector

Cancer research projects and research programs were categorised by the source of funding support (Figure 8). The majority of cancer research projects and research programs were funded by the NHMRC (\$165.8 million, 58 per cent of total direct spend), accounting for 34 per cent (454/1332) of projects. This investment in project and program grants that may include a component of people support is approximately one half of the total spend by NHMRC on cancer research in 2003 to 2005, when people support (fellowships, scholarships and awards) and infrastructure grants are included.¹⁵

Overall, the Australian Government provided 66 per cent (\$185.1 million) of the total direct funding for cancer research project and research program grants, providing support for 572 grants (43 per cent of all research project and research program grants). In addition to the NHMRC, sources for this funding included the ARC and AusIndustry.

State and territory governments contributed a further \$7.0 million for 10 research projects and research programs. State and territory Cancer Councils provided combined funding of \$26.4 million and supported 260 projects and programs (20 per cent of all research projects and research programs). Non-government charities and foundations provided 5 per cent of total funding (\$14.2 million) supporting 169 research projects and research programs (13 per cent of all research projects and research programs).

Figure 6 Details of named collaborators on cancer research projects and research programs in Australia 2003 to 2005

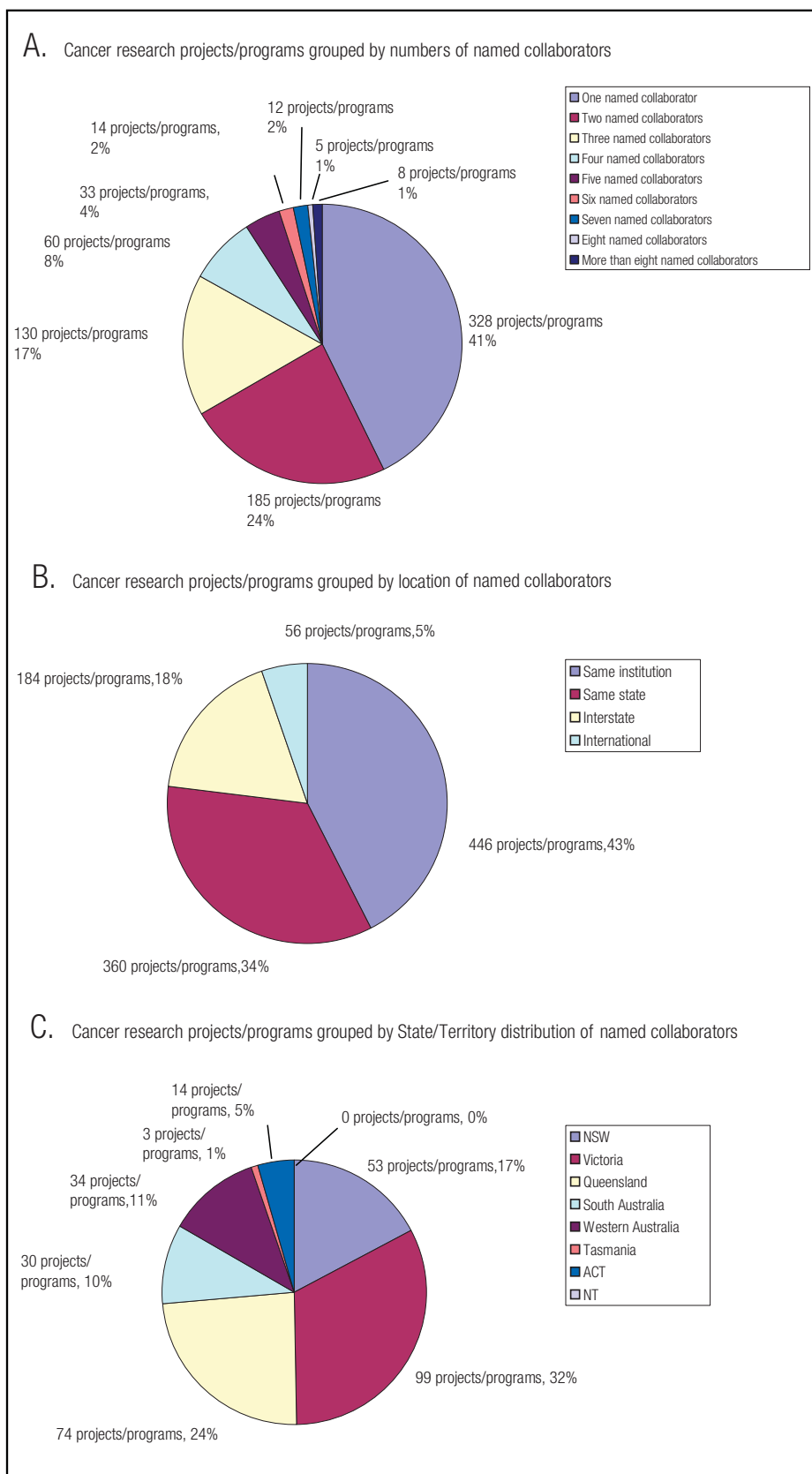
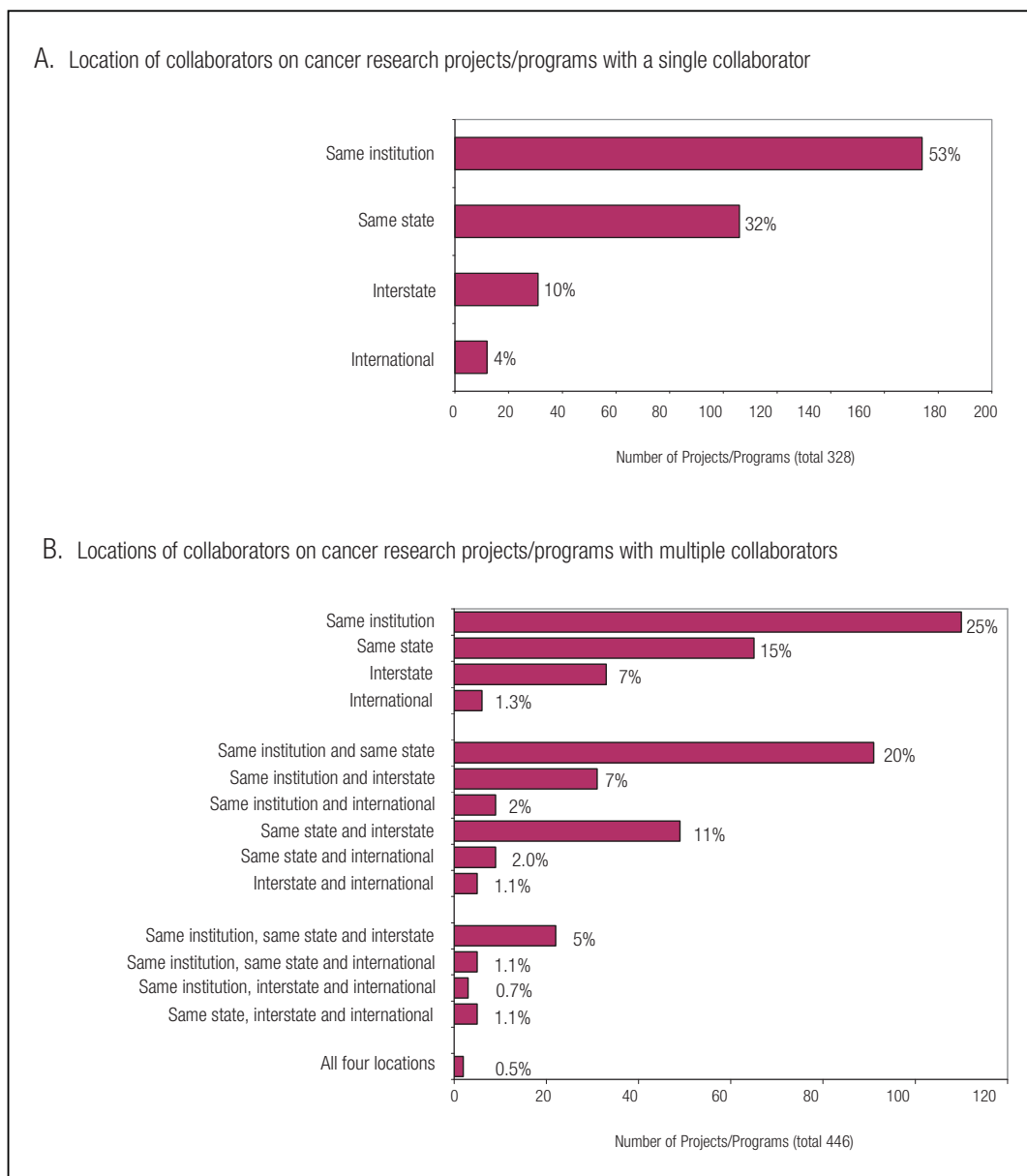
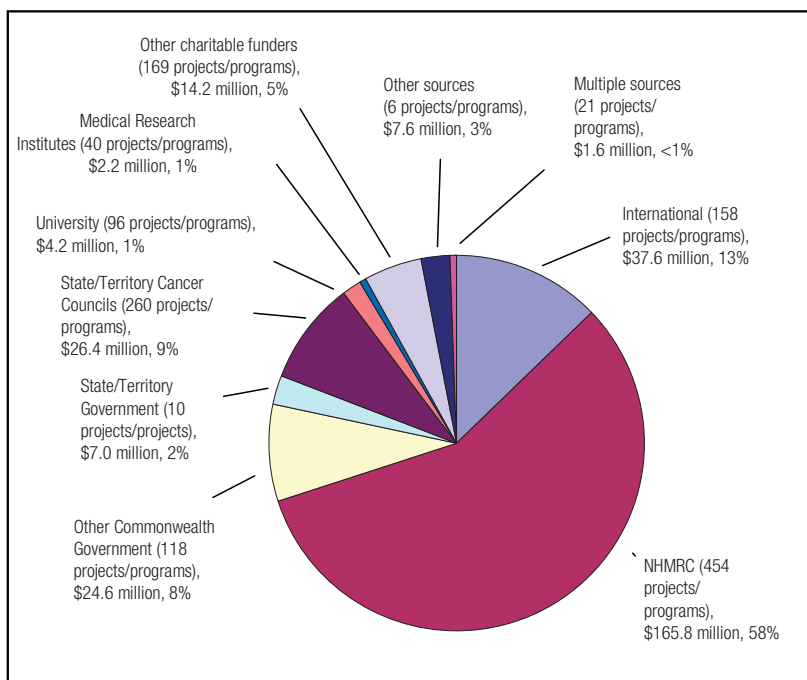


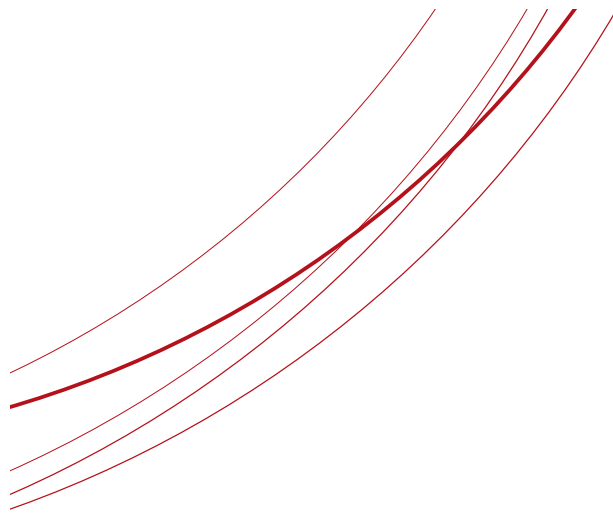
Figure 7 Locations of named collaborators on cancer research projects and research programs in Australia 2003 to 2005, with a single collaborator (A) or multiple collaborators (B).



The success of Australia at an international level in the cancer research arena is evidenced by the fact that international funding agencies supported over 150 research projects and research programs in Australia and contributed \$37.6 million (13 per cent of the identified direct funding) in 2003 to 2005.

Figure 8 Identified direct funding to cancer research projects and research programs in Australia 2003 to 2005, by broad funding agency



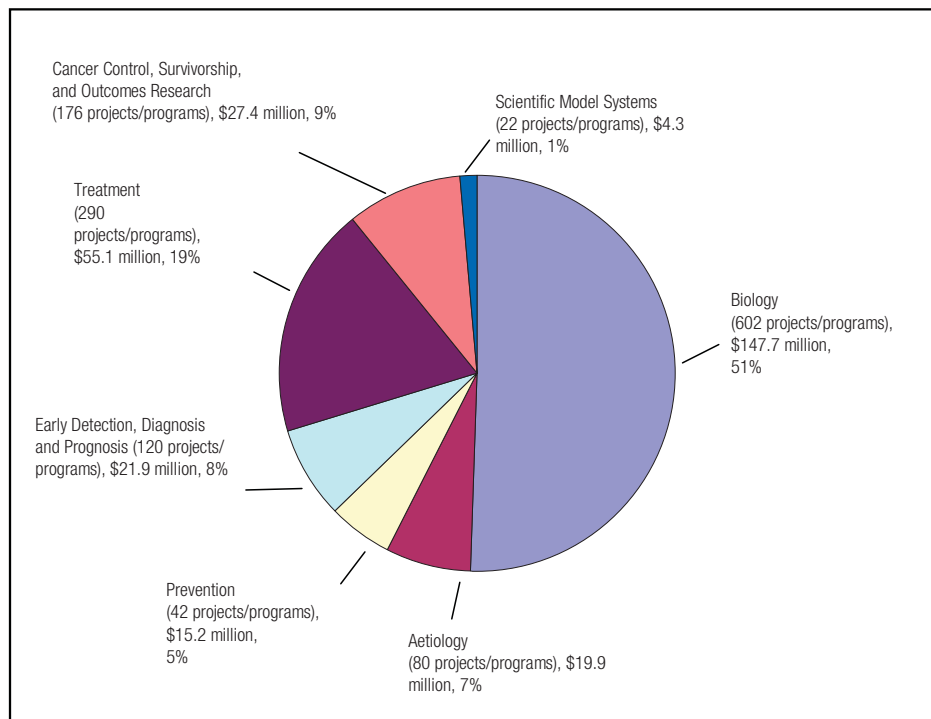


4. RESULTS – DESCRIPTION OF CANCER RESEARCH PROJECTS AND RESEARCH PROGRAMS IN AUSTRALIA

4.1 Classification by Common Scientific Outline

We classified each of the research projects and research programs in our database by a Common Scientific Outline (CSO) category that reflected the primary focus of the research being undertaken in the project. Figure 9 shows the distribution of all projects and programs with identified direct funding to cancer research classified by the seven major CSO categories. The full breakdown of funding by CSO is shown in Appendix F.

Figure 9 Identified direct funding to cancer research projects and research programs in Australia 2003 to 2005, by main category of Common Scientific Outline



The largest proportion of direct funding was to Biology (51 per cent), with a further fifth of the direct funding into research projects focused on Treatment (19 per cent). Funding to Aetiology (7 per cent), Prevention (5 per cent), Early Detection, Diagnosis and Prognosis (8 per cent) and Cancer Control, Survivorship and Outcomes (9 per cent), accounted for the rest of the total funding.

With the large contribution by the NHMRC to cancer research, the pattern of cancer research projects directly funded by the NHMRC versus direct funding provided by all other funders was assessed (Figure 10). The spectrum of funding was generally similar between the two funding groups. However, the proportion of funding from the NHMRC to Biology was higher (59 per cent versus 39 per cent) and somewhat lower in Prevention (1.1 per cent to 10.5 per cent) and Treatment (14.1 per cent to 25.1 per cent) compared with all other funders.

4.2 Analysis of direct funding in CSO Biology

There are five subgroups within the main CSO Biology classification; one is concerned with the study of normal functioning, two focus on cancer initiation, one focuses on cancer progression and metastasis, and one subgroup on resources and infrastructure. Figure 11 illustrates the pattern of spending identified by this audit within the CSO Biology category. Over half of funding (63 per cent) within this category was concerned with studies of normal functioning in cancer-related systems.

Figure 10 Identified direct funding to cancer research projects and research programs by NHMRC versus other funders in Australia 2003 to 2005, classified by main Common Scientific Outline categories

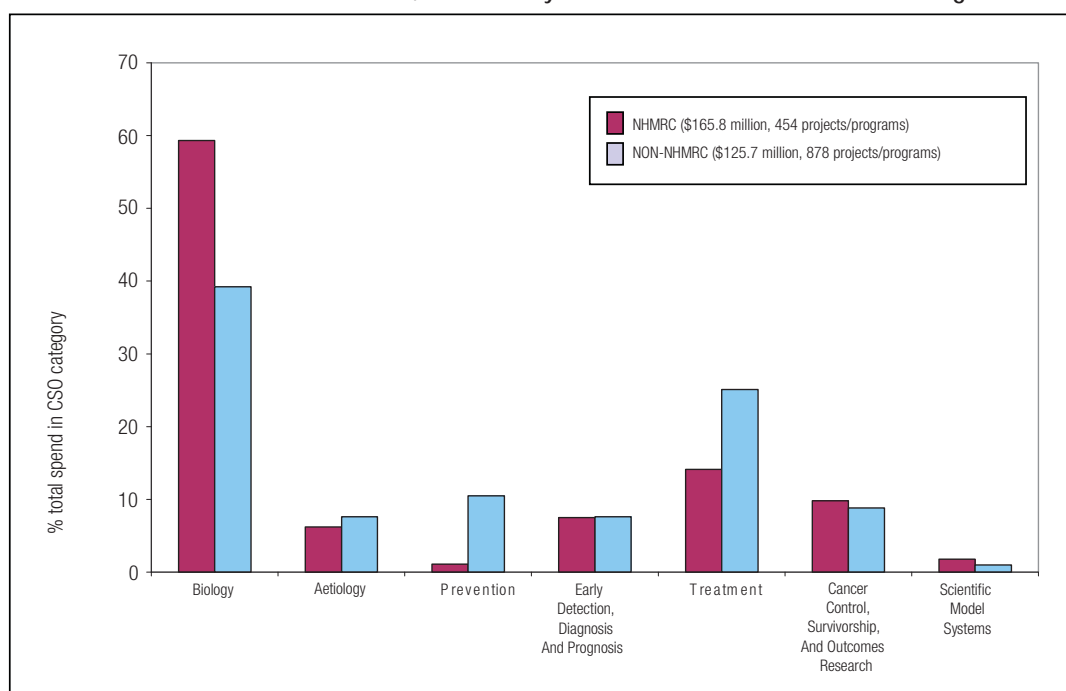
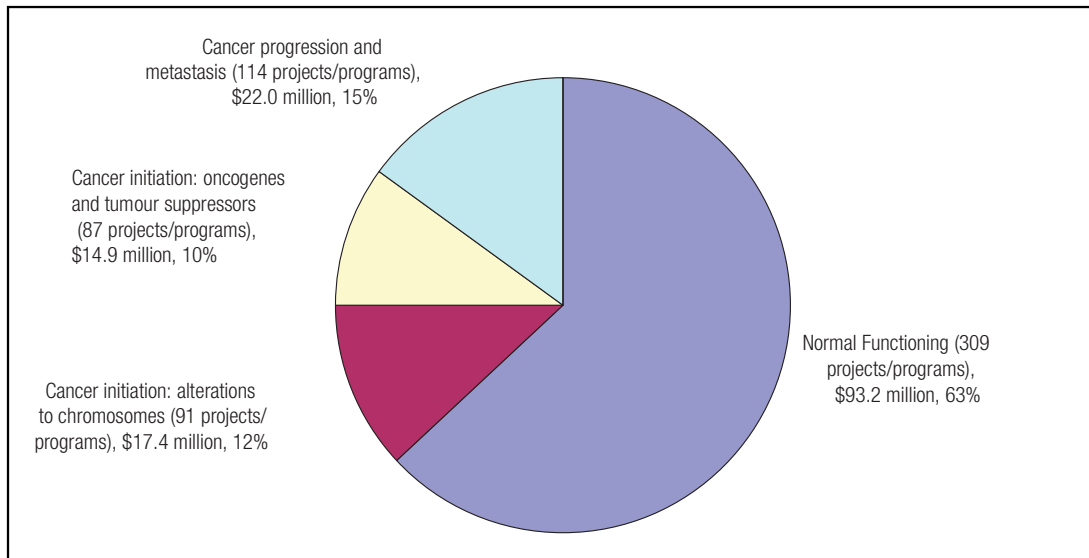


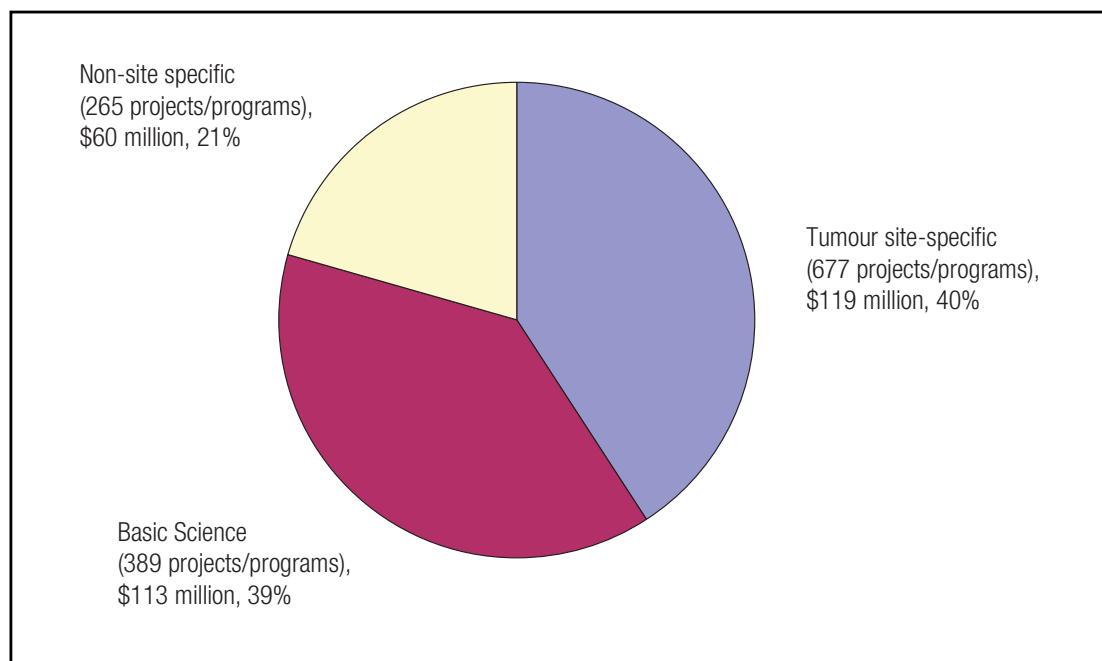
Figure 11 Identified direct funding to cancer research projects and research programs in the Biology subdivision of the Common Scientific Outline in Australia, 2003 to 2005.



4.3 Classification by area of research

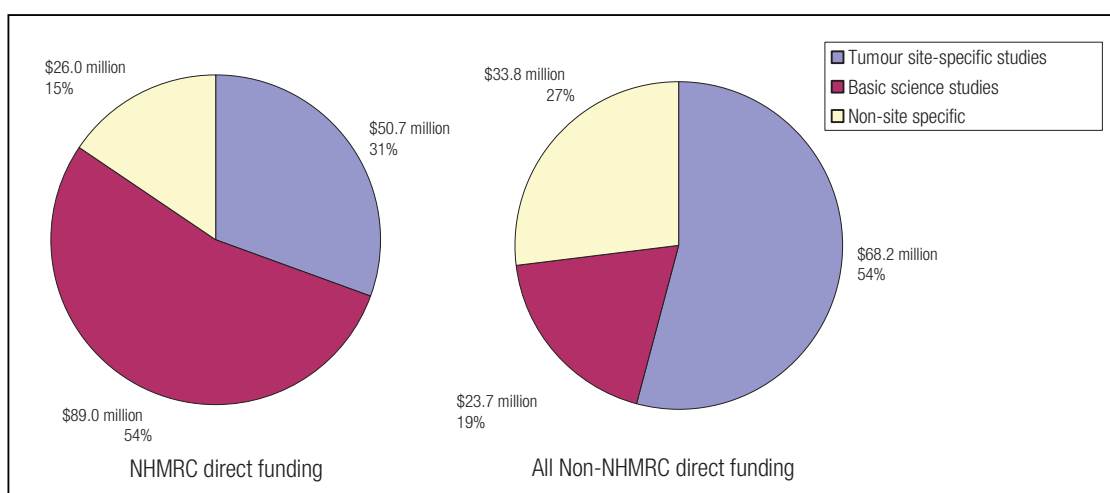
Of 1 332 cancer research projects and research programs, 677 (51 per cent) were to research on a particular cancer site (Figure 12). These projects and programs accounted for 40 per cent of total direct funding in 2003 to 2005 (\$119 million). Of the remainder (654 projects and programs), 389 projects (29 per cent of all projects and programs, and \$113 million; 39 per cent total spend) focused on fundamental or basic science studies of normal or tumour systems and 265 projects (20 per cent of all projects and programs, and \$60 million; 21 per cent total spend) were non-site-specific research.

Figure 12 Project focus of the direct funding to cancer research projects and research programs in Australia 2003 to 2005



When broken down into NHMRC versus all non-NHMRC direct funding (Figure 13), NHMRC funded a greater proportion of research projects into fundamental or basic science research projects and research programs (54 per cent against 19 per cent by other funders) with proportionally less funding to tumour site-specific studies and non-site-specific studies.

Figure 13 Distribution by study focus area of identified direct funding to cancer research projects and research programs in Australia 2003 to 2005 by the NHMRC and all other cancer research funders



4.4 Funding focus area by CSO classification

A breakdown of direct funding to tumour site-specific studies, non-site-specific studies and basic science studies by broad CSO classification is shown in Figures 14–16. The data show the proportion of total funding in each CSO category that is attributable to either basic science studies (Figure 14), tumour site-specific studies (Figure 15) and non-site-specific studies (Figure 16).

4.4a Basic science studies

Basic science studies (Figure 14) accounted for 66 per cent of the overall funding in Biology, whereas these studies only accounted for 21 per cent of the overall funding in Aetiology and 24 per cent in Scientific Model Systems. Basic science studies accounted for 2 per cent of overall funding in Prevention, 4 per cent in Early Detection, Diagnosis and Prognosis, and 15 per cent of overall funding for Treatment research projects.

4.4b Tumour site-specific studies

Direct funding to tumour site-specific studies occurred across all CSO categories (Figure 15). The proportion of total direct funding within each CSO category was broadly similar, ranging from 38–75 per cent in all areas except Biology and Prevention, when direct funding was approximately half that in the other categories.

4.4c Non-site-specific studies

Studies that are non-site-specific can be relevant to a broad range of tumour sites. The majority of these studies were focused in areas with direct patient impact, including Prevention, Cancer Control, Survivorship and Outcomes Research, Treatment and Early Detection, Diagnosis and Prognosis (Figure 16).

Figure 14 Proportion of funding in the main categories of the Common Scientific Outline to basic science cancer research projects and research programs in Australia, 2003 to 2005

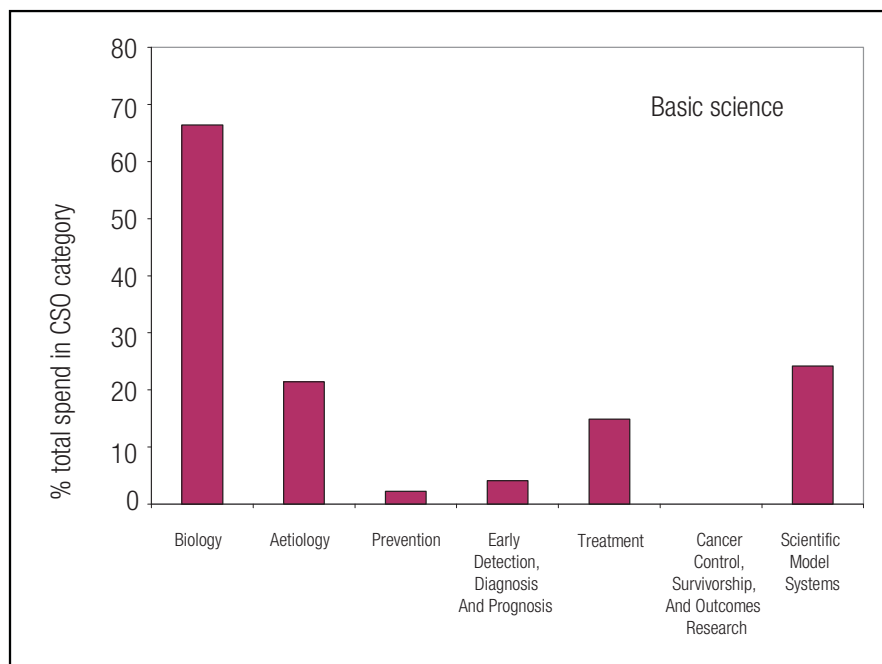


Figure 15 Proportion of funding in the main categories of the Common Scientific Outline to tumour site-specific cancer research projects and research programs in Australia, 2003 to 2005

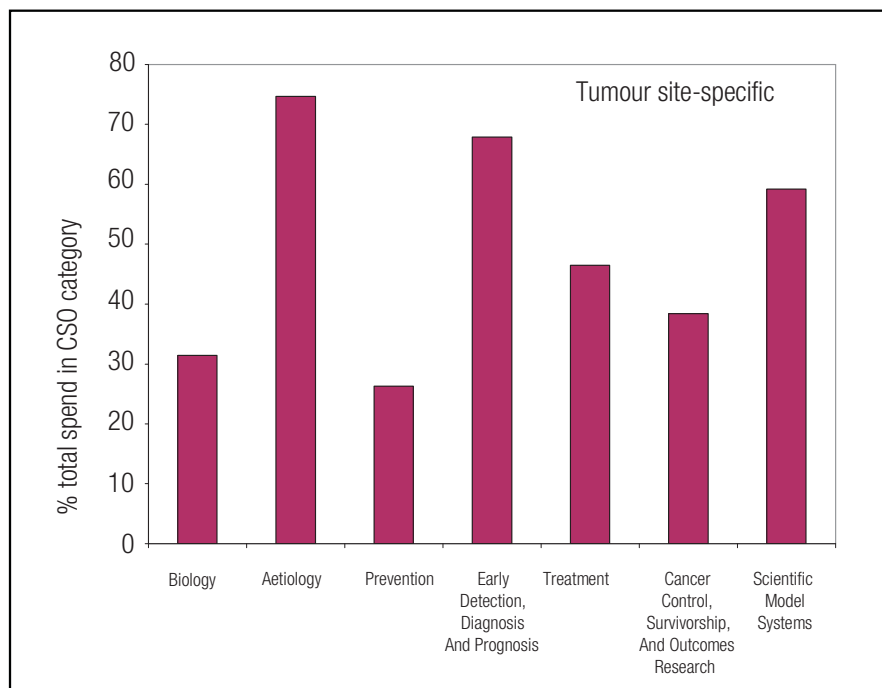
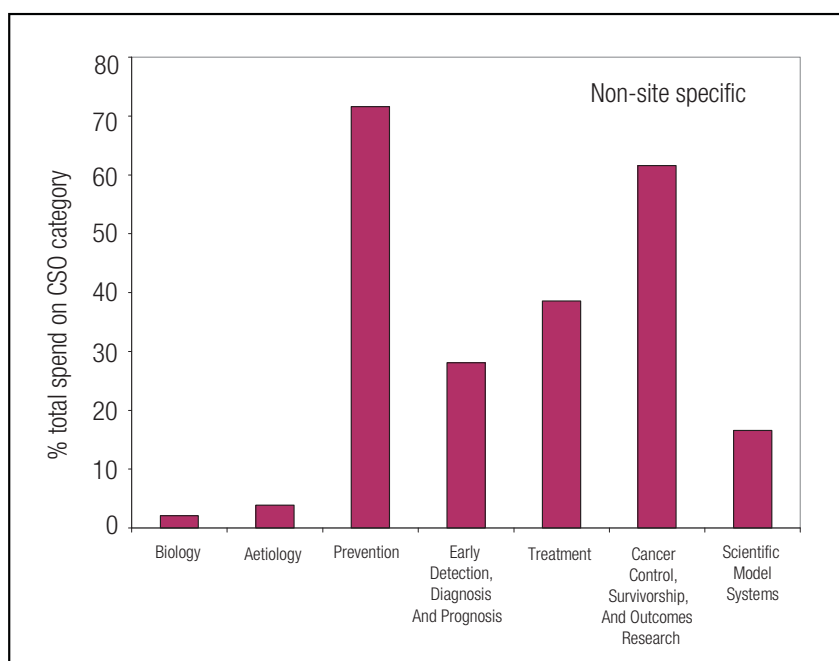


Figure 16 Proportion of funding in the main categories of the Common Scientific Outline to non-site specific cancer research projects and research programs in Australia, 2003 to 2005



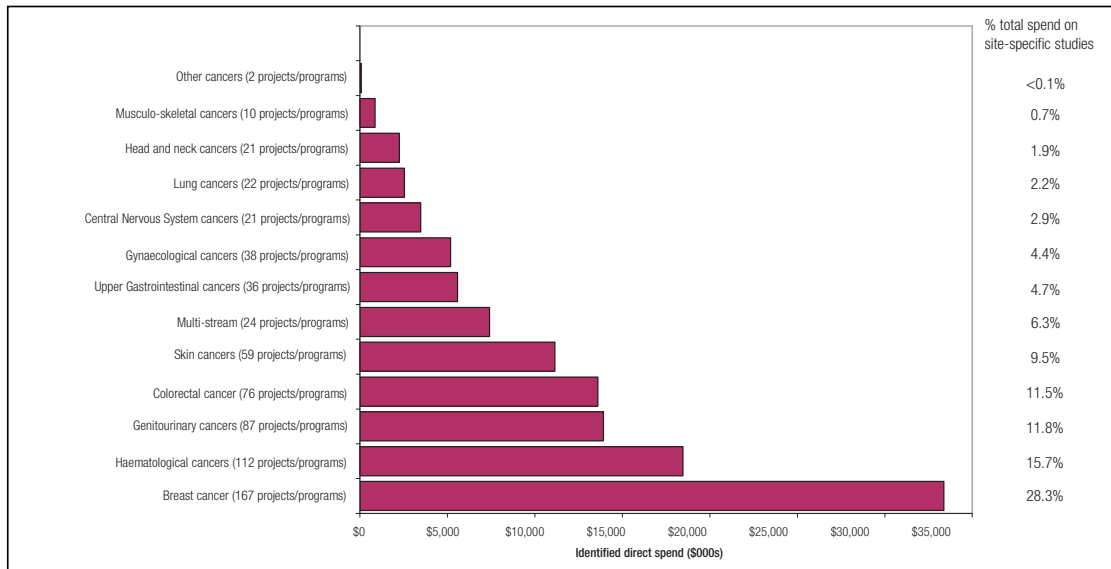
4.5 Research in specific tumour streams and sites

Tumours in different organs can be classified into streams, where related organ sites are grouped together (for example, genitourinary cancers include cancers of the prostate, bladder, kidney, prostate and testis) or as tumours in specific sites (for example, breast cancer or liver cancer; Appendix D). The identified direct funding to research by tumour stream is illustrated in Figure 17. The distribution of this funding by specific tumour site is then shown in Figure 18 for the top 20 funded tumour sites. As the proportions of funding allocated in research projects investigating multiple tumour streams and tumour sites were not identified, it should be noted that data for Figure 18 do not include:

- funding to individual tumour sites in projects and research programs where multiple tumour streams were studied; and
- funding for projects and research programs studying a tumour stream, where multiple tumour sites were studied.

Cancer research in the areas of breast, leukaemia, colon and rectum, prostate and melanoma received 80 per cent of funding provided to research in specific tumour sites.

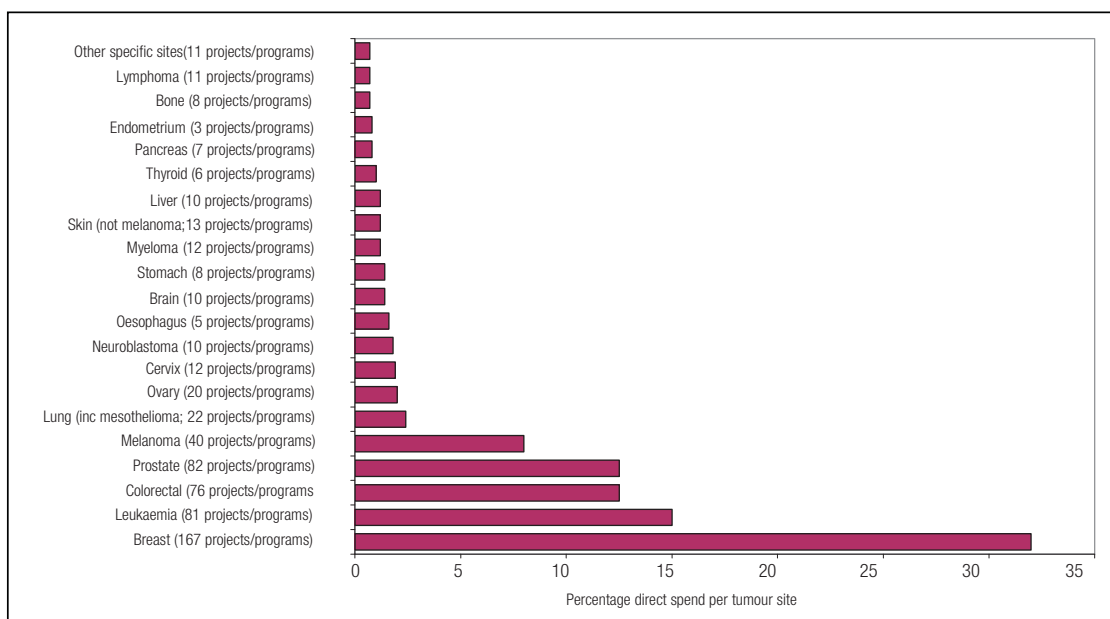
Figure 17 Identified direct funding to cancer research projects and research programs in Australia 2003 to 2005, classified by tumour stream



Burden of Disease measures the impact of disease on the population. Burden of Disease can be measured by several parameters, including by tumour incidence, tumour-site specific mortality and Person Years of Life Lost (PYLL). In the following sections, Burden of Disease for specific tumour sites, as defined by each of these criteria, is compared to:

- (i) the 2003 to 2005 overall direct funding provided to cancer research projects and programs for each tumour site as identified by this audit (Section 4.5a, Figures 19–22); and
- (ii) the 2003 to 2005 direct funding provided to cancer research projects and programs at each tumour site divided by:
 - numbers of individuals with disease at that site in 2003 (Section 4.5b, Figure 23);
 - numbers of deaths from tumours at that site in 2003 (Section 4.5b, Figure 24); and
 - PYLL to 85 years of age for that tumour site in 2003 (Section 4.5b, Figure 25).

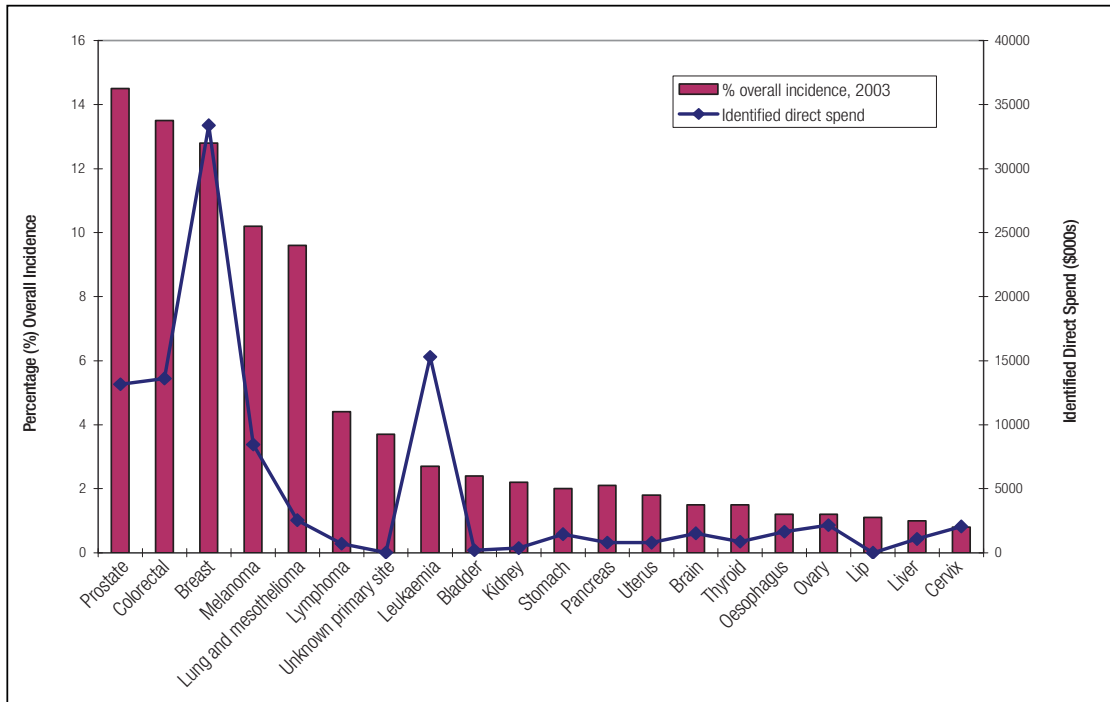
Figure 18 The top 20 tumour sites classified by direct funding to cancer research projects and research programs in Australia, 2003 to 2005



4.5a Burden of disease and overall direct funding to cancer research projects and research programs

Figures 19–22 illustrate the identified direct funding provided to cancer research projects and research programs for the top 20 cancers by incidence, mortality, PYLL to age 75 and PYLL to age 85. By tumour incidence, there is a general trend of direct funding being relative to tumour incidence with some exceptions. There were proportionally lower levels of funding for prostate cancer, colorectal cancer, melanoma, lung cancer and mesothelioma, lymphoma, cancers of unknown primary site, bladder, kidney, pancreas, uterus, thyroid and lip cancers relative to their incidence (Figure 19).

Figure 19 Direct funding to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by overall incidence in Australia in 2003



When spending was analysed in terms of tumour mortality (Figure 20), funding for lung cancers, cancers of unknown primary site, pancreatic cancer, lymphoma and stomach, oesophagus and brain cancers showed proportionally lower levels of funding relative to mortality. There were also proportionally lower levels of funding to cancers of the bladder, kidney and gall bladder relative to mortality caused by these cancers.

A similar pattern of funding was seen when cancers associated with specific tumour sites were categorised by PYLL to age 75 (Figure 21) and PYLL to age 85 (Figure 22), with differences in direct funding between different cancers being more disparate when considered by PYLL to age 85.

Figure 20 Direct funding to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by mortality in Australia in 2003

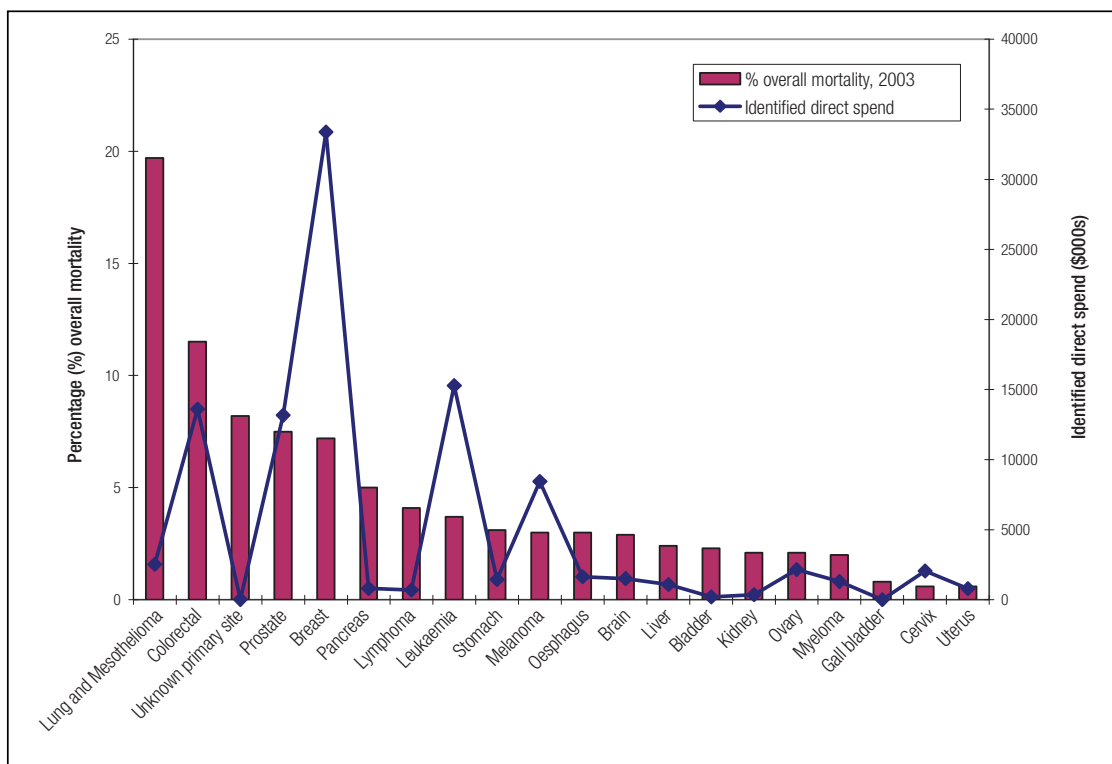


Figure 21 Direct funding to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by Person Years Life Lost (PYLL) to 75 years of age in 2003

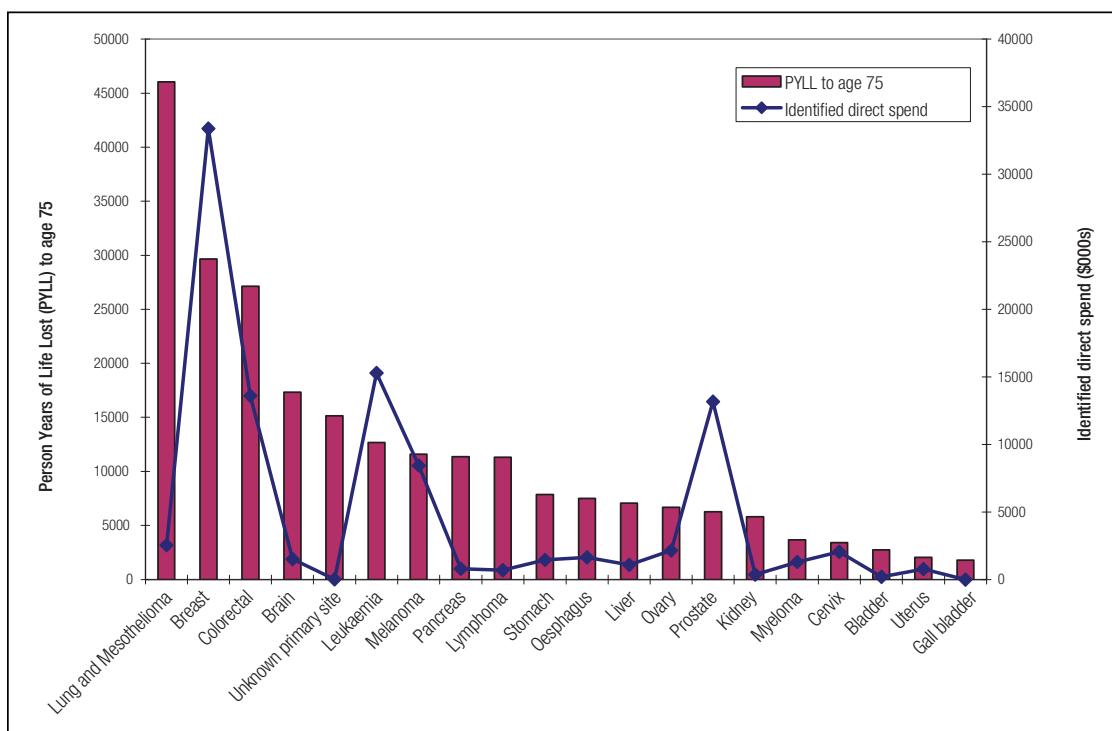
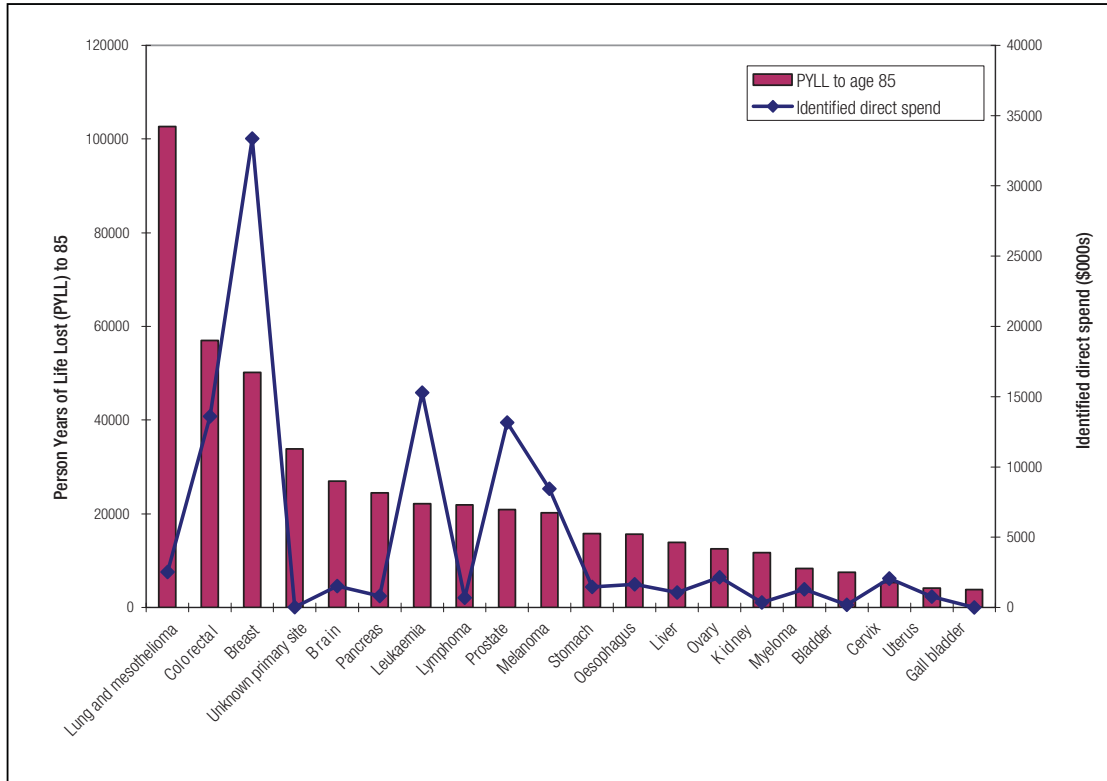


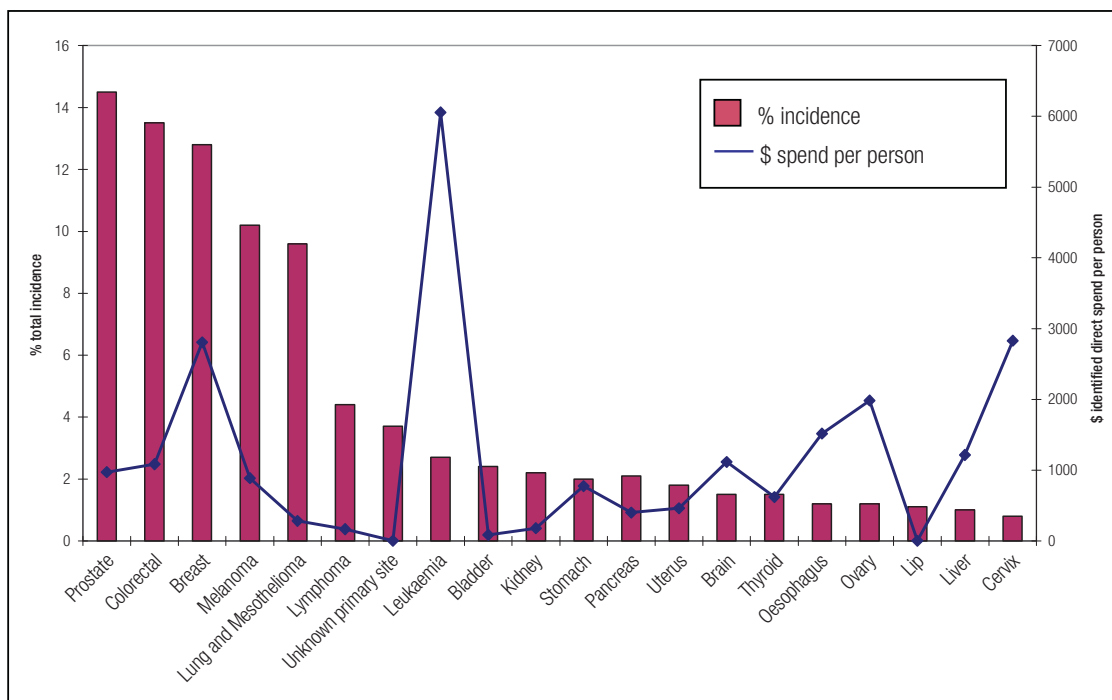
Figure 22 Direct funding to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by Person Years Life Lost (PYLL) to 85 years of age in 2003



4.5b Burden of disease and direct funding per individual with disease/per death/and per Person Years of Life Lost to 85 years of age, for specific tumour sites

A breakdown of the identified direct funding to cancer research divided by numbers of individuals with the disease in 2003 is shown in Figures 23–25. Relative to incidence there were low levels of funding per person for cancers of the prostate, colon and rectum, breast, melanoma and lung, lymphoma, and cancers of unknown primary site, bladder, kidney, pancreas, uterus and lip (Figure 23). There were relatively high levels of funding to leukaemia, brain, oesophagus, ovarian, liver cancer and cancer of the cervix.

Figure 23 Direct funding per person to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by incidence in 2003



When extended to research funding per death from cancer (Figure 24), there were relatively low levels of funding to lung cancer and mesothelioma, cancers of unknown primary site, lymphoma and cancers of the pancreas, bladder, kidney and gall bladder. There were relatively high levels of funding to leukaemia, melanoma, myeloma and cancers of the breast, ovary, cervix and uterus.

A similar trend is observed for direct funding per Person Year of Life Lost (PYLL) to age 85 (Figure 25).

Figure 24 Direct funding per cancer death to tumour site-specific cancer research projects and research programs in Australia 2003 to 2005, compared with the top 20 tumours by mortality in 2003

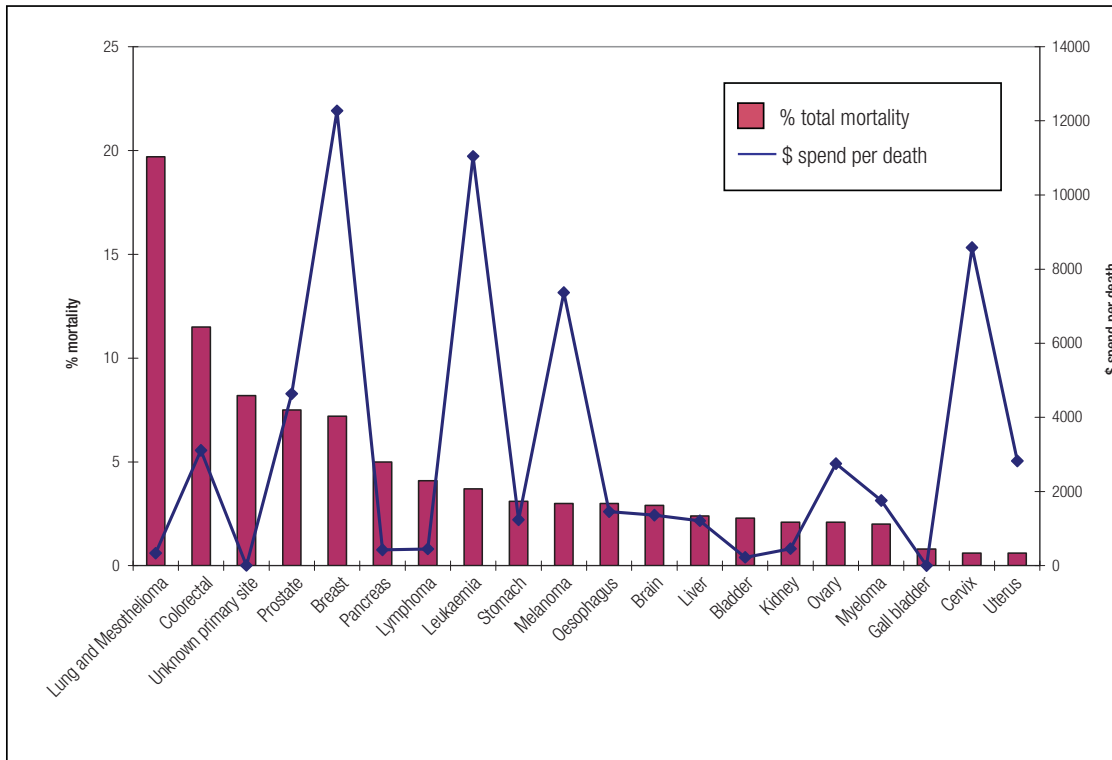
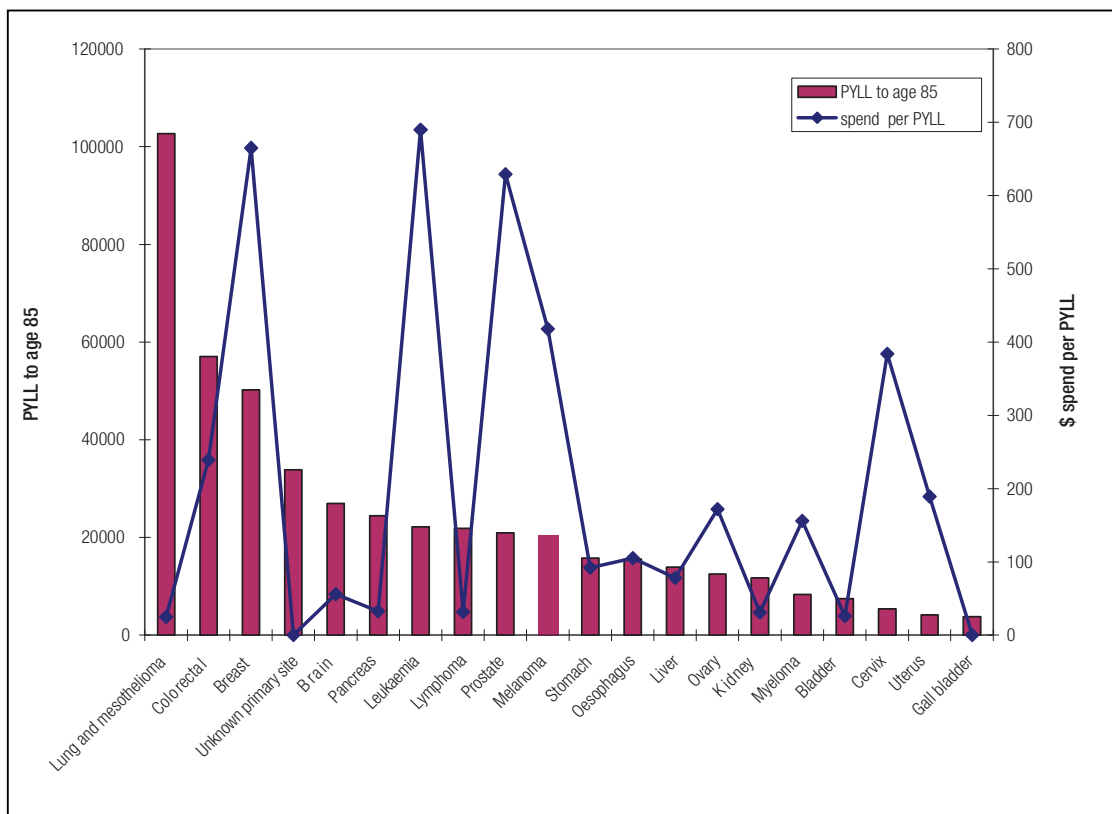


Figure 25 Direct funding of cancer research projects and research programs per Person Year of Life Lost to age 85 years in Australia in 2003 to 2005, compared with the top 20 tumours by Person Year of Life Lost in 2003



4.6 Patterns of cancer research projects at specific tumour sites

The pattern of direct funding in different research areas for specific tumours was examined by analysing distribution of funding for each tumour site by main CSO category. Data presented as kite diagrams in Figure 26 show the patterns of funding in studies of those cancers causing the highest mortality in Australia. In these diagrams, the proportion of direct funding in each CSO category is split into two equal parts above and below zero. Figure 26 includes the CSO category of the single research project in cancer of unknown primary site identified by this audit.

While there was funding across the majority of CSO categories for all cancers, the pattern of funding was different for each tumour type. There was a proportionally low level of funding in Biology, Prevention, Treatment, and Cancer Control, Survival and Outcomes Research, and no funding to Scientific Model Systems for lung cancer and mesothelioma; there was no investment in Treatment, Cancer Control, Survival and Outcomes Research, and Early Detection, Diagnosis and Prognosis in stomach cancer; and no funding to research in Early Detection, Diagnosis and Prognosis, Cancer Control, Survival and Outcomes Research, or Scientific Model systems in lymphoma. In addition, the proportion of funding in CSOs reflecting the patient journey (Early Detection, Diagnosis and Prognosis; Treatment; Cancer Control, Survival and Outcomes Research) in breast cancer was relatively low, though the actual amount of funding to these categories was, in comparison to other tumour sites, relatively high due to the overall high levels of funding to breast cancer research.

Aetiology research projects and research programs in colorectal cancer, prostate cancer or pancreatic cancer received little funding. Funding for studies in Prevention was a very low proportion of the overall funding for all cancer sites, except for lymphoma (26 per cent) and stomach cancer (18 per cent), but this may reflect the focus of the few research projects and research programs, and relatively low overall levels of funding on research, in these cancer sites. A similar basis may underlie the 31 per cent invested into Scientific and Model Systems projects for stomach cancer.

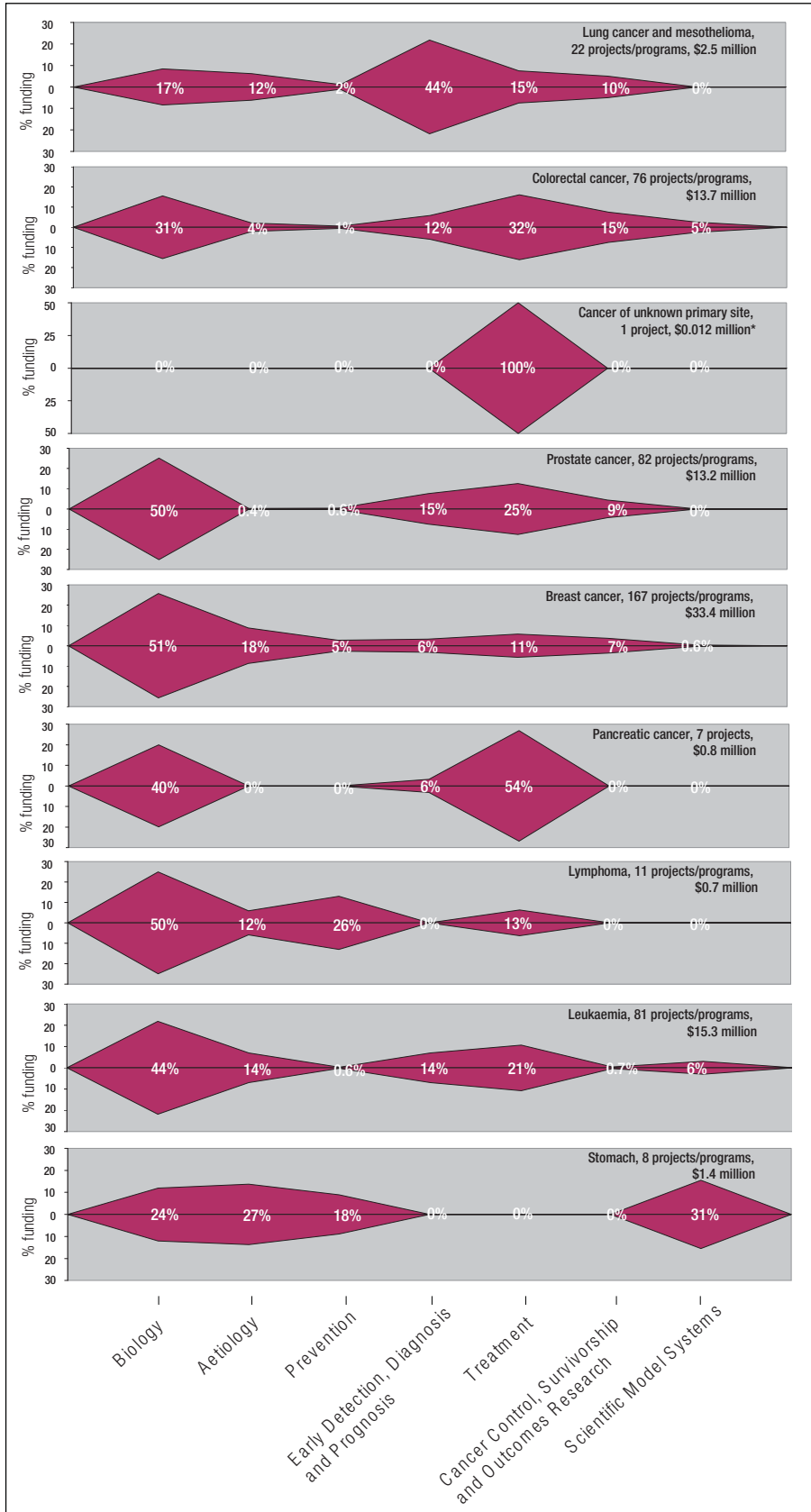
When analysing these data, it is important to understand that several factors other than Burden of Disease can dictate levels of research funding for specific tumour sites.¹⁰ These can include:

- scientific opportunity;
- generalisability to other cancers and other research;
- researchability;
- quality of research being undertaken;
- size of research workforce; and
- fundraising.

For example, recent advances in microarray technology have stimulated research into the genetic and protein changes underlying tumorigenesis, thereby increasing the **scientific opportunity** for researchers to increase our understanding of cancer but also to identify novel targets for therapeutic intervention. These discoveries can be applied across many cancer types and other research (**generalisability**). In an Australian context, the extremely high incidence of skin cancers, particularly of melanoma, remains a high priority affording increased **scientific opportunity** for researchers. **Researchability** describes the ease with which specific cancer types can be studied. This will depend on the quality and availability of model systems (both in vitro and in vivo). For some tumour types, such as leukaemia, prostate and bladder cancer, there are excellent mouse models that facilitate research. In contrast, the study of cancers such as sarcoma is limited by a paucity of good model systems. The size of the **research workforce** in Australia also dictates that not all cancer sites can be investigated, particularly those associated with rare cancers. In addition, many cancers have charitable organisations with specific **fundraising** activities providing dedicated research funds for that cancer type.

Figure 26 Funding to cancer research projects and research programs in specific cancer sites across Australia in 2003 to 2005, classified by main category of Common Scientific Outline

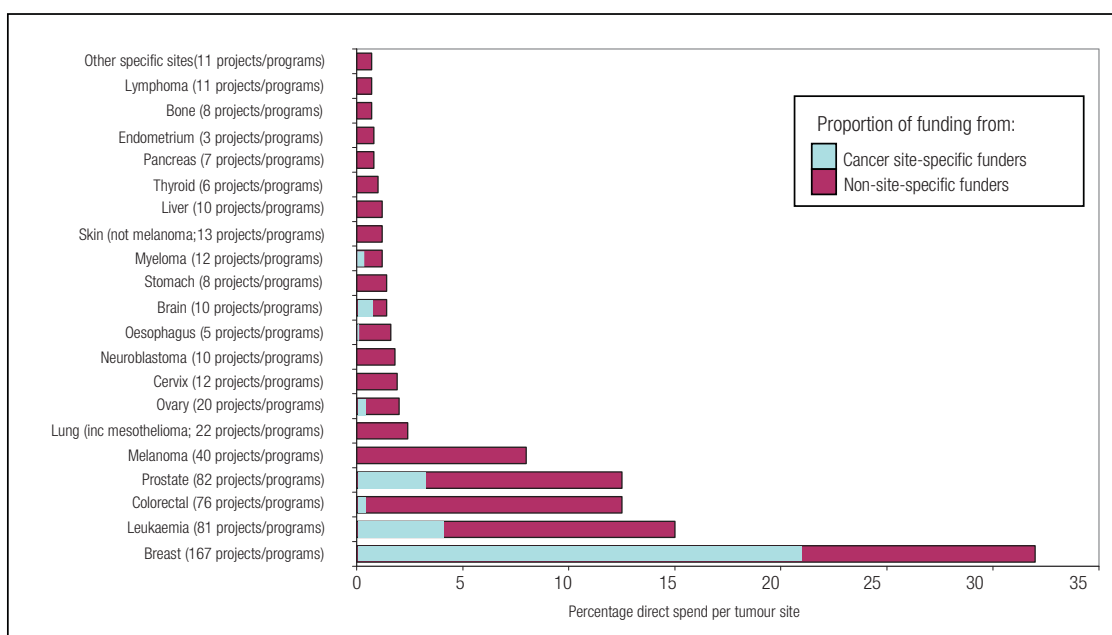
* Note the altered scale for the graph depicting Cancer of unknown primary site, which reflects the single category of Common Scientific Outline studied in the single project identified for this cancer type



4.7 Direct funding to cancer research from organisations raising funds for specific tumour types

Many community-based organisations raise funds for specific tumour types (for example, The National Breast Cancer Foundation or the Prostate Cancer Foundation of Australia), as well as government-directed programs of research into specific tumour types (such as the Congressionally-directed Medical Research Programs in breast or prostate cancer administered by the US Department of Defense). The contribution of these sources to the overall direct funding to cancer research projects and research programs addressing the top 20 tumour sites in Australia in 2003 to 2005 is demonstrated in Figure 27.

Figure 27. Proportion of direct funding to cancer research projects and research programs in Australia 2003 to 2005 provided by organisations raising funds for specific tumour sites



Funding to cancer research projects and research programs from organisations supporting specific tumour sites accounted for over half (59 per cent) of the investment in breast cancer research projects. In addition, these organisations provided 50 per cent of funding to brain cancer research, 33 per cent funding to myeloma research, 25 per cent of funding to leukaemia and prostate cancer research, and a much smaller proportion of funding to research in ovarian cancer (16 per cent) and oesophageal cancer (2 per cent).



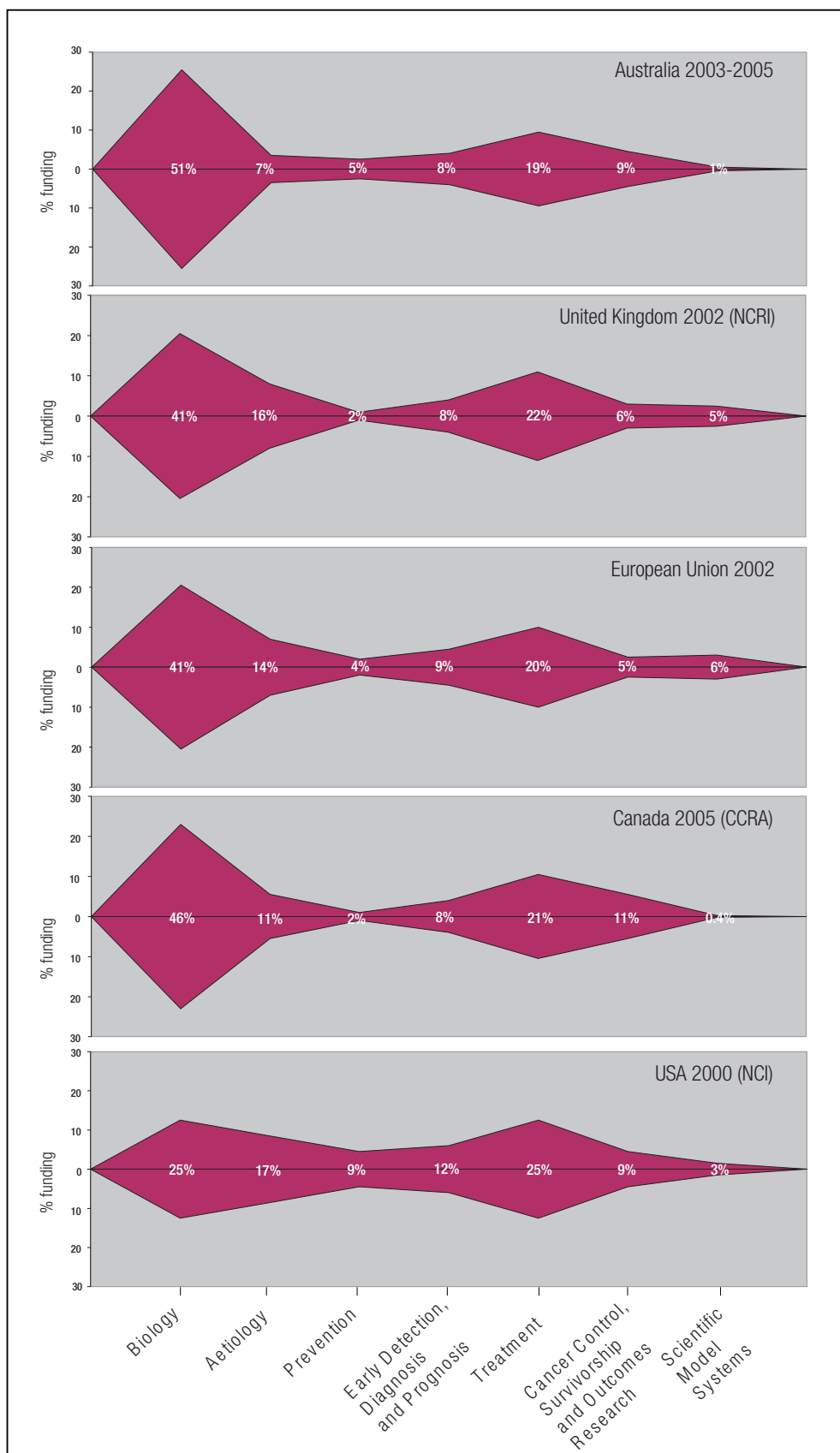
5. RESULTS – INTERNATIONAL COMPARISONS

Direct funding for cancer research projects and research programs in Australia was \$84.9 million in 2003, \$91.7 million in 2004 and \$115.1 million in 2005. Recent international surveys of cancer research have identified funding in 2002 of €388 million by the United Kingdom, €1.43 billion by the European Union and US\$4.192 billion by the National Cancer Institute of the USA¹⁶, and funding in 2005 of CAN\$188 million to cancer research by the Canadian Cancer Research Alliance (CCRA).¹⁷ While the overall totals of funding identified by these different surveys vary between different countries, using CSO classifications has the advantage of permitting comparisons between the funding patterns in cancer research from the different surveys. Figure 28 compares the pattern of CSO spending identified in the present audit with the CSO pattern of funding for cancer research identified in recent international surveys of the National Cancer Institute of the United States of America (NCI, fiscal year 2000)¹⁶, the National Cancer Research Institute (NCRI) of the United Kingdom in 2002¹⁶, the European Union (EU) in 2002¹⁶ and the Canadian Cancer Research Alliance (CCRA) in 2005.¹⁷

Caveats need to be considered when comparing data from the present audit and the cited international surveys. The pattern of funding by the US NCI has been fully validated.¹⁵ The EU used self-reported, top-level CSO categories for the majority of organisations from which funding details were collected.¹⁶ The CCRA survey assigned a relevant CSO code to each project and if more than one CSO code was assigned to a given project, the project budget was equally divided among the codes.¹⁷ The NCRI survey included spending on fellowships, scholarships, units and institutes that could be assigned to specific research projects. The EU classification is more similar to that used in the present audit because it did not include funding for infrastructure, educational grants or advocacy and service delivery. Although collected by the CCRA survey¹⁷, the data from Canada used for preparation of Figure 28 also do not include funding for infrastructure, equipment, salary awards, educational grants or research-related support.

With these caveats in mind, the pattern of funding across the five surveys was broadly similar, with the majority of funding for research projects in Biology and Treatment, and lowest investment in Prevention and Scientific Model Systems. The National Audit of Cancer Research Projects and Research Programs showed that in Australia the proportion of funding to cancer research projects concerned with Aetiology was less when compared with funding in this category identified in the four international surveys.

Figure 28 Pattern of direct funding to cancer research projects and research programs in Australia, 2003 to 2005, classified by main category of Common Scientific Outline and compared with patterns obtained from international cancer research surveys





6. DISCUSSION

The data collected in this audit provide a snapshot of cancer research projects and research programs occurring across Australia from 2003 to 2005. The total number of organisations and groups that provide funding for cancer research in Australia is not known. The National Audit of Cancer Research Projects and Research Programs identified 99 national and international funders of cancer research in Australia; details of direct funding from 68 organisations were included in the analysis. Without knowing the exact total number of funders of cancer research in Australia, it is impossible to quantify what percentage of total cancer research project and research program funding was included in this audit.

A recent survey by Cancer Institute NSW¹⁰ identified 158 organisations funding cancer research in NSW alone in 2004 to 2006 by requesting information directly from investigators. This suggests that the National Audit of Cancer Research Projects and Research Programs may not have captured information from some organisations funding cancer research. However, an analysis of the sources and levels of funding in the NSW survey showed that it captured funding from sources not directly approached by the National Audit, including the pharmaceutical industry (involving contributions from at least 60 individual companies in 2004 to 2006¹⁰) and many organisations such as trusts, philanthropic donors and some universities and hospitals that provided smaller amounts of funding.

In addition, we identified at least 28 organisations for which funding details were not included in the National Audit. Reasons for these omissions included: not providing funding details; not allocating funds directly to cancer research projects in 2003, 2004 or 2005; not able to provide details of funding to specific research projects; funding only infrastructure, equipment or people support; allocating their research funding to cancer research via another funding organisation; or not directly supporting cancer research.

All major organisations funding cancer research in Australia contributed data to this National Audit. As such, the data reported are considered to be a broad and accurate representation of funding provided directly to cancer research projects and research programs in Australia. The exact amounts of direct funding were provided by funding agencies and these data were used in the audit. No extrapolations or inferences regarding the distribution of funding were made.

The National Audit demonstrates that cancer research occurred across the full continuum of cancer research and that much of Australia's cancer research funding and consequently research effort was directed to studies of those tumours of highest burden on the Australian population. However, research within specific areas in the cancer control spectrum and research into several tumour types of high burden on the Australian population were proportionally low.

6.1 Overall figures

A large number of organisations make significant contributions to cancer research across Australia. This audit identified direct funding to cancer research projects and research programs of \$84.9 million (2003), \$91.7 million (2004) and \$115.1 million (2005). This investment supported 1 332 projects and programs. The funding was across the full spectrum of cancer research, from fundamental investigations through to palliative care and survivorship research.

While the importance of this specific investment should be emphasised, it must also be cautioned that this sum underestimates the total of Australia's commitment to cancer research in 2003 to 2005. This conclusion is supported by data from recent state surveys that have estimated a total of \$54.2 million for cancer research in Victoria in 2005⁸ (compared with \$45.8 million identified in this audit) and a total of \$103 million available for cancer research in NSW in 2003 to 2005¹⁰ (compared with \$72.6 million identified by this audit).

Several reasons can account for this underestimate in funding to cancer research. Compared with recent state surveys^{9,10}, the present survey did not collect direct funding in the form of fellowships, scholarships, people support, equipment or infrastructure, or funding to routine clinical care, support services, data collection and ongoing monitoring of service delivery and outcomes. There were also two funding organisations unable to provide specific information on research projects for which they provided funding. At a Commonwealth, and state and territory level, funding for prevention programs has not been included because data on these activities were not provided. Additionally, we have not specifically addressed the considerable ongoing funding by the pharmaceutical industry to cancer research in the form of drug discovery and testing, and clinical trials.

The Australian Government's direct spending on cancer research projects and research programs identified in the National Audit accounted for over 66 per cent of identified spending. It was predominantly from funding provided to projects and programs by the NHMRC. A further 9 per cent was provided by the state and territory Cancer Councils. In 2003 to 2005, international funding organisations accounted for 13 per cent of the total identified direct funding to Australian cancer research. These data compare with approximate total funding derived from each of these sectors of 50 per cent (Australian Government), 8 per cent state Cancer Council and 5 per cent (international) from the review of funding to cancer research in NSW from 2004 to 2006¹⁰, and 53 per cent (Australian Government and including state Cancer Council) and 25 per cent (international) in Victoria 2005.⁹

6.2 Are we collaborating?

The majority of research projects and research programs captured by this audit identified specific collaborators, with the vast majority being within the same institution, same city or same state. This pattern of collaboration may be a reflection of the geographical distribution of the research workforce in Australia, or indicative of traditional patterns of collaboration amongst researchers. For projects with a single collaborator almost 90 per cent of the collaborators were from the same institution or state. However, when there was more than one collaborator, projects and programs were associated with both interstate and international collaborations. Multiple collaborators were associated with increased funding per project. The mean funding for projects with a single named collaborator was \$163 000, whereas the average funding for a project with multiple collaborators was \$268 000.

Overall, there were more intrastate collaborations than interstate and international collaborations. It is difficult to determine reasons for the limited interstate collaborations. The knowledge and availability of research projects and research programs being undertaken across Australia may, in part, limit the extent of interstate collaborations. Both the United States of America and the United Kingdom have searchable online databases of cancer research activity. These databases provide easily accessible information on cancer research projects being undertaken and afford the opportunity for researchers to identify what research is being conducted, by whom and at what institutions.

A survey of cancer research in Victoria in 2005 by the Victorian State Government indicated that approximately 37 per cent of cancer researchers had international collaborations.⁹ In a recent study of cancer research publications, the Cancer Institute NSW found that approximately 80 per cent of publications from NSW alone had international collaborations.¹⁰ The limited number of projects with international collaborations identified by the National Audit (5 per cent) may reflect that applications to many funding organisations in Australia may not include international collaborators as Chief Investigators even though the project will involve international collaborators. In such cases, information on international collaborations was not collected by the funders approached in the National Audit.

Similarly, there may be more collaborators within Australia working on a research project or research program than specified in the original funding applications. While collaborations and the geographical nature of those collaborations were identified for most funded projects in the audit, in some cases we were unable to identify specific collaborators because these details were not collected by funding agencies, and so they could not be provided to us. In other instances named collaborators are not permitted or included as Chief or co-Chief

Investigators on applications. Collaborations may have occurred post award of funding or during the course of the research project or research program; these collaborations may not be reflected in the original grant application and therefore were not included in the audit's assessment of collaboration.

It is therefore likely that the data shown in this report under-represent the full extent of collaboration between investigators in Australia.

6.3 Cancer research projects and research programs

The broad pattern of direct funding showed that in Australia in 2003 to 2005 approximately 40 per cent went to disease-site-specific studies and 60 per cent to studies that were generic to all cancers. Of the projects and research programs not classified as single-site, approximately 39 per cent applied to projects and programs addressing fundamental issues of either cancer or cancer-related normal systems. The importance of this category is that it underpins cancer research in general. Studies that were cancer-related but not focused on any specific tumour site (non-site-specific) composed another 21 per cent of research projects and research programs.

The use of CSO categories permitted an overview of the general pattern of cancer research being carried out across Australia. Nationally, studies in the Biology category were the most prevalent but there was also good representation in Treatment. Fewer funded projects were in the areas of Aetiology, Prevention, Early Detection, Diagnosis and Prognosis, and Cancer Control, Survivorship and Outcomes Research. This pattern was in general maintained when scope of research projects funded by the NHMRC was compared with that of all other funding organisations. However, the NHMRC shows a greater investment in Biology projects, with somewhat less emphasis on Prevention and Treatment.

The prevalence for research funding in Biology and Treatment categories of CSO at the national level was also reflected at the individual state and territory level, in the direct funding to cancer research projects and research programs identified for Victoria, New South Wales, Queensland, South Australia and Western Australia, which together accounted for 96 per cent of direct funding to cancer research projects in 2003 to 2005.

It should be noted that the scope of cancer research across CSO categories shown in this report reflects government and non-government funding to cancer research identified by the present audit as **direct** funding to cancer research projects and research programs in 2003 to 2005. It should also be noted that this audit identified only clinical trials from peer-reviewed funding; therefore there is underestimate of the full scope, which includes unfunded clinical trials.

An indication of the pattern of funding across CSO categories for cancer research projects and research programs at the state level is presented in a recent report of cancer research in Victoria in 2005.⁹ This pattern incorporates information from a wider range of cancer funding sources than taken into account by the National Audit, as well as funding provided to a more extensive range of cancer research-related activities (including infrastructure, fellowships and people support). The pattern of funding is generally similar to that presented in the National Audit, with the majority of funding in Biology (34 per cent), and proportions of funding to other categories of Aetiology (9 per cent), Prevention (8 per cent), Early Detection, Diagnosis and Prognosis (10 per cent), Treatment (14 per cent), Cancer Control, Survivorship and Outcomes research (14 per cent), and Scientific Model Systems (12 per cent). However, it should be noted that these figures are estimated funding for each category in 2005, and do not include funding to clinical trials. Thus, the overall proportions of cancer research funding, particularly within the Treatment category, may be underestimated.

A recent study by the Cancer Institute NSW also examined the spectrum of cancer research across NSW from 2004 to 2006.¹⁰ It is difficult to compare data obtained between this study and that in the National Audit because the NSW study did not use CSO classification of research activities.

At an international level, Australia's overall pattern of direct funding for cancer research as identified in the National Audit and classified by CSO category was similar to that of the National Cancer Research Institute (NCRI) in the United Kingdom, the European Union and the Canadian Cancer Research Alliance (CCRA). This pattern of funding differs from that observed in the United States, where the proportion of research spending on Biology is about half that of Australia, with proportional increases in funding to other CSO categories, particularly Aetiology and Prevention. The exact reasons for the pattern of spending in the United States are not known.

6.4 Possible reasons for funding of research into specific cancers

When burden of disease was measured by tumour incidence, funding was generally directed towards those tumours of highest incidence on the Australian population (70 per cent of direct funding to the five cancers of highest incidence). However, when burden of disease was defined by either mortality or Person Years of Life Lost, the audit showed that some cancers with high burden received proportionally very low levels of funding. These included lung cancer and mesothelioma, cancers of unknown primary site, pancreatic cancer, lymphoma, and cancers of the bladder, kidney, stomach, oesophagus, brain and gall bladder. The relative proportions of funding were particularly low for cancers of unknown primary site and pancreatic cancer which each received less than 1 per cent of overall funding but which together are responsible for almost 5 per cent of cancer incidence and 12 per cent of cancer-related deaths. The proportionally low level of funding in these latter cancers is also shown when funding data are expressed per person with disease, per death or per year of life lost.

Funding for cancer research is provided by a range of government and non-government organisations, charities and fundraising groups. The National Audit has captured the research investment from a range of these funders. Some cancers have a high profile and dedicated charities that raise money for research. These charities and fundraising groups can provide a considerable amount of funding for cancer research and this may contribute to the observed peaks in research funding seen for specific tumours, for example breast cancer, prostate cancer and leukaemia. While some cancers appear to have been proportionally well funded, it is important to recognise that outcomes from research into any cancer have flow-on effects to research, treatment and care for other tumours.

While the audit has provided us with information on the direct funding to research for specific cancers, what we do not know and have not assessed is the outcome and impact of the funding provided. Cancer research can have many consequences, including improved outcomes for the population, changes in knowledge, clinical practice, policy, generation of publications, and conduct of further research. Although the quality of research outcomes and their impact on the population is not always directly proportional to the value of the research investment, it may be hoped that outcomes would be improved by increasing funding to those cancers that had a high burden on the community.

6.5 Conclusions

This report describes the analysis of a snapshot of cancer research projects and research programs across Australia from 2003 to 2005 using information provided by organisations directly funding cancer research. With the caveats outlined, this audit identified funding to cancer research projects and research programs of \$84.9 million in 2003, \$91.7 million in 2004 and \$115.1 million in 2005), and this funding supported 1 332 research projects.

The majority of funding was provided by the NHMRC but Australia also attracted significant levels of overseas funding for cancer research, emphasising the competitiveness of Australian cancer research at an international level.

Numerous organisations make a significant contribution to the funding of cancer research projects and research programs across Australia, and there are opportunities to plan a well coordinated and shared funding of cancer research into the future.

The pattern of funding across Australia generally reflected the distribution of the research workforce, with the majority of funding to the eastern states.

The majority of named collaborators on projects and programs were from the same institution as the Chief Investigator.

The data show that funding occurred across the full continuum of cancer control, with the largest proportions of funding in the fields of Biology, and cancer Treatment.

While there was investment in research into cancers of highest burden on the Australian population in terms of incidence, mortality and Person Years of Life Lost, there were several exceptions. In particular, funding of research was proportionally low in lung cancer and mesothelioma, cancers of unknown primary site, pancreatic cancer, lymphoma and cancers of the bladder and brain.

7. REFERENCES

1. Australian Institute of Health and Welfare & Australasian Association of Cancer Registries 2007, *Cancer in Australia: an overview*, 2006, Cancer series no. 37, cat. no. CAN 32. Canberra: AIHW.
2. National Cancer Control Initiative, *The 2002 non-melanocytic skin cancers survey*, 1-51. 2003 National Cancer Control Initiative, Melbourne.
3. Anderiesz C, Elwood, M, Hill DJ 2006, 'Cancer control policy in Australia', *Aus New Zealand Health Pol*, 3: 125.
4. Australian Institute of Health and Welfare, *Health system expenditures on cancer and other neoplasms in Australia, 2000-01*, cat. no. HWE 29. Canberra: AIHW (Health and Welfare Expenditure Series no. 22).
5. Australian Institute of Health and Welfare 2006. *Australia's Health 2006*, cat. no. AUS 73. Canberra: AIHW.
6. Australian Institute of Health and Welfare, Cancer Australia and the Australasian Association of Cancer Registries 2008, *Cancer survival and prevalence in Australia*. Cancer Series no. In press.
7. Cancer Australia (<http://www.canceraustralia.gov.au>).
8. Strengthening Health Care Initiative (<http://www.health.gov.au/internet/budget/Publishing.nsf/Content/health-budget2005-hbudget-hfact1.htm>).
9. Ministerial Taskforce for Cancer 2007, *Cancer Research in Victoria. Report on cancer research activity in Victoria in 2005*.
10. Welberry H, Edwards C, Weston A, Harvey C, Wilson C, Boll S, Lo M, Bishop J 2008, *Cancer Research in NSW 2001-2006*, Sydney: Cancer Institute NSW, March.
11. Cancer Control Council of New Zealand 2007, *Developing a Strategic Plan for Cancer Control research in New Zealand*, Wellington: Ministry of Health.
12. National Cancer Research Institute 2002, Strategic Analysis 2002. *An overview of Cancer Research in the UK directly funded by the NCRI Partner Organisations*.
13. National Cancer Control Initiative 2004, *Cancer Research in Australia – a survey of cancer researchers*, Melbourne.
14. Common Scientific Outline (<http://researchportfolio.cancer.gov/cso.html>; Box 1).
15. National Health and Medical Research Council 2007, www.NHMRC.gov.au/funding/dataset/index.htm
16. Eckhouse S and Sullivan R 2006, 'A survey of public funding of cancer research in the European Union', *PLoS Medicine*, 3:994-999.
17. Canadian Cancer Research Alliance 2007, 'Cancer Research Investment in Canada, 2005', *The Canadian Cancer Research Alliance's Survey of Government and Voluntary Sector Investment in Cancer Research in 2005*. Toronto: CCRA.

APPENDIXES

Appendix A: Organisations invited to provide details of their funding to cancer research for the National Audit of Cancer Research Projects and Research Programs

American Cancer Society
American Institute for Cancer Research
Association for International Cancer Research
AusIndustry
Australasian Gastro-Intestinal Trials Group
Australasian Leukaemia and Lymphoma Group
Australian and New Zealand Breast Cancer Trials Group Ltd
Australian and New Zealand Children's Haematology & Oncology Group
Australian and New Zealand Germ Cell Trials Group
Australian and New Zealand Gynaecological Oncology Group
Australian and New Zealand Melanoma Trials Group
Australian Cancer Research Foundation
Australian Lung Foundation Inc – Australian Lung Trials Group
Australian National University
Australian Orthopaedic Association
Australian Research Council
Australian Rotary Health Research Fund
Bowel Cancer and Digestive Research Institute Australia
Breast Cancer Institute of Australia
Burnet Institute incorporating the Austin Research Institute
Cancer and Bowel Research Trust
Cancer Institute NSW
Cancer Nurses Society of Australia
Cancer Research Institute
CanTeen
Children's Cancer Institute Australia for Medical Research
Children's Leukaemia and Cancer Research Foundation
Children's Medical Research Institute
Commonwealth Department of Health and Ageing
Commonwealth Department of Education, Science and Training
Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Concern Foundation
Cooperative Research Centre for Aboriginal Health
Cure Cancer Australia Foundation
Garvan Institute Foundation

Health Research Foundation
Human Frontier Science Program
Hunter Medical Research Institute
Ian Potter Foundation
James S. McDonnell Foundation Awards
Kidney Health Australia
Kids Cancer Research Trust
Leukaemia Foundation
Leukaemia Research Fund
Leukaemia Society of America
Lions Medical Research Foundation
Ludwig Institute for Cancer Research
Medical Oncology of Group of Australia
Menzies School of Health
Multiple Myeloma Research Foundation
Murdoch Children's Research Institute
National Breast Cancer Foundation
National Cancer Institute
National Health and Medical Research Council
National Institutes of Health
Peter MacCallum Cancer Foundation
Princess Alexandra Hospital Foundation
Prostate Cancer Foundation of Australia
Psycho-Oncology Co-operative Trials Group
Royal Adelaide Hospital Cancer Centre Foundation
Royal Australasian College of Surgeons
Royal Australian and NZ College of Radiologists
Royal Brisbane and Women's Hospital Foundation
Royal Children's Hospital Foundation
Royal Hobart Hospital Research Foundation
Skin Cancer Foundation Inc
St Vincent's Health, Melbourne
St Vincent's Institute of Medical Research
Susan Komen Foundation
Sydney Children's Hospital Foundation
The Australian Lung Foundation
The Cancer Council Australian Capital Territory

APPENDICES

The Cancer Council New South Wales
The Cancer Council Northern Territory
The Cancer Council Queensland
The Cancer Council South Australia
The Cancer Council Tasmania
The Cancer Council Victoria
The Cancer Council Western Australia
The Children's Hospital at Westmead
The Edward Dunlop Medical Research Foundation
The Garnett Passe and Rodney Williams Memorial Foundation
The Medical Foundation of the University of Sydney
The NSW Office for Science and Medical Research
The Queen Elizabeth Hospital Foundation
The Sydney Cancer Centre Foundation
The Wesley Research Institute
The West Australia Institute for Medical Research
Trans-Tasman Radiation Oncology Group
United States of America Department of Defense, Congressionally-directed Medical Research Programs
University of Adelaide
University of Melbourne
University of Queensland
University of Sydney
University of Tasmania
University of Western Australia
Victorian Breast Cancer Research Consortium
Wellcome Foundation
Women's and Children's Hospital Adelaide

Appendix B: Email Introduction to Audit

Dear

Cancer Australia is a new Australian Government agency which has been established as part of the government's Strengthening Cancer Care initiative, to help reduce the burden of cancer on Australia. Its role is to provide national leadership in cancer control and to improve coordination of and collaboration between all stakeholders, including people affected by cancer, health professionals, researchers, cancer organisations and governments. An initial priority of Cancer Australia is to develop a National Cancer Research Plan.

To inform this plan, Cancer Australia is undertaking a review of cancer research activities. The attached letter from Professor David Currow, CEO of Cancer Australia, is an invitation for (name of funding agency) to contribute to this audit, and requests assistance from you in providing details of cancer research activities funded by (name of funding agency) in the calendar years 2003, 2004 and 2005.

To facilitate incorporation of this information into our database, we would request these details be attached to an email sent to Paul.Jackson@health.gov.au, in a spreadsheet format (preferably using Microsoft Excel); however, we understand that this may not always be possible, in which case, information supplied in a Microsoft Word file format would be an acceptable alternative. In addition, if the files are too large to be attached to electronic mail, we would accept the data on a CD or DVD.

We would appreciate (name of funding agency) giving this invitation urgent consideration and we would hope to receive your information by May 25th 2007.

If you would like any further information, please do not hesitate to contact me using the details below,

Kind regards,

Paul

Dr. Paul Jackson,
Program Manager,
Research Section,
Cancer Australia
PO Box 1201
Dickson ACT 2602

Ph: (02) 6200 1721

FAX: (02) 6200 1799

Email: paul.jackson@health.gov.au

Website: www.canceraustralia.gov.au

Appendix C: Invitation from CEO of Cancer Australia to Cancer Research Funding Agency

Re. Audit of Cancer Research in Australia

Dear

Cancer has a major impact on the Australian community. At current incidence rates, one in three men and one in four women in Australia will develop cancer by the age of 75. Cancer is the leading cause of premature death and disability in Australia. Cancer Australia¹ is a new Australian Government agency which has been established as part of the government's *Strengthening Cancer Care* initiative², to help reduce the burden of cancer on Australia. Its role is to provide national leadership in cancer control and to improve coordination of and collaboration between all stakeholders, including people affected by cancer, health professionals, researchers, cancer organisations and governments.

Cancer Australia's initial priorities are to:

- Enhance support, information and participation in decision-making for people affected by cancer,
- Increase coordination and funding of cancer research, and actively support cancer clinical trials,
- Improve the quality of cancer care, and support and training for health professionals,
- Review current national cancer control and cancer research activity and identify priorities for action to improve cancer outcomes in Australia.

Cancer Australia will also develop a National Cancer Research Plan. This plan will confirm key research priorities and will be updated on a rolling triennium basis. To inform this plan, Cancer Australia is undertaking a review of cancer research activity in the calendar years 2003, 2004, and 2005.

As a funder of cancer research, Cancer Australia would be very pleased if (name of organisation) was able to participate in this audit, and to provide detail of all cancer-related research, development and evaluation projects including clinical trials allocated funds in each of the calendar years 2003, 2004 and 2005. Please include cancer-related postgraduate scholarships.

For this information to be most useful, we will require for each project:

- Title of Project
- Name of lead researcher
- Name of collaborators
- Abstract of the planned Project
- Host/Administering/Principal institution
- Calendar years for which funding was awarded
- Total amount of funding excluding GST

(NB. A project that was funded at the end of 2005 should be included, even if the project has not yet been started. Similarly grants initially funded prior to 2003 may have a component of funding allocated for 2003, 2004, and/or 2005, and these should also be included).

If you would like clarification of the above, or would like to discuss any aspect of this survey further, please contact Dr. Paul Jackson, Program Manager-Research, at Cancer Australia, by email at paul.jackson@health.gov.au or by telephone at (02) 6200 1721.

Thank you for taking time out to help Cancer Australia towards reducing the burden of cancer in Australia.

Yours sincerely,

Professor David Currow

Links to relevant documents and websites

1. Cancer Australia
<http://www.canceraustralia.gov.au>
2. Strengthening Health Care Initiative
<http://www.health.gov.au/internet/budget/Publishing.nsf/Content/health-budget2005-hbudget-hfact1.htm>

Appendix D: Common Scientific Outline (CSO) classification of cancer research

Biology

- 1.1 Normal functioning
Examples of science that would fit
- Developmental biology (from conception to adulthood) and the biology of ageing
 - Normal functioning of genes, including their identification and expression, and the normal function of gene products, such as hormones and growth factors
 - Normal formation of the extracellular matrix
 - Normal cell to cell interactions
- 1.2 Cancer initiation: alterations in chromosomes
Examples of science that would fit
- Abnormal chromosome number
 - Aberration in chromosomes and genes (eg: in CML)
 - Damage to chromosomes and genes
 - Failure of DNA repair
 - Aberrant gene expression
 - Epigenetics
- 1.3 Cancer initiation: oncogenes and tumour suppressor genes
Examples of science that would fit
- Genes and signals involved in growth stimulation or repression, including oncogenes (Ras, etc.), and tumour suppressor genes (p53 etc.) and hormones and growth factors such as oestrogens, androgens, TGF-beta, GM-CSF etc.
- 1.4 Cancer progression and metastasis
Examples of science that would fit
- Latency, promotion and regression
 - Expansion of malignant cells
 - Interaction of malignant cells with the immune system or extracellular matrix
 - Cell detachment
 - Cell motility
 - Invasion
 - Penetration of the vascular system
 - Malignant cells in the circulation
 - Extravasation and growth of metastases

1.5 Resources and infrastructure (not directly addressed in the present audit)

Examples of science that would fit

- Informatics and informatics networks
- Specimen resources
- Epidemiological resources pertaining to biology
- Reagents, chemical standards

Aetiology

2.1 Exogenous factors in the origin and cause of cancer

Examples of science that would fit

- Lifestyle factors, such as smoking, chewing tobacco, alcohol consumption, parity, diet, sunbathing, and exercise
- Environmental and occupational exposures such as radiation, second-hand smoke, radon, asbestos, organic vapours, pesticides, and other chemical or physical agents
- Infectious agents associated with cancer aetiology, including viruses (Human Papilloma Virus, etc) and bacteria (*Helicobacter pylori* etc)
- Viral oncogenes and viral regulatory genes associated with cancer causation

2.2 Endogenous factors in the origin and cause of cancer

Examples of science that would fit

- Free radicals such as superoxide or hydroxide radicals
- Genes known to be involved or suspected of being mechanistically involved in familial cancer syndromes (eg. BRCA1, Ataxia Telangiectasia, and APC)
- Genes suspected or known to be involved in "sporadic" cancer events, for example polymorphisms and/or mutations that may affect carcinogen metabolism (eg. CYP, NAT, glutathione transferase etc).

2.3 Interactions of genes and/or genetic polymorphisms with exogenous and/or endogenous factors

Examples of science that would fit

- Gene-environment interactions
- Interactions of genes with lifestyle factors, environmental and/or occupational exposures such as variations in carcinogen metabolism associated with genetic polymorphisms
- Interactions of genes and endogenous factors such as DNA repair deficiencies and endogenous DNA damaging agents such as oxygen radicals or exogenous radiation exposure

2.4 Resources and infrastructure related to aetiology (not directly addressed in the present audit)

Examples of science that would fit

- Informatics and informatics networks; for example, patient databases
- Specimen resources (serum, tissue etc)

- Reagents and chemical standards
- Epidemiological resources pertaining to aetiology
- Statistical methodology or biostatistical methods
- Centres, consortia, and/or networks
- Education and training of investigators

Prevention

3.1 Interventions to prevent cancer: personal behaviours that affect cancer risk

Examples of science that would fit

- Research on determinants of personal behaviours such as diet, physical activity, sun exposure, and tobacco use, which affect cancer risk
- Interventions to change personal behaviour that affect cancer risk

3.2 Nutritional science in cancer prevention

Examples of science that would fit

- Quantification of nutrients and micronutrients
- Studies on the effect(s) of nutrients or nutritional status on cancer incidence
- Dietary assessment efforts including dietary questionnaires and surveys
- Development, characterisation and validation of dietary/nutritional assessment instruments

3.3 Chemoprevention

Examples of science that would fit

- Chemopreventative agents and their discovery, mechanism of action, development, testing in model systems and clinical testing

3.4 Vaccines

Examples of science that would fit

- Vaccines for prevention, their discovery, mechanism of action, development, testing in model systems and clinical testing

3.5 Complementary and alternative prevention approaches

Examples of science that would fit

- Discovery, development and testing of complementary/alternative prevention approaches such as diet, herbs, supplements or other interventions which are not widely used in conventional medicine or are being applied in different ways as compared to conventional medicine
- Hypnotherapy, relaxation, transcendental meditation, imagery, spiritual healing, massage, biofeedback, etc, used as a preventative measure

3.6 Resources and infrastructure related to prevention

Examples of science that would fit

- Informatics and informatics networks; for example, patient databases
- Specimen resources (serum, tissue etc)
- Reagents and chemical standards
- Epidemiological resources pertaining to prevention
- Statistical methodology or biostatistical methods
- Centres, consortia, and/or networks
- Education and training of investigators

Early detection, diagnosis and prognosis

- 4.1 Technology development and/or marker discovery
- Examples of science that would fit
 - Discovery of markers (eg. proteins, genes) and/or imaging methods that are potential candidates for use in cancer detection, diagnosis and/or prognosis
- 4.2 Technology and/or marker evaluation with respect to fundamental parameters of method
Examples of science that would fit
- Preliminary evaluation with respect to laboratory sensitivity, reproducibility, and accuracy
- 4.3 Technology and/or marker testing in a clinical setting
Examples of science that would fit
- Evaluation of clinical sensitivity, clinical specificity and predictive value
 - Quality assurance and quality control
 - Inter- and intra-laboratory reproducibility
 - Testing of method with respect to effects on morbidity and/or mortality
 - Study of screening methods including compliance, acceptability to potential screenees, receiver-operator characteristics
- 4.4 Resources and infrastructure related to early detection, diagnosis and prognosis
Examples of science that would fit
- Informatics and informatics networks; for example, patient databases
 - Specimen resources (serum, tissue etc)
 - Clinical trials infrastructure
 - Epidemiological resources pertaining to risk assessment, detection, diagnosis or prognosis
 - Statistical methodology or biostatistical methods
 - Centres, consortia, and/or networks
 - Education and training of investigators

Treatment

5.1 Localised therapies – discovery and development

Examples of science that would fit

- Discovery and development of treatments administered locally that target the organ and/or neighbouring tissue directly, including but not limited to surgical interventions and radiotherapy
- Therapies with a component administered systemically but that act locally (eg. photodynamic therapy and radiosensitisers)
- Development of methods of drug delivery

5.2 Localised therapies – clinical applications

Examples of science that would fit

- Clinical testing and application of treatments administered locally that target the organ and/or neighbouring tissue directly, including but not limited to surgical interventions and radiotherapy
- Clinical testing and application of therapies with a component administered systemically but that act locally (eg. photodynamic therapy and radiosensitisers)
- Phase I, II, or III clinical trials of promising therapies that are administered locally

5.3 Systemic therapies – discovery and development

Examples of science that would fit

- Discovery and development of treatments administered systemically such as cytotoxic or hormonal agents, novel systemic therapies such as immunologically directed therapies (vaccines, antibodies), gene therapy, angiogenesis inhibitors, apoptosis inhibitors and differentiating agents
- Defining molecular signatures of cancer cells
- Identifying molecular targets for drug discovery. Includes mechanistic studies, of cellular metabolism, combinatorial chemical synthesis, drug screening, development of high throughput assays and testing in model systems
- Development of methods of drug delivery
- Analysis of molecular mechanisms of drug resistance and preclinical evaluation of new therapies to circumvent resistance

5.4 Systemic therapies – clinical applications

Examples of science that would fit

- Clinical testing and application of treatments administered systemically such as cytotoxic or hormonal agents, novel systemic therapies such as immunologically directed therapies (vaccines, antibodies), gene therapy, angiogenesis inhibitors, apoptosis inhibitors and differentiating agents
- Phase I, II, or III clinical trials of promising therapies that are administered systemically

5.5 Combinations of localised and systemic therapies

Examples of science that would fit

- Development and testing of combined approaches to treatment
- Clinical application of combined approaches to treatment such as systemic cytotoxic therapy and radiation therapy

5.6 Complementary and alternative treatment approaches

Examples of science that would fit

- Discovery, development and clinical application of complementary/alternative prevention approaches such as diet, herbs, supplements or other interventions which are not widely used in conventional medicine or are being applied in different ways as compared to conventional medicine

5.7 Resources and infrastructure related to treatment

Examples of science that would fit

- Informatics and informatics networks; for example, clinical trials networks and databanks
- Mathematical and computer simulations
- Specimen resources (serum, tissue etc)
- Clinical trials groups
- Epidemiological resources pertaining to treatment
- Statistical methodology or biostatistical methods
- Drugs and reagents for distribution and drug screening infrastructures
- Centres, consortia, and/or networks
- Education and training of investigators

Cancer controls, survivorship, and outcomes research

6.1 Patient care and survivorship issues

Examples of science that would fit

- Quality of life
- Pain management
- Psychological impacts of cancer survival
- Rehabilitation
- Reproductive issues
- Long term morbidity
- Symptom management including nausea, vomiting, lymphoedema, neuropathies etc
- Prevention of treatment related toxicities and sequelae including symptom management prevention of mucositis, prevention of cardiotoxicities etc

6.2 Surveillance

Examples of science that would fit

- Epidemiology and End Results Reporting (eg. SEER)
- Surveillance of cancer risk factors such as diet, body weight, physical activity, sun exposure, tobacco use
- Analysis of variations in risk factor exposure by demographic or other factors

- Registries which track incidence, morbidity and/or mortality related to cancer
- Trends in use of interventional strategies
- Method development for risk factor surveillance

6.3 Behaviour

Examples of science that would fit

- Behaviour medicine research and interventions
- Influence of social factors, such as community, policy, education, and legislation, on behaviour related to cancer control
- Attitudes and belief systems and their influence on psychological health and on behaviour related to cancer control. For example, how beliefs can alter attempts to seek screening, detection and treatment
- Interventions to change attitudes and beliefs that affect behaviour related to cancer control and cancer outcomes
- Influences of attitudes and beliefs on compliance to treatment and prevention protocols
- Psychological or educational interventions to promote behaviour that lessens treatment-related morbidity and promote psychological adjustment to the diagnosis of cancer and to treatment effects
- Burdens of cancer on family members/caregivers and psychological/behaviour issues

6.4 Cost analyses and health care delivery

Examples of science that would fit

- Analyses of cost effectiveness of methods used in cancer prevention, detection, diagnosis, prognosis, treatment, and survivor care/support
- Studies of providers, such as geographical or care-setting variations in outcomes
- Effect of reimbursement and/or insurance on cancer control, outcomes and survival support
- Access to care issue

6.5 Education and communication

Examples of science that would fit

- Development of communication tools and methods
- Education of patients, health care providers, at-risk populations, and general population about cancer
- Communication to patients regarding therapeutic options
- Educational interventions to promote self-care and symptom management
- Communicating cancer risk to underserved populations, at-risk populations, and the general public
- Communication of lifestyle models that reduce cancer risk, such as communication of nutrition interventions
- Communicating smoking and tobacco cessation interventions
- Special approaches and considerations for underserved and at-risk populations

- Education, information, prevention/screening/assessment systems for the general public or primary care professionals
- Training, predictive cancer models, pain management, and surveillance systems for primary care professionals, telehealth/telemedicine applications
- Communication regarding cancer genetics, managed oncology care, communicating with survivors
- Barriers to successful health communication

6.6 End-of-life care

Examples of science that would fit

- End-of-life issues including palliative care, psychological interventions with families at end of life, hospice care, pain management for terminally ill patients etc).

6.7 Ethics and confidentiality in cancer research

Examples of science that would fit

- Informed consent modelling and development
- Quality of Institutional Review Boards (IRB)
- Protecting patient confidentiality and privacy
- Research ethics

6.8 Complementary and alternative approaches for supportive care of patients and survivors

Examples of science that would fit

- Hypnotherapy, relaxation, transcendental meditation, imagery, spiritual healing, massage, biofeedback, etc, as used for the supportive care of patients and survivors
- Discovery, development and testing of complementary/alternative approaches, such as diet, herbs, supplements or other interventions that are not widely used in conventional medicine or are applied in different ways as compared to conventional medicine

6.9 Resources and infrastructure related to cancer control, survivorship and outcomes research

Examples of science that would fit

- Informatics and informatics networks; for example, clinical trials networks and databanks
- Clinical trial groups related to cancer control, survival, and outcomes research
- Epidemiological resources pertaining to cancer control, survival, and outcomes research
- Statistical methodology or biostatistical methods
- Surveillance infrastructures
- Centres, consortia, and/or networks
- Education and training of investigators

Scientific Model systems

7.1 Development and characterisation of model systems

Examples of science that would fit

- Development and characterisation of model systems, including but not limited to:
- Computer simulation model systems and computer software development
- In vitro model systems
- Cell culture model systems
- Organ and tissue model systems
- Animal model systems such as *Drosophila*, *C.elegans*, zebra fish, mouse etc.

7.2 Application of model systems

Examples of science that would fit

- Application of model systems, including but not limited to:
- Computer simulation model systems and computer software development
- In vitro model systems
- Cell culture model systems
- Organ and tissue model systems
- Animal model systems such as *Drosophila*, *C.elegans*, zebra fish, mouse etc.

7.3 Resources and Infrastructure related to Scientific Model systems

Examples of science that would fit

- Models made available for distribution to the scientific community
- Centres, consortia, and/or networks
- Education and training of investigators

Appendix E: Tumour streams and disease site codes

Tumour streams

Genitourinary (includes cancers of the prostate, bladder, kidney, and testis)

Colorectal cancer

Breast cancer

Lung cancer

Skin cancers, notably melanoma

Haematological (includes lymphomas, leukaemia, and myeloma)

Gynaecological cancers

Head and neck cancers

Upper gastro-intestinal cancers (includes cancers of the oesophagus, stomach, pancreas, and hepato-biliary system)

Central nervous system tumours

Musculoskeletal

Disease site codes

Adrenocortical cancer

Anal cancer

Bladder

Bone (including osteosarcoma and malignant fibrous histiocytoma)

Brain

Breast

Cancers of unknown primary site

Cervix

Chordoma cancer

Colon and rectal cancer

Endometrial

Eye (not retinoblastoma)

Gall bladder

Heart

Hodgkin's disease

Kaposi's sarcoma

Kidney cancer (including Wilm's tumour)

Laryngeal cancer

Leukaemia (inc. ALL, AML, CLL, CML, HCL)

Liver (inc. bile duct and hepatocellular)

Lung (inc. mesothelioma)

APPENDIXES

Melanoma

Multiple Endocrine Neoplasia 1

Myeloma (including plasma cell neoplasm, Waldenstrom's Macroglobulaemia and Multiple Myeloma)

Nasal cavity and paranasal sinus cancer

Neuroblastoma

Non-Hodgkin's lymphoma

Oesophageal

Oral cavity and lip

Ovarian

Pancreatic

Penile

Pharyngeal

Pituitary

Prostate

Retinoblastoma

Salivary gland

Sarcoma (inc. chondro-, Ewing's-, fibro-, osteo-, rhabdo-, soft tissue and uterine)

Skin (non-melanoma)

Small intestine

Stomach

Testicular

Thymoma

Thyroid

Vaginal

Vulvar

Appendix F: Breakdown of identified direct funding to cancer research projects and research programs by all CSO categories

CSO category	% of category	% total spend
Biology		
1.1 Normal functioning	63.1%	32.0%
1.2 Cancer initiation: alterations in chromosomes	11.9%	6.0%
1.3 Cancer initiation: oncogenes and tumour suppressor genes	10.1%	5.1%
1.4 Cancer progression and metastasis	14.9%	7.5%
1.5 Resources and infrastructure	0.05%*	0.02%*
Aetiology		
2.1 Exogenous factors in the origin and cause of cancer	16.5%	1.1%
2.2 Endogenous factors in the origin and cause of cancer	42.8%	2.9%
2.3 Interactions of genes and/or genetic polymorphisms with exogenous and/or endogenous factors	24.6%	1.7%
2.4 Resources and infrastructure related to aetiology	16.1%*	1.1%
Prevention		
3.1 Interventions to prevent cancer: personal behaviours that affect cancer risk	4.5%	0.2%
3.2 Nutritional science in cancer prevention	1.1%	0.06%
3.3 Chemoprevention	23.2%	1.2%
3.4 Vaccines	66.8%	3.5%
3.5 Complementary and alternative prevention approaches	0.00%	0.00%
3.6 Resources and infrastructure related to prevention	4.3%*	0.2%*
Early detection, diagnosis and prognosis		
4.1 Technology development and/or marker discovery	54.5%	4.1%
4.2 Technology and/or marker evaluation with respect to fundamental parameters of method	14.2%	1.1%
4.3 Technology and/or marker testing in a clinical setting	30.1%	2.3%
4.4 Resources and infrastructure related to early detection, diagnosis and prognosis	1.1%*	0.09%*

APPENDIXES

CSO category	% of category	% total spend
Treatment		
5.1 Localised therapies – discovery and development	8.5%	1.6%
5.2 Localised therapies – clinical applications	6.9%	1.3%
5.3 Systemic therapies – discovery and development	65.7%	12.4%
5.4 Systemic therapies – clinical applications	14.5%	2.7%
5.5 Combinations of localised and systemic therapies	4.1%	0.8%
5.6 Complementary and alternative treatment approaches	0.3%	0.05%
5.7 Resources and infrastructure related to treatment	0%*	0%*
Cancer controls, survivorship, and outcomes research		
6.1 Patient care and survivorship issues	26.1%	2.5%
6.2 Surveillance	23.4%	2.2%
6.3 Behaviour	17.8%	1.7%
6.4 Cost analyses and health care delivery	11.2%	1.1%
6.5 Education and communication	8.5%	0.8%
6.6 End-of-life care	6.1%	0.6%
6.7 Ethics and confidentiality in cancer research	1.2%	0.1%
6.8 Complementary and alternative approaches for supportive care of patients and survivors	0%	0%
6.9 Resources and infrastructure related to cancer control, survivorship and outcomes research	5.8%*	0.5%*
Scientific Model systems		
7.1 Development and characterisation of model systems	84.2%	1.3%
7.2 Application of model systems	15.8%	0.2%
7.3 Resources and infrastructure related to scientific model systems	0%*	0%*

* data do not represent an accurate assessment of the investment in these categories because information regarding resources and infrastructure were not specifically collected in this audit

