Deloitte Access Economics

Economic and social contribution of Menzies School of Health Research to the NT, Australia and the Asia Pacific

Menzies School of Health

Deloitte.

Deloitte Access Economics Pty Ltd
ACN: 149 633 116

Level 1, 9 Sydney Ave
Barton ACT 2600
PO Box 6334
Kingston ACT 2604

Tel: +61 2 6175 2000
Fax: +61 2 6175 2001
www.deloitte.com.au

Adrienne Farago
Executive Officer
Menzies School of Health Research
John Matthews Building
Royal Darwin Hospital Campus
Casuarina NT 0810

3 February 2012

Dear Adrienne

Economic and Social Contribution of Menzies School of Health Research to the NT, Australia and the Asia Pacific

Deloitte Access Economics is pleased to provide this analysis of the economic and social contribution of the Menzies School of Health Research to the NT, Australia and Asia Pacific.

Yours sincerely,

Lynne Pezzullo
Director
Deloitte Access Economics Pty Ltd

Contents

Glossary i

Executive summary i

1 Introduction 1

1.1 Aims and deliverables 1

1.2 Structure of the report 1

1.3 History of Menzies School of Health Research 1

1.4 Indigenous health outcomes in Australia 2

1.5 NT economy 5

1.6 Current role and activities of the Menzies 6

2 Costs 9

2.1 Capital costs 9

3 Quantifiable impacts 10

3.1 Economic activity 10

3.2 Other socio-economic benefits 16

4 Qualitative impacts 40

5 Overall impacts 44

5.1 Methodology 44

5.2 CBA findings 44

5.3 Sensitivity analysis 46

Conclusions 49

Appendix A : Consultation methodology and stakeholders 50

Appendix B : References 52

Limitation of our work 57

Charts

Chart 3.1 : Funding sources 11

Chart 3.2 : Menzies FTEs by location 15

Chart 3.3 : Research higher degree student completions at Menzies, 2002 to 2010 17

Chart 3.4 : Number of publications by Menzies staff 19

Chart 3.5 : Reduction in malaria deaths in the Asia Pacific resulting from the change in treatment regime 25

Chart 3.6 : Reduction in Pv malaria cases in the Asia Pacific resulting from the change in treatment regime 26
Chart 3.7 : Quantified benefit of Menzies malaria research 28
Chart 3.8 : Reduction in new cases of rheumatic heart disease in the NT resulting from the change in treatment regime 32
Chart 3.9 : Reduction in prevalence of dental caries in children under the age of 5 resulting from the change in treatment regime 34
Chart 3.10 : Revenue stream from sales of L-Arginine 39
Chart 5.1 : Benefit and cost streams from Menzies activities for the NT, 2002 to 2030 45
Chart 5.2 : Sensitivity analysis of the economic contribution to the NT 47
Chart 5.3 : Sensitivity analysis of the economic contribution to Australia 48
Chart 5.4 : Sensitivity analysis of the economic contribution to the Asia Pacific 48

Tables

Table 2.1 : Menzies expenditure ($'000), 2002 to 2010 9
Table 2.2 : Menzies capital expenditure ($'000), 2002 to 2010 9
Table 3.1 : Direct economic contribution of Menzies to the NT ($,000), 2002 to 2010 12
Table 3.2 : Direct economic contribution of Menzies to Australia ($,000), 2002 to 2010 12
Table 3.3 : Indirect economic contribution of Menzies to the NT ($,000), 2002 to 2010 14
Table 3.4 : Indirect economic contribution of Menzies to Australia ($,000), 2002 to 2010 14
Table 3.5 : Direct effect to employment in NT of expenditure by Menzies, 2002 to 2010 16
Table 3.6 : Indirect employment contribution in NT of expenditure by Menzies, 2002 to 2010 16
Table 3.7 : Net Present Value (NPV) methodological note 18
Table 3.8 : Australian melioidosis cases and fatalities from 1989 to 2009 29
Table 5.1 : Net benefits and B/C ratio for Menzies activities and research for Menzies expenditure for the period 2002 to 2010 45
Table 5.2 : Ranges and distributions applied to the estimates for sensitivity analysis 46

Figures

Figure 3.1 : Composition of the economic contribution of Menzies 11

Glossary

ABCD(E)	Audit and Best Practice for Chronic Disease Project (Extended)
ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
AIMhi	Australian Integrated Mental Health Initiative
ANZSIC	Australia and New Zealand Standard Industrial Classification
B/C	benefit/cost
CBA	cost benefit analysis
CDU	Charles Darwin University
CRCAH	Cooperative Research Centre for Aboriginal Health
DALY	disability adjusted life year
FTE	full time equivalent
GOS	gross operating surplus
GDP	gross domestic product
GSP	gross state product
Menzies	Menzies School of Health Research
NHMRC	National Health and Medical Research Council
NPV	net present value
NT	Northern Territory
VSL(Y)	value of a statistical life (year)
WHO	World Health Organization

Executive summary

The purpose of this assessment is to analyse and document the economic and social contribution of Menzies School of Health Research (Menzies) to the Northern Territory (NT), Australia and the Asia Pacific using a quantitative approach. This assessment, therefore, considers the impact of Menzies activities on:

- economic activity, including employment impacts;
- knowledge and skills;
- health benefits, or policy and program improvements; and
- commercialisation of research.

This analysis only considers the costs and benefits of Menzies activities period between 2002 and 2010. The results of this analysis suggest that between 2002 and 2010 Menzies activities have generated significant economic benefit to the NT and the Asia Pacific (excluding Australia) regions and a modest net benefit to Australia (excluding NT) (Table i). **Across all perspectives, the net benefits were $393 million and the benefit cost (B/C) ratio was 3.12 for the period 2002 and 2010.** In comparison, the benefit cost ratio for Australian health research and development as a whole is 2.17, demonstrating the exceptional returns generated by investing in Menzies health research activities.[1]

Table i: Net benefits and B/C ratio for Menzies activities and research for Menzies expenditure for the period 2002 to 2010

	NT $NPV_{7\%}$ $2011m	Australia (excluding NT)* $NPV_{7\%}$ $2011m	Asia Pacific (excluding Australia)* $NPV_{7\%}$ $2011m
Costs	**$71.36**	**$110.65**	**$4.15**
Benefits			
Direct economic contribution	$90.88	$3.19	-
Indirect economic contribution	$37.55	$1.45	-
Education	-	$1.52	-
Health benefits			
Malaria	-	$0.57	$296.97
Melioidosis	$1.25	$5.66	-
Rheumatic heart disease	$0.50	$12.09	-
Oral disease	$1.14	-	-
Quality improvement for primary care of chronic disease	$15.22	$99.16	-
Pyoderma	$4.44	-	-
Mental health		Not quantified	
Diabetes		Not quantified	
Tobacco control		Not quantified	
Otitis media		Not quantified	
Commercialisation	$7.77	-	-
Total benefits	**$158.75**	**$123.64**	**$296.97**

[1] Access Economics (2008) *Exceptional Returns: The Value of Investing in Health R&D in Australia II*, Report for the Australian Society for Medical Research, Canberra.

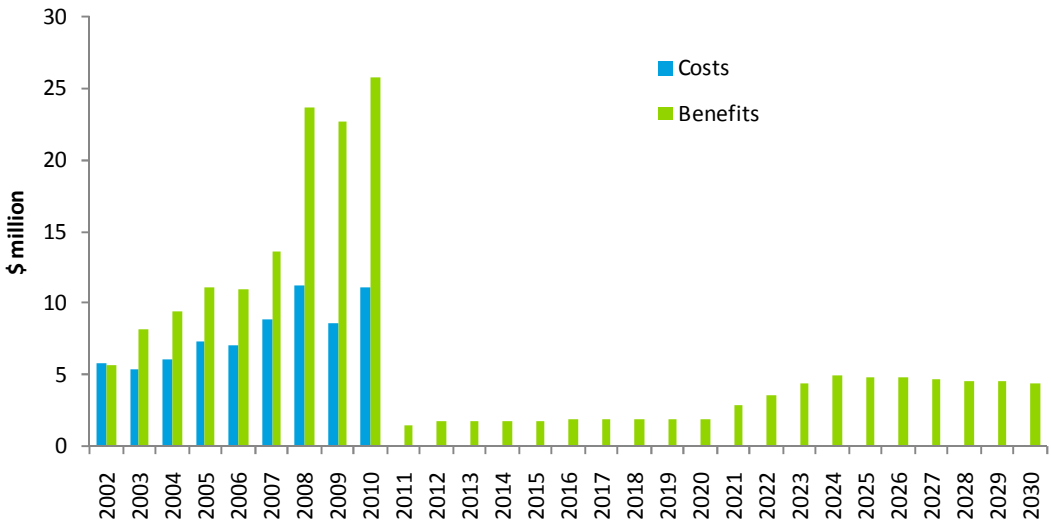
	NT $NPV_{7\%}$ $2011m	Australia (excluding NT)* $NPV_{7\%}$ $2011m	Asia Pacific (excluding Australia)* $NPV_{7\%}$ $2011m
Net benefit	**$87.38**	**$12.99**	**$292.83**
Benefit cost ratio (ratio not $m)	**2.22**	**1.12**	**71.62**

* Throughout the cost benefit analysis perspectives, 'Australia' refers to Australia other than the NT and 'Asia Pacific' refers to Asia Pacific excluding Australia.

The benefits in future years have been discounted by 7% to reflect that the value of a dollar today is worth more than a dollar tomorrow. This means that the present day value of future benefits diminishes the further into the future they occur. In addition, this assessment has only considered the benefits generated by research between 2002 and 2010 that occur before 2030. Therefore, not all of benefits are captured. This is particularly the case for programs directed towards young children where the benefits are only realised in mid or later life.

Chart i further illustrates the cost and benefit streams from Menzies activities for the NT. The benefits in historical years reflect costs in those years, while the benefits in future years reflect benefits still being derived from historical years (discounted). Naturally, the total benefits in those years will be higher as they will also be related to costs in those years.

Chart i: Benefit and cost streams from Menzies activities for the NT, 2002 to 2010



By 2010, it is estimated that Menzies directly supported 120 FTE jobs – many of them highly skilled – in the NT, largely as a function of Menzies capacity to attract funding from outside the Territory.

It must be recognised, however, that this analysis is partial at best and represents the lower bound of the total contribution of Menzies. The total contribution of Menzies is likely to exceed our estimates because:

- it is highly likely that the application of some of the outcomes of research generated between 2002 and 2010 have yet to be identified; and
- many of the outputs of Menzies cannot be reasonably expressed in monetary terms.

Menzies' mission is "to improve the health of people living in northern and central Australia, and regions to the near north, through multidisciplinary research and education"[2]. Indigenous Australians experience the worst health of any one identifiable cultural group in Australia. The majority of Menzies efforts are, therefore, focused on improving the health outcomes of Indigenous Australians. In doing so, Menzies not only contributes economically, it also contributes to addressing one of the most important equity issues in Australia.

[2] Professor O'Dea, "Report from the Menzies School of Health Research, Darwin", in *The Sir Robert Menzies Foundation Limited,* p.7 available at http://menziesfoundation.org.au/annualreports/2003/Pages%207-11%20ARpt%202003.pdf last accessed 6th October 2011.

1 Introduction

1.1 Aims and deliverables

Health and medical research is a multidisciplinary activity which is pursued at local, national and international levels, and generally requires large-scale public investment and support. As with all public spending, governments, other decision-makers, and the medical community regularly debate how much should be spent on health and medical research, how the research dollar should be apportioned among competing priorities and how costs should be shared. Funding for health and medical research and development must contend with competing demands on a limited pool of funding. Hence, it is imperative for research organisations such as the Menzies that they demonstrate *how* and *where* they generate value and the quantum of value generated.

To this end, Menzies engaged Deloitte Access Economics to undertake this project with the following objectives:

- to analyse and document the economic and social contribution of Menzies School of Health Research (Menzies) to the Northern Territory (NT), Australia and the Asia Pacific; and
- to provide a report for the NT government and philanthropic organisations documenting the economic and social contribution of the Menzies.

1.2 Structure of the report

This report is structured in the following way:

- the remainder of this chapter describes the background to this project, including Indigenous health outcomes in Australia and the role and activities of Menzies;
- Chapter 2 documents the cost impact of Menzies;
- Chapter 3 documents the benefits contributed by Menzies;
- Chapter 4 evaluates the overall impact of Menzies, including a description of the methodology used and a sensitivity analysis of results; and
- Chapter 5 discusses conclusions reached.

1.3 History of Menzies School of Health Research

The Menzies School of Health Research (Menzies) was established in 1985 as a body corporate of the Northern Territory Government under the *Menzies School of Health Research Act* (1985) with a mission "to improve the health of people living in northern and central Australia, and regions to the near north, through multidisciplinary research and education"[3].

[3] Professor O'Dea, "Report from the Menzies School of Health Research, Darwin", in *The Sir Robert Menzies Foundation Limited,* p.7 available at http://menziesfoundation.org.au/annualreports/2003/Pages%207-11%20ARpt%202003.pdf last accessed 6th October 2011.

The Education and Training Division deliver the post graduate degrees of the Master of Public Health, the Graduate Diploma of Public Health and, since 2009, the Doctor of Health, which are awarded by Charles Darwin University. It also oversights the research training for Doctoral Degrees and Master by Research students of Charles Darwin University and visiting students from other universities. In addition, it coordinates a program of short courses in public health and research training.

The research and education programs of Menzies are particularly concerned with Aboriginal health issues, health in rural and remote areas and in tropical or developing countries.[4] The *Menzies School of Health Research Act* was amended in 2004 to make Menzies a controlled-entity of Charles Darwin University (CDU), which constitutes a school within the university's Institute of Advanced Studies.[5]

Section 5 of the *Menzies School of Health Research Act* (as at 2007) establishes the functions of the School as:

- *To promote improvement in the health of all people in tropical and central Australia by establishing and developing a centre of scientific excellence in health research and health education*
- *To advance knowledge in the fields of health research and health education, particularly in relation to human health, and to seek and discover the origins and causes of diseases and ill health*
- *To use the knowledge so gained to improve methods of prevention, diagnosis and treatment of disease and ill health in both humans and animals*
- *To serve as a centre for learning and training in health research and health education*
- *To promote and encourage post graduate research into matters relating to the functions of the School within CDU as a research school of that University or in co-operation with other medical or educational institutions; and such other functions as the Board thinks fit.*

Today, Menzies' headquarters is located in Darwin, with other offices in Alice Springs, Brisbane, Adelaide, Thailand and Indonesia and is working in almost 60 Indigenous communities across Australia, as well in Asia and the Pacific. Menzies has grown to become an institution that employs over 300 staff and has an annual turnover of approximately $30 million, the majority of which comes through competitive research grants.[6]

1.4 Indigenous health outcomes in Australia

Indigenous Australians experience poorer health outcomes and higher rates of chronic disease than the non-Indigenous population. The burden of disease suffered by Indigenous

[4] International Education, *Menzies School of Health Research Australia*, available at http://www.australiangraduate.com/study/Menzies.htm, last accessed 6th October 2011.
[5] http://www.menzies.edu.au/about-us
[6] Menzies School of Health Research and Charles Darwin University, *Annual Report 2010 – Menzies School of Health Research*, available at http://www.menzies.edu.au/sites/menzies.edu.au/files/file/communications/2010_Menzies%20School%20of%20Health_Annual_Report.pdf, last accessed 29th September 2011, p.4

Australians is estimated to be two-and-a-half times greater than the burden of disease in the total Australian population.[7]

In 2008, the Council of Australian Governments signed the *National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes*, in which the federal and all state and territory governments agreed to six targets for 'closing the gap' between Indigenous and non-Indigenous Australians across urban, rural and remote areas. These included to close the gap in life expectancy within a generation, and to halve the gap in mortality rates for Indigenous children under five years old, within a decade.

The motivation behind the 'Closing the Gap' initiative was the increasing weight of evidence that Indigenous Australians experience the worst health of any one identifiable cultural group in Australia. Such evidence includes a:

- two-fold rate of low birth weight in Indigenous babies;
- three-fold mortality rates among Indigenous 12 – 24 year olds;
- 12% of the total burden of disease and injury from smoking;
- 7% of all deaths and 6% of the total burden of disease from alcohol;
- lower rates of access to acute care investigations and procedures;
- lower likelihood of being treated for and surviving cancer; and
- discharge against advice for 25 – 44 year olds up to 30 times more than other Australians.[8]

Further evidence of this gap is evident in the Productivity Commission's recent report, *Overcoming Indigenous Advantage – Key Indicators 2011*, which reports that in 2008, 28.2% of Indigenous people aged 15 years and over reported their health as fair or poor, compared with 14.5% of non-Indigenous people.[9] The report also states that in New South Wales, Victoria, Queensland, Western Australia, South Australia and public hospitals in the NT in 2008-09, the Indigenous hospitalisation rate for potentially preventable chronic conditions was 7.0 times the rate for other people and the Indigenous hospitalisation rate for potentially preventable acute conditions was 2.3 times the rate for other people.[10]

1.4.1 The Northern Territory

The estimated resident population of the NT at 30 June 2010 was 229,700,[11] with the estimated resident Aboriginal and Torres Strait Islander population making up 30% of the total NT population, the highest proportion of all the states and territories.[12]

The Australian Human Right Commission estimates that that 72% of the Territory's Indigenous population lives on Aboriginal land outside major towns, where the majority of

[7] Australian Bureau of Statistics *The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples*, cat. no. 4704.0, Oct 2010 (latest issue released February 2011)
[8] Council of Australian Governments (2008) *National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes,* p.4
[9] SCRGSP (Steering Committee for the Review of Government Service Provision) 2011, *Overcoming Indigenous Disadvantage: Key Indicators 2011*, Productivity Commission, Canberra, p.7.4
[10] Ibid, p.7.19
[11] Australian Bureau of Statistics, *Population by Age and Sex, Regions of Australia*, cat. no. 3235.0, 2010 (Latest issue released August 2010)
[12] Australian Bureau of Statistics, *Regional Statistics, Northern Territory*, cat. no. 1362.7, 2010 (Latest issue released March 2011)

Indigenous people do not have good access to mainstream services.[13] Health service delivery to rural and remote areas is known to pose complex challenges due to issues of accessibility, lack of resources, and difficulties in recruiting and retaining a skilled health workforce.[14]

As a result, the ABS 2006 Community Housing and Infrastructure Needs Survey found that 104 discrete Indigenous communities (7,743 people) around Australia had an Aboriginal primary health care centre located within 10 kilometres of their community (8% of the total population participating in the 2006 Survey). In contrast, 417 communities with an aggregate population of 25,486, reported being 100 kilometres or more from the nearest Aboriginal primary health care centre (27% of the total Survey population).[15] Almost half of all the communities located 100 kilometres or more from the nearest Aboriginal primary health care centre were in the NT.[16]

A recent report, released by the NT Department of Health, provides an overview of hospital admissions for Indigenous and non-Indigenous patients in the five NT public hospitals for the period from 1976 to 2008, with a further breakdown by condition from 1992. This report found that, across all years, Indigenous people comprised 41% of hospital admissions,[17] illustrating the over-representation of the Indigenous population, which comprises only a third of the NT's population, in hospital admissions.

The results of the report indicated that the annual hospital separation rate for Indigenous patients increased steadily between 1977-78 and 2007-08.[18] The separation rate for Indigenous patients for most major disease categories and specific conditions also either remained stable or increased, consistent with the increase in the all causes hospital separation rate.[19] The largest increases in separation rates were found to be for:

- diabetes, which increased by over 600% for both males and females;
- cancer of the breast, depression and chronic liver disease, which increased by over 200%; and
- alcohol-related mental disorders, dementia, epilepsy, ischaemic heart disease, asthma, diseases of the pancreas, and intentional self-harm, which increased by over 100%.[20]

The increase in separation rates in the NT is particularly alarming because it is still likely to underestimate the total burden of disease for Indigenous Australians in the NT. This is due to a number of factors, including, as discussed above, the complex challenges posed to health service delivery in rural and remote areas, the lack of access to mainstream services by Indigenous Australians and the high proportion of Indigenous communities in the NT located more than 100km from an Aboriginal primary healthcare facility. These factors meant that, in 2008, 29.9% of Indigenous people aged 15 years and over surveyed reported

[13] Ibid.
[14] Li SQ, Pircher SLM, Guthridge SL, Condon JR. *Hospital Admissions in the Northern Territory 1976 to 2008*. Northern Territory Government, Department of Health, Darwin, 2011
[15] SCRGSP (Steering Committee for the Review of Government Service Provision) 2011, *Overcoming Indigenous Disadvantage: Key Indicators 2011*, Productivity Commission, Canberra, p.7.17
[16] Ibid.
[17] Li SQ, Pircher SLM, Guthridge SL, Condon JR. *Hospital Admissions in the Northern Territory 1976 to 2008*. Northern Territory Government, Department of Health, Darwin, 2011
[18] Ibid.
[19] Ibid.
[20] Ibid.

that they had problems accessing one or more services in the previous 12 months, with the NT having the highest proportion of people with problems accessing services.[21]

In addition to limited accessibility, Indigenous Australians may be less likely to seek medical attention due to other barriers experienced, including discrimination and communication problems. They are also less likely to follow medical advice, with hospital discharges against medical advice for Indigenous people aged 15 years and over six times higher than those for non-Indigenous people in 2008-09.[22] These factors therefore suggest that the already disproportionately high separation rates of Indigenous patients are likely an underestimate of those requiring medical treatment.

This alarming fact highlights the importance of the targets identified by the federal, state and territory governments to 'close the gap' between Indigenous and non-Indigenous Australians' health outcomes. This disadvantage also had significant and far-reaching effects on Indigenous people in areas other than health, including economic and social participation. Indigenous Australians experience significantly higher rates of disability and chronic disease than other Australians, and research by the Australian Institute of Health and Welfare (AIHW) finding that people with chronic disease are 60% more likely not to participate in the labour force, are less likely to be employed full-time, and more likely to be unemployed, than those without chronic disease.[23]

Of particular interest is the over-representation of Indigenous patients in a number of diseases that are the subject of research work at Menzies. For example, the number of separations per 1,000 of the NT population admitted for rheumatic fever and rheumatic heart disease during four year periods remained stable at 0.1 for non-Indigenous females between 1992 and 2008; however, the same figure for Indigenous females rose from 1.2 in 1992-96, to 1.8 in 2004-08.[24] Rheumatic fever and rheumatic heart disease have ceased to be an important health problem in almost all wealthy countries, with the burden of disease remaining now in developing countries, where almost all cases and deaths occur.[25] These diseases, however, remain a significant public health issue in Australian Indigenous communities. Similarly, the number of separations per 1,000 of the population for diabetes increased for non-Indigenous males from 1.0 in 1992-96, to 5.5 in 2004-08, while in the same time period, the figure for Indigenous males increased from 2.2 in 1992-93 to 16.9 in 2007-08.[26]

1.5 NT economy

The estimated resident population of the NT at 30 June 2010 was 229,700,[27] with the Territory recording the second lowest annual population growth rate (0.83%) in the

[21] SCRGSP (Steering Committee for the Review of Government Service Provision) 2011, *Overcoming Indigenous Disadvantage: Key Indicators 2011*, Productivity Commission, Canberra, p.11.40
[22] SCRGSP (Steering Committee for the Review of Government Service Provision) 2011, *Overcoming Indigenous Disadvantage: Key Indicators 2011*, Productivity Commission, Canberra, p.11.38
[23] Australian Institute of Health and Welfare (2009) *Chronic disease and participation in work*, available at http://www.aihw.gov.au/publication-detail/?id=6442468211&tab=2 last accessed 10 October 2011.
[24] Ibid.
[25] Carapetis, J.R. *Rheumatic Heart Disease in Developing Countries*, N Engl J Med 2007; 357:439-441, August, 2007
[26] Li SQ, Pircher SLM, Guthridge SL, Condon JR. *Hospital Admissions in the Northern Territory 1976 to 2008*. Northern Territory Government, Department of Health, Darwin, 2011
[27] Australian Bureau of Statistics, *Population by Age and Sex, Regions of Australia*, cat. no. 3235.0, 2010 (Latest issue released August 2010)

December quarter 2010 of the jurisdictions, ahead of Tasmania (0.77%)).[28] In the five years to 2014-15, Deloitte Access Economics forecasts average annual population growth in the Territory of 1.7%, the third highest of the jurisdictions behind Queensland and Western Australia and above the national forecast of 1.5%.[29]

The Territory economy – measured by gross state product (GSP) – grew by 1.6% in 2009-10, with Deloitte Access Economics forecasting that economic growth in the Territory will moderate to 1.1% in 2010-11, reflecting weak investment and stronger international imports, and economic growth forecast to strengthen to 4% in 2011-12, driven by strong growth in construction and international exports.[30] The main driver of slowing growth in the Territory in 2009-10 was a significant decline in private investment, which decreased by 29.1%, largely reflecting a 61.4% fall in engineering construction activity following the completion of several major projects in the mining and energy sectors, in addition to moderating household consumption growth.[31]

In the year to July 2011, employment growth in the Territory moderated to 1.3%, while national employment growth increased by 2.8%.[32] However in the five years to 2015-16, Deloitte Access Economics forecasts average annual employment growth of 2.6% in the Territory, the second highest growth rate of the jurisdictions behind Queensland, as growth is expected to be supported by increased construction activity.[33]

The Territory's unemployment rate increased by 0.3 percentage points to 4.2% in July 2011 compared to June 2011. This means that the Territory has the third lowest unemployment rate among the jurisdictions, with unemployment rates varying between 4.0% in the Australian Capital Territory to 5.4% in Queensland.[34] In the five years to 2014-15, the Territory's unemployment rate is forecast by Deloitte Access Economics to average 2.7% per annum, the lowest rate of the jurisdictions and below the forecast nation rate of 4.6%.[35]

1.6 Current role and activities of the Menzies

Today, Menzies is the national leader in Aboriginal and Torres Strait Islander health research, with work relevant to communities in Central and Northern Australia, as well as the broader region. It is the only medical research institute in the NT and the only one in Australia with a major focus on Indigenous health. Menzies is also a significant contributor to health education and research training, and has undertaken major research programs have included infectious diseases, chronic diseases, environmental health, health services research, social determinants of health, mental health, and international health.

[28] Northern Territory Treasury, *Territory Economic Review – September 2011,* available at http://www.nt.gov.au/ntt/economics/publications/ter/ter_sept_11.pdf, last accessed 6th October 2011, p.7
[29] Ibid. p.9 (DAE forecast so need to source report)
[30] Ibid. p.9 (DAE forecast so need to source report)
[31] Northern Territory Treasury, *Territory Economic Review – September 2011,* available at http://www.nt.gov.au/ntt/economics/publications/ter/ter_sept_11.pdf, last accessed 6th October 2011, p.5
[32] Ibid, p.8
[33] Ibid. p.9 (DAE forecast so need to source report)
[34] Northern Territory Treasury, *Territory Economic Review – September 2011,* available at http://www.nt.gov.au/ntt/economics/publications/ter/ter_sept_11.pdf, last accessed 6th October 2011, p.8
[35] Ibid. p.9 (DAE forecast so need to source report)

The Menzies also has a strong history of being awarded competitive grants, receiving the fifth highest competitively awarded grants of all medical research institutes that received funding from the National Health and Medical Research Council (NHMRC) in 2010.

Menzies has conducted world-class research to better understand and prevent low birth-weight, poor nutrition, substance abuse, otitis media and chest disease, rheumatic fever and heart disease, kidney disease, melioidosis, malaria, tuberculosis and many other health problems that pose particular challenges to Indigenous Australians and those living in the Asia Pacific region. Menzies has world-class laboratory facilities, conducting groundbreaking research including analysis of deadly bacteria and parasites, snake venom, melioidosis, drug resistance in scabies mite and the malaria parasite.

Menzies's research activities are based on six inter-disciplinary themes, as outlined in the following sections.

1.6.1 Healing and Resilience

Healing and resilience research aims to help to prevent, diagnose and treat mental illness and substance misuse in Indigenous people.[36] Areas of focus include: mental health; palliative care; substance misuse; and youth health.

1.6.2 Global Health

Global health research addresses the major health problems in our region, with researchers working across Southeast Asia and the Pacific. Areas of focus include: malaria, tuberculosis, rheumatic heart disease, and malnutrition.

1.6.3 Preventable Chronic Diseases

Preventable chronic disease research aims to discover the causes of chronic disease including diabetes, heart and kidney disease, and investigate the best ways to diagnose and prevent them. Areas of focus include: clinical research, nutrition and tobacco.

1.6.4 Primary Health Care Systems

Primary health care systems research addresses the successes and areas for improvement of the existing health care, housing and employment systems, as well as the other social and physical environments in which people live and in which health care is delivered.[37] This includes research into health outcomes and access and coordination of services. Work in this area includes: the Audit and Best Practice for Chronic Disease (ABCD) National Research Partnership Project; Comprehensive Primary Health Care; Social Epidemiology; and Women's Health.

1.6.5 Tropical and Emerging Infectious Diseases

Tropical and emerging infectious diseases research aims to identify new health threats with the aim of improving treatments, preventing the spread of disease and helping develop vaccines. Menzies is the nation's leader in tropical health research and is world renowned

[36] Annual Report 2010, p.4
[37] Annual Report 2010, p.4

for its pioneering work in preventing and treating tropical infections and life threatening stings and bites and tracing the natural history of these microscopic and macroscopic killers.[38] State-of-the-art laboratory equipment and methods are used to better understand infectious diseases in our region and to guard against new and expanding threats to our health in the light of environmental challenges such as climate change.[39] Focus areas include: adult respiratory health; antibiotic resistance; melioidosis and emerging infections; skin pathogens; and tropical toxinology.

1.6.6 Child Health

Child Health research investigates ways to prevent and treat conditions affecting Indigenous children, including ear, lung and skin infections, focusing on the links between health and education from pre-birth to leaving school.[40] Focus areas include: life course studies; ear and oral health; child education and development; child protection; healthy skin and rheumatic heart disease; immunisation; respiratory health; and Indigenous parenting and family research.

[38] Tropical and emerging infectious diseases Fact Sheet, p.3
[39] Tropical and emerging infectious diseases Fact Sheet, p.3
[40] Annual Report 2010, p.4

2 Costs

Menzies yearly expenditure was sourced from the Menzies' annual financial reports. Table 2.1 summarises the operating and capital expenditure for each calendar year from 2002 to 2010. Between 2002 and 2010, Menzies expenditure has increased by an average annual rate of 13%. Total expenditure was more than $33 million in 2010. The largest individual cost element for Menzies between 2002 and 2010 was employee expenses, which represented 64% of total expenditure in 2010.

Table 2.1: Menzies expenditure ($'000), 2002 to 2010

Expenses	2002	2003	2004	2005	2006	2007	2008	2009	2010
Employee expenses	$6,993	$7,577	$8,878	$9,734	$10,239	$12,577	$15,079	$17,900	$21,411
Depreciation	$388	$362	$293	$240	$234	$285	$367	$427	$350
Repairs and maintenance	$0	$321	$197	$209	$103	$168	$437	$583	$551
Bad and doubtful debts	$0	$7	$3	-$2	$4	$4	$35	-$35	$0
Other expenses	$3,388	$4,191	$5,305	$8,847	$6,264	$7,871	$9,742	$9,428	$11,056
Total	**$10,768**	**$12,458**	**$14,676**	**$19,028**	**$16,845**	**$20,905**	**$25,661**	**$28,302**	**$33,368**

Source: ABS Cat. No. 6401.0. Note: All figures are expressed in 2011 dollars.

2.1 Capital costs

The majority of expenditure associated with Menzies between 2002 and 2010 has been operational. Table 2.2 provides a summary of the capital expenditure over the period.

Table 2.2: Menzies capital expenditure ($'000), 2002 to 2010

Capital Expenses	2002	2003	2004	2005	2006	2007	2008	2009	2010
Leasehold property	$0	$0	$256	$25	$0	$17	$0	$0	$0
Plant and equipment	$315	$447	$220	$146	$195	$625	$277	$435	$170
Motor vehicles	$0	$25	$111	$0	$58	$0	$0	$46	$40
Total	**$315**	**$471**	**$586**	**$171**	**$253**	**$642**	**$277**	**$481**	**$209**

Source: ABS Cat. No. 6401.0. Note: All figures are expressed in 2011 dollars.

3 Quantifiable impacts

The following chapter provides an assessment of the quantifiable impacts of Menzies activities in the NT, Australia and the Asia Pacific between 2002 and 2010. This assessment considers the impact of Menzies activities on:

- economic activity, including employment impacts
- knowledge and skills
- health benefits, or policy and program improvements; and
- commercialisation of research.

Care needs to be taken in interpreting and using these results as research outcomes are inherently difficult to quantify. It has not been possible to quantify all of the activities undertaken by Menzies between 2002 and 2010. Where aspects of Menzies activities have not been quantified it should not be assumed that these impacts are not important and valued. Rather, it reflects the scope of this project and the reality that there is not currently sufficient evidence to robustly ascribe an economic value to these impacts.

The quantifiable impacts presented in this chapter, therefore, should be understood to be a lower bound estimate of the total impacts of Menzies for the time period under consideration. Further discussion of results of Menzies research that has not been quantified is presented in Chapter 4.

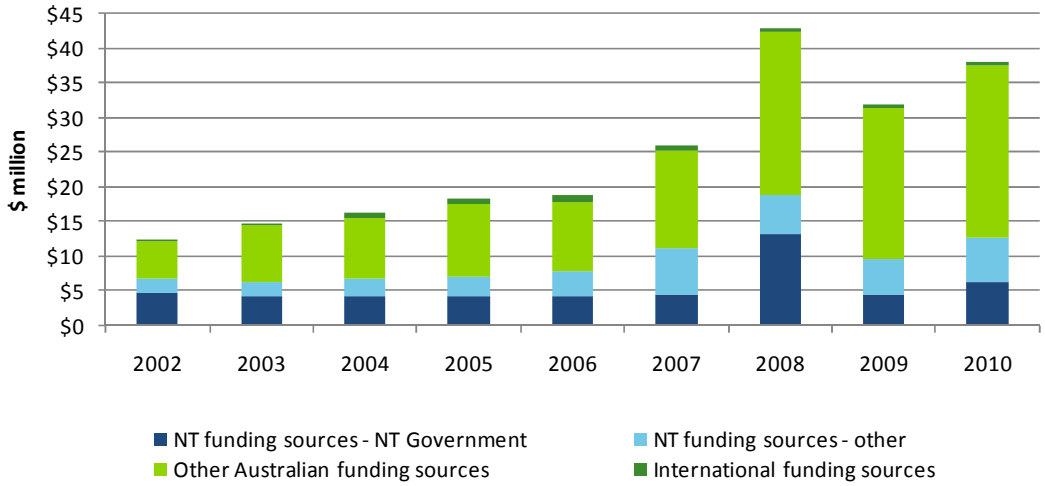
3.1 Economic activity

Economic activity generated by Menzies comprises both direct and indirect contributions to the NT economy and the Australian economy. The significance of Menzies' direct and indirect economic contribution is best assessed in terms of value added that Menzies' generates. Direct economic contributions are those linked with Menzies activities, while the indirect economic contributions represent the flow-on effect from the additional demand generated by Menzies.

This section examines the direct and indirect economic impact of Menzies. The economic impact of Menzies is a function of the amount of expenditure undertaken, the additionality of that expenditure and the type of goods and services purchased. The 'additionality' of expenditure refers to the proportion of spending that can be solely attributed to Menzies activities. For the NT economy this will include Australian Government funding, however, for the Australian economy the impact of this funding will be excluded because the money, if not spent on research at Menzies, would have been spent on some other research body in Australia.

Menzies funding and other revenue has grown in real terms from $12 million in 2002 to $37 million in 2010. While the quantum of funding has grown considerably, the proportion of Menzies funding and other revenue from NT funding sources has declined from 54% to 33%, with the funding from NT Government sources declining from 38% to 17%. Chart 3.1 illustrates the growth in funding and the relative contributions from different funding sources.

Chart 3.1: Funding sources



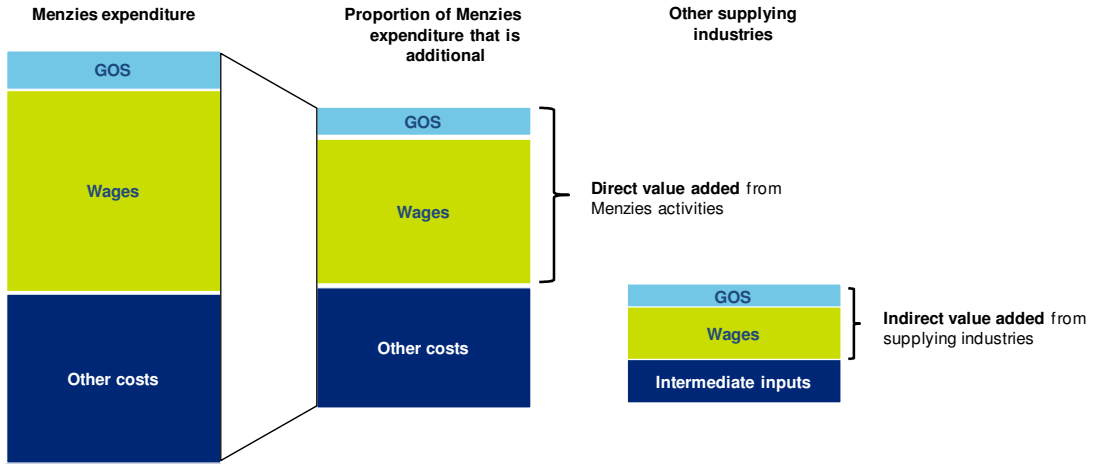
Source: ABS Cat. No. 6401.0. Note: All figures are expressed in 2011 dollars. In 2008 Menzies received in excess of $10 million in capital grants for new buildings.

'Value added' represents the value of output generated by an entity's factors of production (labour and capital), measured by the returns to those factors of production. The return to labour is represented by wages while the return to capital is represented by gross operating surplus (GOS).

Figure 3.1 illustrates the composition of the economic contribution of Menzies and the relationship between Menzies and its suppliers. The total value added that can be attributed to Menzies is equal to the sum of:

- direct value added attributed to Menzies; and
- indirect value added generated by additional demand for supplying industries.

Figure 3.1: Composition of the economic contribution of Menzies



3.1.2 Direct contribution

The direct contribution of Menzies is the value added which the research school provides to the NT and Australian economies through wages and GOS.

The direct contribution of Menzies to the NT from 2002 to 2010 is summarised in Table 3.1. Using Menzies annual financial reports it was determined that in 2010 total gross output attributable to interstate and international sources was $25.6 million. Of this income $14.3 million was returned to labour in the form of wages and $3.4 million was the return to capital in the form of GOS. The direct economic contribution of Menzies to the NT was $18.0 million in 2010. The total direct contribution of Menzies to the NT between 2002 and 2010 is estimated to be $90.9 million.

Table 3.1: Direct economic contribution of Menzies to the NT ($,000), 2002 to 2010

Year	Gross output	GOS	Depreciation	Wages	Value added
2010	$25,581	$3,423	$234	$14,314	$17,971
2009	$22,522	$2,895	$298	$12,506	$15,700
2008	$24,167	$9,304	$206	$8,449	$17,959
2007	$13,804	$1,770	$164	$7,218	$9,151
2006	$11,179	$1,300	$136	$5,972	$7,409
2005	$11,526	$26	$147	$5,955	$6,128
2004	$9,779	$1,082	$172	$5,224	$6,478
2003	$8,504	$1,295	$206	$4,314	$5,815
2002	$5,895	$844	$180	$3,244	$4,268
Total	**$132,957**	**$21,940**	**$1,743**	**$67,196**	**$90,879**

Source: ABS Cat. No. 6401.0. Note: All figures are expressed in 2011 dollars.

The direct contribution of Menzies to the Australian economy from 2002 to 2010 is summarised in Table 3.2. Using Menzies annual financial reports it was determined that in 2010 total gross output attributable to international sources was $332,000. Of this income $186,000 was returned to labour in the form of wages and $44,000 was the return to capital in the form of GOS. The direct economic contribution of Menzies to the Australian economy was $234,000 in 2010. The total direct contribution of Menzies to the Australian economy between 2002 and 2010 is estimated to be $3.2 million.

Table 3.2: Direct economic contribution of Menzies to Australia ($,000), 2002 to 2010

Year	Gross output	GOS	Depreciation	Wages	Value added
2010	$332	$44	$3	$186	$234
2009	$318	$41	$4	$177	$222
2008	$495	$190	$4	$173	$368
2007	$792	$101	$9	$414	$525
2006	$952	$111	$12	$508	$631

Year	Gross output	GOS	Depreciation	Wages	Value added
2005	$679	$2	$9	$351	$361
2004	$704	$78	$12	$376	$467
2003	$183	$28	$4	$93	$125
2002	$352	$50	$11	$194	$255
Total	**$4,807**	**$646**	**$69**	**$2,471**	**$3,186**

Source: ABS Cat. No. 6401.0. Note: All figures are expressed in 2011 dollars.

3.1.3 Indirect contribution

The indirect economic contribution measures the "multiplier" impacts generated as a result of the direct expenditure associated with Menzies activities. For example, the expenditure on computing hardware and software for Menzies staff constitutes will generate expenditure by the providers of computing services to purchase the inputs to providing those services (advertising, bookkeeping, specialised equipment, etc.). These purchases in turn create a demand for inputs to the production process of the suppliers of these services. Thus a flow-on effect is created throughout the economy by the initial expenditure on health research and education.

The indirect contribution of Menzies is the value added created by economic activity stemming from demand for goods and services from Menzies.

Input-output analysis

Input-output analysis involves calculating the economic impact which one activity, one industry, or one sector of the economy has on other sectors of the economy, using flow tables produced by the Australian Bureau of Statistics (ABS). Flow tables measure supply and demand linkages among all industries in the economy by recording industry destinations for outputs and industry sources for intermediate inputs. The flow tables enable estimation of multipliers that can be applied to the direct economic contribution of a business or event, to estimate the indirect economic contribution of that business or event. The input-output analysis in this report is based on the latest available ABS input output tables, *2005-06 Cat No. 5209.0.55.001*, which were published in 2009.

There are several limitations of input-output analysis.

1. The multipliers describe average effects, not marginal effects and thus do not take account of economies of scale, unused capacity or technological change.

2. The input-output tables that underlie multiplier analysis only take account of one form of interdependence, namely sales and purchase links among industries.

The combination of the assumptions used and the excluded interdependence means that input-output multipliers may be higher than would realistically be the case. As a result of these limitations, input-output analysis may tend to overstate the potential impact.

In order to mitigate this potential effect, the approach taken during the assessment of the additionality of the economic contribution of Menzies has been conservative.

Input-output multipliers have been calculated using the input-output tables released by the ABS every four years. The large amount of data required and the complexity of tabulating flows between sectors results in input-output tables being released a few years after the reference period. The 2006-07 input-output tables are the most recent available and were released in 2011.

Contribution to the NT economy

Table 3.3 summarises the indirect economic contribution attributable to Menzies in the NT via the demand created for services and products to support Menzies operations. In 2010 the total indirect economic contribution of Menzies activities is estimated to be $7.0 million dollars. The total indirect contribution of Menzies to the NT between 2002 and 2010 is estimated to be $37.6 million

Table 3.3: Indirect economic contribution of Menzies to the NT ($,000), 2002 to 2010

Year	Gross output	GOS	Wages	Value added
2010	$14,219	$2,457	$4,528	$6,984
2009	$12,766	$2,189	$4,100	$6,289
2008	$10,365	$1,812	$3,341	$5,152
2007	$8,391	$1,473	$2,687	$4,160
2006	$6,704	$1,173	$2,179	$3,351
2005	$9,915	$1,685	$3,237	$4,922
2004	$5,888	$1,009	$1,950	$2,960
2003	$4,601	$778	$1,538	$2,316
2002	$2,816	$475	$942	$1,417
Total	**$75,666**	**$13,050**	**$24,502**	**$37,552**

Source: ABS Cat. No. 6401.0. Note: All figures are expressed in 2011 dollars.

Contribution to the Australian economy

Table 3.4 summarises the indirect economic contribution attributable to Menzies in Australia via the demand created for services and products to support Menzies operations. In 2010 the total indirect economic contribution of Menzies activities is estimated to be $91,000 dollars. The total indirect contribution of Menzies to Australia between 2002 and 2010 is estimated to be $1.5 million

Table 3.4: Indirect economic contribution of Menzies to Australia ($,000), 2002 to 2010

Year	Gross output	GOS	Wages	Value added
2010	$185	$32	$59	$91
2009	$181	$31	$58	$89
2008	$212	$37	$68	$105
2007	$481	$84	$154	$239
2006	$571	$100	$185	$285

Year	Gross output	GOS	Wages	Value added
2005	$584	$99	$191	$290
2004	$424	$73	$140	$213
2003	$99	$17	$33	$50
2002	$168	$28	$56	$85
Total	**$2,904**	**$501**	**$945**	**$1,446**

Source: ABS Cat. No. 6401.0. Note: All figures are expressed in 2011 dollars.

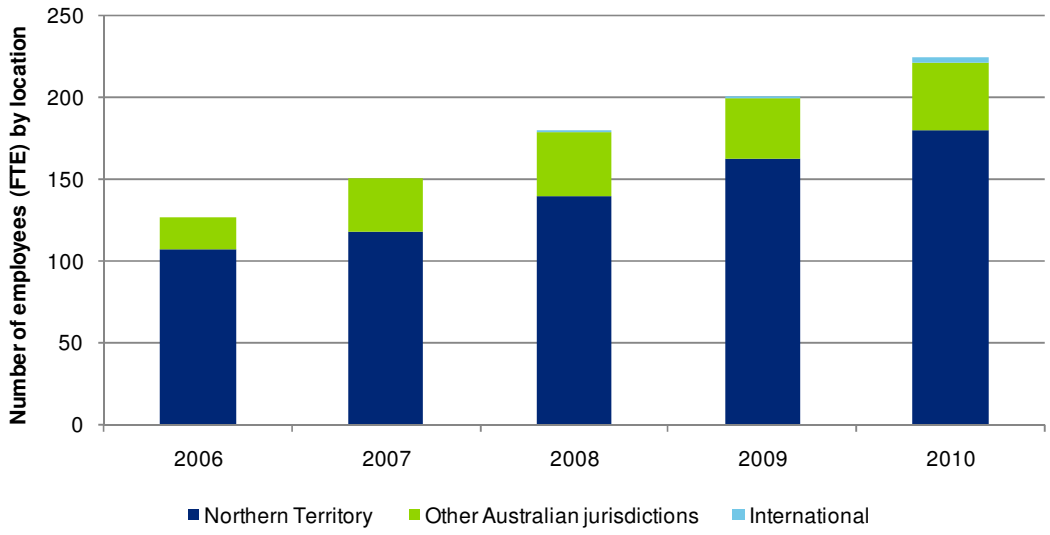
3.1.4 Total contribution

The total contribution of Menzies to the NT and Australian economies is equal to the direct value added by Menzies and the indirect value added attributable to the demand for intermediate goods. **Consequently, between 2002 and 2010 Menzies contributed $128.4 million to the NT economy and $4.6 million to the Australian economy.**

3.1.5 Impact on employment

Direct attributable expenditure by Menzies would be expected to increase demand for labour in the NT, relative to what would otherwise have occurred. The majority of Menzies personnel are employed within the NT. Chart 3.2 illustrates the full time equivalent (FTE) breakdown of employees by location.

Chart 3.2: Menzies FTEs by location



The proportion of these jobs that were supported by funding from sources outside the NT is attributable to Menzies. By 2010, Menzies directly supported 120 FTE jobs – many of them highly skilled – in the NT. Table 3.5 provides a summary of the direct effect to employment of expenditure by Menzies between 2002 and 2010.

Table 3.5: Direct effect to employment in NT of expenditure by Menzies, 2002 to 2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Menzies FTE in NT	86	98	104	105	107	118	140	162	179
Proportion of funding from outside the NT	46%	57%	59%	61%	58%	57%	56%	70%	67%
Attributable direct employment in NT	40	56	61	64	62	68	78	113	120

In addition to the direct jobs created, direct expenditure by Menzies from sources outside the NT had a flow-on effect to employment in those industries supported by that direct expenditure. By 2010, the total indirect employment contribution of Menzies expenditure is estimated to be 431 FTE jobs, including 88 FTE jobs in 2010. Table 3.6 provides a summary of the indirect employment contribution of expenditure by Menzies between 2002 and 2010.

Table 3.6: Indirect employment contribution in NT of expenditure by Menzies, 2002 to 2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Attributable indirect employment in NT	13	22	30	55	37	48	64	74	88

The total additional impact to employment by Menzies in the NT has grown from 53 FTE jobs in 2002 to 208 FTE jobs in 2010.

3.2 Other socio-economic benefits

In addition to the economic impacts from output multipliers and employment, there are impacts associated with Menzies's activities that are less easily valued in dollar terms. These activities include development of knowledge and skills, and health benefits, or policy and program improvements.

3.2.1 Knowledge and skills

To quantify the impact of Menzies on knowledge and skills development the following proxies have been used:

- the value of research higher degree graduates to society[41]; and
- the number of academic publications.

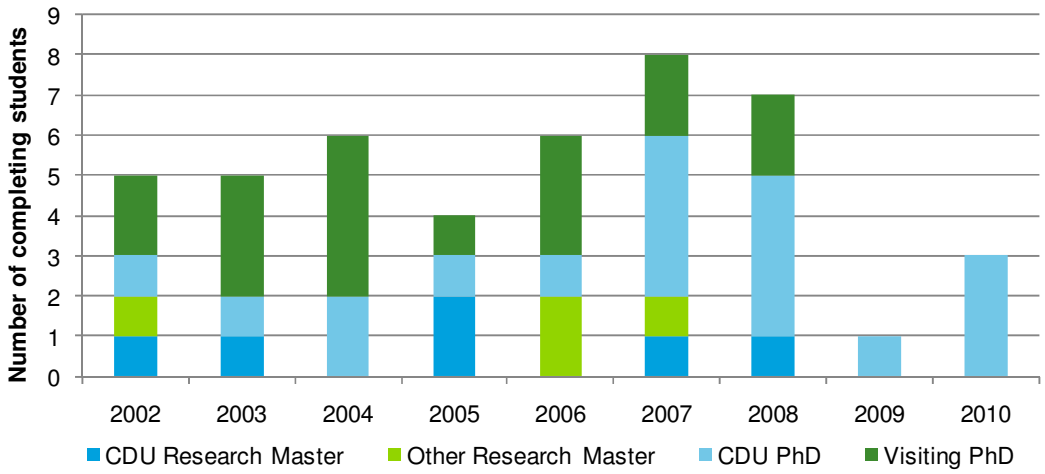
Higher degree graduates

From 2002 to 2010, 45 Menzies students undertook Research Higher Degrees leading to the award of Master by Research and Doctor of Philosophy (PhD) from Charles Darwin

[41] Note: Higher degrees by coursework have been excluded from an assessment of the impact of knowledge and skills because these students could have conducted their degree at an alternative institution. As such, Menzies does not offer any particular advantage beyond what was accessible elsewhere.

University and other Australian Universities. Chart 3.3 shows the number of Research Higher Degrees student completions since 2002.

Chart 3.3: Research higher degree student completions at Menzies, 2002 to 2010



In addition to the health and policy and program improvements that may arise to the NT and broader communities from the research being conducted by students at Menzies (discussed below), there are many benefits that accrue to both the individual and community as a whole from higher education. The main expected benefit of a research higher degree education is the increased productivity for both the individual (reflected in higher lifetime earnings) and for the entire labour force as a result of having more skilled resources available. There are also likely to be other intangible benefits to the individual such as self esteem, status and the enjoyment of learning. For society overall, it is broadly recognised that there are spillover benefits from research training. Benefits typically include social consequences such as improved law and order, and improvements in the 'quality' of society (e.g. involvement in voluntary community activities).

Estimates of the magnitude of benefits to society from research higher degrees are contentious and difficult to quantify.[42] For example, with respect to increased productivity, it is difficult to estimate the proportion of the benefit derived from increased productivity as a result of a research higher degree that is claimed by the individual in the form of earnings versus what spills over to society.

For the individual, it is also difficult to quantitatively measure the benefits of undertaking a higher degree course. In the absence of data we are therefore using the dollar cost of Australian Government funding as a proxy for benefits to the individual and society of undertaking the higher degree course. This is a simple assumption that ignores other costs to the student such as the opportunity cost of not being in the full-time labour force as well as the cost of materials and books, where there is substantial uncertainty in cost estimation. However, the student funding cost represents a defensible minimum benefit estimate since the student would not proceed – according to economic principles of rationality and information – if the net cost exceeded the net benefit.

[42] For discussion see Industry Commission 1997, *Industry Commission Submission to the Review of Higher Education Financing and Policy*, Industry Commission, Canberra, July.

The Australian Government provides funding of $18,180 per year for 3.5 years[43], the current total funding provided for undertaking a higher research degree at the Menzies is therefore $63,560 (noting that we are using the current funding level for all degrees commenced and completed during the 2002-2010 rather than taking into account potential changes in real funding levels over this period, since an historical funding data series could not be located and an appropriate inflator would be difficult to identify). Based on this approach, the total economic value of the 45 completed degrees is $1.52 million ($NPV_{7\%}$) over the next 20 years.[44] We reiterate this is a very conservative estimate.

Table 3.7: Net Present Value (NPV) methodological note

There are several evaluation measures that can be used in the analysis of the value of Menzies benefit impacts. The two most commonly used discounted measures of benefits derived from research are the net present value (NPV) and the return on investment. Future benefits are discounted because the value of a dollar today is worth more than a dollar tomorrow. This study uses the NPV measure. The NPV of research is also known as the discounted value of the net benefit stream. It is obtained by discounting the stream of net benefits produced by the research back to its value in the chosen base period, in this case 2011. The general NPV formula can be represented by:

$$NPV = \sum_{t-0}^{n} \frac{B_t - C_t}{(1+r)^t}$$

where:

B_t is the benefits from research in period t. In this study, benefit are projected 20 years out from the period t are used

C_t is the expenditure on research in period t

r is the economic discount rate, in this case 7%

n is the number of years the benefits from research are accrued. In this study benefits beyond 2031 were not included.

Within this study, costs that were incurred before 2011 were increased to 2011 levels.

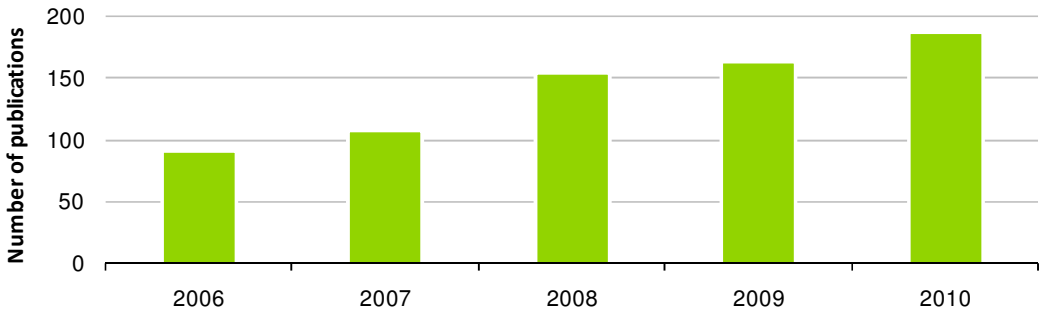
Academic publications

Between 2006 and 2010 the number of published peer reviewed articles written by Menzies staff has more than doubled from 91 to 187. Chart 3.4 shows the growth in the number of peer reviewed articles by Menzies staff that have been published since 2006.

[43] Personal communication: Louise Clarke, 9 December 2011.

[44] Note: Scholarship moneys are not included in this estimate because these represent a living expense rather than real expenditure on education.

Chart 3.4: Number of publications by Menzies staff



While it is not possible to value in dollar terms, these publications generate value through contributing to the body of knowledge, promoting knowledge transfer and promoting both Menzies and NT as a health science research hub.

3.2.2 Health benefits, or policy and program improvements

Estimating the economic value to society of health research is a complex but essential step in establishing and justifying appropriate levels of investment in research. Complexities include:

- identifying and valuing the relevant research inputs (when many pieces of research may contribute to a clinical advance);
- accurately ascribing the impact of the research; and
- appropriately valuing the attributed economic impact.

3.2.2.1 Ascribing the impact of research

The following approach has been used to estimate the proportion of health research benefits generated in areas where a contribution by Menzies has been identified.

First, the proportion of health improvements that can be reasonably attributed to health research has been considered. Prior research has proposed that 33% of total health gains related to a reduction in mortality and morbidity from cardiovascular disease is the result of medical research, while a share of the remaining 67% can be linked to research since gains attributed to changes in public policy and individual behaviour depend on research-derived information.[45] Health research, therefore, is assumed to be responsible for 50% of improvements in healthy lifespan. The remaining 50% is attributed to the other factors associated with the implementation of health research. This approach is consistent with prior studies undertaken by Access Economics.[46]

Second, Australia's contribution to health research was considered using bibliometric analysis. Bibliometric analysis involves the use of publication and citation data in the

[45] Hatfield M, Sonnenschein H, Rosenberg L (2000) *Exceptional Returns: The Economic Return to Health Expenditure*, Funding First, New York www.laskerfoundation.org/reports/pdf/exceptional.pdf

[46] Access Economics (2008) *Exceptional Returns: The Value of Investing in Health R&D in Australia II*, Report for the Australian Society for Medical Research, Canberra. And Access Economics (2008) *Returns to NHMRC funded R&D, Report for the National Health and Medical Research Council*, Canberra.

assessment of research performance.[47] This analysis has been used to estimate the efficacy of health research in Australia. The cohort of publications most relevant to this report are those which fall under clinical science (also referred to as clinical medicine), as the three disease groups under investigation all fall under this overarching umbrella[48]. Bibliometric analysis undertaken by Butler and colleagues found that the Australian global proportion of clinical science publications has increased steadily during the period 1996 through 2006, increasing from 2.72% (1996-2000) to 3.14% (2002-2006).[49]

Therefore, only 1.57% (50% of 3.14%) of the value resulting improved health benefits supported by Menzies research will be attributed to Menzies.

3.2.2.2 Valuing the attributed economic impact

Studies typically consider one or more of the following streams of benefit as a result of health research:

1. direct cost savings arising from research leading to either new less costly treatments or to developments such as vaccines that reduce the number of patients needing treatment;
2. the value to the economy of a healthy workforce;
3. the value to the economy in terms of product development, consequent employment and sales; and/or
4. the intrinsic value to society of health gains generated by research by placing a monetary value on a life.

The following assessment of the value of health research uses the fourth approach. To determine the net benefits from Menzies's activities, the value of gains in wellbeing need to be monetised so they can be compared to the cost of producing those gains. The value of gains in wellbeing can be calculated by multiplying the total number of Disability Adjusted Life Years (DALYs) by the Value of a Statistical Life Year (VSLY).

The concept of VSLY is widely used for the evaluation of public policies in the areas of health, environment and safety. The VSLY represents a trade-off between wealth

[47] Pollitt, A, Wooding, S, Hanney, S, Buxton, M and Grant, J (2011) Project retrosight: understanding the returns from cardiovascular and stroke research, methodology report, *RAND Corporation Europe,* http://www.rand.org/content/dam/rand/pubs/technical_reports/2011/RAND_TR925.pdf, accessed 30 August 2011.

[48] The Web of Science journal sets analysed within the 2009 Butler and Henadeera manuscript include: andrology; anesthesiology; cardiac and cardiovascular systems; clinical neurology; dermatology and venereal diseases; emergency medicine and critical care; endocrinology and metabolism; gastroenterology and hepatology; geriatrics and gerontology; hematology; infectious diseases; medicine, general and internal; obstetrics and gynaecology; oncology; ophthalmology; orthopedics; otorhinolaryngology; pathology; pediatrics; peripheral vascular disease; psychiatry; psychology; radiology, nuclear medicine and medical imaging; rehabilitation; rheumatology; respiratory system; transplantation; surgery; urology and nephrology; tropical medicine.

[49] Butler L and Biglia, B (2001) Analysing the journal output of NHMRC research grants schemes: March 2001, *National Health and Medical Research Council*, March, http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/r21.pdf, accessed 23 August 2011.

Butler, L (2003) NHMRC supported research: the impact of journal publication output 1996–2000, *National Health and Medical Research Council*, October, http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/butler03.pdf, accessed 23 August 2011.

Butler, L, Biglia, B and Henadeera, K (2005) NHMRC supported research: the impact of journal publication output 1999–2003, *National Health and Medical Research Council*, December, http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/nh75.pdf, accessed 23 August 2011.

Butler, L and Henadeera, K (2009) Measuring up 2009. NHMRC – Supported research: The impact of journal publication output 2002–2006, *National Health and Medical Research Council*, February, http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/nh125_bibliometricsreport_2002_2006.pdf, accessed 23 August 2011.

(budgetary resources for a government decision) and a reduction in the probability of death.

For the purposes of this study we will adopt the VSLY and Value of a Statistic Life (VSL) recommended by the Office of Best Practice Regulation (OBPR): $171,200 and $4.0 million (adjusted from 2007 dollars to 2011 dollars).[50]

As the OBPR describes, the VSLY estimates the value society places on reducing the risk of premature death, expressed in terms of saving a statistical life year. This is measured by estimating how much society is willing to pay to reduce the risk of death. The OBPR's recommended VSLY is based on a number of recent empirical studies relevant to Australia that derive estimates for the value of statistical life. The OBPR states that this empirical evidence has been assessed to ensure that it is comprehensive and rigorous. These studies use different methods of measuring society's willingness to pay to reduce the risk of death:

- one direct method is to ask individuals through a survey what they would pay to save or prolong life;
- one method which incorporates a budget constraint is to observe how much consumers pay for products that reduce the risk of death or injury; and
- another indirect method (the most commonly used) is to observe how much workers are willing to pay (through reduced wages) for an improvement in workplace safety.[51]

These are just three of the many methods that have been used to estimate VSLY. There has been a lot of debate about the appropriate method of estimating VSLY. The OBPR's recommended VSLY represents an average across empirical studies, informed by economic theory, international research and international practice and is based on a healthy person living for another 40 years.

Significant debate also surrounds the application of VSLY. It is argued by some that it is not possible to place a value on human life and that to do so is callous and demeaning. However, despite the difficulties in measurement, most economists and public policy makers recognise that, given the scarcity of resources for public projects and the consequent need for efficient allocation, if such valuations are not made explicitly then they will be made implicitly through decisions about which projects proceed and the funding accorded to completing projects. The concept of the VSLY enhances transparency around trade-offs and decisions that are being made every day by government.

It is also important to note that the VSLY does not measure the more nebulous concept of the worth of a life. Rather it measures the value of a statistic life in monetary terms only. Yet VSLY is also not the same as measuring what we would give up for our own life, which in monetary terms would likely be all our wealth. In contrast, reflecting that it has been developed to inform policy-making decisions, the VSLY only measures the value of small risk reductions in premature death or reduced quality of life. Both individuals and governments often make budget-constrained decisions on small risk reductions with respect to their health and safety every day. The VSLY simply formalises and adds rigour to this process.

[50] Department of Finance and Deregulation (2008) *Best Practice regulation Guidance Note: Value of Statistical Life*, November 2008.
[51] Department of Finance and Deregulation (2008) *Best Practice regulation Guidance Note: Value of Statistical Life*, November 2008.

3.2.2.3 Case studies

Menzies has grown rapidly in recent years, resulting in significant additional research activity. Given the long lead times and uncertainty surrounding the ultimate outcomes of research it has not been possible to quantify all of the benefits of Menzies research. The following six areas of research have been quantified because they provide illustrations of how Menzies research has been translated into health outcomes that *can* be quantified.

1. Malaria
2. Meloidosis
3. Rheumatic heart disease
4. Oral disease
5. Improved quality of primary health care for chronic disease
6. Pyoderma

Multiple stakeholders identified during consultation emphasised the importance of other areas of Menzies research including Menzies's role in:

- conducting primary research;
- performing a public advocacy role for Indigenous health issues;
- providing relevant local information to address tropical health issues; and
- enhancing the value of culturally appropriate Indigenous health services through the promotion and specialisation of Indigenous health workers in the Northern Territory.

The following quantification of the benefits does not consider the impact of these benefits. This does not imply, however, that these impacts are not important and valued. Rather it reflects the scope of this project and the reality that there is not currently sufficient evidence to robustly ascribe an economic value to these impacts. As such, the following benefits estimates represent a conservative approach to the valuation of the overall health benefits generated by Menzies research.

Malaria

Malaria is caused by Plasmodium parasites, which are spread to humans through the bites of infected Anopheles mosquitoes. There are five types of human malaria:

- *plasmodium falciparum*, one of the two most common types of malaria and the most deadly;
- *plasmodium vivax*, the other most common types of malaria;
- *Plasmodium malariae*;
- *plasmodium ovale*; and
- *plasmodium knowlesi*, a type of monkey malaria that occurs in certain forested areas of Southeast Asia and has only caused some human cases of malaria in recent years.[52]

The World Health Organization (WHO) estimates that in 2009 there were 225 million cases of malaria and an estimated 781,000 deaths as a result of malaria, with the majority of

[52] World Health Organisation (2011), *Malaria – Fact Sheet No 94 – October 2011,* available at http://www.who.int/mediacentre/factsheets/fs094/en/index.html last accessed 2nd November 2011.

deaths occurring among children living in Africa where the disease accounts for approximately 20% of all childhood deaths.[53]

Malaria causes significant economic losses, with the WHO estimating that the disease can decrease gross domestic product (GDP) by as much as 1.3% in countries with high disease rates and long term aggregated annual losses resulting in substantial differences in GDP between countries with and without malaria over the long term, particularly in Africa.[54] It is estimated that, in some heavy-burden countries, the health costs of malaria account for up to 40% of public health expenditures, 30% to 50% of inpatient hospital admissions, and up to 60% of outpatient health clinic visits.[55]

These significant impacts of malaria also disproportionately affect poorer people who have limited access to health care because, while many countries – especially in temperate and sub-tropical zones – have successfully eliminated malaria, most malaria cases and deaths occur in sub-Saharan Africa, as well as the developing countries of Asia, Latin America, and to a lesser extent the Middle East and parts of Europe.[56]

In 2003, there were an estimated 605 cases of malaria in Australia, resulting in 3 deaths. Menzies works on all five species of the Plasmodium parasite that cause human malaria, focusing on the three types that cause most disease and death in the Asia-Pacific region: *falciparum*, *vivax* and *knowlesi* malaria.

Major research efforts involving Menzies that have resulted in changes in malaria treatment regimes in Australia and throughout Southeast Asia include:

- demonstration of the benefits of treating severe malaria with *artesunate* rather than quinine;
- demonstration of the benefits of treating multi-drug resistant *plasmodium falciparum* and *Plasmodium vivax* malaria with *dihydroartemisinin-piperaquine* (DHA-piperaqine) rather than *artesunate-amodiaquine*; and
- demonstration of the benefits of using DHA-piperaquine as first line treatment of malaria in pregnancy.

Severe malaria treatment

Research conducted by Menzies in collaboration with others as part of the Southeast Asian Quinine Artesunate Malaria Trial demonstrated that *artesunate* reduces the mortality of severe malaria by 34.7% compared with conventional intravenous quinine.[57] **This research made a substantial contribution to the body of evidence supporting artesunate as treatment for severe malaria, which led to changes in the WHO's Global Malaria Treatment Guidelines**. While this study was not the only study to demonstrate the benefits of *artesunate* for the treatment of severe malaria, it was the largest and most extensive. The Global Malaria Treatment Guidelines makes direct reference to the results of the study to support the change in the recommended treatment regime.[58]

[53] Ibid.
[54] Ibid.
[55] Ibid.
[56] Ibid.
[57] The SEAQUAMAT Trial Group. Artesunate versus quinine for treatment of severe falciparum malaria: a randomised trial. *Lancet* 2005; 366: 717-725.
[58] World Health Organisation (2010), *Global Malaria Treatment Guidelines: Second Edition*, available at http://whqlibdoc.who.int/publications/2010/9789241547925_eng.pdf last accessed 2 November 2011

In Australia, malaria results in two to three deaths per year.[59] Based on the reduction in mortality for severe malaria reported by Southeast Asian Quinine Artesunate Malaria Trial, the change in treatment regime will result in 18 fewer deaths over the next 20 years. This is estimated to have an economic value from the improved health, attributable to the Menzies, of $0.6 million ($NPV_{7\%}$) for Australia.

> In 2010, Southeast Asian countries reported 2.3 million cases of malaria and 2,423 malaria deaths, whereas the WHO estimated that the number of cases of malaria and malaria deaths in Southeast Asia were closer to 28-41 million and 49,000 respectively.[60] This discrepancy is likely to be, at least in part, a function of limited access to health care. For the purposes of this assessment, the number of reported malaria deaths has been used, noting that this is a very conservative estimate.

The incidence of reported malaria cases in Asia Pacific has been declining on average by almost 5% per year for the last 10 years,[61] indicating that, in areas sufficiently developed to have appropriate health care, community wide control methods are having an impact. It has been assumed that the incidence of malaria cases will continue to decline. This is a conservative assumption, as it is clear that there is still significant unmet demand for treatment of malaria in the Asia Pacific. Conversely, however, individuals receiving malaria treatment and hence the reported cases and deaths resulting from malaria may fall as countries in the Asia Pacific become more affluent and health care becomes more widely available. The uncertainty surrounding the trajectory of improvements in the availability of health care should be noted.

For the purposes of this assessment, benefits have been assumed to accrue for 20 years. It has further been assumed that the impact of the changes to the WHO guidelines will not be fully implemented in countries in the Asia Pacific until 2015.

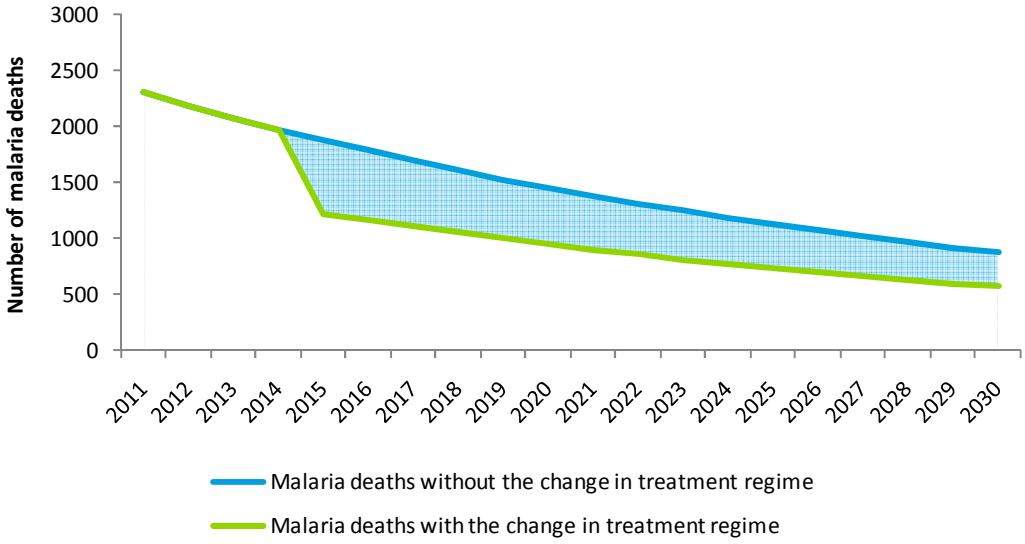
Chart 3.5 illustrates the assumed trend in malaria deaths in Asia Pacific with and without the change in the treatment regime. The gap between the two lines demonstrates the benefit of the estimated reduction in malaria deaths as a result of the change in treatment regime.

[59] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, 2007. The burden of disease and injury in Australia 2003. PHE 82. Canberra: AIHW.

[60] World Health Organisation (2011), *Malaria: Disease Burden in SEA Region*, available at http://www.searo.who.int/en/Section10/Section21/Section340_4018.htm last accessed 1 November 2011.

[61] World Health Organisation (2011), World Malaria Report 2010, available at http://www.who.int/malaria/world_malaria_report_2010/worldmalariareport2010.pdf last accessed 2 November 2011.

Chart 3.5: Reduction in malaria deaths in the Asia Pacific resulting from the change in treatment regime



Based on these estimates and assumptions, the economic value of the improved health benefits for the Asia Pacific of the Menzies contribution to a new treatment regime for severe malaria is $220 million ($NPV_{7\%}$).

Treatment of multi-drug resistant malaria

Research undertaken by Menzies has demonstrated the treatment of uncomplicated multi-drug resistant malaria with DHA-piperaquine results in a significantly lower parasitological failure rate at day 42 (13%) than treatment with *artesunate-amodiaquine* (45%). The research has also demonstrated that the DHA-piperaquine reduced the risk of anaemia.[62] This study made a substantial contribution to the body of evidence supporting the application of DHA-piperaquine for the treatment of uncomplicated multi-drug resistant malaria. **It is cited in the WHO's Global Malaria Treatment Guidelines as the evidence for the use of DHA-piperaquine to treat multi-drug resistant Plasmodium vivax malaria.**[63]

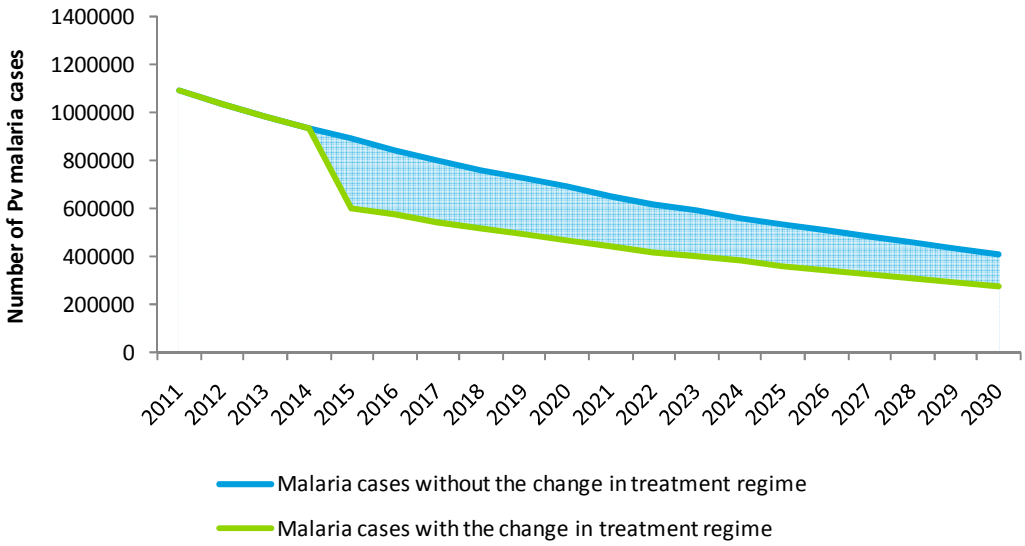
A recurrence of malaria can be the result of either parasitological failure or re-infection. To be conservative it has therefore been assumed that the change in treatment regime results in a reduction in cases for a given year rather than a cure. The value is then the reduced burden of disease of a single episode of malaria for each malaria sufferer who receives the alternate treatment. In addition, the assumptions and estimates outlined above for the valuation of the impact of the Menzies contribution to reduced mortality from severe malaria, have also been applied for this valuation. It has further been assumed that 50% of malaria cases in the Asia Pacific are for Plasmodium vivax (Pv) malaria.

[62] Hagusian RA, Purba LH, Kenangalem E, Wuwung M, Maristela R, Rumaseuw R, Laihad F, Ebsworth P, Anstey NM, Tjitra E, Price RN. Dihydroartemisinin-piperaquine versus artesunate-amodiaquine for multi-drug resistant P. falciparum and P. vivax in Papua, Indonesia. *Clin Infect Dis* 2007; 44:1067-74.

[63] World Health Organisation (2010), *Global Malaria Treatment Guidelines: Second Edition*, available at http://whqlibdoc.who.int/publications/2010/9789241547925_eng.pdf last accessed 2 November 2011

Chart 3.6 illustrates the assumed trend in Pv malaria cases in Asia Pacific with and without the change in the treatment regime. The gap between the two lines demonstrates the benefit of the estimated reduction in malaria cases as a result of the change in treatment regime.

Chart 3.6: Reduction in Pv malaria cases in the Asia Pacific resulting from the change in treatment regime



Based on these trends, and assuming a 0.175 disease weighting for malaria episodes with an average episode length of 0.01 of a year,[64] the economic value of the improved health benefits for the Asia Pacific of the Menzies contribution to a new treatment regime for uncomplicated multi-drug resistant Pv malaria is $7.3 million ($NPV_{7\%}$).

Treatment of malaria in pregnancy

Research undertaken by Menzies has demonstrated that the treatment of pregnant women with DHA-piperaquine in the second and third trimesters reduced the rate of vertical transmission from 3.2% to 0.2% when compared to the currently accepted treatment regime of chloroquine/quinine. It also found the that the proportion of babies born with low birth weight from mothers with malaria dropped from 6.5% to 2.5% [65] **Following on from this study, Indonesia changed national policy to DHA-piperquine for pregnant women.** The WHO is currently reviewing the findings of this work and may be considering changes to international policy.

For the purposes of this assessment, we have only considered the value of improved health outcomes for Indonesia as a result of a reduction in the number of babies born with low birth weight. The study conducted by Menzies was assisted by the other organisations

[64] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, 2007. The burden of disease and injury in Australia 2003. PHE 82. Canberra: AIHW.

[65] Poespoprodjo JR, Fobia W, Kenangalem E, Hasanuddin A, Sugiarto P, Tjitra E, Anstey NM, Price RN. Highly effective therapy for maternal malaria associated with a lower risk of vertical transmission. *J Infect Dis* 2011: in press

involved in the study and the implementation of the new treatment regime was supported by the Indonesian Government.

In Indonesia there were 229,819 reported cases of malaria in 2010.[66] As noted earlier, this is likely to be an underestimate of the total cases of malaria in Indonesia. For the purposes of the assessment, however, the lower estimate of malaria incidence has been applied, as it is assumed that this is the proportion of cases that were able to access health care.

In addition to the above assumptions and estimates:

- it has been assumed that the average fertility rate for mothers with malaria is consistent with the national fertility rate (2.1 per woman);[67]
- a 0.11 disease weighting for mild disabilities resulting infants born with low birth weight has been applied;[68]
- an average incidence of mild disabilities as a result of low birth weight of 5% has been applied; [69]
- the average life expectancy in Indonesia is 68 years; [70] and
- benefits have been assumed to accrue for 20 years from 2011.

Based on these estimates and assumptions, the economic value of the improved health benefits for Indonesia of the Menzies contribution to a new treatment regime for pregnant women with malaria is \$70 million ($NPV_{7\%}$).

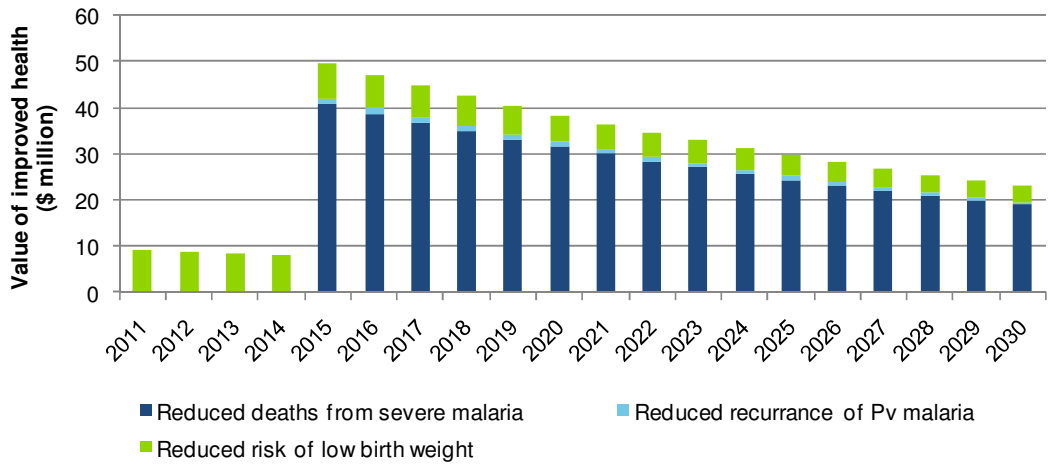
Total estimated benefits from improvements in malaria treatment

The total quantifiable benefit of Menzies malaria research between 2011 and 2035 is estimated to be \$298 million ($NPV_{7\%}$). The majority of this benefit is a result of changes in treatment regimes in Asia Pacific countries. The quantified benefit to Australia of this research is marginal at \$0.6 million ($NPV_{7\%}$).

Chart 3.7 illustrates the year on year quantified benefits of Menzies's malaria research.

[66] World Health Organisation (2011), *Malaria: Disease Burden in SEA Region*, available at http://www.searo.who.int/en/Section10/Section21/Section340_4018.htm last accessed 1 November 2011.
[67] World Health Organisation (2011), *World Health Statistics*, available at http://www.who.int/whosis/whostat/EN_WHS2011_Full.pdf last accessed 2 November 2011.
[68] Ibid.
[69] Ibid.
[70] World Health Organisation (2011), *World Health Statistics*, available at http://www.who.int/whosis/whostat/EN_WHS2011_Full.pdf last accessed 2 November 2011.

Chart 3.7: Quantified benefit of Menzies malaria research



Melioidosis

Melioidosis is a potentially fatal, clinical disease caused by the bacterium *Burkholderia pseudomallei*, which is found in wet soil and surface water in tropical areas, usually after heavy rainfall.[71] *B. pseudomallei* bacteria live below the soil's surface during the dry season but after heavy rainfall are found in surface water and mud and may become airborne.[72] Melioidosis occurs in tropical areas throughout the world, particularly in Southeast Asia and northern Australia, most often in the Top End of the Northern Territory (NT) and in far north Queensland and the Kimberley region of Western Australia.[73] Melioidosis is hyper-endemic in the Top End of the NT and in parts of north-eastern Thailand as it is the commonest cause of fatal community-acquired septicaemic pneumonia (CAP).[74]

People most at risk are those with conditions such as diabetes, which is the greatest risk factor, heavy alcohol consumption, kidney disease, lung disease, cancer, and those on immunosuppressive therapy.[75] The majority of infections occur when skin abrasions or wounds come into contact with wet soil or water contaminated with the bacterium, and very rarely through swallowing contaminated water, or through breathing in fine droplets of such water.[76]

Most incidences of melioidosis are 'acute cases' that have a sudden onset of between 1 – 21 days after an apparent exposure to soil or muddy water, and can present as pneumonia with fever, cough and difficulty breathing or as blood poisoning with fever, confusion and shock.[77] Acute melioidosis can be very severe, and almost always requires hospital inpatient management, with deaths occurring in Australia each year as a result of the

[71] Menzies School of Health Research (2009) *Report to Quinquennial Review Panel – 30 March – 3 April 2009,* p.101-102
[72] Northern Territory Government Department of Health and Families (December 2009) *Melioidosis,* available at http://www.healthylivingnt.org.au/content/?action=getfile&id=705 last accessed 2 November 2011.
[73] Ibid.
[74] Currie BJ, Fisher DA, Howard DM, Burrow JN, Selvanayagam S, Snelling PL, Anstey NM, Mayo MJ. *The epidemiology of melioidosis in Australia and Papua New Guinea*, Acta Trop. 2000 Feb 5;74(2-3):121-7.
[75] Northern Territory Government Department of Health and Families (December 2009) *Melioidosis,* available at http://www.healthylivingnt.org.au/content/?action=getfile&id=705 last accessed 2 November 2011.
[76] Queensland Government (2010) *Topic: Melioidosis*, available at http://access.health.qld.gov.au/hid/InfectionsandParasites/BacterialInfections/melioidosis_is.asp, last accessed 2 November 2011.
[77] Ibid.

disease.[78] Melioidosis can present as a rapidly fatal septicaemic illness and *B. pseudomallei* is now considered a potential biothreat agent, however there are major gaps in the understanding of the disease's global distribution, epidemiology and pathogenesis.[79]

Between 1989 and 2009 the number of cases of melioidosis recorded in Australia was 540. Of those cases, 77 were fatal.[80] One of the major causes of death from melioidosis is the on-set of septic shock. While the number of cases of melioidosis in Australia has remained reasonably steady, the number of fatalities has reduced over time. In particular, as demonstrated in Table 3.8, the proportion of cases of melioidosis septic shock that resulted in death has declined from 100% to 27%.

Table 3.8: Australian melioidosis cases and fatalities from 1989 to 2009[81]

	1989-1994	1995-1999	2000-2004	2005-2009
Number of cases of melioidosis	88	164	139	149
Number of deaths from melioidosis	26 (30%)	24 (15%)	14 (10%)	13 (9%)
Number of cases of melioidosis with septic shock	16	28	39	33
Number of deaths from melioidosis with septic shock	**16 (100%)**	**21 (75%)**	**12 (31%)**	**9 (27%)**

Menzies research has contributed to the body of evidence that improved early diagnosis and improved treatment of melioidosis with new antibiotics and G-CSF in severely ill cases. In 1998, a clinical trial was published that suggested that for a subgroup of patients with severe pneumonia may benefit from the administration of recombinant human G-CSF. **In response to this study intensivists and infectious disease specialists at Royal Darwin Hospital with Menzies staff reviewed the literature about animal and human studies of the use of G-CSF for treating sepsis and it was decided that G-CSF would be added to the means of treating septic shock in a specific attempt to reduce the mortality rate (95%) associated with septic shock due to melioidosis.[82] In 2004 Menzies staff in conjunction with Flinders University reported a decrease in mortality rates from 95% to 10% as a result of improved early diagnosis and improved treatment of melioidosis with new antibiotics and G-CSF in severely ill cases.[83]**

Within the population of northern Australia the incidence of melioidosis is 5.8 in 100,000.[84] The proportion of cases with septic shock between 1989 and 2009 was 21%.[85]

[78] Ibid.
[79] Currie BJ, Ward L, Cheng AC (2010) The Epidemiology and Clinical Spectrum of Melioidosis: 540 Cases from the 20 Year Darwin Prospective Study. PLoS Negl Trop Dis 4(11): e900. doi:10.1371/journal.pntd.0000900, p.1
[80] Ibid.
[81] Ibid.
[82] Cheng, A., Stephens, D.P., Anstey, N.M., & Currie, B.J., 2004. Adjunctive granulocyte colony-stimulating factor for treatment of septic shock due to melioidosis. *Clinical Infectious Diseases*, 38, 32-37.
[83] Ibid.
[84] Cheng, A., Hanna, J., Norton, R., Hills, S., Davis, J., Krause, V., Dowse, G., Inglis, T., & Currie, B.J., 2003. Melioidosis in northern Australia, 2001-02, *Communicable Disease Intelligence*, 27, no. 2.
[85] Currie BJ, Ward L, Cheng AC (2010) The Epidemiology and Clinical Spectrum of Melioidosis: 540 Cases from the 20 Year Darwin Prospective Study. PLoS Negl Trop Dis 4(11): e900. doi:10.1371/journal.pntd.0000900, p.1

Based on these estimates and assumptions, improved diagnosis and treatment of melioidosis with septic shock will avert 230 deaths in Australia between 2011 and 2031. The Menzies contribution of the value of the improved treatment regime for melioidosis with septic shock is $1.3 million in the NT and $5.7 million for the rest of Australia ($NPV_{7\%}$).

Acute Rheumatic Fever and Rheumatic Heart Disease

Acute rheumatic fever (ARF) is an illness following an infection by Group A streptococcus (GAS, *Streptococcus pyogenes*), a Gram positive bacterial pathogen that causes a broad range of diseases.[86] Acute rheumatic fever is widely acknowledged as the major contributor to the burden of GAS diseases globally, because it can lead to rheumatic heart disease (RHD).[87]

Sites of infection with GAS are usually the throat and skin, and presents as a combination of signs and symptoms which may include pain and swelling of the joints, fever, skin rashes, disturbances in the brain, and inflammation of the heart.[88] Both the GAS infection and ARF resolve without treatment, although the ARF may leave residual heart valve damage. This chronic damage to the valves in the heart caused by repeated swelling and stretching of the valves is known as rheumatic heart disease. Recurrences of ARF that occur following repeated GAS infections may cause further valve damage, causing the worsening of RHD and leading to the heart valves becomes severely defective, leaking of the valves or blockages causes obstruction to blood flow due to scarring and sticking together of the valve leaflets. [89] Each ARF recurrence can lead to a worsening of RHD, which in turn may cause heart failure, other complications such as stroke and endocarditis, and lead to the need for cardiac surgery, or result in early death.

Prolonged treatment with penicillin can prevent recurring ARF and thus prevent the development or worsening of RHD.[90]

It is estimated that, in 2005, there were 15.6 million existing cases of rheumatic heart disease, with approximately 282,000 new cases each year and 233,000 deaths each year, not including new cases and deaths of RHD-related strokes or RHD-related infective endocarditis.[91] Although ARF is now rare in most industrialised countries, its incidence remains high in many populations living in poverty, with RHD remaining the major cardiac disease of children and young adults in many less developed countries.[92] This is due to the fact that ARF is more often seen in people who live in poor, crowded conditions and that first episodes of ARF most commonly occur between the ages of 5 and 15 years.[93] In Australia, Aboriginal and Torres Strait Islander and Pacific Islander populations living in

[86] Carapetis, J. (2004) *A review of WHO activities in, the burden of, and the evidence for strategies to control group A streptococcal diseases: summary and recommendations,* Centre for International Child Health, University of Melbourne
[87] Ibid.
[88] Rheumatic Heart Disease Australia, *Health Professionals*, available at http://www.rhdaustralia.org.au/health-professionals, last accessed 2 November 2011
[89] Ibid.
[90] Ibid.
[91] Carapetis, J. (2004) *A review of WHO activities in, the burden of, and the evidence for strategies to control group A streptococcal diseases: summary and recommendations*
[92] Ibid.
[93] Rheumatic Heart Disease Australia, *Teachers and Educators,* available at http://www.rhdaustralia.org.au/teachers-and-educators, last accessed 2 November 2011.

remote northern and central Australia are at high risk of developing ARF, as well as some migrants from high risk countries.[94]

Efforts led Menzies researchers resulted in the introduction of the Rheumatic Heart Disease Control Program in the NT. This work subsequently led to the National Rheumatic Fever Strategy, that includes funding for control programs in the NT, QLD and WA and the establishment of a national coordination unit, RHDAustralia, housed within Menzies. There is anecdotal evidence that this program is a model of best practice for similar programs in other countries. To date, the observed impact of the control program in the NT has included identification of many cases of pre-existing RHD so that better clinical care can be provided, and recent reductions in recurrence rates of ARF. Mortality data show a reduction in RHD related mortality rate in Aboriginal males in the NT from 25.5 per 1,000 in 1987-1996 (pre-control programme) to 14.8 per 1,000 in 1997-2005 (the control programme started in 1997). However, a reduction was not seen in Aboriginal females in the NT (31.2 per 1,000 in 1987-96 and 33.1 in 1997-2005).

The improvements in recurrence rates related to improved secondary prophylaxis have only been seen in more recent years, so RHD related mortality will almost certainly improve at a greater rate when tracked over the coming decade. All the available data suggest that recurrence rates of ARF have approximately halved in recent years. Approximately 40% of all ARF episodes in 1997-2000 were recurrences, compared to approximately 20% in 2005-2010; the proportion of people with ARF suffering a recurrence in the first 3 years (the time of greatest recurrences) reduced from 12.9% in 1997-8 to 6.3% in 2005-7; and when adjusting for multiple factors, the recurrence rate has been decreasing by approximately 9% per year.[95]

Based on these data, it is assumed that, because recurrence rates have approximately halved over the past decade, over the coming decade it will be shown that corresponding rates of rheumatic heart disease will also approximately halve. For this assessment the impact of reduced rates of rheumatic heart disease has only been considered by the Indigenous population of the Northern Territory.

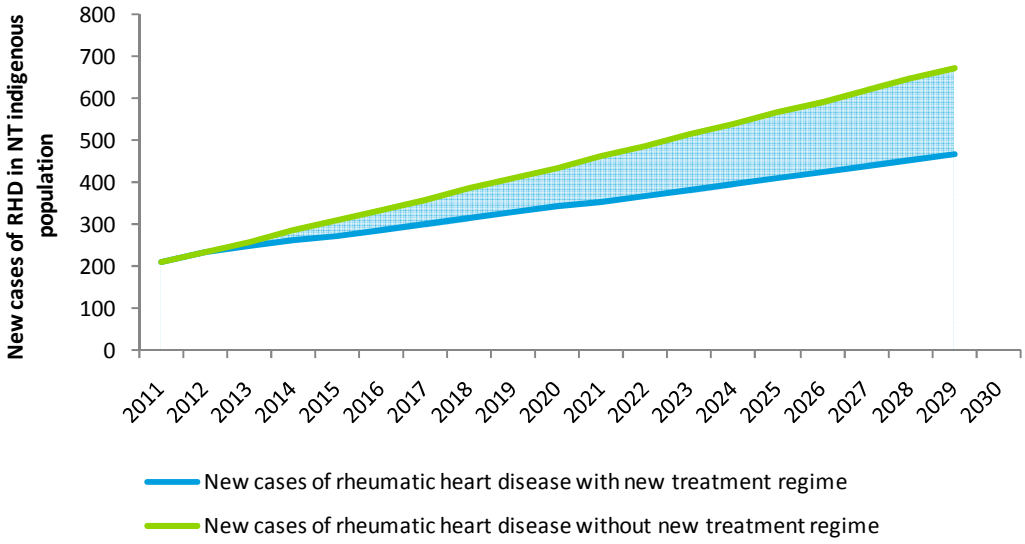
In addition to the above assumptions and estimates:

- a 0.2303 disease weight per case of rheumatic heart disease has been applied;[96]
- the prevalence of rheumatic heart disease in the Indigenous population is assumed to be 2.0% — based on reported prevalence rates for the NT Indigenous population;[97]

Chart 3.8 illustrates the assumed trend in new cases of rheumatic heart disease in the Northern Territory Indigenous population with and without the change in the improved delivery of secondary prophylaxis. The gap between the two lines demonstrates the benefit of the estimated reduction in new cases of rheumatic heart disease in the NT as a result of the improvement.

[94] Rheumatic Heart Disease Australia, *Health Professionals*
[95] Consultation with J. Carapetis
[96] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, 2007. The burden of disease and injury in Australia 2003. PHE 82. Canberra: AIHW.
[97] Cooperative Research Centre for Aboriginal Health, Rheumatic heart disease backgrounder, available at http://www.lowitja.org.au last accessed 2 November 2011.

Chart 3.8: Reduction in new cases of rheumatic heart disease in the NT resulting from the change in treatment regime



Based on these estimates and assumptions, the Menzies contribution of the value of the improved health benefits for the NT Indigenous community from reduced rates of rheumatic heart disease is $0.5 million ($NPV_{7\%}$) and for affected Indigenous communities in the rest of Australia (SA, WA and Qld) is $12 million ($NPV_{7\%}$).

Oral disease

The most common consequences of oral disease are pain, infection and tooth loss, as well as causing difficulties with chewing, swallowing and speech, disrupting sleep and productivity and having a significant impact on self-esteem, psychological and social wellbeing, employment, interpersonal relations, and quality of life.[98]

A significant number of health conditions and diseases are associated with oral disease, including a number of chronic diseases, including cardiovascular disease, cerebrovascular disease, diabetes, preterm and low birth weight babies, aspiration pneumonia, blood borne diseases, infective endocarditis, otitis media, hepatitis C, HIV, infective endocarditis, aspiration pneumonia and nutritional deficiencies in children and older adults.[99]

In 2004-05, dental health made up 10.1% of total health expenditure in Australia, with $5.3 billion making it the second most costly disease group in Australia, after cardiovascular disease.[100] To address this significant health issue in Australia, in 2004 the National Advisory Committee on Oral Health released the *Healthy Mouths Healthy Lives: Australia's*

[98] National Advisory Committee on Oral Health (2004) *Healthy mouths healthy lives : Australia's national oral health plan 2004-2013*, p.5
[99] Australian Health Ministers' Advisory Council Steering Committee for National Planning for Oral Health (August 2001) *Oral Health of Australians – Final Report,* available at http://www.arcpoh.adelaide.edu.au/publications/report/miscellaneous/pdf_files/oral_health_of_Australians_cover.pdf
[100] Australian Institute of Health and Welfare (2010), *Australia's health 2010*, p.429

National Oral Health Plan 2004-2013, to improve Australian health and wellbeing by improving oral health status and reducing the burden of oral disease.

There is also a strong link between socio-economic status and health, reflected in patterns of oral health and disease in Australia,[101] with children in low socioeconomic groups experiencing almost twice as many caries as those in high socio-economic groups.[102] Even higher rates are seen among Aboriginal and Torres Strait Islander children. A study on the oral health of Aboriginal and Torres Strait Islander children by the Australian Institute of Health and Welfare, Dental Statistics and Research Unit in 2007 found that:

- a higher percentage of Aboriginal and Torres Strait Islander children had experienced dental caries than other Australian children at all ages between 4 and 14 years;
- throughout the states and territories observed, Aboriginal and Torres Strait Islander children had consistently higher levels of dental caries (decay) in the deciduous and permanent dentition than their non-Aboriginal and Torres Strait Islander counterparts;
- Aboriginal and Torres Strait Islander children most affected were those in socially disadvantaged groups and those living in rural/remote areas;
- trends in Aboriginal and Torres Strait Islander child caries prevalence indicate that dental caries levels are rising, particularly in the deciduous dentition; and
- Aboriginal and Torres Strait Islander children aged <5 years had almost one and a half times the rate of hospitalisation for dental care as other Australian children.[103]

In addition, good oral health in childhood contributes to better teeth and gums in adulthood–less decay and the loss of fewer natural teeth,[104] meaning that these rates in Aboriginal and Torres Strait Islander children will impact them throughout their adult lives.

To address these issues, Menzies' researchers have developed, implemented and evaluated the effectiveness of a community-oriented primary health care intervention to prevent dental decay among Aboriginal pre-school children in the Northern Territory. The controlled trial involved a dental health program in which fluoride varnish was applied to children's teeth, training provided to staff, and health promotion activities conducted to educate children and their families about tooth brushing and drinking water. The trial found that children in remote communities would benefit from a broader range of preventive services, and corroborated findings in other studies of fluoride varnish's effectiveness in preventing dental caries in children, with children found to have up to 36% fewer cavities compared to those in other communities. This project has been recognised by the National Health and Medical Research Council as one of the ten best research projects in Australia in 2010.[105]

The NT Oral Health Promotion Plan is using evidence from this Menzies project to create objectives and strategies for instituting the program more widely across NT. Children under

[101] National Advisory Committee on Oral Health (2004) *Healthy mouths healthy lives : Australia's national oral health plan 2004-2013,* p.6

[102] Australian Health Ministers' Advisory Council Steering Committee for National Planning for Oral Health (August 2001) *Oral Health of Australians – Final Report*, p.iii

[103] Australian Institute of Health and Welfare, Dental Statistics and Research Unit: Jamieson LM, Armfield JM & Roberts-Thomson KF 2007. *Oral health of Aboriginal and Torres Strait Islander children,* AIHW cat. no. DEN 167. Canberra: Australian Institute of Health and Welfare (Dental Statistics and Research Series No. 35).p.vii

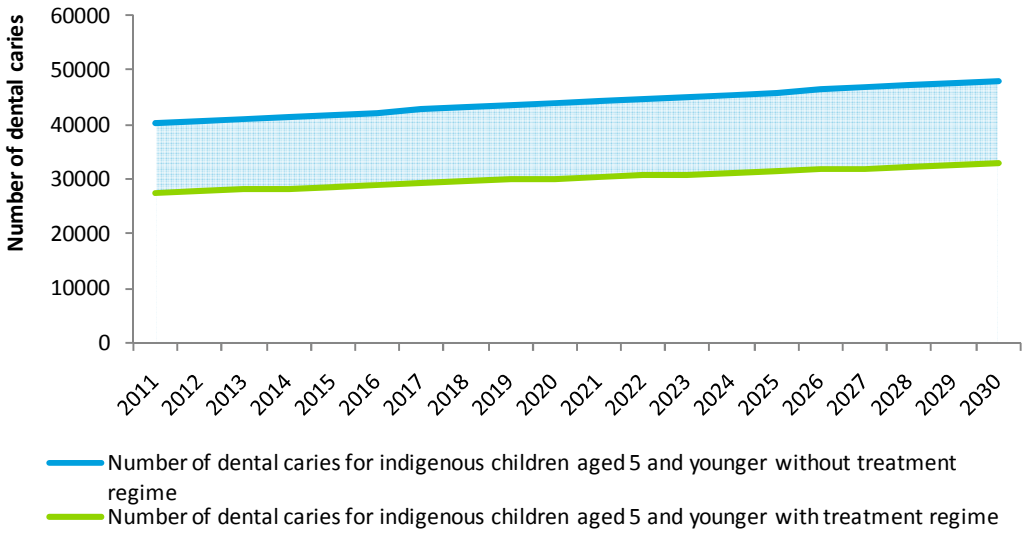
[104] Australian Institute of Health and Welfare (2010), *Australia's health 2010*, p.301

[105] Slade et al (2010) 'Effect of health proportion and fluoride varnish on dental caries among Australian Aboriginal children: results from a community-randomized controlled trial', *Community Dentistry and Oral Epidemiology*

five years of age have been identified for particular focus of oral health promotion in NT over the next five years.

Chart 3.9 illustrates the assumed trend in the prevalence of dental caries in the Northern Territory Indigenous population that is under five year s of age with and without the change in the treatment regime. The gap between the two lines demonstrates the benefit of the estimated reduction in dental caries as a result of the change in treatment regime.

Chart 3.9: Reduction in prevalence of dental caries in children under the age of 5 resulting from the change in treatment regime



Based on these trends, and assuming a 0.014 disease weighting for tooth decay resulting in tooth loss with an average episode length of 0.21 of a year,[106] the Menzies contribution of the value of the improved health benefits for the NT Indigenous community from improvements in the oral health of children under the age of 5 is $1 million ($NPV_{7\%}$).

Improved quality of primary care for chronic disease

Aboriginal and Torres Strait Islander peoples experience significantly higher levels of chronic diseases than other Australians. Disability as a result of chronic health condition affects 36% of Indigenous people over 15 years of age. The prevalence of chronic disease in the Aboriginal and Torres Strait Islander population is particularly high for diabetes, heart disease, hypertension and renal disease. Reducing the incidence of these illnesses within the population has been identified as a major challenge in advancing the health of Indigenous communities by the Australian Governments.[107]

[106] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, 2007. The burden of disease and injury in Australia 2003. PHE 82. Canberra: AIHW.

[107] Department of Health and Ageing (2010) 'Closing the Gap: Tackling Chronic Disease', accessed online: http://www.health.gov.au/internet/main/publishing.nsf/Content/closinggap-tacklingchronicdisease, last accessed 6.12.12

Best practice in chronic disease management has been linked to the implementation of multidisciplinary, cross-cultural teams skilled in health education, clinical care, health promotion and Indigenous knowledge. However, such practice does not yet occur in many parts of rural and remote Australia where there are specific challenges such as: limitations in policy frameworks, high staff turnover, limited preventative activity targeted to well adults and limited infrastructure. While a significant number of studies consider successful chronic disease quality improvement primary settings, a limited level of such work has been completed in Indigenous communities. Addressing this matter, Menzies instituted the Audit and Best Practice for Chronic Disease (ABCD) in 2002, amid a growing body of evidence suggesting that system oriented approaches were important to the improvement of quality of care in primary health care settings.

ABCD was developed as a continuous quality improvement initiative seeking to meet the needs of Aboriginal primary health care services in the Northern Territory. The program works with health centres to improve the delivery of care using a structured and collaborative approach to assess clinical performance against best practice guidelines. It also works to improve health centre systems that are needed to support best practice, such as clear staff roles and responsibilities, data and clinical management systems and the availability of best practice guidelines.

At conception, the project spanned 12 community health centres across the Top End of Northern Territory, in 2006; it received additional funding from the Cooperative Research Centre for Aboriginal Health (CRCAH) and the work was scaled across five regions. This extended program, termed 'ABCDE', enrolled 73 health centres into the research component and provided tools to a further 60 centres. Today, the tools have been adopted by health services nationally and are being used to monitor the success of the Australian Government's $102 million national 'Healthy for Life' program.

The ABCDE program ran for three years until 2009. To continue to support the effective introduction and implementation of CIQ in Indigenous primary health care settings, the ABCD team, with seed funding from the CRCAH, established One21Seventy – a National centre for Quality Improvement in Indigenous Primary Health Care in 2009. One21Seventy is a not-for-profit organisation promoting quality improvement in the Aboriginal community controlled health sector.

To date, the improvement in the delivery of primary health care services for managing chronic disease has resulted in a notable improvement in the proportion of Indigenous people with diabetes that are controlling their blood glucose levels at either ideal or acceptable levels (9% in each category) according to the HbA1c marker.[108] Studies have found that a 1% reduction in HbA1c results in a 25% reduction in the incidence of micro vascular complications such as retinopathy, neuropathy and nephropathy.[109]

In addition to the above assumptions and estimates:

- 6% of the Indigenous population have diabetes[110];

[108] Bailie, R., Si, D., Dowden, M., O'Donoghue, L., Conners, C., Robinson, G., Cunningham, J. & Weeramanthri, T. (2007) Improving organisation systems for diabetes care in Australian Indigenous communities, *BMC Health Services Research*, 7:67.
[109] UKPDS Group (1998) Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33), *Lancet*, 352(9131): 837-53.
[110] ABS (2006) *National Aboriginal and Torres Strait Island Health Survey: Australia, 2004-05*, Cat. No. 4715.0

- 21% of Indigenous diabetics have retinopathy[111] (disease weight 0.254[112] and average duration 10 years) and 9% have neuropathy[113] (disease weight 0.19[114] and average duration 10 years); and
- 2% of the Indigenous population have kidney disease[115], 78% of whom also have diabetes[116] (disease weight 0.29 and average duration 5.4[117]).

Based on these estimates and assumptions, the economic value of the improved health benefits attributable to Menzies for the NT from improvements in the treatment of diabetes is $15 million ($NPV_{7\%}$) and for the rest of Australia is $99 million ($NPV_{7\%}$).

Pyoderma

Pyoderma is a generic term used to describe a clinical diagnosis of superficial bacterial skin infection. Generally, such infections arise as primary infections of the skin known as impetigo or as secondary infections of other lesions such as scabies or insect bites. The usual bacterial causes are Group A streptococci or *Staphylococus aureaus.*[118]

The treatment of pyoderma, as recommended in the Central Australian Rural Practitioners Association Standard Treatment Manual, is to provide benzathine penicillin or trimethoprim-sulfamethoxazole for five days. While mupirocin is extensively used as a treatment, the Manual recommends that it is not used in Central Australia as resistance has been known to develop rapidly.[119] A topical antibiotic treatment is suggested for Scabies, which typically presents alongside cases of pyoderma.[120]

It is estimated that 111 million children have pyoderma worldwide and that many of these children will also have scabies.[121] Prevalence cannot be differentiated by ethnicity or socioeconomic status, but in high-prevalence areas, poverty and overcrowded living

[111] Maple-Brown L., Cunningham J., Dunne K., Whitbread C., Howard D., Weeramanthri T., Tatipata S., (...), Shaw J.E. (2008) Complications of diabetes in urban Indigenous Australians: The DRUID study, *Diabetes Research and Clinical Practice*, 80 (3), pp. 455-462

[112] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, 2007. The burden of disease and injury in Australia 2003. PHE 82. Canberra: AIHW.

[113] Maple-Brown L., Cunningham J., Dunne K., Whitbread C., Howard D., Weeramanthri T., Tatipata S., (...), Shaw J.E. (2008) Complications of diabetes in urban Indigenous Australians: The DRUID study, *Diabetes Research and Clinical Practice*, 80 (3), pp. 455-462

[114] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, 2007. The burden of disease and injury in Australia 2003. PHE 82. Canberra: AIHW.

[115] ABS (2006) *National Aboriginal and Torres Strait Island Health Survey: Australia, 2004-05*, Cat. No. 4715.0

[116] AIHW 2011. Chronic kidney disease in Aboriginal and Torres Strait Islander people. Cat. no. PHE 151. Canberra: AIHW, accessed online at http://www.aihw.gov.au, last accessed 8 12 2011.

[117] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, 2007. The burden of disease and injury in Australia 2003. PHE 82. Canberra: AIHW.

[118] Andrews, R.M.; Kearns, T; Connors, C; Parker, C; Carville, K.; Currie, B.J.; Carapetis, J.R (2009) ' A Regional Initiative to Reduce Skin Infections amongst Aboriginal Children Living in Remote Communities of the Northern Territory, Australia', *PLOS Neglected Tropical Diseases',* 3(11)

[119] Central Australian Rural Practitioners Association (2003) CARPA standard treatment manual, 4th Ed, Alice Springs: Central Australian Rural Practitioners Association; Hay, R., Bendeck, S.E., Chen, S., Estrada, R., Haddix, A, McLeod, T. And Mahe, A. (2006) 'Skin Diseases', in 'Disease Control Priorities in Developing Countries', 2nd Ed., Work Bank

[120] Central Australian Rural Practitioners Association (2003) CARPA standard treatment manual, 4th Ed, Alice Springs: Central Australian Rural Practitioners Association

[121] World Health Organisation (2005) 'The Current Evidence for the Burden of Group A Streptococcal Diseases', accessed online: http://whqlibdoc.who.int/hq/2005/WHO_FCH_CAH_05.07.pdf, last accessed 5.12.11

conditions are important underlying social determinants.[122] In resource poor communities worldwide, scabies prevalence is up to 20%. Prevalence rates are even higher among children living in Australian Aboriginal communities and those living in the Pacific region, ranging between 40% to 90% of children. [123]

Controlling pyoderma and scabies could be an important primary health intervention to reduce serious bacterial infections in childhood, and may be associated with significant longer term benefits. Group A streptococcal pyoderma leads to acute post- streptococcal glomerulonephritis and underlies most cases of invasive Group A streptococcal infections, especially in tropical regions. Links between scabies and high rates of acute rheumatic fever in remote Aboriginal communities in the Northern Territory have also been postulated.[124]

Menzies and others have collaborated with NT communities and the government authorities over more than 10 years to develop strategies for tackling skin infections at a community level. A study conducted by Menzies from 2004 – 2007 targeting pyoderma and scabies among Aboriginal children in the NT found value in implementing measures of regular surveillance and routine service delivery in significantly reducing pyoderma prevalence.[125]

The study implemented routine screening undertaken by trained local community workers and treatment was recommended and provided. The outcome was predominately attributed to increased treatment. The study also noted the importance of local action delivered through basic primary health services and the key role played by local community workers in conducting surveillance for skin infections. Over the course of the study, Pyoderma prevalence dropped from 46.7% at baseline to a median of 32.4% during the follow up period, an absolute reduction of 14.7%. Treatment uptake increased over the same period.[126]

[122] Andrews R.M., McCarthy, J., Carapetis, J.R., Currie, B.J., (2009) ' Skin Disorders, including pyoderma, scabies and Tinea Infections', *Pediatr Clin North Am,* 56(6)

[123] Clucas,D.B., Carville, K.S., Connors, C., Currie, B.J, Carapetis, J.R., Andrews, R.M., (2008), Disease burden and health-care clinic attendances for young children in remote Aboriginal communities of northern Australia', *Bulletin of the World Helath Organisation,* 86(4)

[124] Clucas,D.B., Carville, K.S., Connors, C., Currie, B.J, Carapetis, J.R., Andrews, R.M., (2008), Disease burden and health-care clinic attendances for young children in remote Aboriginal communities of northern Australia', *Bulletin of the World Helath Organisation,* 86(4); Andrews, R.M.; Kearns, T; Connors, C; Parker, C; Carville, K.; Currie, B.J.; Carapetis, J.R (2009) ' A Regional Initiative to Reduce Skin Infections amongst Aboriginal Children Living in Remote Communities of the Northern Territory, Australia', *PLOS Neglected Tropical Diseases',* 3(11)

[125] Andrews, R.M.; Kearns, T; Connors, C; Parker, C; Carville, K.; Currie, B.J.; Carapetis, J.R (2009) ' A Regional Initiative to Reduce Skin Infections amongst Aboriginal Children Living in Remote Communities of the Northern Territory, Australia', *PLOS Neglected Tropical Diseases',* 3(11)

[126] Ibid.

Based on these trends, and assuming a 0.019 disease weighting for pyoderma with an average episode length of 4.7 of a year,[127] the Menzies contribution of the value of improvements in the treatment of pyoderma in children in the NT under the age of 15 is $4 million ($NPV_{7\%}$).

3.2.3 Commercialisation

The treatment of severe malaria currently relies on antimalarial drugs and supportive treatments, but the early case fatality rate remains high. Menzies has identified the potential for L-Arginine to be a potential adjunctive therapy in the treatment of severe malaria because of its ability to increase nitric oxide (NO) production in endothelial and other cells. Menzies has a patent in the US for the use of L-Arginine for the treatment of malaria as an adjunctive therapy to treat malaria. Phase IIa clinical trials in the treatment of L-Arginine for severe malaria commenced in 2008.

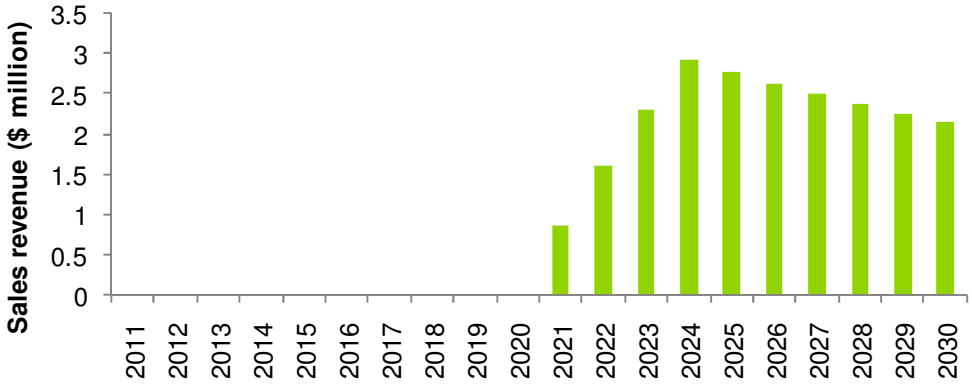
To assess the benefits from commercialisation of this treatment we have used the following estimates and assumptions:

- the cost of a dose of 10g of intravenous L-Arginine is $21.70 based on the reported cost of £12 in 2006;[128]
- each patient receives two 12g doses over the first 24 hours;
- the likelihood of success at phase II trial stage of getting to market is 15%;[129]
- a market penetration rate of 50% because there is currently no other effective adjunctive therapy available;
- a royalty rate of 10%;
- treatment of L-Argnine is first available on the market in 2021 and does not achieve peak sales until 2024; and
- an estimated market size of the reported cases of malaria worldwide, approximately 15.2 million in 2010 — declining to 5.2 million by 2031.

[127] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, 2007. The burden of disease and injury in Australia 2003. PHE 82. Canberra: AIHW.
[128] Hay, E. 2007, *Neonatal Formulary: Drug use in pregnancy and the first year of life*, Blackwell Publishing.
[129] Clinuity 2011, What is the probability of success of clinical trials?, available at http://clinuity.com/blog/2011/02/what-is-the-probability-of-success-of-clinical-trials/ last accessed 2 November 2011.

Based on these estimates and assumptions, the economic value to Menzies of the commercialising L-Arginine is $7.8 million ($NPV_{7\%}$). Chart 3.10 illustrates the annual sales revenue between 2011 and 2031.

Chart 3.10: Revenue stream from sales of L-Arginine



4 Qualitative impacts

The benefits of activities by Menzies are broad in their expression and wide reaching in their impact. As with many organisations operating in the area of health, social policy and research, the full magnitude of benefits cannot be readily quantified, limited by data availability and the nature of the impacts themselves.

Some activities, for example, which serve to raise awareness, attract the attention of researchers, attract funding and other resources are all examples of work that is of notable benefit to the community, but cannot be reasonably expressed in monetary terms. None the less, it would be remiss for a study of this nature to not explicitly recognise the presence of such benefits.

The purpose of this chapter is to highlight some such benefits which were noted in consultation. The discussion below is by no means intended to be exhaustive, rather, it seeks to canvass the variety of benefits which exist, but cannot be captured in the analysis presented in Chapter 3.

Four case studies of activities conducted by Menzies that are of value to the community but cannot be easily quantified are presented in this chapter:

- mental health;
- diabetes;
- tobacco control; and
- otitis media.

4.1.1 Mental health

At present, there isn't any definitive national data about the incidence or prevalence of mental disorders among Aboriginal and Torres Strait Islander people. Limited available research, however, supports the conclusion that serious mental disorders occur in Aboriginal and Torres Strait Islander populations, and such disorders are at least as common as they are among other Australians. [130] Data on hospitalisations and mortality due to serious mental disorders and illness are currently the main sources of information about mental disorders in Aboriginal and Torres Strait Islander people. These data sources indicate that in 2004-5 Aboriginal and Torres Strait Islander people were twice as likely to be hospitalised for conditions classified as 'mental and behavioural disorders' than other Australians. The rate of hospitalisation for Aboriginal and Torres Strait Islander Australians diagnosed with mental disorders due to psychoactive substance use was four to five times higher than they are for other Australians.[131]

[130] Mindframe (2008) ' Facts and Statistics on suicide and mental illness', accessed online: http://www.mindframe-media.info/site/index.cfm?display=84362, last accessed 6.12.11; Australian Bureau of Statistics & Australian Institute of Health and Welfare (2010) The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples, Oct 2010, ABS Cat. No 4704

[131] Mindframe (2008) ' Facts and Statistics on suicide and mental illness', accessed online: http://www.mindframe-media.info/site/index.cfm?display=84362, last accessed 6.12.11

Suicide and self-harming behaviours are also more frequent within Indigenous communities than among other Australians. In 2008, suicide was the leading external cause of death for Indigenous Australians. In recent years, the death rate from suicide for Indigenous Australians was highest in the 15 to 34 year age group. For females, the rates have generally been highest in the 15 to 24 years age group.[132]

Menzies undertakes research on Aboriginal and Torres Strait Islander-focussed mental health issues, particularly aiming to improve access to and engagement with mental health services for Indigenous people, to increase the number of patients who receive a full treatment dose, reduce the risk of hospital readmission, and reduce the incidence of relapse.

Menzies research examines both training and treatment needs, testing the effectiveness of different therapies in Indigenous communities through randomised controlled trials, as well as training Indigenous people in the mental health sector, running 60 training workshops with at least 600 participants. It works to ensure that people have the information they need to make good decisions, studying approaches to Indigenous mental health literacy and developing a number of education tools designed to provide an Indigenous perspective to mental health, which address issues such as the impact of petrol sniffing and attitudes to gambling in remote communities. Menzies is also the coordinator of the Australian Integrated Mental Health Initiative (AIMhi) in the Northern Territory, and has developed mental health assessment tools applicable to Indigenous people as a result of this role. There is evidence that the AIMhi approach has been taken up in services and settings around Australia, and that the work has informed the development of a range of best practice guidelines and other training resources.

The value of this work, particularly in light of the context within which it is delivered, was strongly communicated in consultation. While data availability limits the capacity of this economic contribution study to estimate the monetary value of such work, it is important that its value is recognised and tied qualitatively to the quantitative benefits evaluation.

4.1.2 Diabetes

Type II diabetes is recognised as one of the most important health problems for Indigenous populations across Australia, with the overall prevalence likely to be around four times that of the general population.

Menzies' researchers have conducted research into a number of aspects of diabetes in Indigenous communities. This work has included studying diabetes care in an Aboriginal community in East Arnhem Land and identifying the potential for increased use of insulin, resulting in the education of health practitioners on insulin use and the creation of a number of positions for health practitioners in rural and remote communities.

Menzies' work on training also resulted in the first Indigenous diabetes educator to be employed. Moreover, work by Menzies has determined relationships between disadvantage and rates of diabetes in the urban Indigenous population, and investigated the impact of diabetes and related conditions, such as high cholesterol and blood pressure,

[132] Mindframe (2008) 'Facts and Statistics on suicide and mental illness', accessed online: http://www.mindframe-media.info/site/index.cfm?display=84362, last accessed 6.12.11;Australian Bureau of Statistics (2010). Causes of Death, Australia, 2008. ABS Cat. No. 3303.0. Canberra, ACT: Australian Government.

with heart disease, showing that the risk of heart disease is by far the highest for Indigenous people living in remote communities.

Menzies' personnel are currently commencing work in collaboration with other organisations on diabetes in pregnancy, looking at models of care and implementing best practice, enhancing the flow of information and continuity of care for affected women, improving early diagnosis and developing a clinical register.

4.1.3 Tobacco control

In 2008, the national prevalence of smoking among Indigenous people aged 15 and over was 47% more than double that of other Australians. The NT has the highest Indigenous smoking prevalence (53%) of any Australian jurisdiction.

Effective monitoring of trends in tobacco use is the basis of developing effective and tailored tobacco control policy. In Australia, trends in tobacco consumption can be monitored using estimates derived from self-reported consumption in triennial national surveys, the customs and excise paid on tobacco and the purchase of wholesale or retail data from business sector groups. It is recognised that all of these methods have limitations.

The contributions of Indigenous smokers cannot be identified within consumption trends from tobacco excises and the customs paid, which are only available at the nation-level. The National Drug Strategy Household Surveys used to assess consumption and prevalence trends in the total Australian population have only very small Indigenous samples.

In view of the paucity of regional and locally sourced data on tobacco consumption among Indigenous communities, research is used to store sale or wholesale data to assess local Aboriginal consumption in small remote communities with predominantly Aboriginal populations, especially in the evaluation of local tobacco control interventions. Menzies scaled this methodology, developing mechanisms to routinely and consistently monitor tobacco sales in 25 remote Aboriginal communities. The proposed methodology overcomes some problems with consumption estimates and enables rapid feedback and the use of results. The method is particularly well suited for hard to reach discrete populations such as remote aboriginal communities in Australia. The outcomes of the paper are readily translatable to a whole of Northern Territory or Australia-wide approach.

4.1.4 Otitis media

Otitis media refers to the inflammation of the middle ear, which may include a range of conditions. While milder forms of otitis media occur commonly in childhood, more severe presentations can result in permanent damage such as hearing loss.[133]

The World Health Organization considers that rates of chronic middle ear infection (with eardrum perforation and pus draining out of the ear) greater than 4% represents a serious public health problem.[134] In some remote Aboriginal communities, rates of eardrum

[133] Australian Hearing 'Otitis Media' accessed online: http://www.hearing.com.au/digitalAssets/4735_1174000900894_Otitis%20media.pdf, last accessed 7.12.11

[134] World Health Organisation and Ciba and Foundation (1998) *Prevention of hearing impairments from chronic otitis media*, accessed online: http://www.who.int/pbd/deafness/en/chronic_otitis_media.pdf, last accessed 7.12.11

perforation exceed 60% and up to 50% of school children are eligible for hearing aids. Some Indigenous children have pus discharging from their ears for years. The overall rate in the NT is around 20%.[135]

Ear health research (and specifically otitis media research in young Aboriginal children) began at the Menzies soon after its formation in 1985. The research school has a long history of trying to find solutions to middle ear infection in Aboriginal children. Unfortunately, severe otitis media is a complex medical condition which is thought to be caused by poverty and poor living conditions. Therefore, medical treatment of the condition cannot alone address the causal root of this disease. [136]

Previous research Menzies has described the early onset of disease, the association with early onset bacterial infection, and the clinical spectrum of disease. More recently, Menzies has focused on high quality randomized controlled trials that test interventions. Proposed interventions all have the potential to substantially reduce the burden of disease but it is also possible that they may do more harm than good. To date, Menzies have identified interventions associated with immunisation, family education, additional hygiene practices, appropriate antibiotic use, and case management as being suitable for further investigation. The school recognises any intervention that improves the general health of Aboriginal children will reduce rates of severe ear infection. [137]

The economic contribution of the work conducted by Menzies in this space is valuable in drawing both attention and funding to this serious public health problem which is concentrated within Indigenous communities. Research is needed to determine appropriate treatment methods which address the causal factors of the disease, which are both environmental and medical in nature.

[135] Menzies school of health research 'Response to terms of reference, Senate Community Affairs Reference Committee, Inquiry into Hearing Health in Australia', accessed online: http://www.aph.gov.au/senate/committee/clac_ctte/hearing_health/submissions/sub174.pdf, last accessed 7.12.11
[136] Ibid.
[137] Ibid.

5 Overall impacts

5.1 Methodology

Menzies was evaluated using cost benefit analysis (CBA). A CBA involves the estimation of costs and benefits over a number of years, with future benefits and costs discounted to the present using a discount rate. The NPV of the costs and benefits of a particular intervention program are compared to determine a net benefit (or cost) along with a Benefit/Cost (B/C) ratio. CBA has an internal benchmark – the 'breakeven point' (i.e. anything above this 'zero' benchmark is a net benefit). The B/C ratio was calculated as the ratio of the sum of the discounted benefits of Australian health R&D expenditure relative to the cost of Australian health R&D. The breakeven point for the B/C ratio is 1 i.e. a B/C ratio between 0 and 1 represents net costs.

The benefits estimated are conservative as many of the future benefits of Menzies' work are yet to be realised. The methodology may also be conservative because it only includes the value of wellbeing gains that accrue to the individual as benefits. For example, other health sector benefits of averting DALYs accrue to governments (e.g., health expenditures saved), to firms (to the extent that they bear part of the productivity losses associated with disease and injury) and to the rest of the society (e.g. the value of informal care from family and friends).

A Monte Carlo analysis was applied to test the sensitivity of the net benefit to variation in key model inputs, such as the Value of a Statistical Life Year (VSLY) and time lags between expenditure and gains in wellbeing.

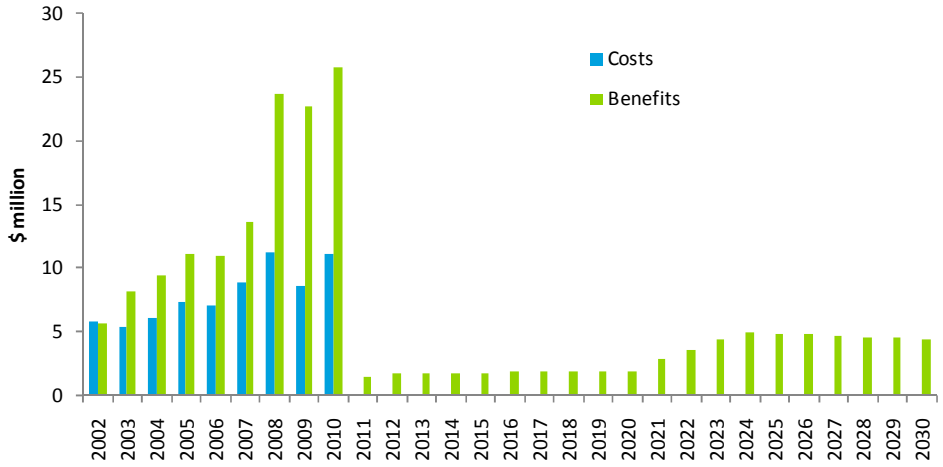
5.2 CBA findings

The annual benefit stream from gains to wellbeing and the cost stream associated with Menzies activities is shown in Chart 5.1.

The costs are based on the estimates presented in Chapter 2, while the benefits reflect the sum of the benefits in Chapter 3.

> In total, in NPV terms and 2011 dollars, the net benefit from Menzies research over the period 2002 to 2010 is $87 million for the NT (with a B/C ratio of 2.2), $13 million for Australia (a B/C ratio of 1.1) and $293 million for the Asia Pacific region (a B/C ratio of 71.6).

Chart 5.1: Benefit and cost streams from Menzies activities for the NT, 2002 to 2030



The net benefits and B/C ratio for Menzies activities performed between 2002 and 2010 are shown in Table 5.1.

Table 5.1: Net benefits and B/C ratio for Menzies activities and research for Menzies expenditure for the period 2002 to 2010

	NT $NPV_{7\%}$ $2011m	Australia (excluding NT)* $NPV_{7\%}$ $2011m	Asia Pacific (excluding Australia) $NPV_{7\%}$ $2011m
Costs	**$71.36**	**$110.65**	**$4.15**
Benefits			
Direct economic contribution	$90.88	$3.19	-
Indirect economic contribution	$37.55	$1.45	-
Education	-	$1.52	-
Health benefits			
Malaria	-	$0.57	$296.97
Melioidosis	$1.25	$5.66	-
Rheumatic heart disease	$0.50	$12.09	-
Oral disease	$1.14	-	-
Quality improvement for primary care of chronic disease	$15.22	$99.16	-
Pyoderma	$4.44	-	-
Mental health		Not quantified	
Diabetes		Not quantified	
Tobacco control		Not quantified	
Otitis media		Not quantified	
Commercialisation	$7.77	-	-
Total benefits	**$158.75**	**$123.64**	**$296.97**
Net benefit	**$87.38**	**$12.99**	**$292.83**
Benefit cost ratio (ratio not $m)	**2.22**	**1.12**	**71.62**

5.3 Sensitivity analysis

There are a number of assumptions in this analysis that, in practice, may vary either side of the estimate used. It is therefore important to sensitivity test assumptions to ensure the robustness of the final estimates.

Key assumptions to sensitivity test are:

- the value of a statistical life year in the Asia Pacific – the VSLY in a given country is a reflection of economic prosperity, given the level of economic development in the Asia Pacific the application of an Australian measure may overestimate the impact;
- the number of cases and deaths from malaria in the Asia Pacific – very conservative estimates of the number of cases of malaria receiving treatment have been applied to the above assessment:
- the discount rate – at 3% and 11% as per OBPR guidelines; and
- the likelihood of success of commercialisation of a therapy at phase II – conservative estimates of the likelihood of success have been applied to the above assessment.

The following sensitivity tests use Monte Carlo analysis. This approach makes it possible to vary all of the estimates discussed above simultaneously to explore the effect of their potential interactions on the impact of Menzies activities. This involves performing 10,000 simulations of the economic impact model using different values, and combinations of values for the estimates adopted. This analysis makes it possible to determine the robustness of the results reported above.

Table 5.2 summaries the range and distribution applied for each estimate for the sensitivity analysis.

Table 5.2: Ranges and distributions applied to the estimates for sensitivity analysis

Estimates	Minimum	Most likely	Maximum	Distribution
VSLY in the Asia Pacific	$42,801	$85,302	$171,249 (Australian VSLY)	Triangular – strongly skewed
Estimated number of deaths from malaria that receive treatment	2423	13462	24500 (half of WHO estimates)	Beta
Estimated number of cases of malaria that receive treatment	2.3 million	15.2 million	28 million (lower bound of WHO estimates)[a]	Beta
Discount rate	3%	7%	11%	Uniform
Assumed success rate of Phase II trails	10%	25%	40%	Beta

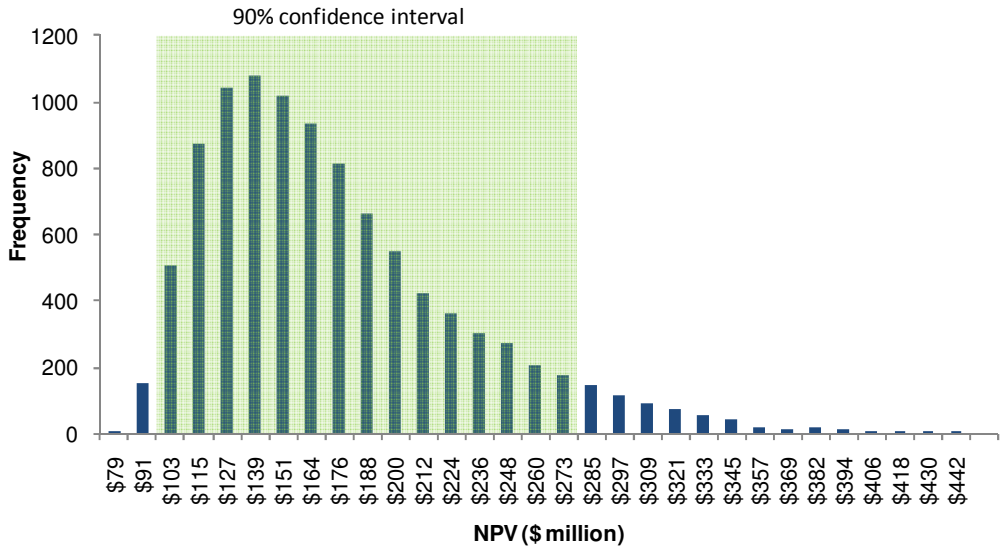
Note (a): WHO estimates that there were between 28 and 41 million malaria cases in Southeast Asia for 2009-10. We have applied the lower bound estimate.

5.3.2 NT

The sensitivity analysis found that the average economic contribution of Menzies to the NT for the period from 2002 to 2010 was $163 million. The lowest possible economic contribution, based on the ranges outlined in Table 5.2 was $79 million; however, the likelihood of such a result is low.

Chart 5.2 illustrates the results of the sensitivity analysis and highlights the robust nature of the results reported in Section 5.2. The analysis suggests a likely economic contribution of Menzies activities to the NT of between $100 and $283 million.

Chart 5.2: Sensitivity analysis of the economic contribution to the NT

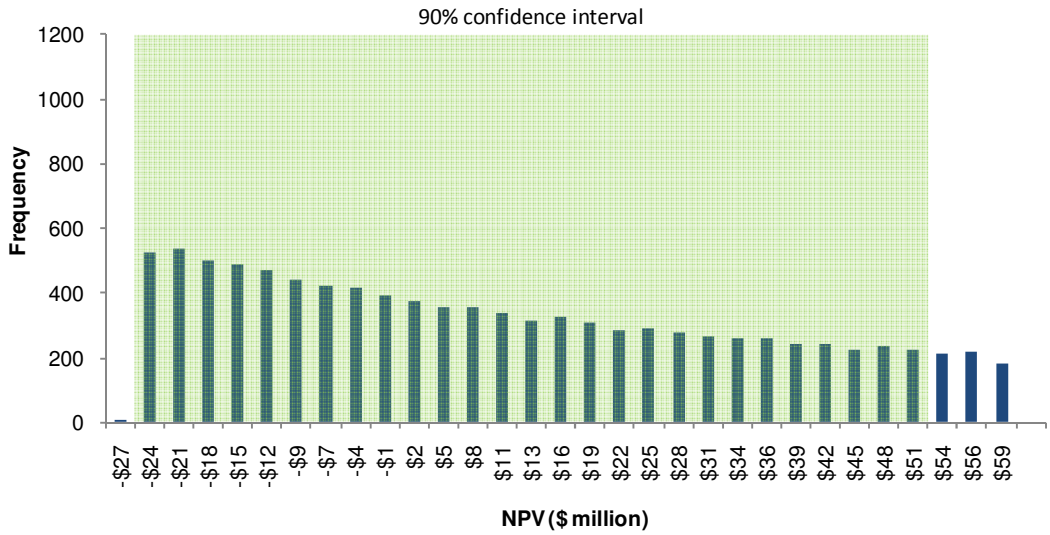


5.3.3 Australia

The sensitivity analysis found that the average economic contribution of Menzies to Australia for the period from 2002 to 2010 was $9 million. The lowest possible economic contribution, based on the ranges outlined in Table 5.2 was -$27 million; however, the likelihood of such a result is low.

Chart 5.3 illustrates the results of the sensitivity analysis and highlights the robust nature of the results reported in Section 5.2. The analysis suggests a likely economic contribution to Australia from Menzies activities will be between -$24 and $52 million.

Chart 5.3: Sensitivity analysis of the economic contribution to Australia

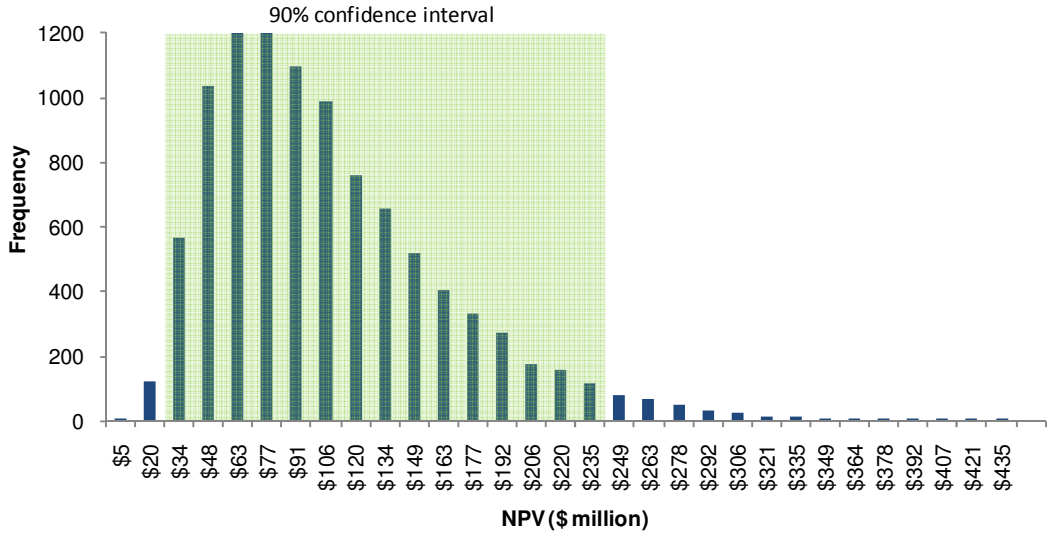


5.3.4 Asia Pacific

The sensitivity analysis found that the average economic contribution of Menzies to the Asia Pacific for the period from 2002 to 2010 was $100 million. The lowest possible economic contribution, based on the ranges outlined in Table 5.2 was $5 million; however, the likelihood of such a result is low.

Chart 5.4 illustrates the results of the sensitivity analysis and highlights the robust nature of the results reported in Section 5.2. The analysis suggests a likely economic contribution to the Asia Pacific from Menzies activities will be between $31 and $214 million.

Chart 5.4: Sensitivity analysis of the economic contribution to the Asia Pacific



Conclusions

This assessment has attempted to provide a quantitative assessment of the economic and social contribution of Menzies activities between 2002 and 2010. Wherever possible we have sought to quantify the impacts of leveraged investment, skills and knowledge investment, commercialisation and improved health outcomes for the NT, Australia and Asia Pacific region.

The results of this analysis suggest that Menzies activities have generated significant economic benefit to the NT and Asia Pacific (excluding Australia) regions. It must be recognised, however, that this analysis is partial at best and represents the lower bound of the total contribution of Menzies. This is because at this stage:

- it is highly likely that the outcomes of research generated between 2002 and 2010 have yet to be identified; and
- many of the outputs of Menzies cannot be reasonably expressed in monetary terms.

Menzies' mission is "to improve the health of people living in northern and central Australia, and regions to the near north, through multidisciplinary research and education"[138]. Indigenous Australians experience the worst health of any one identifiable cultural group in Australia. The majority of Menzies efforts are, therefore, focused on improving the health outcomes of Indigenous Australians. In doing so, Menzies not only contributes economically, it also contributes to addressing one of the most important equity issues in Australia.

[138] Professor O'Dea, "Report from the Menzies School of Health Research, Darwin", in *The Sir Robert Menzies Foundation Limited,* p.7 available at http://menziesfoundation.org.au/annualreports/2003/Pages%207-11%20ARpt%202003.pdf last accessed 6th October 2011.

Appendix A: Consultation methodology and stakeholders

Consultation brief

Date: 3 October 2011

To: [*Stakeholder's name to be inserted*]

From: Deloitte Access Economics

Funding for health and medical research and development contends with competing demands for a limited pool of funding. Hence, it can be strategic for research organisations such as the Menzies School of Health Research (Menzies) to demonstrate *how* and *where* they generate value and the quantum of value generated.

To this end, Menzies engaged Deloitte Access Economics to undertake this project with the following objectives:

- To analyse and document the economic and social contribution of Menzies School of Health Research (Menzies) to the Northern Territory (NT), Australia and the Asia Pacific.
- To provide a report for the NT government and philanthropic organisations documenting the economic and social contribution of the Menzies.

As part of this project, we are assessing the health benefits, or policy and program improvements that have been generated by Menzies' work.

We understand that you have been instrumental in the research work conducted by Menzies into [*Subject area to be inserted*]. We would therefore like to cover a number of discussion points in a half hour phone call with you, including the following:

- Could you please provide a brief description of the type of work that you are undertaking?
- What is the timeline for completing this work?
- Has your research to date resulted in a change in clinical practice either directly or through changes in health policies?
- Prior to your research, what were the impacts of the clinical condition on the community and individuals?
- If Menzies had not undertaken/been involved in this research what would have happened?
- What is the anticipated outcome of any changes that have resulted from your research? When will the impacts of these changes be felt?
- How many people do you estimate will benefit from the outcomes of your research over the next decade? What is the nature of the expected benefits? e.g. improved quality of life.
- Are there other potential future benefits that may be derived from your work?

- Are there considerations particular to Indigenous Australians or other vulnerable groups that we should take into account when assessing the health impacts?
- Can you think of other Menzies staff the WHO we should be talking to about this project?
- Is there any other published material you would recommend we consider as part of this project?
- Is there anything else you would like to discuss?

Appendix B: References

Access Economics (2008) *Exceptional Returns: The Value of Investing in Health R&D in Australia II*, Report for the Australian Society for Medical Research, Canberra.

Access Economics (2008) *Returns to NHMRC funded R&D, Report for the National Health and Medical Research Council*, Canberra.

AIHW 2011. Chronic kidney disease in Aboriginal and Torres Strait Islander people. Cat. no. PHE 151. Canberra: AIHW, accessed online at http://www.aihw.gov.au, last accessed 8 12 2011.

Andrews R.M., McCarthy, J., Carapetis, J.R., Currie, B.J., (2009) ' Skin Disorders, including pyoderma, scabies and Tinea Infections', *Pediatr Clin North Am,* 56(6)

Andrews, R.M.; Kearns, T; Connors, C; Parker, C; Carville, K.; Currie, B.J.; Carapetis, J.R (2009) ' A Regional Initiative to Reduce Skin Infections amongst Aboriginal Children Living in Remote Communities of the Northern Territory, Australia', *PLOS Neglected Tropical Diseases',* 3(11)

Australian Bureau of Statistics & Australian Institute of Health and Welfare (2010) The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples, Oct 2010, ABS Cat. No 4704

Australian Bureau of Statistics (2006) *National Aboriginal and Torres Strait Island Health Survey: Australia, 2004-05*, Cat. No. 4715.0

Australian Bureau of Statistics (2010). *Causes of Death, Australia*, 2008. ABS Cat. No. 3303.0. Canberra, ACT: Australian Government.

Australian Bureau of Statistics *The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples*, cat. no. 4704.0, Oct 2010 (latest issue released February 2011)

Australian Bureau of Statistics, *Population by Age and Sex, Regions of Australia*, cat. no. 3235.0, 2010 (Latest issue released August 2010)

Australian Bureau of Statistics, *Regional Statistics, Northern Territory*, cat. no. 1362.7, 2010 (Latest issue released March 2011)

Australian Health Ministers' Advisory Council Steering Committee for National Planning for Oral Health (August 2001) *Oral Health of Australians – Final Report,* available at http://www.arcpoh.adelaide.edu.au/publications/report/miscellaneous/pdf_files/oral_health_of_Australians_cover.pdf , last accessed 9.12.11

Australian Hearing 'Otitis Media' accessed online: http://www.hearing.com.au/digitalAssets/4735_1174000900894_Otitis%20media.pdf, last accessed 7.12.11

Australian Institute of Health and Welfare (2009) *Chronic disease and participation in work*, available at http://www.aihw.gov.au/publication-detail/?id=6442468211&tab=2 last accessed 10 October 2011.

Australian Institute of Health and Welfare, Dental Statistics and Research Unit: Jamieson LM, Armfield JM & Roberts-Thomson KF 2007. *Oral health of Aboriginal and Torres Strait Islander children,* AIHW cat. no. DEN 167. Canberra: Australian Institute of Health and Welfare (Dental Statistics and Research Series No. 35)

Bailie, R., Si, D., Dowden, M., O'Donoghue, L., Conners, C., Robinson, G., Cunningham, J. & Weeramanthri, T. (2007) Improving organisation systems for diabetes care in Australian Indigenous communities, *BMC Health Services Research*,

Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, 2007. The burden of disease and injury in Australia 2003. PHE 82. Canberra: AIHW.

Butler L and Biglia, B (2001) Analysing the journal output of NHMRC research grants schemes: March 2001, *National Health and Medical Research Council*, March, http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/r21.pdf, accessed 23 August 2011.

Butler, L (2003) NHMRC supported research: the impact of journal publication output 1996–2000, *National Health and Medical Research Council*, October, http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/butler03.pdf, accessed 23 August 2011.

Butler, L and Henadeera, K (2009) Measuring up 2009. NHMRC – Supported research: The impact of journal publication output 2002–2006, *National Health and Medical Research Council*, February, http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/nh125_bibliometricsreport_2002_2006.pdf, accessed 23 August 2011.

Butler, L, Biglia, B and Henadeera, K (2005) NHMRC supported research: the impact of journal publication output 1999–2003, *National Health and Medical Research Council*, December, http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/nh75.pdf, accessed 23 August 2011.

Carapetis, J. (2004) *A review of WHO activities in, the burden of, and the evidence for strategies to control group A streptococcal diseases: summary and recommendations,* Centre for International Child Health, University of Melbourne

Carapetis, J.R (2009) ' A Regional Initiative to Reduce Skin Infections amongst Aboriginal Children Living in Remote Communities of the Northern Territory, Australia', *PLOS Neglected Tropical Diseases',* 3(11)

Carapetis, J.R. *Rheumatic Heart Disease in Developing Countries*, N Engl J Med 2007; 357:439-441, August, 2007

Central Australian Rural Practitioners Association (2003) CARPA standard treatment manual, 4th Ed, Alice Springs: Central Australian Rural Practitioners Association

Central Australian Rural Practitioners Association (2003) CARPA standard treatment manual, 4th Ed, Alice Springs: Central Australian Rural Practitioners Association

Cheng, A., Hanna, J., Norton, R., Hills, S., Davis, J., Krause, V., Dowse, G., Inglis, T., & Currie, B.J., 2003. Melioidosis in northern Australia, 2001-02, *Communicable Disease Intelligence*, 27, no. 2.

Cheng, A., Stephens, D.P., Anstey, N.M., & Currie, B.J., 2004. Adjunctive granulocyte colony-stimulating factor for treatment of septic shock due to melioidosis. *Clinical Infectious Diseases*,

Clinuity 2011, What is the probability of success of clinical trials?, available at http://clinuity.com/blog/2011/02/what-is-the-probability-of-success-of-clinical-trials/ last accessed 2 November 2011.

Clucas,D.B., Carville, K.S., Connors, C., Currie, B.J, Carapetis, J.R., Andrews, R.M., (2008), Disease burden and health-care clinic attendances for young children in remote Aboriginal communities of northern Australia', *Bulletin of the World Helath Organisation,* 86(4)

Clucas,D.B., Carville, K.S., Connors, C., Currie, B.J, Carapetis, J.R., Andrews, R.M., (2008), Disease burden and health-care clinic attendances for young children in remote Aboriginal communities of northern Australia', *Bulletin of the World Helath Organisation,* 86(4); Andrews, R.M.; Kearns, T; Connors, C; Parker, C; Carville, K.; Currie, B.J.

Cooperative Research Centre for Aboriginal Health, Rheumatic heart disease backgrounder, available at http://www.lowitja.org.au last accessed 2 November 2011.

Council of Australian Governments (2008) *National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes,* p.4

Currie BJ, Fisher DA, Howard DM, Burrow JN, Selvanayagam S, Snelling PL, Anstey NM, Mayo MJ. *The epidemiology of melioidosis in Australia and Papua New Guinea*, Acta Trop. 2000 Feb 5;74(2-3):121-7.

Currie BJ, Ward L, Cheng AC (2010) The Epidemiology and Clinical Spectrum of Melioidosis: 540 Cases from the 20 Year Darwin Prospective Study. PLoS Negl Trop Dis 4(11): e900. doi:10.1371/journal.pntd.0000900, p.1

Department of Finance and Deregulation (2008) *Best Practice regulation Guidance Note: Value of Statistical Life*, November 2008.

Department of Health and Ageing (2010) 'Closing the Gap: Tackling Chronic Disease', accessed online: http://www.health.gov.au/internet/main/publishing.nsf/Content/closinggap-tacklingchronicdisease, last accessed 6.12.12

Hagusian RA, Purba LH, Kenangalem E, Wuwung M, Maristela R, Rumaseuw R, Laihad F, Ebsworth P, Anstey NM, Tjitra E, Price RN. Dihydroartemisinin-piperaquine versus artesunate-amodiaquine for multi-drug resistant P. falciparum and P. vivax in Papua, Indonesia. *Clin Infect Dis* 2007; 44:1067-74.

Hatfield M, Sonnenschein H, Rosenberg L (2000) *Exceptional Returns: The Economic Return to Health Expenditure*, Funding First, New York www.laskerfoundation.org/reports/pdf/exceptional.pdf

Hay, E. 2007, *Neonatal Formulary: Drug use in pregnancy and the first year of life*, Blackwell Publishing.

Hay, R., Bendeck, S.E., Chen, S., Estrada, R., Haddix, A, McLeod, T. And Mahe, A. (2006) 'Skin Diseases', in 'Disease Control Priorities in Developing Countries', 2nd Ed., Work Bank

International Education, *Menzies School of Health Research Australia*, available at http://www.australiangraduate.com/study/Menzies.htm, last accessed 6th October 2011.

Li SQ, Pircher SLM, Guthridge SL, Condon JR. *Hospital Admissions in the Northern Territory 1976 to 2008*. Northern Territory Government, Department of Health, Darwin, 2011

Maple-Brown L., Cunningham J., Dunne K., Whitbread C., Howard D., Weeramanthri T., Tatipata S., (...), Shaw J.E. (2008) Complications of diabetes in urban Indigenous Australians: The DRUID study, *Diabetes Research and Clinical Practice*, 80 (3), pp. 455-462

Menzies School of Health and Research (2011) 'About Us', accessed online: http://www.menzies.edu.au/about-us, last accessed 9.12.11

Menzies School of Health Research (2009) *Report to Quinquennial Review Panel – 30 March – 3 April 2009,* p.101-102

Menzies school of health research 'Response to terms of reference, Senate Community Affairs Reference Committee, Inquiry into Hearing Health in Australia', accessed online: http://www.aph.gov.au/senate/committee/clac_ctte/hearing_health/submissions/sub174.pdf, last accessed 7.12.11

Menzies School of Health Research and Charles Darwin University, *Annual Report 2010 – Menzies School of Health Research*, available at http://www.menzies.edu.au/sites/menzies.edu.au/files/file/communications/2010_Menzies%20School%20of%20Health_Annual_Report.pdf, last accessed 29th September 2011, p.4

Mindframe (2008) ' Facts and Statistics on suicide and mental illness', accessed online: http://www.mindframe-media.info/site/index.cfm?display=84362, last accessed 6.12.11

National Advisory Committee on Oral Health (2004) *Healthy mouths healthy lives : Australia's national oral health plan 2004-2013*, p.5

Northern Territory Government Department of Health and Families (December 2009) *Melioidosis,* available at http://www.healthylivingnt.org.au/content/?action=getfile&id=705 last accessed 2 November 2011.

Northern Territory Treasury, *Territory Economic Review – September 2011,* available at http://www.nt.gov.au/ntt/economics/publications/ter/ter_sept_11.pdf, last accessed 6th October 2011, p.7

Poespoprodjo JR, Fobia W, Kenangalem E, Hasanuddin A, Sugiarto P, Tjitra E, Anstey NM, Price RN. Highly effective therapy for maternal malaria associated with a lower risk of vertical transmission. *J Infect Dis* 2011: in press

Pollitt, A, Wooding, S, Hanney, S, Buxton, M and Grant, J (2011) Project retrosight: understanding the returns from cardiovascular and stroke research, methodology report, *RAND Corporation Europe,* http://www.rand.org/content/dam/rand/pubs/technical_reports/2011/RAND_TR925.pdf, accessed 30 August 2011.

Professor O'Dea, "Report from the Menzies School of Health Research, Darwin", in *The Sir Robert Menzies Foundation Limited,* p.7 available at http://menziesfoundation.org.au/annualreports/2003/Pages%207-11%20ARpt%202003.pdf last accessed 6th October 2011.

Queensland Government (2010) *Topic: Melioidosis*, available at http://access.health.qld.gov.au/hid/InfectionsandParasites/BacterialInfections/melioidosis_is.asp, last accessed 2 November 2011.

Rheumatic Heart Disease Australia, *Health Professionals*, available at http://www.rhdaustralia.org.au/health-professionals, last accessed 2 November 2011

SCRGSP (Steering Committee for the Review of Government Service Provision) 2011, *Overcoming Indigenous Disadvantage: Key Indicators 2011*, Productivity Commission, Canberra

Slade et al (2010) 'Effect of health proportion and fluoride varnish on dental caries among Australian Aboriginal children: results from a community-randomized controlled trial', *Community Dentistry and Oral Epidemiology*

The SEAQUAMAT Trial Group. Artesunate versus quinine for treatment of severe falciparum malaria: a randomised trial. *Lancet* 2005; 366: 717-725.

UKPDS Group (1998) Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33), *Lancet*, 352(9131): 837-53.

World Health Organisation (2005) 'The Current Evidence for the Burden of Group A Streptococcal Diseases', *accessed* online: http://whqlibdoc.who.int/hq/2005/WHO_FCH_CAH_05.07.pdf, last accessed 5.12.11

World Health Organisation (2010), *Global Malaria Treatment Guidelines: Second Edition*, available at http://whqlibdoc.who.int/publications/2010/9789241547925_eng.pdf last accessed 2 November 2011

World Health Organisation (2011), *Malaria – Fact Sheet No 94 – October 2011,* available at http://www.who.int/mediacentre/factsheets/fs094/en/index.html last accessed 2nd November 2011.

World Health Organisation (2011), *Malaria: Disease Burden in SEA Region*, available at http://www.searo.who.int/en/Section10/Section21/Section340_4018.htm last accessed 1 November 2011.

World Health Organisation (2011), *World Health Statistics*, available at http://www.who.int/whosis/whostat/EN_WHS2011_Full.pdf last accessed 2 November 2011.

World Health Organisation (2011), *World Malaria Report 2010*, available at http://www.who.int/malaria/world_malaria_report_2010/worldmalariareport2010.pdf last accessed 2 November 2011.

World Health Organisation and Ciba and Foundation (1998) *Prevention of hearing impairments from chronic otitis media*, accessed online: http://www.who.int/pbd/deafness/en/chronic_otitis_media.pdf, last accessed 7.12.11

Limitation of our work

General use restriction

This report is prepared solely for the use of Menzies School of Health Research. This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. The report has been prepared for the purpose of analysing and documenting the economic and social contribution of Menzies School of Health Research to the Northern Territory, Australia and the Asia Pacific. You should not refer to or use our name or the advice for any other purpose.

Contact us

Deloitte Access Economics
ACN: 49 633 116

Level 1
9 Sydney Avenue
Barton ACT 2600
PO Box 6334
Kingston ACT 2604 Australia

Tel: +61 2 6175 2000
Fax: +61 2 6175 2001

www.deloitte.com/au/economics

Deloitte Access Economics is Australia's pre-eminent economics advisory practice and a member of Deloitte's global economics group. The Directors and staff of Access Economics joined Deloitte in early 2011.

About Deloitte

Deloitte provides audit, tax, consulting, and financial advisory services to public and private clients spanning multiple industries. With a globally connected network of member firms in more than 150 countries, Deloitte brings world-class capabilities and deep local expertise to help clients succeed wherever they operate. Deloitte's approximately 170,000 professionals are committed to becoming the standard of excellence.

About Deloitte Australia

In Australia, the member firm is the Australian partnership of Deloitte Touche Tohmatsu. As one of Australia's leading professional services firms. Deloitte Touche Tohmatsu and its affiliates provide audit, tax, consulting, and financial advisory services through approximately 5,400 people across the country. Focused on the creation of value and growth, and known as an employer of choice for innovative human resources programs, we are dedicated to helping our clients and our people excel. For more information, please visit our web site at www.deloitte.com.au.