The State of Cancer Control in Australia 1987-2007:
Changes in cancer incidence and mortality
Cancer Council NSW
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Abbreviations

APC          Annual percentage change
AAPC         Average annual percentage change
ABS          Australian Bureau of Statistics
AHMAC        Australian Health Ministers Advisory Council
AIHW         Australian Institute of Health and Welfare
BMI          Body mass index
DoHA         Australian Government Department of Health and Ageing
DRE          Digital rectal examination
EPIC         European Prospective Investigation into Cancer and Nutrition
FOBT         Faecal occult blood test
HIV - 1      Human immunodeficiency virus 1
HPV          Human papillomavirus
HRT          Hormone replacement therapy
HWA          Health Workforce Australia
IARC         International Agency for Research on Cancer
MBS          Medicare Benefits Scheme
NCD          Non-communicable diseases
NGO          Non-government organisation
NHMRC        National Health and Medical Research Council
NHRA         National Health Reform Agreement

NPAPH        National Partnership Agreement on Preventive Health
NPHP         National Public Health Partnership
NSIF         National Service Improvement Framework
NSW          New South Wales
PBS          Pharmaceutical Benefits Scheme
PSA          Prostate-specific antigen
RFA          Radiofrequency ablation
SES          Socioeconomic status
UICC         Union for International Cancer Control
UK           United Kingdom
USA          United States of America
WHO          World Health Organization
Cancer is currently the largest disease burden in Australia and is growing in incidence, primarily due to an ageing population.\textsuperscript{1-3} The aim of this report is to quantify the changes in cancer incidence and mortality from 1987 to 2007, thus providing a simple summary of the progress over two decades. Additionally, we document some past and present public health policies and programs that have influenced cancer control in Australia, to begin understanding their impact on cancer incidence and mortality. Cancer control refers to any population-based initiative aimed at reducing incidence and mortality and improving the quality of life of cancer sufferers and their carers.\textsuperscript{4} This can include prevention, screening, diagnosis, treatment and palliative care.\textsuperscript{4} For the purpose of this report, we focus predominantly on prevention, screening and diagnosis changes, while acknowledging major breakthroughs and/or future areas for discovery in treatment.

The first section of the report outlines our findings in comparing cancer incident cases and deaths observed in 2007 to those expected in 2007 based on 1987 rates. We took the view that the late 1980s were an appropriate period to benchmark comparisons, as a number of cancer control programs increased in intensity after then. This report compiles information on changes in cancer incident cases and deaths to contrast two time periods over which many changes in cancer control were implemented. These simple statistics, coupled with information on the current political landscape, will enable researchers, advocates and the broader community to identify areas for improvement and where progress has been made, as well as outlets for advocacy in an effort to affect change and to fit calls to action within the broader health care landscape.

In the second section, the changes are put into context for eight specific cancer sites that are amenable to cancer control discovery, evidence and interventions that may affect cancer incidence and mortality – breast, cervical, colorectal, liver, lung, melanoma, prostate and stomach cancers. These have been selected based on a consolidated list of the top five cancer sites for males and females in incidence and mortality according to the International Agency for Research on Cancer (IARC) GLOBOCAN 2008 working estimates, and cancers of significant importance in Australia.\textsuperscript{5, 6} Finally, the third section of the report highlights the approach to cancer control recommended globally, and presents the major issues relating to health care and cancer control in Australia. In doing this, the political decision-making environment in Australia – illustrating how cancer control programs are planned, implemented and evaluated – is broadly outlined.
2 Report Overview

References


3.1 Background

In 2008, an estimated 12.4 million new cases and 7.6 million deaths were attributed to cancer worldwide. Cancer is currently the largest disease burden in Australia and is growing in incidence, primarily due to an ageing population. With a population of 22.6 million, Australia has one of the highest incidence rates of all cancers globally, with an age standardised incidence rate of 314/100,000 and an age-standardised mortality rate of 103/100,000 for all people of all ages. The high ranking of Australia’s cancer incidence compared to other countries may give the impression that local cancer control programs are failing.

The Australian Institute of Health and Welfare (AIHW) publishes reports on cancer in Australia to allow for comparisons of cancer-related information and indicators. This is an important initiative, which provides annual tabulated figures on incidence and mortality. The AIHW has also recently provided projections of cancer incidence to 2020, and a summary of survival and prevalence statistics for all cancer types up to 2010. Rather than reviewing trends and projections across all ages, aptly done by AIHW, we focus on changes between 2 time periods in those under 75 years of age, as intervention programs need significant time to build coverage and effectiveness, and to show an impact on mortality and incidence. The AIHW’s year-by-year trends illustrate gradual changes in incidence and mortality. In this report, we analyse the change over a 20-year period to provide greater contrast between 2 time periods (1987 and 2007). Assessing change using key indicators aids the planning for cancer control initiatives and future evaluations of effectiveness.

3.2 Aims

The aims of this report are to:

1. Provide simple summary measures of changes in cancer deaths and incident cases for individuals under 75 years in Australia by comparing expected and observed figures for 2007, using 1987 as the baseline
2. Analyse in greater detail eight specific cancer sites that are important in Australia, either because of their public health programs and/or high or changing incidence or mortality changes, to highlight how policy, programs or other changes may have affected these measures
3. Provide key information on past and current cancer control programs and approaches, and map the relevant policies and programs in Australia.
Eight specific cancer sites were chosen for more detailed analysis, based on a consolidated list of the top five cancer sites for males and females in incidence and mortality according to IARC GLOBOCAN 2008 working estimates and/or the existing public health programs in Australia.\textsuperscript{5, 6}

3.4.1 Breast cancer

Breast cancer is the most common cancer found in females globally. Non-modifiable risk factors for breast cancer include being female, age, hormonal and reproductive circumstances, family history and breast density.\textsuperscript{7, 18-20} Risk of disease is influenced by body weight and physical activity.\textsuperscript{18} Proven exogenous causes of breast are restricted to ionising radiation, alcohol consumption and pharmacological steroids through hormone replacement therapy (HRT).\textsuperscript{21, 22} Our analysis shows that breast cancer mortality has reduced from the expected numbers by 31\%, while incidence has risen by 34\%. Both were statistically significant changes. The former is largely attributed to the national screening program (BreastScreen), improved management of breast cancer, and reduced population risk through changing behaviour.\textsuperscript{23-25} BreastScreen is part of the Australian Government’s cancer-prevention strategy and developed nationally but managed at a state/territory level. Its evaluation suggested that improved national policy leadership was required to facilitate the availability of an equitable service across the nation.\textsuperscript{26}

3.4.2 Cervical cancer

Cervical cancer is the third most common cancer in females worldwide\textsuperscript{6} and is caused by persistent infection of human papillomavirus (HPV), making it preventable. It has high survival rates if diagnosed early.\textsuperscript{7} Risk factors include parity and low socioeconomic status (SES). Proven exogenous causes include smoking, oral contraceptive use and human immunodeficiency virus 1 (HIV-1)/immune suppression. Co-infection with other sexually transmitted diseases such as Chlamydia trachomatis or herpes simplex virus 2 is highly correlated with HPV infection.\textsuperscript{7, 20} Our analysis shows that cervical cancer incidence and mortality both decreased by 52\% and 62\% respectively, both statistically significant. Much of this improvement is attributed to the national screening program. These findings do not include the time period when the National HPV Vaccination Program was in place.
3.4.3 Colorectal cancer
Colorectal cancer is the third most common cancer in males and the second most common in females. The most prominent non-modifiable risk factor for colorectal cancer is age, with over 90% of cases being diagnosed in people over 50 years of age. Another established non-modifiable risk is adult-attained height. A personal or family history of colorectal cancer, polyps and specific inherited genetic conditions (eg familial adenomatous polyposis and hereditary nonpolyposis colorectal cancer), or a personal history of inflammatory bowel disease significantly increase the likelihood of colorectal cancer. Consumption of processed meat, and to a lesser extent, red meat, is established as increasing risk of colorectal cancer; and obesity increases risk, whilst physical activity decreases risk. Colorectal cancer had a small overall change in incidence (2%). In contrast, there was a statistically significant overall decline of 47% in mortality, being slightly higher for females (50% decline). Reduced mortality is probably due to improved treatment technology and better adherence to national management and treatment guidelines. Early detection may also have had an impact, although there was no organised screening during the time period analysed, apart from the dissemination of faecal occult blood test (FOBT) kits to a limited age group from late 2006. The greatest future reductions in colorectal cancer mortality across the whole population are expected to be gained from population-wide screening. Attaining sufficient coverage of screening is, however, an ongoing challenge in countries that have tried to implement such programs.

3.4.4 Liver cancer
Liver cancer is the fifth most common cancer in males and the seventh most common in females. Worldwide, 70–80% of all liver cancers are associated with chronic hepatitis viruses B and C infection or liver cirrhosis. Smoking and alcohol consumption increase risk of liver cancer. Survival from liver cancer is low and, as a result, it is the third most common cause of death globally. Liver cancer increased in both incidence and mortality over two decades, both being statistically significant changes. Overall, there has been a 70% rise in mortality, which was slightly higher in males than females. Incidence increased by 132%. The substantial burden of undiagnosed chronic hepatitis B infections in some Asian-born Australians, coupled with the natural history of chronic hepatitis B infection in populations where the infection is acquired early in life, contribute to about half of the increasing mortality and incidence in Australia. From 1988, the Australian Government began integrating the hepatitis B vaccination into the National Immunisation Program. Additionally, public health campaigns to curb excessive alcohol consumption may contribute to disease prevention.

3.4.5 Lung cancer
Lung cancer is the leading cause of cancer-related death worldwide, resulting in 1.38 million deaths in 2008. The predominant cause of lung cancer, worldwide and in Australia, is tobacco smoking. Other causes include passive smoking, certain occupational exposures (including those involving asbestos and coal-based industry), pulmonary tuberculosis and atmospheric pollution. Lung cancer had a higher incidence in males; however, the percentage change showed a statistically significant decrease of 38%. Female incident cases have risen by 26%. Overall mortality has dropped by 34%, an encouraging, statistically significant fall. This is predominantly due to the 46% reduction in male mortality. There was a slight increase in mortality for females (7%), which was not statistically significant (based on linear trends). These changes can be largely explained by changes in long-term tobacco consumption. Despite the high burden associated with lung cancer, specific programs (such as organised screening programs for high-risk groups) are not present. The nature of the disease is such that smoking cessation or avoidance is the most fruitful way of addressing the problem, thus lung cancer is a primary focus in public health initiatives through tobacco control strategies. It is also important to note that lung cancer survival after diagnosis has not improved significantly over past decades.

3.4.6 Melanoma
Of the 160,000 new cases of melanoma each year worldwide, approximately 80% are in individuals from North America, Australia and New Zealand. The incidence of melanoma in Australia, and particularly in Queensland, is the highest recorded globally. The major cause of melanoma is ultraviolet radiation exposure resulting in direct cellular damage and modifications to immunologic function, especially in people who are fair skinned. Mortality associated with melanoma of the skin has decreased 11% from expected to observed deaths. Incidence, on the other hand, has increased by 17%, indicating that melanoma is still an ongoing concern. In the
1990s, broad-spectrum sunscreen, which filtered out both ultraviolet A and B radiation, became widely available and used in Australia. This may result in future reductions in incidence and mortality. Initiatives, especially through awareness programs, have successfully raised awareness and improved behaviours in Australia.

### 3.4.7 Prostate cancer

Prostate cancer is the most common cancer in males in Australia. There are no proven exogenous causes of prostate cancer. The incidence of prostate cancer has risen globally, whereas mortality has seen a lower rate of change overall. The only risk factors clearly associated with prostate cancer are advanced age and family history of the cancer. Our analysis shows that prostate cancer incidence has risen dramatically, by 276%. Mortality has declined by 27%. Both are statistically significant changes. As very few lifestyle or other risk factors have been identified for prostate cancer, it is likely that prostate-specific antigen (PSA) testing is largely responsible for the 276% increase in the number of cases diagnosed from this analysis. Pressure is mounting for governments to address prostate cancer screening more formally.

### 3.4.8 Stomach cancer

Stomach cancer is the fourth most common cancer globally, with an estimate of new cases just short of 1 million in 2008. Infection with Helicobacter pylori (H. pylori) can cause inflammation of the gastric mucosa and is the main risk factor of stomach cancer; however, only a small proportion of people with H. pylori will develop cancer. Excessive consumption of salted fish, pickled vegetables, cured meats and soy sauce is also associated with increasing risk. Additional lifestyle influences on stomach cancer include the consumption of alcohol and tobacco. Incidence and mortality have decreased in both males and females. There has been a 50% decrease in mortality and a 34% decrease in incidence, both of which are statistically significant. The observed falls in mortality and incidence reflect improvements in living standards from the 1920s, when the prevalence of H. pylori began to fall. Current public health initiatives run by the Australian Government aimed at reducing tobacco and alcohol consumption and promoting healthy eating practices, address many of the environmental factors that can increase the incidence of stomach cancer.

### 3.4.9 Australian approach to health care and cancer control

Cancer control policy in Australia, predominantly focused on primary and secondary prevention, has evolved over the last few decades. Beginning in the 1980s, cancer control has been incorporated into the national strategic direction as well as in specific public health campaigns. Currently, the range of public health and preventive services in Australia are coordinated and administered by intra- and intergovernmental agencies. The services that relate to cancer control are:

- Immunisation services and other communicable disease control
- Programs to reduce the use and harmful effects of tobacco and alcohol
- Prevention programs to reduce weight gain and to promote physical activity and healthy eating choices
- Programs to promote sun protection
- Environmental monitoring and control, including management of harmful chemicals
- Screening programs for breast, cervical and colorectal cancer.
3.5 Discussion

The two decades selected for analysis in this study coincide with the inception and launch of a number of programs and changes in treatment that either directly address the cancer burden or address modifiable risk factors. This analysis has shown that cancer-related deaths have reduced by 28% from the expected numbers, based on 1987 rates, to the observed numbers in 2007. Cancer incidence, however, has increased over the same period by 21%, predominantly due to the rise in incident cases of prostate cancer. The reduction in mortality can be partially explained by improvements in prevention programs, screening, diagnosis and treatment. Cancer control initiatives have played a critical role in reducing the burden of cancer through systematic changes and encouraging individual behavioural change. They will continue to be central to combating cancer. Having said that, there are factors that are still unknown which would have played a role in mortality reduction.

A large proportion of government investment is on cancer treatment. As the cost of treatment rises, there has been increasing attention on preventive health and screening both to address the disease earlier and reduce costs. Health care systems are challenged by the need to transition from a focus on acute service provision to community-based services. The capacity of the existing system will be placed under pressure through the resource and financial burden of new cancer cases as a result of the ageing population, increased detection, and improved survival requiring increased levels of care. With the majority of guidelines focusing on treatment and management restricted to patients under 75 years, reassessment of current protocols are needed to meet the needs of ageing populations.

Moving forward, further understanding the role of current and emerging potential carcinogens, and the integration of biomarker science to better detect exposures, pre-neoplastic conditions or populations at risk, are all areas of discovery that could pave the way for new prevention strategies or treatment techniques. This requires ongoing investment in sound research to support the evidence base for such initiatives. In order to take full advantage of empirical research, studies of basic science need to have a translational phase which makes them practically applicable to epidemiology, public health and clinical settings. Our findings illustrate that significant progress has been made over two decades. However, there are still a number of cancer types requiring greater focus. For example, cancers with unknown or predominantly unmodifiable risk factors currently have limited scope for prevention. Placing greater emphasis on these cancer sites to improve detection and treatment ought to be a growing priority in research and patient support.

3.6 Conclusion

A number of cancer control measures in Australia have contributed to reducing the number of cancer deaths, despite an overall increase in the number of cases diagnosed. However, cancers that require more emphasis in research, policy support and preventive health action are those with little or no improvement, and these are not always at the forefront of activities by lobby groups or of the cancer control agenda. Cancer control needs to be a collaborative effort in the broader community. Governments, researchers, NGOs and industry need to work together in creating a sound evidence base for cancer control. Local communities can also play an important role in advocating and demonstrating change in their social environments to support the implementation of initiatives. The current level of financial and resource commitment to cancer control needs to be maintained and increased, especially in high-need areas, such as improving screening participation in culturally diverse population groups that are at high risk of cancer. Cancer control will never be finished. It needs to be integrated into long-term health policy to result in long-term benefit for the community, to sustain and build on the improvements that have already been achieved.
3 Executive Summary

References


In 2008, an estimated 12.4 million new cases and 7.6 million deaths were attributed to cancer worldwide. Cancer is currently the largest disease burden in Australia. With a population of 22.6 million, Australia has one of the highest incidence rates of all cancers globally, with an age-standardised incidence rate of 314/100,000 and an age-standardised mortality rate of 103/100,000 for people of all ages. The high ranking of Australia’s cancer incidence compared to other countries can leave the impression that local cancer control programs are failing.

Cancer survival statistics published by the AIHW have shown an improvement over time (5-year relative survival improved from 41.3% to 58.4% in males and 53.2% to 64.1% in females over 2 time periods: 1982–1986 and 1998–2004). Although survival rates serve to indicate the potential burden on the health care system, they may not be as easy to interpret as changes in incidence and mortality. Incidence and mortality represent the pressing and emerging issues for public health concern and health care systems. Mortality statistics indicate the importance of a given illness relative to others, hence its extensive use in determining the cancer burden. Mortality is simple and unambiguous to interpret. Incidence data assist in determining where preventive actions are most useful and to reduce burden on health services.

The AIHW publishes reports on cancer in Australia to allow for comparisons of cancer-related information and indicators. This is an important initiative which provides national annual tabulated figures on incidence and mortality. The AIHW has also recently provided projections of cancer incidence to 2020, and a summary of survival and prevalence statistics for all cancer types up to 2010. Rather than reviewing trends and projections across all ages, aptly done by the AIHW, we focus on changes between 2 time periods in those under 75 years of age, as intervention programs need significant time to build coverage and effectiveness, and to show an impact on mortality and incidence. The AIHW’s year-by-year trends illustrate gradual changes in incidence and mortality. In this report, we analyse the change over a 20-year period to provide greater contrast between 2 time periods (1987 and 2007). Assessing change using key indicators aids the planning for cancer control initiatives and future evaluations of effectiveness.

Australian mortality data are regarded as accurate and complete, so we focused on mortality in the first instance, and then augmented this information with data on incidence, ie
newly diagnosed cases. For simplicity, we refer to diagnosed cases as incident cases, while acknowledging that changes in incidence may be caused by diagnoses being brought forward by improvements in screening and/or diagnostic methods, or increase artificially because of improvements in registration. Section 5 outlines the methods used.

The aims of this report are to:

1. Provide simple summary measures of changes in cancer deaths and incident cases for individuals under 75 years in Australia by comparing expected and observed figures for 2007, using 1987 as the baseline

2. Analyse in greater detail eight specific cancer sites that are important in Australia either because of their public health programs and/or high or changing incidence or mortality changes, to highlight how policy, programs or other changes may have affected these measures

3. Provide key information on past and current cancer control programs and approaches, and map the relevant policies and programs in Australia.

Considering that the intensity of cancer treatment is less uniform in older age groups, and that screening programs stop at about 70 years of age, restricting analyses to individuals aged under 75 more accurately reports premature deaths and incident cases relating to cancer. This cohort is more likely to receive intensive cancer treatment, and cancer control programs are generally targeted at this age range.\textsuperscript{60-71} Thus we conducted an analysis of incidence and mortality to assess the changes between 1987 and 2007 in individuals 74 years of age or younger in Australia.
4 Introduction

References

5.1 Incidence and mortality changes

This analysis compares the observed deaths and incident profile of recorded cases in Australia in 2007 to the expected numbers using 1987 rates as a baseline. The annual numbers of deaths from 1986 to 2008 for each major cancer type, by age group and sex, were obtained from the Australian Bureau of Statistics (ABS). Age groups were 0–14 years, 15–34 years and 5-year age groups from 35 to 74 years for all cancer sites, with the exception of Hodgkin lymphoma (where the groups were 0–14 years, 15–49 years, 50–64 years and 65–74 years).

Where a death count was from 1 to 4 for a given age, sex, cancer site and year, the ABS did not publish the counts for 2 age groups within that cancer site, sex and year. The total number of deaths for those 2 cells was known (the difference between the total number of deaths for that cancer site, sex and year for all ages and the sum of the published counts for the other age groups). Also known was the expected ratio of deaths for those 2 age groups from unpublished data, obtained by averaging the surrounding 4 years of data for each age group for that sex and cancer site (eg an average ratio of 0.4 deaths in the 35–39 years age group to 0.6 deaths in the 45–49 years age group). Death counts were then assigned to the 2 unpublished cells as expected proportions of the known total number of deaths for those 2 cells.

Counts of incident cancer cases from 1986 to 2008, by sex and five-year age group, were obtained from the AIHW. Annual estimates of deaths of the Australian population, also by sex and five-year age group, were obtained from the ABS and used to estimate mortality and incidence rates. Age groups in the AIHW and ABS population data were collapsed to match the categories listed above.

The years of analysis were 1987 and 2007 and – to establish the average number of events for the single year – an additional year before and after was used. That is, the age- and sex-specific rates in 1987 and 2007 were estimated by averaging the observed rates from 1986 to 1988 and 2006 to 2008, respectively. These rates were applied to the 2007 population to calculate the expected and observed number of deaths and incident cases for 2007. These expected and observed numbers were then compared.
Joinpoint regression was used to test the statistical significance of the mortality and incidence changes over time, allowing annual data for this period to be used. Joinpoint regression summarises trends over successive segments of time. A series of joined linear segments is fitted to time series (e.g., annual rates). The connection of two segments is referred to as a ‘joinpoint’ and it represents a point in time where the rate of increase or decrease changed significantly. The annual percent change (APC) is calculated for each time segment. To obtain a single measure that was the same for all cancers from 1987 to 2007, we calculated the average annual percent change (AAPC), a weighted average of the APCs. Details of this methodology are outlined by Clegg et al.74

Annual age-standardised rates for each cancer site and all cancer sites combined were obtained by the method of direct standardisation. The standard population used was the 1997 Australian population under the age of 75, the mid-point of the time period analysed. The analysis covered the years from 1986 to 2008 for mortality and incidence. However, AAPCs were calculated for the period of interest, 1987 to 2007. Analyses were performed in R 2.15.116 and Joinpoint Regression Program 3.5.4.17

Models were fitted to the logarithms of annual age-standardised mortality and incidence rates; between 0 and 4 joinpoints were allowed; standard errors of the rates were inputted; and the permutation method was used to determine the optimal number of joinpoints. The regression mean functions for males and females were tested for parallelism.75

To ensure that disease groups were standard for the entire period of analysis, changes between ICD-9 and ICD-10§ in 1996/97 were accounted for with the use of appropriate bridging codes. Mesothelioma was excluded because the figures were too affected by the changes. A few cancer types (e.g., ‘head and neck’) were grouped differently by the ABS and the AIHW; these discrepancies are noted in the tabulations.

Firstly, the overall findings are presented in Section 6. The cancers with the greatest changes in mortality and incidence are examined. Secondly, eight specific cancer sites were chosen for more detailed analysis (Section 7). The chosen cancer sites – breast, cervical, colorectal, liver, lung, melanoma, prostate and stomach cancers – are amenable to cancer control discovery, evidence and interventions that may affect cancer incidence and mortality. These have been selected based on a combined list of the top five cancer sites for males and females in incidence and mortality according to the International Agency for Research on Cancer (IARC) GLOBOCAN 2008 working estimates, and cancers of significant importance in Australia.5, 6 The first four cancer sites have vaccination, immunisation or screening programs that are reflected in the changing data from 1987 to 2007. The other cancer sites are addressed through prevention strategies such as tobacco control policies and programs and public health campaigns attempting to curb alcohol consumption. Additionally, improvements in sanitation have been fundamental in reducing the burden of stomach cancer. Melanoma of the skin and prostate cancer have been added to the in-depth analysis. Globally, the highest incidence of melanoma of the skin is found in Australia and prostate cancer incidence is rising, making them both local public concerns.

5.2 National policy development

Following the analysis of change over time, we reviewed the national health policies relevant to cancer control and mapped their development over time, as a starting point for understanding the influence of change on cancer incidence and mortality. The aim was to document the relevant policies and programs used in Australia in an effort to uncover how priorities are set relating to cancer control, and how policies and programs could affect cancer.

A descriptive-analysis, narrative literature review of public documents and existing research was used to document the policy and public health campaigns relating to cancer control in Australia from the 1980s to current day. This included policies and associated agencies relating to known cancer risk factors, cancer screening programs and treatment or care strategies.

The framework to guide this review was divided into three stages. The first stage focused on the cancer control initiatives at a global level and looked at the overarching policies and recommendations released through international agencies, such as the World Health Organization (WHO) and the IARC, to form cancer control initiatives. This information was identified through publicly released reports, organisation websites and key publications in academic journals by representatives from relevant international agencies. The search was restricted to information from 1980 to the present day.

§ICD is the International Classification of Diseases established by WHO. It is the standard diagnostic tool used worldwide.
Secondly, government policies and intra- and intergovernmental programs in Australia relating to cancer control were identified, to track the evolution of cancer control over time. This was done predominantly by manually searching existing policies in hard copy or electronically, or records of programs and their evaluations, and backtracking to incorporate previous iterations of similar policies or programs. Once the policy and program names were determined, they were searched in Medline to identify any published reviews or critiques of cancer control in Australia. No date range was used to limit the search – in order to incorporate any possible evolution in cancer control activities.

Finally, Cancer Council Australia’s National Prevention Policy topics were used as the outline to identify and further explore specific cancer prevention programs and initiatives. This policy was used in the absence of a national framework from the Australian Government relating uniquely to cancer control. The focus on prevention in Cancer Council Australia’s policy omitted important issues relating to cancer care, medical discoveries and the monitoring of population trends. These issues were outlined in additional sections. In following these three stages, we assess public documentation and research to provide key information on past and current cancer control programs and approaches, and map the relevant policies and programs in Australia.

5 Methods

References


Table 6–1 and Table 6–2 show the number of deaths and incident cases observed in 2007 by cancer site, compared to those expected using the 1987 mortality profile, together with the AAPC changes estimated from the age-standardised mortality and incidence rates.

6.1 Incidence and mortality changes

Overall, 7,827 (-28%) fewer deaths occurred in 2007 than would have been expected based on 1987 rates (20,104 observed vs. 27,931 expected), and over the full period from 1987 to 2007, there were 61,190 fewer deaths than expected, had the death rate remained constant.

Improvements in mortality for five cancer types, namely lung, colorectal, breast, stomach, and head and neck, account for 74% of all the decrease in deaths (5,779 out of 7,827). The greatest reduction in deaths was for male lung cancer (2,259 fewer deaths, -46%), colorectal cancer (1,797 fewer deaths, -47%), female breast cancer (773 fewer deaths, -31%), stomach cancer (577 fewer deaths, -50%), and head and neck cancer (478 fewer deaths, -46%). Additionally, Hodgkin lymphoma (84 fewer deaths, -70%) and cervical cancer (242 fewer deaths, -62%) had high percentage falls in mortality. Mortality from prostate cancer fell by 27% during this period with 295 fewer deaths in 2007 than expected based on 1987 rates. The decline in mortality from melanoma was 11% (848 fewer deaths). In addition, over this period we observed a 43% fall in deaths from childhood cancers (87 observed vs. 151 expected). Only small changes have occurred in mortality for cancers of the pancreas (69 fewer deaths, -6%), brain and related (148 fewer deaths, -15%) and oesophagus (64 fewer deaths, -9%). No changes in mortality were observed for thyroid cancer (4 fewer deaths, -6%), but mortality from this condition has always been low.

Mortality has fallen for all cancers with a few exceptions. Deaths caused by lung cancer in females have increased, while the number of deaths in males has decreased, resulting in an overall decrease in lung cancer mortality (2,154 fewer deaths overall, -34%). This gender difference is statistically significant. Thyroid cancer in males has also shown a small (non-significant) increase. Liver and intrahepatic bile duct cancer in both males and females, and ‘other cancers’ in both males and females have increased (overall 304 more deaths, +15%). Liver cancer had the largest increase in mortality, increasing by
70% overall (267 more deaths). Figure 6–1 shows the age-standardised mortality rates for all Australians under the age of 75 from 1987 to 2007 for all cancers combined, and then individually for 8 common cancer sites in Australia. This illustrates the mortality trends for these cancers in this target group.

### 6.2 Changes in incident cases

In contrast to the decrease in observed deaths from cancer over this period, there was a 21% increase in the expected and observed number of incident cases, with 13,012 more cases observed in 2007 than would be expected based on 1987 rates. Prostate cancer had the largest increase, with 10,245 more cases recorded in 2007 than would be expected based on 1987 rates, an increase of 276%. Excluding prostate cancer, the cancer types with the highest absolute numbers of new incident cases are female breast (2,736, 34%), a sum of other minor cancer types (1,353, 18%), melanoma (1,138, 17%) and thyroid (1,107, 198%). Liver and kidney cancers also recorded a significantly higher number of cases in 2007 than would have been expected based on 1987 rates, with an additional 465 (132%) and 676 (55%) cases respectively. When separated by gender, female lung cancer incident cases have increased by 26% (468), whereas overall incident cases of lung cancer have decreased by 22% (1,705), and reported cases of melanoma in males have increased more than in females (26% vs. 6%) over this period – both of which are statistically significant changes.

Despite the overall increase in cancer incidence, fewer cases were recorded in 2007 for several cancer types than would have been expected based on 1987 incidence rates. Cancer types with the largest reductions in incidence

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**Figure 6–1**

Age-standardised cancer mortality rates in Australia 1987-2007, 0-74 years
include cervical cancer (690 fewer cases than expected, a reduction of 52%), bladder cancer (1,110 fewer cases, 51%), cancer of unknown primary (904 fewer cases, 41%), stomach cancer (578 fewer cases, 34%), head and neck cancers (562 fewer cases, 27%) and lung cancer (1,705 fewer cases, 22%). There were few other cancer types with lower incidence in 2007 than in 1987. Incidence of oesophageal cancer in females showed a statistically significant reduction of 32% (74 fewer cases).

Figure 6–2 shows the age-standardised incidence rates for all Australians under the age of 75 from 1987 to 2007 for all cancers combined and then individually for 8 common cancer sites in Australia. This illustrates the incidence trends for these cancers in this target group.

6.3 Overall changes

The percentage changes for mortality and incident cases for males (Figure 6–3), females (Figure 6–4) and both males and females (Figure 6–5) highlight the areas of greatest change. After comparing the changes for mortality and incidence, the cancer sites with greatest reductions for both genders and overall are stomach, head and neck, cancer of unknown primary, bladder, and brain and related. Only liver and intrahepatic bile duct cancer and other cancers showed increases in both incidence and mortality.
### Table 6–1
Mortality: number of observed deaths in Australia in 2007 compared to expected number of deaths based on 1987 rates

<table>
<thead>
<tr>
<th>Cancer type</th>
<th>Observed deaths in 2007 (O)</th>
<th>Expected deaths in 2007 (E)</th>
<th>Difference (O-E)</th>
<th>Change in deaths (%) (O-E)/E</th>
<th>Change in deaths (%) (O-E)/E (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Lung (C33-34)</td>
<td>2,668</td>
<td>1,555</td>
<td>4,223</td>
<td>-2,259</td>
<td>-3.0 (-3.3, -2.7)</td>
</tr>
<tr>
<td>Colorectal (C18-20)</td>
<td>1,197</td>
<td>791</td>
<td>1,988</td>
<td>-1,008</td>
<td>-2.9 (-3.3, -2.5)</td>
</tr>
<tr>
<td>Breast (female) (C50)</td>
<td>-</td>
<td>1,691</td>
<td>2,464</td>
<td>-873</td>
<td>-2.8 (-3.4, -2.1)</td>
</tr>
<tr>
<td>Stomach (C16)</td>
<td>368</td>
<td>203</td>
<td>572</td>
<td>-441</td>
<td>-3.8 (-4.5, -3.1)</td>
</tr>
<tr>
<td>Head and neck (C00-C14, C30-C32)</td>
<td>450</td>
<td>109</td>
<td>560</td>
<td>-393</td>
<td>-3.0 (-3.5, -2.4)</td>
</tr>
<tr>
<td>Unknown primary (C77-C80)</td>
<td>594</td>
<td>422</td>
<td>1,017</td>
<td>-297</td>
<td>-2.9 (-3.3, -2.6)</td>
</tr>
<tr>
<td>Prostate (C61)</td>
<td>799</td>
<td>799</td>
<td>1,094</td>
<td>-295</td>
<td>-3.0 (-3.3, -2.7)</td>
</tr>
<tr>
<td>Cervix uteri (C53)</td>
<td>394</td>
<td>220</td>
<td>614</td>
<td>-110</td>
<td>-1.8 (-2.1, -1.5)</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma (C82-C85)</td>
<td>218</td>
<td>68</td>
<td>286</td>
<td>-182</td>
<td>-2.3 (-2.8, -1.8)</td>
</tr>
<tr>
<td>Bladder (C67)</td>
<td>299</td>
<td>139</td>
<td>438</td>
<td>-103</td>
<td>-1.9 (-2.4, -1.4)</td>
</tr>
<tr>
<td>Kidney (C64)</td>
<td>487</td>
<td>487</td>
<td>974</td>
<td>-393</td>
<td>-2.1 (-2.6, -1.6)</td>
</tr>
<tr>
<td>Ovary (C56)</td>
<td>535</td>
<td>334</td>
<td>869</td>
<td>-203</td>
<td>-1.8 (-2.3, -1.3)</td>
</tr>
<tr>
<td>Brain and related (C69-C72)</td>
<td>275</td>
<td>174</td>
<td>450</td>
<td>-19</td>
<td>-1.3 (-1.8, -0.8)</td>
</tr>
<tr>
<td>Myeloid leukaemia (C92)</td>
<td>126</td>
<td>60</td>
<td>185</td>
<td>-58</td>
<td>-1.8 (-2.2, -1.4)</td>
</tr>
<tr>
<td>Melanoma (C43)</td>
<td>506</td>
<td>252</td>
<td>759</td>
<td>-50</td>
<td>-0.5 (-0.9, -0.1)</td>
</tr>
<tr>
<td>Lymphoid leukaemia (C91)</td>
<td>126</td>
<td>60</td>
<td>185</td>
<td>-55</td>
<td>-1.5 (-2.0, -1.0)</td>
</tr>
<tr>
<td>Hodgkin lymphoma (C81)</td>
<td>22</td>
<td>14</td>
<td>36</td>
<td>-71</td>
<td>-2.8 (-3.5, -2.1)</td>
</tr>
<tr>
<td>Pancreas (C25)</td>
<td>678</td>
<td>442</td>
<td>1,120</td>
<td>-20</td>
<td>-0.5 (-0.9, -0.1)</td>
</tr>
<tr>
<td>Oesophagus (C15)</td>
<td>506</td>
<td>112</td>
<td>618</td>
<td>2</td>
<td>0.1 (-0.4, 0.2)</td>
</tr>
<tr>
<td>Uterus (C54-C55)</td>
<td>176</td>
<td>176</td>
<td>176</td>
<td>2</td>
<td>0.1 (-0.4, 0.2)</td>
</tr>
<tr>
<td>Thyroid (C73)</td>
<td>26</td>
<td>37</td>
<td>63</td>
<td>3</td>
<td>0.1 (-0.3, 0.1)</td>
</tr>
<tr>
<td>Liver and intrahepatic bile ducts (C22)</td>
<td>26</td>
<td>37</td>
<td>63</td>
<td>3</td>
<td>0.1 (-0.3, 0.1)</td>
</tr>
<tr>
<td>Other cancers</td>
<td>1,410</td>
<td>951</td>
<td>2,361</td>
<td>123</td>
<td>0.6 (-0.3, 0.9)</td>
</tr>
<tr>
<td>All cancers (C00-C97, D45-D46, D47.1, D47.3)</td>
<td>11,535</td>
<td>8,569</td>
<td>20,104</td>
<td>5,031</td>
<td>-1.8 (-1.9, -1.6)</td>
</tr>
<tr>
<td>0-14 years (All cancers)</td>
<td>46</td>
<td>41</td>
<td>87</td>
<td>-40</td>
<td>-1.5 (-2.1, -1.0)</td>
</tr>
</tbody>
</table>

*T Trend is not statistically significant at the significance level of 0.05
** All figures have been rounded
* This change is the standardised ratio: (O/E)-1

November, 2013
## Table 6–2

**Incidence: number of observed new cases in Australia in 2007 compared to expected number of new cases based on 1987 rates**

<table>
<thead>
<tr>
<th>Cancer type†</th>
<th>Observed incidence in 2007 (O)</th>
<th>Expected incidence in 2007 (E)</th>
<th>Difference (O-E)</th>
<th>Change in incidence (%)</th>
<th>Annual average percentage change (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Persons</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Lung (C33-34)</td>
<td>3,612</td>
<td>2,302</td>
<td>5,915</td>
<td>5,786</td>
<td>1,834</td>
</tr>
<tr>
<td>Colorectal (C18-20)</td>
<td>5,121</td>
<td>3,653</td>
<td>8,774</td>
<td>4,921</td>
<td>3,680</td>
</tr>
<tr>
<td>Breast (female) (C50)</td>
<td>-</td>
<td>10,681</td>
<td>10,681</td>
<td>-</td>
<td>7,945</td>
</tr>
<tr>
<td>Stomach (C16)</td>
<td>765</td>
<td>365</td>
<td>1,131</td>
<td>1,201</td>
<td>508</td>
</tr>
<tr>
<td>Head and neck (C00-C02, C32)§</td>
<td>1,209</td>
<td>307</td>
<td>1,517</td>
<td>1,735</td>
<td>344</td>
</tr>
<tr>
<td>Unknown primary (C77-C80)</td>
<td>748</td>
<td>532</td>
<td>1,281</td>
<td>1,303</td>
<td>882</td>
</tr>
<tr>
<td>Prostate (C61)</td>
<td>13,961</td>
<td>-</td>
<td>13,961</td>
<td>3,716</td>
<td>-</td>
</tr>
<tr>
<td>Cervix uteri (C53)</td>
<td>-</td>
<td>649</td>
<td>649</td>
<td>-</td>
<td>1,339</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma (C82-C85)</td>
<td>1,617</td>
<td>1,168</td>
<td>2,785</td>
<td>1,253</td>
<td>948</td>
</tr>
<tr>
<td>Bladder (C67)</td>
<td>844</td>
<td>218</td>
<td>1,062</td>
<td>1,633</td>
<td>539</td>
</tr>
<tr>
<td>Kidney (C64)</td>
<td>1,285</td>
<td>620</td>
<td>1,904</td>
<td>579</td>
<td>122</td>
</tr>
<tr>
<td>Ovary (C56)</td>
<td>-</td>
<td>910</td>
<td>910</td>
<td>-</td>
<td>-1,077</td>
</tr>
<tr>
<td>Brain and related (C71)‡</td>
<td>704</td>
<td>459</td>
<td>1,162</td>
<td>739</td>
<td>490</td>
</tr>
<tr>
<td>Melanoma (C43)</td>
<td>4,569</td>
<td>3,446</td>
<td>8,015</td>
<td>3,635</td>
<td>3,242</td>
</tr>
<tr>
<td>Hodgkin lymphoma (C81)</td>
<td>267</td>
<td>213</td>
<td>479</td>
<td>226</td>
<td>157</td>
</tr>
<tr>
<td>Pancreas (C25)</td>
<td>781</td>
<td>527</td>
<td>1,308</td>
<td>730</td>
<td>540</td>
</tr>
<tr>
<td>Oesophagus (C15)</td>
<td>573</td>
<td>161</td>
<td>734</td>
<td>524</td>
<td>235</td>
</tr>
<tr>
<td>Uterus (C54-C55)</td>
<td>-</td>
<td>1,521</td>
<td>1,521</td>
<td>-</td>
<td>-1,311</td>
</tr>
<tr>
<td>Thyroid (C73)</td>
<td>408</td>
<td>1,258</td>
<td>1,666</td>
<td>147</td>
<td>412</td>
</tr>
<tr>
<td>Liver and intrahepatic bile ducts (C22)</td>
<td>622</td>
<td>194</td>
<td>816</td>
<td>264</td>
<td>87</td>
</tr>
<tr>
<td>Other cancers</td>
<td>5,611</td>
<td>3,371</td>
<td>8,982</td>
<td>4,899</td>
<td>2,729</td>
</tr>
<tr>
<td>All cancers (C00-C97, D45-D46, D47.1, D47.3)</td>
<td>42,698</td>
<td>32,554</td>
<td>75,252</td>
<td>33,502</td>
<td>26,738</td>
</tr>
<tr>
<td>0-14 years (All cancers)</td>
<td>321</td>
<td>271</td>
<td>592</td>
<td>294</td>
<td>245</td>
</tr>
</tbody>
</table>

* Trend is not statistically significant at the significance level of 0.05
† All figures have been rounded
‡ Leukaemias not available for full time period.
§ Head and neck not available. Incidence data on lip, tongue and pharyngeal
a This change is the standardised ratio: (O/E)-1

**Cancer Council NSW**
Figure 6–3
Change in cancer incident cases and mortality in Australia from 1987–2007 – MALES
Figure 6–4
Change in cancer incident cases and mortality in Australia from 1987–2007 – FEMALES
Figure 6–5
Change in cancer incident cases and mortality in Australia from 1987–2007 – PERSONS

Percentage change 1987–2007
100 x (O-E)/E

Incident cases (%)
Mortality (%)

- All cancers
- 0-14 years (all cancers)
- Hodgkin lymphoma
- Cervix
- Stomach
- Colorectal
- Head and neck
- Bladder
- Kidney
- Lung
- Breast (female)
- Unknown primary
- Ovary
- Non-Hodgkin lymphoma
- Prostate
- Uterus
- Brain and related
- Melanoma
- Oesophagus
- Thyroid
- Pancreas
- Other cancers
- Liver
In this section, eight cancer types are outlined briefly as a way of contextualising the analysis and highlighting cancer types that are important in Australia – either because of their public health programs or because of large incidence or mortality percentage changes – to illustrate how policy, programs or other changes may have affected these measures. These have been selected based on a combined list of the top five cancer sites for males and females in incidence and mortality according to IARC GLOBOCAN 2008 working estimates, and cancer types of national importance in Australia.5

Firstly, trends in incidence and mortality for the cancer type are described – including data from the IARC GLOBOCAN project to illustrate global incidence and mortality working estimates for 2008 in individuals aged 74 years and under. Additionally, the most current survival data available for Australia from the AIHW are also provided.3 The AIHW survival data are presented to provide context rather than to facilitate a comparison between survival trends and our findings. However, the AIHW data were only available for all ages combined. The relative survival and five-year conditional relative survival data reported by the AIHW show the probability of surviving a given number of years, provided that an individual has already survived a specific amount of time after diagnosis.3

A brief overview of current prevention strategies, screening programs and treatment methods in use globally and in Australia are also provided. The results of our analysis for the specific cancer type are then presented and discussed.

References
7.1 Breast cancer (C50)

7.1.1 Background
Breast cancer is the most common cancer diagnosed in females globally. Males can also develop breast cancer but it is a rare condition, with less than 1% of breast cancer cases reported in males. IARC GLOBOCAN 2008 working estimates show that the incidence for breast cancer was 36.3/100,000 in females up to 74 years of age, with considerable variability by region. Incidence is much higher in Western Europe and Australia/New Zealand than in less developed regions such as Eastern Africa. Improved diagnosis and increased use of screening partially accounted for rising number of incident cases of breast cancer until a recent reversal of trends in Western countries, attributed to the reduced use of HRT. The mortality rate for breast cancer is 10.9/100,000 in females under 75 years of age and is decreasing globally. The incidence of breast cancer in Australia rose until the late 1990s but has recently levelled off, and has been decreasing since about 2000. Relative survival is high with an 89% probability of surviving for at least 5 years at diagnosis. The 5-year conditional relative survival was 90% at 1 year and 95% at 5 years after diagnosis. Survival rates, however, are negatively affected by remoteness and socioeconomic group, with more disadvantaged groups having lower survival.

7.1.1.1 Causes and risk factors
Having first-degree relatives with breast cancer doubles the relative risk, while having second-degree relatives with breast cancer increases risk to a lesser extent. Other non-modifiable risk factors for breast cancer include being female, age, breast density, and hormonal factors such as early menarche and late menopause. The risk of breast cancer is higher in females who have a high concentration of the endogenous hormone oestradiol. Multiple risk factors are associated with reproductive history (including low parity, lack of breast feeding and late age for first birth). Obesity is correlated with increased risk. Proven causative agents include alcohol consumption, certain oral contraceptive and HRT formulations, and ionising radiation.

Environmental and lifestyle factors account for more cases of breast cancer than familial history and inherited genetic characteristics. Childbearing is reported to have a protective effect; however, this effect has been isolated to particular age groups, with younger females who have ever given birth being at higher breast cancer risk.
An evaluation of existing evidence, led by the World Cancer Research Fund, has found:

- Convincing evidence for:
  - Lactation decreasing risk of breast cancer in pre- and postmenopausal women
  - Consuming alcoholic drinks increasing risk of breast cancer in pre- and postmenopausal women
  - Body fatness and factors leading to greater adult-attained height increasing risk of breast cancer in postmenopausal women

- Probably evidence for:
  - Body fatness decreasing risk of breast cancer in premenopausal women
  - Physical activity decreasing risk of breast cancer in postmenopausal women (evidence is only limited for premenopausal women)
  - Greater birth weight and factors leading to greater adult-attained height increasing risk of breast cancer in premenopausal women
  - Abdominal fatness and adult weight gain increasing risk of breast cancer in premenopausal women

No dietary factors apart from alcohol consumption have been consistently associated with risk of breast cancer. Despite earlier indications, consumption of fruit or vegetables is not established at the level of ‘limited–suggestive’ evidence as decreasing risk of breast cancer overall in premenopausal or postmenopausal females.

During menopause, limited or no use of HRT has been shown to reduce risk in comparison to continuous use. In an Australian study, a reduction in prescribing of HRT between 2001 and 2003 coincided with a fall in breast cancer incidence in females aged 50 and over. HRT users, depending on the type of treatment, have an elevated risk, which reduces when use is ceased.

Additional modifiable risk factors for all females include X- and y-radiation and alcohol consumption, with an estimated 12% of all breast cancer cases in females 18 and over attributable to alcohol consumption. Combined oestrogen and progestogen oral contraceptive use is also linked to slight increased risk of breast cancer.

The findings of a global collaboration found that risk was increased (1.07–1.24) in premenopausal females either currently using contraception or having ceased it within 10 years; however, there was no increase in risk 10 years after cessation. Similarly, a South African study found negligible risk in breast cancer patients 5 years after cessation.

There are a number of breast tumour subtypes that are associated with differing risk factors. Hormone receptor–positive tumours, in comparison to hormone receptor–negative tumours, have been more strongly associated with reproductive factors such as menarche at an early age, lack of childbearing, higher body mass index (BMI) in younger females and increased age at first full-term birth. Hormone receptor–negative tumour risk was inversely associated with vegetable consumption. Core basal phenotype breast cancer appears to have a different aetiology to other breast cancer types and consequently other risk factors. Importantly, this would suggest that certain breast cancer subtypes may, in future, require specialised risk models and specialised screening and prevention programs.

### 7.1.1.2 International prevention/screening/treatment programs

Some potential chemopreventive drugs have been identified for the prevention of breast cancer. Both tamoxifen and raloxifene reduce the risk of breast cancer, especially in high-risk females. However, further research is required to confirm the exact treatment effects and adverse outcomes. For example, tamoxifen has been convincingly identified as a cause of endometrial cancer, and its use in breast cancer treatment must incorporate additional risk to females.

Population-based screening programs for breast cancer have been established in many countries for females aged 50 years and over, and overall, showed a reduction in breast cancer mortality in past randomised controlled trials. National screening programs, however, have been clouded by conflicting expert opinion on their effectiveness. Some experts argue that screening plays an important role in identifying cancerous growths when they are small and more easily treated, leading to
earlier intervention and more successful treatment.20 Others claim that the benefit provided by screening is outweighed by overdiagnosis, a combination of diagnoses brought forward in detection time and asymptomatic cancers detected through screening.95 Generally, overdiagnosis is compensated for by the lack of screening in older age groups, but adequate follow-up is required for this to be reflected accurately in study results.95 Claims of overdiagnosis resulting from screening have stemmed from differing study methods used to assess its impact.90, 95 It has been suggested that the frequency of mammographies could be personalised for individuals based on risk factors, to reduce overdiagnosis and unnecessary screening.96

Reductions in mortality resulting from organised screening programs are similar to, but not greater than, those from past randomised controlled trials, suggesting that more time may be needed to identify any further trends of screening impact.97 Population studies are often used in national program assessment, which are an important starting point, but need to be supported by cohort or case-control studies based on individual data which is closer to the evaluation method used in the original randomised controlled trials.91 It may take many years before population data show a true change due to screening; and realising full implementation of a national program also requires time and relies on a larger number of professionals to deliver the service.90 This suggests that ecological studies††, although commonly used, are not always appropriate to assess results of screening programs.91

Taking this into account, reportedly two lives are saved for every case overdiagnosed in Europe.98 After adjusting for differing study methods, an approximate 26% reduction in mortality was found after 6–11 years of follow-up in a number of European studies.99 Advances in treatment explain a proportion of the fall in mortality rates, and further advances in technology will continue to change programs and affect incidence and mortality rates.90, 92-94, 100, 101

The Australian national screening program (BreastScreen) was initiated in 1991, and under this scheme, females are invited to participate in fully funded mammograms every two years (see section 8.3.5.8).1, 102 Recently, screening has been extended from females aged 50–69 to those aged 50–7420; however, the scientific rationale for this is unclear. In 2009–2010, 55% of females aged 50–69 participated in the screening program.6 An analysis of BreastScreen participation in South Australia showed a 30–41% reduction in mortality for females aged 50 or over.103 A Western Australian study also suggests a reduction in mortality by about half due to screening.23 In 2007, the BreastScreen Australia Evaluation Advisory Committee undertook an appraisal of the program, and their recommendations supported the program’s continuation – but suggested changes to the target groups and frequency.26 Not all these recommendations have been implemented yet.58

Treatment options depend on the extent and subtype of the cancer, and can range from lumpectomy (removal of the tumour) to mastectomy (complete removal of the breast). This may be followed by radiation therapy, chemotherapy, hormone therapy or other targeted therapy.20 Short-term survival and recurrence can be positively influenced by the use of aspirin, according to an American study.104 Tamoxifen is also used to treat patients with oestrogen receptor–positive breast cancer to reduce the risk of recurrence during treatment and for up to 10 years after treatment.105 The use of tamoxifen generally ceases after 5 years, but a recent study has suggested value in continuing treatment for 10 years after initial treatment, as it reduces recurrence and mortality.105 Tamoxifen, however, has side effects that need to be considered before recommending prolonged use.21 When examining long-term survival, the most important predictors are tumour size, lymph node status and grade.

In Australia, the management of early breast cancer improved with the introduction of clinical practice guidelines in 1995. These guidelines led to increased use of adjuvant radiotherapy, chemotherapy and hormone therapy in oestrogen receptor–positive patients.24, 106 In contrast to the AIHW findings, a review of the literature found that factors such as age and SES have a lower association with long-term survival when other prognostic factors are also taken into account.107

Recurrent incidence of breast cancer can increase in survivors with regular alcohol consumption – especially in postmenopausal and overweight/obese females.108 A healthy lifestyle is associated with increased long-term survival. Other risk factors can increase recurrence and impact the clinical behaviour of a tumour and, therefore, affect survival107

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††Ecological studies are where the units of observation are populations rather than individuals.
7.1.2 Incidence and mortality rates in Australia 1987-2007

Our analysis shows that between 1987 and 2007, breast cancer incidence has increased from the expected numbers by 34%, while mortality has reduced by 31% (Table 7–1). Both changes were statistically significant (Table 7–2) and are largely attributed to the national screening program, improved management of breast cancer and reduced population risk through changing behaviour. For example, after the use of HRT was linked to breast cancer incidence in 2001, its use dropped dramatically among females aged 50 and over, corresponding with a concomitant 6.7% fall in incidence. Incidence and mortality rates from 1987 to 2007 are illustrated in Figure 7–1 and Figure 7–2.

Figure 7–1
Breast cancer deaths and incident cases in Australia 1987-2007

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deaths</td>
<td>Incident Cases</td>
</tr>
<tr>
<td>Observed in 2007 (O)</td>
<td>1,691</td>
<td>10,681</td>
</tr>
<tr>
<td>Expected in 2007 (E)</td>
<td>2,464</td>
<td>7,945</td>
</tr>
<tr>
<td>Difference (O-E)</td>
<td>-773</td>
<td>2,736</td>
</tr>
<tr>
<td>Change in (O-E)/E (%)</td>
<td>-31</td>
<td>34</td>
</tr>
</tbody>
</table>

*An average of the observed rates for 2006 to 2008 was applied to the 2007 population to calculate the observed number of deaths and incident cases for 2007.

§An average of the observed rates for 1986 to 1988 was applied to the 2007 population to calculate the expected number of deaths and incident cases for 2007.

†All figures have been rounded to the nearest whole number.

Table 7–2
Breast cancer: average annual percentage change (AAPC)

<table>
<thead>
<tr>
<th></th>
<th>Mortality</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AAPC</td>
<td>Confidence Interval (95%)</td>
</tr>
<tr>
<td>Male</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>-1.8</td>
<td>-2.2, -1.5</td>
</tr>
<tr>
<td>Persons</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Increase in breast cancer incidence globally has been attributed to changes over time in screening practices, childbearing and breastfeeding; HRT intake; and other lifestyle factors, such as obesity and limited physical activity.\textsuperscript{109} Evidence has shown that earlier detection, modern therapy and healthier lifestyles can improve the long-term survival of breast cancer patients.\textsuperscript{107}

Long-term survivors of breast cancer generally have a good quality of life.\textsuperscript{110, 111} Patient factors positively influencing quality of life, as evidenced in a systematic review, were not undergoing chemotherapy treatment, receiving emotional support from family and friends, and having a relatively high income.\textsuperscript{111} Breast cancer in females under 50 years of age is sometimes more aggressive and presents with a different set of issues, including infertility, early menopause and recurrence of breast cancer.\textsuperscript{112} This group was also more likely to suffer from depression and the anxiety about the prospect of breast cancer recurrence.\textsuperscript{112}

In 2004/05, 24% of Australian government expenditure for cancer was allocated to breast cancer. The largest proportion of this was spent on screening services, followed by hospital admitted–patient services. The total value of this expenditure on breast cancer was approximately AUS$331 million. Breast cancer incidence (2004–2008) decreased with geographical remoteness and increased with improving SES. Breast cancer is also a high health system burden with an increase of 72% in the number of females hospitalised due to breast cancer between 2000/01 and 2009/10.\textsuperscript{113}

In Australia, the increase in incidence is attributed to the success of the BreastScreen program, which is part of the Australian Government’s cancer prevention strategy developed nationally but managed at a state/territory level. Continuous evaluation of the BreastScreen program’s effectiveness is essential to maintaining an optimal use of budgetary health care spending and ensuring the most at-risks groups are being targeted.\textsuperscript{114} As outlined in the BreastScreen evaluation, the current system capacity will not be able to meet demand in the years to come. Revisions have been recommended to various aspects of the program to improve its efficiency.\textsuperscript{26} A key recommendation of the evaluation was improved national policy leadership to facilitate the availability of an equitable service across the nation. The national accreditation process for the provision of screening services is also being reviewed to improve the standardisation of the program across locations.\textsuperscript{26} No reliable national data currently exist on mammography screening coverage.
7.1 Breast cancer

References


92 Gotzsche PC, Nielsen M. Screening for breast cancer with mammography. Cochrane Database Syst Rev. 2011 (1);CD001877.


7.2 Cervical cancer (C53)

7.2.1 Background

Cervical cancer is the third most common cancer in females worldwide.\(^5\) Cervical cancer is caused by persistent infection of HPV, making it potentially preventable, and if diagnosed early, survival rates are high.\(^7\) IARC GLOBOCAN 2008 working estimates show that the global incidence for cervical cancer was 14.9/100,000 in females under 75 years of age.\(^5\) Incidence rates vary between developed and developing countries quite dramatically.\(^7\) In 2008, approximately 85% of cervical cancer cancers were found in less-developed regions of the world,\(^115\) and deaths from cervical cancer in developing countries represent approximately 88% of cervical cancer deaths globally.\(^2\) Global mortality was estimated to be 7.3/100,000 in females under 75 years of age.\(^2\) High-risk areas include sub-Saharan Africa along with South Central Asia, areas of Melanesia, Latin America and the Caribbean.\(^5\)

Squamous cell carcinomas are the most common type of cervical cancer, and the remainder are adenocarcinomas and adenosquamous cancers.\(^7\) Globally, squamous cell carcinomas account for approximately 85–90% of cases,\(^7\) but this proportion is highly setting-specific. Cervical screening can dramatically reduce squamous cell carcinomas over time, but has little impact on glandular cancers such as adenocarcinomas.\(^116\) In 2008, Australian data showed 65% of cervical cancer cases were squamous cell carcinomas and 26% were adenocarcinomas.\(^116\)

The incidence of cervical cancer in Australia has decreased since the 1980s. Survival, however, has not improved greatly since the early 1990s.\(^3\) No great difference has been found in the cervical cancer trends of Australian-born females compared to immigrant females.\(^117\) Higher incidence and mortality are observed in females residing in areas of lower SES, compared to those residing in areas of higher SES,\(^116\) potentially reflecting that females residing in higher SES areas are more likely to participate in cervical screening.\(^116\) Cervical cancer changes for immigrant females compared to Australian-born females in NSW showed that incidence rates were falling for all except the European-born and those from the Rest of World category.\(^117\) Additionally, mortality rates were also decreasing at an increasing rate since the launch of the organised program for all groups except the Rest of World category, reflective of recent immigrants from high-risk regions.\(^117\)

The 5-year relative survival rate is good, with a 72% probability of surviving at diagnosis. The 5-year conditional relative survival rate was increased to 82% at 1 year after diagnosis and 95% at 5 years after diagnosis.\(^3\) Survival rates, however, are negatively affected by remoteness of residence and SES group.\(^3\) Additionally, the more common squamous cell carcinomas have a lower survival rate when compared to adenocarcinomas.\(^3\)
7.2.1.1 Causes and risk factors

Virtually all cases of cervical cancer are associated with persistent HPV infection. However, cervical cancer is a relatively rare outcome of infection. Typically, persistent HPV infection can be followed by a long phase of preinvasive disease and may be followed by invasive cervical cancer. The prevalence of HPV infection is higher for adolescents and females in their early 20s, while cervical cancer peaks approximately 2 to 3 decades later, making age a risk factor.

Additional risk factors are parity, smoking, oral contraceptive use, low SES and HIV/immune suppression. Co-infection with other sexually transmitted diseases such as Chlamydia trachomatis or herpes simplex virus 2 is highly correlated with HPV infection. Multiple sexual partners and initiation of sexual activity at an early age are also associated with cervical cancer, but reflect the probability of being infected with HPV, and are not considered to be co-factors for progression of HPV.

The World Cancer Research Fund found only limited evidence linking carrot consumption with reduced risk of cervical cancer. Other food and nutritional factors are not associated with risk of cervical cancer. The long-term use of oral contraception has been associated with an increased risk of cervical cancer. However, hormonal contraceptive use is still advocated, as the benefits of its use, especially in the developing world, outweigh the moderate causal relationship with cervical cancer.

7.2.1.2 International prevention/screening/treatment programs

Vaccination programs against HPV have been implemented in many settings. Two vaccines, Gardasil® (Merck & Co., Whitehouse Station NJ, USA) and Cervarix® (GlaxoSmithKline Biologicals, Rixensart, Belgium), have been approved for use in many countries. However, the cost of the vaccine means that it remains inaccessible for inclusion in the public health strategy of most developing countries, where approximately 80% of cervical cancer occurs. The long-term efficacy of the vaccine has not been conclusively proven, due to the comparatively short follow-up from clinical trials; however, efficacy and immunogenicity have remained high for over five years. The early impacts of vaccination are being observed in Australia, including a reduction in diagnoses of genital warts in young females and young heterosexual males, and a reduction in high-grade cervical abnormalities in females aged less than 18 years. Vaccination of pre-adolescent girls and regular cervical screening tests in adult females are considered the most effective preventative strategies for cervical cancer. Notably, vaccines prevent HPV infection in those who were previously uninfected, but do not have any preventive or therapeutic effect on females with existing HPV-associated lesions.

Gardasil® is approved in Australia not only for administration to females but also to males. Vaccination of males can prevent HPV transmission to their unvaccinated female partners, as well as potentially preventing HPV-related disease and cancers in males, such as cancers of the anus, penis and oropharynx, and associated lesions. The vaccine is not routinely recommended or administered to all young males globally, as the incremental effectiveness and cost-effectiveness of both-sex compared to female-only vaccination is strongly dependent on price and coverage of the female-only program.

HPV vaccination was included in the immunisation schedule for adolescent males in Australia commencing in 2013, in spite of relatively high coverage in females (over 70%) and following an initial rejection of public funding on cost-effectiveness grounds. It has been suggested that the vaccine has been heavily discounted to allow full program rollout. Modelling has generally found that vaccination of both genders is of most benefit when coverage in an existing female-only vaccination program is low. However, even in this situation, increasing coverage in females is likely to be a more cost-effective approach if it is possible. Targeted vaccination of high-risk groups of males, such as males who have sex with males, could potentially be of benefit and cost effective but requires further investigation and consideration of implementation issues.

The Papanicolaou (Pap) test (cytology) is the most widely used screening technique and is easily administered in primary care facilities. In Australia, the accessibility of Pap tests is considered a contributing factor to the positive impact of cervical cancer screening. Screening for cervical cancer, generally using cytology, is widely used in developed nations and proven to aid in the identification of precancerous lesions of the cervix. The IARC recommends screening every 3 years for females aged 25–49 years, and every 5 years for females aged 50–65 years; however,
individual countries vary the frequency and starting age at which screening is recommended to the population.\textsuperscript{142, 143} For example, Australian guidelines recommend 2-yearly screening, starting from age 18–20 years.

Very similar reductions in cervical cancer incidence and mortality have been observed in Australia and the United Kingdom.\textsuperscript{144} The UK program recommended three-yearly screening and has since moved to recommending screening at IARC-recommended intervals.\textsuperscript{145} Modelled analyses have also found that lengthening the recommended screening interval in Australia from two to three years would not increase rates of cervical cancer, but would decrease the number of females undergoing diagnostic and treatment procedures.\textsuperscript{146} The screening program in Australia is currently undergoing a process called the ‘Renewal’. This aims to review the program in order to take into account the current understanding of the natural history of the disease, evidence around the optimal ages and intervals for screening and the latest screening technologies, and the advent of a vaccinated cohort of young females into the screening program.\textsuperscript{146}

In 2004/05, approximately AUS$103 million was spent on cervical cancer screening: 57% of the total Australian government spend on gynaecological cancers.\textsuperscript{146} However, this did not include all screening-related costs, such as those associated with diagnosis and follow-up of screen-detected abnormalities. It has been estimated that when these costs are fully accounted for, AUS$194.8 million would have been spent on the National Cervical Screening Program in 2010 (excluding administrative overheads), approximately half of which was related to primary screening smears.\textsuperscript{146} Modifying the current two-yearly screening recommendation in Australia to a three-yearly interval would result in a more cost-effective system, resulting from the reduced number of screening and diagnostic tests and a lower burden of treatment for pre-cancer, without compromising women’s health.\textsuperscript{146}

Australian findings are in line with other international studies and practices supporting a three-yearly interval for screening.\textsuperscript{142, 143} Furthermore, the cost-effectiveness of current screening programs will decrease as vaccinated cohorts enter the program, as there is less risk of disease in these females, and thus the absolute benefit which they can receive from screening will be smaller.\textsuperscript{146} The reported participation in the National Cervical Screening Program has recently declined.\textsuperscript{8} Nonetheless, the overall benefit of this program has been seen beyond the incidence and mortality trends: hospitalisations caused by cervical cancer fell by 6% between 2000/01 and 2009/10.\textsuperscript{146}

7.2.2 Incidence and mortality rates in Australia 1987-2007

Our analysis shows that cervical cancer incidence and mortality both decreased, by 52% and 62% respectively between 1987 and 2007, both statistically significant changes (see Table 7–3 and Table 7–4). Much of this improvement is attributed to the national screening program. These findings do not include the time period in when the National HPV Vaccination Program was in place, and the impact of this program on cancer is likely to take at least a decade. Therefore, it is assumed that these figures will improve in the future. The drop in cervical cancer incidence and mortality rates from 1987 to 2007 can be seen in Figure 7–3 and Figure 7–4.
Table 7–3
Cervical cancer deaths and incident cases in Australia 1987–2007

<table>
<thead>
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<th>Female</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deaths</td>
<td>Incident Cases</td>
</tr>
<tr>
<td>Observed in 2007</td>
<td>152</td>
<td>649</td>
</tr>
<tr>
<td>Expected in 2007</td>
<td>394</td>
<td>1,339</td>
</tr>
<tr>
<td>Difference (O-E)</td>
<td>-242</td>
<td>-690</td>
</tr>
<tr>
<td>Change in (O-E)/E (%)</td>
<td>-62</td>
<td>-52</td>
</tr>
</tbody>
</table>

*aAn average of the observed rates for 2006 to 2008 was applied to the 2007 population to calculate the observed number of deaths and incident cases for 2007.

§An average of the observed rates for 1986 to 1988 was applied to the 2007 population to calculate the expected number of deaths and incident cases for 2007.

†All figures have been rounded to the nearest whole number.

Table 7–4
Cervical cancer: average annual percentage change (APPC)

<table>
<thead>
<tr>
<th></th>
<th>Mortality</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AAPC</td>
<td>Confidence Interval (95%)</td>
</tr>
<tr>
<td>Male</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>-5.2</td>
<td>-5.8, -4.6</td>
</tr>
<tr>
<td>Persons</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 7–3
Cervical cancer: age-standardised cancer mortality rates in Australia 1987–2007, 0–74 years

Figure 7–4
Cervical cancer: age-standardised cancer incidence rates in Australia 1987–2007, 0–74 years
As a result of the high survival for cervical cancer, quality of life can sometimes be underemphasised.\textsuperscript{153} A review of the literature relating to cervical cancer suggested that survivors report good general health but have a higher number of comorbidities than the general population.\textsuperscript{154} There are a number of reproductive, sexuality and intercourse concerns for survivors as a result of the location of the cancer, requiring specialised supportive care to address these.

Cervical cancer has received significant political attention since it was included as one of the specific cancers listed in the 1996 National Health Priority Areas. It still significantly contributes to the cancer-related burden of disease and is continuously monitored through the National Cervical Screening Program. Cancer Australia administers a Gynaecological Cancers Program, which attracts ongoing Australian government funding.\textsuperscript{146} It is currently one of the five cancers listed in the Australian Government’s Health Indicators Framework.\textsuperscript{145} Integrating HPV vaccination and the current screening program may prove challenging in managing changing public expectations and improving their understanding of safe and accurate programs.\textsuperscript{150} A major focus area for improvement is reaching unscreened and under-screened females, including by investigating screening options which are more appropriate for these populations.\textsuperscript{146}
7.2 Cervical Cancer (C53)

References


137 Brill D. Australia launches national scheme to vaccinate boys against HPV. BMJ. 2013;346 (Feb 12):f924.


7.3 Colorectal cancer (C18-C20)

7.3.1 Background
Colorectal cancer, also referred to as bowel cancer, is the third most common cancer in males and the second most common in females worldwide. IARC GLOBOCAN 2008 working estimates state that the incidence for colorectal cancer was 11.4/100,000 in females and 15.9/100,000 in males under the age of 75. Incidence is higher in developed countries and as such it is often considered a Western lifestyle disease. In the United States of America (USA), incidence trends have shown a reduction in colorectal cancer. However, incidence has increased in Americans under 50 years of age, who are not eligible for the screening program. Approximately 8% of cancer-related deaths worldwide are from colorectal cancer, with higher rates in males (6.8/100,000) than females (4.9/100,000) under 75.
Colorectal cancer includes cancers of the colon, rectosigmoid junction and rectum. It is more often found in the elderly; however, it can present in people under 40 years of age but commonly in the more advanced stages. Early-stage colorectal cancer typically has no symptoms, therefore screening is currently the only method through which early diagnosis can be made.

In Australia, colorectal cancer is the second most commonly diagnosed cancer and the second most common cause of death. In 2006, a National Bowel Cancer Screening Program was implemented to improve early detection rates. The prognosis improves over time, beginning with a 66% probability of survival for at least 5 years at the time of diagnosis. The conditional relative survival for 5 years was 76% at 1 year after diagnosis and almost 100% for 5 years after diagnosis. Survival rates are higher in major cities in comparison to inner regional and outer regional areas. Survival is also influenced by SES, with lower SES associated with lower survival rates.
7.3.1.1 Causes and risk factors

The most prominent risk factor for colorectal cancer is age, with over 90% of cases being diagnosed in people over 50 years of age.20 In addition to this, there are a number of genetic or personal history factors that increase risk.29 A personal or family history of colorectal cancer, polyps and specific inherited genetic conditions (eg familial adenomatous polyposis and hereditary nonpolyposis colorectal cancer) or a personal history of inflammatory bowel disease significantly increases the likelihood of colorectal cancer.20, 29

A distinction has been identified in the increased risk by dietary patterns between colon and rectal cancers.157, 158 An evaluation of existing evidence, led by the World Cancer Research Fund, has found28:

- Convincing evidence for:
  - Physical activity protecting against colon cancer
  - Consumption of red meat and processed meat increasing risk of colorectal cancer
  - Consuming alcoholic drinks increasing risk of colorectal cancer in men (probably in women)
  - Body fatness and abdominal fatness, and factors leading to greater adult-attained height increasing risk of colorectal cancer

- Probably evidence for:
  - Consumption of garlic, milk and calcium decreasing risk of colorectal cancer

Other food products do not have a conclusive association with decreased risk.28 A high-fibre diet consisting predominantly of fruits and vegetables, whole grains, fish, poultry, legumes and soy products is considered optimal, as it minimises the risk of other chronic conditions.155, 159 Later studies have found that high consumption of milk and other dairy products is statistically associated with a reduction in colorectal cancer compared to low consumption, as a result of their calcium content and its protective effect.7, 160 However, high dairy consumption may have an adverse effect on other diseases.160 Use for one year or more of oral bisphosphonate, often prescribed in the treatment of osteoporosis, has been associated with a reduced risk of colorectal cancer.161 This relationship still requires confirmation in larger randomised trials with longer term follow-up.161

A recent Norwegian cohort study showed that females who consumed more than 60 grams of processed meats per day were at higher risk of colorectal cancer, especially distal cases, compared to those who consume 15 grams or less a day.162 Additionally, higher risk of recurrence is suggested in patients who continued with a diet of processed meats, more prominently in Western cultures.155, 163 An Australian study found that obesity, specifically higher central adiposity, prior to cancer diagnosis was associated with poorer survival of colorectal cancer.164 The Mediterranean diet, as measured by the Italian Mediterranean Index, has been associated with lower risk for all types of colorectal cancer except proximal cancer, when introduced a priori.155 A link between particular gene variations and dietary patterns has been shown, but requires further investigation.166

Alcohol consumption causes colorectal cancer, according to the most recent IARC evaluation.22 A pooled analysis found that consumption of over 30 grams of alcohol per day was significantly associated with increased risk in males and females, for all types of alcoholic beverages and in all subtypes of colorectal cancer.167 The association appeared to be stronger in subjects with a lower BMI.167 Coffee consumption has been linked to a lower risk of colon cancer but not rectal cancer for individuals with higher levels of consumption.168 The antioxidant properties of coffee are thought to be the reason for this effect.168 Despite large international variations in colorectal cancer, a search for definitive lifestyle and dietary causes has been elusive, and it is thought that a still unidentified dietary or lifestyle factor is more likely the cause.169

An additional modifiable risk factor of colorectal cancer is smoking.22, 170-172 This was previously considered a possible risk factor, but more recent analyses showed a significant increased risk of colorectal cancer with smoking.22 A pooled analysis looking at the risk after quitting smoking showed that the risk can continue for up to 25 years after quitting.170 However, risk begins to decline as soon as smoking is ceased for proximal colon and rectal cancer, but for distal colon cancer, a point of decline is only reached after 25 years of cessation.170 Further, higher risk of colorectal cancer was found in individuals who smoked for more than 30 years and smokers of more than 20 cigarettes a day compared to never smokers, as well as in male smokers over female smokers.171 Perhaps controversially, Tsoi et al’s analysis...
of cohort studies found that there was no statistically significant increase in risk for current female smokers, for males or females who smoked less than 20 cigarettes per day and smoked for less than 20 years, and for females who had smoked less than 20 packs per year. A proposition that antioxidant micronutrients could mediate the effect of smoking and reduce the risk of colorectal cancer has been refuted in a Danish study.173

The relationship between physical activity and risk of colorectal cancer varies by sites. There is convincing evidence indicating reduced risk for colon cancer, but no conclusion has been drawn for rectal cancer.175 An Australian study found poorer survival in colorectal cancer patients who did not undertake regular physical activity prior to their diagnosis.174 The lack of conclusive evidence relating to physical activity and colorectal cancer risk is largely due to the study measurements used and design limitations.174 A recent analysis of a cohort of females in the USA found a reduction in mortality risk for females who had a score of 18 or more metabolic equivalent hours of recreational physical activity pre- and post-diagnosis of colorectal cancer.176 However, increased physical activity is promoted as being of overall benefit and providing a protective effect.7, 20

Additional lifestyle factors also alter the risk of colorectal cancer. There is evidence suggesting reduced incidence of colorectal cancer in females using oestrogen-only menopause therapy, but there is no evidence of elevated risk when combined therapies are used.21 Evidence also suggests an inverse relationship between oral contraceptive use and risk of colorectal cancer.21 Additionally, a cohort study suggests that short (five hours or less) or long (nine hours or more) sleep duration increases the risk of colorectal cancer in females.176 This is the first prospective study of its kind. Sleep duration may become an emerging issue in the area of cancer causation. Occupational exposure to asbestos is also associated with higher risk of colorectal cancer.177 Evidence suggests that the association may be greater for colon cancer than rectal cancer.177 X- and y-radiation have been positively associated with rectal cancer; for colon cancer there is convincing evidence making X- and y-radiation a cause of this subtype.93

7.2.1.2 International prevention/ screening/treatment programs

Prevention of colorectal cancer is largely based on addressing the modifiable risk factors which can also decrease the likelihood of diagnosis of other chronic illnesses.175 The major focus – which has had the greatest impact – is colorectal cancer screening. Screening programs are in place worldwide and are recommended for people over 50 years of age.7 Screening can detect precancerous polyps and cancer at its early stage. If caught early, treatment is more successful and less invasive.20 Precancerous polyps can be removed via a polypectomy.7 Specifically, for people who have previously undergone polypectomy, calcium and anti-inflammatory medications such as aspirin and celecoxib play a chemoprevention role.179

A number of screening methods can be used, and suggestions have been made encouraging patient autonomy in choosing preferred screening methods.180 However, FOBT followed by a colonoscopy is the most common process. Two types of FOBT are available. Guaiac FOBT has restrictions on dietary consumption and medications taken for the three days prior to testing. Many countries, such as Australia, have shifted to use immunochemical FOBT, as it is not as restrictive. Colonoscopy and sigmoidoscopy have recently increased in use as first-line screening techniques.181 The latter options are more invasive than the FOBT and more labour intensive to administer. Newer screening tests are available, but have not yet been proven to be cost effective and are not used extensively.182

As previously mentioned, Australia has a screening program, with a one-time immunochemical FOBT at ages 50, 55, 60 and 65, despite the National Health and Medical Research Council (NHMRC) recommendation for biennial screening.183 Those turning 60 in 2013 were recruited, beginning on 1 July 2013, and 70-year-olds will be incorporated into the program from 1 July 2015.67 The Australian program has previously been critiqued for the lack of resources available to perform follow-up colonoscopies when required.184 A comparison of patients participating and not participating in the national program in South Australia showed that diagnoses occurred at earlier stages for individuals participating in the screening program, illustrating positive program outcomes.185 Attaining sufficient coverage of colorectal screening is, however, an ongoing challenge in countries that have tried to implement such programs. A recent evaluation of the national program reported reduced participation rates in the past year, dropping from 38.4% in 2008–2011 to 35% in 2011–2012.186

Surgery is the most common treatment for colorectal cancer. Chemotherapy, with or without radiation therapy, is used before or after surgery if the cancer has spread into the bowel wall or the lymph nodes.20 There are also chemoprevention drugs available that have been shown to benefit some patients.187 Anti-inflammatory medications such as aspirin as prophylaxis can be used against further adenoma development in those with a previous removal of an adenoma.188
7.2.2 Incidence and mortality rates in Australia 1987–2007

Colorectal cancer had a small, non-statistically significant overall change in incidence (2%), (see Table 7–5 and Table 7–6). A substantial, statistically significant difference is seen in mortality. Overall, there has been a 47% decline in mortality, only slightly higher for females (50% decline) (see Table 7–5). Reduced mortality is probably due to improved treatment technology and adherence to national management and treatment guidelines.\(^{30-33}\) Early detection may also have had an impact, although there was no organised screening during the time period analysed, apart from the dissemination of FOBT kits to a limited age group from late 2006. Both incidence and mortality age standardised rates have shown downwards trends over the last 20 years (Figure 7–5 and Figure 7–6). Therefore, it is assumed that these figures will improve in the future. The drop in cervical cancer incidence and mortality rates from 1987 to 2007 can be seen in Figure 7–5 and Figure 7–6.

Table 7–5
Colorectal cancer deaths and incident cases in Australia 1987–2007

<table>
<thead>
<tr>
<th></th>
<th>Deaths(^{†})</th>
<th>Incident Cases(^{†})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Observed in 2007 (O)(^{§})</td>
<td>1,197</td>
<td>791</td>
</tr>
<tr>
<td>Expected in 2007 (E)(^{§})</td>
<td>2,205</td>
<td>1,580</td>
</tr>
<tr>
<td>Difference (O-E)</td>
<td>-1,008</td>
<td>-789</td>
</tr>
<tr>
<td>Change in (O-E)/E (%)</td>
<td>-46</td>
<td>-50</td>
</tr>
</tbody>
</table>

\(^{†}\)An average of the observed rates for 2006 to 2008 was applied to the 2007 population to calculate the observed number of deaths and incident cases for 2007.

\(^{§}\)An average of the observed rates for 1986 to 1988 was applied to the 2007 population to calculate the expected number of deaths and incident cases for 2007.

\(^{‡}\)All figures have been rounded to the nearest whole number.

Table 7–6
Colorectal cancer: average annual percentage change (AAPC)

<table>
<thead>
<tr>
<th></th>
<th>Mortality</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AAPC</td>
<td>Confidence Interval (95%)</td>
</tr>
<tr>
<td>Male</td>
<td>-2.9</td>
<td>-3.3, -2.5</td>
</tr>
<tr>
<td>Female</td>
<td>-3.3</td>
<td>-4.4, -2.2</td>
</tr>
<tr>
<td>Persons</td>
<td>-3.0</td>
<td>-3.4, -2.7</td>
</tr>
</tbody>
</table>

Figure 7–5
Colorectal cancer: age-standardised cancer mortality rates in Australia 1987–2007, 0–74 years

Figure 7–6
Colorectal cancer: age-standardised cancer incidence rates in Australia 1987–2007, 0–74 years
The issue of quality of life in colorectal cancer survivors is becoming more important as mortality decreases and incidence increases or remains stable. Survival has improved over time. As expected, long-term survivors (five years after diagnosis) of colorectal cancer have higher health-related and global quality-of-life in comparison to patients at baseline (five months after diagnosis). A UK study showed that survivors up to five years post-diagnosis had comparable health behaviour outcomes to the general population. Survivors of colorectal cancer have shown very high quality-of-life when they were at least 15 years after diagnosis and had no disease recurrence. Differences are apparent in survivors of different subtypes, with rectal cancer survivors reporting lower quality-of-life compared to the colon cancer survivors when compared to controls. Physical activity has not been found to have a positive effect on quality of life, perhaps a result of low levels of physical activity in patient groups. However, a Taiwanese study found that supervised exercise programs resulted in improved health outcomes and quality-of-life indicators in colorectal cancer patients compared to usual care, although the scores for usual care were also high.

Caring for colorectal cancer patients has high associated costs, especially in later phases of the disease. To this end, an analysis of first-degree relatives of colorectal patients and their adherence to screening guidelines showed that there are low levels of screening for this high-risk group; and interventions should be developed to improve this. Screening and early diagnosis are becoming more important from a budgetary point of view, and the greatest future reductions in mortality across the whole population are expected to be gained from population-wide screening. Later data have shown earlier-stage diagnosis due to participation in the national screening program, potentially leading to reductions in mortality in the future. Individual behaviour modifications, such as increased physical activity, can also reduce colorectal cancer risk.

The recommended biennial program of FOBT, not currently in place in Australia, would be cost effective for people aged 50–74. Given the rising cost of treating colorectal cancer patients, it would seem that improving and expanding the screening program would result in the best, most cost-effective long-term outcome. However, the program in its current form cannot be upgraded to support biennial screening, due to the limited capacity of health care facilities to perform follow-up colonoscopies. In light of this, the Australian Government has committed resources to the program until 2034, to ensure biennial screening is eventually available to all individuals aged 50–74. To facilitate the program’s expansion, the 2013/14 federal budget incorporated AUS$16.1 million to potentiate the program register by incorporating electronic reporting by health professionals. Independent public health and medical authorities continue to call on the Australian Government for an expedited expansion of the screening program.
7.3 Colorectal Cancer (C18-C20)

References


7.4 Liver cancer (C22)

7.4.1 Background

Liver cancer is the fifth most common cancer in males and the seventh most common in females. For individuals under the age of 75, incidence was 14.1/100,000 in males and 5/100,000 in females. Incidence rates are higher in developing countries and Southern Europe in comparison to other developed areas. In Western countries, liver cancer is more prevalent in people aged 75 or over, and more common in males than females, but in African countries this trend is variable. Worldwide, 70–80% of all liver cancers are associated with chronic hepatitis viruses B and C infection or liver cirrhosis. Mortality from liver cancer is 12.5/100,000 in males and 4.6/100,000 in females under the age of 75. Survival from liver cancer is low and, as a result, liver cancer is the third most common cause of death globally. Low survival leads to a higher burden from premature mortality than morbidity.

Approximately 80% of liver cancer cases are hepatocellular carcinomas, resulting from hepatocytes. The remaining 20% of cases are made up of intrahepatic cholangiocarcinoma (affecting the bile duct epithelium), hepatoblastoma (a malignant tumour in infants and children) and angiosarcoma (tumours arising in the liver’s blood vessels). Prognosis of the disease is often measured by the Child–Pugh score, which assesses the level of cirrhosis in the liver. It is often used to determine treatment requirements and need for transplantation.

In Australia, liver cancer is 3 times more common in males than in females, and relative survival is 16% for 5 years after diagnosis. The 5-year conditional relative survival was 38% at 1 year after diagnosis, and 75% at 5 years after diagnosis. Survival rates are similar for both genders but are higher in major cities. Changes from 1988–1993 to 2006–2010 indicated an improvement in survival from 7% to 16%.
### 7.4.1.1 Causes and risk factors

Chronic infection with hepatitis B and C viruses is responsible for approximately 80% of liver cancer cases worldwide.\(^{199}\) With hepatitis B, the progression to hepatocellular carcinoma can bypass the cirrhosis stage in approximately 30% of individuals, which makes hepatocellular carcinoma surveillance more challenging and less reliable.\(^{200}\) On the other hand, hepatitis C infection – the pathway to hepatocellular carcinoma – is mediated through liver fibrosis or cirrhosis, which makes cirrhosis screening a valuable indicator.\(^{200}\) HIV-1 has also been positively associated with liver cancer.\(^{53}\)

Liver cirrhosis is associated with hepatocellular carcinoma, especially in Western countries, with at least 80% of cases having a history of cirrhosis before tumour development.\(^{197, 198}\) High alcohol intake is a significant contributing risk factor for liver cirrhosis and alcohol-related liver cancer.\(^{7, 20, 36, 195, 196, 201, 202}\) Although assumed to be beneficial, alcohol cessation has no clear association with reduced risk.\(^{195, 201}\)

From 1982, hepatitis B vaccine was commercially available, but not immediately administered as part of a population-wide prevention program, because of the high associated cost, especially in the developing world.\(^{195, 203}\) The hepatitis B vaccination is now part of the infant immunisation program in 179 countries. As the vaccine is not effective in people already infected, 350 million people worldwide are still at risk of developing hepatocellular carcinoma. In Australia, the prevalence of hepatitis B is relatively low, except in immigrants from countries where the prevalence is high.\(^{38, 204}\) People with a large number of sexual partners and those who inject drugs with contaminated needles are also considered high-risk population groups for hepatitis B.\(^{38}\)

No vaccine is as yet available against the hepatitis C virus.\(^{205, 206}\) Hepatitis C infection prevention relies on the use of sterilised equipment in medical and on public health interventions, such as safe blood transfusions, safe injection practices, safe tattooing and adequate screening of blood and organ donors.\(^{7, 205, 206}\)

Coffee consumption has been associated with a reduced risk of liver cancer, but the evidence is not conclusive.\(^{36, 207-210}\) A positive relationship has not been found with other caffeinated beverages such as green tea.\(^{208}\) Smoking has a causal relationship with hepatocellular carcinoma, with consistent findings across different geographic regions.\(^{22}\) Additionally, X- and y-radiation are associated with increased risk of liver cancer, but the exact dose-response relationship is not clear.\(^{83}\) Combined oestrogen-progestogen oral contraceptive use has been linked to increased risk of liver cancer.\(^{21}\) There are also autoimmune and metabolic diseases associated with hepatocellular carcinomas.\(^{198}\) Research in iron metabolic disorders has suggested that iron overload is a risk factor.\(^{7, 196}\)

Obesity and diabetes mellitus, both together and independently, have been linked to increased risk of fatty liver disease and hepatocellular carcinomas.\(^{195, 196, 211}\) Diabetes mellitus and liver cancer share similar risk factors, such as alcohol consumption and obesity, and diabetes has been suggested as a potential risk factor for liver cancer.\(^{195, 211}\) Even after adjusting for confounders, the risk of hepatocellular carcinomas in diabetics was double that of non-diabetics.\(^{211}\) Other food- and nutrition-related evidence has only isolated fruit consumption as having a limited–suggestive association with decreased risk of liver cancer.\(^{36}\)

Exposure to aflatoxins through contaminated food consumption has been convincingly associated with liver cancer in developing tropical countries, especially in individuals with chronic hepatitis infections.\(^{7, 20, 36, 195, 212}\) Aflatoxins develop when mould develops on grains that are stored in poorly ventilated sites in hot and humid climates.\(^{7, 20, 196}\)

For intrahepatic cholangiocarcinomas, liver fluke infestation through consumption of raw or undercooked freshwater fish increases cancer risk; this occurs mainly in Thailand and South East Asia.\(^{7, 198, 205, 213}\) An Italian case-control study showed that asbestos exposure increased the risk of intrahepatic cholangiocarcinoma; however, the number of cases was too small to confirm an association in all environments.\(^{214}\)
### 7.4.1.2 International prevention/screening/treatment programs

As the prognosis for liver cancer is poor, major emphasis is placed on prevention.\(^7\) Primary prevention strategies include hepatitis B infant immunisation programs, optimising grain storage to avoid aflatoxin contamination in the tropics, and public health campaigns addressing excessive alcohol consumption.\(^7,196\) Addressing excessive alcohol consumption could, theoretically, eliminate the incidence of alcohol-related liver disease, responsible for approximately 10.7% of deaths from liver cancer globally.\(^202\)

The hepatitis B vaccine is available worldwide as part of many national immunisation programs. The initial immunisation approach targeting high-risk groups was found to be ineffective and, with falling costs of vaccination, universal vaccination became a reality.\(^203\)

In Australia, the risk of liver cancer is high, and its management is challenging.\(^215\) The prevalence of hepatitis B is high in Australians born in countries where hepatitis B infection is endemic, and transmission occurs in the neonatal period and early infancy, such as in many Asian countries.\(^204\) Estimates for the year 2025 suggest that there will be an increase of hepatocellular carcinomas caused by hepatitis B in population groups from the Asia-Pacific region.\(^204\) The Australian Government has developed National Hepatitis B and C strategies to address these issues.\(^216, 217\) Programs such as Cancer Council NSW’s ‘B Positive’ Project, aim to raise awareness and educate these communities – and the health professionals who serve them – about the link between hepatitis B and liver cancer, and ensure regular follow-up and timely institution of antiviral therapy to prevent hepatocellular carcinomas.\(^218\)

Population-wide screening programs for liver cancer are not recommended.\(^219, 220\) It is thought that it is more effective to identify high-risk patients via a relatively simple test for hepatitis B and C, or liver cirrhosis screening.\(^219\)

Population-based hepatocellular carcinoma screening is not systematically practised in Australia, but expert groups recommend it in high-risk populations, including Asian-born individuals (commencing at age 40 for males and age 50 for females). African-born people aged over 20 years, people with cirrhosis, or those with a family history of liver cancer.\(^221, 222\) Screening, as well as diagnosis, can also be conducted in primary care facilities using ultrasounds.\(^7, 219\)

Approximately half the cases of hepatocellular carcinomas have high fetal antigen \(\alpha\)-fetoprotein levels, which could be used as a marker for screening in future.\(^196\)

The treatment of liver cancer is largely dependent on disease stage and the existence of other associated liver diseases. Liver resection is a commonly used technique, with portal vein embolisation if there is little remaining liver.\(^7\) Liver transplantation is also a possibility for patients.\(^7\) In the case of hepatocellular carcinomas, liver resection and transplantation are the only two curative treatment options available.\(^221\) If liver failure is likely, the cancer can be treated with radiofrequency ablation (RFA) or cryoablation.\(^7\) RFA is considered a safe treatment option with low mortality; however, there is a high chance of disease recurrence associated with the technique.\(^223\) Additional regional therapies, such as transarterial chemoembolisation, have shown more promising results when used in combination with RFA.\(^224, 225\) Hepatocellular carcinomas are resistant to radiotherapy, thus limiting its use in treatment.\(^7\) However, chemotherapy can be used, despite little evidence to suggest resulting improvement in survival.\(^7\) Sorafenib, a molecular-targeted drug, is the first agent to show improvements in survival of advanced hepatocellular carcinoma and is now more commonly used in treatment programs.\(^198\)

### 7.4.2 Incidence and mortality rates in Australia 1987–2007

Liver cancer incidence and mortality rates have both increased over two decades (Figure 7–7 and Figure 7–8). Overall, there has been a 70% rise in mortality, which was slightly higher in males than females, and incidence increased by 132% in comparison to expected estimates (Table 7–7). This increase was higher in males, increasing by 165% over this period. Mortality and incidence results were statistically significant for both genders and overall (Table 7–8). The substantial burden of undiagnosed chronic hepatitis B infections in some Asian-born Australians, coupled with the natural history of chronic hepatitis B infection in populations where the infection is acquired early in life,\(^23\) contribute to about half of the increasing mortality and incidence in Australia.\(^9\)
Liver cancer deaths and incident cases in Australia 1987–2007

<table>
<thead>
<tr>
<th></th>
<th>Deaths†</th>
<th>Incident Cases‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Observed in 2007 (O)</td>
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<tr>
<td>Expected in 2007 (E)</td>
<td>265</td>
<td>117</td>
</tr>
<tr>
<td>Difference (O-E)</td>
<td>195</td>
<td>72</td>
</tr>
<tr>
<td>Change in (O-E)/E (%)</td>
<td>73</td>
<td>62</td>
</tr>
</tbody>
</table>

†An average of the observed rates for 2006 to 2008 was applied to the 2007 population to calculate the observed number of deaths and incident cases for 2007.
§An average of the observed rates for 1986 to 1988 was applied to the 2007 population to calculate the expected number of deaths and incident cases for 2007.
†All figures have been rounded to the nearest whole number.

Liver cancer: average annual percentage change (AAPC)

<table>
<thead>
<tr>
<th></th>
<th>AAPC</th>
<th>Confidence Interval (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>2.3</td>
<td>1.9, 2.7</td>
</tr>
<tr>
<td>Female</td>
<td>2.7</td>
<td>2.0, 3.3</td>
</tr>
<tr>
<td>Persons</td>
<td>2.4</td>
<td>2.1, 2.7</td>
</tr>
</tbody>
</table>

Liver cancer: age-standardised cancer mortality rates in Australia 1987–2007, 0–74 years

Liver cancer: age-standardised cancer incidence rates in Australia 1987–2007, 0–74 years

Hepatocellular carcinoma patients have poor quality of life in comparison to the general population, specifically in physical aspects.226 Particular treatment courses, such as sorafenib, can have significant adverse effects which impede a patient’s ability to continue treatment and also affect their physical wellbeing.227 Fan et al226 found that the emotional functioning of these patients was higher than that of other cancer sufferers, proposed to be due to their resolve in combating their illness. Liver transplantation occurs more often in younger patients, and their quality of life post-transplant has been studied.228, 229 Transplant recipients have lower quality of life than their healthy peers, with physical and psychosocial health being lower than average in the healthy population, especially in school functioning.228

From 1988, the Australian Government began integrating the hepatitis B vaccination into the National Immunisation Program. It is now provided in infancy through a general practitioner.230 National strategies focusing on a reduction in transmission of hepatitis B and C have been developed in partnership with the community sector.216, 217 Additionally, public health campaigns to curb excessive alcohol consumption address one of the main risk factors for liver cancer, thus working towards disease prevention. Globally, governments are encouraged to take a harder stance on preventing alcohol-attributed harm through public health initiatives, taxation and legislation restricting alcohol availability.202 High-risk groups with higher rates of hepatitis B and C infections are a key focus of the national strategies, as well as NGOs such as Hepatitis Australia and Cancer Council to further reduce liver cancer incidence and mortality.216, 231
7.4 Liver Cancer (C22)

References


7.5 Lung cancer (C33-34)

7.5.1 Background

Lung cancer is the leading cause of cancer-related death worldwide, resulting in 1.38 million deaths in 2008.\(^5\) Tobacco smoking is heralded as the predominant cause of lung carcinomas.\(^7\) IARC GLOBOCAN 2008 working estimates state the incidence for lung cancer in males and females under 75 years as 27.3/100,000 and 11/100,000 respectively.\(^5\) Many suggest the higher incidence in males is due to the historical differences in the tobacco consumption uptake of males and females.\(^20\) However, an American study found that the mortality rate in male never smokers is higher than in female never smokers suggesting that there are also other factors at play.\(^23\) IARC GLOBOCAN 2008 working estimates for mortality indicate a 22.5/100,000 rate in males and 8.5/100,000 in females under 75 years of age.\(^5\) Developing countries have high rates of new cases, but Northern America still has the highest incidence rates globally.\(^5\) Middle and Western Africa have low rates of lung cancer.\(^5\)

Symptoms of lung cancer include a persistent cough, coughing blood, chest pains, changes in voice register and recurring cases of bronchitis or pneumonia.\(^20\) The main subtypes of lung cancer are squamous cell carcinomas, small-cell carcinoma, adenocarcinomas and large-cell carcinoma. Over time, there has been a reduction in squamous cell carcinomas and an increase in adenocarcinomas. This is largely attributed to changes in tobacco products and smoking behaviours.\(^7\)

In 2007, lung cancer was the leading cause of burden of disease in Australia. The prognosis for lung cancer is very poor, with a 14% relative survival for at least 5 years at diagnosis. The 5-year conditional relative survival was 34% for 1 year after diagnosis, and 74% for 5 years after diagnosis. Survival rates were higher for females, patients living in major cities and in high SES groups.\(^3\)
7.5.1.1 Causes and risk factors

Lung cancer is predominantly caused by the carcinogenic effects of long-term tobacco smoking. While the relationship between smoking and lung cancer has been known since the 1950s, the extent of the association has only been appreciated by the passage of time. The relative risk of lung cancer in current smokers was 2.74 in females and 12.49 in males in the 1960s and rose to 26.18 in females and 27.32 in males in contemporary cohorts (from 2000-2010) from the USA.233 Evidence from China suggests other underlying risk factors for lung cancer.234 Despite populations previously thought less susceptible to the hazards of smoking, they are no different to Western populations once sufficient time has elapsed (eg in Japan).235

Other causes include passive smoking, certain occupational exposures (including those involving asbestos and coal-based industry), pulmonary tuberculosis and atmospheric pollution.2, 20, 39 A predictive model for lung cancer in the USA found that the risk was higher for older people, males, African Americans, individuals with chronic obstructive pulmonary disease, a lower education level, family history of lung cancer, history of recent chest X-rays, lower BMI and smokers of many cigarettes per day or over long durations of time.236

The association between family history and risk of lung cancer is difficult to establish, but is at least partially genetically determined. The specific genes responsible for elevated risk of lung cancer are not well understood.237 The similarity in environmental factors and difficulty in adjusting for smoking makes isolating genetic causes problematic.237 Despite this, there is evidence to suggest that having an affected relative increases an individual's risk of developing lung cancer.238

The high rates of lung cancer in individuals who never smoked have led to the further investigation of additional causes. Incidence and mortality rates have increased in females and have not been associated with tobacco, leading to the investigation of reproductive and hormone factors. In an analysis by cancer subtype, it was found that early menarche was associated with an increased risk of adenocarcinomas, and early menopause also resulted in an increased risk of adenocarcinomas and squamous cell cancers.239

Despite the potential confounding effect of smoking, the results for multiparity, age at first parity, and use of oral contraception or HRT are conflicting in the literature.238 An Italian study found an association of later age at menopause, later age at first live birth and longer reproductive cycle with a reduced risk of lung cancer, suggesting that longer oestrogen production is associated with a greater protective effect.239 This study showed no evidence of a relationship with early menarche, cycle duration, breastfeeding or parity in general and an increased lung cancer risk.239 Larger cohort studies focusing on reproductive factors and biomarkers are essential to confirm causation.

Chronic obstructive pulmonary disease not only increases risk of lung cancer but also shares many risk factors.240 Studies, reviews and pooled analyses have illustrated the causal relationship between previous lung disease and lung cancer of both smokers and never smokers, suggesting that tobacco consumption does not have confounding effect.241, 242 Inflammation of the lung associated with lung diseases and the pathogenesis of lung disease are believed to be the cause of this relationship.241, 242

Fruit and vegetable intake have traditionally been associated with a decreased risk of lung cancer.243 More recent studies have not conclusively found protective effects from overall fruit and vegetable consumption.36, 244, 245 There is some evidence to suggest that subgroups of fruits and vegetable can reduce the risk of lung cancer, and probable evidence linking fruits and foods containing carotenoids with decreased risk of lung cancer.36

Studies analysing the association between weight and lung cancer risk suggest that a low BMI is a predictor of lung cancer.246, 247, 248 In a study of postmenopausal females, ever smokers exhibited an inverse association between BMI and risk of lung cancer, whereas waist circumference was positively associated with increased risk.248 A meta-analysis of both males and females also found an inverse relationship between BMI and lung cancer incidence, which was more pronounced in ever smokers.248 Analyses of never smokers have produced inconsistent results.246, 248 Later French and American studies also found inconsistencies using cohorts of both genders, even when adjusted for smoking status as a confounder.247, 248 The difference could potentially be due to the confounding effect of the preclinical weight loss associated with lung
cancer.\textsuperscript{246} There is limited evidence suggesting a reduction in risk of lung cancer in people who have high to moderate levels of leisure time physical activity.\textsuperscript{26, 243} That is, although weight may not have a clear relationship, fitness could reduce the likelihood of lung cancer in smokers and non-smokers.\textsuperscript{243}

The environmental causes of lung cancer include exposure to asbestos or coal tar pitch in the working environment, or occupational exposure during aluminium production, coke production, coal gasification, iron or steel founding and rubber manufacturing, or working as a painter.\textsuperscript{7, 20, 212} Additionally, there is sufficient evidence linking exposure to beryllium, cadmium, chromium, nickel compounds, nickel metal, X-radiation, \( \gamma \)-radiation, plutonium-239, and underground haematite mining with exposure to radon and crystalline silica in the form of quartz or cristobalite dust as causes of lung cancer.\textsuperscript{83, 177} Mustard gas, radiation, bis[chloromethyl]ether and chloromethyl methyl ether are also considered causes of lung cancer.\textsuperscript{83, 212}

A major focus has been on asbestos, as approximately 125 million people across the globe were reportedly exposed as at 2010.\textsuperscript{250} The link between asbestos exposure in the workplace and an increase in the risk of lung cancer has been established across a number of occupations.\textsuperscript{251, 252}

A recent study in China showed the increased risk of lung cancer when using smoky coal for domestic purposes compared to the use of smokeless coal.\textsuperscript{253} However, risk is increased with active tobacco smoking and exposure to these carcinogens potentially due to the inflammatory state of the airways.\textsuperscript{254} Canadian research has refuted the speculation that lead is a carcinogen by showing no relationship between organic and inorganic lead exposure and risk of lung cancer.\textsuperscript{255}

### 7.5.1.2 International prevention/ screening/treatment programs

Prevention techniques for lung cancer focus on the reduction in modifiable risk factors, specifically smoking cessation. Currently there is no universally endorsed screening method for lung cancer.\textsuperscript{7} In 2006, a seminal paper was published advocating the use of computed tomography scans as an annual screening method for lung cancer.\textsuperscript{256} Initial screening detection results were encouraging, positioning it as a viable method, but it requires further testing.\textsuperscript{256}

Recently developed testing techniques, including low-dose spiral computed tomography scans and molecular markers in sputum, are reportedly more successful in early identification of lung cancer in high-risk groups.\textsuperscript{20, 43, 44, 257-259} Results from a screening trial in the USA claim that approximately 12,000 deaths per year could be averted in heavy smokers through the full implementation of low-dose spiral computed tomography scans.\textsuperscript{259} Thus, high-risk groups could benefit from screening for lung cancer.\textsuperscript{44}

Rolling out a screening program for high-risk groups (based on age and smoking history) has been endorsed by the US Preventive Services Task Force, and in Australia is being assessed for its feasibility.\textsuperscript{260, 261}

Recently a proof of concept has been released to suggest that a breath print could detect the presence of a malignant tumour.\textsuperscript{262} This has led to a larger-scale study that will confirm or deny these results.\textsuperscript{262} As with many screening programs, lung cancer screening trials have been subject to the overdiagnosis vs. benefit debate, despite the claim that the minimal overdiagnosis is insignificant.\textsuperscript{263-265}

The poor survival rate for lung cancer has resulted in a number of clinical trials being conducted in search of innovative treatment methods. Depending on the subtype of cancer and stage, surgery, radiation therapy, chemotherapy and other targeted drug therapies can be used. For small-cell cancer, chemotherapy or a combination of chemotherapy with radiation therapy is used. Generally, this removes the cancerous cells, but these patients have a high probability of relapse. In non–small cell cancers, localised cases are usually treated with surgery and then treatment is supplemented with chemotherapy at a later stage. If in the advanced stage, chemotherapy is often used in conjunction with targeted drug therapies. Vinod et al’s\textsuperscript{266} study of radiotherapy use for lung cancer treatment suggested a gap in the existing system in NSW. The findings, which can be extrapolated to Australia overall, showed that usage was not in line with the estimated optimal level of radiotherapy. This is thought to be a result of the profile of radiotherapy as an effective treatment for lung cancer, and the attitude of physicians to its use.\textsuperscript{266}

Recent improvements in treatment techniques have translated to modest improvements in survival rates.\textsuperscript{20} However, an analysis of survival by SES area in NSW between 1996 and 2001 showed that people in the highest SES quintile had lower excess relative risk of lung cancer, with 9,673 excess deaths that might have been extended for 5 years beyond diagnosis.\textsuperscript{267} Overall, lung cancer patients in NSW received the same treatment between 1996 and 2002.\textsuperscript{268} Only small-cell lung cancer patients were less likely to receive treatment in 2002, in comparison to previous years.\textsuperscript{268}
7.5.2 Incidence and mortality rates in Australia 1987–2007

Overall mortality has dropped by 34%, an encouraging, statistically significant fall (Table 7–9). This is predominantly due to the 46% reduction in male mortality. Age-standardised mortality trends reflect this finding (Figure 7–9). There was a slight increase in mortality for females (7%), not statistically significant based on linear trends (Table 7–10). Lung cancer incidence has decreased overall (22%), also reflected in the age-standardised incidence rates (Figure 7–10). The drop was due to 2,174 fewer incident cases in males whereas the number of females increased by 468. These changes can be largely explained by changes in long-term tobacco consumption rather than differing susceptibility between genders.40, 41 A large proportion of lung cancer cases in Australia are attributed to tobacco use (65% in females, 90% in males).84 The popularity of smoking in Australian females peaked at a later time than in males. We are yet to see the relative declines in lung cancer in females that have been observed in males, and there is usually a time lag between smoking behaviour and lung cancer diagnosis.40, 269 Australian males smoke at higher rates than females in all but one age group (12- to 17-year-olds)270 and lung cancer deaths in males are still significantly higher than in females.72

<table>
<thead>
<tr>
<th>Deaths†</th>
<th>Incident Cases†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td><strong>Observed in 2007 (O)</strong></td>
<td>2,668</td>
</tr>
<tr>
<td><strong>Expected in 2007 (E)</strong></td>
<td>4,927</td>
</tr>
<tr>
<td><strong>Difference (O-E)</strong></td>
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</tr>
<tr>
<td><strong>Change in (O-E)/E (%)</strong></td>
<td>-46</td>
</tr>
</tbody>
</table>

*An average of the observed rates for 2006 to 2008 was applied to the 2007 population to calculate the observed number of deaths and incident cases for 2007.

*An average of the observed rates for 1986 to 1988 was applied to the 2007 population to calculate the expected number of deaths and incident cases for 2007.

*All figures have been rounded to the nearest whole number.
It is important to note that while reduced numbers of lung cancer deaths in the past 20 years are a success story for tobacco control, lung cancer survival after diagnosis has not improved significantly, and research into improved lung cancer outcomes should be a high priority. The 2013/14 federal budget included a AUS$5.9 million allocation over 4 years to improve care for lung cancer patients, their carers and families through Cancer Australia.\textsuperscript{102}

An early study of quality of life in a small sample of lung cancer patients found that marital status has a moderate effect on improved quality of life, and was a statistically significant predictor of survival.\textsuperscript{271} It was posited that married patients had an improved survival rate due to early diagnosis, better treatment, and support from their spouse.\textsuperscript{271} The use of multidisciplinary teams for the management of lung cancer patients can also improve their treatment and, potentially, their quality of life.\textsuperscript{272, 273} However, no direct impact on survival has been reported.\textsuperscript{272}

The stigma associated with lung cancer diagnosis affects sufferers’ quality of life. Sufferers are often blamed or looked down on by society for their disease because of the association between tobacco consumption and lung cancer.\textsuperscript{274} They are often held responsible for their illness, as causes other than tobacco can be overlooked by the general public.\textsuperscript{274, 275} Patients also felt that treatment may have been delayed or denied as a result of negative stigma.\textsuperscript{275}

Studies of non-invasive supportive interventions for lung cancer sufferers benefit all aspects of their quality of life – emotional, psychological and physical. Nurse-led interventions focused on breathlessness, as well as general follow-up interventions, produced positive effects on patients’ wellbeing and satisfaction. Counselling or educational interventions can provide some benefit in improving quality of life through improvements in coping skills. Physical activity and nutritional-based interventions did not show any positive or lasting effects on quality of life in this group of patients. Reflexology also showed some beneficial short-term effects in improving patient quality of life. Despite the variable effects on survival and quality of life of specific interventions, the act of administering an intervention showed the development of a positive relationship with involved health care professionals.\textsuperscript{276}

Lung cancer is the nation’s biggest ‘killer’, but specific programs are not present (eg organised screening programs for high-risk groups).\textsuperscript{42-44} The nature of the disease is such that smoking cessation is the most fruitful way of addressing the problem; thus lung cancer is represented in Australian public health initiatives through tobacco control strategies.\textsuperscript{40} The emphasis placed on quitting smoking should go a long way to reduce the burden of lung cancer while alternative screening and treatment methods are being explored.
7.5 Lung Cancer (C33-34)

References


7.6 Melanoma (C43)

7.6.1 Background

Skin cancer is divided into non-melanoma and melanoma of the skin. Non-melanoma skin cancer is the most common form of skin cancer; however, new cases are not routinely registered in many countries and it is not often a life-threatening disease. On the other hand, melanoma of the skin has greater potential for metastasis, and thus can be more fatal if not diagnosed early. This section focuses on melanoma of the skin, which is recorded in Australian cancer registries.

Of the 160,000 new cases of melanoma each year worldwide, approximately 80% are in individuals from North America, Australia and New Zealand. IARC GLOBOCAN 2008 working estimates state that the incidence of melanoma of the skin in males and females under the age of 75 was 2.6/100,000 and 2.4/100,000 respectively. Although not a cancer of overall global importance, incidence for all ages in Australia is high: 42.4/100,000 in males and 31.7/100,000 in females, making it a cancer of concern nationally. Overall, mortality rates are high, considering that this is a highly curable disease if detected and treated early. IARC GLOBOCAN 2008 working mortality estimates were 0.6/100,000 in males and 0.4/100,000 in females under 75 years of age. Melanoma appears to be more aggressive in males, with higher survival rates in females. Females have been found to have a lower risk of developing metastases than males.

Melanoma occurs in the melanocytes in the epidermis and is more common in fairer-skinned individuals. Individuals with darker skin pigmentation have higher levels of photoprotection against ultraviolet radiation from the epidermal melanin, resulting in lower incidence of melanoma. Physical symptoms of melanoma are naevi which can develop into pigmented lesions. Pigmented lesions often appear on the trunk, especially in males, or on the lower legs in females. The degree of risk associated with a melanoma is determined by its thickness. Melanoma skin cancer is visually recognisable, suggesting that screening could play an important role in early diagnosis.

In Australia, the prognosis for melanoma is good, with 91% relative survival for at least 5 years at diagnosis. The 5-year conditional relative survival was 92% for 1 year after diagnosis and rising to 100% 14 years after diagnosis. Survival varies greatly with the thickness of the tumour. A thicker tumour (more than 4 millimetres) has a 55% 5-year survival rate, in comparison to a 100% rate for thinner tumours.
7.6.1.1 Causes and risk factors

Environmental factors are the predominant cause of all types of skin cancer, suggesting its preventability through their adequate control. The major cause of skin cancer is ultraviolet radiation exposure resulting in direct cellular damage and modifications to immunologic function. However, no simple dose-response relationship between exposure and melanoma has been identified. Occupational exposure, childhood exposure and exposure during holidays in sunny locations have all been related to higher risk of skin cancer. There is recent evidence to suggest that not all exposure is the same and that type of exposure (ie recreational or occupational) and period of exposure in life are important factors to be considered. Purdue et al suggest intrinsic factors may also play a role in melanoma risk.

In the USA, incidence of melanoma is high in people of higher SES but their survival rates are higher, potentially attributable to the rising use of artificial tanning devices (ie tanning beds, sunbeds and solaria). Increased incidence resulting from tanning beds is predominantly cases of non-melanoma skin cancer, but is also associated with increased risk of melanoma. Sunbed use is most prevalent in young females, especially those whose parents are of a lower SES, and exposure at a younger age results in a higher risk of skin cancer. Risk in sunbed users is estimated to increase by approximately 20%. The tanning industry does not self-regulate and has been found to provide clients with information that does not accurately represent the associated risks. In many nations, sunbed use has been restricted to over–18-year-olds and there have been calls for regulations to be changed where restrictions do not currently exist. A Danish study suggested that focusing anti-sunbed messages to preteens, specifically 14-year-olds, would be most effective.

Ultraviolet radiation exposure is essential for the development of vitamin D, important for bone health, but in excess can result in higher risk of skin cancer, especially in people with a light skin pigmentation. Vitamin D has also shown evidence of containing anticancer properties that could inhibit melanoma. The combination of harm and benefit associated with sun exposure can result in mixed public health messages that dilute the sun-safe practices commonly promoted. Ultraviolet radiation passing through after the application of sunscreen has been shown to be sufficient to produce levels of vitamin D that will prevent skin cancer.

Hormonal factors have not conclusively been associated with skin cancer. The development of skin cancer as a result of HRT use has been proposed but not conclusively proven for either non-melanoma skin cancer or melanoma. Other hormone-related medications or issues, including oral contraception and pregnancy, have not conclusively been associated with melanoma. However, there could be a protective factor that is present only in females, or a factor that promotes the development of melanoma in males, that could explain a proportion of the gender differences in survival.

The incidence of melanoma and non-melanoma skin cancer in females has been steadily increasing in the USA, partially attributed to the rising use of artificial tanning devices. The World Cancer Research Fund found probable evidence associating arsenic in drinking water to increased risk of skin cancer (both melanoma and non-melanoma). Other food products and supplements have not been conclusively linked to risk of melanoma.

The State of Cancer Control in Australia

Prevention of melanoma focuses on public education and modifying behaviour to encourage sun-safe practices.
7.6.1.2 International prevention/screening/treatment programs

Prevention of melanoma focuses on public education and modifying behaviour to encourage sun-safe practices.\textsuperscript{46, 299} Sun-safe programs include the use of sunscreen, seeking protective shade cover, and wearing protective clothing, a hat and sunglasses.\textsuperscript{46, 282} Although initially considered controversial, the use of sunscreen has been shown to reduce the incidence of skin cancer.\textsuperscript{300} In the 1990s, broad-spectrum sunscreen, which filtered out both ultraviolet A and B radiation, became widely available and used in Australia.\textsuperscript{47} This may result in future reductions in incidence and mortality.\textsuperscript{47}

As part of public health initiatives, individuals are advised to seek medical attention if any moles change colour or increase in size at any stage.\textsuperscript{46} New initiatives to change individual behaviour are being trialled, such as the use of text messages to promote healthy behaviours to improve prevention and early detection.\textsuperscript{301} Campaigns encouraging reduced sun exposure, increasing sun safe practices, and educating health care and education workers to be sun-smart are more effective if coupled with government policies mandating changes in physical environments and practices.\textsuperscript{46}

Although a commonly diagnosed cancer, no existing screening programs have been endorsed for skin cancer.\textsuperscript{282, 299, 302} In 2009, the US Preventive Services Task Force found that there was insufficient empirical evidence to support the beneficial outcomes of a screening program, and limited information on how a screening program could be integrated into usual care.\textsuperscript{302} Other nations, however, differ in their approach and have implemented pilot screening programs.\textsuperscript{303} In Australia, specialised clinics run by dermatologists became popular in the 1980s and 1990s, and have been suggested to be an effective method of screening.\textsuperscript{304-306} Self-examination, in conjunction with a visit to the general practitioner, has been shown to reduce risk.\textsuperscript{307} Currently work is being done to develop a computer-assisted digital analysis of pigmented lesions to aid in early diagnosis that could be developed into a population-wide screening program.\textsuperscript{277} In the USA, much of the associated cost (approximately 90\%) of melanoma is from individuals with advanced lesions.\textsuperscript{46, 288} Thus, earlier detection would reduce the health care system costs related to this disease.\textsuperscript{286, 307} The required evidence to support this from a randomised controlled trial would be costly and difficult to source, because of relatively low incidence and mortality rates.\textsuperscript{303, 305}

Treatment for melanoma of the skin is commonly surgery, with non-surgical methods used in adjuvant treatments.\textsuperscript{277, 308} For many years, the most common treatment for melanoma has been excision.\textsuperscript{277, 279} Melanoma can also be successfully treated with interferon alfa-2b, an antiviral drug.\textsuperscript{309} If untreatable by surgery, the BRAF inhibitor drug, dabrafenib, can be used to improve survival from melanoma with little toxicity.\textsuperscript{210} Melanoma has been classified as a radio-resistant disease, thus radiotherapy has not been used extensively in its treatment.\textsuperscript{308} However, radiotherapy has been shown to decrease risk of regional relapse, but does not improve survival.\textsuperscript{308} Emerging evidence suggests that treatment of melanoma with β-blockers within 90 days of diagnosis could improve survival.\textsuperscript{311}

7.6.2 Incidence and mortality rates in Australia 1987–2007

Mortality rates of melanoma of the skin have decreased marginally over the 20-year period, while incidence rates have increased (Figure 7–11 and Figure 7–12). There has been an 11\% reduction in mortality associated with melanoma of the skin and a 17\% increase in incidence (Table 7–11). This suggests that melanoma is still an ongoing concern, despite positive survival rates. Considering the extensive sun protection campaigns implemented in Australia, the 11\% decline in mortality over the study period seems low. This could be associated with broad-spectrum sunscreen use only starting the 1990s, and the delayed effect of childhood exposure.\textsuperscript{47} Studies including a more detailed age-specific incidence analysis found a fall in incidence in younger age cohorts.\textsuperscript{312, 313} Research has also shown a general positive change in behaviour and attitudes in younger generations.\textsuperscript{312-314}
The prognosis for melanoma of the skin is good, despite its life-threatening nature. Patients require ongoing, long-term monitoring, which can become demanding and require a shared-care model between health care professionals. Ongoing monitoring can help reduce anxiety associated with the prospect of recurrence. As with most cancer types, at diagnosis and post-treatment, patients’ quality of life is lower than the general population. However, it increases over time. Quality of life can decrease during treatment with drugs such as interferon alfa-2b, but then return to normal after treatment has ceased. A German quality-of-life study has shown that patients’ scores are comparable to the general population two years after diagnosis without recurrence. It has been suggested that providing sufficient information to patients regarding melanoma improves their quality of life significantly.

Initiatives in Australia, including the SunSmart Program; the Mole Patrol; Slip! Slop! Slap! and Slip! Slop! Slap! Seek! Slide! have successfully raised awareness and improved behaviours – these programs are described in section 8.3.5.5. Modifying exposure to ultraviolet radiation could significantly reduce health care costs. A balance in sun exposure recommendations needs to be determined which takes into account both its vitamin D–related benefits and its harmful effects. This balance should be reflected in public policy and programs. Evidence of positive changes to individual behaviours as a result of Australian campaigns, and their cost-effectiveness, have seen them continue to the present day.

Skin cancer prevention in Australia is evolving. A skin cancer prevention policy has been developed in NSW to encourage the reduction of overexposure to ultraviolet radiation. Additionally, NSW and Victoria have planned legislation on the operation of solaria that will bring in a ban on all solaria by the end of 2014.

Table 7–11
Melanoma deaths and incident cases in Australia 1987–2007

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<thead>
<tr>
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<th>Deaths</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Observed in 2007 (O)</td>
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<td>Change in (O-E)/E (%)</td>
<td>-9</td>
<td>-14</td>
</tr>
</tbody>
</table>

*An average of the observed rates for 2006 to 2008 was applied to the 2007 population to calculate the observed number of deaths and incident cases for 2007.

†An average of the observed rates for 1986 to 1988 was applied to the 2007 population to calculate the expected number of deaths and incident cases for 2007.

§All figures have been rounded to the nearest whole number.

Table 7–12
Melanoma average annual percentage change (AAPC)

<table>
<thead>
<tr>
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<th>Mortality</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AAPC</td>
<td>Confidence Interval (95%)</td>
</tr>
<tr>
<td>Male</td>
<td>-0.5</td>
<td>-0.8, -0.1</td>
</tr>
<tr>
<td>Female</td>
<td>-0.9</td>
<td>-1.5, -0.4</td>
</tr>
<tr>
<td>Persons</td>
<td>-0.6</td>
<td>-0.9, -0.4</td>
</tr>
</tbody>
</table>

Figure 7–11
Melanoma age-standardised cancer mortality rates in Australia 1987–2007, 0–74 years

Figure 7–12
Melanoma: age-standardised cancer incidence rates in Australia 1987–2007, 0–74 years

The prognosis for melanoma of the skin is good, despite its life-threatening nature. Patients require ongoing, long-term monitoring, which can become demanding and require a shared-care model between health care professionals. Ongoing monitoring can help reduce anxiety associated with the prospect of recurrence. As with most cancer types, at diagnosis and post-treatment, patients’ quality of life is lower than the general population. However, it increases over time. Quality of life can decrease during treatment with drugs such as interferon alfa-2b, but then return to normal after treatment has ceased. A German quality-of-life study has shown that patients’ scores are comparable to the general population two years after diagnosis without recurrence. It has been suggested that providing sufficient information to patients regarding melanoma improves their quality of life significantly.

Initiatives in Australia, including the SunSmart Program; the Mole Patrol; Slip! Slop! Slap! and Slip! Slop! Slap! Seek! Slide! have successfully raised awareness and improved behaviours – these programs are described in section 8.3.5.5. Modifying exposure to ultraviolet radiation could significantly reduce health care costs. A balance in sun exposure recommendations needs to be determined which takes into account both its vitamin D–related benefits and its harmful effects. This balance should be reflected in public policy and programs. Evidence of positive changes to individual behaviours as a result of Australian campaigns, and their cost-effectiveness, have seen them continue to the present day.

Skin cancer prevention in Australia is evolving. A skin cancer prevention policy has been developed in NSW to encourage the reduction of overexposure to ultraviolet radiation. Additionally, NSW and Victoria have planned legislation on the operation of solaria that will bring in a ban on all solaria by the end of 2014.
7.6 Melanoma (C43)

References


7.7 Prostate cancer (C61)

7.7.1 Background

Prostate cancer is the most common cancer in males in Australia. The incidence of prostate cancer has risen globally, whereas mortality has seen a lower rate of change overall.\(^7\) IARC GLOBOCAN 2008 working estimates reported the incidence for prostate cancer was 20.4/100,000 in males under 75 years of age.\(^6\) Developed countries have higher rates of prostate cancer, attributed to the prevalence of PSA testing, with Australia recording the highest incidence rates of 105/100,000 for all ages.\(^5\) Mortality rates are 3.6/100,000 in males under 75 years of age globally and 6.6/100,000 in Australia.\(^5\)

Prostate cancer has no known carcinogen associated with its aetiology.\(^3\) It does not present in the early stages with any specific symptoms. Symptoms of advanced stage prostate cancer (eg weak or interrupted flow; difficulty stopping or starting the flow; frequent urination and blood; pain or burning associated with urination) are also generally symptoms of benign enlargement of the prostate.\(^2\) Higher than usual levels of PSA will be present in the blood if the prostate is enlarged, diseased or infected, not only if cancer is present.\(^3\) Although there is a strong association between PSA levels and prostate cancer, its specificity is only moderate.\(^3\) The Gleason score grades the prostate cancer tissue to determine the stage of the cancer. The clinical and histopathological staging, Gleason score and PSA levels are used independently and in combination to assess the stage of prostate cancer.

The incidence of prostate cancer in Australia increased dramatically in the early 1990s with the expansion of PSA testing. Incidence rates remain relatively high in Australia, again due to continued testing; however, mortality has changed to a lesser extent. Relative survival is relatively high, with a 92% probability of surviving for at least 5 years at diagnosis.\(^3\) The 5-year conditional relative survival was 93% at 1 year and 92% at 5 years after diagnosis.\(^3\) Five-year survival rates are higher for males in the highest SES group, and lower for males who are younger at diagnosis.\(^3\)
7.7.1.1 Causes and risk factors
The only risk factors clearly associated with prostate cancer are advanced age and family history of the cancer. There is speculation regarding the impact of early-life exposures, such as sex hormones, on the likelihood of developing prostate cancer that has stimulated further research. Research linking food and nutrition to prostate cancer risk has found probable evidence of foods containing selenium or lycopene and selenium (administered through a supplement) having a protective effect. On the other hand, there is probable evidence that diets high in calcium increase risk of prostate cancer.

A review of studies analysing the association between BMI and prostate cancer showed a significant relationship between high BMI and increased risk of future prostate cancer mortality in the general population. Overall, an estimated 12% to 20% of prostate cancer deaths have been attributed to BMI in the overweight and obese ranges. Unlike cancer in other sites, it has been suggested that diabetes mellitus reduces the risk of prostate cancer, possibly explained by lifestyle changes recommended to diabetes sufferers, which include a diet low in calories and fat that also reduces the risk of prostate cancer.

A link between increased risk of prostate cancer and tobacco consumption has not been conclusively proven. However, a recent study showed a higher risk for prostate cancer mortality in current smokers at diagnosis, and a moderate, but statistically insignificant, increase in risk for former smokers who quit 10 years before diagnosis, compared to never smokers. A pooled analysis of various cohort studies has shown a moderate increase in prostate cancer incidence and mortality with elevated levels of tobacco consumption. Conversely, a large European cohort study, the European Prospective Investigation into Cancer and Nutrition (EPIC) study, found that current smokers had a reduced risk of prostate cancer incidence in low-grade cases of the disease. However, heavy smokers or long-term smokers have an increased risk of prostate cancer-related mortality.

International analyses have identified an inverse association between ultraviolet radiation and prostate cancer incidence. Studies have varied in their strength of association between sun exposure and vitamin D with prostate cancer incidence but results indicate that less exposure to solar radiation leads to a higher incidence of prostate cancer. This is an area of active research.

7.7.1.2 International prevention/screening/treatment programs
Currently, finasteride and dutasteride are two chemoprevention drugs available which can reduce the amount of male hormones in the body to prevent prostate cancer. Their use decreases the incidence of low-grade cancers and increases the diagnosis of high-grade cancers. Both drugs have been found to lower the risk of cancer by 25%, but are also associated with side effects such as reduced libido and erectile dysfunction. Existing evidence surrounding primary chemoprevention for prostate cancer is inconclusive, but shows some promising results requiring confirmation.

PSA testing and digital rectal examination (DRE) are used to screen for prostate cancer. DRE is not considered to be as effective a method of screening as PSA testing, but generally recommendations suggest that the two tests are used in combination. Screening for prostate cancer using PSA testing has been subject to much debate, with doubt cast on the benefits being greater than the harm caused. PSA testing often detects cancer that may have otherwise gone unnoticed and not caused any harm or shortened survival. There has not been sufficient evidence from randomised controlled trials to support any population-based screening programs. Professional associations commonly recommend the use of PSA testing if the individual can potentially benefit and are well informed as to the uncertainty involved. For PSA testing to be recommended on a population basis, there need to be more specific trials to identify the thresholds for...
‘positive’ and ‘negative’ results, to limit overdiagnosis and unnecessary follow-up.\textsuperscript{323} This has resulted in larger studies, notably the European Randomized Study of Screening for Prostate Cancer and Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial, to track the long-term effect of screening on prostate cancer trends, including a revised method for determining the level of overdiagnosis.\textsuperscript{321, 323, 338, 340}

Treatment of prostate cancer can result in side effects that impact on quality of life, such as sexual dysfunction, incontinence and other adverse reactions that can cause longer-term harm.\textsuperscript{321, 338} In an analysis of incidence trends in the USA, it was estimated that over a million males had been diagnosed and treated for prostate cancer as a result of PSA testing.\textsuperscript{341} This increase was most notable in males younger than 50 years of age, and it is claimed that a large proportion of these males do not benefit from early detection.\textsuperscript{341} Current findings do not present screening programs in a positive and cost-effective light. It has been shown that over a 13-year period, there is no benefit gained from organised annual screening over opportunistic screening as part of usual care.\textsuperscript{340} As a result, recommendations suggest that males with a life expectancy of 10–15 years or less be informed of the limited usefulness of screening.\textsuperscript{323} Additionally, PSA testing is prostate-specific rather than prostate cancer–specific. The identification of alternative prostate cancer–specific biomarkers is urgently required.\textsuperscript{323} It has been concluded that screening does reduce mortality, but is associated with considerable overdiagnosis.\textsuperscript{342} In light of this, it has been found that males are willing to trade off the risk of prostate cancer if they are not subjected to unnecessary treatment for non–clinically concerning prostate cancer.\textsuperscript{343}

In Australia, media surrounding the diagnosis of celebrities with prostate cancer has resulted in spikes in levels of PSA test claims through the Medicare Benefits Scheme (MBS), and confusing messages, despite the known associated harms.\textsuperscript{344, 345} A Victorian study has recently shown that there has been a shift to earlier diagnosis of prostate cancer, with the majority of males diagnosed with localised disease.\textsuperscript{346} There is currently division between organisations in their support of PSA testing.\textsuperscript{347} Routine screening is not recommended by the NHMRC, but is funded through the MBS for males who have not previously presented with a prostate disease.\textsuperscript{348}

Active surveillance replaced watchful waiting as the preferred ‘passive’ treatment method as part of standard care.\textsuperscript{349} Watchful waiting defers treatment until a symptomatic, metastatic stage has been reached.\textsuperscript{349} Active surveillance follows the disease progression more closely with repeated and systematic monitoring of PSA tests and biopsies.\textsuperscript{349} These methods of closer monitoring before treatment have been proposed as a solution to overdiagnosis and overtreatment.\textsuperscript{349, 350} The results of existing trials of this method suggest similar mortality rates to that of the ‘overtreated’ population.\textsuperscript{350} The Prostate Cancer Research International: Active Surveillance Study, a worldwide observational prospective study, has thus far found that active surveillance is a viable option for monitoring patients without compromising their long-term health.\textsuperscript{351} Further trials are required with clear guidelines on patient selection and psychological counselling for patients managed by active surveillance and specific surveillance methods.\textsuperscript{350}

Current evidence suggests that following watchful waiting or active surveillance could benefit survival.\textsuperscript{352} Treatment for prostate cancer varies depending on age, stage and grade of the cancer. The number of males receiving curative treatment increased substantially from the early 1990s to 2011 in Victoria.\textsuperscript{346} Other medical conditions may also influence the treatment course chosen. Early-stage cancer can be addressed using surgery, external beam radiation or radioactive seed implants. Hormonal therapy, chemotherapy and/or radiation are required for more advanced cancers.\textsuperscript{20} Radiation oncology is now using more advanced techniques associated with conformal radiotherapy and intensity-modulated radiation therapy, as well as the introduction of tomotherapy, which are varying the treatment options for prostate cancer patients.\textsuperscript{347, 353}

7.7.2 Incidence and mortality rates in Australia 1987–2007

Our analysis shows that prostate cancer incidence has risen dramatically, by 276\%, from expected numbers (Table 7–13). Mortality has declined by 27\% (Table 7–13). Both are statistically significant changes (Table 7–14). The age-standardised mortality rates for prostate cancer also showed a decline in cancer deaths following a peak in the early 1990s (Figure 7–13). Figure 7–14 shows the change in incidence rates, illustrating the rise in the number of incident cases over the same period of time.
The increased in incidence can be attributed to PSA testing and the high-profile nature of prostate cancer in the media. As a result of the uncertainty surrounding the effectiveness of screening, prostate cancer initiatives have not been fully integrated into the Australian political agenda beyond the current reimbursement through the MBS and the recent allocation of funds to further prostate cancer research.\textsuperscript{102, 344, 348} Despite this, prostate cancer receives considerable publicity from initiatives such as Movember and the Prostate Cancer Foundation of Australia, raising concerns relating to the advocacy for annual screening tests without adequate information on the associated benefits and harm provided consistently.\textsuperscript{354} In recent years, Movember has broadened its focus to incorporate male mental health and testicular cancer as well as prostate cancer in its key messages.\textsuperscript{355}

Quality-of-life studies of prostate cancer patients often separate males according to the treatment they received. Treatment methods can result in specific side effects, such as declined sexual function, that affect physical and psychological elements of a patient’s quality of life.\textsuperscript{356, 357} A review of quality-of-life studies and the association with physical activity showed that exercise is an important part of survivorship and should be a regular and encouraged element of usual care.\textsuperscript{358} An Australian study comparing the longer-term quality of life of patients with localised prostate cancer found that there was little difference between groups based on the type of treatment they received.\textsuperscript{359} The most common negative effect of treatment in males with localised prostate cancer was sexual dysfunction, with poor urinary function also present but less common.\textsuperscript{357} Those having undergone external beam radiotherapy reported poor bowel function as a result.\textsuperscript{357}

It has been shown that patients with advanced prostate cancer have differing issues to those with localised cancer, and these differences are often only apparent in the results of longitudinal studies.\textsuperscript{356} Further research could be conducted in comparing different treatment types and identifying which types can maximise quality of life.
7.7 Prostate cancer (C61)

References


322 Medical Services Advisory Committee. Prostate specific antigen (PSA) near patient testing for diagnosis and management of prostate cancer. Canberra: Commonwealth of Australia 2005 (MSAC Application 1068).


7.8 Stomach cancer (C16)

7.8.1 Background

Stomach cancer, or gastric cancer, is the fourth most common cancer globally with an estimate of new cases just short of 1 million in 2008.5, 7 IARC GLOBOCAN 2008 working estimates reported the incidence for stomach cancer was 16.2/100,000 in males under 75 and 7.3/100,000 in females in the same cohort.5 Large variations in incidence and mortality are apparent between regions across the globe, with concentrations in Eastern Asia and Latin America.5, 7, 55, 360 Recent trends have shown a decline in incidence in Western countries.20, 361 Risk is reduced for immigrants moving from a high-risk country to a low-risk country, where they acquire the risk of the host nation within a generation of migration.360 Approximately 70% of new cases are found in developing countries, and the highest mortality rate was for Eastern Asia and the lowest in Northern America.5 The global mortality rates for individuals aged under 75 years of age are 11/100,000 in males and 5.2/100,000 in females.5

The prognosis for stomach cancer is generally poor, as patients are often diagnosed late and at quite an advanced stage.7 Stomach cancer is largely asymptomatic, or associated with non-specific symptoms, which is the reason for its late presentation and poor prognosis.52, 362 Beginning with precancerous lesions and often a progression from chronic gastritis, stomach cancers can largely be divided into subtypes. Cancers of the gastric cardia (the area of the stomach attached to the oesophagus), fundus and body of the stomach are referred to as proximal gastric cancers.52 Distal gastric cancers are found in the remaining two sections of the stomach. Stomach cancers are also often divided into cardia or non-cardia groupings, as incidence rates for these two groups vary significantly, with larger increases in incidence in industrialised countries.7 Distal gastric cancer is more prevalent in developing countries and in lower socioeconomic populations, whereas proximal tumours are common in developed countries.52 In contrast to this trend, there is a high prevalence of distal gastric cancer in Japan.52

In Australia, twice as many males are affected by stomach cancer than females.6 This is thought to result from environmental factors, with differing diets and poorer refrigeration of food products, but the relative importance of these factors is unknown.57 Relative survival is initially poor, with a 27% probability of surviving for at least 5 years at diagnosis. The 5-year conditional relative survival increases to 51% at 1 year.3 At 15 years after diagnosis, conditional survival jumps to 100%.3 Survival rates are higher for patients in major cities and decrease as SES decreases.3
7.8.1.1 Causes and risk factors

Stomach cancer is largely attributed to environmental causes.\(^7, 50\) It is more commonly diagnosed in individuals between the ages of 50 and 70 and is not common in individuals under 30 years of age, making age a risk factor.\(^50\) Overall, stomach cancer is more common in males, especially for the cardia subtype.\(^50\) For obvious reasons, diet has been associated with stomach cancer: specific dietary patterns are associated with distal tumours whereas obesity is commonly associated with proximal tumours.\(^52\)

Infection with H. pylori, officially listed by IARC as a carcinogen in 1994\(^7,\) can cause inflammation of the gastric mucosa and is the main risk factor of stomach cancer; however, only a small proportion of people with H. pylori will develop cancer.\(^51-53\)

It has been suggested that a diet high in fruit and protein-quality and non-starchy vegetables can lower the risk of stomach cancer.\(^7, 52, 363\) The World Cancer Research Fund found probable evidence to support the decrease in stomach cancer risk with the specific consumption of non-starchy vegetables, allium vegetables and fruits.\(^36\) On the other hand, there is probable evidence associating salt and consumption of salted or salty foods with increased risk of stomach cancer.\(^36, 364, 365\)

Evidence of risk associated with other food and nutritional factors was not conclusive, according to the World Cancer Research Fund’s report.\(^36\)

A recent meta-analysis has suggested that the consumption of cruciferous vegetables has an inverse association with risk of gastric cancer.\(^366\) Following a Mediterranean diet has been associated with a significant reduction in stomach cancer incidence.\(^367\) This association was not as strong for individual components of the diet: the overall diet had stronger protective effect, often associated with the higher proportion of plant-based rather than animal-based products.\(^367\)

The bacterium H. pylori is present in the stomach appears to be transmitted by saliva or faecal contamination.\(^205, 368\) All infected will develop gastritis.\(^368\) H. pylori infection has been shown to have causal relationship with non-cardia gastric cancer.\(^7, 54\) Although this is the strongest risk factor, only a small proportion of individuals with H. pylori will develop gastric cancer.\(^365, 368\) H. pylori is most prevalent in developing countries and is often acquired during childhood and present through to adulthood, but can be cured with antibiotics.\(^7, 369\) An increase in incidence of stomach cancer has been associated with the Epstein-Barr virus but the evidence is not conclusive, and the reason for the association has not been clearly established.\(^53, 213, 365, 370\)

In conjunction with specific dietary elements, cooking practices including broiling of meat, roasting, grilling, baking, deep frying in open furnaces, sun drying, salting, curing and pickling can increase the formation of N-nitroso compounds which can increase the risk of stomach cancer.\(^36, 52\) However, the evidence supporting this is limited.\(^36\) Excessive consumption of salted fish, pickled vegetables, cured meats and soy sauce can promote the development of Helicobacter pylori (H. pylori) that causes damage in the gastric mucosa, thus increasing risk.\(^50, 54\)

Additional lifestyle influences on stomach cancer include the consumption of alcohol and tobacco.\(^52, 55, 56\) Alcohol is an irritant on the stomach and regular consumption could increase the risk of stomach cancer.\(^52, 371\) The interaction between alcohol consumption and stomach cancer, while biologically plausible, is confounded by dietary factors and smoking.\(^371, 372\) A pooled analysis has shown that there is no association between moderate alcohol consumption and increased risk of stomach cancer; however, when consumption is heavy (four or more drinks per day), the risk of stomach cancer is significantly increased, especially in non-cardia tumours.\(^371\) Conclusive evidence has not been found to support this association in some cultural groups, such as the Japanese population.\(^372\)

Tobacco smoke is associated with increased likelihood of precancerous lesions and damage of the gastric mucosa leading to stomach cancer.\(^52, 373\) A meta-analysis showed that the risk of stomach cancer is 60% higher in male smokers and 20% higher in female smokers compared to never smokers, with similar but not as strong relationships for current and former smokers.\(^374\) A cohort study of ethnic minority groups in the USA showed similar results; however, only male former smokers were at higher risk than never smokers.\(^375\) Nomura et al.’s\(^375\) findings suggested there was a higher incidence of cancer of the cardia in ever smokers than distal gastric cancers in the cohort. Other cohort studies have shown similar results.\(^373\)

**History of stomach cancer in first-degree relatives can double or triple the risk.**
Evidence suggests that there may be some genetic influence on stomach cancer incidence.\textsuperscript{7, 50, 369} History of stomach cancer in first-degree relatives can double or triple the risk, depending on the number of relatives with the disease.\textsuperscript{362, 376} Approximately 10% of cases are hereditary.\textsuperscript{52} Because family members often share the same environments, hereditary cases of stomach cancer are also influenced by similar environmental risk factors in addition to genetic disposition.\textsuperscript{50, 52} The protective effect of aspirin against non-cardia gastric cancer, especially for individuals infected with H. pylori, has been suggested.\textsuperscript{377} Sufficient evidence also exists linking heavy long-term asbestos exposure, X- and y-radiation exposure or working in rubber manufacturing to stomach cancer.\textsuperscript{53, 177, 212}

7.8.1.2 International prevention/ screening/treatment programs

Prevention strategies are the best hope of continuing the trend of declining incidence and mortality associated with stomach cancer.\textsuperscript{369} Prevention initiatives for stomach cancer revolve around dietary controls and reducing the possibility of H. pylori infection.\textsuperscript{7, 364} Promoting positive dietary habits could reduce the burden of stomach cancer by approximately 50%.\textsuperscript{54, 57} Healthy living and eating campaigns work towards reducing associated risk factors.\textsuperscript{52} For stomach cancer, this also includes modified cooking practices and correct refrigeration of food items.\textsuperscript{52, 369} Clean water, sanitation and good hygiene are believed to limit the spread of H. pylori infection. Prevention of H. pylori is more effective if targeted at young individuals, before the infection has the opportunity to develop.\textsuperscript{364}

As a significant cause of stomach cancer, screening of H. pylori would be a simple test that could be of benefit despite the declining prevalence of bacterial infection in some countries.\textsuperscript{379, 379} Modelling simulations in the UK suggest a long-term benefit from a once-off test at age 40.\textsuperscript{378} Screening for stomach cancer involves imaging and endoscopy with a biopsy. Nationwide screening is not essential in all nations; however, in Korea and Japan, where incidence and mortality are high, mass-screening programs have been implemented as cost-effective ways of improving survival rates.\textsuperscript{360} No randomised trials have been conducted to objectively evaluate the efficacy of screening for stomach cancer to date.\textsuperscript{382} Use of the endoscopy screening method outside of Japan may not prove to be cost effective or practical, so a more appropriate method could be researched.\textsuperscript{360} The radiolabelled urea breath test, which is used to diagnose H. pylori, has been trialled and proposed as a potential mass-screening method for stomach cancer.\textsuperscript{380}

Very small tumours can be treated using an endoscopy; otherwise, the gold standard treatment for stomach cancer is a total or subtotal gastrectomy.\textsuperscript{360, 381} Radiotherapy and chemotherapy in advanced cases of stomach cancer are limited in their usefulness because of poor survival prognoses.\textsuperscript{52} However, adjuvant therapies used to treat recurrence can be of some benefit to survival.\textsuperscript{360, 361} Adjuvant chemotherapy can improve survival when compared to best supportive care.\textsuperscript{381} Combined agent use, rather than single agent, is largely used in Western countries and proven to be statistically more effective, but is not widely used as standard treatment in countries such as Japan.\textsuperscript{381} The role of radiotherapy in treatment is considered controversial in its clinical benefit, but was shown to have a significant impact on five-year survival.\textsuperscript{381} Treatment of non-curative patients has not shown evidence of improvements in survival or mortality rates.\textsuperscript{382} Often surgery is undertaken in this patient group to relieve specific obstructions or to ease suffering, but these procedures often have poor outcomes.\textsuperscript{382}

7.8.2 Incidence and mortality rates in Australia 1987–2007

Incidence and mortality dropped in both males and females over two decades (Figure 7–15 and Figure 7–16). There has been a 50% decrease in mortality and a 34% decrease in incidence over this time period, both of which are statistically significant (Table 7–15 and Table 7–16). The observed falls in mortality and incidence reflect improvements in living standards from the 1920s, when the prevalence of H. pylori began to decline.\textsuperscript{7} There is some evidence of lower prevalence of H. pylori in younger adult groups,\textsuperscript{383} suggesting further reductions in stomach cancer may occur in the future.
Considering the low survival rates of stomach cancer initially, quality of life has been compared for various treatment types to assess the impact of necessary and unnecessary treatments.\(^{360}\) In a group having undergone a subtotal or total gastrectomy, quality of life was significantly reduced after surgery and took approximately six months to stabilise.\(^{384}\) Total gastrectomy patients had lower quality-of-life scores than those who having undergone a subtotal gastrectomy, up to 12 months after surgery.\(^{385}\) In comparing the laparoscopy-assisted distal gastrectomy with open distal subtotal gastrectomy, it was found that although the former is preferred because of reduced pain and faster recovery in the individual, the quality of life associated with a laparoscopy-assisted distal gastrectomy was lower up to five years after treatment.\(^{386}\)

Current public health initiatives run by the Australian Government aimed at reducing tobacco and alcohol consumption and promoting healthy eating practices address many of the environmental factors that can increase the incidence of stomach cancer. Although analyses of stomach cancer trends in areas of Australia have suggested lower risk for Australian-born individuals compared to other nations,\(^{382}\) specific groups, including immigrants from high-prevalence countries, present a more immediate issue for policymakers.
7.8 Stomach Cancer (C16)

References


8 Cancer control policies, programs and emerging issues

8.1 Cancer as a non-communicable disease and cancer control

In 2008, an estimated 63.5% of deaths worldwide were attributed to non-communicable diseases (NCDs). Estimates from 1990 to 2010 show the shifting contribution of risk factors to the global burden of disease moving from communicable diseases in children to NCDs – cardiovascular disease, cancer, diabetes and chronic lung disease – in adults. The world's population is growing, life expectancy is increasing, and the demographic composition is shifting to comprise a higher proportion of older people, leading to a continued rise in the burden of NCDs. As a consequence, healthy ageing is prominent in health agendas with a key focus on control of chronic disease risk factors. The existing body of evidence shows that addressing the known and modifiable risk factors of NCDs can reduce a large proportion of these deaths and their associated social impact, consistent with healthy ageing public health campaigns. Despite this, the likelihood of a cure for NCDs is low once they have developed, except in some cases. Changing population trends suggest that existing programs require revision to incorporate older cohorts, who are generally outside the target groups for interventions and treatment.

In 2008, an estimated 12.4 million new cases and 7.6 million deaths were attributed to cancer globally. The importance of addressing cancer control is undeniable. However, governments traditionally focused on cancer care. Cancer care and treatment are limited to cancer patients and their support networks, whereas control incorporates the potential to prevent cancer occurrence and recurrence and improve quality of life, using current knowledge and modern techniques for prevention, care and treatment. Specifically, cancer control has been described by WHO in the following way:

Cancer control aims to reduce the incidence, morbidity and mortality of cancer and to improve the quality of life of cancer patients in a defined population, through the systematic implementation of evidence-based interventions for prevention, early detection, diagnosis, treatment, and palliative care. Comprehensive cancer control addresses the whole population, while seeking to respond to the needs of the different subgroups at risk.
This shift from care to control stems from the preventability of NCDs, where a whole-of-population approach can ease the disease burden by addressing modifiable risk factors and implementing appropriate screening programs. Analysis of the American population has suggested that approximately 60% of cancer deaths are potentially avoidable, as they were attributed to modifiable risk factors. There is not one main risk factor for all cancers, and risk factors can vary depending on the background genetic makeup of a population and the presence of other risk factors or co-factors. Investing in rigorous local research in cancer control to understand the relative importance of known and emerging risk factors is needed to underpin the strategic basis for cancer control implementation and health care system transition.

Since the early 1980s, greater public awareness has increased the prominence of cancer. This is not solely a result of increasing diagnosis rates, but due to changes in societal attitudes and the health care context. In developed countries, cancer is now better understood – socially – than in the past, and discussed more openly. With treatments and survival rates improving, there is now less of a stigma around cancer, with some exceptions. However, the plethora of confusing messages about the cancer burden can leave the impression that control measures are underperforming. Improved care and treatment of other NCDs such as heart disease and stroke, traditionally major causes of death, have resulted in cancer becoming a leading cause of death. This increases the likelihood of the elderly dying of cancer. Time exposes the elderly to more carcinogens and genetic changes, resulting in higher cancer incidence and mortality.

This section presents a snapshot of cancer control as a health policy priority globally and nationally over recent years. Tracking these changes in public health initiatives and developments in cancer control provides a context in which trends in cancer incidence and mortality can be understood more completely. WHO provides leadership on global health and guidance for cancer control programs, beginning with preventive health and moving through to palliative care, and policy and advocacy initiatives. Here we outline the broader guidelines for cancer control established at global and regional levels, which are used as recommendations for the cancer control approach in Australia.

8.2 Cancer control globally

WHO is leading the drive to integrate issues relating to NCDs and cancer control in national health agendas. The WHO-developed cancer control program outlines actions for cancer control program development incorporating the six elements of planning, prevention, early detection, diagnosis and treatment, palliative care, and policy and advocacy. WHO encourages governments to combat cancer through a systematic approach, with the involvement of stakeholders and effective partnerships to support implementation. WHO has more recently incorporated cancer control into their action plan and strategy for NCD prevention and control, to facilitate the integration of key principles in practice. The complexity of cancer control can overshadow basic steps that can be implemented, especially in developing nations, such as vaccination for hepatitis B, improved sanitation and safe blood transfusions to reduce the burden of disease associated with cancer.

Frameworks and recommendations need to be implemented at both regional and country levels. In response, some regions have formed collaborations to meet targets. For example, the European Union has acknowledged capacity and resource limitations in the region to meet WHO recommendations. A collaborative project across member nations to determine cancer health indicators was subsequently funded. The inherent diversity in populations and geographies must be applied to a global framework, and incorporate differences in treatment settings and government policy to be effective. Political processes and legislation often fail to set adequate disease-prevention priorities at national levels. However, responsibility for cancer control is not solely reliant on government policy. Cancer control is the responsibility of all stakeholders, from governments and their agencies to for-profit organisations in the health sector and non-health sector, as well as NGOs and the broader community.

Working with WHO recommendations, the Australian Government has begun integrating cancer control into the health agenda at a federal and state/territory level. This work has involved collaboration between a number of government agencies and NGOs. Other stakeholders play a role in various facets of the process, as exemplified by key NGOs. The specific role of NGOs in cancer control is not well described or defined, but they are generally seen to play an important part in promoting and supporting cancer control.
8.2.1 The role of NGOs
As no individual institution has the capacity to provide comprehensive NCD or cancer control initiatives and care services, a consortium of agencies from government, for-profit and not-for-profit sectors come together to provide the spectrum of services required. Traditionally, NGOs are formed by groups with common interests or to provide a service, often associated with religious institutions and generally more active in health care, delivering welfare and other community services.407-409 NGOs generally operate at a local level and have strong local community ties through their formal and informal networks – often undertaking activities that are not deemed viable in for-profit organisations or the government sector.408, 409

Generally speaking, NGOs have brought about changes in government policy and attitude by stimulating political processes to drive action from the ground up through social movements.406 Their independence from the government allows NGOs to advocate for issues that may not be on the political agenda411 and, as such, NGOs play an important role in increasing the awareness of the general public and key decision-makers about cancer control issues.412 Further, because of their community links, NGOs can extend the reach of prevention programs, take on their implementation, or take the lead in cancer control planning in the absence of government leadership.413 NGOs can trial and pilot programs or interventions that may be considered too risky or impractical by governments until detailed data are available.407 Cancer advocacy has traditionally begun with cancer societies and other related NGOs.411 NGOs provide a link between the clinical setting and the community.

The role of NGOs in cancer control is more often assumed rather than explicitly defined. At a global level, the Union for International Cancer Control (UICC) drives cancer control advocacy globally through member states, WHO and government agencies.412 Recently, the UICC produced a collaboratively established World Cancer Declaration, with the aim of gaining commitment from all stakeholders to reduce the global cancer burden through improved screening and diagnosis, adequate access to treatment, adequate vaccination programs, sufficient training programs for health care professionals, and prevention.413 At a national level, there are some examples of formalised approaches to cancer control, such as the Canadian Strategy for Cancer Control and the National Cancer Research Institute in the UK.414, 415

The effectiveness of NGOs is not widely reported in the area of cancer control. The broader literature on NGOs details the debate surrounding ownership and its effect on health outcomes.410 Public perception reportedly favours for-profit organisations for their provision of perceived better care.416 However, studies have indicated more positive results in NGOs, with lower numbers of deaths, lower cost of care and higher quality of care.417-420

In Australia, the government and the not-for-profit sector have recently entered into a partnership to establish a shared vision for NGOs: the National Compact. This followed the 2010 Productivity Commission Report claiming that the sector was uncoordinated, with differences between Commonwealth and state/territory level directives.421 Australian cancer control collaborations between NGOs and other agencies appear to be on an ad hoc basis. There are a number of NGOs with an interest in cancer control, and they are often specifically focused on a particular cancer site. One of the largest groups of all cancer NGOs is Cancer Council Australia and its independent members in each state and territory. Cancer Council aims to help beat cancer through research, and also provides patient information and support services.422 The national coverage available through the state and territory–based Cancer Council offices provide a breadth of services that is not always possible through NGOs.422

Collaborations have also been born from particular elements of cancer control, such as the Cancer Research Leadership Forum, which brings together NGO cancer research funding bodies in an effort to improve collaboration and coordination of investments. NGOs are part of a larger approach to cancer control involving a number of government agencies and policies guiding specific initiatives and programs. The approach taken in Australia is outlined in section 8.3. This also describes some NGO activities relating to cancer control in Australia.
8.3 Australian approach to cancer control

Cancer is the largest cause of disease burden in Australia, resulting in approximately 30% of all deaths in 2010. A greater proportion of older people are affected by cancer, with the mean age of diagnosis being 67 for males and 64 for females in 2007. With a population of 22.6 million, Australia had one of the highest incidence rates of all cancers globally in 2008, with an age-standardised incidence rate of 314/100,000 and an age-standardised mortality rate of 103/100,000. According to the IARC GLOBOCAN 2008 working estimates, the age-standardised incidence rate of cancer was higher in Australia than in any other country, largely due to the higher rate of melanoma of the skin and prostate cancer.

Geographic and demographic characteristics specific to Australia affect cancer control and its implementation. For example, the composition of Australia is such that the population is concentrated on the eastern coastline, while Western Australia and the central parts of the continent are sparsely populated. Geographic location can affect the ability to access health care services and cancer survival rates, depending on the type of cancer, with survival decreasing as remoteness increases. Cancer incidence and mortality can also vary in different population groups. Immigrant population groups have cancer incidence and mortality trends that vary from Australian-born people. With 29% of the Australian population over 15 years of age born overseas, this is an emerging issue.

Cancer risk factors can affect these groups differently, based on their host nation trends, such as a higher prevalence of hepatitis B in Vietnamese immigrants.

Keeping in line with global trends, the current focus of the Australian Government is on improvements in preventive health, healthy ageing, acute care and primary health care; equality in funding and access to services; integration of technology; and retention and continuing development of the health workforce.

The treatment of all NCDs, including cancer, requires distinct functionality from the health care system. Almost universally, health care systems have traditionally serviced patients with acute conditions and are now challenged by chronic illness management and addressing NCD risk factors. The need for hospital services is increasing, with 1 in 10 hospitalisations a result of cancer-related issues in 2010/11. Maintaining a system which provides the most effective and efficient level of service is an ongoing challenge.

8.3.1 Health care in Australia

Health is a state/territory issue but is made more complex by national frameworks on primary health care, and drug and alcohol consumption. Cancer control can be considered a national issue and, as will be shown, many national policies affecting cancer are developed nationally but jointly coordinated by the Australian Government and the individual State or Territory Governments. The precise nature of the split between these government levels varies by specific initiative. For example, the MBS and the Pharmaceutical Benefits Scheme (PBS) are both managed federally by the Australian Government Department of Health and Ageing (DoHA) and administered by the Department of Human Services. The MBS, the federally funded public health care system, allows access to hospital treatment and services as well as some out-of-hospital treatment and services, and dictates the services that are subsidised by the Australian Government. The PBS outlines subsidised pharmaceutical products. The public health care system operates alongside private health care offerings available, and various other medical and complementary medicine treatments and services.

Recent health system reforms have divided the funding for primary care and hospitals, which has made the federal and state/territory separation more challenging. A national funding pool, the Health and Hospitals Fund, was recently created for public hospitals, removing the financial responsibility from the states and territories. Recent primary care reform addressed the accessibility of health services, through GP Super Clinics and Medicare Locals, by providing care in underserviced areas and boosting healthcare workers in areas of need. Ideally, this will relieve the pressure in public hospitals.

Changes to the health care system have been stimulated by increasing health care costs. Specifically, the financial burden of cancer is high and rising. Mainly attributed to treatment costs, estimated health expenditure on cancer from 2003 to 2033, assuming a decrease in cancer incidence over this period, has been projected to increase by a total of AUS$6.6 billion to AUS$10.1 billion. Rises are attributable to increased services required per cancer
case, population growth, an ageing population and price inflation. The total lifetime economic cost of cancer for people from diagnosis onwards in Australia was estimated to be approximately AUS$94.6 billion in 2005, with 29% representing health care costs (including treatment). 434

The direct and indirect health care costs can constrain nations to prioritising cancer care investment over integrated cancer control programs or research initiatives, especially in times of financial strain. 391 The cost of cancer treatment in the public health system and to the individual patient is increasing at a greater rate than the launch of treatment innovations to market.391, 435, 436 Even when new drugs are released to market, the cost-effectiveness ratio is often above acceptable thresholds.437 Over the last 20 years, there has only been a handful of new drug treatments that have significantly changed cancer care. 438, 439 Novel interventions have been developed, but the cost-effectiveness of their use in cancer care has limited their adoption.391, 435 Public funding for new drugs or treatments is subject to scrutiny by committees independent of government decision-makers, to ensure objective assessments of their cost-effectiveness. There is considerable public funding associated with health care: in 2009/10 more than two-thirds of the total health expenditure was funded by the Federal, State, Territory and Local Governments.1

At a national level, health priorities and allocation of funding has been done by the Council of Australian Governments, which represents Federal, State and Territory Governments and the Australian Local Government Association. It promotes policies of national significance and is involved in key decisions pertaining to the health care system, with the input of health ministers through the Standing Council on Health. This Council is a grouping of all health ministers and is responsible for the overall coordination of public health care delivery. The Australian Health Ministers Advisory Council (AHMAC) advises the Standing Council on Health and is a group of the head health authorities from all government levels. The Medical Services Advisory Committee and the Pharmaceutical Benefits Advisory Committee are the independent committees that advise Australian Government on the cost-effectiveness of new drugs or treatments. Then there are a number of agencies that feed information back to this central point (Figure 8–1).

Shifts in funding uses and policy position on health care often coincide with changes in government leadership. Evidence-based decision models are not used as commonly in public health to guide policy implementation as in clinical practice.440, 441 The relationships and policies relevant to cancer control are depicted in Figure 8–1 to aid our understanding of the evolution in policy and high-level decision-making.

8.3.2 Evolution of cancer control and related policies in Australia

Beginning in the 1980s, cancer control has been incorporated into the national strategic direction for health.58 In 1996, cancer control became a National Health Priority Area and officially on the political agenda.442 The first National Action Plan for cancer was created in 2001443 and led to the Priorities for Action in Cancer Control: 2001–2003 plan outlining prevention, screening, early detection, treatment, support and palliative care.442 The 2001–2003 plan was followed by the National Service Improvement Framework (NSIF) for Cancer in 2005.443, 444 The NSIF outlined high-level policy priorities across the cancer control spectrum.444 All governments in Australia – federal, state and local – endorsed the NSIF; however, there was no implementation plan. A number of the NSIF initiatives have nonetheless been implemented over subsequent years. Individual states and territories were encouraged to form their own localised plans in the place of a national plan.

![Figure 8-1 Australian government and preventive health structure](https://example.com/fig8-1.png)
Up to this point, policy was leading cancer control in the correct direction but the lack of national leadership inhibited overall implementation. A national agency, Cancer Australia, was established in 2006, designed to guide related policy recommendations and the direction of cancer control nationally. However, since 2005, there has not been any updated national plan. In 2010, a National Cancer Expert Reference Group was brought together and was expected to issue a National Cancer Work Plan in 2011 (not publicly released at the time of writing). The National Cancer Work Plan and the National Cancer Workforce Strategic Framework will set the framework for providing coordinated care and fostering a workforce to support ‘best practice’ care in the future. On a regional level, NSW has established a statewide government cancer-control agency, Cancer Institute NSW, responsible for design, delivery and evaluation of public awareness campaigns. Their mission is to improve outcomes in cancer diagnosis, treatment, care and ultimately, survival. This model has not been adopted by other states and territories at this stage.

Since the early 1980s, much of the policy-related activity has revolved around the known risk factors of cancer – tobacco control, alcohol control and nutrition. During the same period, prevention became part of the health agenda. In 1996, the National Public Health Partnership (NPHP) was established to develop a national approach to public health issues, with a prevention focus. Beginning in 1997, prevention was incorporated into a series of Public Health Outcome Funding Agreements, including funding for the breast and cervical cancer screening programs, and later colorectal cancer screening, and placed cancer in the spotlight. The NPHP was disbanded and replaced with two subcommittees of AHMAC in 2006. In 2008, as these agreements were coming to an end, the Minister for Health and Ageing announced the formation of the National Preventative Health Taskforce (the Taskforce), with the aim of developing strategies to tackle the health challenges caused by tobacco, alcohol and obesity, all issues relating to cancer control.

Current key health policies, strategies and agencies relating to cancer control predominantly revolve around the modifiable risk factors of tobacco control, alcohol consumption, nutrition, physical activity and obesity. The focus on modifiable risk factors aligns with cancer control principles and emphasises prevention. Past and present policies are outlined in Table 8–1 as far as they relate to cancer screening, modifiable risk factors and other health issues. The key national policies and strategies relating to specific cancers or risk factors are detailed in section 8.3.5. Some of the more recent strategies around women’s health, men’s health and primary health care are not directly related to cancer, but effective cancer control relies on a well-functioning public health system, improved infrastructure and coordinated primary care. In this way, these strategies improve the platform from which cancer control initiatives are provided. National strategies pave the way for policies and implementation plans in individual jurisdictions. For this reason, many recent strategies have detailed the overarching primary health care issues or health system reform. The aim is to establish an equitable system across the nation to reduce chronic diseases in all Australians.

The National Partnership Agreement on Preventive Health (NPAPH) is the most recent policy to provide practical interventions aimed at creating healthier environments for all Australians. In 2009, the Taskforce developed the National Preventative Health Strategy, which focused on seven strategic directions to reduce premature death, illness and suffering through preventive strategies. Funding has been allocated to these initiatives through the NPAPH, with a maximum total of AUS$872 million committed from 2009 to 2015. The focus on modifiable risk factors aligns with many cancer control strategies that are focused on cancer prevention. The targets set are:

- To stop and reverse the increase in overweight and obese Australians
- To reduce daily smoking rates to 10% or less by 2020
- To reduce short-term risky/high-risk alcohol intake levels to 14% and long-term risky/high-risk levels to 7% by 2020
- To contribute to the National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes targets

Health care reform overall was formalised in July 2012 through the National Health Reform Agreement (NHRA), after two years of negotiation between the Federal, State and Territory Governments, with the aim of improving the delivery of health and aged care. The focus of the NHRA is around patient access to services and improving the efficiency of public hospitals, which are run by the State and Territory Governments and primary health care. Public
### Table 8-1
Past and present policies on modifiable risk factors in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Cancer Screening</th>
<th>Modifiable risk factors</th>
<th>Health care system and primary care issues</th>
</tr>
</thead>
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<td>2006</td>
<td>National Alcohol Strategy</td>
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<td>National Cancer Workforce Strategic Framework</td>
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funding and quality standards are also major elements of this reform, with initiatives to improve transparency and accountability through the Health and Hospitals Fund. All elements of cancer control rely on a well-functioning public health system and coordinated primary care. In this way, the NHRA intends to improve the platform from which cancer control initiatives are provided.

The National Drug Strategy is a policy framework to drive the minimisation of alcohol, tobacco and other drug-related harm to Australians. It aims to improve health, social and economic outcomes. Individual policies for drug types are being developed with the National Tobacco Strategy and National Alcohol Strategy already released. There are also state-based strategies that mandate requirements at the grassroots level.

8.3.3 Government agencies

Changes in the 2000s led to the inception of a number of government agencies designed to guide health reform implementation (Figure 8–1). The National Health Performance Authority, the Australian National Preventive Health Agency and Health Workforce Australia (HWA) have all been created from 2009 onwards, and have been given the brief of monitoring the performance of the public health system, improving health outcomes through prevention, and building capacity of the health workforce, respectively.

Other related agencies include the AIHW, the ABS and the NHMRC. The AIHW is a national monitoring agency established in 1987 for the collation and provision of information and statistics. All health and welfare issues are covered, and cancer-based reports are produced using data from the ABS, the national statistical agency, and state and territory cancer registries. The NHMRC’s role is to promote the development and maintenance of public and individual health standards through managing research funding, and developing advice on health-related issues. It assists in setting research priorities and directing funding to important health and medical research areas.

The complexities of the systems governing cancer control and the number of policies and programs that exist present a challenge for the Australian Government to manage effectively. Additionally, many of the government agencies working in the healthy ageing and preventive health space have been established only relatively recently. As a result, in their initial phases, these agencies have had to develop a proven reputation to be able to influence and indeed modify individual behaviours. Working at a national level, there is also the potential for duplication of roles or responsibilities, with existing organisations at both national and regional levels. These factors, combined with the political agenda set by the Australian Government, can take the focus off the main aim of cancer control initiatives in practice. In these situations, NGOs, which often have goodwill in the community and reputable backgrounds, can be effective in promoting the cancer control programs in the long term.

Leadership in health care and cancer control is important to the success of new initiatives. Laws and regulations can be used as tools to modify behaviour of populations, through legislation restricting or changing access to harmful substances or limiting harmful situations, and improving access and availability of health services for primary and secondary prevention. Health promotion activities conducted in parallel to legislative changes promote the sustainability of behavioural changes initiated by an individual, and can modify the local environment to support healthier living. For cancer control, further regulation is required on the tobacco, alcohol and food industries. To date, only changes to tobacco consumption have had a notable effect on modifying the behavioural risk associated with cancer.

8.3.4 Australian cancer control policy

Individual states and territories have developed specialised cancer control plans. In NSW, for example, the Cancer Institute NSW led the process for the development of a cancer plan aimed at increasing the survival rate for cancer patients, reducing the incidence of cancer, improving the quality of life of cancer survivors, and developing expertise in cancer control for the region. In Victoria, the State Government prepared a cancer action plan to ensure all individuals have access to services throughout the process of cancer control. The overall aim is to increase the cancer survival rate to 74% by 2015.

The uniquely diverse population of Australia has resulted in some differences in health outcomes among some minority and ethnic groups. Many reasons for these differences have been debated, but generally revolve around more limited access to screening, diagnostic and treatment services. Participation in preventive health programs and clinical trials could also have influenced these differences apparent between minority groups and the overall population. Notable exceptions are lower incidence and mortality rates of melanoma and colorectal cancer in immigrants – with the exception of those who are New Zealand–born for colorectal cancer, compared with Australian-born individuals. Higher
rates of melanoma are thought to be because of the higher exposure of Australian-born people to ultraviolet radiation in early childhood. Considering this cultural diversity, ethnic differences are a specific focus of the Australian Government. However, reliable data in relation to incidence and mortality of immigrant populations is not routinely available.

8.3.5 Existing cancer control-related programs and initiatives

Government spending on public health programs has been steadily increasing. Most recently, the Australian Government allocated AUS$872 million over 6 years to the NPAPH, the largest government spending on health promotion and associated activities to date. For the financial year 2009/10, the public health investment in Australia by government and non-government agencies was AUS$2 billion. This was down from the previous years, when spending reached a high of AUS$2.3 billion in 2007/08. The level of spending fluctuates depending on the particular initiatives being conducted in a given time period, and although not all expenditure is cancer-related, the higher levels of spending before 2009/10 were attributed to the implementation of the National HPV Vaccination Program.

Currently, the range of public health and preventive services in Australia are coordinated and administered by the previously mentioned agencies in conjunction with additional stakeholders made up of both intra- and intergovernmental agencies. Broadly, the services that relate to cancer control are:

- Immunisation services and other communicable disease control
- Programs to reduce the use and harmful effects of tobacco and alcohol
- Prevention programs to reduce weight gain and to promote physical activity and healthy eating choices
- Programs to promote sun protection
- Environmental monitoring and control, including management of harmful chemicals
- Screening programs for breast, cervical and colorectal cancer.

Programs, positions and other non-government agency initiatives are not always specific to cancer control but address the underlying modifiable risk factors. They are outlined using the National Cancer Prevention Policy as a framework. The policy detailed recommendations for cancer prevention that require action on national level from governmental and non-governmental stakeholders.

8.3.5.1 Indigenous people

Aboriginal and Torres Strait Islander people (hereafter respectfully referred to as Indigenous people) comprise approximately 2.5% of the Australian population. Overall, the life expectancy of Indigenous Australians is 10 years lower than non-Indigenous people, and is similar to that of the life expectancy reported for low–middle income countries. The high burden of cancer contributed greatly to this difference in overall disease burden and life expectancy.

Although not a key element of the analysis, it is important to acknowledge Australia’s diverse ethnic composition affects cancer incidence and mortality rates. Since 2008, efforts to quantify the effects of ethnicity on incidence and mortality have led to improvements in recording Aboriginal and Torres Strait Islander status on pathology, hospital admission, outpatients forms and the death certificate. To specifically address issues relevant to Indigenous people, the DoHA released an Indigenous Chronic Disease Package as part of the National Partnership Agreement on Closing the Gap in Indigenous Health Outcomes, to initiate preventive programs and improve access to primary care services.

8.3.5.2 Tobacco control

Globally, tobacco smoking is the most serious risk factor of premature mortality and cause of cancer. Not only is smoking a cause of cancer, but environmental smoking has a causal relationship with increased cancer risk in males and females. Preliminary studies linking smoking and cancer came to light in the 1940s, but anti-smoking campaigns gained more powerful momentum in the 1960s and 1970s, with landmark reports in the USA and the UK, and Doll and Peto’s reporting of the association between excess risk of lung cancer and number of cigarettes smoked. Tobacco control is one of the main areas of cancer prevention, as smoking is the number one most preventable cause of poor health, and the disease burden...
caused by smoking is still considered unacceptably high in Australia.\textsuperscript{457, 461} Estimates of tobacco-attributed deaths in Australia from all causes range from 15,000 to 19,000 per annum,\textsuperscript{483} and smokers reduce their life expectancy by an estimated 10 years.\textsuperscript{484, 485}

Historically, there have been higher mortality rates in males associated with smoking than females. Recently, the rates for females have risen and risk of mortality is almost identical to males.\textsuperscript{233, 485} The Million Women’s study in the UK showed that females who ceased smoking at 40 years of age avoid approximately 90% of the risk of current smoking, despite their higher mortality rate than never smokers.\textsuperscript{486} This supports other analyses which have shown that smoking cessation, rather than a reduction in smoking, is most effective in reducing death from any cause.\textsuperscript{233}

In Australia, public health campaigns to promote smoking cessation began in the early 1980s.\textsuperscript{456, 467} Adult smoking prevalence (regular smokers) in 1980 was 30% in females and 41% in males.\textsuperscript{467} The Australian Government’s approach to tobacco control was formalised in 1991, with the National Health Policy on Tobacco, raising the issue to the status of national health concern.\textsuperscript{468} Over time, national strategies relating to tobacco have been released, and have increased the legislation pertaining to tobacco advertising, distribution and consumption.\textsuperscript{467, 488} In 2010, prevalence of regular smokers dropped to 18% in females and 22% in males.\textsuperscript{467} The overall number of daily smokers dropped between 2007 and 2010 in people over 14 years of age, but the number of smokers remained stable of this period.\textsuperscript{270} The drop is attributed to a variety of policies, restrictions, taxes and public health campaigns.

National public health awareness campaigns are being conducted to further reduce prevalence. Over 4 years, AUS$61 million of the NPAPH is being used for a national social marketing campaign on tobacco risks, with specific campaigns initiated to access particular groups of people, such as pregnant females and people living in low socioeconomic areas.\textsuperscript{469} The national QuitNow program aims to support individuals through the whole smoking cessation process by providing personalised support.\textsuperscript{469}

Currently, a National Tobacco Strategy exists and is a guide for legislation at a State and Territory Government level. Additional restrictions are in place to improve tobacco control, such as advertising regulations for tobacco products limiting their promotion, and smoking bans in restaurants, pubs and other public places.\textsuperscript{454} Packaging of cigarettes has undergone major changes to include graphic warnings and, more recently, the plain packaging of cigarettes.\textsuperscript{450} Higher excise taxes have been introduced to reduce the affordability of tobacco and, hopefully, to discourage more people from smoking.\textsuperscript{465} In August 2013, it was announced that the excise tax would be increased again by a further 12.5% over a 4-year period to reduce premature deaths and diseases caused by smoking.\textsuperscript{461}

### 8.3.5.3 Alcohol control

Alcohol is similar to tobacco in that it is one of the known lifestyle factors associated with increased cancer risk.\textsuperscript{492} Changes to legislation on a global scale have been recommended to address the harmful use of alcohol and support behavioural change.\textsuperscript{493} Alcohol drinks and ethanol are carcinogenic to humans, and there is a dose-response association with cancers of the oral cavity, pharynx, larynx, oesophagus, colon and rectum, liver and female breast.\textsuperscript{72} Limited consumption of alcohol is recommended to reduce the risk of cancer,\textsuperscript{494} as existing evidence does not indicate a level of consumption where the risk of cancer is increased or decreased.\textsuperscript{38} However, emerging evidence identifies heavy alcohol consumption (≥50 grams per day) as having a positive association with increased risk of all cancers and low alcohol consumption (≤12.5 grams per day) with a reduced risk of cancer.\textsuperscript{492} These new findings, along with the beneficial effect of low-level consumption on cardiovascular health,\textsuperscript{495, 496} suggest that further research is needed to establish the dose-response relationship in specific cancer types.

Beginning with a national health policy on alcohol in Australia in 1989, levels of alcohol consumption have been addressed in various legislations through to the National Alcohol Strategy (2006–2011; not updated at the time of writing) and incorporated into the National Drug Strategy framework (2010–2015).\textsuperscript{462, 464, 487} NHMRC guidelines, beginning in 1986, have consistently recommended limited consumption of alcohol to avoid the harmful effects of alcohol.\textsuperscript{493} In 2010, the number of people over 14 years of age consuming alcohol on a daily basis declined in comparison to 2007.\textsuperscript{270} There was only very little change to the number of people drinking at risky levels over the same period of time.\textsuperscript{270} The current public health initiative related to alcohol consumption focuses on binge drinking among young people.\textsuperscript{492} Although the guidelines and campaigns are not exclusively focused on reducing risk factors for chronic disease, it is raising awareness of safe drinking practices (ie following recommended guidelines) and healthy behaviours at a young age with the hope that these responsible drinking practices will continue later in life.
Aside from increasing the risk of some NCDs, alcohol abuse has a large social cost to the community. An estimated AUS$15.3 billion made up the total social cost of alcohol abuse in 2004/05. Changes to public policy and specific interventions to reduce the social cost would include increasing the taxation on alcohol, restricting the promotion of alcohol, continued reduction of drink driving through more random breath testing and/or lowering the legal blood alcohol concentration level and, finally, through the implementation of brief interventions by primary care workers to reduce alcohol consumption. Although these interventions may not be exhaustive or practically plausible, they can guide policy development with a broad-reaching positive impact in the long term.500

Changes to legislation in relation to alcohol consumption have not been as forthcoming as tobacco-related changes. Alcohol, while being harmful in excess, is still socially acceptable to consume, and is not as stigmatised as smoking is becoming. The alcohol industry has become increasingly active in political discussions, which may affect the consumption or demand for alcohol both nationally and internationally.400, 501 The alcohol industry’s role and responsibilities in public health is being debated.496 The advertising code for alcoholic beverage promotions, issued in 2009, recommends that a responsible approach to alcohol consumption is depicted, and that advertising is not targeted directly at children or adolescents.502 Experts in the area have suggested that implementation of the new code have not been effective in reaching underage exposure to alcohol advertising.503 Current debate also exists around the implementation of minimum pricing of alcohol and tax reform, opposed by large industry players as affecting moderate drinkers rather than the problematic heavy drinkers.503, 504 It has been claimed that a reallocation of resources dedicated to reducing alcohol-associated harm could achieve a greater reduction in health burden than is currently seen.501

8.3.5.4 Community wellbeing: nutrition and physical activity initiatives

Obesity is a growing epidemic in Australia as well as in other developed countries.505, 506 The Global Burden of Disease Study in 2010 identified high BMI as the leading risk factor in Australasia, with physical inactivity and low activity ranking fourth for the region, indicating the growing nature of the problem.500 Obesity in the USA was estimated to have caused up to 14% of all cancer mortality in males and up to 20% in females over 50 years of age.507 Obesity has been linked to an increased risk of cancers of the colon, kidney, oesophagus, endometrial and breast (in postmenopausal females).508 It is also associated with a modest increase in risk of thyroid cancer in females.509 Weight control, through a reduced-calorie diet, is one of the important modifiable risk factors for cancer.509 Additionally, obesity is linked with a number of other chronic diseases, which can make it both difficult to study in relation to a single disease type and more important to understand.509 Obesity can also limit the ability to provide treatment to cancer patients, such as external beam radiation.510

The 2011/12 National Health Survey in Australia showed the increasing prevalence of overweight and obese adults aged 18 years and over since 1995.511 Much of this increase is attributed to the increased consumption of energy-dense foods and junk food, and an increasingly sedentary lifestyle.406, 505, 506 In 2011/12, 63.4% of the adult population were classified as overweight or obese, rising from 56.3% in 1995.511 However, the obesity rate in Australian children aged 5–17 has remained stable at 25.3%;511 but only limited time points are available to track changes in children.512 Addressing the obesity epidemic cannot be achieved without supporting government policy to endorse change.513 The NHMRC provides dietary guidelines for all Australians to promote health and wellbeing, as well as to reduce the risk of conditions caused by poor diet.514

The association between improved nutrition and cancer risk is not always clear. However, Willett515 estimated in 1995 that approximately 32% of cancer cases could be avoided through dietary changes. As such, recommendations for healthy living, and cancer prevention, incorporate a balanced diet and maintaining regular physical activity.516, 517 The EPIC study has been designed to investigate this relationship and that of other lifestyle factors with cancer, as well as their association with other chronic diseases.517 Preliminary evidence from EPIC shows that improved nutrition can reduce the risk of cancer, although this relationship varies depending on nutrient intake and cancer type.518 The World Cancer Research Fund and the American Institute for Cancer Research also produce reports evaluating existing evidence on food, nutrition and the prevention of cancer to produce a more solid evidence base and to guide future research.56

Physical activity was not publicly accepted as a modifiable risk factor related to cancer until the late 1990s, when supporting research was released. To this day, the association is supported predominantly by observational studies rather than randomised control trials. However, increased physical activity is now widely accepted as having an overall positive association with
health improvements, and is incorporated into management guidelines for cancer. Increased physical activity can reduce the risk of many chronic diseases, including cancer. Positive associations between increased physical activity and reduced risk of cancer have been established for colorectal, breast and endometrial cancers. Some studies suggest that prostate, kidney and lung cancer risk are reduced with increased physical activity, but the evidence is still inconclusive. Public health messages encourage increased physical activity, but there are no specific physical activity recommendations that could apply to all cancers.

Public health campaigns to promote physical activity and reduce obesity have been in place since the late 1970s, beginning with the Life. Be In It! campaign, the first Food and Nutrition Policy in 1979, and in 1989 when dietary guidelines were developed. The 1992 Food and Nutrition Policy was formalised the Australian Government’s commitment to improving nutrition in all Australians. Through the 1990s, the Food and Nutrition Policy led to the Stage 1 National Public Health Nutrition Strategy, developed through NPHP, and represented the framework for government authorities working in this area. The Eat Well Australia program was the NPHP’s nutrition strategy and action plan launched in 2000. The strategy aimed to guide public investment into improving nutrition through to 2010. The Eat Well campaign, stemming from this strategy, was launched the following year.

In 2005, Be Active Australia: A Framework for Health Sector Action for Physical Activity, 2005–2010 was released. Its aim was to provide strategic guidance in the promotion of physical activity through public policy and public action, and to enable behavioural change. Its recommendations included a highlighting of the need to consolidate the various investments in programs and other funding from government, NGOs and industry. This framework has spawned a series of programs.

The National Preventative Health Strategy includes many preventive programs specific to social groups or communities of people. For example, the healthy children initiative aims to encourage healthy lifestyles at a young age, which is a reportedly cost-effective method of beginning to combat obesity. The Get Set 4 Life – Habits for Healthy Kids guide provides information to encourage healthy habits in children, and incorporates health checks for four-year-olds to assess all health indicators. The national Go for 2 & 5 campaign also began in 2005 as a joint initiative by the Federal, State and Territory Governments. Initially, AU$4.76 million was invested to promote the consumption of fruit and vegetables in children and their parents. The Measure Up Campaign targeted nutrition and obesity in adults aged 25–50 with children, and 45–65-year-old adults, in an effort to reduce chronic disease risk factors. An offshoot of this campaign is the Swap It, Don’t Stop It initiative, which encourages all Australians to choose healthier meals and increase levels of physical activity. Evaluations of these programs have shown their success in raising awareness, but there was little behavioural change found. State-based programs have also been initiated to promote healthier lifestyles, such as Cancer Council NSW’s Eat It To Beat It campaign.

The federal Healthy Communities Initiative funds Local Governments to implement community-based physical activity and healthy eating programs, and policies promoting healthier lifestyles. Healthy Spaces and Places is a service for building and design practitioners, to educate them in design principles and development types that promote healthy and active living. These initiatives are broadly targeting wellbeing and the reduction of all chronic illnesses. Their benefit is indirectly transferable to cancer control.

Many individuals, organisations and industries play a part in the responsibility of reversing the obesity epidemic. In 2008, obesity was established as a National Health Priority Area, highlighting the focus on obesity prevention. The Australian Government is responsible for modifying policy and supporting initiatives to create an environment that supports healthy behaviours. The onus is also on the food manufacturers, food retailers, the school system and the individual. Government has largely funded public health campaigns, some infrastructure changes, and programs run through schools and workplaces to promote healthy eating – while the food industry has been largely unregulated in how their products are marketed to society and especially children.

International debate exists concerning the responsibility of unhealthy industries in addressing the prevention of NCDs through modifiable risk factors such as obesity. Some claim that it is only through legislative action to modify the existing environmental pressures that the prevalence of obesity can be truly reduced. Legislation around all facets of food production systems, food advertising and targeting of children, as well as those issues influencing
the physical environment, can benefit obesity prevention.533 The complexity of food policy structures and the decision-making process affecting change create barriers to the implementation of prevention policy around obesity.533

8.3.5.5 Skin cancer: prevention and screening

Australia has the highest rate of melanoma of the skin worldwide.8 Over 1,000 Australians are estimated to die of melanoma every year,534 and it is almost entirely preventable through appropriate sun protection. Although there has been evidence to suggest that screening may be effective,504 there is currently no population-based screening for skin cancer. Individuals being encouraged to report any unusual changes and medical monitoring of any high-risk patients is deemed to be sufficient.534 The emerging purported link between a deficiency of vitamin D (which is normally obtained from sunlight) and chronic diseases has complicated the sun protection message.534 In the early 2000s, there was a rapid increase in the number of skin cancer clinics in Australia, which has resulted in clinics and general practitioners being involved in the treatment and management of skin cancer, both with similar diagnostic accuracy.306, 535, 536

Over the years, there have been a number of public health campaigns aimed at minimising skin cancer risk through education, and discouraging the use of sun beds and solaria. NGOs have played a large part in promoting sun protection behaviour.49 The sun protection public health campaign in Victoria by the then Anti-Cancer Council has prevented more than 100,000 skin cancers.317, 318 In 1981, the Slip! Slop! Slap! campaign was introduced, which evolved into Slip! Slop! Slap! Seek! Slide! in 1988, which recommended the public wear long-sleeved clothes, sunscreen, sunglasses and a hat, and seek shade.49 The SunSmart Program was also born out of the initial Slip! Slop! Slap! campaign in 1988, and is being run throughout Australia by the respective state and territory Cancer Councils in an effort to influence sun protection behaviour and an awareness of the link between ultraviolet exposure and vitamin D.49, 537 A central part of the program is the membership of early childhood care centres and primary schools. Members receive SunSmart status and recognition, and make a commitment to abide by sun safe practices and to model sun protection behaviour.537 Action was developed using epidemiological findings which raised the community’s concern regarding skin cancer and enabled them to seek change.49 Evidence of positive changes to individual behaviours as a result of the program, and its cost-effectiveness, has seen it continue to the present day.517, 518 The Melanoma Foundation also ran an Australian version of the American Cancer Society’s Mole Patrol, advising the public of sun-safe practices.506 In addition, the Australian Government has been active in encouraging changes to current practices. For example, run until 2010, the National Skin Cancer Awareness Campaign invested approximately AUS$5 million in increasing awareness of sun protection behaviours.538 An evaluation of the program showed that it impacted the behaviour of the target group, with increased use of protective clothing, hats, sunscreen, shade and sunglasses.539 Modifications to the target groups of the campaign reduced the impact of the campaign on knowledge and awareness of safe practices in people outside the targeted groups.539 The gravity of unsafe sun practices has encouraged the development of policies to guide regulations. NSW has led the way with the recent release of a Skin Cancer Prevention Strategy to encourage the reduction of overexposure to ultraviolet radiation.319 States such as NSW and Victoria have stringent legislation placed on the operation of solaria and will bring in a ban on all solaria by the end of 2014.320 The recent announcement of the 2014 ban in Victoria has resulted in outrage from solarium owners, but despite this negative reaction, the Australian Government is committed to developing a nationwide ban.540 Melanoma of the skin is discussed in more detail in section 7.6.

8.3.5.6 Colorectal cancer: screening

International evidence of effectiveness of colorectal (bowel) cancer screening emerged in the early 1990s541–543 and the first population-wide programs were established in Japan and Israel in 1992 and 1993 respectively; however, Australian adoption has been slow.544 Australian national guidelines have advocated screening since 1999 for asymptomatic people from the age of 50 years.30, 31 FOBTs have been available from 1982 via the Rotary program Bowelscan, which is run annually throughout most states of Australia at a nominal cost to the individual. An awareness, education and screening campaign, Bowelscreen Australia®, is also run through community pharmacies, which makes FOBT kits available to asymptomatic people over 50.545 A nationally organised and funded Bowel Cancer Screening pilot was conducted from 2002 to 2004, to establish the feasibility and cost-effectiveness of a population-based program of its kind in Australia.47 A federally funded National Bowel Cancer Screening Program was then developed, and all Australians turning 50 and 55 were invited to participate from 2006, and those turning 50, 55 and 65 from 2008. The program was extended to include Australians turning 60 from 2013, and will incorporate people...
turning 70 from 2015. Eligible participants are contacted via mail and asked to complete an immunochemical FOBT kit in their home, which is then sent to a pathology laboratory.

The program was suspended from May 2009 to December 2009, due to a higher than normal number of negative results in the six months prior. The kits being used were changed and the program recommenced. The program has received some criticism for being poorly planned, not incorporating sufficient forward planning based on evidence to cope with the volume of follow-up required, and not meeting the recommendations of biennial screening.

The 2012/13 federal budget included details of program expansion through to 2034, when all Australians aged 50–74 should be provided with the opportunity to be screened every two years. The 2013/14 federal budget incorporated AU$16.1 million to potentiate the program register by incorporating electronic reporting by health professionals.

Currently, the quadrivalent vaccine against high-risk types HPV16 and HPV18 and low-risk types 6 and 11 is administered in Australia. Australia was the first country to begin a vaccination program for females aged 12–13 years from 2007. When the program was first introduced, there was also a catch-up program run for cohorts of females up to 26 years of age. Moving forward, the challenge will be to integrate the HPV vaccination program and screening to maintain a cost-effective system for cervical cancer prevention and screening. Since February 2013, boys aged 12–13 years have also been eligible for vaccination, with a 2-year catch-up for boys aged 14–15 years. Others have spoken out regarding the vaccination of boys, claiming it is of little to no proven benefit, especially in light of an effective program among girls. The boys’ program has begun in Australia and there are calls for its introduction in the UK.

Persistent HPV infection has been linked to cervical cancer. A HPV vaccine was developed and approved for use in 2006. Prior to its administration, there was evidence of debate in the scientific community as to the safety and efficacy of the vaccine. The objective approval process, through the Pharmaceutical Benefits Advisory Committee, was undertaken in 2006 but its rejection of the proposal to include the vaccine on the PBS did not receive positive public response, and the Australia Government was pressured to overrule this recommendation.

The cost-effectiveness of the vaccine, the reason for which it had been rejected, was revised when the DoHA reportedly negotiated a revised price of the vaccine with the manufacturer. The results of extensive lobbying were seen in the approval of the vaccine and its administration in practice from 2007.

8.3.5.7 Cervical cancer: vaccination and screening

Following international trends, Australia introduced the National Cervical Screening Program in 1991. The program recommends that all females aged 18 or over (or 2 years after their first sexual encounter) have a Pap test until the age of 69, to check for precancerous or cancerous cells. The test is funded through the National Health Care Agreements and the MBS, and conducted in a primary care facility by either a general practitioner or a qualified practice nurse (in rural or remote locations).

Each State or Territory Government is responsible for the implementation of the program locally. This involves a register of all females who have been screened, to enable timely reminders at 27 months after a negative test result, if required, and diagnostic facilities required to administer screening. Screening intervals of two years are currently being used in Australia, a more intensive approach than followed by some nations such as the UK, as it has been argued that the initial phases of implementation require a safety margin. A program renewal is currently being conducted to ensure all recent advancements in cervical cancer screening are incorporated into the program.

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Cervical cancer, vaccination and screening are discussed in more detail in section 7.3.

8.3.5.8 Breast cancer: screening

BreastScreen Australia is the national breast cancer screening program, which started in 1991 and is dually funded by the Federal and State and Territory Governments. Females aged 50–69 are targeted for 2-yearly mammograms, though women from 40–49 years of age and 70 years and over were also considered eligible. An evaluation of the BreastScreen program in 2006/07 showed that participation in the program was declining. The report recommended a change to the age groups that have access to the program. Recommendations focused on changes to the age groups eligible for screening. If the report’s recommendations were implemented, females aged 40–44 and 75+ would no longer be eligible, and the invited target group for screening would be extended to include females aged 45–49 and 70–74, despite the limited evidence to support the effectiveness of their inclusion.
Despite the lack of conclusive evidence, the target group has recently been extended to 74 years of age. In addition to the targeted age group, females aged 40–49 and 75 and over are also eligible to attend. Screening is conducted in specialised facilities with national accreditation for service provision. In addition, a federal government initiative supports the placement of specialist breast cancer nurses in regional and remote locations through the McGrath Foundation. The issues with the existing program revolve around the limited national guidelines and the current accreditation system that results in jurisdictional differences in service delivery and inequity across screening locations; limited workforce resources; and non-comparable data sources across states.

Recently, some BreastScreen facilities have begun using digital screening technology for mammograms. A review in South Australia has raised some concerns, finding 95 fewer smaller cancers than expected. The process is currently under independent review. Breast cancer and screening are discussed in more detail in section 7.1.

8.3.5.9 Liver cancer: hepatitis B immunisation

A large proportion of liver cancer cases are associated with hepatitis B and C infection. A vaccine for hepatitis B was developed over 20 years ago; however, hepatitis C is still without a vaccine. The hepatitis B vaccine has been administered to at-risk groups from 1988 and was later phased in as part of the adolescent program in Australia from 1997. Various preventive practices can be implemented to limit the prevalence of hepatitis B and C. These include safe injection practices and safe blood transfusions. These initiatives are covered by the National Hepatitis B Strategy 2010–2013, partnerships between governments and the community. Liver cancer and immunisation are outlined in more detail in section 7.4.

8.3.5.10 Prostate cancer: testing

Prostate cancer is very common, with incidence rates rising across the globe. There are two common purported screening procedures for prostate cancer: the PSA blood test and the DRE. The Priorities for Action in Cancer Control: 2001–2003 plan included a call to disseminate information to promote informed decision-making relating to PSA testing.

A survey of males in 2012 found that 64% of respondents between the ages of 40 and 74 had been tested at least once for prostate cancer, and 41% were tested in the 12 months prior to being surveyed. Despite these high numbers of participants, Australia does not currently support the use of PSA testing as a population screening test. The Australian Government has recently allocated AUS$4 million to fund a new prostate cancer research centre and to continue funding of existing centres focused on this issue. Prostate cancer and screening are discussed in more detail in section 7.7.

8.3.5.11 Occupational cancer prevention

Occupational cancers have decreased in high-resource countries over the past 50 years, due to the move away from heavy industries where the risk of exposure was higher, and the implementation of procedures and processes addressing occupational exposure. Industrialised countries have banned or restricted use of carcinogenic materials; however, in developing nations, their use is still common. In Australia, industries susceptible to occupational cancers have been mandated to put in place preventive measures and minimise the risk to workers. Primary prevention through workplace regulation, worker education, removing carcinogenic substances from the workplace, and adhering to safe practices are the most efficient and cost-effective measures to overcome occupational cancer. Screening of people working in high-exposure environments has been suggested but is not used in practice, as no screening program has been found effective. Occupational cancers are difficult to distinguish from other cancers, with the exception of mesothelioma, which is caused by exposure to asbestos; thus the extent of harm caused cannot always be fully understood. In Australia, it has been estimated that 5,000 cancers each year are caused by occupational exposure to carcinogens. Asbestos, one such carcinogen, was widely used in Australia until its ban in 2003 and, as a result, Australia has high rates of asbestos-related diseases.
including cancer, and in particular, mesothelioma.\textsuperscript{560} The responsibility for asbestos management is shared by all levels of government, but the majority of daily management falls on local councils.\textsuperscript{560} There are cases associated with childhood exposure to these materials. A Western Australian community located close to an asbestos mine has higher all-cancer incidence and mortality from childhood exposure.\textsuperscript{561} A recent Asbestos Management Review, commissioned by the Australian Government, recommended the development of a National Strategic Plan to lead the way and eliminate jurisdictional differences.\textsuperscript{560} As a result, the Government announced the launch of the Office of Asbestos Safety, to develop the National Strategic Plan which is currently underway.\textsuperscript{562}

\textbf{8.3.6 Cancer control data sources: monitoring of trends}

Cancer-related data are critical in establishing an understanding of the cancer burden and past, present and future trends.\textsuperscript{412} In many countries, the registration of new cases of cancer has not been a legal requirement. Historical data are not always accurate and, although improving, estimates can often be incomplete and not of high quality. WHO and NGOs play a significant role in advocating for the improvement of recording of cancer cases and tracking of global trends of cancer-related statistics.\textsuperscript{550}

In Australia, indicators to measure chronic diseases have been developed by the AIHW. In relation to cancer, the specific indicators focus on incidence, prevalence, mortality and survival of particular cancer types. There are also a number of indicators relating to risk factors associated with cancer and an overall risk index for chronic disease, which will improve analyses of trends over time.\textsuperscript{563}

Indicators of the prevalence of cancer risk factors are calculated by the ABS. Relevant data are largely available through the National Health Survey results.\textsuperscript{511} Information relating to cancer risk factors and social trends, such as tobacco and alcohol consumption and obesity indicators, are also available through these data sources. Often the sampling methods used allow trends to be generalised to the total population.

The AIHW has had an ongoing program to estimate tobacco- and alcohol-related mortality and morbidity using a number of indirect methods based on risk estimates of effect from all over the world. These have been key to identifying the enormous burden caused by tobacco, but these methods do yield varying results: for example, the number of tobacco-attributed deaths varies from 15,000 to 19,000 depending on the method used.\textsuperscript{483} Considering the diversity present in the Australian population, more accurate data-collection methods could be sought.\textsuperscript{483} Including questions on the death certificate, for example, have been useful in gaining insight into tobacco-related deaths in South Africa.\textsuperscript{564, 565} If similar information were gathered in Australia, it would vastly improve evidence to support tobacco control activities.\textsuperscript{483} It could also improve the quality of data collected for disadvantaged population groups, which become problematic when comparing cancer indicators in subgroups.\textsuperscript{566}

Australia is one of the few countries that has complete national cancer registration. Data on new cancer cases in Australia have been recorded in the Australian Cancer Database from 1982. The data are sourced from state and territory registries. In Australia, it is a legal requirement to register any new cases of cancer with the local cancer registry.\textsuperscript{566} The AIHW Cancer and Screening Unit is responsible for monitoring, investigating and reporting on cancer incidence, prevalence, mortality and survival. The unit compiles data from the individual registries and from other sources through the National Cancer Statistics Clearing House, in collaboration with the Australasian Association of Cancer Registries. These data are used to calculate incidence rates in Australia. The National Mortality Database is also used to compute prevalence, mortality and survival rates. Again, this is maintained by the AIHW with data provided by the Registrars of Births, Deaths and Marriages, and coded into disease states by the ABS.\textsuperscript{6} The only two points at which mandatory recording are required are diagnosis and death. The ABS also provides information on the demographic profile of the Australian population that is used in analyses. Along with the Australian Cancer Database, the AIHW also maintains databases for BreastScreen, the National Cervical Cancer Screening Program and the National Bowel Cancer Screening Program.\textsuperscript{567}

The National Cancer Data Strategy addresses the current lack of information on family history, incomplete identification of Indigenous status, limited country of birth data, limited occupational data collected and no collection of information on precursor lesions.\textsuperscript{568} This lack of information limited our ability to compare trends across groups and for different grades of disease. These are all being targeted as areas for improvement.\textsuperscript{568} Cancer Australia has recently been allocated AUS$2.4 million in funding to collate national cancer data pertaining to the stage of cancer at diagnosis, treatment and frequency of
recurrence to address the current gap. Analysis of cancer treatment pathways require linked data from more than one source in the health system. Record linkage is becoming a more important component of cancer research, and can help identify causal relationship and expand on existing understanding of relationships.

Additionally, MyHospitals has been established to gather information in relation to Australian public hospitals and is managed by the AIHW. A 2012 report recorded hospital waiting time for cancer surgery for the first time. Waiting times, it stated, were dependent on the urgency of surgery, and benchmarking will now be take place to track performance in public hospitals.

8.4 Cancer control in practice

In practice, cancer control is implemented in varying ways. In both the first and second line stages of prevention, screening and diagnosis of cancer, primary health care professionals play a pivotal role. General practitioners, pharmacists, nurses and other allied health care professionals can help individuals. Initially, health care professionals play a role in endorsing preventive health measures. Also, the administration of vaccination and immunisation programs takes place predominantly in the primary care setting. Screening and diagnosis can also occur in the primary health setting, but often require the involvement of specialised professionals, or primary care professionals with specialised training. Once diagnosed, the patient is referred to oncology specialists for individual treatment.

In 2003, the now disbanded National Cancer Control Initiative, a collaboration of the Australian Government DoHA and Cancer Council Australia, worked with the lead oncologist association, the Clinical Oncological Society of Australia, to prepare a report outlining the reforms needed in cancer care. The focus was on continuity of care and integration of the health care system to improve the treatment experience of cancer patients. Cancer care and treatment is generally provided by a multidisciplinary team of oncology specialists and other members of the primary care team. In theory, multidisciplinary teams deliver in the best treatment outcome for an individual patient’s condition. However, the logistics involved in organising these initiatives are intensive, and require substantial leadership and follow-up.

Evidence suggests that positive outcomes are possible but require investment in team infrastructure and training.

8.4.1 Cancer care: key elements and emerging issues

Aside from the policy-specific actions and programs currently being rolled out, there are additional issues relating to health provision and cancer care. These issues relate to available funding for cancer care infrastructure, costs and accessibility to treatment, healthcare workforce capacity, and electronic linkages of patient records to facilitate transitions through the system. Although steps are being taken to address these concerns, at times their importance to comprehensive cancer control can be overlooked if only a prevention focus is used.

8.4.1.1 Cancer care infrastructure, costs and accessibility

As previously discussed, the health expenditure on cancer care is high and treatment-related costs are often inaccessible for an individual patient. Subsidies from governments and other sources are required, as not all cancer-related medications and treatments are included on the MBS or PBS, because of high production costs.

The geography of Australia accentuates the inherent difficulties in providing and accessing adequate health care services, especially for cancer patients. The limited access to health services in rural and remote locations has resulted in a high number of hospitalisations for acute conditions. These rural and remote locations lack the infrastructure and the health care professionals to provide the level of service required. Presumably, the number of acute episodes could be greatly reduced through adequate access to primary, diagnostic and early intervention services.

Cancer incidence and survival rates are lower in remote areas compared to major cities. This suggests that, in general, cancer sufferers in remote locations either do not have the access to screening and diagnostic services to accurately measure incidence of cancer in these locations, or lack adequate access to treatment and monitoring services to improve survival rates. Analysing survival by individual cancer site shows some variations. A NSW study showed that patients in remote locations have an excess risk of dying of cancer in comparison to those in highly accessible locations, especially for prostate and cervical cancers. Movement of patients from remote locations to treatment centres for lengthy periods of time are speculated to contribute to this trend. A review of treatment of breast and prostate cancer patients in non-metropolitan locations suggested that improvements to treatment would be possible if general practitioner-based interventions were available.
There are distinct differences in patterns of care for cancer patients in different locations where consistency is needed. The Australian Government allocated AUS$560 million to the establishment of regional cancer centres and associated accommodation facilities in the 2009/10 budget, as part of the Health and Hospitals Fund. A total of 24 additional regional cancer centres have been proposed and approved, notably the Alan Walker Cancer Centre in Darwin, which has been built to service cancer patients in the Northern Territory. A total of 57 breast cancer nurses dedicated to providing coordinated care are also part of this funding, which was boosted by AUS$19.5 million in the 2013/14 federal budget.

In recognition of the challenges faced by people in rural and remote locations, governments – and some NGOs – provide subsidies for travel and accommodation when required to access health services. The schemes are not limited to cancer patients, and can be used by any individuals who require specialist services. A major criticism of the government program is the lack of awareness in groups that could benefit the most, and the amount of documentation required to receive funding.

A review of radiotherapy services in Australia called for an improvement in availability through better outreach services, and reimbursement for rural and remote residents. The high costs associated with radiotherapy centres and equipment in the initial set-up limits the potential for growth. Once established, radiotherapy facilities are a relatively cost-effective treatment option. As at December 2009, there were 50 fewer linear accelerators than required to service the Australian population’s needs, based on the estimated 52.3% of cancer patients who could benefit from the service. They were distributed unequally around the nation. This meant that only 38% of patients could be treated at the time if all linear accelerators were at full capacity. Radiotherapy services have increased with the rising incidence of cancer, but do not meet the reportedly optimal level of servicing required for cancer patients. However, the situation in Australia is not as problematic as in low- and middle-income countries where the supply of equipment and staff do not meet predicted demand.

Chemotherapy services will also undergo a review, announced in the 2013/14 federal budget, to outline the current arrangements in place and establish a long-term solution to funding for chemotherapy. As an interim measure, an additional AUS$29.6 million was allocated to increase dispensing fees of chemotherapy medications for a 6-month period, from 1 July 2013 to 31 December 2013.

Even when initial treatment has finished, patients require support. Patients in remission require ongoing monitoring at less regular intervals. This means that the continuous management of cancer patients needs to be incorporated into the increasing demand on the system caused by the increased incidence rates. This also includes rehabilitation services. Psychosocial support is funded through the MBS, but is not the central emphasis of current policies and programs. Services in this area are also provided by NGOs such as Cancer Councils. Palliative care funding is critical, and is supported by the National Palliative Care Strategy and Program, which aim to improve palliative care through support for patients and families, access to appropriate medications, health workforce training, palliative care-specific research and quality improvements.

### 8.4.1.2 Cancer control workforce issues

Globally, health care workforce trends indicate current and future shortages across many disciplines. This leads to increasingly difficult access to preventive health programs and adequate health services. All forecasting relating to primary care health workers and specific medical specialties highlight geographic distribution as one of the major challenges now and moving forward. The ageing population not only impacts the workforce by increasing demand, it also brings an ageing health workforce. In Australia, it has been recently acknowledged that the current arrangements in the health workforce are not sustainable and reform is required, leading to the inception of HWA. Patterns of retirement are changing, retention rates are decreasing, and there is a trend of feminisation in many health professions.

Integration and substitution between health care professions has been suggested as a solution to the health workforce shortage. Integration can improve the work between existing stakeholders by improving collaborations. The Australian Primary Care Collaborative was established through a federal government initiative to implement this idea for NCDs and has been successfully implemented. On the other hand, substitution requires the adequate and credentialed training of workers to facilitate the transfer of tasks and acceptance from all interested parties. For example, nurse practitioners have limited prescribing rights, can request pathology tests and can provide referrals in some cases, upon their successful completion of a Masters program.

Now that key issues and opportunities have been identified, the HWA aims to establish a national agreement on strategies to alleviate the foreseen problems and act
on these items through collaboration, consultation and leadership of health workforce reform. The HWA released a National Cancer Workforce Strategic Framework, detailing recommended actions to overcome the current workforce issues in cancer-related health professions.

8.4.1.3 Electronic linkage of patient information

Increasing the emphasis on multidisciplinary care and the involvement of multiple health care professionals in a cancer patient’s treatment requires the transfer of knowledge and information between all interested parties. The high volume of transactions that make up NCD management, and the time period over which it is conducted, support the use of more advanced information management systems. Health information management systems can include decision-making support tools for health professionals, information sources for patients and their carers, and electronic patient records and provider order entries. In theory, using these systems can also allow health care professionals to spend more face-to-face time with patients; however, supporting evidence has not been found in practice. The most pertinent issue relating to cancer appears to be the electronic linkage of treatment records.

The electronic linkages of patient records can facilitate the large number of transitions through the system, but have been typically difficult to administer and maintain. Electronic records can help identify adverse drug events, highlight medication errors, and track prescribed medications and prescribed dosage. Widespread adoption by physicians and other health professionals is difficult to achieve and maintain. In Australia, linkage programs have been established to enable research into health services and assess the performance and safety of the health care system, including cancer care.

In 2010, the Australian Government approved a personally controlled electronic health record system, eHealth. The eHealth system aims to improve information exchange by moving from paper-based to electronic keeping of clinical records. The National eHealth Transition Authority has been established to facilitate this change. Program development has been challenged by short timeframes and the overwhelming size of the undertaking. Currently, consumers can choose to enrol in the eHealth system, but it is purely on a voluntary basis.

8.4.2 Discovery and advancement in prevention, diagnosis and treatment

The discovery and use of new cancer prevention drugs, diagnosis techniques and curative treatments affect incidence and mortality rates. The rise in incidence rates is largely reflective of improvements in diagnostic techniques and new screening practices that are becoming more diffused. It is important to identify advancements of these methods when interpreting cancer-related data. Modern discoveries in medicine and technology can greatly influence cancer control policies and actions. Treatment methods for cancer are constantly evolving; however, the therapeutic pathway for most cancer sites consistently include surgery, radiotherapy and chemotherapy. However, recently complementary and alternative therapies have been integrated into treatment options. Acupuncture, for example, is becoming more widely used as an adjuvant treatment for chemotherapy-induced nausea or vomiting.

A significant area of development in treatment is in therapeutic vaccines. Work in immunotherapy, which aims to induce specific immune responses to cancer cells, is an important part of this line of research. In prostate cancer, for example, immunotherapy is one of the novel strategies being explored to treat recurring cases. There are a number of tumour-associated antigens that can be targeted at the specific tumour cells. One of the purported benefits associated with therapeutic vaccines in comparison to other treatment methods is their less toxic nature. There is also potential to use therapeutic vaccines in conjunction with other treatment methods, which can potentially improve the efficacy of the vaccine.

Much of the emerging cancer control research is focused on cancer cells and altering their states through gene therapy and genomics. A subset of this stream is epigenetics, a line of research focused on early modifications in cancer cells and altering the components of the genome. A significant area of development in treatment is in therapeutic vaccines. Work in immunotherapy, which aims to induce specific immune responses to cancer cells, is an important part of this line of research. In prostate cancer, for example, immunotherapy is one of the novel strategies being explored to treat recurring cases. There are a number of tumour-associated antigens that can be targeted at the specific tumour cells. One of the purported benefits associated with therapeutic vaccines in comparison to other treatment methods is their less toxic nature. There is also potential to use therapeutic vaccines in conjunction with other treatment methods, which can potentially improve the efficacy of the vaccine.

Epigenomes differ from genomes in that they change with cell type and age. Understanding the components generating non-coding ribonucleic acids is essential to analysing the biology of the cancer cell and abnormalities or alterations found which can be reversible with chemicals. Unlike other biomarkers, epigenetic biomarkers respond not only to an individual’s genetic composition but also their environmental exposure. Epigenomics could be used to define cancer subtypes and become indicators of patient responses to therapies or their outcomes.
Diagnosis can also be aided by the use of microfluidic technology, a study of the control and manipulation of fluids. It can be used to analyse fluids in vitro and can be developed into a non-invasive diagnosis and treatment technique. Microfluidics can help understand the biology of the tumour, isolate tumour cells, detect and identify tumour cells, and provide high-throughput screening. The affordability of this technology creates a more cost-effective alternative to be explored.607

Metabolomics is the study of the chemical processes of molecules in a biological cell, and measures the output of biological pathways.606, 608, 608 It provides a snapshot of cellular activity in a normal or disruptive state.606, 608 Research in metabolomics is focused on identifying still unknown causes of cancer, improving early diagnosis, or developing targeted drugs.605 Biomarkers can be more rapidly identified using metabolomics, and used for earlier diagnosis of cancer and as predictors of treatment responses.606 Cancer staging and tumour characterisation can also be improved using this method.608 By analysing the chemical processes of molecules, metabolic analysis can measure the biochemical response to new drugs and their pathways to aid drug development.608

Nanotechnology is now being explored in medicine as a way of improving cancer from prevention through to treatment.605 Nanodevices are being developed to improve detection of cancer at early stages, isolating its exact location, and delivering therapeutic drugs.605 It is the study of nanoparticles in cancer sites and the development of nanodrugs which can reduce the ability for the body’s defences to capture nanoparticles.605 Treating the nanoparticles can improve imaging in diagnosis and reduce side effects associated with traditional cancer therapies.609 Nanoparticle treatment can treat hard-to-reach cancerous growths and improve delivery of medication to allow more particles to access the tumour site.610 Several nanodrugs are successfully being used to treat cancer as targeted therapies.605, 610 Nanoparticles have also been used in analysing volatile organic compounds in exhaled breath to detect the presence of cancer.262, 380

Although developments are being made, only a few treatments and discoveries have radically changed cancer prevention and care.438, 439 Drug discovery is plagued by the often slow development period of cancers or identification in late, advanced stages of the disease. This makes trials and testing lengthy processes, which do not always conclusively illustrate the positive aspects of new treatments. Monitoring cancer incidence and mortality trends over time can help identify critical points in history where treatments or technology had a significant impact.

8.4.3 Cancer control implementation process and leadership

All of the elements described are part of a process of cancer control implementation. In Australia, this process is spread across a number of government agencies, industry partners, NGOs and other stakeholders. There are four key stages apparent in the current process, as depicted in Figure 8–2. The stages give an overview of how stakeholders and their actions are brought together.

Stage 1 is the design, trial and pilot phase. It is the innovative and conceptual period of an initiative that can be initiated by researchers, NGOs, governments, industry representatives or clinicians and their institutions. The motivation of these groups can vary greatly, and new initiatives can stem from emerging international or national evidence, pecuniary interests or observed need in the community. Pecuniary interests, in the case of industry, focus on the trialling of medications before market launch to prove their clinical benefit and financial viability. In the case of governments, pilot studies are essential to establish the cost and benefit to the health care system overall. The majority of action in this phase is focused on conceptual design of initiatives and rigorous clinical trials or pilot studies.

Especially in the case of cancer control, this stage generally occurs once, but is typically lengthy. For trials or pilots to show evidence of clinical significance that is cost effective and applicable to the real world, approximately 5–10 years must pass. Often findings from trials will be interpreted in conjunction with outcomes from additional trials in other research environments. In order to reach the trial phase, there must be a solid evidence base for the efficacy of an intervention. Pilot studies are generally used to understand the local application of the concept. Although governments are not always an active player in this stage, they are important stakeholders. If governments are not aware of the concept and the benefits of the trial or pilot, movement to Stage 2 will be more challenging. Often governments are involved in pilot studies, especially if they are national studies. Pilots can sometimes overlap with the proof of concept element of Stage 2.

Stage 2 builds on the previous phase and focuses on strategic planning, budgeting, legislative development, protocol and guideline development and proof of concept. The aim of Stage 2 is to integrate the concept into the existing systems, with practical application. Governments play an essential role in this phase of implementation. Approval processes and decisions, albeit being lengthy and usually a one-off occurrence, are influenced by changes in government and the overall health...
agenda. Budgetary issues also greatly affect the viability of a program’s integration in the health system.

The new concept must work with the existing or future health agenda and be of benefit to a sufficient number of people to make it feasible. The proof of concept element establishes the commercial viability of the project from a government perspective as well as an individual perspective, if required. Input from health economists and public health experts is often required at this stage. In the case of specific medical treatment options, the Therapeutic Goods Administration is specifically involved in regulating medications that can be used in Australia. Additionally, the Pharmaceutical Benefits Advisory Committee is an independent body of experts that advises the government on which medications should be included on the PBS, hence reducing the cost to consumers and impacting the health budget. The Medical Service Advisory Committee advises the Health Minister on inclusions on the MBS.

Some initiatives require underpinning by legislative changes to effect change and require the involvement of multiple levels of government. Both federal and state tiers of government are involved in cancer control, and are lobbied by industry and consumer stakeholders. NGOs play a large role in advocacy by giving a voice to the consumer groups they represent. Prior to widespread implementation, protocols and guidelines are required. In this part of the process, clinical experts and other stakeholders are brought together to define the activity and make recommendations around practical implementation, such as credentialing of health professionals to provide a given service or accreditation programs for service provision centres.

Stage 3 focuses on the implementation of the activity and is a continuous process over the lifetime of the program. Application to the real world requires the involvement of all levels of government and clinicians or other providers. Already established examples of national screening programs illustrate the variety of implementation options available. The National Bowel Cancer Screening Program is administered nationally, with home kits sent directly to individuals in the target age groups. BreastScreen is provided through specialised centres and administered on a state/territory level. The National Cervical Cancer Screening Program is run through primary health care facilities and also administered on a state/territory level. Implementation can also involve Local Governments, which are established by the State or Territory Governments and are responsible for local community services, planning approvals for buildings and public spaces, and limited public health protection measures.

Stage 4 is the continuous monitoring and evaluation phase, which should feedback into any or all of the previous stages. This phase tracks and appraises the performance of activities and identifies the need for change to existing structures and processes. Generally the role of monitoring activities is conducted by government data-collection agencies, predominantly the role of the ABS and the AIHW for cancer control. Evaluations of activities are ideally conducted by independent researchers who can critical appraise performance and systems to make recommendations for improvement.

Small-scale projects can be implemented – moving through all four stages – at a local community level, largely through NGOs and Local Government. This involves direct lobbying to Local Governments by NGOs and community advocates for issues such as banning smoking in busy outdoor areas, including children’s playgrounds and alfresco dining areas on
Local Government land. When the success of the program is proven on a small scale at a Local Government level, the concept can be integrated at a state/territory level or in other local areas following the four-stage process. Isolated incidents at Local Government levels illustrate potential resistance to national or state based legislations. In Sydney, this resistance was shown by Parramatta City Council when a previous smoking ban was recently rescinded in outdoor dining areas due to industry pressure. State legislation will be brought in from 2015 which will ban outdoor smoking across NSW, and in this instance the Local Government made the decision to allow smoking until 2015.611

As described in the individual stages, the leadership of cancer control implementation is spread across a number of stakeholders – depending on the stage of the process and the specific initiative. Engagement at government and clinician levels is most important as they can create the bottlenecks in the process. Communication is integral in moving the process from one stage to the next, and for the overall success of the process. Much of the communication to the public stems from the final two stages: relaying information about programs being implemented and how they are progressing. Data used to communicate the results of programs and initiatives are integral to their continued development.

8.5 Summary of cancer control policies, programs and emerging issues

Cancer control policy in Australia has evolved over the past few decades.58 Since the 1980s, cancer control has been incorporated into the national strategic direction, beginning with the inclusion of cancer as a National Health Priority Area in 1996.612 Additionally, there have been specific public health campaigns and cancer screening for three cancer types and to reduce modifiable risk factors. However, few are the cancer types that are given the majority of the attention in most publically funded prevention, screening and treatment initiatives. In 2005, the intergovernmental NSIF for cancer was released, outlining high-level policy priorities across the cancer control spectrum.544 All Australian Governments – federal, state and local – endorsed the NSIF; however, there was no implementation plan. A number of the NSIF initiatives have nonetheless been implemented over subsequent years.

Evaluations of past cancer control activities have shown varying levels of impact in their specific target areas. Often, they have been supported by public policy. More recently, a series of government agreements and strategies has been launched to further promote the preventive health agenda. As part of these agreements, as well as continuing activities from past initiatives, the Australian Government has made a substantial financial and resource contribution to programs relating to cancer control. Legislative action has not always been used to support systematic change as opposed to efforts to encourage individual change. Currently, the range of public health and preventive services in Australia are coordinated and administered by intra- and intergovernmental agencies.

Services that relate to cancer control include:1

- Immunisation services and other communicable disease control
- Programs to reduce the use and harmful effects of tobacco and alcohol
- Prevention programs to reduce weight gain, and to promote physical activity and healthy eating choices
- Programs to promote sun protection
- Environmental monitoring and control, including management of harmful chemicals
- Screening programs for breast, cervical and colorectal cancer.

A number of recently formed national government agencies are predominantly responsible for cancer control initiatives, as well as the longstanding ABS, AIHW and NHMRC. The current capacity of the newer agencies to influence change is yet to be fully released. The plethora of cancer control activity requires the involvement of a number of government agencies and other stakeholders – including NGOs – to most effectively disseminate preventive health messages and provide cancer support programs.

The Australian healthcare system has limitations in treating the needs of patients with chronic illnesses, as it has historically focused more on acute care. The challenges of caring for an increased number of cancer patients at a time when population ageing will place other pressures on the health system will be significant. We can expect to see increases in the numbers of cancers related to obesity, with the high and increasing numbers of people being classified overweight and obese – as well as increases in cases of other prevalent diseases such as cardiovascular disease and diabetes. Furthermore, most population-based preventive interventions are targeted at people under the age of 75 years, where actions could prevent cancer and mortality benefit is likely to be greater.613
8 Cancer control policies, programs and emerging issues

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The two decades selected for analysis in this study coincide with the inception and launch of a number of public health programs (around the early 1990s) that either directly addressed the cancer burden or focused on modifiable risk factors. This analysis has shown that cancer-related deaths have reduced by 28% from the expected numbers based on 1987 rates to the observed numbers in 2007. Cancer incidence, however, has increased over the same period by 21%, predominantly due to the rise in incident cases of prostate cancer. The population analysed – those aged under 75 years – are individuals in the age range who would have benefited most from the programs available.

By comparing ‘before and after’ estimates for 2007, we estimated a fall in mortality of 28% (for people below than 75 years) for the time period, which included widespread implementation of cancer control programs for individuals under 75. Previous AIHW estimates of age-standardised mortality (for all ages) were 212.1/100000 in 1987 and 176.1/100000 in 2007, indicating a 17% reduction in mortality. We estimated a 21% rise in incidence and, similarly, the AIHW rates rose from 408.2/100000 in 1987 to 490.1/100000 in 2007, a 20% increase. The dominant reason for the difference in these estimates is our restriction to people under the age of 75, the primary target population for cancer control interventions. People over 75 years were excluded to more accurately report premature deaths and incident cases relating to cancer. Additionally, the elderly are not always included in clinical trials, nor is cancer treatment as aggressive as in younger patients. Better and more cost-effective treatment for other NCDs increases the likelihood of the elderly dying of cancer. Time exposes the elderly to more carcinogens and genetic changes, resulting in higher cancer incidence and mortality.

Mortality and incidence trends have been analysed here for their clear and concise representation of change over time. Over three decades ago, Doll and Peto suggested a shift in focus to cancer types with increasing incidence. At the time, rising incidence suggested the introduction of a number of cause(s) of a cancer with a realistic possibility that they could be controlled or eradicated once identified. However, enhanced detection techniques have also caused diagnoses to be brought forward and thus have artificially increased the incidence of certain cancers. Further artificial increases in incidence include improvements in cancer
registration methods, all of which have an important influence on the measurement of survival and prevalence. In light of this, there has been a more recent shift to assess cancer mortality trends, augmented by incidence rather than prevalence and survival.\textsuperscript{13, 15, 65, 615} The latter two statistics serve other important purposes in health planning such as the potential burden on the health care system and the length of time over which relevant services may be required. Incidence and mortality represent the pressing and emerging issues for public health concern and health care systems.

9.1 Burden of early diagnosis

Virtually all cases of cervical cancer are associated with persistent The increasing burden of cancer represented in this analysis by early diagnosis means health care systems are challenged by the need to transition from a focus on acute service provision based in large hospital facilities to building community-based services for preventive health, screening and diagnosis, treatment and ongoing monitoring.\textsuperscript{59} Complex interactions associated with cancer diagnosis have given rise to a patient-focused and integrated approach to care. In Australia, consumer empowerment supports a more active role of the patient. To align with this change, the health system needs to adopt a more patient-centred approach to cancer control.\textsuperscript{427, 446, 454, 616} Success in these endeavours requires improved infrastructure in order to optimise quality, efficacy and timeliness of service provision.\textsuperscript{7} Reform, through the various national agreements and health performance frameworks, is working towards this goal. Additionally, integrated care is often multidisciplinary, and incorporates alternative treatment and therapies alongside more traditional techniques.\textsuperscript{617}

9.2 Health records

The transfer of patient-related information is becoming a more important issue with the increasing number of professionals involved in care, and the increasing number of cancer patients entering the health system at older ages and with more complex comorbidities. In Australia, much emphasis has been given to optimising the use of electronic portals to share information between health care professionals and across care sites. Such portals are an important enabler of patient-centred care.\textsuperscript{618} This initiative will contribute to improvements in the continuity of care, and the de-identified data could be used for future analysis of service provision and use of the health care system.\textsuperscript{1} Current research in cancer patients' experiences is moving towards the use of linked data from various sources to better understand their treatment patterns in order to improve care. The use of linked administrative health data has been identified as valuable, despite the lack of information relating to diagnostic interventions and accurate descriptions of disease stage to explain the complete scenario.\textsuperscript{619} Government initiatives, including the Cancer Data Strategy, are working towards closing this gap.

9.3 Implications for the ageing population

The resource and financial burden of new cancer cases will continue to weigh on the Australian health system because of the shift in the age distribution of the population, which is ever-increasing, with a larger proportion of elderly people.\textsuperscript{620} Demographic projections suggest that this trend will continue into the future. Conditional life expectancy at age 60 is now another 24 years. With ageing populations and most guidelines focusing on treatment and management restricted to patients under 75, reassessment of current protocols is needed.\textsuperscript{60, 61} Clinical trials often exclude older patients from participating, limiting the evidence base for the treatments or interventions under evaluation.\textsuperscript{60, 61, 621} Older individuals are often excluded as they have more complex health issues and comorbidities which are difficult to allow for in a trial.\textsuperscript{60, 61} There is often a lack of statistical power to show any statistically significant effects of treatment in older age groups.\textsuperscript{621} Trials with alternative study designs to accommodate the differences in older subjects may be required.\textsuperscript{621, 622}

Maintaining adequate and cost-effective access to health care is one of the major challenges moving forward.\textsuperscript{654} It is often difficult to assess the cost-benefit of cancer control in comparison to other health priority areas. Benchmarking cancer against other disease states such as cardiovascular disease is challenging.\textsuperscript{598} Cost-benefit analyses often revolve around preventive services and treatment. However, there are also indirect costs – such as health system infrastructure upgrades, and patient and carer travel and accommodation expenses – which are important elements of cancer control.\textsuperscript{570}
9.4 Focus on prevention
A recent overview of Australia’s health care system reiterates the importance of prevention programs in reducing the cancer burden in the future.620 Actions currently being taken by the Australian Government indicate a move towards an emphasis on preventive health and screening. The ongoing management of the cancer burden is incorporated into the initiatives for public health care system reform and improved performance and transparency. This may reduce the emphasis on cancer specifically, but takes a global approach to population wellness and prevention rather than cure. Focusing on primary prevention will not only reduce the impact of chronic diseases such as cancer, but also improve the overall health of Australians. The potential benefit is illustrated in a study from the USA showing that adherence to guidelines for ideal cardiovascular health has reduced the incidence of all cancers over a 20-year period.623 However, optimal outcomes can only be reached using evidence-based approaches to prevention and screening initiatives.184, 624, 625

9.5 Evidence-based interventions and government decision-making
Cancer control initiatives are generally preceded by evidence-based trials to support their implementation. However, criticism has been expressed of the practical applications of findings in Australia, especially in relation to the National Bowel Cancer Screening Program.183, 184 Guidelines for screening are not always used as the model for implementation in practice. Leadership and clear decision-making in health care policy and cancer control are important to the success of new initiatives. Transparency and fairness are imperative in government priority-setting, and are guided by the broader interpretation of social justice in a society.144 For example, the National Cervical Cancer Screening Program recommends two-yearly screening intervals, despite the evidence suggesting three-yearly intervals are sufficient.89, 144, 145 It has been argued that a shorter time interval is safer during the implementation phase.146 The ‘Renewal’ of the screening program will address this issue and the effect of HPV vaccination of future target cohorts, to provide a more cost-effective program.

The government priority-setting process is critical for the broader community to understand and interpret. The growing emphasis on translational research and implementation feeding into an evidence base that can be used for the launch of new initiatives means that researchers need to be cognisant of the political framework within which they are working and facilitate the process. The gap between research discovery and practical implementation needs to be minimised, and this can be achieved through transparent decision-making and priority-setting processes with clear public health–improvement goals. The evidence supporting changes to public programs must be communicated effectively to the public to foster support for the changes. Other interested stakeholders, such as NGOs, can also be more effective and increase their impact in the community if their actions and directions are more closely aligned with public policy and use evidence to support action.

9.6 Dilemmas in cancer control
Although there are different issues for the health care system, preventive strategies and treatment requirements for different cancer types, an overall approach to cancer control is important to incorporate into policy. Recommendations can be contradictory across cancer types or other disease states at times, and public health initiatives should incorporate the breadth of evidence available. For example, alcohol intake is said to be associated with increased risk for some cancer types. However, moderate consumption reduces the risk of cardiovascular disease, yet alcohol in general is linked to accidents, violence and increased extraneous causes of death.167 Also, the use of oral contraception is often analysed as a risk factor for some cancer types. Increased use has been shown to increase risk in cancer types such as breast and cervical cancer.626 However, there is no significant relationship between oral contraceptive use and increased risk of cancer overall.626 and it appears that long-term hormonal contraception imparts lifelong protection against ovarian and endometrial cancers.86 As with a number of risk factors, there is a beneficial effect in reducing incidence of some cancer types, but the general health or societal-related benefits or harms could be more important than any protective effect. The implications of not recommending oral contraception or recommending alcohol consumption could cause other public health issues.
Assessments of many cancer types describe an increase in incidence resulting from improved screening and diagnostic techniques. This can give the impression that cancer control is not effective. To address this, overdiagnosis resulting from advances in technology needs to be incorporated into analyses. There is no clear methodological consensus on how to deal with and interpret overdiagnosis, especially in the context of screening; however, in a comprehensive review of European breast cancer screening programs, ecological studies were found to be the least informative.

### 9.7 Future research

Further understanding the role of current and emerging potential carcinogens and the integration of biomarker science to better detect exposures, pre-neoplastic conditions or populations at risk are all areas of discovery that could pave the way for new prevention strategies or treatment techniques. This requires ongoing investment in sound research to support the evidence-based grounding for initiatives, as has previously been provided.

In order to take full advantage of empirical research, studies of basic science need to have a translational phase which makes them practically applicable to epidemiology and public health.

Our findings illustrate that significant progress has been made over two decades. However, there are still a number of cancer types requiring greater focus. Cancers with unknown or predominantly unmodifiable risk factors currently have limited scope for prevention. Placing greater emphasis on these cancer sites to improve detection and treatment ought to be a growing priority in research and patient support.
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Cancer control measures in Australia have largely been effective in reducing the number of cancer deaths, despite an overall increase in the number of cases diagnosed. This analysis shows that in 2007, for Australians under 75 years of age, cancer mortality had decreased by 28% compared with 1987 statistics. Incidence, however, increased by 21%, largely due to diagnoses brought forward by the use of more modern technologies and the increased coverage of screening programs. Prevention, by means of smoking reductions, improvements in treatment, and screening programs, all played an significant role and are still important elements of cancer control.

Overall, Australia is progressing well with life expectancies for males and females (of 84 years for females and 80 years for males) exceeding those of the UK, the USA and Canada, and just below those of Japan (87 years for females and 80 years for males). While the increasing cancer incidence rates necessitate some action to understand the drivers of increased diagnoses, much of this rise is focused on few cancer types. However, cancers that require more emphasis in research, policy support and preventive health action are those with the poorest survival and are not always at the forefront of activities by lobby groups or of the cancer control agenda. This creates an imbalance in the emphasis on cancer types, which requires continued investment in research to provide an evidence-based understanding of their causes.

The health care system has inherent limitations, which become more apparent when assessing health equality between population groups. Governments are working to address these issues through infrastructure changes to provide services as required, as well as encouraging behavioural change in individuals. Government investment has also focused on additional funding for health care professionals in specialisation areas with shortages or where demand is expected to rise.

Cancer control needs to be a collaborative effort in the broader community. Beginning with a sound base developed by governments, researchers, NGOs, industry and local communities play an important role in advocating and demonstrating change in their social environments to support the implementation of cancer control initiatives.

The Australian Government has shifted the health agenda to incorporate an increasing focus on preventive health over the last few decades. Longer-term benefits of addressing modifiable risk factors causing all NCDs are a key element of public health messages. Many of the interventions encourage lifestyle-based changes and involve a higher level of commitment by individuals to improve their own health status. The extent to which this can be achieved is a moot point, but progress and improvements can always be made. The tobacco industry has been successfully constrained by legislation, but food and alcohol industries that also provide a large number of potentially harmful commodities to the community need further action. The current level of financial and resource commitment to cancer control needs to be maintained and increased in high-need areas. Specialised programs focused on high-risk groups are in development, but need to continue. Cancer control will never be a task that can be finished. It needs to be integrated into long-term health policy to result in long-term benefit for the community, to sustain and build on the improvements that have already been achieved.
10. Conclusion

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