

1 Introduction

This report presents projections of cancer incidence for Australia from 2002 to 2011. These projections were commissioned by the National Cancer Strategies Group (NCSG) to support planning of cancer services, and the report is a joint publication of the Australian Institute of Health and Welfare (AIHW), the NCSG and the Australasian Association of Cancer Registries (AACR). The project has been jointly funded by the Australian Government Department of Health and Ageing (DoHA) and AIHW.

This report includes national projections of cancer incidence for selected cancer groups and sites, but does not include any state or regional projections of cancer incidence, which have been produced by some state cancer registries (Tracey et al. 2005; SACR 2005; Threlfall & Thompson 2004; Tracey & Supramaniam 2002; Threlfall 1997).

The most recently available national data, published in *Cancer in Australia 2001* (AIHW & AACR 2004) are the starting point for these projections, which use cancer incidence data from 1982 to 2001, held by the AIHW in the National Cancer Statistics Clearing House (NCSCH). Refer to Appendix A for further details.

In producing the projections, it was necessary to make a number of assumptions about various cancers. These assumptions were made in consultation with the following expert advisers appointed by the NCSG Data Subcommittee and the AACR:

- NCSG Data Subcommittee: Professor Alan Coates, Professor Mark Elwood, Professor David Roder.
- AACR Statistical Advisory Committee: Dr Michael Coory, Professor Dallas English, Mr Graeme Tucker.

1.1 Key assumptions

The statistical methods described in Section 1.3 below and in Appendix B were used to extrapolate trends in the cancer incidence data from 1982 to 2001. These incidence data reflect changes in cancer prevention, in the detection rates of cancer and in the treatment of precancerous conditions. Where such changes have occurred gradually over time, using statistical methods to extrapolate past trends assumes that these gradual changes will continue to occur in the future at a similar rate.

The introduction of a new screening program or a new diagnostic test may cause changes in incidence trends. The expert advisers highlighted the commencement of national screening programs for female breast cancer and cancer of the cervix and the introduction of prostate-specific antigen (PSA) testing for prostate cancer as having caused major changes in incidence rates.

In particular, the introduction of PSA testing around 1990 caused a rapid, but temporary, increase in male cancer incidence rates in the early 1990s. PSA tests are designed to identify cancers before the onset of clinical symptoms. Much of the temporary increase in prostate cancer incidence has been attributed to the early detection of cancers that would not have been detected at that time except for PSA testing.

Following consultation with the experts, the projection for female breast cancer uses incidence data from 1994 to 2001, the projection for cancer of the cervix uses data from 1991 to 2001 and the projection for prostate cancer uses data from 1997 to 2001.

It is difficult to anticipate and quantify future developments that may cause rapid changes in incidence rates, such as the proposed introduction of a national bowel cancer screening program (DoHA 2005) or the advent of a vaccine for human papilloma virus (HPV), which is strongly linked to cancer of the cervix (Frazer 2004). The projections in this report do not reflect such possible future changes. Expert commentary has been sought on these issues and Chapter 2 includes comments on whether the projections for particular cancers may be too high or too low.

Similarly, these projections do not reflect any anticipated increase in the avoidance of risk factors such as smoking and alcohol consumption, increased response to continuing prevention campaigns, or improvements in detection tests and the treatment of precancerous conditions. If such underlying trends accelerate, rather than simply continue at the current rates of improvement, these projections may overstate the expected incidence of some cancers.

1.2 Cancer groups

For the purposes of these projections, rarer cancers were grouped together so that there were sufficient cases to ensure a stable projection. These groups were based on a set of clinical groups agreed on by the AACR in November 2004, with some minor differences to conform to the tabulation categories used in *Cancer in Australia 2001* (AIHW & AACR 2004), the starting point for these projections.

The clinical groups are designed to group cancers that are similar in terms of clinical treatment. Cancers have been grouped into 16 clinical groups for the purposes of these projections: skin and lip cancers; head and neck cancers; cancers of upper digestive tract (the oesophagus, stomach and small intestine); cancers of the colon, rectum and anus (colorectal cancer); cancers of the liver, gallbladder and pancreas; cancers of respiratory and thoracic organs; cancers of bone and connective tissue; breast cancer; cancer of female genital organs (gynaecological cancers); cancers of male genital organs; cancers of the urinary tract; eye cancer; cancers of the brain and central nervous system; cancers of the thyroid and other endocrine glands; cancers of unknown primary site; and cancers of lymphoid and haematopoietic tissue. Full details of the groups and the ICD-10 codes (WHO 1992) for each group and cancer are given in Table 2 for female cancers and in Table 4 for male cancers.

Projections have been produced separately for females and males for each of the 16 clinical groups, as well as projections for all cancers for both sexes. Separate projections were also produced for particular cancers of interest nominated by DoHA or during consultation with the experts. These include the National Health Priority Area (NHPA) cancers melanoma, lung, colorectal, breast, cervix, prostate and non-Hodgkin lymphoma; as well as a number of other major cancers and cancers of interest. Incidence from 1982 to 2001 of all the cancer groups and cancers of interest is shown in Table 1 for females and Table 3 for males.

Non-melanoma skin cancers (NMSC), which are also NHPA cancers, have not been included in these projections, nor have conditions with ICD-10 codes in the range D45–D47, as coverage of these cancers is not yet complete in the NCSCCH. For further details, see Appendix A. These cancers are also excluded from the projections for all cancers.

A summary of the results of the projections for each cancer from 2002 to 2011 is shown in Table 2 for female cancers and in Table 4 for male cancers. The expected accuracy of the projections differs considerably between cancers, due mainly to differences in the number of cases, and prediction intervals (confidence intervals for predictions, see Appendix B) have

been calculated for each projection and are shown in the more detailed tables for each projection (Tables 7 to 66).

Projections for subgroups and individual cancers within each clinical group have been constrained to add to the overall projection for the group. Prediction intervals were calculated separately for each projection and do not add to the group totals. The projections for all cancers were also constrained to equal the total of the projections for the clinical groups, though separate prediction intervals were again calculated.

For the reasons stated in Section 1.1, separate projections were produced for female breast cancer, cancer of the cervix and prostate cancer, with the results later added to the projections for the relevant clinical groups and to the projections for all cancers.

1.3 Projection methods

Each projection involves calculating the age-specific rates of cancer incidence for 1982 to 2001, as described in Appendix B on statistical methods, and projecting these rates to 2011. The methods chosen to project the age-specific rates are based on the functional data analysis (FDA) approach introduced by Ramsey and Silverman (1997), which can be used to generalise the Lee-Carter approach (Lee 2000, Lee & Carter 1992) to demographic forecasting.

These relatively new statistical methods have been used to produce demographic projections (Hyndman & Ullah 2005; Booth et al. 2001, 2002; Lee & Miller 2001; Lee & Carter 1992) and to forecast breast cancer mortality (Erbas et al. 2005). However, this is the first time the methods have been used to project cancer incidence rates.

Appendix B describes the FDA approach and compares these methods with other methods that have been used to project cancer incidence. Computer routines supplied by Professor Rob Hyndman of Monash University (Hyndman & Ullah 2005) were adapted to apply the FDA approach to project cancer incidence rates and to produce 95% prediction intervals.

The projected age-specific rates and prediction intervals were applied to the Australian estimated resident population (ERP) for 2002 and 2003 (ABS 2003b) and to the AIHW preferred series (series 8) of the Australian Bureau of Statistics (ABS) population projections from 2004 to 2011 (ABS 2003c) to produce estimates of the expected number of new cancer cases from 2002 to 2011.

Appropriate error margins are not given for the ABS estimates of ERP and projected ERP, so the 95% prediction intervals for the projected number of new cases reflect only the variability in the projected cancer incidence rates. The 95% prediction intervals for the projected number of new cases should be considered to be low and high scenarios, rather than true 95% prediction intervals.

The sensitivity of the projected age-specific rates to changes in the application of the techniques and to minor changes in the incidence data was examined. The separate projections for all cancers produced results very close to the total of the group projections (the separately projected numbers of new cases were within 1% of the total), suggesting the group level projections are reasonably stable.

The projections were also reviewed by Dr Mark Clements of the National Centre for Epidemiology and Population Health at the Australian National University (NCEPH) who fitted a series of alternative models to the data. For the major cancers, the alternative projection methods produced generally consistent results with a few exceptions, which are discussed in Chapter 2.