

## ■ Summary of results

This chapter summarises the key results of the modelling and forecasting process. First, projections of the rates and counts of cancer among adults (15 years and above) for all sites combined ('all adult cancer') are presented. The contribution of different cancers ('sites') to the adult cancer burden – historically and projected into the future – is then discussed. Finally, rates and counts for childhood cancer are briefly analysed.

### All adult cancer

#### Incidence

Adjusting for changes in the age structure of the New Zealand population over time, the incidence rate of 'all adult cancer' (15 years and above) has increased fairly steadily over the past half century (the period for which a reasonably comprehensive and reliable cancer registry has existed in this country). Among males, the age standardised (to the WHO world population) incidence rate rose steeply from 245 per 100,000 in 1956<sup>1</sup> to reach 437 per 100,000 in 1981, an increase of nearly 80% (or 3.1% per year, following an almost linear trajectory, see Chapter 7). Among females the rise over the corresponding period was about 70% (or 2.8% per year linear), from a rate of 219 per 100,000 to 371 per 100,000.

During the 1980s and 1990s the incidence rate continued its upward trend in both genders, but more slowly than before. Since the mid 1990s the male rate has been artefactually inflated by the widespread use of prostate specific antigen (PSA) testing, which has led to a dramatic but most probably transient increase in the number of prostate cancers being registered. Using modelled rather than observed prostate cancer registration data from 1994 onwards to exclude this transient 'PSA effect', the age standardised 'all adult cancer' incidence rate for males would have risen only to 478 per 100,000 by 1996<sup>2</sup> – an increase of just 9% over the 1981 level. Among females the corresponding rate reached 423 per 100,000 in 1996, a more substantial increase of 14% since 1981.

Over the 40 year observation period as a whole (from 1956 to 1996) the age standardised 'all adult cancer' incidence *rate* doubled for both genders. At the same time the cancer *burden* (count) quadrupled, with the average annual 'all adult cancer' registration count increasing from 1902 to 7336 registrations<sup>3</sup> among males (the latter count adjusted for the 'PSA effect'), and from 1836 to 7472 registrations among females. The total count (both genders) increased from 3738 to 14,808 registrations (adjusted).<sup>3</sup>

The increasing risk of cancer explains only one-third of this increase in burden. The remaining two-thirds of the increase reflects the action of demographic forces over the period – mainly the growth in size of the adult population.

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<sup>1</sup> All years quoted for incidence or mortality represent the central year of the corresponding five year period (see Table 2.1), and the associated counts or rates are the annual average for that period.

<sup>2</sup> The actual observed age standardised rate for males in 1996 was 549 per 100,000.

<sup>3</sup> 8,448 registrations among males and 15,920 registrations for both genders if not adjusted for the 'PSA effect'.

Incidence rates of ‘all adult cancer’ are forecast by our model to continue to increase further for both genders over the next decade, but even more slowly than has been the case over the past decade. Among males, after adjusting for the ‘PSA effect’ (which should be largely over by 2011 in any case), the age standardised ‘all adult cancer’ incidence rate is forecast to reach 510 per 100,000 (CI 429 – 624)<sup>4</sup> by 2011, an increase of 7% over 1996. Among females the corresponding forecast is for a 6% increase from 1996, to a rate of 450 per 100,000 (CI 370 – 553).

Once the anticipated growth in population size, and the structural ageing that the population will undergo over the forecasting period (1996 to 2011), are superimposed on this relatively small continued increase in cancer risk, the cancer burden is projected to increase more substantially. Among males ‘all adult cancer’ registrations are expected to number 11,005 (CI 9050 – 13,790) in 2011, an increase of 50% over the 1996 count (adjusted for the ‘PSA effect’). The corresponding increase for females is forecast to be 44%, to 10,772 (CI 8584 – 13,360). Total cancer registrations are therefore forecast to increase from 14,808 (adjusted) in 1996 to 21,777 in 2011, a 47% increase, while the corresponding increase in risk is less than 7%.

## **Mortality**

The modelling of cancer mortality trend is based on available data from 1970 to 1999. Among males the age standardised (to the WHO world population) ‘all adult cancer’ mortality rate increased slightly from 261 per 100,000 in 1972 to 270 per 100,000 in the early 1980s, but has since fallen slowly but steadily to reach 246 per 100,000 in 1997 – an overall decline of 20% over the full observation period. As this net fall occurred despite increasing cancer incidence rates, it must reflect gains in cancer survival in the interim – which could have resulted from earlier detection and intervention, or better treatment, or a combination of both, for at least some cancers.

Among females the cancer mortality pattern has been broadly similar if less dramatic. From an age standardised ‘all adult cancer’ mortality rate of 178 per 100,000 in 1972, the trend increased to 190 per 100,000 in the late 1980s – somewhat later than when the male rate reached a maximum – and then fell slowly to reach 181 per 100,000 in 1997, only slightly higher than at the start of the observation period.

In contrast to this rising-then-falling pattern for cancer mortality risk, the absolute number of cancer deaths has risen consistently throughout the observation period – reflecting the impact of demographic trends superimposed on the changing pattern of risk. From 1972 to 1997 male cancer deaths increased 57%, from 2485 to 3898. The corresponding increase for females was even larger (70%), from 2090 to 3549 deaths.

‘All adult cancer’ mortality rates are forecast by our model to continue the decline seen over the past two decades, but at an accelerating pace. For males, the age standardised ‘all adult cancer’ mortality rate is projected to fall to 198 per 100,000 (CI 173 – 233) in 2012, a 20% decline from 1997. The corresponding decrease for females is projected to be a smaller 11%, to 162 per 100,000 (CI 140 – 188).

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<sup>4</sup> CI refers to the 90% credible interval for the Bayesian BAMP estimate (see Chapter 3).

Despite these accelerated declines in the risk of dying from cancer, the annual number of cancer deaths is forecast to increase each year over the forecasting period, reflecting the impact of population growth and (increasingly) of population ageing. Among males, 4554 cancer deaths (CI 3854 – 5537) are projected for 2012, an increase of 17% over the 1997 burden. The corresponding increase for females is projected to be 24%, amounting to 4409 deaths (CI 3681 – 5294). Total cancer deaths are projected to increase from 7447 deaths in 1997 to 8963 deaths in 2012, a 20% increase over the 15 year forecasting period.

### Major historical phases in cancer incidence and mortality

The analysis presented above suggests that historical trends in cancer incidence and mortality can be divided into two major phases: (1) a phase of rapid increase in incidence rates<sup>5</sup> accompanied by almost stable mortality rates (up to the early 1980s); followed by (2) a phase of more slowly increasing incidence rates accompanied by decreasing mortality rates (from the early 1980s to the late 1990s). The projections for incidence and mortality rates appear to amplify the trends seen in the second phase.

Table 4.1 summarises the historical and projected annual changes in the age standardised incidence and mortality rates during the respective phases, assuming a linear trajectory.

**Table 4.1** Average annual change (linear) in age standardised incidence or mortality rate, historical and projected, all adult cancer

	Change (per 100,000 per annum)					
	Incidence			Mortality		
		Male	Female		Male	Female
Phase 1	1954–1980	7.7	6.0	1970–1981	0.8	0.6
Phase 2	1981–1995	2.7*	3.5	1982–1996	-1.6	-0.2
Projection	1996–2013	2.1*	1.8	1997–2014	-3.2	-1.3

\* Adjusted for the ‘PSA effect’.

### Summing individual sites

The ‘all adult cancer’ projections presented in this report were obtained by projecting ‘all adult cancer’ as if it were a single entity (site) in itself. The equivalent set of results could also be derived by summing the separate projections for the individual cancer sites. As shown in Table 4.2, results from both methods agree very closely, with differences between them of 5% or less for registrations and 8% or less for deaths.

<sup>5</sup> The extent of the increase in incidence rates may partly reflect improvement in the completeness of cancer registration over the period.

**Table 4.2** Comparison of projections of all adult cancer and sum of individual cancer sites among adults

	Registrations 2011 (counts)			Deaths 2012 (counts)		
	all adult cancer	sum of individual sites	difference (%)*	all adult cancer	sum of individual sites	difference (%)*
Male	11,005	10,760	2.3	4554	4934	-7.7
Female	10,772	10,252	5.1	4409	4651	-5.2

\* Calculated using the sum of individual sites as the base.

## Impact of tobacco consumption on the cancer burden

That the risk of being diagnosed with cancer is forecast to increase over the next decade in both genders – albeit only slightly (approximately a 6–7% increase from 1996 to 2011) – is an unexpected finding of this study. With declining tobacco consumption, the age standardised all cancer incidence rate might have been expected to fall.

We have used estimates of smoking prevalence adjusted for lag by the Peto and Lopez method (Peto et al 1994), together with relative risk estimates from the CPS-II study (Chao et al 2000, Thun et al 2000), to calculate tobacco attributable fractions for all cancers over the period 1956 to 2011 for both genders and all age groups.<sup>6</sup> This has allowed us to disaggregate the ‘all adult cancer’ forecast into separate projections for tobacco related and non-tobacco related cancers, as summarised in Figures 4.1 and 4.2.

The results of this analysis confirm that the burden of tobacco related cancer among males has been declining since its peak in the early 1980s, reaching 23% of all cancer registrations and 30% of all cancer deaths in the late 1990s. The burden will continue to decline further over the forecasting period to 14% and 23% of registrations and deaths in 2011/12, respectively. Among females the tobacco related cancer burden is projected to reach approximately 10% of all cancer registrations and 21% of all cancer deaths by the early 2010s.

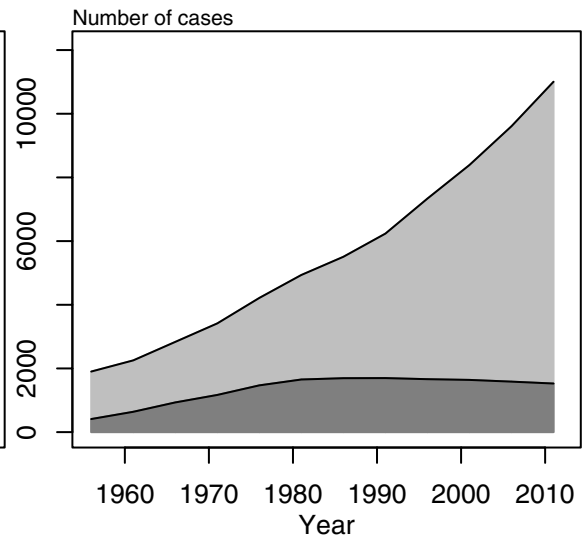
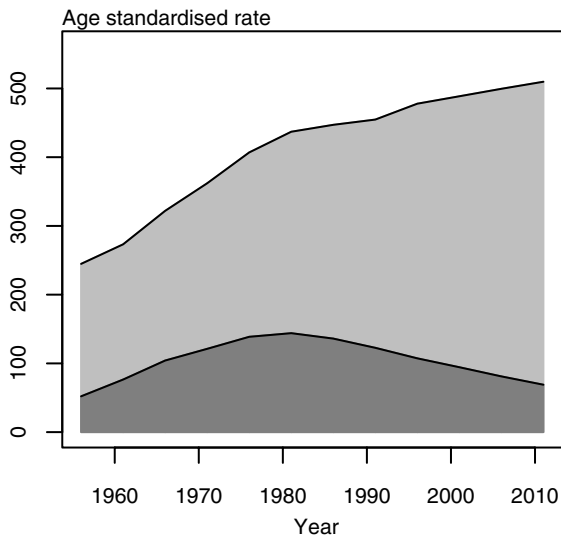
By contrast, the burden of non-tobacco related cancer is projected to continue to increase steadily over the forecasting period for both genders. This may reflect increasing exposure to lifestyle factors, including dietary exposures, physical inactivity and obesity (Adami et al 2001), as well as other environmental exposures and reproductive behaviours.

<sup>6</sup> See Chapter 3 for details of tobacco related cancer, and the method for calculating attributable fractions.

**Figure 4.1** Comparison of tobacco and non-tobacco related cancer rates and counts, males

(a) Male age standardised incidence rates\*

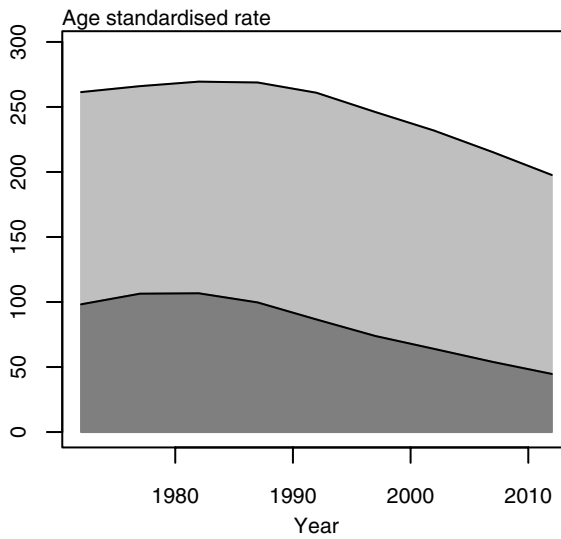
(b) Male number of registrations\*



\* Adjusted for the 'PSA effect'.

(c) Male age standardised mortality rates

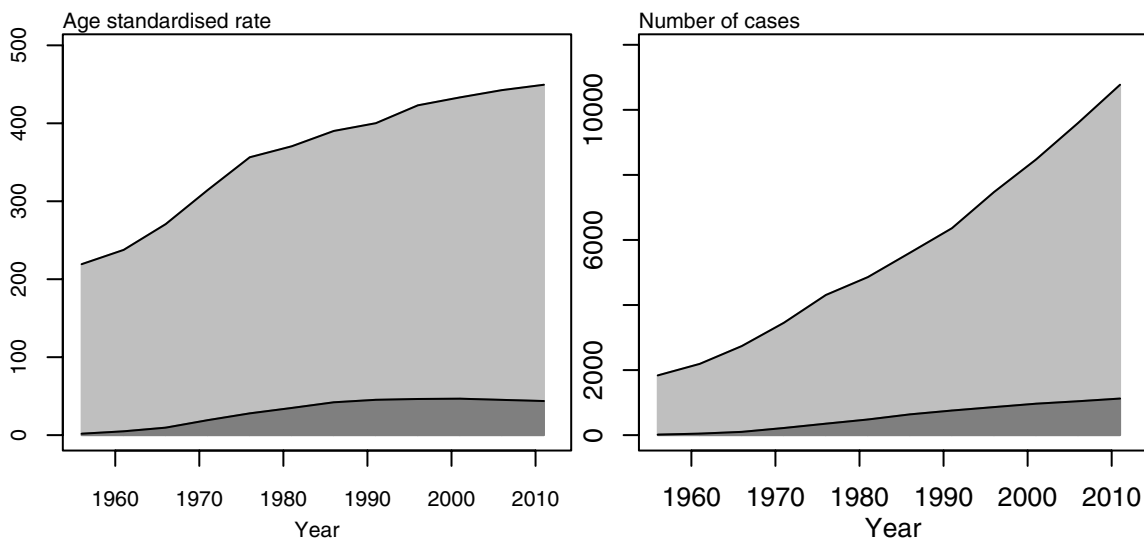
(d) Male number of deaths



Key:   
 Tobacco related cancer   
 Non-tobacco related cancer

**Figure 4.2** Comparison of tobacco and non-tobacco related cancer rates and counts, females

(a) Female age standardised incidence rates      (b) Female number of registrations



(c) Female age standardised mortality rates      (d) Female number of deaths



Key:      ■ Tobacco related cancer  
          ■ Non-tobacco related cancer

## Adult cancers by site

### Counts and rankings

For this report some 26 specific cancers among adults were modelled separately. Counts for registrations and deaths in 1996/97 and 2011/12 for these sites are shown in Table 4.3.

The contribution of each major cancer (excluding ‘adult cancer of other sites’) to the total non-fatal and fatal cancer burden (ie total incidence and mortality counts respectively) is summarised in Table 4.4. This table shows the 10 most highly ranked cancers in 1996/97 and their projected rankings in 2011/12, based on our models. The ranking is based on the share that each cancer contributes to the ‘all adult cancer’ burden (shown in parenthesis) in terms of absolute number (not rate) of registrations or deaths, pooled over all age and ethnic groups.

#### *Incidence*

Inspection of Table 4.4 shows few changes in ranking over the forecasting period for incidence, but some noteworthy shifts in relative shares contributed by different cancers to the total non-fatal cancer burden. For males, prostate cancer’s share of the non-fatal burden is forecast to increase by half, from 14% in 1996 to 22% in 2011 – even with the ‘PSA effect’ excluded. Non-Hodgkin’s lymphoma is projected to show a similar relative rise – from 4% to 6% of the total burden. By contrast, lung cancer’s share is forecast to fall by almost half, from 14% in 1996 to 8% in 2011, while melanoma’s share is anticipated to remain stable at 11% of the total.

Among females the most dramatic relative change in incidence count is forecast to be in non-Hodgkin’s lymphoma’s share, which is expected to double, from 3% of the total in 1996 to 6% in 2011. Breast cancer’s share is forecast to increase slightly (from 26% to 28%), while lung cancer’s share remains stable (at 8%) and melanoma’s decreases (from 10% to 8%). For both genders the share contributed by colorectal cancer is forecast to decrease slightly.

#### *Mortality*

The noteworthy changes forecast in the mortality burden for males are the dramatic decrease projected in lung cancer’s share of the total cancer mortality burden (from 23% in 1997 to 16% in 2012); the increase in prostate cancer’s contribution (from 14% to 17%); and the continuing decrease in stomach cancer’s share (from 5% to 3% of the total burden). Among females lung cancer is forecast to overtake breast cancer as the leading cause of cancer mortality, with its share of the total burden rising from 15% to 19%. For both genders the share held by colorectal cancer is forecast to decrease slightly, as for the non-fatal burden.

Changes in shares contributed by the top 10 cancers for both genders and endpoints (incidence and mortality) over the study period are given in more detail in the next chapter.

**Table 4.3** Registration and death counts, by cancer site, 1996/97 and projected 2011/12

	Male (counts)				Female (counts)			
	Registrations		Deaths		Registrations		Deaths	
	1996	2011	1997	2012	1996	2011	1997	2012
All adult cancer	7336*	11,005	3898	4554	7472	10,772	3549	4409
Bladder	398	754	113	124	144	284	54	71
Bone and connective tissue	78	112	31	39	58	78	25	27
Brain	123	172	104	138	91	114	84	115
Breast	-	-	-	-	1936	2893	643	774
Cervix	-	-	-	-	217	195	79	62
Colorectal	1230	1589	576	673	1194	1382	541	542
Endometrium	-	-	-	-	260	346	72	85
Gallbladder	35	45	22	24	47	51	32	29
Hodgkin's disease	35	32	9	4	25	23	7	3
Kidney	208	362	92	129	126	226	62	86
Larynx	68	55	22	20	12	15	5	5
Leukaemia	259	450	132	163	202	327	103	112
Lip, mouth and pharynx	179	165	68	65	89	91	35	39
Liver	89	158	80	134	44	73	38	62
Lung	1002	858	881	807	582	826	528	863
Melanoma	746	1148	128	183	740	799	85	113
Myeloma	112	183	70	98	99	157	67	95
Non-Hodgkin's lymphoma	287	623	147	255	258	574	142	251
Oesophagus	129	183	127	185	71	91	66	82
Ovary	-	-	-	-	283	412	173	188
Pancreas	156	177	145	148	163	214	156	190
Prostate	1002*	2394	531	844	-	-	-	-
Stomach	239	254	173	163	152	160	118	108
Testis	124	163	6	3	-	-	-	-
Thyroid	37	64	7	8	92	143	14	15
Other sites	544	819	418	727	544	778	410	734

\* Prostate cancer registrations are based on projecting from 1993 data instead of observed 1994–98 data. This adjusts for the 'PSA effect'.

**Table 4.4** Rankings by count, major cancer sites, 1996/97 and projected 2011/12**Male**

Registrations			Deaths		
Site	1996 ranking	2011 ranking	Site	1997 ranking	2012 ranking
Colorectal	1 (17%)	2 (15%)	Lung	1 (23%)	2 (16%)
Prostate*	2 (14%)	1 (22%)	Colorectal	2 (15%)	3 (14%)
Lung	3 (14%)	4 (8%)	Prostate	3 (14%)	1 (17%)
Melanoma	4 (11%)	3 (11%)	Stomach	4 (5%)	8 (3%)
Bladder	5 (6%)	5 (7%)	Non-Hodgkin's lymphoma	5 (4%)	4 (5%)
Non-Hodgkin's lymphoma	6 (4%)	6 (6%)	Pancreas	6 (4%)	9 (3%)
Leukaemia	7 (4%)	7 (4%)	Leukaemia	7 (3%)	7 (3%)
Stomach	8 (3%)	9 (2%)	Melanoma	8 (3%)	6 (4%)
Kidney	9 (3%)	8 (3%)	Oesophagus	9 (3%)	5 (4%)
Lip, mouth and pharynx	10 (3%)	14 (2%)	Bladder	10 (3%)	13 (3%)

\* Prostate cancer registrations are based on projecting from 1993 data instead of observed 1994–98 data.

**Female**

Registrations			Deaths		
Site	1996 ranking	2011 ranking	Site	1997 ranking	2012 ranking
Breast	1 (26%)	1 (28%)	Breast	1 (18%)	2 (17%)
Colorectal	2 (16%)	2 (13%)	Colorectal	2 (15%)	3 (12%)
Melanoma	3 (10%)	4 (8%)	Lung	3 (15%)	1 (19%)
Lung	4 (8%)	3 (8%)	Endometrium	4 (5%)	6 (4%)
Ovary	5 (4%)	6 (4%)	Pancreas	5 (4%)	5 (4%)
Endometrium	6 (3%)	7 (3%)	Non-Hodgkin's lymphoma	6 (4%)	4 (5%)
Non-Hodgkin's lymphoma	7 (3%)	5 (6%)	Stomach	7 (3%)	10 (2%)
Cervix	8 (3%)	12 (2%)	Leukaemia	8 (3%)	9 (2%)
Leukaemia	9 (3%)	8 (3%)	Melanoma	9 (2%)	8 (2%)
Pancreas	10 (2%)	11 (2%)	Brain	10 (2%)	7 (2%)

## Patterns

While the contribution of major cancers to the total burden is of great policy relevance, it is also useful to examine the trends forecast for the individual cancers in more detail. Four possible patterns can be distinguished by examining the projected age standardised rates for each site (Table 4.5):

- Category 1: increase in both incidence and mortality
- Category 2: increase in incidence but decrease in mortality
- Category 3: decrease in both incidence and mortality
- Category 4: decrease in incidence but increase in mortality.

The first category suggests that the increase forecast in cancer risk is probably real, rather than artefactual. The second category suggests that the projected incidence increase may be real, but the possibility of an artefactual explanation – changes in completeness of registration, introduction or enhanced coverage of screening, changes in diagnostic processes, or changes in classification or coding systems – warrants careful consideration. The third category suggests careful attention to the mortality:incidence ratio, as a more rapid rate of fall in incidence than in mortality to a level below that for mortality would suggest modelling error. The fourth category is less logically plausible, except perhaps in the short term and/or unless it involves relatively small changes.

Among males, cancers forecast to increase in age standardised incidence rate over the forecasting period include, most notably, cancer of the prostate (even with the ‘PSA effect’ excluded) and non-Hodgkin’s lymphoma. Smaller increases are forecast for cancers of the liver, bladder, kidney, blood (leukaemia), testis and thyroid. Very small increases are anticipated for melanoma and brain tumours.

Cancers whose age standardised incidence rates are projected to fall among males include, most notably, the tobacco related cancers of the lung, larynx, lip, mouth and pharynx. Smaller decreases are projected for a number of digestive tract cancers, including cancers of the pancreas, stomach, gallbladder and – most importantly – colorectum.

Increases in mortality rates among males are projected for non-Hodgkin’s lymphoma, liver cancer, and – to a lesser extent – prostate cancer, in all cases most probably reflecting their (projected) increases in incidence. The most dramatic mortality rate decreases are projected for cancer of the testis and for Hodgkin’s disease – both cancers highly responsive to chemotherapy and which can be considered virtually curable. Other projected mortality declines are in line with the corresponding incidence forecasts.

Among females, cancers whose incidence rates are forecast to increase include non-Hodgkin’s lymphoma, cancers of the bladder and kidney, leukaemia, cancer of the thyroid, and myeloma. Small but important increases are forecast for breast cancer and ovarian cancer incidence rates. The female age standardised lung cancer incidence rate is forecast to rise slightly and then remain stable, at least to the forecasting horizon.

**Table 4.5** Patterns of change in projected age standardised incidence and mortality rates, 1996/97 to 2011/12

**Male**

	Incidence			Mortality		
	1996	2011	change (%)	1997	2012	change (%)
All adult cancer	478	510	+7	246	198	-20
<b>Category 1 (increase in incidence rate, increase in mortality rate)</b>						
Liver	6	8	+27	5	6	+20
Non-Hodgkin's lymphoma	19	30	+57	9	11	+22
Prostate*	77	102	+33	33	34	+4
Other sites	36	37	+5	26	31	+18
<b>Category 2 (increase in incidence rate, decrease in mortality rate)</b>						
Bladder	26	34	+33	7	5	-28
Bone and connective tissue	5	6	+9	2.1	2.0	~
Brain	8	9	+7	7	7	-2
Kidney	14	17	+24	6	6	-2
Leukaemia	17	21	+25	9	8	-12
Melanoma	50	55	+10	8	8	-3
Myeloma	7	8	+14	4.3	4.2	~
Testis	9	11	+24	0.4	0.2	~
Thyroid	2.6	3.4	~	0.4	0.4	~
<b>Category 3 (decrease in incidence rate, decrease in mortality rate)</b>						
Colorectal	80	71	-11	36	29	-21
Gallbladder	2.3	2.0	~	1.4	1.0	~
Hodgkin's disease	2.5	1.9	~	0.6	0.2	~
Larynx	4.5	2.5	~	1.4	0.8	~
Lip, mouth and pharynx	12	8	-34	4.4	3.0	~
Lung	64	38	-40	55	35	-37
Pancreas	10	8	-21	9	6	-30
Stomach	15	12	-25	11	7	-34
<b>Category 4 (decrease in incidence rate, increase in mortality rate)</b>						
Oesophagus	8	8	-1	8	8	+2

~ Indicates that either one or both age standardised rates are less than 5 per 100,000, so percentage change calculation is not robust.

\* Prostate cancer registrations are based on projecting from 1993 data instead of observed 1994–98 data.

## Female

	Incidence			Mortality		
	1996	2011	change (%)	1997	2012	change (%)
All adult cancer	423	450	+6	181	162	-11
<b><i>Category 1 (increase in incidence rate, increase in mortality rate)</i></b>						
Kidney	7	9	+37	3.0	3.2	~
Liver	2.3	2.8	~	1.9	2.3	~
Lung	32	33	+2	28	33	+17
Myeloma	5	6	+17	3.1	3.3	~
Non-Hodgkin's lymphoma	14	24	+67	7	9	+31
Other sites	28	29	+5	19	25	+28
<b><i>Category 2 (increase in incidence rate, decrease in mortality rate)</i></b>						
Bladder	7	11	+48	2.3	2.3	~
Bone and connective tissue	3.5	3.7	~	1.5	1.3	~
Breast	117	127	+9	36	31	-12
Leukaemia	10	13	+23	5.1	4.0	~
Ovary	17	18	+9	10	7	-23
Thyroid	6	7	+24	0.7	0.5	~
<b><i>Category 3 (decrease in incidence rate, decrease in mortality rate)</i></b>						
Cervix	14	10	-27	4.7	2.7	~
Colorectal	63	50	-21	26	18	-31
Endometrium	15	15	-5	3.6	3.2	~
Gallbladder	2.3	1.9	~	1.5	1.0	~
Hodgkin's disease	1.7	1.5	~	0.4	0.2	~
Larynx	0.7	0.6	~	0.2	0.2	~
Lip, mouth and pharynx	4.8	3.6	~	1.7	1.3	~
Melanoma	45	36	-20	4.6	4.4	~
Oesophagus	3.3	3.1	~	2.9	2.7	~
Pancreas	8	8	-6	8	7	-13
Stomach	7	6	-19	5.5	3.8	~
<b><i>Category 4 (decrease in incidence rate, increase in mortality rate)</i></b>						
Brain	5	5	-1	5	5	+6

~ Indicates that either one or both age standardised rates are less than 5 per 100,000, so percentage change calculation is not robust.

Cancers whose incidence rates among females are expected to fall include cancers of the cervix, colorectum, stomach, gallbladder, melanoma, and (perhaps surprisingly) tobacco related cancers of the lip, mouth and pharynx, larynx and (to a lesser extent) pancreas.

Increases in mortality rates among females are projected for non-Hodgkin's lymphoma, cancer of the lung, and primary liver cancer. On the other hand, decreases in mortality rates are forecast for cancers of the cervix, colorectum, gallbladder, stomach, larynx, lip, mouth and pharynx, ovary, breast and thyroid, and for Hodgkin's disease.

Potentially anomalous trends between the independent forecasts of incidence and mortality rates were found for only a small number of sites: oesophageal cancer in males, brain cancer in females, and (to a lesser extent) lung cancer in females. Either the incidence or the mortality forecasts could be too high (or too low) for these sites. An alternative explanation is that these apparently inconsistent trends are in fact short-term phenomena only.

Table 4.6 qualitatively summarises cancer sites projected to undergo substantial change in either incidence or mortality rates (or both).

**Table 4.6** Cancer sites projected to undergo substantial\* change in age standardised incidence and/or mortality rates, 1996/97 to 2011/12

**Incidence**

	Both genders	Single gender
Projected to increase	Bladder Kidney Leukaemia Myeloma Non-Hodgkin's lymphoma	Liver (male) Prostate Testis Thyroid (female)
Projected to decrease	Colorectal Stomach	Cervix Lip, mouth and pharynx (male) Lung (male) Melanoma (female) Pancreas (male)

**Mortality**

	Both genders	Single gender
Projected to increase	Non-Hodgkin's lymphoma	Liver (male) Lung (female)
Projected to decrease	Colorectal Pancreas Stomach	Bladder (male) Breast Cervix Leukaemia (male) Lung (male) Ovary

\* Greater than 10% change in the age standardised rate.

## **Selected major cancers**

### **Female breast cancer (Chapter 12)**

Breast cancer dominates the cancer spectrum among adult females, accounting for a quarter of all registrations and a fifth of all cancer deaths in the late 1990s. Our model forecasts continued growth in breast cancer incidence rates, such that by 2011 this site is projected to account for 28% of all female registrations. By contrast, breast cancer mortality rates are projected to decline slowly until (at least) 2012, with the result that lung cancer displaces breast cancer as the leading cause of cancer deaths among females by that year.

This mortality forecast does not include any impact from the BSA, which began too recently (1998) to be reflected in the historical data (on which the projection is based). A subsidiary model indicates that the screening programme may reduce projected breast cancer mortality by a further 11–15% by 2012, corresponding to approximately 85–115 avoided deaths in that year alone.<sup>7</sup>

### **Cervical cancer (Chapter 13)**

Cervical cancer is of special interest in view of the existence of the National Cervical Screening Programme (NCSP).

Cervical cancer incidence and mortality rates have been falling since the 1990s and the 1970s, respectively, and these downward trends are forecast to continue despite the arrival in the high risk age groups of birth cohorts of women at higher risk of cervical cancer than their immediate predecessors (Cox and Skegg 1992). Registration counts are projected to fall from 217 in 1996 to 195 (CI 131 – 378) in 2011; deaths are projected to fall from 79 in 1997 to 62 (CI 46 – 106) in 2012.

Two sets of forecasts have been produced, one set using data up to the 1986/87 five year period only, and the other using all available data. The gap between them demonstrates the existence of a powerful period effect that has led to falling incidence and mortality across all ages since the late 1980s, overcoming the countervailing cohort effect. However, the timing of the gap suggests that not all of this period effect is attributable to the NCSP. The audit of the NCSP currently in progress should help to evaluate the effectiveness of this programme.

### **Colorectal cancer (Chapter 14)**

Colorectal cancer is currently ranked first for incidence and second for mortality among the selected cancer sites for males, and second for both endpoints among females. The forecast declines in both incidence and mortality rates for this cancer represent a major finding of this report. By 2011/12 age standardised incidence and mortality rates of colorectal cancer are projected to decline by 11% and 21% respectively among males, and by 21% and 31% respectively among females, relative to their 1996/97 levels. These forecasts do not include the possible introduction of a screening programme (based on

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<sup>7</sup> This estimate is lower than the 30% reduction based on randomised controlled trials, reflecting conservative assumptions for coverage and efficacy used in our model.

faecal occult blood testing followed by colonoscopy), which would have at most only a small additional impact by the forecasting horizon.

### **Lung cancer (Chapter 23)**

Our model forecasts a continuation of the rapid decline in lung cancer incidence and mortality rates experienced over the past two decades among males, reflecting the time course of the tobacco epidemic in this gender lagged by about 20 years. By 2011/12 male rates are expected to be about 40% below their 1996/97 levels.

By contrast, female rates are expected to rise slightly and then stabilise, again reflecting the (suitably lagged) timing and magnitude of the tobacco epidemic in this gender. The projected convergence between female lung cancer incidence and mortality rates suggests that either the rise in incidence rate has been underestimated slightly, or the rise in mortality rate has been overestimated slightly by our model.

The increase in mortality will move lung cancer into first place as the leading cause of female cancer death by 2012, overtaking both breast and colorectal cancer. Even so, a 'crossover' between male and female lung cancer rates is not projected to occur by the forecasting horizon, although this long awaited milestone could occur shortly thereafter – unless, of course, substantive gains can be made in terms of lowering female tobacco consumption in the interim.

### **Melanoma (Chapter 24)**

Melanoma registrations had to be adjusted for undercount for the years prior to 1994. Using the adjusted data, only a small further increase in male, and a decline in female, incidence rates are projected by 2011. This is an unexpected and important finding of this report. However, if the unadjusted data are used, continued increases in incidence rates are then projected for both genders (and the male increase is even steeper). Small decreases in melanoma mortality rates are forecast for both genders. Nevertheless, melanoma is expected to remain among the top five or six cancers for both endpoints for both genders at the forecasting horizon.

### **Prostate cancer (Chapter 30)**

Forecasting prostate cancer incidence is problematic because widespread if unsystematic PSA testing over the past five or so years has led to a sudden and dramatic inflation in registration counts (and rates). Yet it would be false to assume that this period effect will continue: much of the increase may represent advancement in the date of diagnosis of prostate cancers, which should ultimately be followed by a deficit in incident cancers available for diagnosis: that is, the period effect should be at least partly transient. To avoid distortion of the underlying trend by this 'PSA effect', only the registration data to 1993 have been used for forecasting prostate cancer incidence. All available data (ie to 1999) have been used to forecast mortality, however.

Using the data to 1993, a steady but non-dramatic increase in prostate cancer incidence rates are forecast to 2011, accompanied by an even smaller increase in mortality rates. Nevertheless, these increases are sufficient, when coupled with increasing population size and (especially) accelerating population ageing, to propel prostate cancer to first place for

both incidence and mortality among the selected cancer sites for males by the end of the forecasting period.

The mortality forecast does not include any benefit from PSA testing (or any organised PSA screening that may be introduced in the interim). However, even if such benefit exists, it is unlikely to impact substantively within the forecasting horizon.

## **Childhood cancer**

Detailed analysis of childhood cancer is presented in Chapter 8. A summary of the results is provided here to complete the overview presented in this chapter.

Cancer in children (0–14 years) is relatively uncommon, with childhood leukaemia accounting for just over a third of all cases. In 1996/97 there were an average of 136 registrations and 36 deaths per year (genders pooled), comprising less than 1% of the total cancer burden in the whole population.

The age standardised incidence rate of childhood cancer among males increased from 13 per 100,000 in 1956 to approximately 17 per 100,000 in 1996, and from 10 per 100,000 to 15 per 100,000 among females over the same period. In contrast, the corresponding mortality rate has fallen steadily, from 8 per 100,000 in 1972 to 5 per 100,000 in 1997 among males, and from 7 per 100,000 to 4 per 100,000 among females.

Trends in incidence and mortality rates are forecast to continue. By 2011 the incidence rate is projected to increase to 21 per 100,000 (CI 14 – 29) among males and 19 per 100,000 (CI 12 – 26) among females. Given anticipated trends in the size of the child population, this corresponds to 85 (CI 51 – 125) male and 75 (CI 45 – 106) female registrations – increases of 15% and 21% over the 1996 numbers, respectively. The mortality rate is forecast to decrease further, to 4 per 100,000 (CI 2 – 5) and 3 per 100,000 (CI 2 – 4) in 2012 among males and females, respectively. This corresponds to 16 (CI 8 – 22) male and 12 (CI 5 – 15) female deaths, decreases of 24% and 20% over 1997, respectively.