



### Introduction

In 2006 the National Cancer Registry published projections of cancer numbers to 2020, based on trends from 1994-2003 and population projections to 2036 (1). With the availability of revised population projections (2) and some additional years of incidence data, we have decided to revise these projections.

### Current trends in incidence

Trends in cancer numbers depend on two factors—the underlying risk of developing cancer and the number of persons at risk. The underlying risk of cancer is best estimated from age-standardised incidence rates; recent trends in these rates for the commoner cancers are given in Table S1.

| <b>Table S1. Trends in cancer incidence rates 1994-2006</b>                  |           |         |  |           |  |
|--|-----------|---------|--|-----------|--|
| <i>Figures in bold indicate statistically significant trends (p&lt;.05).</i> |           |         |  |           |  |
| cancer site  | period    | females |  | males     |  |
|  |           | period  | annual percentage change (95% confidence limits) | period    | annual percentage change (95% confidence limits) |
| all invasive cancers (C00-C96)   | 1994-2006 |         | <b>0.8% (0.5%, 1.1%)</b>                         | 1994-2006 | <b>0.8% (0.4%, 1.1%)</b>                         |
| all invasive cancers (C00-C96) excluding non-melanoma skin (C44)             | 1994-2006 |         | <b>0.8% (0.5%, 1.2%)</b>                         | 1994-2006 | <b>1.1% (0.7%, 1.5%)</b>                         |
| head and neck (C01-C14)  | 1994-2006 |         | 1.2% (-0.4%, 2.9%)                               | 1994-2002 | <b>-5.6% (-7.5%, -3.6%)</b>                      |
|  |           |         |  | 2002-2006 | 4.9% (-1.0%, 11.1%)                              |
| oesophagus (C15)   | 1994-2006 |         | <b>-1.3% (-2.5%, 0.0%)</b>                       | 1994-2006 | 0.1% (-1.4%, 1.5%)                               |
| stomach (C16)  | 1994-2006 |         | <b>-2.2% (-2.9%, -1.5%)</b>                      | 1994-2006 | <b>-2.5% (-3.0%, -2.0%)</b>                      |
| colorectal (C18-C21)   | 1994-2006 |         | 0.0% (-0.6%, 0.7%)                               | 1994-2006 | 0.0% (-0.3%, 0.3%)                               |
| pancreas (C25)   | 1994-2006 |         | 0.5% (-0.9%, 1.9%)                               | 1994-2006 | -0.3% (-1.5%, 0.9%)                              |
| lung (C34)   | 1994-2006 |         | <b>2.2% (1.6%, 2.7%)</b>                         | 1994-2006 | <b>-1.2% (-1.7%, -0.7%)</b>                      |
| melanoma of skin (C43)   | 1994-2006 |         | <b>2.3% (1.2%, 3.4%)</b>                         | 1994-2006 | <b>4.2% (3.0%, 5.4%)</b>                         |
| non-melanoma skin (C44)  | 1994-2006 |         | <b>0.7% (0.0%, 1.3%)</b>                         | 1994-2002 | <b>-1.8% (-2.9%, -0.6%)</b>                      |
|  |           |         |  | 2002-2006 | <b>2.9% (1.1%, 4.8%)</b>                         |
| female breast (C50)  | 1994-1999 |         | 1.3% (0.0%, 2.7%)                                |           |  |
|  | 1999-2002 |         | 5.1% (-0.5%, 11.0%)                              |           |  |
|  | 2002-2006 |         | <b>-2.0% (-3.5%, -0.4%)</b>                      |           |  |
| gynaecological (C51-C58)   | 1994-2006 |         | <b>0.6% (0.0%, 1.2%)</b>                         |           |  |
| prostate (C61)   |           |         |  | 1994-2004 | <b>7.9% (6.6%, 9.2%)</b>                         |
|  |           |         |  | 2004-2006 | -5.3% (-16.1%, 7.0%)                             |
| kidney (C64)   | 1994-2006 |         | <b>3.7% (2.3%, 5.1%)</b>                         | 1994-2002 | <b>5.5% (2.8%, 8.3%)</b>                         |
|  |           |         |  | 2002-2006 | -3.3% (-9.3%, 3.2%)                              |
| bladder (C67)  | 1994-2006 |         | -1.3% (-3.2%, 0.6%)                              | 1994-2006 | <b>-2.1% (-2.9%, -1.4%)</b>                      |
| brain and central nervous system (C70-C72)                                   | 1994-2006 |         | 0.4% (-1.4%, 2.2%)                               | 1994-2006 | 0.3% (-0.5%, 1.0%)                               |
| lymphoma (C81-C85)   | 1994-2006 |         | <b>1.6% (0.4%, 2.8%)</b>                         | 1994-2006 | <b>1.7% (0.8%, 2.6%)</b>                         |
| leukaemia (C91-C95)  | 1994-2006 |         | -0.2% (-2.0%, 1.7%)                              | 1994-2004 | <b>2.9% (1.4%, 4.5%)</b>                         |
|  |           |         |  | 2004-2006 | -13.4% (-28.3%, 4.5%)                            |

There have been statistically significant increases for both sexes in rates for all invasive cancers combined, both including and excluding non-melanoma skin cancer. Statistically significant increases in rate have occurred over the period 1994-2006 for lung cancer, melanoma and non-melanoma cancers of the skin, gynaecological cancers, cancers of kidney and lymphoma for women and for melanoma of skin and lymphoma in men.

For women, there were significant overall decreases in rate for oesophageal and stomach cancer, and for men there were decreases in rate for cancers of the stomach, lung and bladder.

The time trends for a number of cancers changed during the period studied. Cancer of the breast in women showed a slow rate of increase from 1994 to 1999 (1.3% per year) which accelerated to 5.1% per year in 1999-2002, and then fell by 2.0% per year between 2002 and 2006. Cancer of the prostate increased rapidly (7.9% per year) between 1994 and 2004 but appears now to be falling in rate. For men, cancers of the head and neck, non-melanoma skin cancer, kidney cancer and leukaemia all showed reversals of the incidence trend during the period studied. With the exception of female breast and non-melanoma skin cancer, the more recent trends were not statistically significant.

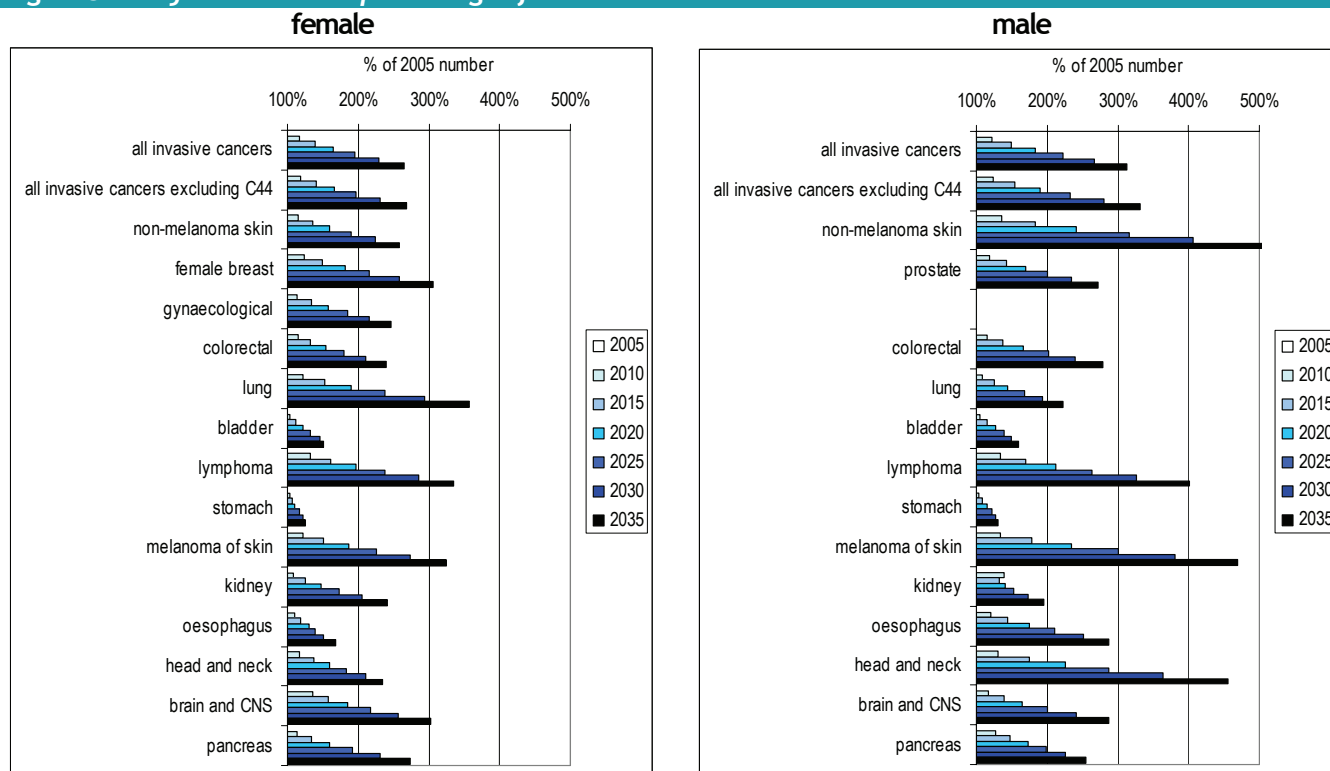
### Projections

Between 2005 and 2035, the overall number of invasive cancers is projected to increase by 17063 (165%, 6% annually) for females and by 24809 (213%, 7% annually) for males (Table S2, Figure S1). If non-melanoma cancer of the skin is excluded, over the same period the number of invasive cancers is projected to increase by 12479 (168%, 6% annually) for females and by 19139 (232%, 8% annually) for males.

Over the ten-year period 2010 to 2020, the total number of cancers is projected to increase by 40% for women and by just over 50% for men. An increase is expected in the numbers of all common cancer types, ranging from 1% for kidney cancer to 78% for non-melanoma skin cancer in men, and from 6% for stomach cancer to 66% for kidney cancer in women.

Over the period 2010 to 2030 the projected overall increase in numbers is 95% for women and 120% for men (127% excluding non-melanoma skin cancer), with the largest increases being expected in skin cancers (both melanoma and non-melanoma) in men and kidney cancer in women. By 2020-2025, the number of lung cancers in women is projected to exceed the number in men. As noted in the previous report, most of the projected increase is attributable to expected demographic change. Although the size of the national population is projected to increase by 37% between 2010 and 2030, the number aged over 65 (the great majority of cancer patients) is expected to increase by 90% for females and 112% for males (2). This demographic change alone (assuming no change in underlying cancer rates) would increase the number of invasive cancer cases in females by 12338 and by 19882 in males between 2005 and 2035.

**Figure S1. Projected cases as percentage of 2005 total**



**Table S2. Actual case numbers for 2005 and projected case numbers 2010-2035 ( $\pm$  95% prediction intervals)**

| site  | sex                      | 2005  | 2010            | 2015            | 2020            | 2025             | 2030                   | 2035             | % increase<br>2010-2020 | % increase<br>2010-2030 | % increase<br>2010-2035 |
|---|--------------------------|-------|-----------------|-----------------|-----------------|------------------|------------------------|------------------|-------------------------|-------------------------|-------------------------|
| all invasive cancers (C00-C96)                                      | female                   | 10341 | 12165 $\pm$ 281 | 14380 $\pm$ 379 | 17024 $\pm$ 519 | 20127 $\pm$ 703  | 23708 $\pm$ 942        | 27404 $\pm$ 1236 | 40%                     | 40%                     | 95%                     |
|   | male                     | 11632 | 14118 $\pm$ 305 | 17418 $\pm$ 430 | 21355 $\pm$ 616 | 25922 $\pm$ 878  | 31072 $\pm$ 1232       | 36441 $\pm$ 1696 | 51%                     | 51%                     | 120%                    |
| all invasive cancers (C00-C96)<br>excluding non-melanoma skin (C44) | female                   | 7439  | 8838 $\pm$ 239  | 10460 $\pm$ 324 | 12387 $\pm$ 441 | 14632 $\pm$ 596  | 17230 $\pm$ 796        | 19918 $\pm$ 1038 | 40%                     | 40%                     | 95%                     |
|   | male                     | 8239  | 10222 $\pm$ 259 | 12727 $\pm$ 365 | 15723 $\pm$ 522 | 19199 $\pm$ 741  | 23169 $\pm$ 1038       | 27378 $\pm$ 1424 | 54%                     | 54%                     | 127%                    |
| head and neck (C01-C14)   | female                   | 83    | 97 $\pm$ 25     | 114 $\pm$ 34    | 133 $\pm$ 46    | 152 $\pm$ 62     | 175 $\pm$ 83           | 194 $\pm$ 108    | 37%                     | 37%                     | 80%                     |
|   | male                     | 194   | 255 $\pm$ 68    | 338 $\pm$ 133   | 440 $\pm$ 222   | 557 $\pm$ 339    | 707 $\pm$ 492          | 884 $\pm$ 682    | 73%                     | 73%                     | 177%                    |
| oesophagus (C15)  | female                   | 120   | 132 $\pm$ 30    | 143 $\pm$ 41    | 156 $\pm$ 57    | 168 $\pm$ 80     | 181 $\pm$ 110          | 202 $\pm$ 149    | 18%                     | 18%                     | 37%                     |
|   | male                     | 214   | 257 $\pm$ 41    | 310 $\pm$ 58    | 374 $\pm$ 84    | 452 $\pm$ 119    | 537 $\pm$ 167          | 613 $\pm$ 227    | 46%                     | 46%                     | 109%                    |
| stomach (C16)   | female                   | 167   | 174 $\pm$ 33    | 179 $\pm$ 40    | 185 $\pm$ 49    | 195 $\pm$ 61     | 204 $\pm$ 74           | 209 $\pm$ 87     | 6%                      | 6%                      | 17%                     |
|   | male                     | 286   | 294 $\pm$ 43    | 312 $\pm$ 54    | 331 $\pm$ 68    | 350 $\pm$ 85     | 365 $\pm$ 103          | 372 $\pm$ 121    | 13%                     | 13%                     | 24%                     |
| colorectal (C18-C21)  | female                   | 888   | 1020 $\pm$ 82   | 1176 $\pm$ 111  | 1367 $\pm$ 154  | 1601 $\pm$ 211   | 1867 $\pm$ 287         | 2128 $\pm$ 381   | 34%                     | 34%                     | 83%                     |
|   | male                     | 1223  | 1402 $\pm$ 97   | 1687 $\pm$ 137  | 2035 $\pm$ 199  | 2464 $\pm$ 284   | 2938 $\pm$ 398         | 3409 $\pm$ 545   | 45%                     | 45%                     | 110%                    |
| pancreas (C25)  | female                   | 207   | 235 $\pm$ 39    | 278 $\pm$ 53    | 331 $\pm$ 74    | 398 $\pm$ 102    | 477 $\pm$ 139          | 565 $\pm$ 187    | 41%                     | 41%                     | 103%                    |
|   | male                     | 177   | 224 $\pm$ 40    | 262 $\pm$ 56    | 306 $\pm$ 83    | 353 $\pm$ 121    | 401 $\pm$ 172          | 451 $\pm$ 242    | 37%                     | 37%                     | 79%                     |
| lung (C34)  | female                   | 741   | 904 $\pm$ 76    | 1131 $\pm$ 102  | 1413 $\pm$ 140  | 1763 $\pm$ 190   | 2182 $\pm$ 254         | 2642 $\pm$ 331   | 56%                     | 56%                     | 141%                    |
|   | male                     | 1090  | 1180 $\pm$ 91   | 1326 $\pm$ 130  | 1493 $\pm$ 189  | 1697 $\pm$ 274   | 1904 $\pm$ 386         | 2104 $\pm$ 531   | 27%                     | 27%                     | 61%                     |
| melanoma of skin (C43)  | female                   | 360   | 438 $\pm$ 52    | 545 $\pm$ 69    | 671 $\pm$ 92    | 816 $\pm$ 122    | 983 $\pm$ 159          | 1170 $\pm$ 204   | 53%                     | 53%                     | 124%                    |
|   | male                     | 246   | 329 $\pm$ 45    | 440 $\pm$ 61    | 576 $\pm$ 83    | 740 $\pm$ 114    | 935 $\pm$ 154          | 1153 $\pm$ 205   | 75%                     | 75%                     | 184%                    |
| non-melanoma skin (C44)   | female                   | 2092  | 3328 $\pm$ 147  | 3924 $\pm$ 199  | 4642 $\pm$ 273  | 5502 $\pm$ 373   | 6489 $\pm$ 504         | 7504 $\pm$ 669   | 39%                     | 39%                     | 95%                     |
|   | male                     | 3393  | 4616 $\pm$ 253  | 6197 $\pm$ 471  | 8208 $\pm$ 788  | 10751 $\pm$ 1227 | 13786 $\pm$ 1815       | 17181 $\pm$ 2580 | 78%                     | 78%                     | 199%                    |
| female breast (C50)   | based on 1994-1996 trend | 2196  | 2720 $\pm$ 359  | 3294 $\pm$ 542  | 3976 $\pm$ 773  | 4752 $\pm$ 1056  | 5670 $\pm$ 1411        | 6724 $\pm$ 1818  | 46%                     | 46%                     | 108%                    |
|   | based on 2002-2006 trend | 2196  | 2696 $\pm$ 157  | 2781 $\pm$ 137  | 3040 $\pm$ 315  | 3484 $\pm$ 623   | 4123 $\pm$ 1100        | 4833 $\pm$ 1771  | 13%                     | 13%                     | 53%                     |
| gynaecological (C51-C58)  | female                   | 1002  | 1146 $\pm$ 86   | 1350 $\pm$ 117  | 1587 $\pm$ 157  | 1850 $\pm$ 210   | 2154 $\pm$ 277         | 2464 $\pm$ 356   | 38%                     | 38%                     | 88%                     |
|   | male                     | 2415  |                 |                 |                 |                  | no projection possible |                  |                         |                         |                         |
| prostate (C61)  | female                   | 148   | 185 $\pm$ 34    | 240 $\pm$ 45    | 307 $\pm$ 60    | 384 $\pm$ 80     | 477 $\pm$ 105          | 578 $\pm$ 135    | 66%                     | 66%                     | 158%                    |
|   | male                     | 227   | 316 $\pm$ 56    | 302 $\pm$ 45    | 318 $\pm$ 103   | 347 $\pm$ 191    | 393 $\pm$ 313          | 445 $\pm$ 445    | 1%                      | 1%                      | 24%                     |
| kidney (C64)  | female                   | 143   | 147 $\pm$ 31    | 160 $\pm$ 43    | 174 $\pm$ 60    | 190 $\pm$ 83     | 208 $\pm$ 114          | 216 $\pm$ 152    | 18%                     | 18%                     | 41%                     |
|   | male                     | 331   | 350 $\pm$ 47    | 383 $\pm$ 61    | 420 $\pm$ 80    | 460 $\pm$ 105    | 497 $\pm$ 133          | 529 $\pm$ 166    | 20%                     | 20%                     | 42%                     |
| bladder (C67)   | female                   | 118   | 161 $\pm$ 33    | 187 $\pm$ 44    | 219 $\pm$ 60    | 257 $\pm$ 80     | 303 $\pm$ 105          | 357 $\pm$ 135    | 36%                     | 36%                     | 88%                     |
|   | male                     | 188   | 221 $\pm$ 39    | 261 $\pm$ 53    | 311 $\pm$ 72    | 377 $\pm$ 98     | 454 $\pm$ 131          | 539 $\pm$ 171    | 41%                     | 41%                     | 105%                    |
| brain and central nervous system (C70-C72)                          | female                   | 274   | 363 $\pm$ 48    | 443 $\pm$ 64    | 539 $\pm$ 86    | 652 $\pm$ 115    | 782 $\pm$ 151          | 919 $\pm$ 194    | 48%                     | 48%                     | 115%                    |
|   | male                     | 327   | 441 $\pm$ 53    | 553 $\pm$ 73    | 692 $\pm$ 101   | 862 $\pm$ 138    | 1070 $\pm$ 188         | 1314 $\pm$ 247   | 57%                     | 57%                     | 143%                    |
| lymphoma (C81-C85)  | female                   | 94    | 193 $\pm$ 36    | 221 $\pm$ 49    | 252 $\pm$ 67    | 287 $\pm$ 90     | 329 $\pm$ 120          | 384 $\pm$ 159    | 31%                     | 31%                     | 70%                     |
|   | male                     | 116   |                 |                 |                 |                  | no projection possible |                  |                         |                         |                         |

As the older male population is expected to increase more rapidly than the corresponding female population, numbers of almost all cancers are expected to increase more rapidly for men than for women (Figure 1). This demographic effect is expected to account for 72% of the expected increase in numbers in females and 80% in males.

The contribution of demography to trends in the individual cancer types will depend on the underlying trend in incidence. For colorectal cancer, for instance, there is no current upward or downward trend, and so demography will contribute about 95% of the expected increase. For lung cancer in women, on the other hand, demography will contribute only 51% of the expected increase, the rest being attributable to the underlying upward trend in female lung cancer risk. For men, the projected increase in lung cancer numbers is only 56% of that predicted by demography alone, as lung cancer risk is already declining in men.

## Conclusions

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As noted in our previous report (1), the number of newly diagnosed cancers is increasing by 6-7% annually and, unless major reversals of trends occur in the near future, the number is likely to double in the next 20 years. The underlying risk of developing cancer is increasing by less than 1% annually and the expected increase in numbers is primarily attributable to the projected rise in our older population. Given that both our knowledge of the modifiable causes of cancer (3) and our ability to change these are both limited, immediate action to reduce cancer risk is unlikely to have a major impact at the population level. However, specific problems, particularly the continuing rise in smoking-related cancers in women, will need decisive action.

The projected increase in non-melanoma skin cancers in men is difficult to interpret. These cancers occur mainly in an elderly population and there are well-known problems in identifying all of them. The recent trends in men may be due to better diagnosis and ascertainment rather than to a real increase in risk. The increase in melanoma, on the other hand, is likely to be real, and suggests that consideration should be given to programmes focussed on earlier diagnosis and better awareness of sun risk. The expected increase in head and neck cancers in men is based on a recent upturn in incidence rates, which may not be sustained. However, this may represent an increase in HPV-related oropharyngeal cancers, as most of the recent increase in male head and neck cancer has been in the oropharynx (data not shown).

The limitations of projections of this kind can be seen in the problems associated with the projected numbers for the two commonest cancers—breast and prostate. The models used assume that fluctuations in cancer risk occur slowly and predictably; while this is generally true for aetiological factors, health care interventions such as innovations in diagnosis, screening or treatment may happen on a much shorter time-scale. Screening, in particular, gives rise to an initial increase in cancer numbers, as cancers which would have been picked up symptomatically over a number of years are diagnosed over a much shorter period during the first screening round. Once these prevalent cancers have been detected, the incidence rate tends to settle back to the pre-screening level, or to somewhat above it if over-diagnosis is occurring.

The expected effect of demography on cancer numbers is striking, but not specific to cancer. The burden of many diseases is expected to increase dramatically in the next 20 years, with clear consequences for the provision of services (4). The changing demography of cancer patients will also pose challenges in diagnosis and treatment. We have previously noted the low levels of treatment of the elderly in the Irish population compared to other countries, and there is a well-recognised scarcity of clinical trial evidence for older patients. The clear improvements in cancer survival seen over the last twenty years and our improving life expectancy will contribute to continuing falls in mortality, despite an increase in disease burden, but will also result in an increasing number of ageing cancer survivors in the population.

## References

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