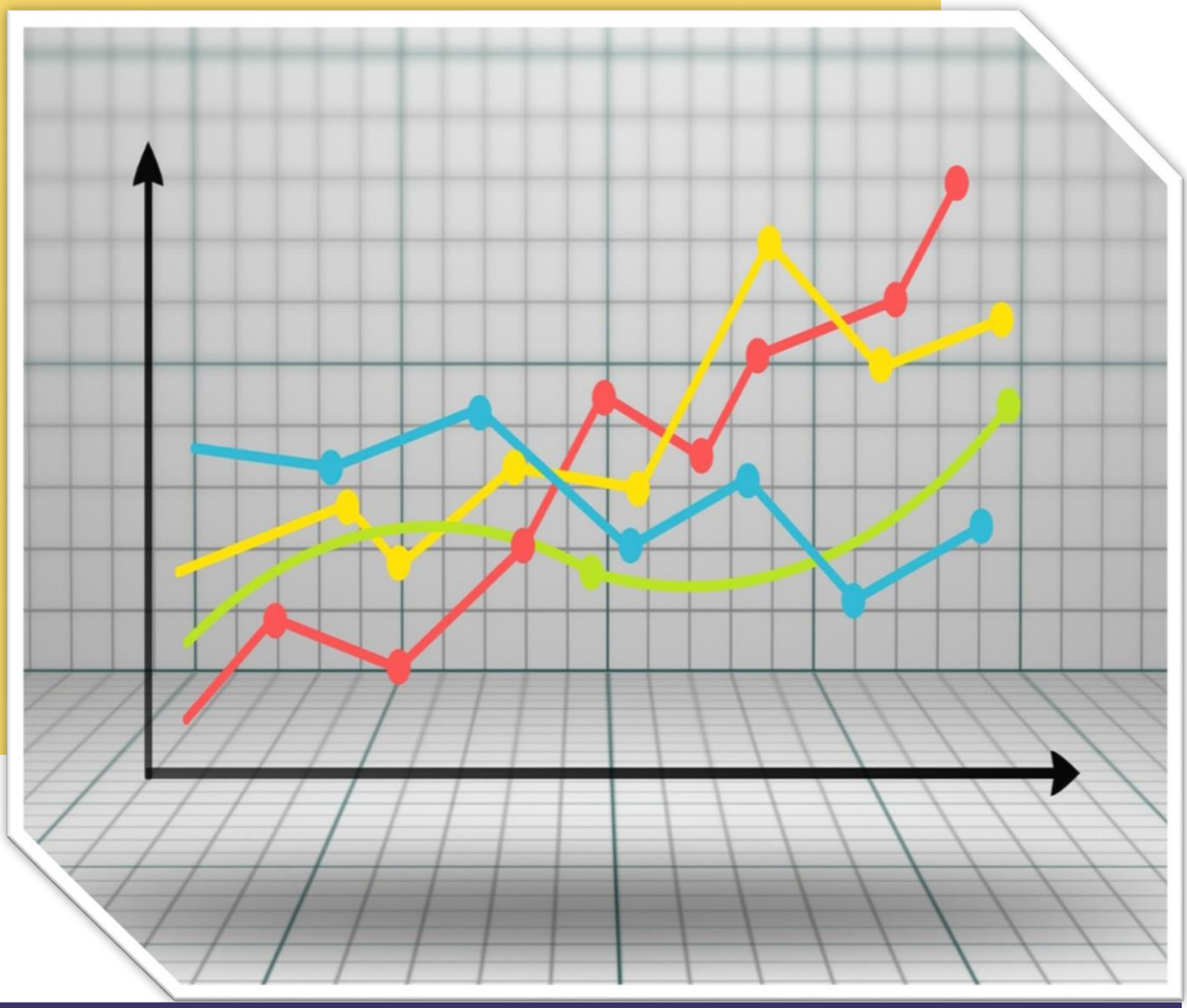

CANCER INCIDENCE PROJECTIONS FOR IRELAND 2020-2045

2019

National Cancer Registry Ireland

GLOSSARY	
95% CI	95% confidence interval
ASR	Age-standardised rate (European standard population)
CNS	Central nervous system
CSO	Central Statistics Office
ESP	European Standard Population
HD	Hakulinen-Dyba (projection models)
IARC	International Agency for Research on Cancer
ICD	International Statistical Classification of Diseases and Related Health Problems
NCRI	National Cancer Registry, Ireland
NMSC	Non-melanoma skin cancer

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FOREWORD

The most recent annual statistical report of the National Cancer Registry, published in November 2018, provided a summary of projected changes in the cancer incidence burden in Ireland over the coming decades, up to 2045. Fuller details are provided in this report, covering a wider range of cancers, updating the last detailed report, published in 2014, which projected cancer incidence to 2040.

There is no doubt that population growth and ageing will result in substantial increases in numbers of cancers diagnosed in Ireland over the coming decades, with resultant increases in the demands on cancer healthcare services. Potentially, between 2015 and 2045, we could see a doubling of the number of cases diagnosed annually if current cancer rates continue to apply.

Nevertheless, there are some grounds for optimism. Recent trends in age-standardised cancer incidence rates, which reflect the risk of an individual being diagnosed with cancer, appear to show a levelling-off or even a decline for a range of cancers. If these recent trends continue, increases in numbers of cancers diagnosed may prove to be substantially smaller, but they are still likely to amount to at least a 50% increase by 2045. But even that more limited increase in projected numbers of cancers will depend on sustained and where possible expanded public health and cancer prevention interventions aimed at reducing the risk of cancer diagnosis at the individual and population level.

Following the publication of this report, the NCRI plans to produce a report in late 2019 focusing on the contribution of various risk factors to the cancer incidence burden in Ireland. That report will also consider how changes in the exposure to these risk factors could impact on future incidence of cancer. A further report will examine treatment projections in more detail and consider the economic implications.

Professor Kerri Clough-Gorr
Director
National Cancer Registry

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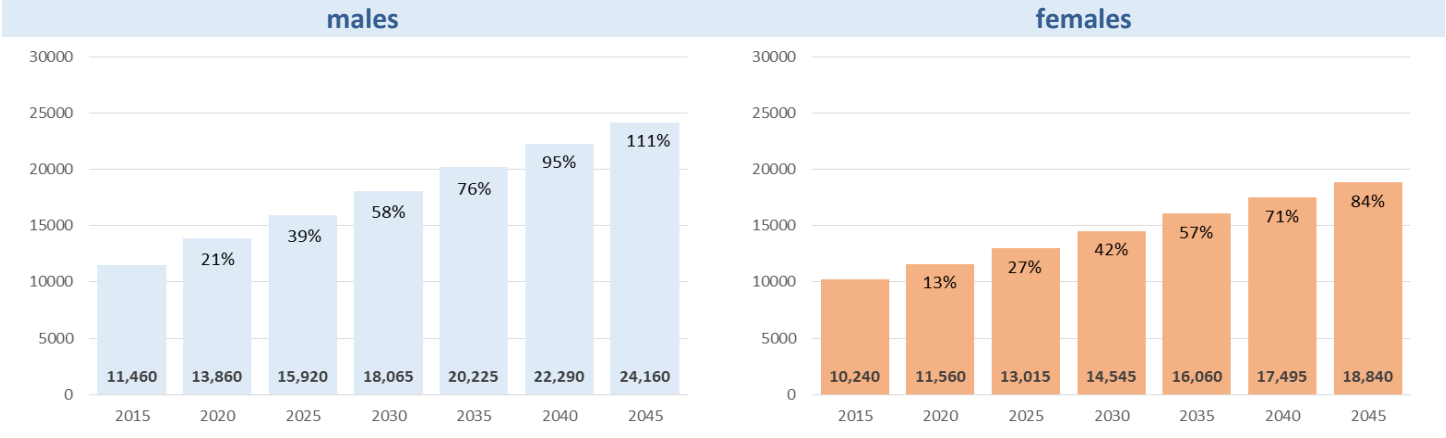
Who are we, and what do we do?

The National Cancer Registry of Ireland (NCRI) works on behalf of the Department of Health and collects information from all hospitals in Ireland on the number of persons diagnosed with cancer and the types of cancer they have. NCRI also follows up the numbers dying from their cancer or from other causes. All the patient's personal and private details are removed before summaries of this information are made available to the public and health professionals through our annual cancer report and other reports on our website.

What will the cancer figures look like in the decades ahead?

The population of Ireland increased by over one million between 1996 and 2016. Moreover, the proportion of the population most likely to be diagnosed with cancer (age 65+ years) expanded by over 50% over the same period. As the population is expected to continue to increase, it is likely that the numbers of cancer cases will continue to increase over the next three decades. If average rates of cancer (at each age) during 2011-2015 are applied to population estimates up to 2045, estimated (projected) numbers of invasive cancer, excluding non-melanoma skin cancer (NMSC), are summarised in the following figure.

Projections: All invasive cancers, excluding NMSC



The figures for 2015 represent the number of cases observed in that year. The figures for 2020, 2025, 2030, 2035, 2040 and 2045 are projections. The percentages are the increase on the observed 2015 case count.

What these figures mean is that, if future populations have the same risk of being diagnosed with cancer as currently, numbers of cancers (excluding NMSC) would be expected to increase by more than double in men and to almost double in women by 2045 – to 43,000 cases in total, a doubling of numbers overall.

However, a word of caution is required here. It is very difficult to anticipate cancer case numbers three decades into the future. Indeed, an overview of projections based on different sets of assumptions suggests that the overall increase by 2045 could be a more modest 50% increase overall if recent trends, including declines, in some cancers continue.

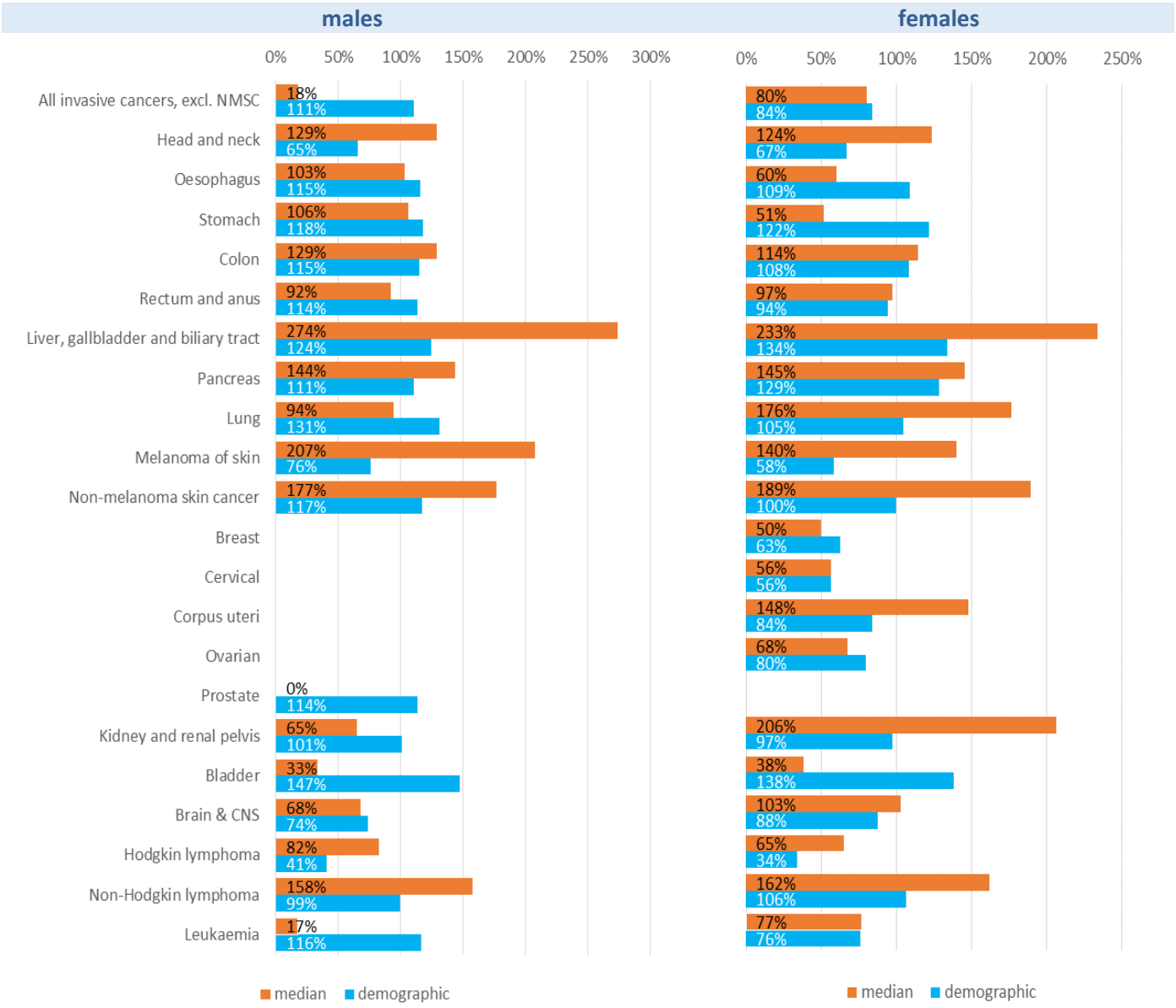
The number of projected cases can vary widely depending on the assumptions used. In this report, six different projection models were used, and the resulting projected total cases increased by between 27% and 143%.

The picture varies even more widely when looking at individual cancer sites. The figure on the next page shows the projected percentage increase in the number of cancer cases between 2015 and 2045, by cancer site and sex. The percentage increases are presented for two models, the demographic model which assumes risk of cancer is the same in the future as it is now, and the median of all projections. The median projection gives an estimate of the middle point of all the projection models and takes into account the range of alternative projections, depending on to what extent recent or longer-term trends in cancer rates (or individual risk of being diagnosed with cancer) carry on into the future.

Longer-term projections for individual cancer sites can have additional uncertainty when screening programmes are in place, as these can lead to initial increases followed by later decreases in cancer rates. Recent downward trends in breast and cervical cancer incidence rates are likely to be in part the result of the national screening programmes, BreastCheck and CervicalCheck. A recent decline in prostate cancer incidence rates may reflect high levels of PSA testing from the mid-1990s on (in effect, a form of unorganised screening). It is not clear if these declining trends are likely to continue into the future, and changes in trends in the years to come make it less likely that the projections presented in this report will accurately reflect future case counts. Changes in the trend in incidence rates for colon or rectal cancers may also occur, following the recent introduction of the BowelScreen programme.

Potential changes in trends in risk factors, such as rates of smoking, alcohol consumption, obesity rates and exposure to UV radiation could also impact on incidence rates for specific cancer sites, causing incidence to decrease (e.g. due to lower rates of smoking) or increase (e.g. due to higher rates of obesity) in the future. The contribution of these risk factors to incidence rates and trends is not examined in this report, but will be looked at in detail in a report due to be released in November 2019.

Summary Figure: Projected percentage increase in number of cancer cases 2015-2045, by cancer site and sex



For individual cancer types in males, the increases in case numbers ranged from 41% (Hodgkin lymphoma) to 147% (bladder) using demographic projections, or from 0% (prostate) to 274% (liver, gallbladder and biliary tract) using the median projection.

For females, the increases in case numbers ranged from 34% (Hodgkin lymphoma) to 138% (bladder) using demographic projections, or from 38% (bladder) to 233% (liver, gallbladder and biliary tract) using the median projection.

This illustrates the wide variation in projections when different assumptions are used. But, overall, these projections indicate that at least a 50% increase, and potentially a doubling, in annual cancer case numbers, for all invasive cancers excluding NMSC, is likely to be seen between 2015 and 2045.

1. TECHNICAL SUMMARY

General methodology

Cancer incidence data from the National Cancer Registry from 1994 to 2015 and population projections from the Irish Central Statistics Office (CSO) have been combined to estimate the number of new cancer cases expected in the years 2020, 2025, 2030, 2035, 2040 and 2045.

Cancer sites

Projections for the 21 major cancer groups listed in Table 1.1, as well as all cancers combined excluding non-melanoma skin cancer, are presented in this report.

Table 1.1. Cancer sites and groups of cancer for which projections are presented in this report

Cancer site	ICD10 codes
All invasive cancers, excl. NMSC	C00-43,C45-96
Head and neck	C01-C14, C30-32
Oesophagus	C15
Stomach	C16
Colon	C18
Rectum and anus	C19-21
Liver, gallbladder and biliary tract	C22-24
Pancreas	C25
Lung	C34
Melanoma of skin	C43
Non-melanoma skin cancer	C44
Female breast	C50
Cervix uteri	C53
Corpus uteri	C54
Ovary	C56
Prostate	C61
Kidney and renal pelvis	C64-65
Bladder	C67
Brain & central nervous system (CNS)	C70-72
Hodgkin lymphoma	C81
Non-Hodgkin lymphoma	C82-85
Leukaemia	C91-95

Projection methods

A number of different estimation methods were used:

1) Demographic projections, which apply the average annual age-specific incidence rates for 2011-2015 to the future projected populations provided by the CSO. These assume that there are no changes in the underlying incidence rates over time and therefore make the fewest assumptions.

2) Age-period methods, as described by Hakulinen and Dyba (HD) [1-3], which apply linear, non-linear and log-linear models to historical data.
3) The Nordpred method [4,5], which uses a special version of the age-period-cohort model with a power link.

The advantages and limitations of cancer projections have been described in previous reports [6-9]. It is important to note that this report gives projections of current data into the future, and not predictions as such. To make predictions would ideally require knowledge of underlying exposure to risk factors (and trends in such exposure).

In the absence of appropriate risk-factor data (and methodologies to account for them), the projections made here assume that available cancer-rate data reflect exposure to relevant risk factors, and that either recent trends continue or current rates prevail in future years.

The figures in this report highlight projections based on demographic changes and the median of all projections generated, with the full range of available projections also shown (highlighting the variability of projections, reflecting different model assumptions).

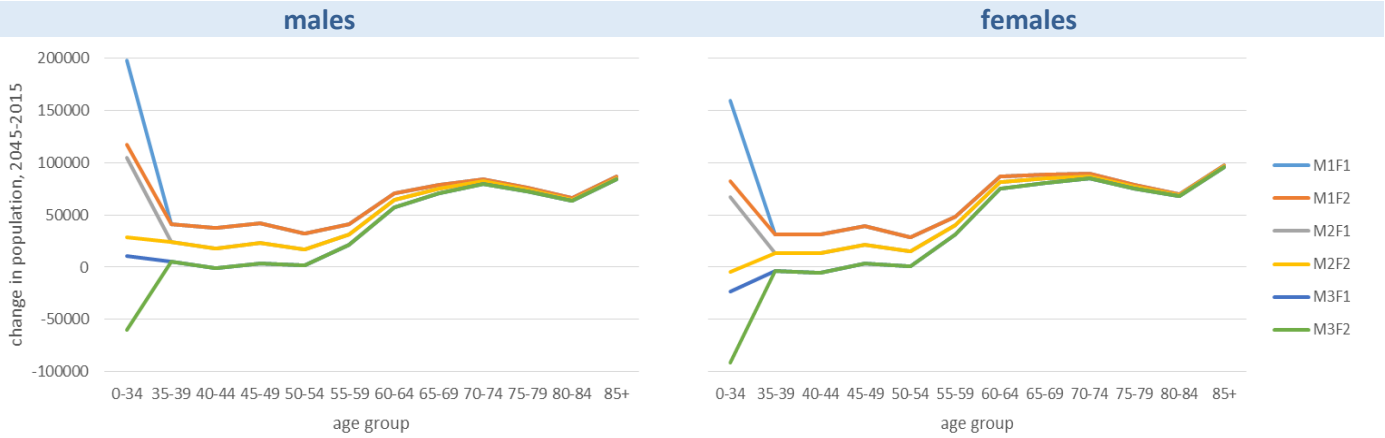
Projected population changes 2020-2045

The cancer case projections in this report are based on the population projections of the CSO. The CSO population projections [10], are themselves based on different assumptions regarding mortality, migration (M) and fertility (F). These give expected population numbers for each year 2020-2045, by five year age group and sex.

Six different population projections, based on combinations of the above assumptions, have been published by the CSO (M1F1-M3F2). Three migration assumptions and two fertility assumptions are used. The mortality assumptions are the same for all population projections.

Figure 1.1 shows the differences between the 2015 population and the projected 2045 populations for the different assumptions. The youngest age groups have the widest variation in population projections. For most ages over 50 the projections suggest a population increase of between 50,000 and 100,000 in each five-year age group.

Figure 1.1. Projected population increase 2015 to 2045, by age group and population growth model

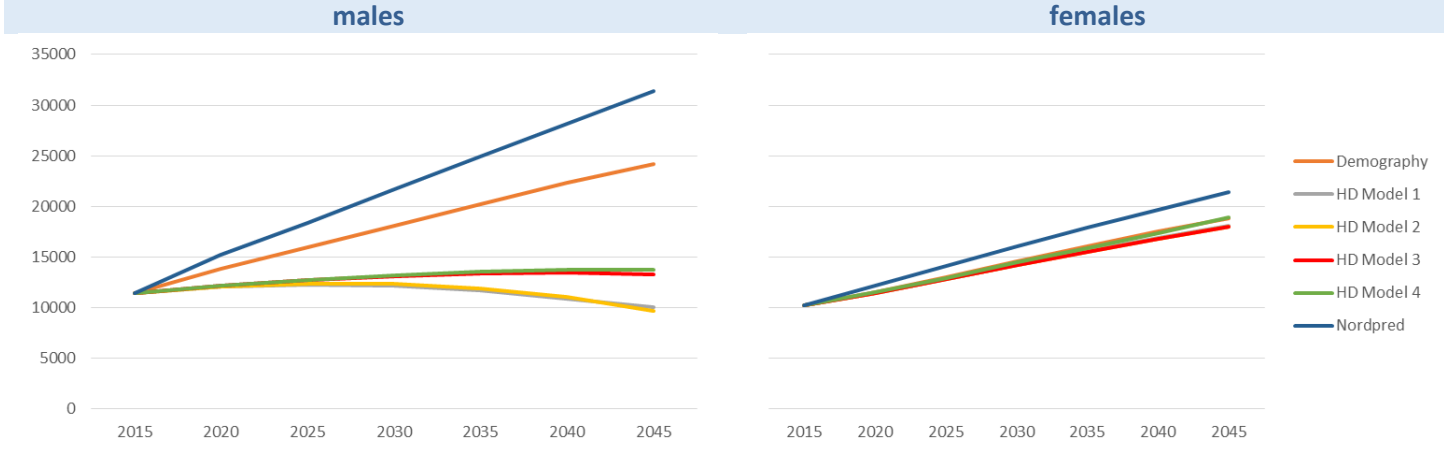


As most of the difference between the models is in the population under 60, who have a low cancer incidence, the impact of using different population projections is relatively small, with a 5-6% difference between the smallest and largest incidence projection by 2045.

The different fertility assumptions made almost no difference to the incidence projections. The M1 migration assumption gives the highest incidence projections, and the M3 assumption gives the lowest. For this report, the M2F1 population projections have been used as they produce projected case numbers which are approximately midway between the lowest and highest estimates.

Projections of overall numbers of cancers from 2020 to 2045, based on the four HD models, Nordpred and the demographic approach, are shown in Figure 1.2. For females, the projections made by the six models are broadly similar, reflecting the fact that trends in age-standardised rates for females have been quite stable over time. For males, on the other hand, the projections are very different, based on the different models used, as a recent decline in the age-standardised rates is factored in to the HD models but is not reflected in the Nordpred projection (which is based on longer-term rate trends) or the demographic projection (which assumes no rate trend).

Figure 1.2. Projections of cancer cases based on HD models 1-4, Nordpred and demographic models, using M2F1 population; all invasive cancers excluding NMSC

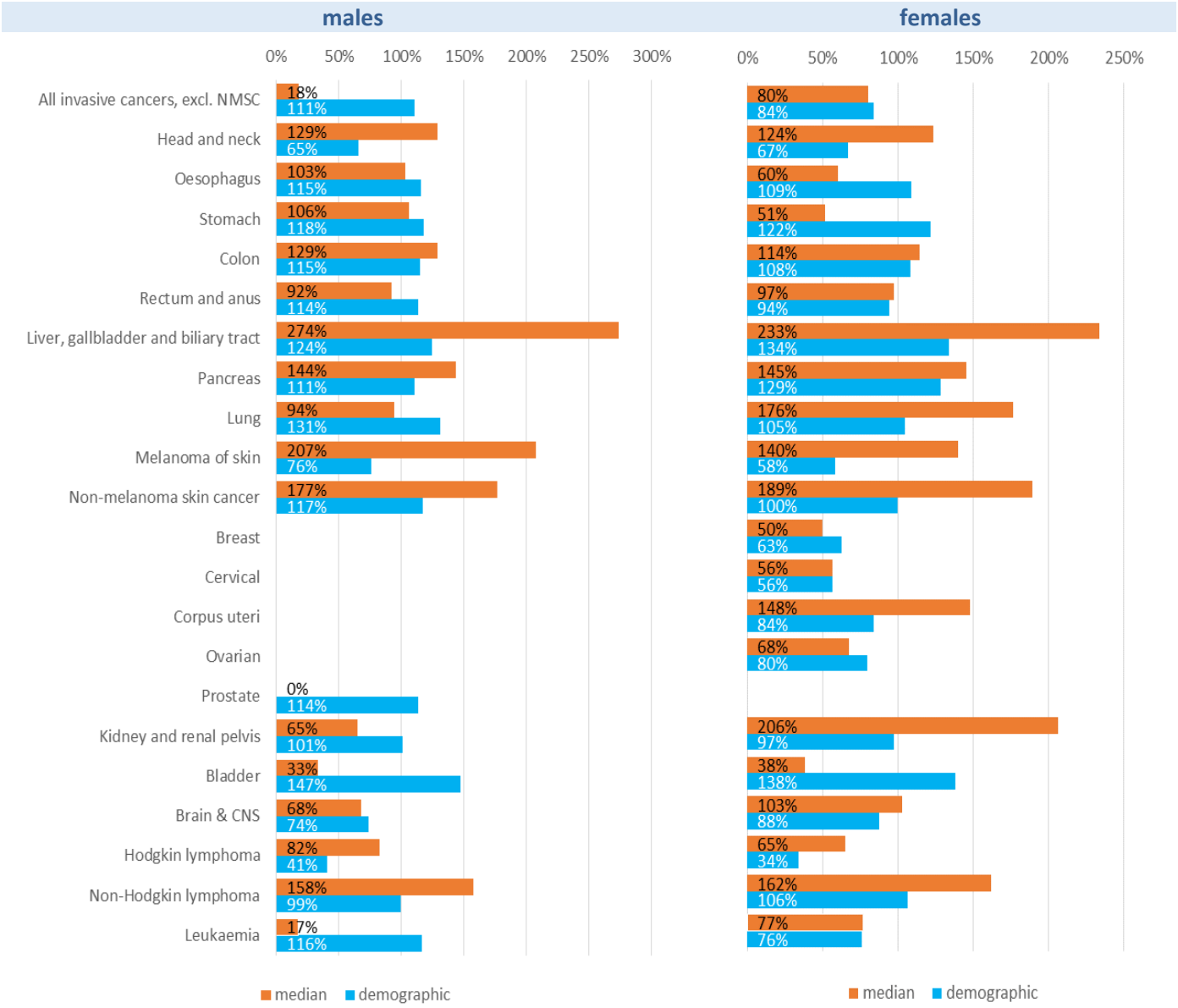


Incidence projections 2020-2045

Figure 1.3 below shows the projected percentage increase in the number of cancer cases between 2015 and 2045, by cancer site and sex.

For all cancers combined, excluding non-melanoma skin cancer, the demographic model projected an increase of 111% increase for males and an 80% increase for females – a doubling of numbers overall. The median model projections showed a similar picture for females with an 84% increase in incidence, whereas for males the position was very different, showing a much more modest projected increase of only 18% - about a 50% increase overall for males and females combined.

Figure 1.3. Projected percentage increase in number of cancer cases 2015-2045, by cancer site and sex



Longer-term projections for individual cancer sites can have additional uncertainty when screening programmes are in place, as these can lead to initial increases followed by later decreases in cancer rates. Recent downward trends in breast and cervical cancer incidence rates are likely to be in part the result of the national screening programmes, BreastCheck and CervicalCheck. A recent decline in prostate cancer incidence rates may reflect high levels of PSA testing from the mid-1990s on (in effect, a form of unorganised screening). It is not clear if these declining trends are likely to continue into the future, and changes in trends in the years to come make it less likely that the projections presented in this report will accurately reflect future case counts. Changes in the trend in incidence rates for colon or rectal cancers may also occur, following the recent introduction of the BowelScreen programme.

Potential changes in trends in risk factors, such as rates of smoking, alcohol consumption, obesity rates and exposure to UV radiation could also impact on incidence rates for specific cancer sites, causing incidence to decrease (e.g. due to lower rates of smoking) or increase (e.g. due to higher rates of obesity) in the future. The contribution of these risk factors to incidence rates and trends is not examined in this report, but will be looked at in detail in a report due to be released in November 2019.

Across individual cancer types, for males, the increases in case numbers ranged from 41% (Hodgkin lymphoma) to 147% (bladder) using demographic projections, and from 0% (prostate) to 274% (liver, gallbladder and biliary tract) using the median projection.

For females, the increases in case numbers ranged from 34% (Hodgkin lymphoma) to 138% (bladder) using demographic projections, and from 38% (bladder) to 233% (liver, gallbladder and biliary tract) using the median projection.

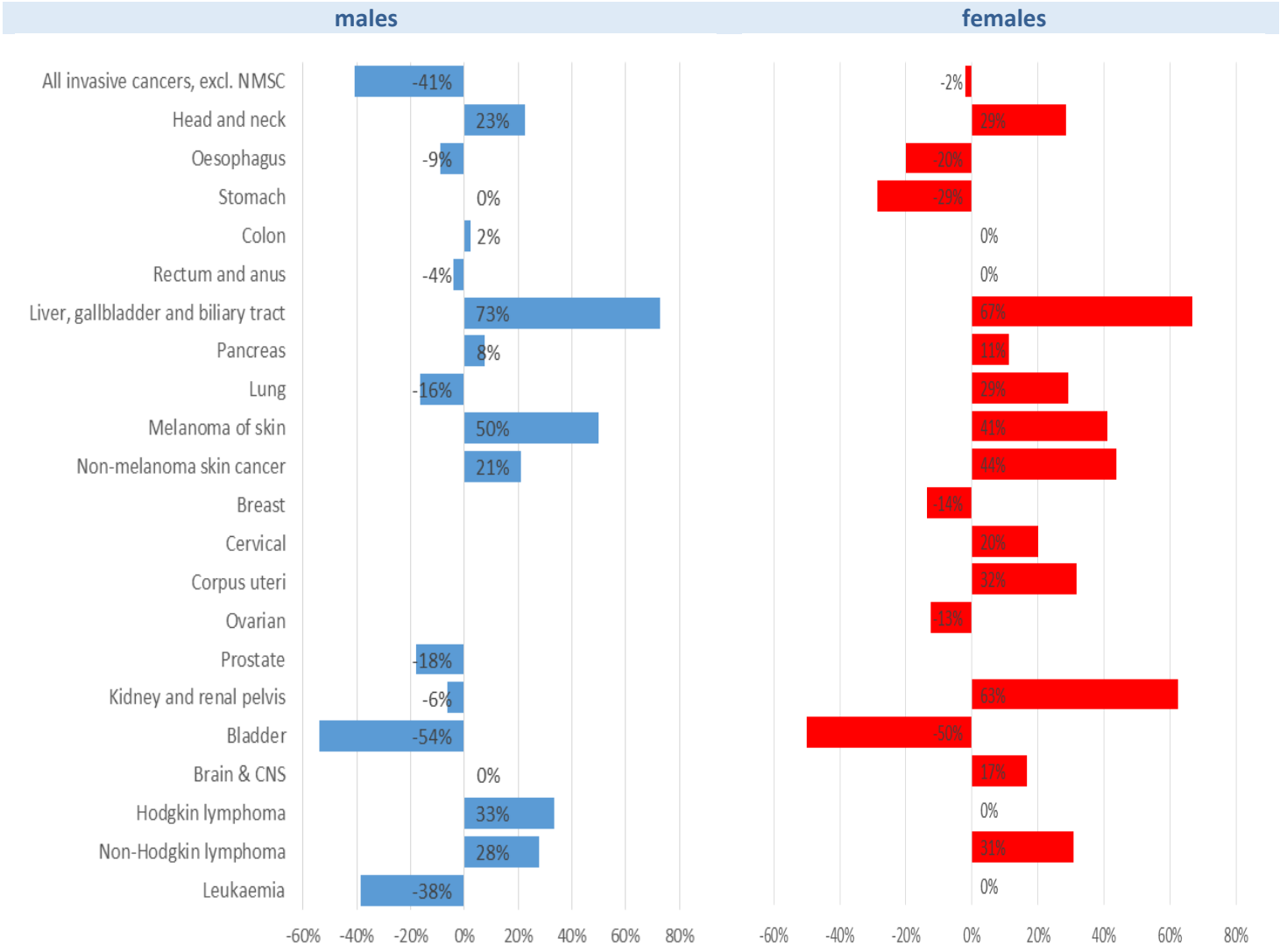
This illustrates the wide variation in projections based on different methodologies, where the site with the largest increase using the demographic method, has the smallest increase using the median projection.

Cancers most strongly associated with advanced age tend to see the biggest increase in the demographic projection, as the elderly population is expected to increase substantially between now and 2045. This is reflected in large increases in cases of bladder (147% for men and 138% for women), lung (131% for men and 105% for women) and prostate cancer (114%).

Sites with smaller projected increases using demographic projections, such as melanoma of skin, Hodgkin lymphoma, and cervical cancer, are more likely to be cancers that affect younger age groups.

Changes in age-standardised rates 2015-2045

Figure 1.4. Median projected percentage increase in age-standardised rates 2015-2045, by cancer site and sex



While the demographic method assumes that the age-standardised rates remain steady from 2015 to 2045, the HD and Nordpred methods assume that recent trends in age-standardised rates will continue into the future. As a result, the age-standardised rate of the median of the projected models, in most cases, will change over time.

Figure 1.4, above, shows the percentage change in age-standardised rates between 2015 and 2045, based on the median of all six models used. For all cancers combined, excluding non-melanoma skin cancer, the median projection showed a decrease of 41% for males and a much more modest 2% decrease for females.

For individual sites, for males, the median projected change in age-standardised rates ranged from a 54% decrease (bladder cancer) to a 73% increase (liver, gallbladder and biliary tract). For females,

the median projected change in age-standardised rates ranged from a 50% decrease (bladder cancer) to a 67% increase (liver, gallbladder and biliary tract).

For both males and females, bladder cancer had the biggest fall in the age-standardised rate in the median of the projections models, while liver, gallbladder and biliary tract cancer had the biggest increase.